Biannual Report

Department of Mathematics
2013 and 2014

TECHNISCHE UNIVERSITÄT DARMSTADT

Ladies and Gentlemen,
Dear Readers and Friends of the Department of Mathematics at TU Darmstadt,

You are holding the biannual report of the Department of Mathematics in your hands. In the last two years the institutional evaluation of our department as part of the quality management of the TU Darmstadt was a main topic in our daily business. It has demonstrated that we are highly cross-linked with nearly all departments of our university with our self-contained, broad mathematical profile in research and education. The constructive coexistence and cooperation of theoretical, applied, and engineering-related mathematics were highly emphasized by the evaluation committee as a distinguishing attribute of our department. The experts further claimed that through excellent achievements, the Department of Mathematics has attained a top rank among all mathematical departments of TU9 – the alliance of the nine leading German Institutes of Technology – and regularly received best scores in relevant national rankings. Numerous high-ranked international publications and awards reinforce its international visibility. The third-party funding is outstanding, especially that from the German Research Foundation. The manifold participation in interdisciplinary joint research projects proves that the department significantly contributes to the university's distinct profile. The department takes its central role in the mathematical education of all students with complete conviction and enormous effort. These statements are both a recognition of our work so far and an incentive to continue our course. Without our exceptionally motivated members in research, education, service, and administration this would be impossible.

We also look forward to see a reunification of our research groups in one location and a qualitative improvement of our housing in the near future. The evaluation process also helped to recognize that the considerably increased number of students at the TU Darmstadt and the successful transformation to the Bachelor and Master programmes guided by the Bologna Process caused an unbalance between high-quality education and resources provided to support our high teaching load for students in engineering and science from other departments. Both issues are subject to current negotiations with the president of the university.

Beside all the details documented in this report, I would like to draw your intention to a few selected topics and highlights. First, I warmly welcome the new faculty employed in 2013/2014: Frank Aurzada and Matthias Meiners (stochastics), Anna-Maria von Pippich (algebra), Christoph Erath (numerical analysis), Alexandra Schwartz (optimization), and Mads Kyed (analysis). They immediately began to implement new ideas and to open new fruitful perspectives for our department. I am also happy that we were able to convince Dieter Bothe (modeling and analysis), who had an offer from the University of Paderborn, to stay with us. Our thanks go to Philipp Habegger, Priska Jahnke, Michael Joswig, Matthias Schneider, Irwin Yousept, and Martin Ziegler for their personal commitment in Darmstadt. We wish them all the best for their further career at their new work-places. I would also like to take the opportunity to thank Hans-Dieter Alber who had been professor for analysis/partial differential equations from 1988 to his retirement in April 2015. He was dedicated with his heart and soul to his work, took on responsibilities for the department, and significantly co-founded the excellent reputation of the analysis group in Darmstadt. We hope that he will keep in touch with us in the future.

Our International Research Training Group *Mathematical Fluid Dynamics*, jointly with the Waseda University in Tokyo and the University of Tokyo, which started in 2009 was successfully evaluated by the German Research Foundation in 2014 and now continues its fundamental and internationally highly recognized research on analytical, stochastic, geometric and optimization as well as on aero-dynamical aspects of fluid dynamics. In October 2014, the new Collaborative Research Centre Transregio TRR 154 *Mathematical Modelling, Simulation and Optimization Using the Example of Gas Networks* started operating together with researchers from Berlin, Erlangen, and Duisburg-Essen. We will find answers to new challenges originating from the nuclear power phase-out and the demand for an efficient natural gas supply implying a multiplicity of problems concerning gas transport and network technology as well as the consideration of market-regulatory conditions. The department was also able to continue its research activities at its established high level in numerous projects supported by the Excellence, Loewe and smaller initiatives funded by the DFG and the State of Hesse. I would like to mention two research prizes received by members of the department. Ulrich Reif received the *John A. Gregory Memorial Award* which is currently the highest award in the field of Geometric Design. Thomas Streicher won the *Logic-in-Computer-Science Test-of-Time Award* in 2014 for a fundamental paper that he published in 1994 together with Martin Hofmann from Munich and that opened a series of investigations leading to the development of homotopy type theory.

In the last two years, we have further strengthened the structure of our teaching activities, combining successful components of the old Diploma programme with new aspects such as modularization and a credit point system. Now our Bachelor programmes only start in October and offer a bilingual certificate which is highly appreciated by the Bachelor students. An impressive variety across a considerable breadth of research areas and an improved reliability made our Master level courses more attractive for our own Bachelor students as well as for new Master students from elsewhere. Members of our department received two prestigious prizes for outstanding teaching: Regina Bruder and Nora Feldt-Caesar received the *Best E-Teaching Award 2014* of the Carlo and Karin Giersch Foundation. The *Athene Price for Best Teaching 2013* was awarded to Robert Haller-Dintelmann. Congratulations!

I wish you an enjoyable reading of our report. You will find interesting facts and technical details of our education, research, and services, of our projects, and the statistics about publications, lectures and many others. Thank you for your interest.

Prof. Dr. Jens Lang
(Dean of the Department of Mathematics)

Contents

1 Research Groups

This section gives a brief overview of the research done in the eight research groups.

1.1 Algebra

The main research areas of this group are algebraic geometry, number theory and conformal field theory.
We are interested in automorphic forms and their applications in geometry and arithmetic. For example we investigate intersection and height pairings of special algebraic cycles on Shimura varieties and their connection to automorphic L-functions. We also study the relation between the representation theory of conformal field theories and automorphic forms. Regularized theta lifts play an important role in both areas.

Members of the research group

Professors

Jan Hendrik Bruinier, Philipp Habegger, Priska Jahnke, Ivo Radloff, Nils Scheithauer

Retired professors

Karl-Heinrich Hofmann

Postdocs

Thomas Creutzig, Raffael Dahmen, Stephan Ehlen, Walter Freyn, Ralf Lehnert, Yingkun Li, Lukas Pottmeyer, Jethro van Ekeren, Francesco Veneziano, Mingxi Wang, Shaul Zemel

Research Associates

Claudia Alfes, Moritz Dittmann, Linda Frey, Tobias Hufler, Sven Möller, Sebastian Opitz, Stefan Schmid, Markus Schwagenscheidt, Fabian Völz, Fabian Werner

Secretaries

Karolin Berghaus, Ute Fahrholz, Gerlinde Gehring

Project: Harmonic weak Maass forms

In this project the Fourier coefficients and periods of weak Maass forms are investigated. In particular, we study the coefficients of weight $1/2$ harmonic weak Maass forms. If such a form f maps under the ξ-operator to a newform g of weight $3/2$, then the Fourier coefficients of the holomorphic part of f are given by periods of normalized algebraic differentials of the third kind associated to the Shimura lift of g. For instance, the real periods of differentials of the third kind on rational elliptic curves are related to coefficients of such harmonic Maass forms. We also use (regularized) theta lifts to investigate periods of harmonic Maass forms. In joint work with Ono we construct a lift from harmonic Maass forms of weight -2 to harmonic Maass forms of weight $-1/2$ and study its integrality properties. As an application, we derive a finite algebraic formula for the partition function. This lift is generalized by C. Alfes to arbitrary weights. In joint work with Funke and Imamoglu we investigate a regularized theta lift from weak Maass forms of weight 0 to weak Maass forms of weight $1/2$ and show that the coefficients of the lift are given by CM traces and period integrals. In particular we find a definition of the central value of the (non-existent) L-function of Klein's j-invariant.

Partner: K. Ono, Emory University; J. Funke, Durham University; O. Imamoglu, ETH Zürich

Support: DFG, NSF

Contact: J. H. Bruinier, C. Alfes

References

[1] C. Alfes. Formulas for the coefficients of half-integral weight harmonic Maass forms. *Mathematische Zeitschrift*, 2014.

[2] C. Alfes, M. Griffin, K. Ono, and L. Rolen. Weierstrass mock modular forms and elliptic curves. *Research in Number Theory*, accepted for publication.

[3] J. H. Bruinier. Harmonic Maass forms and periods. *Mathematische Annalen*, 2013.

[4] J. H. Bruinier, J. Funke, and O. Imamoglu. Regularized theta liftings and periods of modular functions. *Journal für die reine und die angewandte Mathematik*, accepted for publication.

[5] J. H. Bruinier and K. Ono. Heegner divisors, L-functions and harmonic weak Maass forms. *Annals of Mathematics*, 2010.

[6] J. H. Bruinier and K. Ono. Algebraic formulas for the coefficients of half-integral weight harmonic weak Maass forms. *Advances in Mathematics*, 2013.

Project: Arithmetic intersection theory on Shimura varieties

We study special cycles on integral models of Shimura varieties associated with unitary similitude groups of signature $(n-1,1)$. We construct an arithmetic theta lift from harmonic Maass forms of weight $2-n$ to the first arithmetic Chow group of a toroidal compactification of the integral model of the unitary Shimura variety, by associating to a harmonic Maass form f a suitable linear combination of Kudla-Rapoport divisors, equipped with the Green function given by the regularized theta lift of f. Our main result expresses the height pairing of this arithmetic Kudla-Rapoport divisor with a CM cycle in terms of a Rankin-Selberg convolution L-function of the cusp form of weight n corresponding to f and the theta function of a positive definite hermitian lattice of rank $n-1$. When specialized to the case $n=2$, this result can be viewed as a variant of the Gross-Zagier formula for Shimura curves associated to unitary groups of signature $(1,1)$. We also prove that the generating series of the height pairings of arithmetic Kudla-Rapoport divisors with a fixed CM cycle is an elliptic modular form of weight n. These results rely on (among other things) a new method for computing improper arithmetic intersections. In ongoing work with Howard, Kudla, Rapoport, and Yang we are aiming to generalize the above modularity result and to apply it to prove new cases of Colmez' conjecture.

Partner: B. Howard, Boston College; S. Kudla, University of Toronto; M. Rapoport, Universität Bonn; T. Yang, University of Wisconsin at Madison

Support: DFG, NSF, AIM

Contact: J. H. Bruinier, S. Ehlen, S. Zemel

References

[1] J. H. Bruinier, B. Howard, and T. Yang. Heights of Kudla-Rapoport divisors and derivatives of L-functions. *Inventiones Mathematicae*, accepted for publication.

[2] J. H. Bruinier, S. S. Kudla, and T. Yang. Special values of Green functions at big CM points. *International Mathematics Research Notices*, 2012.

[3] J. H. Bruinier and T. Yang. Faltings heights of CM cycles and derivatives of L-functions. *Inventiones mathematicae*, 2009.

Project: Modularity of formal Fourier-Jacobi series

A famous theorem of Gross, Kohnen, and Zagier states that the generating series of Heegner divisors on a modular curve is an elliptic modular form of weight $3/2$ with values in the Picard group. This result can be viewed as an elegant description of the relations among Heegner divisors. More generally, Kudla conjectured that the generating series of codimension g special cycles on an orthogonal Shimura variety of dimension n is a Siegel modular form of genus g and weight $1+n/2$ with coefficients in the Chow group of codimension g cycles. Wei Zhang showed that certain formal Fourier-Jacobi coefficients of Kudla's generating series are modular for genus 1 Jacobi groups. We prove a general convergence result for formal series of Jacobi forms that satisfy a natural symmetry condition. They are formal analogues of Fourier-Jacobi expansions of Siegel modular forms. By combining Zhang's and our result, we deduce Kudla's modularity conjecture for special cycles of arbitrary codimension and for all orthogonal Shimura varieties.

Partner: M. Westerholt-Raum, MPI Bonn

Support: DFG

Contact: J. H. Bruinier

References

[1] J. H. Bruinier. Vector valued formal Fourier-Jacobi series. *Proceedings of the AMS*, accepted for publication.

[2] J. H. Bruinier and M. Westerholt-Raum. Kudla's modularity conjecture and formal Fourier-Jacobi series. Preprint, 2014.

[3] S. S. Kudla. Special cycles and derivatives of Eisenstein series. In *Heegner points and Rankin L-series*, volume 49 of *Math. Sci. Res. Inst. Publ.*, pages 243–270. Cambridge Univ. Press, Cambridge, 2004.

Project: Algebraically Primitive Teichmüller Curves in Genus 3 and Just Likely Intersections

The goal of this project is to prove that the moduli space of compact genus 3 Riemann surfaces contains only finitely many algebraically primitive Teichmüller curves. This is in contrast to the genus 2 case where Calta [2] and McMullen [3] independently found infinitely many such curves. In a recent preprint [1] we were able to do this using various methods. Among them are techniques from diophantine geometry involving heights which were also successful in treating some problems around the Zilber-Pink Conjecture.

Partner: M. Bainbridge (Indiana) and M. Möller (Frankfurt)

Contact: P. Habegger

References

[1] M. Bainbridge, P. Habegger, and M. Möller. Teichmüller curves in genus three and just likely intersections in $\mathbb{G}_m^n \times \mathbb{G}_a^n$. *Preprint* `arXiv:1410.6835v1`.

[2] K. Calta. Veech surfaces and complete periodicity in genus two. *J. Amer. Math. Soc.*, 17(4):871–908, 2004.

[3] C. McMullen. Billiards and Teichmüller curves on Hilbert modular surfaces. *J. Amer. Math. Soc.*, 16(4):857–885, 2003.

Project: Integral Points in Divisible Groups

This project is motivated by Vojta's general conjecture on integral points and a result of Baker, Ih, and Rumely [1]. We study the set of points in the division closure of a finitely generated subgroup of $\overline{\mathbb{Q}}^{\times}$ that are integral relative to certain divisors. In [2] we clarify for which divisors there are only finitely many such integral points. We also pose certain problems in higher dimension and for more general algebraic groups. The case of an elliptic curve seems the most promising candidate for a feasible problem.

Partner: S. Ih (University of Colorado Boulder)

Contact: P. Habegger

References

[1] M. Baker, S. Ih, and R. Rumely. A finiteness property of torsion points. *Algebra Number Theory*, 2(2):217–248, 2008.

[2] P. Habegger and S. Ih. Distribution of Integral Division Points on the Algebraic Torus. *Preprint*.

Project: Unlikely Intersections and O-minimal Structures

Zannier [3] introduced a new and powerful strategy in diophantine geometry that involves a connection to model theory through the Pila-Wilkie Counting Theorem [2]. In this project we study to what extent this strategy is applicable for the (open) Zilber-Pink Conjecture on unlikely intersections [5, 4]. We have some partial results towards this conjecture [1] and give a full proof for curves in abelian varieties when everything is defined over the field of algebraic numbers. To what extent this strategy can extend to give unconditional results for more general subvarieties of abelian varieties or any subvarieties Shimura varieties remains to be seen.

Partner: Jonathan Pila (University of Oxford)

Contact: P. Habegger

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[2] J. Pila and A. J. Wilkie. The rational points of a definable set. *Duke Math. J.*, 133(3):591–616, 2006.

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Project: Curves of Genus 2 with Complex Multiplication and Bad Reduction

By a famous theorem of Serre and Tate [2], any abelian variety with complex multiplication defined over a number field has everywhere potentially good reduction. Moreover, it is well-known that if a curve (of any genus) over a number field has good reduction at a given place, then so does its jacobian. The purpose of this project is to investigate the failure of the converse of this statement in genus 2 if the jacobian has complex multiplication. An important invariant of a curve of genus 2, the Faltings height of its jacobian, can be computed in two different ways if the jacobian has complex multiplication. Comparing the two expressions lets us extract information on the reduction type and leads us to believe that bad reduction of the curve is the rule and not the exception. This is connected to Goren and Lauter's [1] study of evil primes.

Partner: Fabien Pazuki (Université Bordeaux I, University of Copenhagen)

Contact: P. Habegger

References

[1] E. Goren and K. Lauter. Evil primes and superspecial moduli. *Int. Math. Res. Not.*, 2006. Art. ID 53864, 19.

[2] J.-P. Serre and J. T. Tate. Good reduction of abelian varieties. *Ann. of Math. (2)*, 88:492–517, 1968.

Project: Arithmetic Riemann-Roch theorem for singular metrics

This research project is devoted to establishing an arithmetic Riemann–Roch theorem for a fibration of arithmetic varieties where the relative tangent bundle is equipped with a logarithmically singular metric. More precisely, together with G. Freixas, we aim at generalizing the arithmetic Riemann–Roch theorem for pointed stable curves to the case where the metric is allowed to have conical singularities at the marked points. As one main ingredient of the proof we established a Mayer–Vietoris type formula for the singular hyperbolic metric. The next step requires the explicit computation of the regularized determinants for hyperbolic cusps and cones. One arithmetic application of the theorem consists in an exotic analytic class number formula for the Selberg zeta function for the modular group, which can be expressed in terms of class numbers and fundamental units of quadratic forms of positive discriminant.

Partner: G. Freixas, CNRS Paris

Contact: A.-M. von Pippich

Project: Generalized Eisenstein series

Eisenstein series are an essential ingredient in the theory of automorphic forms with numerous applications to number theory and arithmetic geometry. In this project, a unifying approach to the construction of the elliptic, hyperbolic and parabolic Eisenstein series on a finite volume hyperbolic Riemann surfaces is developed. Namely, there is a sequence of integral transforms which begins with the heat kernel, obtains a Poisson and wave kernel, and then yields the corresponding Eisenstein series. The next goal of this project is to generalize this construction to define and study analogues of elliptic and hyperbolic Eisenstein series in more general settings, such as spaces of non-constant negative curvature or quotients of symmetric spaces.

Partner: J. Jorgenson (City College, New York); L. Smajlović (University of Sarajevo)

Contact: A.-M. von Pippich

Project: Orthogonal groups of discriminant forms

A discriminant form is a finite abelian group D with a nondegenerate quadratic form $q : D \to \mathbb{Q}/\mathbb{Z}$. Discriminant forms play a prominent role in the theory of automorphic forms. A discriminant form of prime level p is a vector space over $\mathbb{F}_p$ with a nondegenerate quadratic form. In this case Witt's Theorem says that for two nonzero vectors v, w of the same norm there is an automorphism f of D preserving q with $f(v) = w$. An important question is under which condition two elements of an arbitrary discriminant form D are conjugate under $\mathrm{O}(D)$. This problem has been solved for discriminant forms of odd order. The general case is investigated at the moment.

Contact: N. Scheithauer

Project: Moonshine for Conway's group

The fake monster algebra is an infinite-dimensional Lie algebra describing the physical states of a bosonic string moving on a 26-dimensional torus. Its denominator identity is given by

$$e^{\rho} \prod_{\alpha \in II^+_{25,1}} (1 - e^{\alpha})^{[1/\Delta](-\alpha^2/2)} = \sum_{w \in W} \det(w)\, w \left(e^{\rho} \prod_{n=1}^{\infty} (1 - e^{n\rho})^{24} \right)$$

where

$$\Delta(\tau) = q \prod_{n=1}^{\infty} (1 - q^n)^{24} = q - 24q^2 + 252q^3 - 1472q^4 + 4830q^5 - 6048q^6 + \ldots$$

is Dedekind's delta function. The real simple roots of the fake monster algebra correspond to the Leech lattice and the automorphism group of the Leech lattice acts by diagram automorphisms on the Lie algebra. Borcherds conjectured that the corresponding twisted denominator identities are automorphic forms of singular weight on orthogonal groups. It is now well-known that this holds for elements of squarefree level. Some of the remaining cases are proved in [1].

Contact: N. Scheithauer

References

[1] N. Scheithauer. Some constructions of modular forms for the Weil representation of $\mathrm{SL}_2(\mathbb{Z})$. *To appear in Nagoya Mathematical Journal*, 2014.

Project: Classification of automorphic products of singular weight

Borcherds' singular theta correspondence is a map from vector valued modular forms, which transform under the Weil representation of $\mathrm{SL}_2(\mathbb{Z})$ on discriminant forms, to automorphic forms on orthogonal groups. Since these automorphic forms have nice product expansions they are called automorphic products. They have found various applications in algebra, geometry and arithmetic. A famous example is the function

$$\Phi(Z) = e((\rho, Z)) \prod_{\alpha \in II^+_{25,1}} \big(1 - e((\alpha, Z))\big)^{[1/\Delta](-\alpha^2/2)}$$

where Δ is Dedekind's delta function. This function is an automorphic form of weight 12 for a discrete subgroup of $O_{26,2}(\mathbb{R})$. One of the main problems in the theory of automorphic forms on orthogonal groups is to derive classification results. In [1] automorphic products of singular weight, whose divisors are zeros of order 1 corresponding to all roots, on lattices of squarefree level are classified. The result is that there are only 10 such functions. They are in one-to-one correspondence with the solutions of the equation

$$-\frac{k}{k-2}\frac{1}{B_k}\prod_{p|N}\frac{1}{p^k-1}\left((-1)^k\left(p^{k-n_p/2}+p^{n_p/2}\right)+2\right)=1\,.$$

The goal of this project is to prove more general classification results for automorphic products of singular weight. In [2] it is shown that holomorphic automorphic products of singular weight on lattices of prime level exist only in small signatures and a complete classification of reflective automorphic products of singular weight on such lattices is given.

Contact: N. Scheithauer

References

[1] N. Scheithauer. On the classification of automorphic products and generalized Kac-Moody algebras. *Invent. Math.*, 164:858 – 877, 2006.

[2] N. Scheithauer. Automorphic products of singular weight. Preprint, submitted, TU Darmstadt, 2014.

Project: Orbifold theory of vertex algebras

Vertex algebras axiomatise 2-dimensional chiral quantum field theories. In this project we develop an orbifold theory for cyclic orbifolds of holomorphic vertex algebras and use this theory to construct new examples of holomorphic vertex algebras of central charge 24.

Contact: N. Scheithauer

Partner: J. van Ekeren, G. Höhn, S. Möller, H. Shimakura

1.2 Analysis

The research group Analysis consists of six professors, H.-D. Alber, D. Bothe, R. Farwig, M. Hieber, M. Kyed and S. Roch (apl.), R. Haller-Dintelmann as 'Akademischer Rat', and about 25 assistants as state employees or paid by third party funding. The field of research of this group covers theory and applications of partial differential equations and of integral equations. Having close contact to the departments of engineering and natural sciences, the group of analysis at TU Darmstadt is open to new mathematical problems and scientific challenges.

One focal point of research activities is the investigation of the nonlinear equations of fluid mechanics including an enhanced analysis of linear model problems which are solved by methods of evolution equations, maximal regularity and harmonic analysis. A famous open problem concerning the existence of smooth solutions of the so-called Navier-Stokes equations is one of the seven Millennium Problems of Clay Mathematics Institute.

A second focus is put on the modeling and analysis of problems in solid mechanics with a special emphasis on viscosity and plasticity; these questions are of crucial importance in material sciences and fracture mechanics. Furthermore, models of phase transitions and microstructures in crystal lattices are under investigation. The mathematical tools in this field are based on nonlinear analysis and homogenization. Recently also numerical simulation is used to validate phase field models.

The third point is on mathematical modeling and computational analysis of complex flow problems, in particular two-phase flows and transport processes occurring at fluid interfaces. The research builds on continuum mechanical modeling employing and further developing sharp-interface models with increasing levels of physico-chemical interface properties. For a deep understanding of the elementary transport and transfer processes, direct numerical simulations with the Volume-of-Fluid method are employed.

The fourth focal point lies in the analysis and numerical approximation techniques for singular integral equations which can be applied in fluid mechanics, computer tomography and image processing.

The research group Analysis presents two “Open Seminars” on a regular weekly basis, introductory seminars on functional analytic tools in the theory of partial differential equations as well as graduate seminars on recent questions in the above-mentioned fields of research. In addition to basic courses on mathematics for engineers, the research group offers lectures on analysis for majors in mathematics as well as advanced courses on partial differential equations and on related fields for graduate students.

Moreover, the research group jointly organizes several workshops per year with the International Research Training Group on “Mathematical Fluid Dynamics”. The venues alternately take place at the TU Darmstadt or Waseda University, Tokyo, Japan.

Several members of the research group Analysis are Principal Investigators of the German Research Foundation-Excellence Cluster “Smart Interfaces”, where fluid interfaces and boundaries are investigated in an interdisciplinary environment, and/or of the International Research Training Group (IRTG 1529) (Internationales Graduiertenkolleg) “Mathematical Fluid Dynamics” funded by DFG and JSPS and associated with TU Darmstadt, Waseda University in Tokyo and University of Tokyo. The program seeks to combine methods from several mathematical disciplines such as analysis, stochastics, geometry and optimization to pursue fundamental research in Fluid Dynamics.

Members of the research group

Professors

Hans-Dieter Alber, Dieter Bothe, Reinhard Farwig, Matthias Hieber, Mads Kyed, Steffen Roch, Jürgen Saal

Postdocs

Maksym Berezhnyi, Matthias Geißert, Robert Haller-Dintelmann, Matthias Köhne, Christian Komo, Nataliya Kraynyukova, Holger Marschall, Sergiy Nesenenko, Martin Saal

Research Associates

Christoph Albert, Lorenz von Below, Anke Böttcher, Martin Bolkart, Xingyuan Chen, Daniel Deising, Kathrin Dieter-Kissling, Moritz Egert, Manuel Falcone, Anja Fath, André Fischer, Stefan Fleckenstein, Christian Focke, Johannes Kromer, Muyuan Liu, Tomislav Maric, David Meffert, Siegfried Meier, Matthias Niethammer, Chiara Pesci, Jonas Sauer, Katharina Schade, Patrick Tolksdorf, Paul Weber, David Wegmann, André Weiner

Secretaries

Christiane Herdler, Anke Meier-Dörnberg, Verena Schmid, Kerstin Schmitt

Project: Analytical and numerical comparison of a hybrid phase field model for phase transitions and damage with the Allen-Cahn model

Simulation of phase transitions and damage is an issue of increasing importance in material science. The mathematical models, on which these simulations are based, are either of the sharp interface or phase field type. Phase field models are computationally advantageous. Practically all phase field models are of the Allen-Cahn or Cahn-Hilliard type. However, for realistic simulation of phase interfaces carrying low surface energy the parameters in these models must be chosen such that the diffusive interfaces in these models become almost sharp. In such situations, which are very common, simulations become very ineffective and the computational advantage of phase field models is lost.

In recent years two new models have been developed in the research group, which we call hybrid models. The analytical results obtained up to now indicate that with these models interfaces with low surface energy can be simulated effectively. However, because of the unusual form of the evolution equation in these models, standard mathematical methods to prove existence and convergence results cannot be used. We derived such results only for very special situations. Therefore the hybrid models must be justified and validated by numerical tests. Matlab-simulations based on a finite difference scheme have been carried out for some special situations. These simulations confirm the analytical results. However, for a thorough and reliable validation many more numerical tests must be carried out. In particular, computations based on the Finite Element Method must be performed.

In cooperation with B. Markert from the Institut für Angewandte Mechanik der Universität Stuttgart we therefore plan to develop numerical methods for the hybrid model and to compare the computational results for the Allen-Cahn model with the results for the hybrid model.

Partner: B. Markert, Universität Stuttgart

Contact: H.-D. Alber

Project: Solution of the hybrid phase field model with finite elements

For the hybrid phase field model, which is explained in the preceding project description, we aim in this PhD research project to develop alternative numerical methods. As basic computational tool we want to use Finite Elements.

Contact: H.-D. Alber, A. Böttcher

Project: Existence theory for phase field models

For the hybrid phase field model described above existence results are only available in one space dimension when the constitutive relation is linear. When the constitutive relation is nonlinear or when the space dimension is greater than one no results exist. Moreover, no convergence results are known. The goal of this project is therefore to prove such existence and convergence results.

Partner: Peicheng Zhu, Basque center of applied mathematics, Bilbao

Contact: H.-D. Alber

Project: Hybrid Lagrangian / Eulerian Two-Phase Flow DNS methods on Unstructured Meshes in OpenFOAM®

The project focus is placed on developing a numerically consistent geometrical advection algorithm for the volume fraction field on arbitrary unstructured finite volume meshes.
In addition, the project has been extended with a development of a hybrid Level Set / Front Tracking method.
In the first project stage, an implementation of the geometrical transport algorithm and the algorithm parallelization together with an advection validation study was performed, and the transport algorithm was coupled with the local dynamic refinement (local dynamic AMR) engine in OpenFOAM®; see [1]. Afterwards, an enhancement of the geometrical transport was implemented, taking into account the non-planarity of the flux polyhedron faces. This leads to a complete re-organization and extension of the software library used for geometrical calculations. Future developments will be focused on improvements of the flow solution algorithm as well as curvature calculations in order to improve the balance of forces acting on the discrete interface.
A visit to the ICMF-2013 conference has resulted in an idea of implementing an additional hybrid Lagrangian / Eulerian two-phase DNS method - the hybrid Level Set / Front Tracking method. The method implementation and validation was completed and the results published in [2]. Future developments will be focused on completing the method parallelization as well as the numerical modeling of the surface tension force.

Contact: D. Bothe, H. Marschall, T. Maric

References

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[2] T. Marić, H. Marschall, and D. Bothe. lentFoam–A hybrid Level Set/Front Tracking method on unstructured meshes. *Computers & Fluids*, 2014.

Project: Stability of buoyant droplets

The hydrodynamic stability of fluid droplets freely rising in an ambient liquid is investigated in order to identify transition regions of dynamic regimes. Perturbations of both the shape of the free interface and velocity field are taken into account by a global linear stability algorithm, which is closely related to Arnoldi's algorithm for the eigensystem analysis of sparse matrices. For this, it is necessary to evaluate the response of the stationary base flow to perturbations which is done with the Volume of Fluid in-house code *FS3D*, originally developed by [2]. This work is close in spirit to [1].

Contact: D. Bothe, J. Kromer

References

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[2] M. Rieber. *Numerische Simulation der Dynamik freier Grenzflächen in Zweiphasenströmungen*. PhD thesis, Universität Stuttgart, 2004.

Project: Numerical modeling of complex fluid-structure interaction

In the present project the interaction between rheologically complex fluids and elastic solids is studied by means of numerical modeling. The investigated complex fluids are viscoelastic fluids. The fluid-structure interaction (FSI) of this kind is frequently encountered in injection molding, food processing, pharmaceutical engineering, and biomedicine. FSI with non-Newtonian fluids has been studied for years, but not many works are concerned with viscoelastic fluids. In order to contribute to that field, the aims of the present projects are: 1) developing a stable numerical solver for viscoelastic fluid-structure interaction (VFSI) problems; 2) investigating the behaviour of a VFSI system; 3) using the developed numerical solver to study a valveless micro-pump as a potential application

Partner: M. Schäfer, TU Darmstadt

Support: Center of Smart Interfaces, Graduate School of Computational Engineering

Contact: D. Bothe, X. Chen

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Project: Direct Numerical Simulation of surface tension driven flows

The research is focusing on the correct numerical representation of thermocapillary flows. Next to the correct treatment of the temperature depending surface tension in a multiphysics/-phase Volume of Fluid code with an interface reconstruction, the improvement of the current implemented heat transfer algorithm is one of the major aims. In addition, the code is expanded by a boundary condition allowing physical setups including dynamic contact line movement and contact angle hysteresis. Furthermore, industry relevant applications are studied within this project. These include short-scale Marangoni flows on heated structured surfaces [1] and thermal droplet actuation of droplets attached to a wall with a linear temperature gradient. All simulations serve a deeper physical understanding of thermocapillary driven phenomena.

Support: Center of Smart Interfaces, Graduate School of Computational Engineering

Contact: D. Bothe, A. Fath

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Project: Dynamic behaviour of buoyant high viscosity droplets rising in a quiescent liquid

A systematic computational analysis of the rise dynamics of high viscosity droplets in a viscous ambient liquid is initiated. This configuration resembles an intermediate case between free rigid particles and bubbles, as the droplet shape adjusts to outer forces while almost no inner circulation is present. As a prototype system, the study focuses on corn oil droplets rising in water, where the droplet diameter ranges from 0.5 mm to 16 mm. The computations are conducted employing the Volume of Fluid in-house code *FS3D*. In terms of rise path, center of mass velocity and interface shape – among others – the dynamic behaviour features a rich spectrum of phenomena and bifurcations, ranging from rectilinear movement to chaotic trajectories.

Contact: D. Bothe, J. Kromer

Partner: C. Albert, A. M. Robertson, University of Pittsburgh, Pittsburgh (PA)

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Project: Numerical study of head-on droplet collisions at high Weber numbers

Head-on collisions of binary water droplets at high Weber numbers are studied by means of Direct Numerical Simulations. The extremely thin lamelles arising at high Weber numbers are kept from artificial rupture by the lamella stabilization method. Simulation results are compared with experimental work of Pan et al. [1]. It is found that a proper disturbance has to be initialized in order to get good agreements between simulation results and experimental results. The influences of disturbances on the collision dynamics are identified. Looking into the pressure field and the velocity field within the collision complex, we gain more insights into the unstable development of the rim of the collision complex.

Support: DFG - project TRR 75

Contact: D. Bothe, M. Liu

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Project: Mathematical Modeling and Direct Numerical Simulation of Mass Transfer from Rising Bubbles under Influence of Surfactant

The influence of surfactants on mass transfer across fluid interfaces in the sharp interface model framework has been studied both theoretically and numerically. Recently, a thermodynamically consistent extension of the sharp interface model has been proposed in [1]. Herein, it is shown how interface concentration and chemical potential mediate the influence on interfacial mass transfer by the change in interface energy due to adsorbed species. In order to gain local insights based on Direct Numerical Simulations, we have implemented and successfully tested an algorithm for mass transfer from bubbles under the influence of surfactant in the Arbitrary Lagrangian Eulerian interface tracking framework of OpenFOAM. Interfacial mass transfer is established by a Dirichlet-Neumann partitioning algorithm which has been implemented by means of two coupled boundary conditions. In order to increase the convergence rate, Aitken's adaptive under-relaxation algorithm is used. Interfacial transport of surfactant species on the fluid interface is taken into account using the Finite Area Method (FAM) for discretization. The flux of transfer component has been locally corrected taking into account the interface concentration of surfactant according to [1].

Support: DFG Priority Program – SPP 1506 & 1740

Contact: D. Bothe, H. Marschall

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Project: Computational Analysis of Fluidic Interfaces Influenced by Soluble Surfactant

This project is concerned with continuum physical and numerical modeling of free-surface and two-phase flows under the influence of surfactant. Direct Numerical Simulation (DNS) are performed to obtain quantitative information about interfacial transport processes in two-phase systems with surfactant which are not accessible through experimental investigations. An Arbitrary Lagrangian Eulerian (ALE) interface-tracking method is employed. The model equations are discretized by means of collocated Finite Volume/Finite Area methods for transport processes in the bulk and on the interface, [5]. The method supports a moving computational mesh with automatic mesh deformation and eventually re-meshing. Particular attention will be given to multicomponent mixture of surfactants diffusing and adsorbing at the interface. The description of the transport of surfactant in the bulk and on the interface is included in the model. Several sorption models are included to account for sorption processes. Test cases comprise growing droplets with soluble surfactants for free surface flows, [2, 1], and single rising bubbles in quiescent contaminated water for two-phase flows, [4, 3]. Future steps involve the study of the influence of surfactant on species transfer, partitioning in oil/water systems, improvement of the model based on the Gauss-Laplace equation in a dynamic scenario, and interface rheology.

Support: DFG Priority Program – SPP 1506

Partner: R. Miller, MPI Potsdam/Golm

Contact: D. Bothe, H. Marschall, C. Pesci

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Project: Modeling and Numerical Simulation of Multi-Component Two-Phase Fluid Systems with Ionic Species

This project aims for an increased understanding of the influence of electrical effects in two-phase flows with mass transfer. The investigation is carried out by means of Direct Numerical Simulation applied to mathematical models within the sharp interface context. The equation systems are discretized using an Arbitrary Lagrangian Eulerian formulation with a Finite Volume/Finite Area Method for the bulk phases and the interface, respectively. As software basis serves the open source solver interTrackFoam [1] handling the hydrodynamics. The software is extended throughout this project in three steps: first extension is the interfacial transport of a passive scalar, second the treatment of multi-component cross-effects, and third the capability to simulate mixtures containing ions.

Partner: S. Schöps, TEMF, TU Darmstadt

Support: Graduate School of Computational Engineering, TU Darmstadt

Contact: D. Bothe, P. Weber

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[1] Ž. Tuković and H. Jasak. A moving mesh finite volume interface tracking method for surface tension dominated interfacial fluid flow. *Computers & Fluids*, 55:70 – 84, 2012.

Project: Development and Application of a Direct Numerical Method for Reactive Transport Processes in Bubble Systems

The project is concerned with both the development and application of a Direct Numerical Method for reactive mass transfer at dynamic interfaces in multiple bubble systems. Two crucial properties for a high-fidelity Direct Numerical Method for reactive mass transfer, namely adaptive and sufficient spatial resolution and intrinsic conservation, are conceptually combined to the proposed hybrid (Lagrangian/Eulerian) method. The Lagrangian part is intended to fully resolve the sharp concentration gradients occurring for realistic Péclet and Hatta numbers, while the method's overall conservative property results from the Eulerian one. By applying the method it is investigated (i) the complex interplay at the bubble interface between two-phase hydrodynamics, local transport processes, and single chemical reactions, and (ii) the quantitative relative importance of above phenomena near the bubble interface on the degree of liquid phase utilization, product selectivity and byproduct formation for competitive prototype reactions within the bubble wake. The development and the application of the novel method are done within the framework of the free open source C++ library OpenFOAM for Computational Continuum Mechanics.

Support: DFG Priority Program SPP 1740

Contact: H. Marschall, M. Falcone, D. Bothe

Project: Numerical Methods for Viscoelastic Fluid Flows at High Weissenberg Number

The objective of the present research is the development of robust numerical methods for viscoelastic fluid flows. Within the project, a general mathematical framework for the derivation of locally decomposed evolution equations of the conformation tensor has been developed and tensorial transformations have been applied to the conformation tensor constitutive equations. Such change-of-variable formulations effectively alleviate the High Weissenberg Number Problem, which refers to the loss of convergence of all numerical methods beyond some limiting value of the fluid elasticity and has been a major challenge in computational rheology for the past three decades. The generic stabilization framework has been implemented into a Finite Volume Method on general unstructured meshes and appropriate solution algorithms for transient single- and two-phase flows of incompressible, viscoelastic fluids have been developed. Evaluations of established benchmark-tests have shown that the numerical methods are both robust and accurate.

Support: BASF SE, Ludwigshafen

Contact: M. Niethammer, H. Marschall, C. Kunkelmann, D. Bothe

Project: Direct numerical simulation of reactive mass transfer at single and multiple bubbles

In two-phase flows with complex local interaction between mass transfer, species transport, and chemical reactions, additional multi-physics phenomena become relevant which can often be ignored for dilute or clean systems. Therefore we extend our two-scalar approach for 3D Direct Numerical Simulations of mass transfer at gas bubbles, which is based on the Volume of Fluid (VOF)-method, to incorporate volume effects accompanied by chemical transformations. One of the main problems here is to numerically resolve the extremely thin concentration boundary layers which becomes even more demanding due to chemical reactions. Coupled, reactive subgrid-scale modeling and a transformed formulation of the species equations in terms of the chemical potentials are employed to mitigate this problem. The developed method is used to study reactive mass transfer from rising form-dynamic bubbles, at interacting bubble pairs, and in small bubble swarms.

Support: DFG Priority Program – SPP 1740

Partner: IMS, TU Hamburg-Harburg; CUP, LMU München; IAAC, JLU-Giessen; Helmholtz-Zentrum, Dresden-Rossendorf

Contact: D. Bothe, A. Weiner

Project: Thermodynamically consistent modeling of chemically reacting multicomponent fluid systems

Multicomponent diffusion in fluid systems is commonly modeled via the Maxwell-Stefan equations. This approach is also employed for chemically reacting systems, but the standard derivation does not cover this case. This project aims at a rigorous deduction of the Maxwell-Stefan equations together with an extension to chemically reactive mixtures. The approach is based on partial balances in particular of the species momenta, where the entropy principle is exploited to obtain information on the interspecies momentum transfer. This yields a closed system of partial mass and momentum balances, from which the system of (extended) Maxwell-Stefan equations follows via an entropy based model reduction. This fundamental mixture theory is developed in [1].

Partner: W. Dreyer, WIAS Berlin

Contact: D. Bothe

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Project: Global existence for reaction-advection-diffusion systems

We investigate the question of global well-posedness for a general system with triangular structure from the class of reaction-convection-diffusion equations in terms of unique weak solutions ([1]). In view of the complexity of huge reaction networks also the situation of fast chemical reactions is studied, where we investigate the link between the limit behaviour of solutions subject to increasing reaction speeds and a related model which is based on a certain kind of model reduction ([1]).

Partner: M. Pierre, G. Rolland

Support: DFG, Rennes Métropole

Contact: D. Bothe

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Project: Global existence in reaction-diffusion systems modeling heterogeneous catalysis

A coupled system of reaction-advection-diffusion equations is studied, where the transport processes take place both in a bulk phase and on the boundary. The exchange of mass between bulk and boundary happens via sorption processes and the chemical reactions occur only for the adsorbed species, i.e. on the boundary. The goal is to construct global-in-time positive strong solutions and to characterize their long-time behaviour ([1]).

Partner: M. Köhne, S. Maier, J. Saal

Contact: D. Bothe

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[1] D. Bothe, M. Köhne, S. Maier, and J. Saal. Global well-posedness of a heterogeneous catalysis model. *In preparation*.

Project: Quasi-optimal Initial Values

Quasi-optimal initial values for weak solutions of the Navier-Stokes equations are initial values close to the optimal initial value condition studied by H. Sohr, W. Varnhorn and R. Farwig during the last years. In that approach u_0 is contained in the Besov space $B^{-1+3/q}_{q,s_q}$ where $\frac{2}{s_q} + \frac{3}{q} = 1$ (Serrin condition). In this project we admit weak solutions for initial values satisfying a Serrin-type integrability which due to a power weight in time is valid only on intervals excluding the origin. To be more precise, for the initial value u_0 the integral $\int_0^\infty \left(t^\alpha \|e^{-tA}u_0\|_q\right)^s dt$ with time weight t^α, $\alpha > 0$, is finite. Such initial values can be described in the class of scaling invariant Besov spaces $B_{q,s}^{-1+3/q}$ where $\frac{2}{s} + \frac{3}{q} = 1 - 2\alpha$, $0 < \alpha < \frac{1}{2}$, i.e., s is larger than the optimal value s_q from above. The problem is to prove existence, regularity, and uniqueness of such solutions and working in functions spaces with weights with respect to time.

Partner: Prof. Dr. Y. Giga, Tokyo University, and his students

Contact: R. Farwig.

Project: Nonzero Dirichlet Boundary Data of Navier-Stokes Flow

The nonstationary Navier-Stokes equations pose new problems when nonhomogeneous boundary data are considered. The main reason is the energy estimate due to a possible energy transfer through the boundary into the fluid domain. One possibility to find solutions is to solve first of all a linear Stokes system with the nonhomogeneous boundary data, then to substract this solution from the Navier-Stokes solutions and finally to solve a modified Navier-Stokes system containing several perturbation terms. This strategy has been successfully applied by H. Kozono, H. Sohr and R. Farwig for bounded and exterior domains during the last years. Even weak solutions satisfying the strong energy inequality can be obtained for exterior domains. The project concerns the asymptotic decay for weak solutions for large data at time close to 0 but decaying as $t \to \infty$ so that the perturbations terms will determine the rate of decay of solutions.

Partner: D. Wegmann, TU Darmstadt, and Prof. Dr. H. Kozono, Waseda University, Tokyo

Contact: R. Farwig.

Project: Boussinesq equations in exterior domains

The Boussinesq system describes the flow of a viscous incompressible and heat-conductive Newtonian fluid where the equations are coupled by the term $g\vartheta$ of the temperature ϑ and the gravity field g acting as a buoyancy force in the momentum equation and the transport term $u \cdot \nabla\vartheta$ in the heat equation. Based on papers by H. Kozono and M. Yamazaki we investigate the stationary and nonstationary Boussinesq system in an exterior domain with nonhomogeneous boundary data. Due to the decay of the fundamental solution as $|x|^{-1}$ for $|x| \to \infty$ and to prove stability results we have to work in Lorentz-Bessel potential spaces. A new feature arises from the nonhomogeneous Dirichlet data which must be defined in trace spaces for Lorentz-Bessel potential spaces. These trace spaces are beyond classical Besov spaces.

Partner: Patrick Matos de Ribeiro, TU Darmstadt, and Prof. Dr. M. Yamazaki, Waseda University, Tokyo

Contact: R. Farwig.

Project: Asymptotic Theory for Stationary 2D-Navier-Stokes Flows

The two-dimensional Navier-Stokes problem in unbounded domains is not well understood due to problems for weak stationary solutions. The main reasons are the logarithmic behavior of the fundamental solution as $|x| \to \infty$ and the lack of embeddings of the Sobolev space H^1. These problems can be overcome by symmetry assumptions on the domain, the data, and corresponding solutions. The problem at hand concerns weak stationary solutions for an aperture domain where the flux through the hole connecting the two half spaces is an important physical and mathematical quantity. For small symmetric data (flux condition) and a symmetric geometry it has been proved by G.P. Galdi, M. Padula and V.A. Solonnikov that there exists a unique weak solution with an even/odd parity satisfying the decay rate $1/|x|$ as $|x| \to \infty$. This rate of decay is related to the structure of classical Jeffery-Hamel flow. Moreover, the proof strongly depends on cancellation properties of (weakly) singular integrals under symmetry and parity assumptions. The project concerns the non-symmetric situation where the results of the above-mentioned quality cannot be expected.

Partner: Prof. Dr. T. Hishida, Nagoya University, Nagoya

Contact: R. Farwig.

Project: Uniqueness of Solutions with Precompact Range

Real world solutions to the Navier-Stokes equations are not periodic, but close to periodicity. One possible generalization is given by almost periodic solutions defined on the time axis $(-\infty, \infty)$. On the other hand there are functions such as $\sin(t^2)$ which are neither periodic nor almost periodic but have a precompact range. Actually, it seems to be possible to extend known uniqueness results for time-periodic and almost periodic solutions to solutions with precompact range with respect to $t \in (-\infty, \infty)$. In such a setting on unbounded domains of $\mathbb{R}^3$ one mild solution is assumed to have small values in the Lorentz space $L^{3,\infty}$ uniformly in time whereas the second mild solution is assumed to have a precompact range in $L^{3,\infty}$ without any smallness condition.

Partner: Y. Taniuchi, Shinshu University, Matsumoto, and T. Nakatsuka, Nagoya University, Nagoya

Contact: R. Farwig.

Project: Existence of Solutions with Precompact Range

For the Navier-Stokes equations in unbounded domains and/or on unbounded time intervals conditions at space infinity and/or at time infinity, let it be $t \to -\infty$ or $t \to \infty$, are needed to find a functional analytic setting to prove existence and uniqueness of solutions. Concerning the behavior in time the concept of periodicity, but also of almost periodicity is a standard tool to work with. However, there are functions such as $\sin(t^2)$ which are neither periodic nor almost periodic but have a precompact range with respect to time. This condition is related to an 'almost' finite dimensional behavior (cf. the concepts of total boundedness and of measures of noncompactness) as $t \to \pm\infty$ and is satisfied for periodic and almost periodic functions. The project concerns the existence of $BUC(\mathbb{R})$-solutions of the Navier-Stokes system in unbounded domains of $\mathbb{R}^3$ with precompact range in the space L^3.

Partner: Y. Taniuchi, Shinshu University, Matsumoto, and T. Nakatsuka, Nagoya University, Nagoya

Contact: R. Farwig.

Project: Asymptotic Decay for the Fractional Navier-Stokes Equations

The fractional Navier-Stokes system is a model for fluid flow where in contrast to the classical Navier-Stokes system on the whole space $\mathbb{R}^3$ the friction term $-\Delta u$ is replaced by the fractional Laplacian $(-\Delta)^{\alpha/2}u$, $0 < \alpha < 2$. Using the Fourier transform we have to consider the term $|\xi|^\alpha$ rather than $|\xi|^2$ leading to a fundamental solution $E_\alpha(x,t) = t^{-3/\alpha}E_\alpha^0(xt^{1/\alpha})$ with Fourier transform $e^{-t|\xi|^\alpha}$ of the fractional heat equation. Here E_α^0 is positive and bounded by $c(1+|x|)^{-\alpha-3}$ and hence not exponentially decaying. The first aim of the project is to determine the asymptotic structure of solutions of the corresponding fractional Navier-Stokes equations where the Helmholtz projection must be taken into account as well. A second aim is to prove the possibility of a concentration-diffusion phenomenon under suitable symmetry assumptions on the initial value. Such a result requires that the solutions of the nonlinear problem depend in an analytic way on the initial datum.

Partner: H.-O. Bae, Ajou University, Suwon, South Korea

Contact: R. Farwig.

Project: Regularity Theory for the Navier-Stokes System in Besov Spaces

Optimal initial values for weak solutions to the Navier-Stokes equations to yield even strong solutions can easily be described in terms of Besov spaces. This well-known result for the whole space also holds in bounded domains and several types of unbounded domains. The aim of the project is to apply this result not only at the initial time $t = 0$, but at almost all times t_0 to get new regularity results for weak solutions. To identify locally the given weak solution with the new strong solution starting at t_0 Serrin's uniqueness theorem is an indispensable tool. Such regularity results are usually of local nature, either right-sided or left-sided or both-sided with respect to t_0. Moreover, it is possible to get control of the length of the regularity interval. A further aim is to obtain such results for inhomogeneous boundary data and for boundary conditions different from the Dirichlet case.

Partner: Prof. Dr. H. Sohr, Universität Paderborn, and Prof. Dr. W. Varnhorn, Universität Kassel

Contact: R. Farwig.

Project: Fundamental Solutions of Fluid Flow

The fundamental solution of linear problems play a crucial role in finding adequate function spaces to solve related nonlinear problems and to determine asymptotic properties in space and/or time of solutions. In this project we are looking for fundamental solutions arising from problems of fluid flow past a rigid body with prescribed angular and translational velocity. The corresponding linearized equations are obtained by a global coordinate transform so that the domain filled by the fluid is independent of time. In a next step these equations are considered in the whole space yielding a fundamental solution of non-convolution type due to x- and/or t-depending coefficients in the resulting equations. This kind of problem was recently solved in cooperation with R. B. Guenther and E. A. Thomann in the case of a rotating body with constant translational velocity parallel or non-parallel to the axis of revolution. New problems will occur when the prescribed angular and translational velocities are arbitrary and t-dependent. Only in very specific cases an almost explicit fundamental solution can be expected.

Partner: Prof. Dr. Š. Nečasová, Academy of Sciences of the Czech Republic, Prague, and S. Kračmar, TU Prague, Prague

Contact: R. Farwig.

Project: Very Weak Solutions of the Navier-Stokes System in Unbounded Domains

The Navier-Stokes equations in general smooth unbounded domains pose new problems since the Helmholtz decomposition my fail to exist in L^q-spaces. In that case also the Stokes operator and the corresponding Stokes semigroup cannot be defined except for the L^2-case. To solve this problem H. Kozono, H. Sohr and R. Farwig did work in the class of function spaces $\tilde{L}^q := L^q \cap L^2$ when $2 < q < \infty$ and $\tilde{L}^q := L^q + L^2$ when $1 < q \leq 2$. In these spaces the Helmholtz projection $\tilde{P}_q$ exists and the Stokes operator $\tilde{A} := -\tilde{P}_q \Delta$ generates an analytic semigroup and has maximal regularity. Based on these properties we look for strong solutions and by duality methods also for very weak solutions in these function spaces. Very weak solutions can be used to prove local regularity results for weak solutions of the Navier-Stokes system by identifying the given weak solution via Serrin's uniqueness theorem with a very weak one for the same data. Moreover, the Kato iteration will work in the space $\tilde{L}^n$ to yield mild solutions in (almost) scaling invariant spaces.

Partner: Paul Felix Riechwald, TU Darmstadt

Contact: R. Farwig.

Project: The Stokes System in Unbounded Domains with Navier Slip Boundary Condition

Based on the function spaces $\tilde{L}^q := L^q \cap L^2$ when $2 < q < \infty$ and $\tilde{L}^q := L^q + L^2$ when $1 < q \leq 2$ we will analyze the (Navier-)Stokes equations in general unbounded smooth domains with non-Dirichlet data. To be more precise we consider the Navier slip boundary condition of the type $\alpha(T(u) \cdot \mathrm{n})_\tau + \beta u_\tau = 0$ ($\alpha > 0$, $\beta \geq 0$) where $T(u) = T(u, p)$ denotes the Cauchy stress tensor, n the exterior normal vector on the boundary, and τ denotes the tangential component along the boundary. Using results of Y. Shibata and R. Shimada it is known that the corresponding Stokes operator generates an analytic semigroup on bounded domains on every L^q-space, $1 < q < \infty$, and has maximal regularity. The aim of the project is to generalize this result to general smooth unbounded domains by working in spaces of type $\tilde{L}^q$. To pass to the limit from a sequence of bounded domains to the unbounded domain (method of exhaustion) we take special care on the approximation of the boundary to prove the Navier slip boundary condition in the limit.

Partner: Veronika Rosteck

Contact: R. Farwig.

Project: Extension operators for mixed boundary conditions

We aim for a result in the spirit of the Jones Theorem for the extension of Sobolev functions on domains to the whole space adapted for mixed boundary conditions. For this we want to take full advantage of the fact that the extension over the Dirichlet part of the boundary should be possible without any boundary regularity, while all known results need some regularity near the interface between the boundary parts.

Partner: R. Brown, University of Kentucky, Lexington

Contact: R. Haller-Dintelmann, P. Tolksdorf

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Project: The Stokes- and Navier-Stokes equations subject to mixed boundary conditions

Based on earlier work on elliptic differential operators on Lipschitz domains subject to mixed boundary conditions and the special competence on Stokes- and Navier-Stokes equations present in Darmstadt, we aim to broaden the theory for the Stokes operator and the Navier-Stokes equations on Lipshchitz domains. We hope to treat various boundary conditions, e.g. mixed ones, and a special focus is laid on maximal parabolic regularity results.

Contact: P. Tolksdorf, R. Haller-Dintelmann

Project: The Klein-Gordon equations on a star-shaped network

We consider the Klein-Gordon equations on n copies of the interval $(0, \infty)$ glued together at the origin with usual Kirchhoff (or other) transmission conditions in the vertex. In earlier work we already established a spectral representation of the corresponding operator and, based on this, an explicit solution formula.
Exploiting this formula, we intend to understand in a quantitative manner effects related to the tunnel effect like retarded reflection and advanced transmission. Furthermore, we study the L^∞-time decay of the solutions and apply this to non-linear eqations.

Partner: Felix Ali Mehmeti, Virginie Régnier (Université de Valenciennes)

Contact: R. Haller-Dintelmann

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Project: Operator theory and numerical analysis

On the operator theory side, our main interest is twofold: first in index formulas for Toeplitz plus Hankel operators. These operators occur in many applications, e.g. in numerical analysis for singular integral equations. Whereas the Fredholm theory for Toeplitz plus Hankel operators with piecewise continuous generating functions is fairly well understood, the known formulas for the Fredholm index of these operators are quite involved and hard to use. Recently we succeeded to derive an (as we believe, handy) index formula, which is based on the observation that several Hankel operators belong to the Banach algebra generated by Toeplitz operators. It would be interesting to extend this formula for other clases of Toeplitz plus Hankel operators. Our second objective in the field of operator theory is limit theorems of Szegö type. The classical Szegö theorems study the asymptotic behaviour of the determinants of the finite sections $P_n T(a) P_n$ of Toeplitz operators. We want to generalize these results to operators which have non-constant functions on their diagonals. Particular attention is paid to operators with almost periodic coefficients, which are of immense importance in applications (the prominent Almost Mathieu operator is an example of a band operator with almost periodic coefficients). Whereas the generalizations of the so-called first and strong Szegö limit theorems to this context is now widely accomplished, some serious questions still remain open. For example, the case of operators where more than one "irrationality" occurs is still largely open. Second part: For the numerical solution of an operator equation on an infinite-dimensional space, one discretizes the operator to obtain a sequence of $n \times n$ matrices A_n. Interesting asymptotic properties of the sequence (A_n) can be studied by embedding this sequence into an appropriate C^*-algebra and by studying the structure of that algebra. Of particular interest are algebras of matrix sequences which own the following (self-similarity) property: Every sequence in the algebra can be rediscovered from each of its infinite subsequences modulo a sequence tending to zero in the norm. Examples of such algebras arise, for instance, from the finite sections method for Toeplitz or singular integral operators. Sequences (A_n) in self-similar algebras are distinguished by their excellent asymptotic properties: for example, the pseudospectra of the A_n converge with respect to the Hausdorff metric. A basic tool to analyse algebras of matrix sequences is a Fredholm theory of sequences, which has also found interesting applications: a proof of the Arveson dichotomy for self-adjoint sequences, a proof of the index formula for band-dominated operators, and the creation of an algorithm to determine partial indices of matrix functions numerically, for instance. We derived results along these lines for spatial discretizations of several classes of C^*-algebras including Cuntz algebras, reduced group C^*-algebras and algebras generated by truncated Toeplitz operators on model spaces, and we (still) plan to extend them to multi-dimensional disk algebras and other algebras generated by isometries.

Partner: Torsten Ehrhardt, Bernd Silbermann

Contact: S. Roch

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[3] S. Roch. Finite sections of truncated Toeplitz operators. *Concrete Operators*, 2:8–16, 2014.

[4] S. Roch. On a question by M. Seidel and the answer by D. Dragicevic et al. *Oper. Theory: Adv. Appl.*, 242:307–310, 2014.

[5] S. Roch and B. Silbermann. A handy formula for the Fredholm index of Toeplitz plus Hankel operators. *Indagationes Mathematicae*, 23:663–689, 2012.

Project: Spectral theory of band operators

Our main interest is in Jacobi (= tridiagonal band) operators, which occur, for example, as discretizations of one-dimensional Schrödinger operators. We consider random potentials (and can allow also random entries on the other diagonals), which are deterministically modelled by pseudo-ergodic sequences, following an idea by E. B. Davies. We study a version of the finite section method for the approximate solution of equations $Ax = b$ in infinitely many variables, where A is a pseudo-ergodic Jacobi operator. In other words, we approximately solve infinite second order difference equations with stochastic coefficients by reducing the infinite volume case to the (large) finite volume case. Our goal is to design the finite sections by choosing the truncations in such a way that the associated limit operators are of a special form (e.g., Toeplitz operators) and to derive spectral inclusions.

Partner: Marko Lindner

Contact: S. Roch

References

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Project: Band-dominated operators, their Fredholm theory and finite sections

A band-dominated operator is the norm limit of a sequence of band operators, i.e., of operators which have a band matrix as their representation with respect to a fixed basis. For example, pseudodifferential operators on $L^2(\mathbb{R}^N)$ with symbols in $S^0_{0,0}$ and several classes of convolution operators own this property. Fredholm properties of band-dominated operators can be studied via their limit operators, which reflect the behaviour of the operator at infinity. A typical result says that a band-dominated operator is Fredholm if and only if each of its limit operators is invertible and if the norms of their inverses are uniformly bounded. Also the index of a Fredholm band dominated operator (on $l^2(\mathbb{Z})$) can be expressed in terms of (local) indices of its limit operators. The last two years have seen tremendous progress in the field of general band-dominated operators. Lindner and Seidel solved one of the big questions in this field by showing that the condition of *uniform* boundedness of the inverses of the limit operators is indeed redundant - a fact that was conjectued for a long time and that was known before for special cases only. The proof of Lindner and Seidel worked for band-dominated operators on the additive group $\mathbb{Z}^N$. Their result was generalized to band-dominated operators acting on quite general groups by Spakula and Willett in 2014. It would be fascinating to investigate the consequences of these results to the operator theory and numerical analysis for concrete band-dominated operators. Another goal of the project is to use the above methods to study the Fredholm properties of Schrödinger operators (and other operators of mathematical physics) and the decay of their eigenfunctions. A third line of research concerns the Fredholm theory and numerical analysis of discretized differential operators acting on periodic nano-structures (like honeycomb structures and nano-tubes). Third, as we observed only recently, the above sketched methods seem to apply to study diffraction by ($\mathbb{Z}^1$- or $\mathbb{Z}^2$-) periodic graphs for second order elliptic equations. In general, the study of the solvability of pseudodifferential operators on a periodic graph rises serious difficulties because the graph is a singular manifold with an infinite set of singular points. We are mainly interested in a setting where the graph is periodic, but the coefficients of the operator and in the transmission conditions are not (such that the standard Floquet method does not apply).

Partner: Vladimir S. Rabinovich

Support: CONACYT, DFG

Contact: S. Roch

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[2] V. Rabinovich and S. Roch. Finite sections of band-dominated operators on discrete groups. *Oper. Theory: Adv. Appl.*, 220:239–253, 2012.

[3] V. Rabinovich and S. Roch. Pseudodifferential operators on periodic graphs. *Integral Equations Oper. Theory*, 72:197–217, 2012.

[4] V. S. Rabinovich and S. Roch. Essential spectrum of difference operators on periodic metric spaces. *Funk. Anal. Appl.*, 43:151–154, 2009.

Project: Numerical analysis for convolution-type operators

The goal of this project is to investigate the stability of projection methods for several classes of convolution type operators. In particular, we will consider operators on $L^p(\mathbb{R})$ which belong to the closed Banach algebra generated by all operators of multiplication by a piecewise continuous function, all operators of convolution by a piecewise continuous Fourier multiplier, and by a flip operator. The latter operator involves serious difficulties since localization techniques do not apply in the standard way. Another difficulty arises because the spectra of the generators become massive sets, which makes it much harder to verify the inverse closedness of the considered algebras in the algebra of all bounded linear operators on $L^p(\mathbb{R})$. In the reference cited below we succeeded to derive a Fredholm criterion for operators in this algebra, which applies in particular to Wiener-Hopf plus Hankel operators on Lebesgue spaces L^p, and to Toeplitz plus Hankel operators on Hardy spaces H^p, and we succeeded to derive stability criteria for several kinds of finite sections approximations for these operators. Formally, this means to identify the above mentioned operators with constant sequences and to examine an algebra which contains these constant sequences together with a (non-constant) sequence of projections. Moreover, we defined this algebra in such a way that it contains with each sequence (A_t) the (appropriately defined) sequence $(F^{-1}A_tF)$, with F the Fourier transform. Thus, this algebra provides a suitable frame to study approximation methods with cut-off both in the original space as in the frequency domain. The proof of the stability criteria is based on localization techniques, which reduce the invertibility of an object in a "global" algebra to the invertibility of a family of objects in "local" algebras. We were able to describe these local invertibilities completely with only one exception: the algebra associated with (∞, ∞), for which we have only partial results (still covering a lot of interesting approximation sequences). A full unterstanding of this remaining algebra is a challenging task for future research.

Partner: Pedro dos Santos

Support: CEAF/FCT

Contact: S. Roch

References

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[4] S. Roch and P. A. Santos. A tour to compact type operators and sequences related to the finite sections projection. *Oper. Theory: Adv. Appl.*, 242:311–323, 2014.

Project: Strong Stability of 2D Viscoelastic Poiseuille-Type Flows

Viscoelasticity describes a property of materials exhibiting both viscous and elastic characteristics under deformation. Such a material may show elastic behavior like memory effects as well as fluid properties.

In this joint project with Y. Giga (University of Tokyo) and K. Schade (TU Darmstadt), we investigate L_p-stability issues of small viscoelastic Poiseuille-type flows in two dimensions stemming from a model considered in Fang-Hua Lin, Chun Liu, and Ping Zhang (2005). We show local existence of perturbed flows of locally-in-time existing Poiseuille-type flows and global existence of the perturbed flows whenever the initial perturbation is small and the layer is sufficiently thin. In the latter case the perturbed flow decays exponentially.

Partner: Prof. Dr. Y. Giga, The University of Tokyo

Contact: J. Sauer, K. Schade

References

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1.3 Applied Geometry

The research group “Geometry and Approximation” investigates geometric objects, typically surfaces, as well as approximations thereof.

Classical Differential Geometry deals with curves and surfaces. Surfaces arising in the sciences are frequently minimizers to certain functionals. In the simplest case, say for a biological cell, they might bound a given volume in such a way that the area of the surface is minimal. Other interfaces minimize functionals involving curvatures. Critical points satisfy Euler equations, namely non-linear partial differential equations. Our goal is to establish new solutions and properties of solutions, in Euclidean 3-space but also in other Riemannian spaces, by employing analysis and Riemannian Geometry.

In Geometric Modeling, mathematical tools for the explicit description of geometric objects are developed and analyzed. Unlike in elementary geometry, the focus is not on simple objects like circles or spheres, but on more complex structures, as they arise in various applications. One may think of a car body, a piece of cloth, or a dinosaur in an animated film.

The surfaces considered in Differential Geometry and Geometric Modeling typically have a fairly complicated structure. For further processing, it is necesary to approximate them in a function space of reduced complexity, say a spline space. For that reason, the development of tools for efficient approximation of geometric objects is an important task, giving rise to interesting mathematical questions in the field of multivariate approximation theory.

Members of the research group

Professors

Karsten Große-Brauckmann, Ulrich Reif, Matthias Schneider

Research Associates

Jerome Alex, Tristan Alex, Tobias Ewald, Roland Gunesch, Dietmar Hildenbrand, Dominik Kremer, Susanne Kürsten, Nicole Lehmann, Lars-Benjamin Maier, Claudia Möller, Sonja Odathuparambil, Miroslav Vrzina

Secretaries

Karolin Berghaus, Sybille Drexler

Project: Triply periodic Steiner Trees

The Steiner Tree problem is a problem of combinatorial optimization. Given a set of points, interconnect them by a network of shortest length, where the length is the sum of the lengths of all edges. In order to reduce the length of the spanning network, new vertices and edges may be introduced. The Steiner tree problem has applications in circuit layout or network design. Periodic Steiner Trees are used to describe various multi-atomic structures and their molecular configurations.

Contact: J. Alex.

Project: Periodic Minimal Surfaces in Homogeneous Manifolds

Schwarz reflection is a well-known procedure to generate triply periodic minimal surfaces in Euclidean 3-space. In isotropic homogeneous 3-manifolds, the same techniques apply to obtain periodic minimal surfaces; vertical planes and horizontal sections used as barriers guarantee the embeddedness of a Plateau solution with respect to a polygon consisting of vertical and horizontal geodesics. This solution is reflected across its boundary geodesics to obtain a periodic minimal surface. In non-isotropic manifolds, additional work is required to obtain the necessary barriers. Additionally, the notion of periodicity is more complicated and leads to restrictions on the Jordan polygon bounding the Plateau solution.

Contact: T. Alex.

Project: Analysis of Geometric Subdivision Schemes

In recent years, non-linear univariate subdivision schemes came up to generate smooth limit curves sensitive to the geometry of the coarse initial data solving some disadvantages unavoidable in the well-studied linear subdivision. But until now their analysis of smoothness remain highly specialized to the concrete setting. The goal of this project is to establish a general framework answering this question for a whole variety of non-linear schemes. To this end, we introduced in [1] a broad class of geometric, local, uniform and equilinear schemes and gave a $C^{1,\alpha}$-theory for these so called GLUE-schemes. For an important subset thereof, including all real-valued schemes, a $C^{2,\alpha}$-analysis is possible. The theory is based on studying the decay of a newly introduced quantity named *relative distortion*. The verification of its decay rate can be done automatically and rigorously by a computer when using affine arithmetics. We implemented this non-trivial algorihm and applied it to the circle-preserving Dodgson-Sabin scheme showing $C^{1,1}$-regularity for a wide range of initial data, which was only conjectured beforehand. When generalizing the class of GLUE-schemes by dropping equilinearity, we can formulate necessary and sufficient conditions for convergence while working on conditions for G^1-continuity. Also the extension to non-linear subdivision surfaces will be further investigated.

Contact: U. Reif, T. Ewald

References

[1] T. Ewald, U. Reif, and M. Sabin. Hölder regularity of geometric subdivision schemes. Preprint, TU Darmstadt, 2014.

Project: Surfaces in homogeneous 3-manifolds

Minimal and constant mean curvature surfaces are a traditional subject when the ambient space is Euclidean space or more generally a space form such as hyperbolic space or a sphere. Recently, the case of homogeneous 3-manifolds has received much attention. We study these spaces as Riemannian fibrations and investigate minimal surfaces in these spaces in order to obtain minimal and constant mean curvature surfaces in Riemannian product spaces by the Benoit sister construction.

Partner: Rob Kusner (Amherst, MA)

Contact: K. Grosse-Brauckmann

References

[1] B. Daniel. Isometric immersions into 3-dimensional homogeneous manifolds. *Comment. Math. Helv.*, 82:87–131, 2007.

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Project: Periodic surfaces and interfaces

Periodic surfaces play an important role for the modelling of various naturally occuring interfaces. The functional to be minimized is often not exactly known. Nevertheless, there are obvious candidates such as area, the Willmore functional, etc.; perhaps under a volume constraint. In the constrained Willmore case, limits of the surface families form a way to construct a Schoen skeletal graph rigorously as a periodic Steiner tree in three-dimensional space. It is investigated in which skeletal graphs are optimal in a suitable sense.

Partner: G. E. Schröder-Turk (Erlangen)

Contact: K. Grosse-Brauckmann

References

[1] K. Grosse-Brauckmann. Triply periodic minimal and constant mean curvature surfaces. *Interface Focus*, 2(5):582–588, 2012.

Project: Ambient B-Splines

Ambient B-Splines are a new approach to approximating functions on embedded manifolds with arbitrary smoothness and order. It is based on restricting standard tensor product splines, defined on ambient space, to the manifold. The well-known stability problem is solved by extending the function defined on the manifold constantly in normal direction.

In this project, we investigate applications of the method in the reconstruction of smooth surfaces and in the approximation of large data sets in geo-sciences, like the geoid.

Partner: Fraunhofer IGD, Darmstadt

Contact: U. Reif

Project: Diversified B-Splines

We investigate approximation properties of tensor product splines on bounded domains in $\mathbb{R}^d$. In the bivariate case $d = 2$, the concept of diversification, which uses a separate copy a B-spline for each connected component of its support intersected with the domain, yields a spline space with optimal approximation power with respect to anisotropic Sobolev norms. Stability of the basis can be achieved by a local adaption of the knot sequence, called condensation. By contrast, for dimensions $d \geq 3$, examples show that standard error estimates with constants independent of the aspect ratio of the knot grid are not possible.

Partner: Dr. Nada Sissouno (Universität Passau)

Contact: U. Reif

Project: Geometric Subdivision Algorithms

While linear subdivision algorithms are well understood, the analysis of newly devised geometric algorithms offers a new challenge. In this project, we develop an approach to determining critical Hölder exponents of univariate schemes which are invariant with respect to the group of similarity transformations.

Partner: Dr. Malcolm Sabin (University of Cambridge), Tobias Ewald (TU Darmstadt)

Contact: U. Reif

Project: Collocation with WEB-Splines

Weighted extended B-splines (web-splines) are a variant of standard B-splines which is geared to the approximation of elliptic boundary value problems. While Ritz-Galerkin methods have been studied extensively in the past, we now consider collocation methods. First experiments show that the approach yields high approximation order without any need for numerical integration and thus high efficiency. We intend to elaborate on our implementation and to establish theoretical results based on old-fashioned proof techniques developed in the context of finite difference schemes.

Partner: Prof. Dr. Klaus Höllig (Universität Stuttgart)

Contact: U. Reif

Project: Constant mean curvature surfaces in homogeneous 3-manifolds

In the recent years constant mean curvature surfaces have been studied in simply connected homogeneous 3-manifolds. In the ambient spaces $\mathbb{H}^2 \times \mathbb{R}$ and Sol_3 new surfaces with two ends are constructed with methods from geometric analysis. i.e., they are obtained as solutions from ordinary and partial differential equations. In Sol_3 we also construct triply-periodic minimal surfaces. Solutions of these differential equations are computed with Mathematica and the Surface Evolver.

Contact: M. Vrzina.

1.4 Didactics and Pedagogics of Mathematics

The working group on subject didactics accommodates two lines of research.

Research Group in Didactics

The working group on subject didactics with Regina Bruder considers their focus to be on theoretically and empirically founded concepts of course development for secondary levels I and II. This includes discussions on curricular issues regarding content selection and substantiation for general-education mathematics classes. Through academic monitoring of several long-term projects on course development in various German federal states - particularly on a concept-based use of technology and on internal differentiation within secondary level I and, since 2014, also on long-term capacity building at secondary levels, as well as on the implementation of secondary school leaving examination standards in the form of guidelines for teaching staff – expertise in research methodology has also been built, for instance, in how to enter developmental progress in learning processes.

Due to participation in various working groups of the GDM [Society for Didactics of Mathematics], major book projects, and through extensive teacher training activities, inter alia, at the DZLM [German Centre for Mathematics Teacher Education], subject didactics has built a strong network throughout the German-speaking areas.

The implementation of preliminary mathematics courses (online) at the commencement of the engineering degree courses in four departments (VEMINT project in cooperation with Kassel, Paderborn and Lüneburg) and university-wide e-portfolio project dikopost demonstrate the broad networking and anchoring of the working group on subject didactics at TU Darmstadt.

Research Group in Operator Algebras and Mathematical Physics

Quantum probability is an extension of classical probability theory that allows to treat also probabilistic effects of quantum systems. Operator algebras allow a unified treatment of both cases, classical probability as well as probability in quantum systems. All basic notions of probability like expectations, random variables, stochastic processes, martingales, etc. can be formulated in the language of operator algebras in such a way that they reduce to the notions of classical probability whenever the operator algebra is commutative.

Our **research interests** range from theoretical mathematical investigations to physical applications. Consequently, the members of our research group as well as our research partners range from pure mathematicians to physicists.

Common to most of our research is its focus on certain **dynamical behaviour**, be it the dynamics of classical and quantum stochastic processes (Markov processes, noise, quantum trajectories, filtering, etc.), be it the dynamics generated by completely positive maps (ergodic properties, existence and numerical computation of equilibrium states, quantum state preparation, etc.). Our investigations on the long time behaviour of Markov processes have opened the door to our recent research on quantum coding. It links quantum probability in a new and unexpected way with the fields of quantum information and quantum control.

Recently the **geometry of entangled states** came into the focus of our research interests, in particular entanglement on infinite systems, multipartite entanglement, entanglement of Fermionic states, and criteria for entanglement by methods from convex algebraic geometry.

Members of the research group
Professors
Regina Bruder, Burkhard Kümmerer

Research Associates
Isabell Bausch, Julia Berlin-Bonn, Axel Böhnke, Uwe Böttcher, Nora Feldt-Caesar, Andreas Gärtner, Angela Karl, Renate Nitsch, Walter Reußwig, Kristina Richter, Ulrike Roder, Oliver Schmitt, Nadine Scholz, Florian Sokoli, Stefan Wilhelm

Secretaries
Heike Müller, Elisabeth Müller-Klingenburg

Project: Effects of Learning and Diagnostic Environments for Mathematics with Game Elements (Effekte mathematischer Lern- und Diagnosumgebungen mit spielerischen Elementen) (2011-2013)

Funded by the department "FiF – Forum für interdisziplinäre Forschung" of Technische Universität Darmstadt an interdisciplinary research cooperation was initiated. The cooperation was launched with Prof. Regina Bruder (Working Group Didactic of Mathematics, FB 4), Prof. Ralf Steinmetz (Working Group Serious Games, FB 18) and Prof. Bernhard Schmitz as heads for the project and Kristina Richter (FB 4) as project coordinator.
The research project adresses the topic of instructional and diagnostic support of game elements in learning environments for mathematics. The scope of the cooperation is the conception and development of a learning game as well as the investigation of effects on motivation and learning outcomes of studends in mathematics classrooms. The conceptualization and development ist in progress, the pilot studies ar in preparation.
Website: `http://www3.mathematik.tu-darmstadt.de/ags/didaktik/forschung/didaktik/projekte/fif-seite`

Support: FiF – Forum interdisziplinare Forschung (2011-2013)

Contact: R. Bruder and K. Richter

Project: HEUristic work with REpresentations of functional relationships and the diagnosis of mathematical COmpetencies of students (HEUREKO)

The research goal of this project was the development and the empirical verification of a competence structure model concerning the field of functional relationships in grade 9 and 10. In this context we focused on situations where processes of growth and change are mathematically assessed (overarching idea "change"). We systematically investigated the ability to translate between different forms of representation (algebraic, graphic, numerical and verbal form of representation). Therefore, we used methods of item response theory to gain an important prerequisite for the development of effective teaching and learning concepts. Additionally, we focused on certain elements of cognitive action to get a deeper understanding in the translation process action (Indentification, Construction, Description and Explanation).
Concerning the translations between different forms of representation we empirically tested the anticipated 5 dimensional competence structure model. In comparison with other possible models (using information criteria measures) our model showed the best

model fit and could be verfied.
Concerning the elements of cognitive action we additionally analyzed the data set and verified a 3 dimensional model with within-item-multidimensionalty
(s. `http://www.kompetenzmodelle.dipf.de`)

Partner: Prof. Timo Leuders and Prof. Markus Wirtz Freiburg; Prof. Tino Kelava Darmstadt

Support: GRF (Priority Research Program "Competence Models")

Contact: R. Nitsch, R. Bruder

References

[1] R. Nitsch, A. Fredebohm, R. Bruder, D. Naccarella, T. Leuders, and M. Wirtz. Students' competencies in working with functions in secondary mathematics education – empirical examination of a competence structure model. In *International Journal of Science and Mathematics Education*. Springer (http://link.springer.com/journal/10763/onlineFirst/page/6), 2014.

Project: CALiMERO 2005-2013

On the basis of the experiences made with graphics calculators in the German Federal State of Lower Saxony the school project started in summer 2005 with the aim to introduce the reasonable use of CAS-calculators in secondary school level I. To reach this target it is planned to develop a curriculum and design concept for maths lessons where a new tasks culture is established and the calculator is used for the enhancement of mathematical competencies. The project CAliMERO was started in the school year 2005/2006 in six Gymnasiums with 29 classes of level 7 which are working very closely with the developed lesson elements. In the current school year they are already 50 schools to use the material developed and tested the year before. In the next years CAliMERO will be continued up to class level 10. In order to enhance sustainable maths learning with CAS it is necessary, as described by Stacey (2003), to establish a teaching culture which corresponds to the use of CAS. Therefore a further training course of several days took place at the beginning of the project with representatives of the participating schools, experts from Lower Saxony and under the direction of Prof. Dr. Regina Bruder. There were discussions about appropriate teaching methods to support the development of competencies in CAS-supported lessons according to the German education standards (KMK, 2003). The teaching concept developed with the participating teachers intends to make use of the complex potential of calculators for the discovery of maths and for effective exercises for a better understanding. Additional meetings during the project are organized every three months to improve communication between the participants, to develop the next teaching elements and learning materials for the students and to discuss the state of evaluation. Moreover, the TU Darmstadt offers project coaching by means of a special internet platform which allows the ideas exchange of the participants and contains all developed materials (www.prolehre.de).

Partner: Prof. Dr. Guido Pinkernell, Heidelberg

Support: TEXAS Instruments and Ministry of Education Lower Saxony

Contact: R. Bruder

References

[1] R. Bruder and W. Weiskirch. *CAliMERO – Computer-Algebra im Mathematikunterricht. Analysis: Methodische und didaktische Handreichung.* T^3 Münster, 2012.

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[4] R. Bruder and W. Weiskirch. *CAliMERO – Computer-Algebra im Mathematikunterricht. Stochastik: Methodische und didaktische Handreichung*. T^3 Münster, 2013.

[5] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht. Stochastik: Arbeitsmaterialien*. T^3 Münster, 2013.

[6] R. Bruder and W. Weiskirch. *CAliMERO – Computer-Algebra im Mathematikunterricht. Analysis: Arbeitsmaterialien*. T^3 Münster, 2014.

Project: TELPS - Teacher Education Lesson Plan Survey (2009-2013)

The aim of the project is to explore prospective teachers' mathematical pedagogical content knowledge (MPCK) within a Repertory Grid Survey and to support prospective teachers' development of professional competencies within this survey. This project is designed as a cross-sectional study with longitudinal components at the University of Technology Sydney and the Technische Universität Darmstadt.

We adapted the Repertory Grid Method and chose lesson plans as objects, which should be compared by the participants. Initially the participants were asked to focus their thoughts on the features of a "good" mathematics lesson, listing them in no particular order. We believed that this initial part of the survey would help them to get started with the analysis of the lesson plans that was important for those students who were in their first teacher education class. They then compared two lessons. The results of this comparison are documented in agrid, where the participantsestimated the occurrence of the characteristics.

Within the project we can show, that students' perspectives on mathematics lesson plans changed in different ways: Some are more detailed in their lesson plan analysis, some change the focus of their analysis, some lose facets or foci, and some get more multifarious in their lesson plan comparison. These results are used to create an individual partly automated feedback, which is furthering participants' individual development of MPCK. This feedback was programmed in cooperation with the department of computer science (TU Darmstadt).

Partner: Prof. Dr. Anne Prescott (University of Technology Sydney)

Contact: I. Bausch, R. Bruder

References

[1] A. Prescott, I. Bausch, and R. Bruder. A method for analysing mathematics pre-service teachers' Pedagogical Content Knowledge.

Project: COnceptual DIfficulties in the field of functional relationships

In the project CODI we analysed students' learning difficulties in the field of functional relationships. We developed a diagnostic tool in which multiple translations are considered to identify students' learning difficulties at a nearly stage. For this purpose, we focused on the identification of stable phenomena as misconceptions and developed an online tool which can be evaluated with an automatic feedback. The study is limited to linear and quadratic functions,as these are the two types with which the examined age group (class

9 and 10) is familiar in the German curriculum.
As the aim of this study was to develop a flexible diagnostic tool which can be converted into an online version with automatic feedback, most items were designed in a multiple choice format. All multiple choice items have four response possibilities and only one correct answer. As many distractors as possible represent a specific systematic error. Typical systematic errors were chosen from literature and by analysing students' answers to the written test in the project HEUREKO. We assumed that misconceptions can be identified by analysing consistent error patterns. Therefore, we considered at least two items of each translation and function type.
N=569 students of classes 9, 10 and 11 took part in the main study. Overall, we identified nine errorpatterns which occurred among more than 10% of the students. In general, it was possible to ascribe these error patterns to underlying misconceptions, not least with the help of the fruitful diagnostic interviews.
Additionally, we conducted a cluster and a variance analysis in order to find group structures. We found several factors which influence the occurrence of error patterns, such as the educational treatment.
With the help of such a diagnostic tool, teachers are supported in the identification of typical learning difficulties. A preliminary (German) version is accessible online at `http://www.codi-test.de/`

Contact: R. Nitsch, R. Bruder

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Project: Knowing how to reflect on linear algebra at the level of secondary education

When focusing on competence orientation, one sometimes loses sight of subject-specific knowledge and skills as prerequisite for competence. However, it is known that subject-specific knowledge is the most important individual factor for successful learning processes. Different institutions such as universities or training companies complain about deficient pre-knowledge of high school graduates. Due to the aforementioned reasons, representatives of mathematical education sectors started to discuss about basic knowledge or basic competences in terms of minimum standards. The Didactic and Pedagogy Working group is researching on this topic in different projects with the goal to develop a concept of mathematical basic knowledge and basic skills. The respective research is based on action theory. Mathematical basic knowledge and basic skills comprises all kinds of mathematical knowledge and skills, abilities as well as capabilities that exist on a long-term basis and independent of situations at the end of both secondary levels; especially without the use of any auxiliary means. The demands and requirements resulting from a pragmatic point of (vocational training) employers have to be complemented by subject-specific viewpoints and the educational viewpoints of schools. In the German speaking research communities of didactics or pedagogy, an interesting construct is currently being discussed with the term "reflective knowledge". This construct allows a broadening of the basic knowledge and basic skills perspective with regard to educational demands. In this project, a concept of reflective knowledge will be developed and substantiated for the secondary level of high school in linear algebra used for the construction and selection of tasks that are especially suitable for the development of reflection. Basic actions will then be derived for these tasks concerning the necessary requirements. This way it will be possible to indicate the depth and quality in an operationalized form of the skills that are necessary for these basic actions.

Contact: O. Schmitt

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Project: MAKOS 2014-2016

The project MAKOS (technology supported mathematics classes with a competency development that considers individual student differences in upper secondary school) is based on the results of the school trials CALiMERO and MABIKOM. MAKOS is a joint project between the Universität Kassel, the TU Darmstadt and the seminar for trainees in Darmstadt and Kassel.

After the introduction of the standards for general qualification for university entrance, it is necessary to concretize these standards in new curricula. Therefore, the aim of the MAKOS project is to develop supplementary material, which considers the heterogeneity in learning groups and is based on the KMK-Standards for general qualification for university entrance. These materials are designed to support the introduction of the new curriculum in upper secondary school in Hesse and the Project is supported by the DZLM and the Hessian Ministry of Education.

Teachers and trainees from 21 project schools create the material in workshops (four workshops a year) and afterwards it is tested in class. The MAKOS concept of internal differentiation is based on the teaching concept of MABIKOM (2008-2012) that is adequate for daily use and appropriate for considering individual differences in mathematics classes.

The quality in the context of material development is assured first by testing in the classroom and second by the scientific monitoring of development and testing process at the two universities.
Details: www.mabikom.de

Partner: Werner Blum (Universität Kassel), Kerstin Krimmel (Universität Kassel), Andreas Eichler (Universität Kassel), Karl-Friedrich Gründer (Studienseminar Kassel), Alexander Best (Studienseminar Darmstadt), Frank Dill (Studienseminar Darmstadt), Ulrike Roder (TU Darmstadt)

Support: DZLM Deutsches Zentrum für Lehrerbildung Mathematik, Hessisches Kultusministerium, Landesschulamt, Studienseminare für berufliche Schulen und Gymnasien in Darmstadt und Kassel, Universität Kassel

Contact: R. Bruder

Project: Conceptualization and Operationalization of Mathematical Basic Knowledge

In this project mathematical basic knowledge is conceptualized and operationalized in order to develop a suitable method of diagnosing mathematical basic knowledge at the end of secondary school (Abitur).
Defining the concept of basic knowledge, social historical activity theory provides an adequate framework for describing required contents and actions. Against this theoretical background demands on a diagnostic tool have been outlined. Based on these demands a digital tool for the assessment of basic knowledge within the field of differential calculus has been developed. The tool uses adaptive elements for a stepwise break down of the demanded cognitive actions. Thus testing time can be used more effectively and possible sources of errors deriving from elementary deficits might be detected. Since construction and usage raise many research questions, the tool was tested with high-school students and first-year students (n=623). Additionally, diagnostic interviews were conducted. On the basis of the collected quantitative and qualitative data prospects and constraints of this diagnostic method could have been carved out and guidelines for constructing adaptive elements could have been derived. The tool is intended to support mathematics teachers with the diagnosis of basic knowledge by locating potential deficits precisely. An automatically generated feedback enables teachers to counteract those deficits. In the long term suitable learning material will be provided within the feedback to facilitate learners to work on their basic knowledge single-handedly.

Contact: N. Feldt-Caesar, R. Bruder

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Project: Stationary States, Recurrence and Transience for Quantum Dynamics

Probabilistic Markovian behavior is described by semigroups of transition matrices or, more generally, by transition kernels. In quantum probability, this generalizes to semigroups of completely positive operators on the algebra of observables. As in classical probability, existence, uniqueness, and convergence to stationary states—states generalize probability distributions—are an important issue whenever one is interested in the long time behavior of such a dynamics. For finite systems a Perron-Frobenius type theory is available, for infinite systems, notions of recurrence and transience become crucial.
Starting from a noncommutative version of the Riesz decomposition theorem we develop a coherent approach to recurrence and transience. It leads to a classification of idempotent Markov operators, thereby identifying concretely the Choi-Effros product, and to an abstract Poisson integral. The paradigmatic case of semigroups on the algebra $\mathscr{B}(\mathscr{H})$ of all bounded operators on a Hilbert space was studied in more detail. These may be viewed as a quantum version of Markovian semigroups on countably many states.

Partner: R. Gohm (Aberystwyth)

Contact: B. Kümmerer, A. Gärtner

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Project: Representations of Finitely Correlated States

A stationary Markov Chain on a finite set in probability theory permits two basically equivalent descriptions: Given a stochastic matrix with invariant probability distribution one can consider the induced stationary Markov measure on the path space or one can consider the induced stationary Markov process.
In noncommutative probability theory this equivalence breaks: There is no way of a canonical correspondence between noncommutative stationary Markov processes – Markov Dilations – and noncommutative stationary Markov measures – certain states on an infinite tensor product C*-algebra. This lack is due to non existence of needed conditional expectations which is a pure noncommutative phenomenon.

In this project, we succeed in constructing representations of a certain class of noncommutative Markov measures known as finitely correlated states using inductive limits of Hilbert spaces, C*-algebras and representations.
This techniques allow us to analyse entanglement properties of the one side restriction of a pure finitely correlated state and, especially, determining its von Neumann entropy which would be impossible using only restrictions on finite dimensional subalgebras. We clarify the connection between aperiodic irreducibility of a pure transition operator, irreducibility of certain representations and thus purity of certain finitely correlated states.

Contact: B. Kümmerer, W. Reußwig

Project: Quantum Control: Approach based on Scattering Theory for Non-commutative Markov Chains and Multivariate Operator Theory

The aim of this project is to explore genuinely non-commutative versions of control theory with a view toward direct applications to the emergent discipline of quantum control.
A basic idea of this project is to make use of recent developments in multivariate operator theory. While in classical operator theory a single operator is analysed, in multivariate operator theory the joint action of a family of operators is studied. These operators may not commute with each other. Nevertheless, there are analogues to classical results in complex analysis such as the idea of multi-analytic operators. In fact, many of the operator results which are relevant for classical control theory can be extended to this setting. We develop these tools with applications to quantum control. Scattering theory for non-commutative Markov chains is a theory about open quantum systems with many connections to operator theory. Recently the wave operator occurring in this theory has been rewritten as a multi-analytic operator. On the other hand it is possible to interpret this theory as a version of open-loop control, for example it has been successfully applied to the preparation of states in a micromaser interacting with a stream of atoms.
Hence it is very natural to start here to develop the methods of multivariate operator theory as applied to the problems in quantum control. Once the bridge between quantum control and multivariate operator theory is understood in the specific directions described above we speculate that a considerable amount of related mathematics becomes available for engineering applications.

Partner: R. Gohm, J. Gough, C. Köstler, Aberystwyth University; H. Maassen, University of Nijmegen

Support: Engineering and Physical Sciences Research Council (EPSRC), GB.

Contact: B. Kümmerer

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Project: A Coupling Method for Quantum Markov Processes

In the theory of Markov processes it is important to obtain information on their long time behaviour. Markov processes with finite state space always have a stationary distribution and for irreducible aperiodic processes there are various ways to estimate the speed of convergence to the equilibrium distribution.
On an infinite state space, however, a Markov process in general does not admit a stationary distribution. In the recent decade the coupling method has established as a tool to investigate their asymptotic behaviour. In particular, the coupling inequality plays a major role for estimating the distance between two initial distributions after long times.
In this project we succeeded in developing coupling techniques for quantum or non-commutative Markov chains. In particular, a coupling inequality is derived for such processes. The lack of the notion of a diagonal in this setting drives us to find an approach different from the classical one. In particular, the commutant of an operator algebra and Tomita-Takesaki-Theory comes in. It may be interesting to note that our approach

links couplings to the decay of entanglement of certain quantum states, a subject of great interest in quantum information.

Contact: B. Kümmerer, K. Schwieger

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Project: Measures of Entanglement and Norms on Tensor Products

It is one of the basic problems of quantum information to measure degrees of entanglement for quantum states.
A quantum system is described by a state on a Hilbert space, i. e. a non-negative trace class operator with trace one. For the description of composed quantum systems one has to use a state on the tensor product of the corresponding Hilbert spaces. For example, a tensor product of states describes a joining of independent quantum systems. Since the state space of a quantum system is a convex set one can consider the convex hull of the product states: The set of *separable states*. But not all states on the tensor product Hilbert space are separable. Such states are called *entangled*. Experiments show that only entangled states behave truely quantum mechanically as they violate Bell's inequalities and can be used for quantum cryptography and quantum computation.
There exist various notions in the literature of how to measure the degree of entanglement: it should measure the usability of an entangled state for true quantum effects. But most of these notions are bound to bi-partite or finite dimensional systems. Recently, W. Arveson established a universal measure of entanglement which is geometrically motivated and may attain the value "infinity" for certain states. However, in the finite case this measure equals the maximal or projective tensor norm previously proposed by O. Rudolph. In this project we aim to gain a deeper understanding of the structure of Arveson's measure of entanglement. For example, we try to compute its value for some interesting states on multipartite systems or give better bounds for it. Moreover, we intend to apply Arveson's measure to more general notions of physical entanglement such as entanglement of fermionic or bosonic particles, genuine multipartite entanglement and others. Due to the existence of "infinitely entangled states" we also address the problem of explicitly characterizing this set and try to find concrete physical examples for such states.

Contact: B. Kümmerer, F. Sokoli, W. Reußwig

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Project: Ergodic Properties of Quantum Birth and Death Chains

In this project we study a class of quantum Markov processes that, on the one hand, is inspired by the micromaser experiment in quantum optics and, on the other hand, by classical bith and death processes. We study their geometric properties and ergodic properties like irreducibility. Furthermore, we analyse the ergodic properties of the corresponding transition operators. It turns out that for homogeneous birth and death rates these can be fully determined by explicit calculation. As for classical birth and death chains we obtain a rich yet simple class of quantum Markov chains on an infinite space, which allow only local transitions while having divers ergodic properties.

Contact: B. Kümmerer, A. Gärtner, K. Schwieger

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Project: Universal Preparability for Quantum Input-Output-Systems

For a class of quantum input-output-systems we introduce a notion of universal preparability for a normal state on a von Neumann algebra. It describes a situation where from an arbitrary initial state it is possible to prepare a target state with arbitrary precision by a repeated interaction with a sequence of copies of another system. For $\mathscr{B}(\mathscr{H})$ we develop criteria sufficient to ensure that all normal states are universally preparable which can be verified for a class of non-commutative birth and death processes realized by the interaction of a micromaser with a stream of atoms. As a tool the theory of tight sequences of states and of stationary states is further developed and we show that in the presence of stationary faithful normal states universal preparability of all normal states is equivalent to asymptotic completeness, a notion studied earlier in connection with the scattering theory of non-commutative Markov processes.

Contact: R. Gohm, B. Kümmerer

1.5 Logic

The research group in *Mathematical Logic and Foundations of Computer Science* represents the subject area of Mathematical Logic viewed as an applied foundational discipline between mathematics and computer science. Research activities focus on the application of proof theoretic, recursion theoretic, category theoretic, algebraic and model theoretic methods from mathematical logic to mathematics and computer science.
Beside classical mathematical logic (represented with proof theory, recursion theory and model theory) this involves constructive type theory, categorical logic, universal algebra, domain and lattice theory, finite model theory and complexity theory.
Within mathematics, a primary field of applications in the proof- and recursion-theoretic setting is the extraction of new information from proofs in classical mathematics (proof mining: Kohlenbach). This concerns qualitative aspects (e.g., independence of existence assertions from certain parameters) as well as quantitative aspects of computability and complexity of solutions, extraction of algorithms and bounds from proofs, and links with exact real arithmetic, computational mathematics (Kohlenbach, Streicher, Ziegler). Model theoretic investigations make intra-mathematical links with algebra and discrete mathematics, e.g. graphs and hypergraphs (Blumensath, Otto).
Concerning Logic in Computer Science and the mathematical foundations of computer science, major activities revolve around issues of semantics. On the one hand, this involves the mathematical foundation of the semantics and the logic of programming languages (Keimel, Streicher); on the other hand, logics and formal systems are investigated in the sense of model theoretic semantics, w.r.t. expressiveness and definability, with an emphasis on computational aspects (algorithmic and finite model theory, descriptive complexity:

Otto). Besides specific application domains in computer science, as, e.g., verification, data bases and knowledge representation, there is work on foundational issues in the areas of computability and complexity (Ziegler), as well as type theory and category theory (Streicher).

Overall, the logic group forms an internationally well connected cluster of expertise, with a characteristic emphasis on the connections that mathematical logic has to offer, both w.r.t. to other areas within mathematics and w.r.t. to the "logic in computer science" spectrum.

The logic group takes part with 2 PI's (Kohlenbach, Zieger) in the IRTG 1529 'Mathematical Fluid Dynamics'.

A research group on *Formal Concept Analysis* focuses on graphical logic systems for concept analysis in knowledge acquisition and processing applications (Burmeister, Wille). Rooted in the *General Algebra and Discrete Mathematics* group (former AG1) this research is being pursued in particular in co-operation with the "Ernst Schröder Zentrum für Begriffliche Wissensverarbeitung e.V."

Members of the research group

Professors

Ulrich Kohlenbach, Martin Otto, Thomas Streicher, Martin Ziegler

Retired professors

Peter Burmeister, Christian Herrmann, Klaus Keimel, Rudolf Wille

Postdocs

Achim Blumensath, Kord Eickmeyer, Vassilios Gregoriades, Stéphane Le Roux, Davorin Lešnik, Carsten Rösnick, Matthias Schröder

Research Associates

Julian Bitterlich, Felix Canavoi, Yves Baudelaire Fomatati, Daniel Günzel, Robin Hesse, M. Aqeel A. Khan, Daniel Körnlein, Angeliki Koutsoukou-Argyraki, Pavol Safarik, Florian Steinberg

Secretaries

Barbara Bergsträßer, Betina Schubotz

Project: The Expressive Power of Monadic Second-Order Logic, its Fragments, and its Variants

The goal of this project is to study the expressive power of various variants of monadic second-order logic. There are two main parts. The first one concerns extensions of monadic second-order logic by boundedness quantifiers. Here the focus in on decidability issues. The second part concerns the development of an algebraic language theory for infinite trees. The ultimate goal is to obtain effective characterisations for fragments of monadic second-order logic, in particular for first-order logic.

Contact: A. Blumensath.

Project: Fluctuations, effective learnability and metastability in analysis

We investigate what kind of quantitative information one can extract under which circumstances from proofs of convergence statements in analysis. It turns out that from proofs using only a limited amount of the law-of-excluded-middle, one can extract functionals (B, L), where L is a learning procedure for a rate of convergence which succeeds after at most $B(a)$-many mind changes. This (B, L)-learnability provides quantitative information strictly in between a full rate of convergence (obtainable in general only from semi-constructive proofs) and a rate of metastability in the sense of Tao (extractable also from classical proofs). In fact, it corresponds to rates of metastability of a particular simple form. Moreover, if a certain gap condition is satisfied, then B and L yield a bound on the number of possible fluctuations (as is the case in [1]). This allows one to explain recent applications of proof mining to ergodic theory in terms of these results.

Support: DFG as part of project KO 1737/5-1

Contact: U. Kohlenbach, P. Safarik

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Project: Computing common fixed points and quantitative image recovery theorems

We use logical proof-mining techniques to extract an explicit effective and uniform bound on the rate of asymptotic regularity of an iteration schema involving a finite family of nonexpansive mappings. The results presented in this paper contribute to the general project of proof mining as developed by the second author as well as generalize and improve various classical and corresponding quantitative results in the current literature. More precisely, we give a rate of asymptotic regularity of an iteration schema due to Kuhfittig for finitely many nonexpansive mappings in the context of uniformly convex hyperbolic spaces. The bound only depends on an upper bound on the distance between the starting point and some common fixed point, a lower bound $1/N \leq \lambda_n(1-\lambda_n)$, the error $\epsilon > 0$ and a modulus η of uniform convexity. Our results generalize previous results due to the 2nd author (in the normed case) and L. Leuştean (in the hyperbolic case) for one map to the case of finitely many maps [3]. Another topic concerns a quantitative version of the classical image recovery problem to find an ϵ-approximate solution of the problem [1, 2]. The rate of asymptotic regularity of the iteration schemas, connected with the problem of image recovery, coincides with the existing optimal and quadratic bounds for Krasnoselskii-Mann iterations. We then provide explicit effective and uniform bounds on the approximate fixed points of the mappings under consideration to be an approximate solution of the image recovery problem up to a uniform change from ϵ to $\delta_{(\epsilon)}$. When combined, these results provide algorithms with explicit rates of convergence for the recovery of an ϵ-perturbation of the original image in different settings [4].

Support: Higher Education Commission of Pakistan (HEC), DAAD, DFG as part of project KO 1737/5-1

Contact: M.A.A. Khan, U. Kohlenbach.

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Project: Classical provability of uniform statements versus intuitionistic provability

Along the line of Hirst-Mummert [3] and Dorais [1], we analyze the relationship between the classical provability of uniform versions Uni(S) of Π_2-statements S with respect to higher order reverse mathematics and the intuitionistic provability of S. One of the main results is that (in particular) for every Π_2-statement S of some syntactical form, if its uniform version derives the uniform variant of ACA over a classical system of arithmetic in all finite types with weak extensionality, then S is not provable in strong semi-intuitionistic systems including bar induction BI in all finite types but also nonconstructive principles such as König's lemma KL and uniform weak König's lemma UWKL. Our result is applicable to many mathematical principles whose sequential versions imply ACA.

Support: Tohoku University COLABS program, Shigakukai

Contact: M. Fujiwara, U. Kohlenbach.

References

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Project: Logical metatheorems for abstract spaces axiomatized in positive bounded logic

In this project we show that normed structures which can be axiomatized in positive bounded logic (in the sense of Henson and Iovino [2]) admit proof-theoretic metatheorems (as developed by Kohlenbach since 2005) on the extractability of explicit uniform bounds from proofs in the respective theories. This can be applied to design such metatheorems for abstract Banach lattices, L^p- and $C(K)$-spaces as well as bands in $L^p(L^q)$-Bochner spaces. It turns out that that a proof-theoretic uniform boundedness principle can serve in many ways as a substitute for the model-theoretic use of ultrapowers of Banach spaces.

Support: DFG project KO 1737/5-2

Contact: D. Günzel, U. Kohlenbach.

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Project: Metastability for iterations and nonexpansive and pseudocontractive operators

This project is concerned with the extraction of a rate of metastability (in the sense of Tao) for a celebrated iteration scheme due to [1] for pseudocontractive operators in Hilbert space. In [4], such a rate is extracted from a proof due to [2] for Lipschitzian pseudocontractions. Based on Bruck's original proof, a rate of metastability that only uses demicontinuity is extracted in [3] by-passing the use of Zorn's lemma (to construct maximally monotone extensions of monotone operators) in [1] based on ideas from [4]. Another topic is the extraction of rates of metastability for ergodic averages of nonexpansive mappings in uniformly smooth spaces [5] from a proof by [6].

Support: DFG project KO 1737/5-2

Contact: D. Körnlein, U. Kohlenbach.

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Project: Quantitative results on abstract Cauchy problems and strongly continuous semigroups

In this project we extract explicit rates of convergence and metastability for abstract Cauchy problems generated by accretive operators [2]. These rates are extracted by applying proof-theoretic techniques to proofs in [1]. A second part is concerned with explicit bounds on the asymptotic behavior of an algorithm due to Suzuki [3] for the computation of a common fixed point of a one-parameter strongly continuous semigroup of nonexpansive mappings.

Support: DFG International Research Training Group 1529: Mathematics Fluid Dynamics

Contact: A. Koutsoukou-Argyraki, U. Kohlenbach.

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Project: Construction and Analysis in Hypergraphs of Controlled Acyclicity

This is a DFG project, approved in 2012, which is based on results and new directions provided by the successful completion (in 2011) of its forerunner "Model Constructions and Model-Theoretic Games in Special Classes of Structures", see in particular [2, 3, 1].
Acyclicity conditions play an important role as tractability criteria for various issues of model theory and computational logic. Full acyclicity is often available through processes of unfolding (e.g., of transition systems or game graphs into trees), albeit typically unavailable in settings where only finite structures are admissible. For such applications, especially in the realm of finite model theory, the focus must therefore be on

- suitable relaxations of full acyclicity that can be realised in finitary coverings (partial unfoldings), and
- methods that can use these relaxed notions of acyclicity to similar algorithmic and model-theoretic benefit as full acyclicity.

The new project puts the development of constructions and methods at the center, with a view to a more systematic understanding and to extending the reach of corresponding model-theoretic techniques to further application domains.
At the level of basic research the project is geared to draw on logical and model-theoretic methods as well as on new connections with techniques from discrete mathematics (e.g., permutation groups, the combinatorics of graphs and hypergraphs, discrete geometry, combinatorial and algebraic methods). Substantial results are being presented in [4].

Support: DFG

Contact: M. Otto

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Project: Classical Realizability over the Stable Scott Model

In a paper submitted to the Festschrift for P.-L. Curien I have shown that classical realizability over the Scott model for Lambda Calculus in Coherence Spaces the axioms of countable and dependent choice do hold. Adapting the traditional technique of bar recursion has been crucial for the proof. We hope to show that classical realizability over the *effective* Scott model does not validate countable choice which would answer an open question about Krivine's classical realizability.

Partner: Jean-Louis Krivine PPS, Paris

Contact: T. Streicher.

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Project: From Real Computability via Complexity Theory to Numerical Practice

Recursive Analysis, as initiated by Alan Turing in his 1937 publication, provides a rigorous algorithmic foundation to approximate computations over real numbers, vectors, sequences, functions, operators, and Euclidean subsets — qualitatively. We refine this theory quantitatively from the perspective of computational complexity: both non-uniformly relative to common hypothesis like $P \subsetneq NP \subsetneq \#P \subsetneq CH \subsetneq PSPACE \subsetneq EXP$ (cf. Millennium Prize Problems); and uniformly by adapting adversary arguments from Information-Based Complexity to the bit cost model. More precisely, we devise provably correct algorithms with axiomatized semantics over (possibly multivalued and enriched) continuous data types. Our research yields canonical interface declarations in contemporary object-oriented imperative programming languages, accompanied by rigorous parameterized running-time bounds and complemented by optimality proofs. Implementations confirm the predictions of these investigations in practice.

Partner: U. Brandt, TU Darmstadt; A. Karamura, University of Tokyo; N. Müller, Universität Trier; A. Pauly, Cambridge

Support: EU IRSES 294962; DFG Zi 1009/4

Contact: M. Ziegler, M. Schröder

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[2] A. Kawamura, H. Ota, C. Rösnick, and M. Ziegler. Computational complexity of smooth differential equations. *Logical Methods in Computer Science*, 10(1), 2014.

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[4] N. Müller and M. Ziegler. From calculus to algorithms without errors. In *Proc. 4th International Congress on Mathematical Software (ICMS)*, volume 8592 of *LNCS*, pages 718–724. Springer, 2014.

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1.6 Numerical Analysis and Scientific Computing

The research focus of the group for *Numerical Analysis and Scientific Computing* lies in the development, analysis, and implementation of novel, efficient, accurate, and reliable numerical methods for the solution of complex problems of practical interest. This includes the derivation and simplification of models, their analysis, the construction of appropriate numerical schemes for their simulation, the analysis of these numerical methods, the derivation of a-posteriori error estimates, the adaptive solution, and the consideration of related optimization and inverse problems.

The long-term goal of the group is to contribute to the fundamental research topics in the area of numerical mathematics and scientific computing, but also to provide software and expertise for the tackling of specific problems in engineering and the natural sciences. The group is currently engaged in projects in various application areas, e.g., in computational medicine and biology, in the simulation and optimal control of gas and water supply networks, in inverse problems in fluid dynamics and non-destructive testing, in modeling and simulation of radiative transfer phenomena, in acoustic and optical tomography, in the modeling, simulation, and characterization of ion channels and nanopores, in simulation of transient electromagnetic phenomena, or the modeling and simulation in energy science.

Particular research directions in the area of numerical mathematics that are pursued along these applications are, e.g., the development of novel discretization schemes for wave propagation problems, the design and analysis of a-posteriori error estimates, the construction of asymptotic preserving numerical schemes, and the design of physically consistent discretization schemes.

The research group *Numerical Analysis and Scientific Computing* is engaged among others in the Excellence Cluster EXC 259 Center of Smart Interfaces, the Graduate Schools (Excellence Initiative) GSC 233 Computational Engineering and GSC 1070 Energy Science and Engineering, the Graduate School GSC 1344 Instationary System Modelling for Aircraft Turbines, the Transregional Collaborative Research Centers (Transregio/SFB) TRR 154 Mathematical Modelling, Simulation and Optimization Using the Example of Gas Networks and TRR 146 Multiscale Simulation Methods for Soft Matter Systems, the International Research Training Group IGK 1529 Mathematical Fluid Dynamics, the German Research Foundation (DFG) Priority Programs SPP 1253 Optimisation with Partial Differential Equations, SPP 1276 Multiple Scales in Fluid Mechanics and Meteorology (MetStröm), and SPP 1420 Biomimetic Materials Research: Functionality by Hierarchical Structuring of Materials, and the Funding Program "Future-oriented Technologies and Concepts for an Energy-efficient and Resource-saving Water Management - ERWAS" of the Federal Ministry of Education and Research (BMBF) (`http://www.bmbf.nawam-erwas.de/en`). In addition, the group has various industry partners, including cooperations with BASF Ludwigshafen and Infineon München.

Members of the research group

Professors

Herber Egger, Christoph Erath, Martin Kiehl, Jens Lang

Retired professors

Peter Spellucci

Postdocs

Debora Clever, Pia Domschke, Sofia Eriksson, Alf Gerisch, Michelle Lass, Raimondo Penta, Jan-Frederik Pietschmann, Matthias Schlottbom, Mirjam Walloth

Research Associates

Matthias Frankenbach, Karen Kuhn, Axel Ariaan Lukassen, Alexander Rath, Bettina Schieche, Dirk Schröder, Tobias Seitz, Zhen Sun, Sara Tiburtius, Sebastian Ullmann, Lisa Wagner

Secretaries

Elke Dehnert, Sigrid Hartmann, Anke Utecht

Project: Non-Local Effects and Surface-Bound Reactions in Cancer Invasion

The ability to invade tissue and form metastases (secondary tumours) is what makes cancer so dangerous. Key biological processes occurring during invasion are the secretion of matrix degrading enzymes, cell proliferation, the loss of cell-cell adhesion on one hand and enhanced cell-matrix adhesion on the other hand as well as active migration. A better understanding of the effect that biochemical (intracellular) and cellular processes have on tissue scale rearrangement of cells and matrix may help to develop treatment strategies. Hence, the modelling and numerical simulation of cancer cell invasion is of great interest and is the subject of ongoing research. In this project, we focus on two key aspects in the modelling of cancer invasion: cell-cell and cell-matrix adhesion and surface-bound reactions (tissue-level modelling).

Partner: M. A. J. Chaplain (University of Dundee, Scotland); D. Trucu (University of Dundee, Scotland)

Support: DFG Research Fellowship (DO 1825/1-1), Northern Research Partnership PECRE Scheme

Contact: P. Domschke, A. Gerisch

References

[1] P. Domschke, D. Trucu, A. Gerisch, and M. A. J. Chaplain. Mathematical modelling of cancer invasion: Implications of cell adhesion variability for tumour infiltrative growth patterns. *Journal of Theoretical Biology*, 361:41–60, 2014.

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Project: Adaptive Dynamical Multiscale Methods

The flow of gas through pipelines is of great interest in the engineering community. There are many challenges of running a gas transmission network. Various contracts have to be fulfilled, e.g., gas fed in by multiple suppliers has to be routed through the network while consumers' demands have to be met. The aim of operating a gas transmission network is to minimize the running costs. Those costs are mainly the running costs of compressor stations and contractual penalties. This leads to an optimal control problem on a network. Similar optimal control problems also occur for example in water supply networks. While monitoring systems are already quite advanced, efficient simulation and optimization tools are only available to some extend. Of course, before considering optimization tasks, reliable simulation algorithms are essential. Since the application of coarse discretizations or simplified models is often adequate in many parts of the considered networks to resolve the dynamics in the daily operation of gas and water supply networks, information about the quality of the computed solutions is very important. Within this project, we develop an algorithm to adaptively control model and discretization errors in simulations for gas and water supply networks with respect to a given quantity of interest using adjoint techniques.

Partner: O. Kolb (Universität Mannheim)

Support: Project B01 within DFG TRR 154

Contact: P. Domschke, J. Lang

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[1] P. Domschke, B. Geißler, O. Kolb, J. Lang, A. Martin, and A. Morsi. Combination of nonlinear and linear optimization of transient gas networks. *INFORMS J. Comput.*, 23(4):605–617, 2011.

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Project: Hierarchical Galerkin methods for hyperbolic problems with parabolic asymptotics

This project is part of the Transregional Collaborative Research Centre TRR 154 *Mathematical modelling, simulation and optimization of gas networks*, and deals with the construction and analysis of numerical methods for singularly perturbed hyperbolic problems with parabolic limit. The main goal is to devise efficient asymptotic preserving numerical schemes together with reliable a-posteriori error estimators. Of particular interest are the isothermal one-dimensional Euler equations with friction, which are used to model gas flow in pipes and networks. Basic physical principles, like the conservation of mass, the balance of momentum, and the boundedness of solutions should be preserved on the discrete level on single pipes and across junctions.

Support: Project C04 within DFG TRR 154

Contact: H. Egger, J. Lang

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[1] H. Egger and M. Schlottbom. Diffusion asymptotics for linear transport with low regularity. *Asymptotic Analysis*, 89:365–377, 2014.

[2] O. Kolb, J. Lang, and P. Bales. An implicit box scheme for subsonic compressible flow with dissipative source term. *Numer. Algorithms*, 53(2):293–307, 2010.

Project: Finite element methods for coupled volume-surface reaction-diffusion problems

This project deals with the development of asymptotic preserving numerical schemes for the simulation of reaction-diffusion processes acting in the volume and at the boundary simultaneously. Such applications arise in the modeling of biological systems, e.g., in cell metabolism. A key ingredient in the design of proper numerical schemes is the conservation of mass and the guarantee of positivity on the discrete level. Based on analytical considerations, long-term stability and exponential convergence to equilibrium can be obtained.

Partner: Tang Quoc Bao and Klemens Fellner (KFU Graz)

Support: Project within IGDK 1754, Munich/Graz

Contact: H. Egger

References

[1] T. Q. Bao, K. Fellner, and S. Rosenberger. A reaction-diffusion system modelling asymmetric stem-cell division: existence, uniqueness, numerical simulation and rigorous quasi-steady-state approximation. Technical report, KFU Graz, 2014.

Project: On finite element methods for modified Allen-Cahn equations

This project deals with the numerical simulation of modified Allen-Cahn equations that arise in the modelling of phase transitions in elastic bodies. The main goal is to devise stable numerical schemes that obey an energy dissipation law which is valid, at least for simplified models, on the continuous level. Convergence and asymptotic stability of the schemes are investigated.

Contact: A. Böttcher, H. Egger

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[1] H.-D. Alber and P. Zhu. Comparison of a rapidely converging phase field model for interfaces in solids with the Allen-Cahn model. *J. Elast.*, 111:153–221, 2013.

[2] R. Mueller, A. Böttcher, B. Xu, J. Aurich, and D. Gross. Driving forces on interfaces in elastic-plastic two phase materials. *ZAMM Z. Angew. Math. Mech.*, 90:812–820, 2010.

Project: Discontinuous Galerkin Trefftz approximations for Maxwell's equations

The project aims at the construction and numerical analysis of discontinuous Galerkin methods for the time-dependent Maxwell equations utilizing Trefftz polynomials. A systematic construction of a basis for the Trefftz polynomials is provided and a particular basis consisting of polynomial plane waves is constructed. The latter can be utilized to formulate new types of absorbing boundary conditions. Stability and convergence of the numerical schemes is investigated.

Partner: I. Tsukerman (Akron) and S. M. Schnepp (ETH Zürich)

Support: GSC 233 Computational Engineering, TU Darmstadt

Contact: H. Egger, F. Kretzschmar

References

[1] H. Egger, F. Kretzschmar, S. Schnepp, I. Tsukerman, and T. Weiland. Transparent boundary conditions in a discontinuous Galerkin Trefftz method. Technical report, TU Darmstadt, October 2014. arXiv:1410.1899.

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[3] F. Kretzschmar, F. Ahmadi, N. Nowak, S. M. Schnepp, I. Tsukerman, H. Egger, and T. Weiland. Trefftz absorbing boundary conditions in analytical, discontinuous Galerkin and finite difference form. *ICEAA*, pages 176–177, 2014.

Project: Inverse problems in nonlinear diffusion processes

The project deals with identification of unknown parameter functions in non-linear parabolic and elliptic diffusion problems. Such inverse problems arise, e.g., in the modeling of biological systems, where the identification can be considered a learning process about the system under investigation. Questions of uniqueness and stability are discussed and numerical methods are proposed for a stable solution.

Partner: M. Schlottbom (Universität Münster)

Support: DFG PI 1073/1-1

Contact: H. Egger, J.-F. Pietschmann

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[1] H. Egger, J.-F. Pietschmann, and M. Schlottbom. Identification of chemotaxis models with volume-filling. *SIAM J. Appl. Math.*, 75:275–288, 2014.

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[3] H. Egger, J.-F. Pietschmann, and M. Schlottbom. Numerical identification of a nonlinear diffusion law via regularization in Hilbert scales. *Inverse Problems*, 30:025004, 2014.

[4] H. Egger, J.-F. Pietschmann, and M. Schlottbom. Simultaneous identification of diffusion and absorption coefficients in a quasilinear elliptic problem. *Inverse Problems*, 30:035009, 2014.

Project: Inverse free boundary value problems

Free boundary value problems arise in the modeling of various physical phenomena, e.g., in the melting of ice, in population dynamics, but also in biological applications like wound healing. The goal of this project is to utilize observations of the physical state in order to determine unknown model parameters, e.g., nonlinear diffusion or source terms. Questions of uniqueness and stability in the identification process are discussed and numerical methods are proposed for an efficient solution.

Partner: M. Yamamoto (University of Tokyo) and Yuki Kaneko (Waseda University, Tokyo)

Support: DFG IRTG 1529

Contact: H. Egger, J.-F. Pietschmann

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[1] H. Egger, J.-F. Pietschmann, and M. Schlottbom. Simultaneous identification of diffusion and absorption coefficients in a quasilinear elliptic problem. *Inverse Problems*, 30:035009, 2014.

[2] Y. Kaneko. Spreading and vanishing behaviors for radially symmetric solutions of free boundary problems for reaction-diffusion equations. *Nonlinear Anal. Real World Appl.*, 18:121–140, 2014.

[3] Y. Kaneko and Y. Yamada. A free boundary problem for a reaction-diffusion equation appearing in ecology. *Adv. Math. Sci. Appl.*, 21(2):467–492, 2011.

Project: Gibbs sampling for spatial probit models

Probit and logit models are basic tools in econometrics to describe observable quantities governed by an underlying market model. Spatial models take into account dependence of distance, e.g., between customers or companies. One of the key questions in spatial probit/logit is the inference of model parameters from indirect observations of the underlying process. This can be accomplished, e.g., in the framework of Bayesian inference. To obtain information about the posterior distributions of the parameters of interest, very high dimensional nonlinear problems have to be solved. This can be circumvented by stochastic sampling, i.e., by computing samples of the posterior in an efficient way. The aim of the project is to investigate Gibbs sampling strategies for Baysian inference in spatial probit and logit models.

Partner: P. Egger, M. Kesina (ETH Zürich)

Contact: H. Egger

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[1] H. Badinger and P. Egger. Estimation of higher-order spatial autoregressive cross-section models with heteroscedastic disturbances. In *Papers in Regional Science*, volume 90, pages 213–235. Wiley Blackwell, 2011.

Project: FVM-BEM coupling for parabolic-elliptic interface problems

An interesting approach to deal with problems on unbounded domains is to couple the finite volume method with the boundary element method. Previously novel work has been done for problems of diffusion convection reaction type in an interior domain coupled to a diffusion process in an unbounded exterior problem. The next step will be to extend this methodology to problems of other types, e.g. parabolic-elliptic interface problems.

Contact: C. Erath, S. Eriksson

References

[1] C. Erath. Coupling of the finite volume element method and the boundary element method: an a priori convergence result. *SIAM Journal on Numerical Analysis*, 50:574–594, 2012.

[2] C. Erath. A posteriori error estimates and adaptive mesh refinement for the coupling of the finite volume method and the boundary element method. *SIAM Journal on Numerical Analysis*, 51(3):1777–1804, 2013.

Project: Multiscale structure-functional modeling of musculoskeletal mineralized tissues

Musculoskeletal mineralized tissues (MMTs) are natural examples of materials that show unique and highly variable combinations of stiffness and strength. One of the striking features of MMTs is that this diversity of elastic function is achieved by only one common building unit, that is the mineralized collagen fibril, but variable structural arrangements at several levels of hierarchical organization. A profound understanding of the structure-function relations in MMTs requires both experimental assessment of heterogeneous elastic and structural parameters and theoretical modeling of the elastic deformation behavior. Multi-scale and multi-modal assessment of MMTs will be used to probe not only the microarchitecture, but also anisotropic linear elastic properties from the nanoscale to the macroscale. By combining experimental data obtained from MMTs at various length scales with numerical homogenization approaches in continuum mechanics, we hypothesize to gain new insight into self-assembly mechanisms, construction rules and physiological boundary conditions of MMTs.

Within this joint project we focus in Darmstadt on the development as well as efficient and reliable implementation of numerical homogenisation techniques. Together with the groups in Berlin and Paris we devise new mathematical models in order to aid the understanding of MMTs. The experimental assessment of MMTs is performed in Berlin and with external cooperation partners.

Partner: K. Raum (Charité-Universitätsmedizin Berlin); Q. Grimal (Biomedical Imaging Lab (LIB), UPMC Paris, France)

Support: DFG grants GE1894/3 and Ra1380/7 within DFG SPP 1420

Contact: A. Gerisch, R. Penta, S. Tiburtius

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[1] M. Granke, Q. Grimal, W. Parnell, K. Raum, A. Gerisch, F. Peyrin, A. Saïed, and P. Laugier. To what extent can cortical bone millimeter-scale elasticity be predicted by a two-phase composite model with variable porosity? Technical report, accepted for publication in Acta Biomaterialia, 2014.

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Project: Numerical methods for time-dependent PDE problems from mathematical biology

Biological processes like the invasion of tissue by cancer cells, or the adhesion-driven reorganisation of tissue, or the cascade of steps in fracture healing can be modelled as time-dependent PDEs. For the reliable, efficient and accurate simulation of these models dedicated numerical schemes are required. We focus on general methods for taxis-diffusion-reaction systems and on particular schemes for the evaluation of the spatially nonlocal terms in models of cellular adhesion. In our approach we follow the method of lines with finite volumes in space and linearly-implicit methods in time.

Partner: M. A. J. Chaplain (University of Dundee, Scotland); K. J. Painter (Heriot-Watt University, Edinburgh, Scotland); L. Geris (University of Liège, Belgium)

Contact: A. Gerisch

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[1] P. Domschke, D. Trucu, A. Gerisch, and M. A. J. Chaplain. Mathematical modelling of cancer invasion: Implications of cell adhesion variability for tumour infiltrative growth patterns. *Journal of Theoretical Biology*, 361:41–60, 2014.

[2] K. Painter, J. Bloomfield, J. Sherratt, and A. Gerisch. A nonlocal model for contact attraction and repulsion in heterogeneous populations. Technical report, submitted to Bulletin of Mathematical Biology, 2014.

Project: Anisotropic Meshes and Explicit Runge-Kutta Methods

We study the stability of explicit Runge-Kutta integration schemes for the linear finite element approximation of linear parabolic equations. The derived bound on the largest permissible time step is tight for any mesh and any diffusion matrix within a factor of $2(d+1)$, where d is the spatial dimension. Both full mass matrix and mass lumping are considered. The bound reveals that the stability condition is affected by two factors. The first one depends on the number of mesh elements and corresponds to the classic bound for the Laplace operator on a uniform mesh. The other factor reflects the effects of the interplay of the mesh geometry and the diffusion matrix.

Partner: Weizhang Huang (University of Kansas, USA); Lennard Kamenski (WIAS Berlin)

Contact: J. Lang

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[1] W. Huang, L. Kamenski, and J. Lang. Adaptive finite elements with anisotropic meshes. In A. C. et al., editor, *Numerical Mathematics and Advanced Applications 2011: Proceedings of ENUMATH 2011, the 9th European Conference on Numerical Mathematics and Advanced Applications, Leicester, September 2011*. Springer, 2013.

[2] W. Huang, L. Kamenski, and J. Lang. Stability of explicit Runge-Kutta methods for finite element approximation of linear parabolic equations on anisotropic meshes. Technical Report 1869, WIAS Berlin, 2013.

Project: Large Eddy Simulation on Moving Meshes

This project is concerned with an automated adaptive mesh design approach for Large Eddy Simulation (LES) of turbulent flows. Based on a dynamic moving mesh partial differential equation (MMPDE), a fixed number of grid points is redistributed according to statistical quantities of interest (QoI) selected to capture certain mean flow properties. Physically motivated LES-specific QoI, as the time-averaged gradient of streamwise velocity and the production rate, as well as more general QoI derived from the dual weighted residual method (DWRM) for time-averaged statistics are investigated for a flow over periodic hills with Re = 10 595. The numerical results compared to a highly resolved LES reference solution show the high potential of moving mesh methods to efficiently improve the resolution of turbulent flow features.

Partner: Claudia Liersch (TU Dresden); Jochen Fröhlich (TU Dresden)

Support: DFG SPP 1276 MetStröm

Contact: J. Lang

References

[1] C. Hertel, M. Schümichen, J. Lang, and J. Fröhlich. Using a moving mesh pde for cell centres to adapt a finite volume grid. *Flow, Turbulence and Combustion*, 90:785–812, 2013.

[2] C. Liersch, M. Frankenbach, J. Lang, and J. Fröhlich. Recent progress in designing moving meshes for complex turbulent flows. *Meteorologische Zeitschrift*, 23:425–439, 2014.

[3] S. Ullmann, S. Löbig, and J. Lang. Adaptive large eddy simulation and reduced-order modeling. In J. Janicka, A. Sadiki, M. Schäfer, and C. Heeger, editors, *Flow and Combustion in Advanced Gas Turbine Combustors*, Fluid Mechanics and Its Applications. 2013.

Project: Adaptive Multilevel Methods for PDAE-Constrained Optimal Control Problems

The main goal of this project is to develop a fully adaptive optimization environment, suitable to solve complex optimal control problems of practical interest, which are restricted by partial differential algebraic equations (PDAEs) and pointwise constraints on control and state. The environment relies on continuous adjoint calculus, coupling our fully space- time adaptive PDAE solver KARDOS, highly efficient optimization techniques, and a multilevel strategy which tailors the grid refinement to the optimization progress. Controlling the inconsistencies caused by inexact reduction, the multilevel strategy ensures global convergence of the finite dimensional control iterates to a stationary point of the infinite dimensional problem.

Partner: Stefanie Bott (TU Darmstadt); Stefan Ulbrich (TU Darmstadt); Debora Clever (Ruprecht-Karls-Universität Heidelberg)

Support: DFG SPP 1253 “Optimization with Partial Differential Equations”

Contact: J. Lang, D. Schröder

References

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[2] D. Clever, J. Lang, and D. Schröder. Model hierarchy based optimal control of radiative heat transfer. *International Journal of Computational Science and Engineering*, 9:509–525, 2014.

[3] D. Schröder, J. Lang, and R. Weiner. Stability and consistency of discrete adjoint implicit peer methods. *Journal of Computational and Applied Mathematics*, 262:73–86, 2014.

Project: Multigrid methods for the optimal control of elliptic variational inequalities

This research project aims to contribute to the development and advancement of finding faster and more efficient numerical techniques for optimal control problems governed by elliptic variational inequalities (VIs). The prototypical problem is the optimal control of a VI of obstacle type. Different nonlinear multigrid techniques are evaluated and utilized to directly solve an appropriate optimality system of the optimal control problem without regularization. The numerical performance and efficiency of the proposed multigrid algorithms is studied and interpreted in comparison with other existing numerical methods, which typically employ an additional regularization loop for solving this type of problems. The motivation for such extensions is to be able to provide optimality solutions with optimal computational complexity and robustness with respect to optimization parameters. The main challenge here is to show the textbook multigrid convergence behaviour similar to the PDE-based problems in order to obtain optimal computational complexity.

Partner: Roland Herzog (TU Chemnitz)

Support: Alexander von Humboldt-Stiftung (Georg Forster-Forschungsstipendium)

Contact: M. Lass (Vallejos)

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[1] C. Gräser and R. Kornhuber. Multigrid methods for obstacle problems. *J. Comput. Math.*, 27(1):1–44, 2009.

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Project: Simulation of reactive flows by projection onto time- and space-variable quasi-steady states

The simulation of a reactive flow leads to a partial differential equation, which usually contains a large number of unknown variables. Furthermore, the time scales of the different chemical reactions cover several orders of magnitude. In addition to the size the obtained partial differential equation is also very stiff and solving the partial differential equation is very time consuming. However, the fastest chemical reactions have small timescales and eventually reach their equilibrium in a period of time shorter than the timestep of the solver. In this case we can replace these chemical reactions by an algebraic equation. This approach leads to simulation of the chemical reaction system on a lower dimensional manifold describing the partial equilibrium of the fast reactions. Though, the state of the system can differ in time and space, the reaction rates depend on the state. For this reason the manifold changes in time and space. The goal of the project is to develop a model, which dynamically switches in space and time between the description of the chemical reactions via the kinetic model and the partial thermodynamic equilibrium. Later this model will be implemented in an existing solver for partial differential equations like Kardos.

Contact: A. Lukassen, M. Kiehl

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[1] S. Franz. *Modellierung und Simulation reaktionskinetischer Prozesse mit Hilfe dynamisch angepasster quasi-stationärer Zustände*. Logos Verlag Berlin, 2003.

Project: Global Error Estimation for Stiff Systems of Ordinary Differential Equations

Modern solvers for ordinary differential equations gain in efficiency by adaptively optimizing their grids based on local error control. However, the accuracy imposed by the user applies to the global error of the approximation. If the conditioning of the considered system is bad, a local error control alone should not be trusted and estimates on the global errors are required. In the literature, reliability of existing global error estimates from the theory on ordinary differential equations is proven only in the non-stiff case. Nevertheless, for the various examples of stiff systems, e.g., appearing subproblems in the method of lines for partial differential equations of parabolic type or equations describing chemical reactions, reliability of the estimates can be questioned. In this project we focus on efficient and reliable estimation and control of the global errors for stiff differential equations. We estimate the global errors by solving linearized error transport equations. For global error control we use the property of tolerance proportionality. Due to the stiffness of the considered problems, our strategies are based on the concepts of B-stability and B-convergence. We propose two choices of continuous extensions and give a proof for asymptotic correctness of the associated estimators.

Partner: K. Debrabant (University of Southern Denmark, Odense, Denmark)

Contact: A. Rath, J. Lang

References

[1] K. Debrabant and J. Lang. On global error estimation and control of finite difference solutions for parabolic equations. *ArXiv e-prints*, 2009.

[2] J. Lang and J. G. Verwer. On global error estimation and control for initial value problems. *SIAM Journal on Scientific Computing*, 29:1460–1475, 2007.

Project: Fully adaptive linearly implicit peer methods

In [1] linearly-implicit two-step peer methods are sucessfully applied in the numerical solution of time-dependent partial differential equations. The computations were performed adaptive in time, but on a fixed spatial grid. However problems like the propagation of flame fronts are solved more efficiently when solved both adaptive in time and space. This project addresses the fully adaptive solution of PDEs with linearly-implicit peer methods. We first discretize in time with linearly implicit peer methods and then discretize in space with linear finite elements. The error in time is estimated by an embedded solution of lower order, while the spatial error is estimated by the DLY error estimator based on hierarchical bases. It can be shown, that the derived spatial error estimator is efficient and reliable. Numerical experiments for several nonlinear test problems show the potential benefit of linearly-implicit two-step peer methods compared to traditional Rosenbrock methods.

Contact: D. Schröder, J. Lang

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Project: Inverse problems for incompressible flow

Flow measurements provide an important source of information for the development, calibration, and discrimination of models for fluid flow. Magnetic Resonance Velocimetry [1] allows to obtain fully three dimensional, time-averaged measurements of the flow field in a single measurement process. Like in many other measurement techniques, the measured flow fields are perturbed by a rather large amount of measurement noise which inhibits a direct use of the results for further investigations. In this project, we utilize specific flow models and methods from inverse problems and optimal control to reconstruct a physically consistent improved flow field that allows for further post-processing and can be used to deduce the required information. The reconstruction process is formulated as an inverse problem which can be cast into an optimization problem with pde constraints. This inverse problem is studied from a theoretical point of view, uniqueness and stability issues are investigated, but also numerical methods for its efficient solution are proposed and analyzed. The results obtained in this project will be used for the characterization of flow regimes and in the design of heat exchangers.

Partner: F. Wassermann, MRV Group, CSI, TU Darmstadt

Support: DFG IRTG 1529 and GSC 233

Contact: T. Seitz, H. Egger

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Project: Adaptive Large Eddy Simulation for Flexible Energy Converter

The aim of this project is to develop robust numerical methods for improving combustion technologies with respect to efficiency, emissions and stability of aircraft engines and gas turbines. Nowadays, the design of smart energy networks, electrical power systems and flexible energy converters strongly demands for accuracy and reliability of the modeled process. Such dynamic and multi-physics systems are usually modeled by coupled time-dependent PDEs and ODEs as well as algebraic equations on computational grids. Since multi-physics models exhibit a wide range of space and time scales, this kind of simulations is always time-consuming and in the worst case scenario the corresponding computations are not even capable using traditional numerical simulation algorithms. Therefore, adaptive discretization methods are commonly recognized as an effective approach in the numerical solution of such complex systems. To obtain a more accurate and robust result from the complicated simulations, our research will focus on recent developments in the field of adaptive moving mesh methods based on the dual weighted residual error estimation for the large eddy simulation of a chemical reactive flow.

Partner: C. Sehrt (TU Darmstadt); S. Ulbrich (TU Darmstadt); S. Doost (GSC Energy Science and Engineering, TU Darmstadt); J. Janicka (GSC Energy Science and Engineering, TU Darmstadt)

Support: DFG Excellence Initiative, Darmstadt Graduate School of Excellence Energy Science and Engineering (GSC 1070)

Contact: Z. Sun, J. Lang

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Project: Reduced-order modeling for incompressible flows with stochastic boundary conditions

We investigate POD-Galerkin reduced-order modeling in the context of statistical estimation for incompressible flows with uncertain boundary data. The stochastic collocation on sparse grids is a standard method to solve such problems. The method relies on the numerical solutions of deterministic equations for a possibly large set of collocation points contained in a multi-dimensional parameter domain. By replacing a full-order finite element model with a reduced-order POD-Galerkin model a considerable acceleration can be achieved. In order to accurately represent the stochastic boundary data in the reduced-order model we provide an extension to previously available techniques.

Support: DFG SPP 1276 "MetStröm: Skalenübergreifende Modellierung in der Strömungsmechanik und Meteorologie", 2013; DFG Graduate School of Excellence Computational Engineering, TU Darmstadt, 2014

Contact: S. Ullmann, J. Lang

Project: EWAVE

EWAVE is part of the cooperation project ERWAS founded by the BMBF. The goal is to develop an innovative energy-management system which will be tested at the Rheinisch-Westfälischen Wasserwerkgesellschaft (RWW). A management system allows to compute optimal operation plans for the constructions of the water production, the water preparation and the water distribution. Additionally, the system should also manage to decide if self-generated energy is used or purchased from energy supply companies. Mathematically, we want to develop new dynamic simulation and optimization models for transport processes in water distributions under consideration of procedural constructions of the water supply with continuously dynamic multi-scale methods for time behaviour and modeling depth.

Partner: Alexander Martin (Universität Erlangen-Nürnberg), Günter Leugering (Universität Erlangen-Nürnberg), Gerd Steinebach (Hochschule Bonn-Rhein-Sieg), Ronald Roepke (RWW Rheinisch-Westfälische Wasserwerkgesellschaft mbH), Olaf Kremsier (GreyLogix Aqua), Andreas Pirsing (Siemens AG, Siemens Industry Automation), and Roland Rosen (Siemens AG, Siemens Corporate Technology)

Contact: L. Wagner, J. Lang

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Project: Adaptive finite element discretization methods for the numerical simulation of static and dynamic contact problems

Often, in the numerical simulation of real world problems, e.g., arising from mechanics or biomechanics, precise information about the regularity of the solution cannot be obtained easily a priori. In fact, the solution may be more or less regular in different regions of the computational domain and even singularities may occur. In this case, increasing the number of degrees of freedom within or close to a critical region of low regularity can improve the overall accuracy of the numerically obtained approximation. The detection of such a critical region can be made feasible by using a posteriori error estimators which do not rely on any additional regularity assumptions. One of the most common a posteriori error estimators is the standard residual estimator which is directly derived from the equivalence of the norm of the error and the dual norm of the residual. For contact problems this relation is disturbed due to the non-linearity. Thus, additional effort is required to derive an a posteriori error estimator for contact problems. This project deals with the construction and the analysis of efficient and reliable residual-type a posteriori error estimators for the numerical simulation of contact problems. We consider static and dynamic contact problems and different discretization methods.

Partner: A. Veeser (University of Milan, Italy); R. Krause (USI Lugano, Switzerland)

Contact: M. Walloth

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Project: Discontinuous Galerkin methods for variational inequalities

This project deals with the numerical solution of variational inequalities by discontinuous Galerkin methods. Advantages and disadvantages of different methods are investigated and a-priori as well as a-posteriori error estimates are established. The application to obstacle and simplified friction problems will be investigated.

Contact: H. Egger, M. Walloth

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1.7 Optimization

The research group **Optimization** consists of the groups **Algorithmic Discrete Mathematics**, **Discrete Optimization**, and **Nonlinear Optimization**, which cooperate closely. Mathematical Optimization considers the development, analysis, and application of efficient numerical methods for minimizing (or maximizing) a function under constraints. While Discrete Optimization studies mainly linear or convex problems involving integer variables, Nonlinear Optimization focuses on nonlinear problems with continuous variables. The research group covers both research topics in a comprehensive way and cooperates in particular in the challenging field of Mixed Integer Nonlinear Programming, which considers nonlinear optimization with mixed discrete-continuous variables.

Algorithmic Discrete Mathematics combines aspects of pure and applied mathematics. The group focuses on geometric combinatorics with links to graph algorithms, linear and integer programming, toric and tropical algebraic geometry and related areas.
We develop mathematical software for research in mathematics and beyond.

Discrete Optimization has become an important component in modern applied mathematics. Many problems from business and industry can be modeled as discrete optimization problems. The development of solution methods for these problems is the main focus of the group Discrete Optimization. This includes the development of mathematical models of real-world problems, the theoretical analysis (using methods mainly from graph theory, polyhedral combinatorics, and integer programming), and the design and implementation of fast algorithms as well as their evaluation in practice.
Experiences of the group are, for instance, in the following applied areas: public mass transportation (line planning, disruption management), energy optimization (gas transport), or optimization in mechanical engineering (truss topology optimization), see the projects for details.

Nonlinear Optimization is nowadays an important technology in applied mathematics, science, and engineering. Nonlinear optimization problems appear in many applications, e.g., shape optimization in engineering, robust portfolio optimization in finance, parameter identification, optimal control, etc. Nonlinear Optimization has emerged as a key technology in modern scientific and industrial applications. Challenging are in particular optimization problems with partial differential equations as constraints (PDE-constraints), for example optimization problems for flows, transport problems, diffusion processes, wave propagation, or mechanical structures. An efficient solution of such problems requires highly developed optimization methods, which use modern adaptive multilevel techniques of scientific computing.

The research group Nonlinear Optimization considers the development, theory, implementation, and application of efficient algorithms for nonlinear optimization. Particular research topics are PDE-constrained optimization, large scale optimization, adaptive multilevel techniques, preconditioning, global optimization, and relaxation of discrete problems.

The research group Optimization is engaged among others in the Excellence Cluster EXC 259 *Center of Smart Interfaces*, the Graduate School (Excellence Initiative) GSC 233 *Computational Engineering: Beyond Traditional Sciences*, the Collaborative Research Center (SFB) 666 *Integral Sheet Metal Design with Higher Order Bifurcations – Development, Production, Evaluation*, the Collaborative Research Center (SFB) 805 *Control of Uncertainties in Load Carrying Systems of Mechanical Engineering*, the Transregional Collaborative Research Center (Transregio/SFB) 154 *Mathematical Modelling, Simulation and Optimization on the Example of Gas Networks*, the LOEWE-Center *AdRIA: Adaptronic: Research, Innovation, Application*, the International Research Training Group IRTG 1529 *Mathematical Fluid Dynamics*, and the Deutsche Forschungsgemeinschaft (DFG) Priority Program SPP 1253 *Optimization with Partial Differential Equations*. In addition, the group has various industry partners, including cooperations with Open Grid Europe and Schenck.

Members of the research group

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Postdocs

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Benjamin Assarf, Vera Bommer, Stefanie Bott, Daniela Bratzke, Thorsten Ederer, Sarah Essert, Michael Fischer, Tobias Fischer, Tristan Gally, Jane Ghiglieri, Thea Göllner, Christopher Hojny, Kai Habermehl, Katrin Herr, Benjamin Horn, Silke Horn, Imke Joormann, Philipp Kolvenbach, Anja Kuttich, Madeline Lips, Hendrik Lüthen, Sonja Mars, Hannes Meinlschmidt, Thomas Opfer, Sebastian Pfaff, Anne Philipp, Rolf Roth, Johann Michael Schmitt, Carsten Schäfer, Cedric Sehrt, Adrian Sichau, Jan Wolf

Secretaries

Kirsten Hessenmüller, Ursula Röder

Project: Numerical analysis and fast solvers for the optimal control of electromagnetic processes governed by the time-domain 3D Maxwell equations

Electromagnetism plays an important role in many modern high-technological applications. They include applications in the magnetic connement fusion, transportation based on the magnetic levitation technology, microwave heating, sensor and signal technology, and many more. The mathematical and numerical analysis of the electromagnetic field control is highly challenging and calls for a careful study. This project is aimed at the numerical analysis and the development of fast and efficient solvers for the optimal control of electromagnetic processes governed by the time-domain 3D Maxwell equations. This project is original and has not been investigated by any other authors. In fact, the optimal control theory in electromagnetism is a rather new research area, and there is only a small number of studies devoted to the static or time-harmonics cases.

Partner: Graduate School of Computational Engineering (GSC 233); speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt)

Support: DFG

Contact: Vera Bommer, Irwin Yousept

Project: Adaptive Multilevel SQP Methods for PDAE-Constrained Optimization with Restrictions on Control and State

The project is part of the DFG-Priority Program SPP 1253 "Optimization with Partial Differential Equations".
The adaptive multilevel SQP method for control constrained optimal control problems of Ziems and Ulbrich, see [4], [7], is extended to state constrained optimal control problems governed by PDAEs. To this end, we combine the Moreau Yosida regularization with the adaptive SQP method. The refinement conditions and the penalty parameter update are modified specifically. We ensure that the regularized subproblems satisfy the assumptions of the adaptive SQP method and that the combined algorithm is well-posed. Based on the convergence theory for the Moreau Yosida regularization of Meyer and Yousept [5] and the SQP method of Ziems and Ulbrich [6], [7], we show a new first order necessary optimality result for the output of the combined algorithm, see [1] and [2].
Additionally we include a reduced-order model based on POD combined with DEIM in the adaptive SQP method. This reduces the computational effort significantly. The algorithm is implemented for an application in glass manufacturing by Clever, Lang and Schröder, see [2].

Partner: Graduate School of Computational Engineering (GSC 233); speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt), D. Clever, J. Lang, D. Schröder (TU Darmstadt)

Support: DFG

Contact: Stefanie Bott, Stefan Ulbrich

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Project: Simulation-based optimization methods for the hydroforming of branched structures (Subproject A6 of Collaborative Research Centre (SFB) 666)

This project is part of the Collaborative Research Centre (SFB) 666 (Integral sheet metal design with higher order bifurcations - development, production, evaluation) and is concerned with the optimal control of the sheet metal hydro-forming. The sheet metal hydroforming process is a complex forming process, which involves contact, friction, and plasticity to manufacture complexly curved sheet metals with bifurcated cross-section. Mathematically, this leads to a quasi-variational inequality. We want to find optimal controls for typical control variables, e.g., the time dependent blank holder force and the fluid pressure, by the use of simulation-based optimization methods. Our goal is to obtain a desired final configuration, taking into consideration relevant parameters for the production. On the one hand, we use derivative free optimization methods to solve the optimal control problem, where the commercial FEM-software ABAQUS is invoked for the simulations and, on the other hand, instantaneous optimization methods are under investigation. In this context model reduction techniques, e.g. Proper Orthogonal Decomposition, will be employed to achieve a suboptimal solution for the optimal control problem.

Partner: Collaborative Research Centre (SFB) 666: "Integral sheet metal design with higher order bifurcations - development, production, evaluation"; speaker Prof. Dr.-Ing. Dipl.-Wirtsch.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt)

Support: DFG

Contact: Daniela Bratzke, Stefan Ulbrich

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Project: Adaptive Multigrid Methods for Fluid-Structure Interaction Optimization

Strong fluid structure coupling is part of many technical systems. The aim of this project is to develop an efficient adaptive multilevel algorithm to solve an optimization problem governed by Fluid-Structure Interaction (FSI).
This algorithm should combine modern techniques of PDE-constrained optimization, adaptivity and Fluid-Structure Interaction simulation. Since for elliptic as well as for parabolic partial differential equations an adjoint based Trust-Region SQP method has shown good results, we plan to adapt this method. Thus we aim for an adjoint based algorithm that is able to refine the given grids (both the spatial and the temporal) adaptively during the optimization process.
The Fluid-Structure Interaction problem we consider as the constraint for the optimization problem, is the weak form of the FSI problem considered in an Arbitrary-Lagrangian-Eulerian (ALE) framework. The coupling of the two different parts of the partial differential equation is done via strong coupling.
Similarly, the adjoint equation is also considered in an ALE framework and in a strongly coupled way.

Partner: Graduate School of Computational Engineering (GSC 233); speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt)

Support: DFG

Contact: Sarah Essert, Stefan Ulbrich, Michael Schäfer

Project: Shape optimization with the Boussinesq equations

The project is part of the DFG supported International Research Training Group 1529 “Mathematical Fluid Dynamics”.
The analytical and numerical results on shape optimization problems governed by the Navier Stokes equations by Brandenburg and Lindemann et al. [1] are extended to the more general Boussinesq equations. To this end, we extend the differentiability results from Lindemann et al. [2] to the case of the Boussinesq equations. Additionally to the investigation of the problem in the infinite dimensional case, we consider suitable P2/P1 and P1/P1 discretizations of the differential equation to apply the theory in a practical example. Here, the research concerning the P1/P1 discretization is done in cooperation with the the numerics group of Prof. Notsu at Waseda University during a six month exchange program.

Partner: International Research Training Group (IRTG) 1529: “Mathematical Fluid Dynamics”; speakers Prof. Dr. Matthias Hieber (TU Darmstadt) and Prof. Dr. Yoshihiro Shibata (Waseda University, Tokyo)

Support: DFG and Japan Society for the promotion of science

Contact: Michael Fischer, Stefan Ulbrich

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Project: Optimization with Complementarity Constraints

Complementarity constraints require that at most one of two variables is nonzero. They are a well known tool for the modeling of logical relations expressing that from a set of possible events not more than one is allowed to occur. The applications of such relations are abundant, e.g., in machine learning, communication systems, finance or scheduling.

The aim of this project is to investigate a branch-and-cut algorithm for complementarity constrained optimization problems, including presolving techniques, branching rules, primal heuristics and cutting planes. The implemented software has to deal with problem instances involving large data in a robust manner. Furthermore, it should recognize and exploit special structures of a given problem instance automatically. As a tool, we use the software SCIP (see `scip.zib.de`) which provides a framework for solving discrete and combinatorial optimization problems. The purpose is to include further components to SCIP and to make them freely available for academic use.

Partner: Graduate School of Computational Engineering (GSC 233); speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt)

Support: DFG

Contact: Tobias Fischer, Marc Pfetsch

Project: Optimal Flow Control based on Reduced Models

Tollmien-Schlichting waves are responsible for the laminar-turbulent transition in a flat plate boundary layer. By damping these waves, a significant reduction of drag can be achieved. Motivated by an experiment conducted in the windtunnel at the institute SLA, the objective is to dampen Tollmien-Schlichting waves by using a body force which is induced by a plasma actuator. These actuators induce a body force which leads to a fluid acceleration, so the velocity profile is changed next to the surface. By optimal control of the plasma actuator parameters it is possible to reduce or even cancel the Tollmien-Schlichting waves and delay the turbulence transition.

We use a Model Predictive Control (MPC) approach for the cancellation of Tollmien-Schlichting waves in the boundary layer of a flat plate. The model that predicts the next flow field in a time horizon, has to fulfill the Navier-Stokes equations. Instead of solving a high-dimensional system, a low-order model description is used to perform the optimization. The reduced-order model is obtained with a Galerkin projection and an appropriate basis. We use Proper Orthogonal Decomposition (POD) in which the basis function are generated from numerical solutions for carefully chosen initial data and control inputs. The optimization of the control parameters is performed within the reduced system. The efficiency of the reduced-order controller is demonstrated for the damping of Tollmien-Schlichting waves by plasma actuators.

Partner: Graduate School of Computational Engineering (GSC 233); speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt), Institute of Fluid Mechanics and Aerodynamics (SLA), Institute of Numerical Methods in Mechanical Engineering

Support: DFG

Contact: Jane Ghiglieri, Stefan Ulbrich

References

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Project: Polyhedral Description of Star Colorings

Star colorings are node colorings of an undirected graph which ensure that adjacent nodes are not colored equally, and additionally, that no path on four nodes is colored with exactly two colors. The computation of star colorings which minimize the number of colors are important for the efficient computation of sparse Hessian matrices. The smallest number of colors which is needed for a star coloring of a graph is called the star chromatic number. In the literature, however, the number of colors is mostly determined heuristically which leads to an upper bound on the star chromatic number.

The aim of this project is to develop polyhedral models which allow for the exact computation of the star chromatic number. We focus on the facial structure of the derived polytopes to obtain strong cutting planes, which can be used within branch-and-cut procedures to determine the star chromatic number. Furthermore, we investigate complete linear descriptions for the polytopes corresponding to our models for several graph classes to detect structural properties which can be adapted to further graph classes.

Contact: Christopher Hojny, Marc Pfetsch

Partner: Andrea Walther, Universität Paderborn

Project: Generation of Certificates for the Infeasibility of Technical Capacities

This project was part of the BMWi cooperative project "Investigation of the technical capacities of gas networks", in which six research partners, the gas transportation company Open Grid Europe, and the German Federal Network Agency (Bundesnetzagentur) were involved. The technical capacities determine bounds on the amount of gas that can be charged into or discharged from a gas network. Therefore, a central aspect was to compute these technical capacities.

In our sub-project, we determined so-called certificates for the infeasibility of certain gas nominations. For the analysis of technical capacities one has to decide which requests can be handled by the network. If a certain nomination cannot be transported, one wants to know the reason why this nomination is infeasible. Thus a justification is required, i.e., a certificate that is easy to understand. This should be possible without the need for involved simulations or computations. We concentrated on the development of methods to find such certificates and applied them to the analysis of technical capacities.

Partner: Zuse-Institut Berlin; Universität Hannover; Universität Duisburg-Essen; HU Berlin; Universität Erlangen-Nürnberg; German Federal Network Agency (Bundesnetzagentur); Open Grid Europe

Support: German Federal Ministry of Economics and Technology (BMWi)

Contact: Imke Joormann, Marc Pfetsch

Project: FORNE

In this project, we dealt with gas network optimization, together with our industrial partner Open Grid Europe (OGE). The goal was to provide tools for the mid to long term planning of gas networks. One main step dealt with the question to decide whether a given amount of gas and given bounds on the pressure can be transported in a stationary gas network. Furthermore, the extension of the existing gas network topology was considered. We developed algorithms that provide solutions to the corresponding mixed-integer nonconvex, nonlinear optimization problems. The methods were tested on the real-world instances of OGE.

Partner: Zuse-Insitut Berlin; Universität Hannover; Universität Duisburg-Essen; HU Berlin; Universität Erlangen-Nürnberg; WIAS Berlin; Open Grid Europe

Contact: Imke Joormann, Marc Pfetsch

Project: Mathematical Programming in Robust Design (Subproject A3 of Collaborative Research Centre (SFB) 805)

The presence of uncertainty is a prevalent characteristic in mechanical engineering, which can lead to severe economical and safety consequences. This applies particularly to fields like lightweight design, e.g., aircraft construction, where high load-bearing capacity has to be combined with low weight and where system failure is not tolerable at any point.
As part of the Collaborative Research Centre (SFB) 805: "Control of uncertainty of load carrying systems in mechanical engineering" we want to find - for load-carrying mechanical systems - the optimal robust design regarding uncertainty of parameters, e.g., material properties and loading scenarios, as well as uncertainty of the manufacturing quality.
This is achieved by simulation-based optimization of geometry, topology and the placement of actuators, at which modern techniques of robust optimization are applied and extended. In particular we choose a worst-case approach to incorporate the existing uncertainty into our optimization model. This leads to a computationally intractable problem formulation since we consider nonlinear nonconvex objective functions and further employ complex PDE constraints in order to model the mechanical behaviour of the considered structures. Hence, this so-called robust counterpart is approximated by means of a second order Taylor expansion which is solved by an efficient SQP method.

Partner: Collaborative Research Centre (SFB) 805: "Control of uncertainty of load carrying systems in mechanical engineering"; speaker Prof. Dr.-Ing. Peter Pelz (Department of Mechanical Engineering, TU Darmstadt)

Support: DFG

Contact: Philip Kolvenbach, Adrian Sichau, Stefan Ulbrich

References

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Project: Mathematical methods and models for the optimal combination of active and passive components in trusses (Subproject A4 of Collaborative Research Centre (SFB) 805)

This project is part of the Collaborative Research Centre (SFB) 805: "Control of uncertainty of load carrying structures in mechanical engineering". The project deals with the optimal design of mechanical trusses under uncertainty. Trusses are important in many applications (undercarriages of airplanes, bicycles, electrical towers, etc.) and are often overdimensioned to withstand given forces under several uncertainties in loadings, material and production processes. Active parts can react on these uncertain effects and reduce the dimension of trusses. The Collaborative Research Centre (SFB) 805 introduces new technologies to handle uncertainty in load carrying systems. The aim of this project is to find optimal combinations of active and passive parts in a mechanical truss under uncertain loadings. Mathematically, this leads to mixed-integer nonlinear semidefinite problems. For this kind of problem, there exist no solvers that exploit the structure of the problem efficiently. Besides the development of an appropriate solver another focus lies in a mathematical handling of the upcoming uncertainties. Ellipsoidal and polyhedral sets are used to integrate uncertainty in different loading scenarios. The focus of the second funding period lies in the generalization to dynamic loads and the integration of different hinges as well as different kinds of active elements. All of this includes interdisciplinary communication to mechanical engineers to achieve realistic models.

Partner: Collaborative Research Center (SFB) 805: "Control of Uncertainty of load carrying structures in mechanical engineering"; speaker Prof. Dr.-Ing. Peter Pelz (Department of Mechanical Engineering, TU Darmstadt)

Support: DFG

Contact: Tristan Gally, Kai Habermehl, Anja Kuttich, Sonja Mars, Marc Pfetsch, Stefan Ulbrich

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Project: Robust optimization (Subproject AP 4 of SIMUROM)

This subproject is part of SIMUROM, a project that focuses on the modeling, simulation and optimization of electromechanical energy converters that can work as motors or generators. As a subproject the focus is on the optimal design of such energy converters under uncertainty. Due to manufacturing, there are uncertainties in material and production precision. During the design process it is important to consider these uncertainties in order to obtain reliable and efficient machines. A robust optimization problem is formulated that incorporates the uncertainties into the initial optimization problem utilizing the worst-case approach. In order to obtain numerically feasible problems, different approximation methods are investigated. For this, the robust counterpart is approximated by different degrees of Taylor expansions [1, 2]. To solve the resulting nonlinear PDE constraint optimization problems, efficient algorithms are needed. To achieve this, different model order reduction techniques [3], adaptive multilevel methods [4] and possible extensions are investigated.

Partner: Prof. Dr. Sebastian Schöps (Graduate School for CE and Institut für Theorie Elektromagnetischer Felder, TU Darmstadt); Dr. Andreas Bartel (Angewandte Mathematik, Bergische Universität Wuppertal); Prof. Dr. Michael Hinze (Fachbereich Mathematik, Universität Hamburg); Dr. Oliver Rain (Robert Bosch GmbH); Dr. Markus Brunk (Robert Bosch GmbH); Dr.-Ing. Enno Lange (CST – Computer Simulation Technology AG)

Support: Federal Ministry of Education and Research (BMBF)

Contact: Oliver Lass, Stefan Ulbrich

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Project: Mathematical models and algorithms for an automated product development of branched sheet metal products (Subproject A2 of Collaborative Research Centre (SFB) 666)

This project is part of the Collaborative Research Centre (SFB) 666 (Integral sheet metal design with higher order bifurcations – development, production, evaluation) and addresses the shape optimization of sheet metal products. There are different types of considered sheet metal products: Multi-chambered profiles, mechanical connectors and hydroformed branched sheet metal structures.

For profiles, the goal is to find the optimal design of the profile-cross-sections as well as optimal decompositions into smaller parts that are easier to produce. For this purpose, a combination of topology and geometry optimization as well as graph partitioning techniques are applied. To solve the decomposition problem more efficiently, the information of the defined polyhedron will be used in the integer program solvers.

For the optimization of mechanical connectors multi body models including contact constraints are used. To solve the resulting PDE constrained problems optimization techniques for nonsmooth and nonconvex problems are applied.

As hydroformed parts can show arbitrary curvature, the geometry of those parts is parameterized by cubic B-spline surfaces. The product behavior is described by the three dimensional linear elasticity equations. To optimize the geometry optimization of the branched and hydroformed sheet metal products, PDE constrained optimization techniques are used. The arising nonconvex geometry optimization problem is solved with an algorithm using exact constraints and a globalization strategy based on adaptive cubic regularization. For decreasing the computational effort multilevel-techniques are applied.

Partner: Collaborative Research Centre (SFB) 666: "Integral sheet metal design with higher order bifurcations - development, production, evaluation"; speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt)

Support: DFG

Contact: Thea Göllner, Katrin Herr, Benjamin Horn, Hendrik Lüthen, Marc Pfetsch, Stefan Ulbrich

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[1] T. Göllner. *Geometry Optimization of Branched Sheet Metal Structures with a Globalization Strategy by Adaptive Cubic Regularization*. Dissertation, TU Darmstadt, Dec. 2014.

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Project: Optimal Control of Quasilinear PDAEs

Partial Differential Algebraic Equations (PDAEs) have received increased attention in the recent years because of their versatility in modeling dynamics in systems. In this project, we consider optimal control problems subject to quasilinear PDAEs.

PDAEs or DAEs in general are used to model dynamics in which parts of the system states are subject to (partial-) differential equations, and the other parts of the system states are given by purely algebraic constraints. The project is concerned mainly with PDAEs in the form of abstract DAEs in Banach spaces, in the simplest form of one evolutionary PDE for one searched-for state, and one (quasi-) stationary PDE for the other. Here, the PDEs may be of up to quasilinear type with full coupling.

These problems then serve as the constraints in an optimal control problem, where the set of admissible solutions is further restricted by state- and control constraints. Especially the state constraints and the quasilinear structure give rise to particular difficulties in the theoretical handling of the optimal control problems, which makes the considered problems both interesting and challenging.

The developed theory is simultaneously tried and applied on a real-world example, the thermistor problem, for this class of optimal control problems.

Contact: Hannes Meinlschmidt, Stefan Ulbrich

Project: Triangulations and other decompositions of lattice polytopes in toric and tropical geometry

Lattice polytopes are objects at a junction between combinatorics and algebraic geometry. The study of their triangulations, coarsest subdivisions, mixed subdivisions, and other decompositions is motivated by the mutual interaction between these fields as well as by applications in number theory, optimization, statistics, mathematical physics, and algorithmic biology.

Attacking fundamental open problems in this area requires to combine theoretical insight with algorithmic ingenuity and computer experiments. Specific topics addressed in this project include the following: unimodular triangulations of lattice polytopes (in particular, matroid polytopes), the relationship between smoothness and normality of a toric variety, combinatorial and geometric interpretations of h^*-polynomials, and symmetric lattice polytopes.

Partner: Priority Program 1489 "Algorithmic and Experimental Methods in Geometry, Algebra, and Number Theory"; speaker: Wolfram Decker (Department of Mathematics, TU Kaiserslautern)

Support: DFG

Contact: Andreas Paffenholz

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Project: `polymake`

The mathematical software system `polymake` provides a wide range of functions for convex polytopes, simplicial complexes, and other objects.

While the system exists for more than a decade it was continuously developed and expanded. The most recent version fundamentally changes the way to interact with the system. It now offers an interface which looks similar to many computer algebra systems. However, on the technical level `polymake` differs from most mathematical software systems: rule based computations, a flexible object hierarchy and an extendible dual Perl/C++ interface are the most important characteristics. There are interfaces to programs written in C, C++, Java, and Perl.

`polymake` is an open source software project. The current version 2.14 can be downloaded freely from `www.polymake.org`.

Partner: Michael Joswig (TU Berlin), Ewgenij Gawrilow (TomTom N.V.) and the `polymake` team

Contact: Andreas Paffenholz

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[1] B. Assarf, E. Gawrilow, K. Herr, M. Joswig, B. Lorenz, A. Paffenholz, and T. Rehn. polymake in linear and integer programming. August 2014.

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Project: Optimal control of switched networks for nonlinear hyperbolic conservation laws

The project is part of the DFG-Priority Program SPP 1253 "Optimization with Partial Differential Equations". Its aim is the analysis of optimal control problems for hyperbolic balance laws on networks under modal switching, where the switchings are considered in the source terms as well as at boundary nodes and junctions. This type of problems arises for example in traffic flow models or in models for water and gas networks. The main difficulty of the analysis of conservation laws stems from the fact that even in the case of a single scalar conservation law and smooth data the entropy solution usually develops shocks, which causes the control-to-state operator not to be differentiable in the usual sense. However, encouraging progress has been achieved recently for the optimal control of conservation laws by using a generalized notion of differentiability (so called shift-differentiability). Switching between different modes may result in additional discontinuities in the solution, which is, however, quite natural in the context of entropy solutions. The project focuses on the investigation of the existence of optimal controls, the differentiability properties of the reduced objective function w.r.t. the initial and boundary data, the node conditions (at junctions) and switching times as well as the corresponding sensitivity and adjoint equations.

Partner: Günter Leugering (Universität Erlangen-Nürnberg)

Support: DFG

Contact: Sebastian Pfaff, Stefan Ulbrich

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Project: Global Methods for Stationary Gastransport (Project A01 of Transregio/SFB 154)

This project is part of the Transregio/SFB 154: "Mathematical Modelling, Simulation and Optimization on the Example of Gas Networks".

This project develops adaptive methods for the global solution of nonlinear integer optimization problems with ODEs, on the example of stationary gastransport. One main issue is the construction of convex relaxations based on a priori error bounds. Here, the adaptivity with respect to the approximation of the ODEs and convex relaxations have to be handled by integrated means. Moreover, integral decisions, e.g., arising at valves in a gas network, are handled via branch-and-bound. The solution process should be improved via infeasibility cuts and the development of primal heuristics with a posteriori error bounds. Furthermore model reduction techniques need to be applied.

Partner: Transregio/SFB 154: “Mathematical Modelling, Simulation and Optimization on the Example of Gas Networks”; speaker Prof. Dr. Alexander Martin (Department of Mathematics, Universität Erlangen-Nürnberg)

Support: DFG

Contact: Marc Pfetsch, Stefan Ulbrich

Project: Mixed-Integer nonlinear models in wireless networks

This project is part of the LOEWE Priority Program Cocoon (Cooperative Sensor Communication) supported by the LOEWE research initiative of the state of Hesse/Germany. In this project we explore the utilization of mixed-integer optimization in wireless telecommunication networks. Typical for problems occurring in this context is the simultaneous consideration of continuous optimization variables, e.g., like beamforming vectors and combinatorial aspects, like the assignment of base stations to mobile users. Mathematical models are derived that account both for the requirements of the application and the solvability. Usually one has to deal with NP-hard problems in this context that cannot be solved by standard software. We investigate convex approximations as well as heuristics to derive reasonable good solutions. We use these approximations as primal heuristics in connection with convex SDP-based relaxations within a branch-and-bound method to solve the mixed integer nonlinear optimization model to global optimality. The global optimal solution can also be used to evaluate heuristic and approximation approaches.

Partner: LOEWE Priority Program Cocoon (Cooperative Sensor Communication); speaker Prof. Dr.-Ing. Abdelhak Zoubir (Department of Electrical Engineering and Information Technology, TU Darmstadt)

Support: Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz (LOEWE)

Contact: Anne Philipp, Stefan Ulbrich

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Project: Optimal design and control of adaptronic systems

This project is part of the LOEWE-Center AdRIA, which is a collaborative reserach initiative of the Fraunhofer Institute for Structural Durability and System Reliability LBF, the TU Darmstadt and the Hochschule Darmstadt to create a leading international research center for adaptronic systems. Two demonstrators were developed which provides

an appropriate platform to interpret, implement and evaluate the approaches, methods and solutions for vibration reduction. The *truss structure* provides a modular model of a lightweight structure, e.g., ships, aircraft, cars, wind turbines or bridges. The *vibrating plate* is representative for flat building elements (windows, facades, partition walls), technical installations (pipes, heating and air conditioning), office equipment (projectors, printers, copiers), machine covers, sound insulation cabinets, robotic arms, rotor blades of helicopters and aircraft wings.
As part of the technology area *simulation tools*, we determine the optimal position and number of actuators and sensors for dynamical systems. An FE model was developed for these demonstrators and approximated by model order reduction. Using controllability and observability measures, a method for determining the optimal actuator and sensor placement is designed, which leads to an optimization problem with binary and continuous variables and linear matrix inequalities. It was shown that an LQR or MPC controller provides a better vibration reduction with the optimal actuator and sensor positions than with the actuator and sensor positions, which were determined heuristically.

Partner: LOEWE-Center AdRIA; speaker Prof. Dr.-Ing. Tobias Melz (Department of Mechanical Engineering, TU Darmstadt), Technology Division Simulation; speaker Dr. Sven Herold (LBF Fraunhofer)

Support: Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz (LOEWE)

Contact: Carsten Schäfer, Stefan Ulbrich

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Project: Adaptive Multilevel Methods for the Optimal Control of Hyperbolic Equations in Gas Networks (project A02 of Transregio/SFB 154)

This project is part of the Transregio/SFB 154: “Mathematical Modelling, Simulation and Optimization on the Example of Gas Networks”. We want to analyze the optimal control of hyperbolic PDE systems with state constraints on the example of gas networks. Through the time-dependent control of compressors and valves, the pressure and velocity distribution of the transported gas in the network has to be optimized under constraints, e.g., such that the pressure lies within a specified tolerance range. The constraints of the resulting optimal control problem (P) consist of coupled systems of one-dimensional isothermal Euler equations describing the gas flow, node conditions and state constraints. We plan to use Moreau-Yosida regularizations to approximate (P) in order to derive optimality conditions. The main goal of this project is to provide an optimization theory, which will form the basis of adaptive multilevel methods.

Partner: Transregio/SFB 154: “Mathematical Modelling, Simulation and Optimization on the Example of Gas Networks”; speaker Prof. Dr. Alexander Martin (Department of Mathematics, Universität Erlangen-Nürnberg)

Support: DFG

Contact: Johann Michael Schmitt, Stefan Ulbrich

Project: Optimal Control of Navier-Stokes with Combustion

Based on the work of the SFB 568 subproject D5 we continue to develop efficient methods for the optimization of combustion chambers containing turbulent fluid flow and combustion processes, which are modeled by partial differential equations.
The employed optimization methods rely on adjoints and derivative information, calculated by automatic differentiation [1]. The implementation uses the parallel multi-grid flow solver "Fastest", which incorporates recent simplified combustion models such as the flamet-generated-manifold (FGM) method.

Partner: Darmstadt Graduate School of Excellence Energy Science and Engineering (GSC 1070); speakers Prof. Dr. Wolfram Jaegermann, Prof. Dr. Johannes Janicka (TU Darmstadt)

Support: DFG

Contact: Cedric Sehrt, Stefan Ulbrich

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Project: SPEAR – Sparse Exact and Approximate Recovery

The research project "SPEAR – Sparse Exact and Approximate Recovery" deals with the problem to recover a sparse solution of an underdetermined linear (equality) system. This topic has many applications and is a very active research area. It is located at the border between analysis and combinatorial optimization. The main goal of our project is to obtain a better understanding of the conditions under which (efficiently) finding such a sparse solution, i.e., recovery, is possible. Our project is characterized by both theoretical and computational aspects as well as the interplay of continuous and discrete methods.
The SPEAR project is a collaboration of the Research Group Optimization at the TU Darmstadt (since 2012, previously: Institute for Mathematical Optimization at the TU Braunschweig) and the Institute for Analysis and Algebra at the TU Braunschweig. The project is funded by a DFG research grant. Project period: 2011–2014.

Partner: Dirk Lorenz and Christian Kruschel, TU Braunschweig

Support: DFG

Contact: Marc Pfetsch, Andreas Tillmann

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1.8 Stochastics

Research in the stochastics group is split into a probability theory part (Aurzada, Betz, Meiners) and a part on mathematical statistics (Kohler).

In the mathematical statistics part, we work on curve estimation. The particular focus here is on nonparametric regression and nonparametric density estimation. The major research topics studied by the probability group are statistical mechanics, interacting particle systems, stochastic processes, and queueing theory with applications to engineering problems. The particular problems considered are from the following areas: spacial random permutations, probabilistic methods in quantum theory, the theory of Bose-Einstein condensation, exit problems for stochastic processes, the analysis of steady-state properties of Markov chains, fixed-point equations for distributions, and percolation.

The members of the research group stochastics are involved in joint projects with colleagues working in probability and statistics as well as colleagues in sciences where probability and statistics are applied to, such as econometrics, engineering, telecommunication, physics, and psychology. Furthermore, we carry out research projects in applied stochastics with industrial partners.

Members of the research group

Professors

Frank Aurzada, Volker Betz, Michael Kohler, Matthias Meiners

Postdocs

Mehdi Slassi

Research Associates

Christoph Baumgarten, Ann-Kathrin Bott, Tina Felber, Dmytro Furer, Ida Hertel, Daniel Jones, Tanja Kramm, Lisa Kristl, Jan-Erik Lübbers, Christian Mönch, Florian Müller, Helge Schäfer, Reinhard Tent, Stefan Walter

Secretaries

Alexandra Frohn, Ute Hasenzahl

Project: First passage times of Lévy processes with moving boundaries

It is a classical area in the study of Lévy processes to consider the law of the first passage time over a fixed level. There is a well-built theory for this topic and numerous applications in insurance, finance, etc. In this project we study the law of the first passage time over a deterministic functions, called moving boundaries.

Partner: Tanja Kramm (Darmstadt), Mladen Savov (University of Reading, UK)

Contact: F. Aurzada

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[1] F. Aurzada and T. Kramm. The first passage time problem over a moving boundary for asymptotically stable Lévy processes. Preprint, arXiv:1305.1203, *Journal of Theoretical Probability*, to appear.

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Project: Persistence probabilities for Gaussian processes

Persistence concerns the question that a stochastic process has a long negative excursion. The first goal is to understand the probability of such a long excursion, which for many naturally scaled processes decays polynomially with an exponent θ called the persistence exponent. The analysis of this exponent for a number of Gaussian (and related) process has been an extremely active research topic in the last five years. We contribute to this theory with a number of results for particular processes with the hope that a general picture emerges and one can start to develop general theory.

Partner: Christoph Baumgarten (Darmstadt), Steffen Dereich (Münster), Mikhail Lifshits (St. Petersburg), Thomas Simon (Lille)

Contact: F. Aurzada

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Project: Small deviations of stochastic processes

Small deviation theory concerns the probability that a stochastic process remains in a small ball of its target space. This question has a large range of applications in particular in functional analysis and statistics but also in coding theory, approximation theory, and other areas. Our contributions concern the development of this theory for Lévy processes and its relation to the regularity structure of the involved processes, on the one hand, and the investigation of the relation of small deviation theory to the compactness properities of certain linear operators, on the other hand.

Partner: Mladen Savov (Reading), Leif Döring (Zürich), Wenbo Li (Delaware), Qi-Man Shao (Hong Kong), Thomas Kühn (Leipzig), Fuchang Gao (Idaho, USA)

Contact: F. Aurzada

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Project: Mathematical analysis of telecommunication networks

Telecommunication networks are part of our everyday life. In this project we investigate the performance of future telecommunciation networks. Here, we consider two types of networks: wireless communication networks such as the LTE technology and fiber optical communication networks, which are bound to replace the 'last mile' of the internet, i.e., the connection of homes and private businesses with the internet. The goal is to understand how different network architectures and the proposed communciation protocols influence the performance of the systems. By that we mean the throughput and delay behaviour of the networks. The research is carried out in close cooperation with industry partners such as LG Electronics.

Partner: Martin Reisslein, Revak R. Tyagi, Xing Wei (Arizona State University), Michael P. McGarry (University of Texas), Martin Maier, Martin Lévesque (INRS Montréal), Géza Jóos (McGill University Montréal), Sang Kim, and Ki-Dong Lee (LG Electronics San Diego).

Contact: F. Aurzada

References

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[2] M. Lévesque, F. Aurzada, M. Maier, and G. Joós. Coexistence Analysis of H2H and M2M Traffic in FiWi Smart Grid Communications Infrastructures Based on Multi-Tier Business Models. *IEEE Transactions on Communications*.

[3] R. R. Tyagi, F. Aurzada, K.-D. Lee, S. Kim, and M. Reisslein. Impact of retransmission limit on preamble contention in LTE-advanced network. IEEE Systems Journal, to appear.

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Project: Spatial random permutations and Bose-Einstein condensation

The theoretical understanding of the quantum phenomenon of Bose-Einstein condensation is one of the great unsolved problems of theoretical physics. It is well known that the quantum mechanical problem can be translated into a probabilistic one by using the Feynman-Kac formula. The result is a system of interacting spatial permutations, and the question to be answered is about a phase transition in the typical length of cycles, with the order parameter being the typical distance of two spatial points that will be mapped into each other by the permutation. Even though an understanding of the full probabilistic model is currently out of reach, there are various simplifications that should exhibit typical properties of the full model and are interesting in their own right. Moreover, these simpler models touch on many other current topics of statistical mechanics, such as motion by mean curvature, percolation or Schramm-Löwner evolution. The work in the research group is focused on understanding various of these aspects in simple cases, using both analytical and numerical methods.

Partner: D. Ueltschi (University of Warwick); Tadahisa Funaki (University of Tokyo)

Contact: V. Betz

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[3] V. Betz, D. Ueltschi, and Y. Velenik. Random permutations with cycle weights. *Ann. Appl. Probab.*, 21:312–331, 2011.

Project: Enhanced binding through path integrals

The description of electrically charged matter coupled to its quantized radiation field has been an active and successful area of research in the past decade. One possible way to study the problem is to use path integrals, thus converting the problem into a probabilistic one. One particular area where this is promising is the study of the effective mass of coupled particles: as charged particles are surrounded by a cloud of photons, their mass is increased. Probabilistically, this leads to a non-Markovian modification of Brownian motion where in the diffusive scaling a functional central limit theorem to holds. The diffusion matrix is known to be smaller or equal to the one of the original Brownian motion, but is expected to be strictly smaller. This discrepancy, leading to a reduced expected mobility of the particle, corresponds exactly to the increased effective mass. The aim of the project is to quantify and prove the difference of the diffusion constants, and to apply it to models like the Nelson scalar field model where so far enhanced binding has not been shown.

Partner: E. Bolthausen (Universität Zürich)

Contact: V. Betz

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[1] J. Lőrinczi, F. Hiroshima, and V. Betz. *Feynman-Kac-Type Theorems and Gibbs Measures on Path Space*. de Gruyter, 2011.

Project: Estimation of the random behavior of fatigue parameters

In this project we estimate a conditional density. In contrast to standard results in the literature in this context we assume that for each observed value of the covariate we observe a sample of the corresponding conditional distribution of size larger than one. A density estimate is defined taking into account the data from all the samples by computing a weighted average using weights depending on the covariates. The error of the density estimate is measured by the L_1 error. Results concerning consistency and rate of convergence of the estimate are derived, and the performance of the estimate for finite sample size is illustrated by using simulated data. Furthermore the estimate is applied to a problem in fatigue analysis. Here we apply our estimator to examine the fatigue behavior of steel under cyclic loading. The data is obtained by relatively time consuming experiments where for each material and several adjusted total strain amplitudes the corresponding numbers of cycles N till failure are determined. We use the above described estimate in order to estimate the random behavior of N.

Partner: SFB 666 (TU Darmstadt)

Contact: M. Kohler.

References

[1] A.-K. Bott and M. Kohler. Nonparametric estimation of a conditional density. Preprint, TU Darmstadt, 2014.

Project: Efficient estimation of uncertainty in a simulation model

In this project we consider a simulation model of a complex technical system described by $Y = m(X)$, where X is a d dimensional random variable with density f and m is a known real-valued function which is expensive to evaluate. Given a sample of (X, Y) and an additional sample of X we construct estimates of the density g of Y and of quantiles of Y. This problem is motivated by experiments carried out in the Collaborative Research Centre 805 at the Technische Universität Darmstadt, which is interested in the measurement of uncertainty in load-bearing systems like bearing structures of aeroplanes. The simplest example of a load-bearing system in mechanical engineering is a tripod. In the experiments a static force is applied on the tripod. On the bottom side of the legs force sensors are mounted to measure the legs axial force. If the holes where the legs are plugged in have exactly the same diameter, a third of the general load should be measured in each leg. Unfortunately, such an accurate drilling is not possible in the manufacturing process. Since there is always a small deviation, the force is distributed non-uniformly in the three legs. The random vector Z represents the diameters of the three holes. The real-valued function m describes the physical model of the tripod and $Y = m(Z)$ is the resulting load in one fixed leg of the tripod. Here, the measurement of Z is very cheap, so there are many observations of the diameters available. Based on the physical model of the tripod we are able to compute the reliability $y_i = m(z_i)$ for arbitrarily chosen diameters z_i, but due to the fact that this is an expensive and time consuming process we do this only n times and observe additional N values of the random diameter Z.

The task is to improve the estimate of the distribution of the reliability by using the additional observations of Z. The distribution of the reliability is described by its density g, which we assume to exist, or by quantiles corresponding to this distribution, so we are facing the problem of estimating the density or quantiles of $Y = m(Z)$ given n observations of the function m at arbitrarily chosen points and additional independent observations of Z.

Using methods of nonparametric regression in order to estimate the function m we derive various estimates of the density and of the quantile and derive results concerning their rate of convergence.

Partner: SFB 805 (TU Darmstadt)

Contact: M. Kohler.

References

[1] G. Enss, B. Götz, M. Kohler, A. Krzyzak, and R. Platz. Nonparametric estimation of a maximum of quantiles. *Electronic Journal of Statistics*, 8:3176–3192, 2014.

[2] T. Felber, M. Kohler, and A. Krzyzak. Adaptive density estimation based on real and artificial data. *Journal of Nonparametric Statistics*, 27:1–18, 2015.

[3] M. Kohler, A. Krzyzak, R. Tent, and H. Walk. Nonparametric quantile estimation using importance sampling. Preprint, TU Darmstadt, 2014.

[4] M. Kohler, A. Krzyzak, and H. Walk. Nonparametric recursive quantile estimation. *Statistics and Probability Letters*, 93:102–107, 2014.

Project: Estimation of a regression function corresponding to latent variables

The problem of estimation of a univariate regression function from latent variables given an independent and identically distributed sample of the observable variables in the corresponding common factor analysis model is considered. Nonparametric least squares estimates of the regression function are defined. The strong consistency of the estimates is shown for subgaussian random variables whose characteristic function vanishes nowhere. This consistency result does not require any assumptions on the structure or the smoothness of the regression function.

Contact: M. Kohler.

References

[1] M. Kohler, F. Müller, and H. Walk. Estimation of a regression function corresponding to latent variables. *Journal of Statistical Planing and Inference*, 2015.

Project: Optimal global rates of convergence for noiseless regression estimation problems

Given the values of a measurable function $m : \mathbb{R}^d \to \mathbb{R}$ at n randomly or arbitrarily chosen points in $\mathbb{R}^d$ the problem of estimating m on whole $\mathbb{R}^d$ is considered. Here the estimate has to be defined such that the L_1 error of the estimate (with integration with respect to a fixed but unknown probability measure) is small. Under the assumption that m is (p, C)-smooth (i.e., roughly speaking, m is p-times continuously differentiable) it is shown that the optimal minimax rate of convergence of the L_1 error is $n^{-p/d}$, where in case of arbitrarily chosen points the upper bound is valid even if the support of the design measure is unbounded but the design measure satisfies some moment condition.

Partner: Prof. Adam Krzyżak (Concordia University, Montreal)

Contact: M. Kohler.

References

[1] M. Kohler. Optimal global rates of convergence for noiseless regression estimation problems with adaptively chosen design. *Journal of Multivariate Analysis*, 132:197–208, 2014.

[2] M. Kohler and A. Krzyzak. Optimal global rates of convergence for interpolation problems with random design. *Statistics and Probability Letters*, 83:1871–1879, 2013.

Project: Estimation of a distribution from data with small measurement errors

In this project we study the problem of estimation of a distribution from data that contain small measurement errors. The only assumption on these errors is that the average absolute measurement error converges to zero for sample size tending to infinity with

probability one. In particular we do not assume that the measurement errors are independent with expectation zero. Throughout the paper we assume that the distribution, which has to be estimated, has a density with respect to the Lebesgue-Borel measure.
We show that the empirical measure based on the data with measurement error leads to a uniform consistent estimate of the distribution function. Furthermore, we show that in general no estimate is consistent in the total variation sense for all distributions under the above assumptions. However, in case that the average measurement error converges to zero faster than a properly chosen sequence of bandwidths, the total variation error of the distribution estimate corresponding to a kernel density estimate converges to zero for all distributions. In case of a general additive error model we show that this result even holds if only the average measurement error converges to zero. The results are applied in the context of estimation of the density of residuals in a random design regression model where the residual error is not independent from the predictor.

Partner: Prof. Luc Devroye (McGill University, Montreal)

Contact: M. Kohler.

References

[1] A.-K. Bott, L. Devroye, and M. Kohler. Estimation of a distribution from data with small measurement errors. *Electronic Journal of Statistics*, 7:2457–2476, 2013.

Project: Nonparametric recursive quantile estimation

A simulation model with outcome $Y = m(X)$ is considered, where X is an $\mathbb{R}^d$-valued random variable and $m : \mathbb{R}^d \to \mathbb{R}$ is p-times continuously differentiable. It is shown that an importance sampling Robbins-Monro type quantile estimate achieves for $0 < p \leq d$ the rate of convergence $\log^{3+p/2}(n) \cdot n^{-1/2-p/(2d)}$.

Partner: Prof. Adam Krzyżak (Concordia University, Montreal), Prof. Harrow Walk (Universität Stuttgart)

Contact: M. Kohler.

References

[1] M. Kohler, A. Krzyzak, and H. Walk. Nonparametric recursive quantile estimation. *Statistics and Probability Letters*, 93:102–107, 2014.

Project: Prediction of failure rates of electronic devices

In this project methods of nonparametric regression are used to predict failure rates of electronic devices. Time intervals are identified, where these failure rates are higher than usual, and these time intervals are used to identify those of the approximatley 300,000 electronic devices used by the Deutsche Bahn AG, which have to be checked in the near future.

Partner: Dr. Ing. Martin Brake (Department of Civil and Environmental Engineering, TU Darmstadt), Deutsche Bahn AG, Siemens AG

Contact: M. Kohler.

2 Collaborative Research Projects and Cooperations

The department is involved in a number of interdisciplinary research projects including excellence projects, collaborative research centres and priority programs. This section gives a brief overview of these activities.

2.1 Center of Smart Interfaces

The Center of Smart Interfaces (CSI) started as a Cluster of Excellence (EXC 259), funded by the German Research Foundation (DFG). The DFG funding period began in November 2008 and lasted until October 2014, having a total volume of about € 42 million. From November 2014 on, the Center of Smart Interfaces continues as one of the Research Clusters of the TU Darmstadt.

The CSI is an international center for interdisciplinary research, focusing on the scientific areas "static and dynamic wettability", "heat and mass transfer enhancement", "near wall reactive flows", "near wall multiphase flows" and "drag and circulation control" with the aim to understand and design fluid boundaries.

The CSI has 24 Principal Investigators, combining the expertise of the departments of Mechanical Engineering, Physics, Chemistry, Mathematics, and Material Sciences at the TU Darmstadt with four non-University research institutes in Darmstadt and Mainz. In addition, six research professors and three young research group leaders were newly appointed at the Cluster of Excellence.

With the four Principal Investigators Reinhard Farwig, Matthias Hieber, Jens Lang and Stefan Ulbrich and the two newly appointed professors Dieter Bothe and Jürgen Saal, the Department of Mathematics is strongly involved in the CSI. Scientifically, mathematics also plays an eminent role for the fundamental research in all of the above mentioned areas which is performed at the CSI. The involved mathematical disciplines are Mathematical Modeling, Analysis of Partial Differential Equations, Numerical Analysis, and Optimization. This enables relevant contributions to the understanding of continuum mechanical flow models via their mathematical analysis, numerical simulation and the solution of inverse problems such as the optimization concerning complex model parameters.

In 2014, Jürgen Saal obtained and accepted an offer for a full professorship at the Heinrich-Heine Universität Düsseldorf. At least partly, this offer was due to the interdisciplinary expertise which Jürgen Saal had gained during his time at the CSI - a strong proof of the success of the interdisciplinary concept.

The CSI was also involved in several activities in mathematics, the most prominent one in the report period being the co-funding and co-organization of the International Conference on Numerical Methods in Multiphase Flows (ICNMMF-II) hold in Darmstadt June 2014. This outstanding event with main speaker including H. Jasak, D. Juric, S. Popinet, A. Prosperetti, M. Shashkov, M. Sussman, S. Takagi and B. van Wachem attracted about 150 participants.

2.2 Collaborative Research Centre SFB 666

The Collaborative Research Centre SFB 666 "Integral Sheet Metal Design with Higher Order Bifurcations", established in 2005, considers the enormous prospective potential of the new linear flow splitting technique for sheet metal and develops methodical tools to integrate this technique into the product development processes. The research center is interdisciplinary, involving mechanical and civil engineers, mathematicians and material scientists. After a very successful evaluation, the collaborative research centre SFB 666 is currently in its third funding period.

The investigated technologies of the SFB, linear flow splitting and linear bend splitting, make it possible to produce branched sheet metal products in integral style. Hereby, the disadvantages of conventional procedures to create branched sheet metal structures, e.g., gluing or welding, can be avoided. The SFB is structured into the four main units of development, production, evaluation and synthesis. In each of these units, new methodologies, techniques and proceedings arise. They cope with the occurring new requirements of this product category. This interdisciplinary research environment has lead to novel product development methodologies by combining engineering expertise with mathematical modeling and optimization methods.

The Department of Mathematics participates in the SFB 666 within three sub-projects (Kohler, Pfetsch, Ulbrich). The mathematical research is concentrated on development and on evaluation. In the product development process, the aim is to provide an optimal design of the desired product as well as an optimal process control of selected forming methods. This is done by means of discrete optimization and PDE-constrained nonlinear optimization. In the evaluation process, statistical methodologies are used to provide estimates for relations between properties of the considered sheet metal part and its structural durability. Thus, a smaller number of costly and time consuming experiments have to be carried out.

2.3 Collaborative Research Centre SFB 805

The Collaborative Research Centre SFB 805 "Control of Uncertainties in Load-Carrying Structures in Mechanical Engineering" was established in January 2009. The second funding period started January 2013. Its main objective is the development of methods and techniques to control uncertainties in the development, production and usage of load-carrying structures to significantly enhance their safety, reliability and economic efficiency. While uncertainty cannot be avoided or eliminated, its influence during the product life-cycle – from material properties to production and usage – can be controlled and hence minimized. Especially in the area of light-weight construction, the trade-off between low weight and low production cost on one hand and adequate load-bearing capacity on the other hand makes the influence of uncertainties critical. Hence, the control of uncertainty is of significant importance and is therefore a focus of the research to be conducted by the SFB 805.

The control of uncertainty through the entire process chain of development, production and usage necessitates a close interdisciplinary cooperation of engineers and mathematicians. Within the collaborative research centre, the engineering sciences address uncertainty in terms of physical and technical phenomena. The mathematical research assesses the influence and effects of uncertainty and its interdependencies. It then derives optimal solution strategies for processes with minimal uncertainty and optimal design concepts for load-carrying systems from this.

The Department of Mathematics is involved in four projects of SFB 805 (Kohler, Pfetsch, Ulbrich; and Lorenz until October 2014). To deal with uncertainty, the tool of robust optimization is applied, where complex products are optimized while controlling inherent uncertainty already in the product development phase. Uncertainty may occur because of uncertain loadings, uncertain material properties or unknown user behavior. Furthermore, the SFB 805 examines the use of active elements to react on uncertainty in a load-carrying system. The question of optimal placement of active elements in the structure is a challenging nonlinear mixed-integer optimization problem. In the production process, the optimization of process chains under uncertainty is considered in order to reduce costs and uncertainty caused by uncertain market conditions. Additionally an attempt is made to control stochastic uncertainty at the planning stage of a product. Therefore, knowledge of the effects of unavoidably occurring (random) fluctuations in the production or usage are required. Based on suitable models of the underlying process, methods of nonparametric regression were and will be developed to do this in an efficient way.

2.4 Collaborative Research Centre Transregio TRR 154

The Collaborative Research Centre Transregio TRR 154 "Mathematical Modelling, Simulation and Optimization Using the Example of Gas Networks" was established in 2014. The energy transition ("Energiewende") in Germany and its success are currently in the focus of public interest. This transition is of central significance to society, politics, and science, since Germany, like many other industrial nations, finds itself in a situation of dramatically increased dependence on a reliable, secure, and affordable energy supply. At the same time, the request for clean, environment and climate-friendly energy generation is as large as never before. In order to achieve that and, in parallel, to master the nuclear power phase-out, natural gas as an energy source will play a pivotal role in the coming decades. Within this time span, a sufficient amount of natural gas will be available; it will be readily accessible, tradable, and storable. Nevertheless, the focus on an efficient natural gas supply implies a multiplicity of problems concerning gas transport and network technology as well as the consideration of market-regulatory conditions, and also the coupling with other energy sources. As an example we mention that gas carriers must provide evidence that, within given technical capacities, all contacts which come into existence on the market are physically and technically satisfiable.

The aim of the TRR 154 is to offer answers to these challenges by using methods of mathematical modelling, simulation, and optimization and in turn to provide solutions of increased quality. Novel mathematical findings are required in different areas such as mathematical modelling, numerical analysis and simulation, as well as integer, continuous, and stochastic optimization in order to achieve this aim. As examples we mention the modelling and analysis of complex networks of hyperbolic balance equations including switches and the development of a mixed-integer optimization theory together with its algorithmic realisation for such networks. Furthermore, efficient hierarchical numerical approximation techniques for the resulting algebraically coupled PDEs need to be developed and a sophisticated error control, taking the interaction with the mixed-integer optimization algorithms into account, is required.

The Department of Mathematics at TU Darmstadt is involved with Dr. Domschke and Professors Egger, Lang, Pfetsch, and Ulbrich in the collaborative research centre Transregio TRR 154. Furthermore, groups at Universität Erlangen-Nürnberg (speaker), HU Berlin, TU Berlin, Universität Duisburg-Essen, Konrad-Zuse-Zentrum für Informationstechnik Berlin (ZIB), and Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS) – Leibniz-Institut im Forschungsverbund Berlin e.V. are part of TRR 154.

The homepage of TRR 154 is `trr154.fau.de`.

2.5 Graduate School of Computational Engineering

Computational Engineering (CE) denotes computer based modeling, analysis, simulation, and optimization. It is a cost-effective, efficient and complementary approach to study engineering applications and to engineer new technical solutions when experimental investigations are too complex, risky, or costly. CE enables the creation of scalable models to support research, development, design, construction, evaluation, production, and operation of engineering applications which address key issues in future technology developments for the economy and society in areas such as energy, health, safety, and mobility. However, such engineering applications are becoming increasingly complex. Consequently, the theory and methodologies required to investigate corresponding systems become challenging.

With the Graduate School of Computational Engineering, TU Darmstadt was able to further strengthen its role in CE. The school enables highly talented PhD students to develop their scientific skills in a focused way, and to cooperate under optimal conditions in a highly stimulating interdisciplinary environment based on the interaction of Computer Science, Mathematics, and Engineering Sciences. Partnerships with well established research organizations as well as cooperation with industry increase the impact of the Graduate School. Building on the well established interdepartmental expertise at TU Darmstadt, the Graduate School focusses on the following key research areas: modeling and simulation of coupled multi-physics problems, simulation based optimization, and hierarchical multi-scale modeling and simulation. The research efforts in the above fields are accompanied by corresponding developments of methods of visualization, simulated reality, high-performance computing, verification and validation, as well as software engineering and lifecycle research. The PhD students work together within research foci comprising one or more of the above topics. The joint research on specially defined use cases will further strengthen the interdisciplinary skills and cooperation.

Six professors of the Department of Mathematics are Principal Investigators within the Graduate School Computational Engineering (Aurzada, Bothe, Egger, Lang, Pfetsch, Ulbrich) with expertise in Probability Theory and Stochastic Analysis, Mathematical Modeling and Analysis, Numerical Analysis and Scientific Computing, Numerics of Partial Differential Equations, Discrete Optimization, and Nonlinear Optimization and Optimal Control. Three more members of the department are Research Group Leaders (Erath, Schwartz, Ullmann) with scientific focus on Numerical Analysis, Discrete-Nonlinear Optimization, and Uncertainty Quantification. Together they supervise more than 10 interdisciplinary PhD projects within the Graduate School in close cooperation with a co-supervisor from Engineering or Computer Science.

2.6 Graduate School of Energy Science and Engineering

The mission of the Darmstadt Graduate School of Energy Science and Engineering is to educate tomorrow's leading Energy Engineers in a multidisciplinary field of expertise needed to identify and master the most demanding scientific, engineering, economic and social challenges in an interdisciplinary approach. The main challenge is viewed to be a continuous transition from the carbon-based, non-renewable primary energy sources of today to renewable and environmentally friendly energy resources of tomorrow.

The optimal strategy to meet this challenge is on the one hand to improve conventional energy technologies and render them progressively more efficient, to meet the ever more stringent demands on pollutant emissions, and on the other hand to simultaneously develop innovative, advanced renewable energy technologies, which must be brought to a competitive technological readiness level and provide safe, reliable and cost-effective solutions.
Two professors of the Department of Mathematics are Principal Investigators within the Graduate School Energy Science and Engineering (Lang, Ulbrich) with expertise in Numerical Analysis, Nonlinear Optimization and Optimal Control.

2.7 International Research Training Group IRTG 1529

The International Research Training Group "Mathematical Fluid Dynamics" (IRTG 1529) is funded by the German Research Foundation (DFG) and the Japan Society for the Promotion of Science (JSPS). It is associated with TU Darmstadt and with two universities located in Tokyo, Waseda University and University of Tokyo.
The research of the program focuses on analytical, numerical and stochastic aspects as well as on modeling, optimization and aerodynamics of fluid dynamics. It distinguishes itself through joint teaching and supervision. The core program consists of interdisciplinary lectures and seminars and includes research and study periods in Tokyo. Presently, there are 12 PhD students and 2 Postdocs on the Darmstadt side and a similar amount on the Japanese side.
The principal investigators in Darmstadt are Volker Betz, Dieter Bothe, Herbert Egger, Reinhard Farwig, Matthias Geissert, Matthias Hieber, Ulrich Kohlenbach, Maria Lukáčová, Cameron Tropea, Stefan Ulbrich and Martin Ziegler. The participating colleagues in Tokyo are Tadahisa Funaki, Yoshikazu Giga, Yosuke Hasegawa, Akitoshi Kawamura, Hideo Kozono, Hirofumi Notsu, Yoshihiro Shibata, Masahiro Yamamoto, Masao Yamazaki and Keita Yokoyama.
IRTG 1529 is organizing seminars, short courses, workshops and conferences on a regular basis in Darmstadt and Tokyo. The list of speakers in 2013 and 2014 includes leading experts of the field, e.g., L. Brandolese, P. Constantin, R. Danchin, G. Galdi, M. Lopes Filho, G. Karch, J. Kelliher, Y. Maekawa, S. Monniaux, Š. Nečasová, P. Mucha, J. Prüss, L. Székelyhidi, E. Titi.
Highlights of the program were altogether 8 conferences or bigger workshops in 2013 and 2014, e.g., the "International Workshops on Mathematical Fluid Dynamics" at Waseda University, Tokyo, in June and November 2013 and the "Autumn School on Mathematical Fluid Dynamics" in Bad Boll in October 2014.
The "Information Days on Mathematical Fluid Dynamics" in December 2013 were selforganized by our PhD students and attracted other PhD students to apply for a PhD position within the IRTG.
A "Winter Seminar and Klausurtagung on Fluids and Snow" took place in January 2014 in La Clusaz, France.

2.8 Priority Programme SPP 1506

The DFG priority programme 1506 "Transport Processes at Fluidic Interfaces" investigates transport processes at fluidic interfaces on a continuum mechanical level, with increasing multi-physics phenomena at the interface including transfer of mass and heat across deformable interfaces, capillary and Marangoni effects, effects of absorbed components (surfactants, colloids) as well as phase change (evaporation, condensation) phenomena. The priority programme is anchored within Applied Mathematics, but with strong interdisciplinary links to the Natural and Engineering Sciences. The above-mentioned processes are studied using complementary approaches from the research areas "Mathematical Modeling and Analysis", "Numerical methods and simulation" and "Experiments and Validation". Important goals of the Priority Programme are (i) to derive and expand mathematical models that describe relevant physico-chemical interface phenomena; (ii) to improve and deepen the understanding of mechanisms and phenomena occurring at fluidic interfaces by means of rigorous mathematical analysis of the underlying PDE-systems; (iii) the development and analysis of numerical methods for the simulation of multiphase flow problems which resolve the local processes at the interface; (iv) validation of the models and the numerical simulation methods by means of specifically designed experiments. The SPP1506 is coordinated by Dieter Bothe and Arnold Reusken (RWTH Aachen). It started in 2010 and runs until 2016, comprising 26 projects in the current second funding phase. Besides several summer schools, workshops etc., the Priority Programme supported and co-organized the International Conference on Numerical Methods in Multiphase Flows (ICNMMF-II), held in Darmstadt June 2014. This outstanding event with main speaker including H. Jasak, D. Juric, S. Popinet, A. Prosperetti, M. Shashkov, M. Sussman, S. Takagi and B. van Wachem attracted about 150 participants.

2.9 LOEWE Centre AdRIA

The LOEWE Centre "AdRIA: Adaptronics: Research, Innovation, Application" was established in 2008 and is funded with an amount of 34 million Euro for 6 years by the State of Hesse within the research support program LOEWE-Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz. It is an interdisciplinary collaboration of Fraunhofer LBF, TU Darmstadt and Hochschule Darmstadt.

The aim of the LOEWE Centre AdRIA is the scientific and technological study of adaptronic systems in order to ensure a systematic and holistic development of advanced adaptronic products. A particular emphasis is the development of light weight structures based on adaptronic systems with improved energy efficiency, functionality and performance. The LOEWE Centre AdRIA is structured into several technology areas in order to advance basic research as well as three exemplary technological demonstrator applications.

The Department of Mathematics participates in the LOEWE Centre AdRIA within the technology area "Simulation Tools" (Ulbrich) and contributes to the development of optimization methods for adaptronic systems, in particular the optimal placement and control of sensors, actuators and active absorbers.

2.10 LOEWE Research Priority Program Cocoon

The LOEWE Priority Program "Cooperative sensor communication (Cocoon)" was established in January 2011 and is funded with an amount of 4.5 million Euro for 3 years by the State of Hesse. The grant was secured within the frame of the third round of the research support program LOEWE-Landes-Offensive zur Entwicklung Wissenschaftlich-ökonomischer Exzellenz.

Research in the field of wireless sensor communication will enable us to make an essential contribution to the improvement of our daily life. Sensors we consider in our research include environmental sensors, mobile phones, PDAs, navigation equipment, car keys, electronic purses or pulse rate measurement devices. New diverse applications, which can be integrated into the context of a smart city, will arise. This concept requires an intelligent environment in which daily life supporting services are ubiquitous.
The Department of Mathematics participates in the LOEWE Priority Program within a sub-project (Ulbrich). The mathematical research considers the development of efficient discrete-continuous optimization methods for the optimal design of wireless communication networks, which leads to challenging nonconvex mixed-integer polynomial optimization problems.

2.11 Research Unit Symmetry, Geometry, and Arithmetic

The DFG Research Unit 1920 "Symmetry, Geometry and Arithmetic" examines current issues in modern arithmetic. An important and key theme is the investigation of absolute Galois groups and their generalisations. These elegantly code arithmetic information which can be extracted through the study of these groups and their representations. The researchers, who are based in Heidelberg and Darmstadt, are hoping that by dovetailing motivic homotopy theory, deformation theory, Iwasawa theory, the theory of automorphic forms and L-functions, they will be able to draw interesting conclusions from new insight into one of these areas which they can apply to the others, in a contemporary vision and modern understanding of basic mathematical research.
As a principal investigator Jan Bruinier is part of this research unit with a project centered around special cycles on the moduli space of abelian surfaces and their connections with L-functions. The spokesperson is Alexander Schmidt from the Universität Heidelberg.

2.12 Scientific and Industrial Cooperations

In the following we list all scientific and industrial projects by names of the researcher of our department in alphabetic order, by names of partners in universities and industry, and the title of the project.

Hans-Dieter Alber

– B. Markert (Universität Stuttgart), R. Müller (Universität Kaiserslautern): Analytical and numerical comparison of a hybrid phase field model for phase transitions and damage with the Allen-Cahn model.

– A. Böttcher (TU Darmstadt): Solution of the hybrid phase field model with finite elements.

– Peicheng Zhu (Basque Center of Applied Mathematics, Bilbao): Existence theory for phase field models.

Frank Aurzada

– Prof. Dr. S. Dereich (Universität Münster), Prof. Dr. M. Lifshits (St. Petersburg): Persistence probabilities for Gaussian processes.

- Prof. Dr. A. Iksanov (University of Kiev): First passage times of Lévy processes.
- Prof. Dr. N. Guillotin-Plantard (University of Lyon): Persistence probabilities and exponential functionals.
- Prof. Dr. M. Savov (University of Reading): Small deviations for stochastic processes, First passage times of Lévy processes with moving boundaries.
- Prof. Dr. L. Döring (Universität Zürich), Prof. Dr. F. Gao (Idaho), Prof. Dr. Wenbo Li (Delaware), Prof. Dr. Qi-Man Shao (Hong Kong), Prof. Dr. T. Kühn (Leipzig): Small deviations for stochastic processes.
- Prof. Dr. T. Simon (University of Lille 1): Persistence probabilities.
- Prof. Dr. M. Reisslein, Dr. X. Wei, Dr. R.T. Tyagi (Arizona State University), Prof. Dr. M.P. McGarry (University of Texas), Sang Kim, Ki-Dong Lee (LG Electronics, San Diego, CA): Analysis of wireless telecommunication networks (LTE).
- Prof. Dr. M. Maier (INRS Montréal), Géza Joos (McGill University Montréal): Analysis of fiber optical telecommunication networks.

Volker Betz

- Dr. Daniel Ueltschi (University of Warwick): Spatial random permutations and Bose-Einstein condensation.
- Prof. George Hagedorn (Virginia Tech): Nonadiabatic Transition through Born-Oppenheimer surfaces.
- Prof. Tadahisa Funaki (University of Tokyo): Interacting Brownian motions and motion by mean curvature.
- Prof. Erwin Bolthausen (Universität Zürich): Enhanced binding via path integrals.
- Prof. Vincent Beffara (University of Marseille): Cardys formula for spatial random permutations.
- Prof. Peter Moerters (University of Bath) and Prof. Steffen Dereich (Universität Münster): Universal shape of condensing waves.

Dieter Bothe

- Prof. Dr. W. Dreyer (WIAS Berlin): Thermodynamically consistent modeling of chemically reacting multicomponent fluid systems.
- Prof. Dr. H. Jasak (Imperial College London and University Zagreb): Extension of coupled methods for interfacial and two-phase flows with OpenFOAM.
- Prof. Dr. J. Málek (Charles University Prague): Mathematical modeling and analysis of heterogeneous catalysis problems.
- Prof. Dr. M. Pierre (ENS Rennes): Global existence for reaction-advection-diffusion systems.

- Prof. Dr. J. Saal (Universität Düsseldorf): Electromigration in reaction-diffusion systems.
- Dr.-Ing. C. Kunkelmann (BASF Ludwigshafen): Development of stable flow solvers for viscoelastic fluids with OpenFOAM.

Regina Bruder

- Ministry of Education Hessen, Rheinland-Pfalz, Niedersachsen and Brandenburg: Development of concepts for further teacher training. Projects MAKOS, HEMAS and LEMAMOP.
- KOM - Multimedia Communications Lab, Dr. Göbel: game-based learning.
- Prof. Koepf (Universität Kassel): (Project VEMINT) Development of bridge courses in mathematics.
- Prof. Anne Prescott (University of Technology Sydney): Development of competencies in the inservice training of Math-teachers and measurement of competencies.
- Prof. Dr. Gilbert Greefrath (Universität Münster) and Prof. Dr. Guido Pinkernell (Pädagogische Hochschule Heidelberg): Definition of basic knowledge on secondary level.
- Ministry of Education, Vienna, Austria: bifie: project for modelling competencies for the examination MATURA.

Jan H. Bruinier

- Prof. Dr. B. Howard (Boston College) and Prof. Dr. T. Yang (University of Wisconsin at Madison): Arithmetic intersection theory on Shimura varieties.
- Prof. Dr. J. Funke (University of Durham) and Prof. Dr. Ö. Imamoğlu (ETH Zürich): Regularized theta liftings and periods of modular functions.
- Prof. Dr. E. Freitag (Universität Heidelberg): Automorphic products.
- Prof. Dr. S. Kudla (University of Toronto): Regularized theta liftings for symplectic groups.
- Dr. M. Westerholt-Raum (MPI Bonn): Formal Fourier-Jacobi series.

Pia Domschke

- Prof. Dr. O. Kolb (Universität Mannheim): Adjoint-Based Error Control for the Simulation and Optimization of Gas and Water Supply Networks.
- Dr. A. Gerisch (TU Darmstadt), Prof. Dr. M. A. J. Chaplain (University of Dundee, Scotland), Dr. D. Trucu (University of Dundee, Scotland): Mathematical Modelling of Cancer Invasion.

Herbert Egger

- Prof. Dr. A. Düster (TU Hamburg-Harburg): Domain Decomposition Solvers for the Finite Cell Method.
- Prof. Dr. P. Egger, M. Kesina (ETH Zürich): Efficient Gibbs Sampling for Spatial Probit Models.
- Dr. S. M. Schnepp (ETH Zürich), Prof. I. Tsukerman (Akron, US), F. Kretzschmar (TU Darmstadt): Discontinuous Galerkin Methods for Maxwell's Equations.
- Dr. M. Schlottbom (Universität Münster), Dr. J.-F. Pietschmann (TU Darmstadt): Identification of Chemotaxis Models with Volume Filling.
- Dr. M. Schlottbom (Universität Münster): Explicit Time Stepping Methods for Radiative Transfer.
- Prof. S. Arridge (UCL London), M. Schlottbom (TU Darmstadt): Fast Solvers for Optical Tomography.
- Prof. Dr. B. Wohlmuth (TU München), Prof. Dr. U. Rüde (Universität Erlangen-Nürnberg): Finite Element Methods for Corner Singularities.
- Yuki Kaneko (Waseda University Tokyo), J.-F Pietschmann (TU Darmstadt): Inverse Free Boundary Value Problems.
- Prof. K. Fellner, Bao Q. Tang (KFU Graz): Finite Element Methods for Surface-Volume Reaction-Diffusion Systems.

Christoph Erath

- Dr. Mark A. Taylor (Sandia National Laboratories, Albuquerque, NM, USA) and Ramachandran Nair (NCAR, CO, USA): Semi-Lagrangian scheme for the spectral element dynamical core.
- Prof. Dr. Ilaria Perugia (Universität Wien), Prof. Dr. Jens Markus Melenk and Prof. Dr. Dirk Praetorius (TU Wien): Coupling Discontinuous Galerkin Methods with Boundary Element Methods for the Helmholtz equation.
- Prof. Dr. Dirk Praetorius (TU Wien): Convergence of some adaptive finite volume methods.
- Dr. Günther Of (TU Graz): Non-symmetric coupling of finite volume methods and boundary element methods.

Sofia Eriksson

- Prof. Jan Nordström (Linköping, Sweden): Non-reflecting boundary conditions for finite difference methods.

Reinhard Farwig

- Prof. Dr. Y. Giga (Tokyo University): Quasi-optimal Initial Values for the Navier-Stokes System.
- Prof. Dr. H. Kozono (Waseda University, Tokyo) and D. Wegmann: Decay of Nonstationary Navier-Stokes Flow with Nonzero Dirichlet Boundary Data.
- Prof. Dr. M. Yamazaki (Waseda University, Tokyo): Boussinesq Equations in Exterior Domains.
- Prof. Dr. T. Hishida (Nagoya University): Asymptotic Theory for Stationary Navier-Stokes Equations.
- Dr. T. Nakatsuka (Nagoya University): Uniqueness of Almost Periodic Solutions to the Navier-Stokes System.
- Prof. Dr. Y. Taniuchi (Shinshu University, Matsumoto): Uniqueness of Solutions with Precompact Range.
- Prof. Dr. Y. Taniuchi (Shinshu University, Matsumoto): Existence of Solutions with Precompact Range.
- Prof. Dr. H.-O. Bae (Ajou University, Suwon, South Korea): Asymptotic Decay for the Fractional Navier-Stokes Equations.
- Prof. Dr. H. Sohr (Universität Paderborn): Regularity Theory for Weak and Very Weak Solutions to the Navier-Stokes System in Besov Spaces.
- Prof. Dr. Š. Nečasová (Academy of Sciences, Prague): Fundamental Solutions of Fluid Flow past a Moving Obstacle.
- Paul Felix Riechwald: Very Weak Solutions of the Navier-Stokes System in Unbounded Domains.
- Veronika Rosteck: Analytic Semigroup Theory for the Navier-Stokes System in Unbounded Domains with Navier Slip Boundary Condition.

Tobias Fischer

- Group of Prof. Dr. Anja Klein (TU Darmstadt): Multihop Wireless Networks.

Alf Gerisch

- Prof. Dr. M. A. J. Chaplain (University of Dundee, Scotland), Dr. D. Trucu (University of Dundee, Scotland), Dr. P. Domschke (TU Darmstadt): Mathematical Modelling of Cancer Invasion.
- Prof. Dr. K. Raum (Charité Universitätsmedizin Berlin), Prof. Dr. Q. Grimal (Biomedical Imaging Lab (LIB), UPMC Paris, France), Dr. R. Penta (TU Darmstadt): Multiscale structure-functional modelling of musculoskeletal mineralized tissues.

- Prof. Dr. J. Lang (TU Darmstadt), D. Schröder (TU Darmstadt), Prof. Dr. R. Weiner (Universität Halle-Wittenberg), Dr. H. Podhaisky (Universität Halle-Wittenberg): PEER methods and their application in the Finite Element system KARDOS.
- Prof. Dr. J. Lang (TU Darmstadt), Prof. Dr. F. Müller-Plathe (TU Darmstadt), Prof. Dr. M. Böhm (TU Darmstadt): Uncertainty quantification in multiscale models of soft matter systems.

Karsten Grosse-Brauckmann

- Prof. Dr. John Sullivan (TU Berlin): Constant mean curvature surfaces.
- Prof. Dr. Robert Kusner (University of Massachusetts at Amherst): Constant mean curvature surfaces.
- Prof. Dr. Steffen Fröhlich (Universität Mainz): Constant mean curvature surfaces.
- Prof. Dr. Gerd Schröder-Turk (Universität Erlangen-Nürnberg): Periodic surfaces and interfaces.

Philipp Habegger

- Robert Grizzard (University of Texas at Austin), Lukas Pottmeyer (TU Darmstadt): Small Points and Free Abelian Groups.
- Suion Ih (University of Colorado Boulder): Integral Points in Divisible Groups.
- Gareth Jones (University of Manchester), David Masser (Universität Basel): Effectivity and Unlikely Intersections.
- Martin Möller (Universität Frankfurt), Matt Bainbridge (Indiana University): Algebraically Primitive Teichmüller Curves of Genus 3.
- Fabien Pazuki (Université Bordeaux I): Curves of Genus 2 with Complex multiplication and bad reduction.
- Jonathan Pila (University of Oxford): O-minimality and Unlikely Intersections.

Robert Haller-Dintelmann

- Joachim Rehberg (WIAS Berlin): Hardy's inequality for mixed boundary conditions.
- Felix Ali Mehmeti and Virginie Régnier (University of Valenciennes, France): The Klein-Gordon equations on a star-shaped network.
- Russell Brown (University of Kentucky, Lexington, KY, USA): The Jones extension operator for mixed boundary conditions.

Imke Joormann

- Group of Dr. René Henrion, WIAS Berlin: Gas Transport Optimization.
- Group of Dr. Thorsten Koch (Zuse-Institut Berlin): Gas Transport Optimization.

- Group of Prof. Dr. Alexander Martin (Universität Erlangen-Nürnberg): Gas Transport Optimization.
- Group of Prof. Dr. Werner Römisch (HU Berlin): Gas Transport Optimization.
- Group of Prof. Dr. Rüdiger Schultz (Universität Duisburg-Essen): Gas Transport Optimization.
- Group of Prof. Dr. Marc Steinbach (Universität Hannover): Gas Transport Optimization.
- German Federal Network Agency (Bundesnetzagentur): Project "Technical Capacities of Gas Networks".
- Open Grid Europe GmbH, formerly E.ON Gastransport GmbH: Project FORNE.

Michael Kohler

- Prof. Dr. Luc Devroye (McGill University Montreal): Estimation of a distribution from data with small measurement errors.
- Prof. Dr. Adam Krzyżak (Concordia University Montreal): Optimal global rates of convergence for interpolation problems with random design.
- Prof. Dr. Harro Walk (Universität Stuttgart): Nonparametric recursive quantile estimation.
- SFB 666 (TU Darmstadt): Estimation of the random behavior of fatigue parameters.
- SFB 805 (TU Darmstadt): Efficient estimation of uncertainty in a simulation model.

Burkhard Kümmerer

- Dr. G. Giedke (MPI Garching): Entanglement.
- Prof. Dr. R. Gohm (Aberystwyth): Quantum System Theory.
- Dr. C. Koestler (Cork): Quantum System Theory.
- Prof. Dr. H. Maassen (Nijmegen): Quantum Probability.
- Prof. Dr. R. Kaenders (Köln): Understanding of Mathematics.
- Prof. Dr. U. Kirchgraber (ETH Zürich): Understanding of Mathematics.

Jens Lang

- Prof. Dr. Willem Hundsdorfer (CWI, Amsterdam, The Netherlands): IMEX-PEER Methods.
- Prof. Dr. Weizhang Huang (University of Kansas, USA), Lennard Kamenski (WIAS Berlin): Anisotropic mesh methods.
- Jun.-Prof. Dr. Oliver Kolb (Universität Mannheim): Simulation and optimization of gas and water networks.

– Prof. Dr. Rüdiger Weiner (Universität Halle-Wittenberg): Linearly implicit time integrators.

– Bodo Erdmann (ZIB, Berlin): Kardos programming.

– Prof. Dr. Jochen Fröhlich (TU Dresden): Large Eddy Simulation with Adaptive Moving Meshes, Supported by DFG SPP 1276 MetStröm, 2007-2014.

Matthias Meiners

– Prof. Dr. Frank Aurzada (TU Darmstadt): Exponential moments of first exit times and related quantities for Lévy processes.

– Prof. Dr. Nina Gantert (TU München): Einstein relation and regularity of speed of biased random walk in a one-dimensional percolation model.

– Prof. Dr. Alexander Iksanov (Taras Shevchenko National University of Kyiv): Random processes with immigration at the epochs of a renewal process.

– Dr. Alexander Marynych (Taras Shevchenko National University of Kyiv): Random processes with immigration at the epochs of a renewal process.

– Dr. Sebastian Mentemeier (TU Dortmund): Solutions to complex smoothing equations.

– Dr. Sebastian Müller (LATP Marseille): Einstein relation and regularity of speed of biased random walk in a one-dimensional percolation model.

Hannes Meinlschmidt

– Prof. Christian Meyer (TU Dortmund): Optimal control of the thermistor problem.

– Dr. Joachim Rehberg (WIAS Berlin): Optimal control of the thermistor problem.

– Dr. Joachim Rehberg (WIAS Berlin): Hölder-estimates for non-autonomous parabolic problems with rough data.

Christian Mönch

– Prof. Dr. S. Dereich (Universität Münster), Prof. Dr. Peter Mörters (University of Bath): Distances in complex random networks.

Martin Otto

– Prof. Dr. Martin Grohe (RWTH Aachen): Linear programming, Ehrenfeucht–Fraïssé games and graph isomorphism.

Andreas Paffenholz

– PD Dr. Barbara Baumeister (Universität Bielefeld): Permutation Polytopes.

– Prof. Sandra Di Rocco (KTH Stockholm): Polyhedral Adjunction Theory.

- Prof. Dr. Christian Haase (FU Berlin): Permutation, Cut, and Marginal Polytopes; Polyhedral Adjunction Theory; Unimodular Triangulations.
- Prof. Dr. Benjamin Nill (University of Stockholm): Polyhedral Adjunction Theory.
- Prof. Francisco Santos (University of Cantabria): Unimodular Triangulations.
- Hung P. Tong-Viet (University of Pretoria): Permutation Polytopes.
- Priority Program 1489 (DFG) "Algorithmic and Experimental Methods in Geometry, Algebra, and Number Theory": Speaker: Prof. Dr. Wolfram Decker.

Marc Pfetsch

- Group of Dr. René Henrion, WIAS Berlin: Gas Transport Optimization.
- Group of Dr. Thorsten Koch (Zuse-Institut Berlin): Gas Transport Optimization.
- Prof. Dr. Dirk Lorenz (TU Braunschweig): Compressed Sensing.
- Group of Prof. Dr. Alexander Martin (Universität Erlangen-Nürnberg): Gas Transport Optimization.
- Prof. Dr. Sebastian Pokutta (Georgia Institute of Technology, Atlanta, USA): Augmentation methods for integer programs.
- Prof. Dr. Marius Pesavento (TU Darmstadt): Mixed-integer programs in signal processing.
- Group of Prof. Dr. Werner Römisch (HU Berlin): Gas Transport Optimization.
- Group of Prof. Dr. Rüdiger Schultz (Universität Duisburg-Essen): Gas Transport Optimization.
- Group of Prof. Dr. Marc Steinbach (Universität Hannover): Gas Transport Optimization.
- German Federal Network Agency (Bundesnetzagentur): Project "Technical Capacities of Gas Networks".
- Open Grid Europe (OGE): Project FORNE.

Jan-Frederik Pietschmann

- Group of Prof. Dr. Martin Burger (WWU Münster): Crowded Transport.
- Group of Prof. Dr. Zuzanna Siwy (UC Irvine): Simulation of Nanopores.

Anna-Maria von Pippich

- Dr. G. Freixas (CNRS Paris): Arithmetic Riemann–Roch theorem for singular metrics.
- Prof. Dr. Ö. Imamoğlu (ETH Zürich) and Prof. Dr. Á. Tóth (Eötvös Loránd University): Jensen's formula in higher dimensions.

- Prof. Dr. J. Jorgenson (City College, New York) and Prof. Dr. L. Smajlović (University of Sarajevo): Wave representation of Eisenstein series.
- Prof. Dr. J. Kramer (HU Berlin): Regularized determinants for conical singularities.

Steffen Roch

- Prof. Dr. Bernd Silbermann (TU Chemnitz): Operator theory and numerical analysis.
- Prof. Dr. Marko Lindner (TU Hamburg-Harburg): Spectral theory of band operators.
- Prof. Dr. Vladimir S. Rabinovich (IPN Mexico City): Limit operators and their applications to the spectral theory of PDE.
- Prof. Dr. Pedro A. dos Santos (IST Lisbon): Numerical analysis for convolution-type operators.
- Prof. Dr. Torsten Ehrhardt (UC Santa Cruz): Szegő limit theorems.

Saal, Martin

- Prof. Dr. J.E. Muñoz Rivera (Federal University of Rio de Janeiro/LNCC): Uniform stability and the lack of exponential stability in a class of transmission problems.
- Prof. Dr. O. Vera Villagrán (University of Bío-Bío) and Dr. M. Alves (Federal University of Viçosa): Thermoelasticity with second sound.

Jonas Sauer

- Prof. Dr. Yoshikazu Giga (The University of Tokyo) and MSc. Katharina Schade (TU Darmstadt): Strong Stability of 2D Viscoelastic Poiseuille-Type Flows.

Katharina Schade

- Prof. Dr. J. Prüss (Martin-Luther-Universität, Halle-Wittenberg): Dynamics of Nematic Liquid Crystals: The Quasilinear Approach.
- Prof. Dr. Y. Shibata (Waseda University): On strong dynamics of compressible nematic liquid crystals.
- Prof. Dr. Y. Giga (The University of Tokyo), Dr. Ken Abe (University of Nagoya) and MSc. T. Suzuki (The University of Tokyo): On the Stokes semigroup in some non-Helmholtz domain.
- Prof. Dr. Y. Giga (The University of Tokyo), Dr. Ken Abe (University of Nagoya) and MSc. T. Suzuki (The University of Tokyo): On the Stokes resolvent estimate for domains with finitely many outlets.
- Prof. Dr. Y. Giga (The University of Tokyo) and MSc. Jonas Sauer (TU Darmstadt): Strong Stability of 2D Viscoelastic Poiseuille-Type Flows.

Nils Scheithauer

- Prof. Dr. R. E. Borcherds (UC Berkeley): Automorphic forms and vertex algebras.
- J. van Ekeren, PhD (IMPA): Vertex algebras.
- Prof. Dr. E. Freitag (Universität Heidelberg): Automorphic forms.
- Prof. Dr. G. Höhn (Kansas State University): Vertex algebras and Lie algebras.
- Prof. Dr. H. Shimakura (Tohoku University): Vertex algebras.

Matthias Schlottbom

- Prof. S. Arridge (UCL London), Prof. Dr. H. Egger (TU Darmstadt): Fast Solvers for Optical Tomography.
- Prof. M. Frank (RWTH Aachen), Prof. M. Herty (RWTH Aachen): Reduced Models in Radiotherapy.
- Prof. M. Burger (WWU Münster), O.L. Elvetun (Norwegian University of Life Sciences): Diffuse Domain Methods for Heart Imaging.

Alexandra Schwartz

- Group of Prof. Dr. Wolfgang Leininger (TU Dortmund): Optimal Design of Contests.
- Prof. Oleg Burdakov, Ph.D. (Linköping University, Sweden): Reformulation and Numerical Methods for Cardinality Constraints and Sparse Optimization.
- Michal Červinka, Ph.D. (Czech Academy of Sciences and Charles University, Prague): Optimality Conditions and Stability of Reformulated Cardinality Constraints.
- Prof. Dr. Christian Kanzow (JMU Würzburg): Complementarity-type Reformulation of Cardinality Constraints and Sparse Optimization Problems.

Andreas Tillmann

- Yonina Eldar (Technion, Israel), Julien Mairal (INRIA, France): Dictionary Learning for Phase Retrieval.
- Dirk Lorenz, Christoph Brauer (TU Braunschweig): Heuristic Optimality Checks for ℓ_1-Minimization.
- Rémi Gribonval (INRIA, France), Marc Pfetsch (TU Darmstadt): Complexity of Cosparse Projection.
- Dirk Lorenz, Christian Kruschel (TU Braunschweig), Marc Pfetsch (TU Darmstadt): SPEAR project.

Stefan Ulbrich

- Group of Prof. Dr. Michael Hintermüller (HU Berlin): Gas Transport Optimization.

- Group of Prof. Dr. Günter Leugering (Universität Erlangen-Nürnberg): Gas Transport Optimization.
- Group of Prof. Dr. Alexander Martin (Universität Erlangen-Nürnberg): Gas Transport Optimization.
- Prof. Dr. Marius Pesavento (TU Darmstadt): Mixed-integer programs in communication systems.
- Prof. Dr. Matthias Heinkenschloss (Rice University, Houston): PDE-Constrained Optimization, Model Reduction.
- Dr. Anton Schiela (TU Berlin): Preconditioning Techniques for PDE-Constrained Optimization.
- Prof. Dr. Michael Ulbrich (TU München): Multilevel Methods for PDE-constrained Optimization.

Mirjam Walloth

- Prof. Dr. R. Krause (USI Lugano, Switzerland): Adaptive finite element discretization methods for the numerical simulation of static and dynamic contact problems.
- Prof. Dr. A. Veeser (University of Milan, Italy): Adaptive finite element discretization methods for the numerical simulation of static and dynamic contact problems.

Martin Ziegler

- Dr. Arno Pauly (Cambridge): Descriptive Complexity in Fragments of Dependence Logic with Applications to Computable Real Multivalued Functions.
- Prof. Dr. Akitoshi Kawamura (The University of Tokyo): Quantitative Theory and Practice of Exact Real Computation.
- Apl. Prof. Dr. Norbert Müller (Universität Trier): Quantitative Theory and Practice of Exact Real Computation.
- Prof. Dr. Ning Zhong (University of Cincinnati): Computability and Complexity Theory of Partial Differential Equations.

3 Teaching

Teaching of Mathematics in our department can be divided into three categories: teaching in mathematical degree programmes, specific teaching activities for future mathematics teachers (in secondary education), and teaching mathematics to students in the sciences and engineering subjects (often described as 'service teaching'). Each of these teaching activities has its own characteristics in terms of mathematical content and style as well as in terms of specific regulations of corresponding degree schemes.

3.1 Degree Programmes in Mathematics

There are currently three mathematics programmes: the Diplom programme in mathematics (being discontinued), the Bachelor's programme in mathematics (since 2007) and the Master's programme in mathematics (since 2005). The current Bachelor's programme incorporates the old Bachelor's programme "Mathematics with Computer Science". The following table shows the enrollment numbers over the last 8 years:

Students in Mathematics programmes

Programme	2007	2008	2009	2010	2011	2012	2013	2014
Diplom	571	443	341	260	151	88	58	35
Bachelor (incl. MCS)	264	363	502	624	674	629	646	580
Master	16	25	41	68	141	189	224	276
Teacher (secondary)	267	297	363	410	417	398	380	351
Teacher (vocational)	21	21	38	49	47	42	41	23

The sum total of the student numbers in our Diplom, Bachelor's and Master's programmes remains roughly at the same level over the years, but there are some special circumstances, that call for an explanation. Among these are the abolishment of student fees ("Studienguthabengesetz") with the beginning of the academic year 2008/09, the nearly two-fold increase in students finishing school in Bavaria (2011) and Baden-Württemberg (2012) caused by the transition from 13 to 12 school years, the last conscription calls in Germany in 2011, and the introduction of an aptitude test ("Eignungsfeststellungsverfahren") for our Bachelor's and Teacher programmes from the academic year 2011/12. In 2012, it was also decided to discontinue enrollment of beginners in the summer semester, and as of the summer of 2013 we do not offer enrollment for beginners in our Bachelor's programme in a summer semester.

New enrollments

Programme	2007	2008	2009	2010	2011	2012	2013	2014
Diplom	75							
Bachelor	114	167	235	277	275	173	177	150
Master	11	18	22	36	58	68	73	94
Teacher (secondary)	80	80	104	116	72	56	54	40
Teacher (vocational)	12	7	21	22	15	13	8	2

Looking at the number of students who turned up for their courses, it seems that the introduction of the aptitude test has a stronger effect on our Teacher's programme than on our Bachelor's programmes. We suspect that in both tracks it largely discourages some of the less motivated students from applying, and especially those who might not have the intention to pursue university studies seriously.

With the start of the Master's programme in mathematics, accredited and started in the year 2005, and with the Bachelor's programme in mathematics, accredited and started in the year 2007, the department completed the implementation of the Bologna Accord. The new programme structure replaces the Diplom programme and incorporates the previous Bachelor's programme "Mathematics with Computer Science". With the academic year 2011/12, the study regulations for the Bachelor's and Master's programmes were modified, and the corresponding accreditations were successfully renewed until September 30, 2017. Due to the interdependencies between our Bachelor's programme and our Teacher's programme, also the study regulations for the latter had to be revised (with effect from the academic year 2012/13).

The main aspects in the design of the current programme structure could be described as both modern and conservative at the same time. A more detailed look at both programmes resolves this apparent contradiction. They combine proven and tested components of the Diplom programme with new aspects such as modularization and a credit point system. The new programme retains the idea that mathematics should be studied together with a minor, which is typically a subject in which mathematics is applied. The standard choice of a minor can be one of computer science, economics, physics and chemistry, and further subjects are available upon application. If students choose the option "Mathematics with Economics" (available both for Bachelor and Master), their minor is a combination of economics and computer science.

The Bachelor's programme has a duration of six semesters and finishes with a Bachelor thesis on a mathematical topic. A unique feature of our Bachelor's programme are the optional bilingual courses. Both options "Mathematics" (with arbitrary minor) and "Mathematics with Economics" can be studied as a bilingual programme since 2009. According to a survey during the orientation week in the winter semester 2014/15, about 43 % of the 127 Bachelors students interviewed expressed the objective of obtaining the bilingual certificate.

Graduates of the Bachelor's programme have the option of taking up a job or continuing their studies in a Master's programme. This can be the Master's programme at our department, at a different university or even a Master's programme in a different area based on their education in mathematics.

Our Master's programme has a duration of four semesters. It is centred on two in-depth specializations or focus areas within mathematics or, alternatively, one focus area in mathematics and one in a cognate subject in which mathematics is applied (such as computer science, economics, physics or chemistry). The mathematical specializations (Vertiefungsrichtungen) are offered by the research groups in the department. Beside the two focus areas (at 18 CP each), there is room for additional courses in mathematics, minors and general studies. The topic of the Master's thesis is selected in one of the two focus areas; in the case of a combination with an extra-mathematical focus area, the topic of the Master's thesis may be chosen from that other subject but has to be related to mathematics.

Graduates of the Bachelor's programme (incl. MCS)

Programme	2010	2011	2012	2013	2014
Total	51	59	80	87	83
Female students	14	31	24	29	27
Graduation within 3 years	34	37	33	48	29
Graduation within 4 years	41	54	71	71	71

Graduates of the Master's programme

Programme	2010	2011	2012	2013	2014
Total	4	9	27	46	37
Female students	3	4	5	19	12
Graduation within 2 years	1	2	18	23	16
Graduation within 3 years	3	6	22	40	31

Graduates in Education for Secondary Schools

Programme	2010	2011	2012	2013	2014
Total	13	16	6	10	tba
Female students	6	14	4	5	tba
Graduation within 9 semesters	2	1	0	0	tba
Graduation within 11 semesters	5	10	2	2	tba

Graduates in Education for Vocational Colleges

Programme	2010	2011	2012	2013	2014
Total	7	10	11	6	6
Female students	0	4	5	2	3
Graduation within 4 semesters	3	6	7	0	1
Graduation within 6 semesters	6	10	10	5	3

International exchange

Many students choose to study for a year at a university abroad, typically in their third year. The department provides general information (online and through an annual information event) as well as individual advice for students who plan a year abroad and also maintains contacts with various popular destinations abroad. Students who return from a year abroad are encouraged to share their experiences through short summaries with informal advice on the departmental web pages. Close cooperation between the students and the department ensures that students can transfer their credits from abroad into their study programme in Darmstadt. This helps to avoid negative effects on the overall duration of studies.

Academic year	06/07	07/08	08/09	09/10	10/11	11/12	12/13	13/14
Erasmus places	30	35	35	36	38	49	56	52
Erasmus outgoers	14	14	15	12	11	20	15	11
Further outgoers	16	11	13	9	8	13	9	7
Incomers	8	3	4	3	2	5	8	3

3.2 Teaching for Other Departments

Students in almost all study programmes of this university have to take at least one course in mathematics. The department teaches students in the engineering sciences (mechanical, electrical, civil engineering, material sciences), in computer science, the natural sciences (chemistry, physics, biology, geology), economics, the liberal arts, social sciences and in architecture.

Service teaching comprises courses of a variety of different formats. There are large lecture courses providing a solid foundation in mathematics covering subjects such as basic analysis (calculus), differential equations, numerical methods and stochastics. For instance, there is a four semester cycle for students of Electrical Engineering, with four hours of lectures and two hours of exercise groups per week. There are also smaller courses, concentrating on special areas in mathematics used in particular disciplines, as, for instance, our one-semester statistics courses for students in Biology or the social sciences. In an innovative format (Team Teaching), the course "Mathematik für Chemiker" is taught jointly by a mathematician and a chemist.

Service courses, no. participants, winter semester 2014/15

(Source: TUCaN, 02.04.2015)	
Darstellende Geometrie	331
Höhere Mathematik I	159
Mathematik I für Bauwesen	859
Mathematik I für Elektrotechnik	654
Mathematik I für Informatik	1052
Mathematik I für Maschinenbau	815
Mathematik III für Bauwesen	676
Mathematik III für Elektrotechnik	474
Mathematik III für Maschinenbau	773
Mathematik für Chemiker	180
Mathematik und Statistik für Biologie	168
Statistik I für Human- und Sozialwissenschaft	232
Statistik I für Wirtschaftsingenieurwesen	454

It is one of the principles of this university that the Department of Mathematics is responsible for the teaching of mathematics across all subjects that require mathematics in their education. The importance of this aspect of our teaching activities is also borne out in the university's KIVA initiative, which among other aspects emphasises the critical role of mathematics education in the early phases of university studies in the sciences and engineering disciplines. Among our efforts to strengthen the basis for this mathematical education, the department has set up optional extra learning platforms under the name of "Treffpunkte Mathematik", which serve to give extra support to students in the large mainstream mathematics lecture courses. One of the guiding ideas in these activities is the attempt to provide auxiliary training and to improve the motivation of students from those other subjects through problems that relate mathematics better with themes from the own subjects. Participation and student evaluations show, that this approach is a success.

3.3 Characteristics in Teaching

As in previous years, the efforts of the Department of Mathematics were rewarded in the "CHE-Hochschul Ranking Mathematik". According to the results published in April 2012, the Department of Mathematics again holds one of the top positions among all universities in Germany, with excellent grades especially for "IT infrastructure" (1.6), "scientific publications" (1.7) and "research funding". Good grades were also obtained for "mentoring by the lecturers" (1.9) and "overall course situation" (2.0). This success also reflects the emphasis on teaching methods at the Department of Mathematics. Our aim in teaching is to encourage and motivate students to actively pursue the understanding of the taught material. The learning of mathematics is an intellectual activity equally supported by classroom teaching, by individual work and study, and by teamwork, both with and without direct supervision.

Lectures present mathematical content and methods through personal presentation; the systematic development and exposition of the material in the lectures is intended to stimulate the students' mathematical intuition. Lectures are complemented by exercise groups, and by additional tutorials during the first year. The time ratio between classroom lectures and exercises is 2:1.

In exercise classes, students work on problems and topics from the lecture with the support of a tutor and they are encouraged to present and discuss solutions to homework problems. Students are also expected to work on weekly sets of homework problems and to submit their solutions to their tutors for marking in order to obtain feedback. In 2011/12 the department has implemented a new format for tutorials in the first year, which are provided as an additional learning platform besides exercise groups. Here, teaching assistants hold classroom sessions devoted to the review of current material from the lecture classes, current and past problems from the exercises, further examples, basic problems and illustrations, or to filling gaps in students' basic understanding. Regarded as optional rather than mandatory, these tutorials are offered on a weekly alternating basis for the two main first-year courses (Analysis and Linear Algebra). Overall, all these activities are meant to support the learning process and to give students ample opportunity to improve and to test their knowledge and understanding.

Exercise groups and homework activities also form an integral part of most of the more advanced lecture courses, including those at the Master's level. In the course of the re-accreditation in 2011/12, the department decided to strengthen the Master's programme with its rich spectrum of focus areas to choose from, by giving firmer guarantees as to the concrete choices of specialization areas that would be available to any cohort of Master's students in the upcoming three years. The department also committed itself to devote any extra teaching capacity that was freed through the termination of freshers' enrollment in the summer semester to a corresponding strengthening of the Master's programme. Among other changes this has enabled us to allow for a larger number of teaching assistants to be employed in exercises for Master level courses. These measures are meant to make our Master's programme even more competitive through its quality of teaching, greater reliability and impressive variety across a considerable breadth of research areas – both to retain our own Bachelor students and to attract new Master students from elsewhere.

Moreover, the department supports students in their learning experience by the following measures:

- the organisation of exercises and tutorials typically lies in the hands of experienced teaching assistants;
- newly recruited tutors and student demonstrators undergo a dedicated training programme (which serves as an example of good practice in the context of the KIVA project, where similar ideas are being tested in other departments' teaching);
- exercise groups are limited to a size of 20 students in the first year and 25 students from the second year onwards;
- we provide an open learning environment with small learning groups;
- all teaching staff offer weekly consultation hours for individual help and support;
- the department provides altogether 12 student rooms (open access and reserved) with about 160 places for students to meet in learning groups, to work on their theses or to prepare for their final exams;
- the Mathematics Learning Center (Lernzentrum Mathematik) is staffed during opening hours by an assistant or professor, available to answer questions; in addition textbooks and up-to-date material for the current teaching courses are provided;
- there are 32 places for reading and studying in the departmental library (towards the end of 2012, this departmental library was incorporated into the new central university library);
- the department has three open access computer labs (with a total of 43 Linux machines) and two reserved computer labs (with a total of 15 Linux machines).

3.4 E-Learning/E-Teaching in Academic Training

E-Learning is present in the Department of Mathematics in teaching and research.
Standards and innovation of E-Learning and E-Teaching in the Department of Mathematics:

- purchase of six Tablet PCs (WACOM Cintiq and Microsoft Surface Pro 3) to facilitate lectures supported by hand-written comments and graphs;
- video capturing of selected lectures;
- annual International Internet Seminar (organized and taught by PD Dr. Haller-Dintelmann);
- two online-lessons (task-diversity (MAVIE) and task-training) for teacher education.

Research and research-based development

The research projects TELPS and PEDALE (for more information, see “research projects” (Didactics of Mathematics) give students support for their individual assessment. Based on the innovation of these two projects, students receive subject-specific, content-based digital feedback for their homework. Both projects were also published internationally. Further research on Feedback-Based Quality Improvement in E-Learning funded by the German Research Foundation (DFG) covering technology enhanced diagnosis and learning in mathematics education was started with a DFG-scholarship. Within this work, a cooperation with the working group Serious Games at TU Darmstadt was established (FIF-project). In the German-Japanese postgraduate programme, "‘Mathematical Fluid Dynamics"’ (1529), the weekly seminar presentations were transferred via video to Tokyo (Waseda University) so that all participants could benefit from the seminar, regardless of place and time. In connection with the VEMA project (cooperation between TU Darmstadt (Bruder, Nitsch, Schaub, Bausch)), Universität Paderborn (Biehler) and Universität Kassel (Kroepf)) and Universität Lüneburg (Hochmuth), some new E-Learning elements, e.g., for self-regulation in cooperation with psychologists (Dr. Bellhaeuser) and for training of basic school knowledge in mathematics with initial differentiation, were developed for the preparatory math courses for new students. Since 2009, the preparatory course has been presented online via Moodle each winter semester for nearly 800 new students of departments 4, 13, 16 and 20.
`http://www3.mathematik.tu-darmstadt.de/fb/mathe/startseite/studienanfaengerinnen-und-anfaenger/mathematikvorkurs.html`.
VEMA project homepage:
`http://www.mathematik.uni-kassel.de/~vorkurs/Willkommen1.html`.

MaViT: Mathematical Video Tutorials for Students of Engineering Sciences

Since the winter semester 2013/14 mathematical video tutorials have been produced to support students of Engineering Sciences to improve their mathematical basic skills single-handedly.
Especially within the service courses taken by students of other departments a large heterogeneity can be observed regarding previous knowledge as well as learning strategies. Video tutorials offer a good opportunity to train essential mathematical basic skills of the course self-dependently. Against this background the Department of Mathematics has been funding the project MaViT to create video tutorials illustrating students how to deal with typical mathematical problems. The videos are embedded into interactive digital learning environments that give graded hints on how to solve the problem if required and provide a collection of additional exercises with sample solutions. In addition assisted forums offer the possibility to ask and discuss questions regarding the respective content. Students can access the learning environments via Moodle.
The evaluation shows that students appreciate the offered material for being valuable support of their learning process.

dikopost: Digital Competence Portfolio for Students

From 2010 to 2013, the dikopost project was launched with Prof. Regina Bruder as head and under the leadership of the Center for Teacher Education (ZfL). It is a project to sup-

port academic teaching and learning using digital portfolios. One of its aims is to present a platform for all students studying at the TU Darmstadt, while emphasising the importance of E-Portfolio usage for students studying to become a teacher. For dikopost, the platform Mahara is used in combination with Moodle. The pilot project runs for two years on QSL funds with a budget of 250,000 Euros and is already implemented in the E-Learning Center and Hochschuldidaktische Arbeitsstelle (HDA) for sustainable use. The goal of dikopost is to develop course concepts where the use of an E-Portfolio helps students to learn, reflect and showcase their competences and learning outcomes.
The current link to Mahara can be found here:
`http://wwwdid.mathematik.tu-darmstadt.de/mahara/artefact/internal/`

Blended learning for further training

The use of blended learning concepts is an important trend in further training for teachers. Based on the results of research projects, five online programmes as half-year-courses for further education were presented on the learning platform Moodle hosted by DZLM (Deutsches Zentrum für Lehrerbildung Mathematik) `www.dzlm.de`. In 2013 and 2014 our online courses were attended by 273 teachers.
For additional support, see `http://www.madaba.de`, a database for exercises with about 50 new tasks and an update of the interface.

3.5 Career-related Activities

In the series of lectures "Heute Mathe, morgen . . . ?" female mathematicians present their current area of work, their vita and their employer. The main purpose is to give students a more personal insight into jobs for mathematicians outside the university than can be given by a job fair. A further intention is to give female students an easy opportunity to ask gender-specific questions and to present role models to the students.

05/06/2013 Rike Betten (EnBW), *Gestern Mathe, dann Consultant, heute EnBW*

19/06/2013 Prof. Dr. Hannah Markwig (Universität des Saarlandes), *Gestern Mathe, heute Mathe*

20/11/2013 Dr. Kathrin Schumacher (Bosch), *Gestern Mathe, heute Bosch*

27/11/2013 Prof. Dr. Christine Bach (h_da), *Gestern Mathe, heute Mathe*

04/12/2013 Bianca Hinz (Deutsche Bahn), *Gestern Mathe, heute Deutsche Bahn*

11/12/2013 Laura Ströter (Börse), *Gestern Mathe, heute Börse*

11/06/2014 Dr. Meike Schaub (Opel), *Gestern Mathe, heute Opel*

02/07/2014 Kristina Reiss (Tonbeller), *Gestern Mathe, heute Tonbeller*

16/07/2014 Anne Kleppe (d–fine), *Gestern Mathe, heute d–fine*

03/11/2014 Dr. Sandra Strohbücker (E.ON), *Gestern Mathe, heute E.ON*

17/11/2014 Dr. Zahra Lakdawala (DHI-WASY), *Gestern Mathe, heute DHI-WASY*

24/11/2014 Tanja Berger, Kerstin Sauer (Commerzbank), *Gestern Mathe, heute Commerzbank*

08/12/2014 Dr. Kathrin Hatz (Bayer), *Gestern Mathe, heute Bayer*

4 Publications

4.1 Co-Editors of Publications

4.1.1 Editors of Journals

Hans-Dieter Alber

- *Mathematical Methods in the Applied Sciences* (Member of the editorial board)
- *Asymptotic Analysis* (Member of the editorial board)
- *Demonstratio Mathematica* (Member of the editorial board)
- *Journal of Multiscale Modelling* (Member of the editorial board)

Dieter Bothe

- *International Journal of Multiphase Flows* (Editorial Advisory Board)
- *Nonlinear Analysis: Real World Applications* (Editorial Board)

Regina Bruder

- *mathematik lehren* (Associate Editor)

Jan H. Bruinier

- *Forum Mathematicum* (Associate Editor)
- *Annali dell'Università di Ferrara* (Associate Editor)

Reinhard Farwig

- *Annali dell'Università di Ferrara* (Associate Editor)
- *Mathematica Bohemica* (Associate Editor)
- *Analysis (Munich)* (Associate Editor)
- *Mathematische Nachrichten* (Associate Editor)

Alf Gerisch

- *In Silico Cell and Tissue Science* (Associate Editor)

Philipp Habegger

- *Journal de Théorie des Nombres de Bordeaux* (Member of the Editorial Board)

Karl H. Hofmann

- *Journal of Lie Theory* (Deputy Managing Editor)
- *Semigroup Forum* (Honorary Editor)

Michael Joswig

- *Mitteilungen der Deutschen Mathematiker Vereinigung (DMV)* (Editor-in-chief)
- *Electronic Geometry Models* (Co-Managing Editor)

Klaus Keimel

- *Order* (Associate Editor)
- *Beiträge zur Algebra und Geometrie* (Associate Editor)

Ulrich Kohlenbach

- *Annals of Pure and Applied Logic* (Coordinating Editor)
- *Notre Dame Journal of Formal Logic* (Member of Editorial Board)
- *Mathematical Logic Quarterly* (Member of Editorial Board)
- *Computability* (Member of Editorial Board)

Michael Kohler

- *AStA Advances in Statistical Analysis* (Associate Editor)

Jens Lang

- *Applied Numerical Mathematics* (Member of the editorial board)

Martin Otto

- *Bulletin of Symbolic Logic* (Associate Editor)

Marc Pfetsch

- *Operations Research Letters* (Associate Editor)
- *Mathematical Programming Computation* (Technical Editor)

Anna-Maria von Pippich

- *Elemente der Mathematik* (Member of the editorial board)

Ulrich Reif

- *Journal of Approximation Theory* (Associate Editor)
- *Computer Aided Geometric Design* (Associate Editor)

Werner Schindler

- *Journal of Cryptographic Engineering* (Associate Editor)

Thomas Streicher

- *Applied Categorical Structures* (Associate Editor)

Stefan Ulbrich

– *Journal of Optimization Theory and Applications* (Associate Editor)

– *Optimization Methods and Software* (Regional Editor Europe)

– *SIAM Journal on Optimization* (Associate Editor)

– *Asymptotic Analysis* (Associate Editor)

– *ESAIM: Control, Optimisation and Calculus of Variations* (Associate Editor)

– *SIAM Book Series: MOS-SIAM Series on Optimization* (Associate Editor)

Martin Ziegler

– *Journal of Logic and Analysis* (Guest Editor)

4.1.2 Editors of Proceedings

Reinhard Farwig

– *Conference "Vorticity, Rotation and Symmetry (II) - Regularity of Fluid Motion" (2011) at CIRM, Luminy/Marseille, Discrete Contin. Dyn. Syst. Ser. S 6 (2013)* (jointly with J. Neustupa (Prague), P. Penel (Toulon))

Klaus Keimel

– *International Workshop on Domain Theory and Applications (Domains X), Journal of Logical and Algebraic Methods in Programming, vol. 84, 2015* (jointly with U. Berger, J. Blanck, M. Escardo)

Ulrich Kohlenbach

– *Proceedings of the ASL Logic Colloquium 2011, Ann. Pure Appl. Logic vol.164, pp. 1177-1519, 2013* (jointly with K. Ambos-Spies, J. Bagaria, E. Casanovas)

– *Proceedings of 20th International Workshop on Logic, Language, Information and Computation (WoLLIC 2013), Springer LNCS 8071, 2013* (jointly with L. Libkin, R. de Queiroz)

– *Proceedings of 21st International Workshop on Logic, Language, Information and Computation (WoLLIC 2014), Springer LNCS 8652, 2014* (jointly with P. Barcelo, R. de Queiroz)

4.2 Monographs and Books

[1] I. Bausch. *Mathematisches Wissen mit TELPS erfassen und fördern – Ein Instrument zur Erforschung und Förderung von mathematikdidaktischem Wissen in Bezug auf die Planung und Gestaltung von Mathematikunterricht*. Wiesbaden: Springer Spektrum, 2014.

[2] M. Behr, A. Bode, M. Bücker, J. Lang, E. Rank, U. Rüde, and M. Schäfer. *Multiphysics Problems in Computational Engineering*, volume 9 of *Int. J. Comput. Science and Engineering*. Inderscience Enterprise Ltd, 2014.

[3] R. Bruder, J. Reibold, and T. Wehrse. *Binnendifferenziertes Aufgabenmaterial für den Mathematikunterricht der Sek I*. Schroedel Verlag, 2014.

[4] R. Bruder and W. Weiskirch. *CAliMERO – Computer-Algebra im Mathematikunterricht. Lineare Algebra: Arbeitsmaterialien*. T^3 Münster, 2013.

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[7] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht. Stochastik: Arbeitsmaterialien*. T^3 Münster, 2013.

[8] R. Bruder and W. Weiskirch. *CAliMERO – Computer-Algebra im Mathematikunterricht. Analysis: Arbeitsmaterialien*. T^3 Münster, 2014.

[9] J. Ghiglieri. *Optimal flow control based on POD and MPC and an application to the cancellation of Tollmien-Schlichting waves*. Dr. Hut Verlag, 2014.

[10] T. Göllner. *Geometry Optimization of Branched Sheet Metal Structures with a Globalization Strategy by Adaptive Cubic Regularization*. Dr. Hut Verlag, 2014.

[11] K. Habermehl. *Robust Optimization of Active Trusses via Mixed-Integer Semidefinite Programming*. Dr. Hut Verlag, 2014.

[12] K. Herr. *Core Sets and Symmetric Convex Optimization*. Dr. Hut Verlag, 2013.

[13] K. H. Hofmann and S. A. Morris. *Tbe Structure of Compact Groups, 3rd Edition, Revised and Augmented*. Walter De Gruyter, Berlin, 2013, 944pp.

[14] M. Joswig and T. Theobald. *Polyhedral and Algebraic Methods in Computational Geometry*. Universitext. Springer, London, 2013.

[15] J. Kramer and A.-M. von Pippich. *Von den natürlichen Zahlen zu den Quaternionen. Basiswissen Zahlbereiche und Algebra.* Wiesbaden: Springer Spektrum, 2013.

[16] S. Mars. *Mixed-Integer Semidefinite Programming with an Application to Truss Topology Design*. Dr. Hut Verlag, 2013.

[17] R. Nitsch. *Diagnose von Lernschwierigkeiten im Bereich funktionaler Zusammenhänge*. Wiesbaden: Springer Spektrum, in press.

[18] A. Sichau. *Robust Nonlinear Programming with Discretized PDE Constraints using Second-order Approximations*. Dr. Hut Verlag, 2013.

[19] A. Tillmann. *Computational Aspects of Compressed Sensing*. Dr. Hut Verlag, Germany, 2013.

4.3 Publications in Journals and Proceedings

4.3.1 Journals

[1] K. Abe, Y. Giga, and M. Hieber. Stokes resolvent estimates on spaces of bounded functions. *Ann. Sci. Ec. Norm. Super.*, 2014.

[2] H.-D. Alber, K. Hutter, and C. Tsakmakis. Nonconventional thermodynamics, indeterminate couple stress elasticity and heat conduction. *Continuum Mechanics and Thermodynamics*, 2014.

[3] H.-D. Alber and P. Zhu. Comparison of a rapidely converging phase field model for interfaces in solids with the Allen-Cahn model. *Journal of Elasticity*, 111,2:153–221, 2013.

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[6] C. Alfes. Parity of the coefficients of Klein's j-function. *Proc. Amer. Math. Soc.*, 141:123–130, 2013.

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[9] C. Alfes and S. Ehlen. Twisted traces of CM values of weak Maass forms. *J. Number Theory*, 133:1827–1845, 2013.

[10] C. Alfes, M. Griffin, K. Ono, and L. Rolen. Weierstrass mock modular forms and elliptic curves. *Research in Number Theory*, accepted.

[11] F. Ali Mehmeti, R. Haller-Dintelmann, and V. Régnier. Dispersive waves with multiple tunnel effect on a star-shaped network. *Discrete Contin. Dyn. Syst. Ser. S*, 6:783–791, 2013.

[12] G. Alsmeyer and M. Meiners. Fixed points of the smoothing transform: two-sided solutions. *Probability Theory and Related Fields*, 155:165–199, 2013.

[13] S. Arridge, H. Egger, and M. Schlottbom. Preconditioning of complex symmetric linear systems with applications in optical tomography. *APNUM*, 74:35–48, 2013.

[14] B. Assarf, M. Joswig, and A. Paffenholz. Smooth Fano Polytopes With Many Vertices. *Discrete & Computational Geometry*, 52:153–194, 2014.

[15] F. Aurzada and C. Baumgarten. Persistence of fractional Brownian motion with moving boundaries and applications. *J. Phys. A*, 46(12):125007, 12, 2013.

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[17] F. Aurzada, S. Dereich, and M. Lifshits. Persistence probabilities for a bridge of an integrated simple random walk. *Probab. Math. Statist.*, 34(1):1–22, 2014.

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[75] M. Vrzina. Cylinders as invariant CMC surfaces in simply connected homogeneous 3-manifolds. Preprint, TU Darmstadt, 2014.

[76] S. Zemel. A Gross–Kohnen–Zagier Type Theorem for Higher Codimensional Heegner Cycles. Technical report, TU Darmstadt, 27 2013.

[77] S. Zemel. An Algebraic Description of the Exceptional Isogenies to Orthogonal Groups. Technical report, TU Darmstadt, 6 2014.

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4.5 Reviewing and Refereeing

Claudia Alfes: Zentralblatt; International Journal of Number Theory, Research in Number Theory, Forum Mathematicum

Frank Aurzada: Mathematical Reviews; Electronic Journal of Probability, Electronic Communications in Probability, Central European Journal of Mathematics, Theory of Probability and its Applications

René Bartsch: Rostocker Mathematisches Kolloquium, Quaestiones Mathematicae

Dieter Bothe: International Journal for Numerical Methods in Fluids, Nonlinearity, SIAM Journal on Mathematical Analysis, Advances in Colloid and Interface Science, AIChE Journal, Journal of Applied Mechanics Reviews, International Journal for Heat and Mass Transfer, International Journal of Multiphase Flow, Journal of Computational Physics

Regina Bruder: Journal für Didaktik der Mathematik; Journal mathematik lehren, Zentralblatt für Didaktik der Mathemtatik

Jan H. Bruinier: Inventiones Mathematicae, Annals of Mathematics., Acta Mathematica, Journal of the AMS, Mathematische Annalen, Duke Mathematical Journal, Journal für die Reine und Angewandte Mathematik, Advances in Mathematics, Compositio Mathematica, etc.

Herbert Egger: Computational Methods in Applied Mathematics, ESAIM: Mathematical Modelling and Numerical Analysis, Journal of Mathematical Analysis and Applications, SIAM Journal on Scientific Computing, IMA Journal on Numerical Analysis, Applied Mathematics and Computation, SIAM Journal on Matrix Analysis and Applications, Mathematics and Computers in Simulation, Inverse Problems, Mathematical Methods in the Applied Sciences, IMA Journal of Applied Mathematics, Numerical Algorithms, SIAM Journal on Numerical Analysis, Journal of Applied Mathematics and Computing, Computers and Mathematics with Applications, Applicable Analysis

Christoph Erath: SIAM Journal on Numerical Analysis, Mathematical Reviews, Journal for Computational Physics, Geoscientific Model Development Discussion, Finite Volumes for Complex Applications VII

Reinhard Farwig: Mathematical Reviews; Advances in Calculus of Variations, Annales de l'Institut Henri Poincaré (C) Analyse Non Linéaire, Annali dell'Università di Ferrara, Sez. VII Sci. Mat., Applications of Mathematics (Prague), Asymptotic Analysis, Calculus of Variations and Partial Differential Equations, Discrete and Continuous Dynamical Systems-S, Journal of Differential Equations, Journal of Mathematical Analysis and Applications, Journal of Mathematical Fluid Mechanics, Journal of the Mathematical Society of Japan, Mathematical Methods in the Applied Sciences, Mathematische Nachrichten, Nonlinear Analysis, Proceedings EQUADIFF 13, Topological Methods in Nonlinear Analysis, Zeitschrift für Angewandte Mathematik und Mechanik

Alf Gerisch: Journal of Computational and Applied Mathematics, Engineering Computations, Journal of Theoretical Biology, Applied Mathematics and Computation, Biomechanics and Modeling in Mechanobiology, Mathematical Biosciences and Engineering, SIAM Journal on Scientific Computing

Vassilios Gregoriades: Mathematical Reviews

Philipp Habegger: Mathematical Reviews; International Journal of Number Theory, Bulletin de la Société Mathématique de France, Annali della Scuola Normale Superiore di Pisa – Classe di Scienze, Duke Mathematical Journal, Pacific Journal of Mathematics, Acta Arithmetica, Afrika Mathematika, Proceedings of the London Mathematical Society, Advances in Mathematics, Algebra & Number Theory, Journal de Théorie des Nombres de Bordeaux, Compositio Mathematica, Transactions of the American Mathematical Society, Mathematical Proceedings of the Cambridge Philosophical Society

Robert Haller-Dintelmann: Mathematische Nachrichten

Karl H. Hofmann: Advances in Mathematics, Advances in Pure and Applied Mathematics, Algebra Universalis, American Mathematical Monthly, Journal of Lie Theory, Mathematische Nachrichten, Semigroup Forum, Topology and its Applications

Silke Horn: Linear Algebra and its Applications

Klaus Keimel: Journal of Algebra and its Applications, Journal of Lie Theory, Semigroup Forum, Topology and its Applications, European Science Foundation (ESF), Order, Algebra Universalis, Bulletin of the Korean Mathematical Society, Bulletin of the Malaysian Mathematical Society, Electronic Notes in Theoretical Computer Science, Logical Methods in Computer Science, Mathematical Structures in Computer Science, Applied and Computational Mathematics, LICS'13, FOSSACS'15

Ulrich Kohlenbach: Annals of Pure and Applied Logic, Applied Mathematics and Computation, Ergodic Theory and Dynamical Systems, Journal of Optimization Theory and Applications, London Mathematical Society, Mathematical and Computer Modelling, Numerical Functional Analysis and Optimization, Transactions of the American Mathematical Society

Michael Kohler: Annals of Statistics, Communications in Statistics - Theory and Methods, IEEE Transactions on Information Theory, International Journal of Mathematics and Mathematical Sciences, Journal of Multivariate Analysis, Journal of the American Statistical Association, Mathematical Problems in Engineering, Metrika

Burkhard Kümmerer: Journal of Functional Analysis, Communications in Mathematical Physics, Journal of Operator Theory, Journal of Statistical Physics, Journal of Mathematical Analysis and Applications, Journal of Mathematical Physics

Jens Lang: Applied Numerical Mathematics, Combustion Theory and Modelling, Journal of Physics A: Mathematical and General, Inverse Problems, Computing and Visualization in Science, International Journal of Hyperthermia, International Journal for Numerical Methods in Fluids, Transactions on Mathematical Software, Journal of Computational Physics, Computational and Applied Mathematics, IMA Journal of

Numerical Analysis, Mathematics of Computation, SIAM Journal Numerical Analysis, SIAM Journal Scientific Computing

Oliver Lass: International Journal for Numerical Methods in Engineering, Journal of Mathematical Analysis and Applications, Journal of Optimization Theory and Applications

Matthias Meiners: Mathematical Reviews, Zentralblatt; Advances in Applied Probability, Journal of Applied Probability, Journal of Difference Equations and Applications, Journal of Mathematical Analysis and Applications, Journal of Statistical Planning and Inference, Stochastic Processes and their Applications

Christian Mönch: Electronic Journal of Probability

Martin Otto: Annals of Pure and Applied Logic, Journal of Symbolic Logic, Logica Universalis, Journal of Logic and Computation, Logical Methods in Computer Science, Journal of Computer and System Sciences, ACM/IEEE Symposium on Logic in Computer Science, Symposium on Theoretical Aspects of Computer Science, Computer Science Logic, International Symposium on Games/Automata/Logics/Formal Verification, Austrian Science Foundation

Andreas Paffenholz: International Symposium on Computational Geometry, Advances in Geometry, European Journal of Combinatorics, Mathematical Programming SERIES A and B, Journal of Combinatorial Theory, Series A

Marc Pfetsch: ATMOS 2013, Discrete and Computational Geometry, 16th Conference on Integer Programming (IPCO) 2013, IEEE International Symposium on Information Theory (ISIT) 2013, Journal of the OR Society of China, Linear Algebra and its Applications, Mathematical Programming Computation, Mathematical Programming, Operations Research Letters, Optimization Methods and Software, Transactions on Mathematical Software, Transactions on Signal Processing

Anna-Maria von Pippich: International Journal of Number Theory, Elemente der Mathematik

Ulrich Reif: Journal of Approximation Theory, Computer Aided Geometric Design, Graphical Models, SIGGRAPH, Advances in Computational Mathematics, Constructive Approximation, Linear Algebra and Applications

Steffen Roch: Mathematical Reviews; Journal of Functional Analysis, SIAM Journal on Mathematical Analysis, Operators and Matrices, Linear Algebra and its Applications, Journal of Mathematical Analysis and Applications, Complex Variables and Elliptic Equations, Complex Analysis and Operator Theory, Operator Theory: Advances and Applications

Nils Scheithauer: Annals of Mathematics, Compositio Mathematica, Communications in Mathematical Physics, Duke Mathematical Journal, Proceedings of the London Mathematical Society, The Ramanujan Journal

Werner Schindler: International Cryptographic Module Conference, International Symposium on Foundations & Practice of Security FPS 2013, CHES 2014; Journal of Cryptographic Engineering, International Journal of Information Security

Matthias Schlottbom: Zentralblatt, Mathematical Reviews; Abstract and Applied Analysis, Computers and Mathematics with Applications

Alexandra Schwartz: Mathematical Programming, Numerical Algorithms, Applied Mathematics and Computation, Annals of Operations Research, Journal of Optimization Theory and Applications

Thomas Streicher: Theoretical Computer Science, Mathematical Structures in Computer Science, Annals of Pure and Applied Logic

Andreas Tillmann: IEEE 8th Sensor Array and Multichannel Signal Processing Workshop (SAM) 2014, 22nd European Signal Processing Conference (EUSIPCO) 2014; IEEE Transactions on Information Theory

Stefan Ulbrich: Applied Numerical Mathematics, Computational Optimization and Applications, ESAIM: Control, Optimisation and Calculus of Variations, Journal of Optimization Theory and Applications, Mathematical Programming, Numerische Mathematik, Optimization Methods and Software, SIAM Journal on Numeriscal Analysis, SIAM Journal on Control and Optimization, SIAM Journal on Optimization

Sebastian Ullmann: Mathematical Modelling and Analysis

Mirjam Walloth: International Journal for Numerical Methods in Engineering, Journal of Computational and Applied Mathematics, SIAM Journal on Numerical Analysis

Irwin Yousept: Mathematical Reviews, SIAM Journal on Scientific Computing, ESAIM Control Optimisation and Calculus of Variations, IMA Journal of Numerical Analysis, Computational Optimization and Applications, Mathematical Methods in the Applied Sciences, Acta Applicandae Mathematicae, Mathematical and Computer Modelling of Dynamical Systems

Shaul Zemel: Zentralblatt; Taiwanese Journal of Mathematics, Annales des Mathématiques du Québec

Martin Ziegler: Theory of Computing Systems, Logical Methods in Computer Science; Computability in Europe; Journal of Computation and Mathematics; Computational Complexity; Latin American Theoretical Informatics Symposium; Symposium on Computational Geometry; International Colloquium on Automata, Languages, and Programming; Mathematical Foundations of Computer Science; Mathematical Structures in Computer Science; Mathematical Logic Quarterly; Information Processing Letters; Applied Mathematics and Computation; Logic in Computer Science

ANACONDA: *Solving Hyperbolic Partial Differential Algebraic Equations on Networks*
ANACONDA is a software package to solve hyperbolic partial differential algebraic equations on networks. Particularly, it is designed to solve simulation and optimal control tasks for gas and water supply networks.

Contributor at TU Darmstadt: Pia Domschke, Jens Lang, Lisa Wagner

HOMME: *Integrating Semi-Lagrangian schemes*
A spectral-element dynamical core based on the High-Order Method Modeling Environment (HOMME) framework is the default dynamical core for the Community Atmosphere Model (CAM, version 5.2 and higher) - CAM-SE. The grid system in HOMME is based on the cubed-sphere geometry resulting from a gnomonic equiangular projection of the sphere. It has been shown that this approach is highly scalable, up to 170 000 cores. Atmospheric models used for practical climate simulation must be capable of handling the transport of hundreds of tracers. For computational efficiency conservative multi-tracer semi-Lagrangian type transport schemes are appropriate. The integration of two schemes, SPELT and CSLAM, and the coupling to the spectral element dynamical core is part of the software contribution.

Contributor at TU Darmstadt: Christoph Erath

SDP Package for SCIP: *Solving mixed integer semidefinite programs using SCIP*
The SDP Package is a plug-in for the non-commercial software SCIP for solving general MISDPs. It combines the branch-and-bound framework of SCIP with interfaces to interior-point SDP-solvers.
For more information, see `http://www.opt.tu-darmstadt.de/scipsdp/`

Contributor at TU Darmstadt: Tristan Gally, Marc Pfetsch, Sonja Mars

FastCOIN: *Fast adaptive stochastic COllocation INfrastructure*
FastCOIN is a software package that implements an adaptive, anisotropic stochastic collocation approach on sparse grids for the quantification of uncertainty in PDE's or other models with random parameters described by finitely many random variables. This includes, in particular, finite-dimensional parametrizations of correlated random fields. Similar to a Monte Carlo simulation, this approach decouples and hence parallelizes the stochastic problem into a set of deterministic problems. FastCOIN is able to resolve a stochastic parameter space of dimensions up to $20 - 50$.

Contributor at TU Darmstadt: Jens Lang, Alf Gerisch, Sebastian Ullmann, and formerly Bettina Schieche (now at Comsol)

KARDOS: *Solving Time-Dependent Partial Differential Equations*
KARDOS is a software package to solve partial differential equations in one, two and three space dimension adaptively in space and time. Linearly implicit one-step methods of Rosenbrock type or two-step PEER-methods are coupled with standard Finite Elements of various orders. Extensions that we are working on include: incorporation of computational fluid dynamics (CFD), optimisation and moving finite elements.

Contributor at TU Darmstadt: Jens Lang, Alf Gerisch, Dirk Schröder

polymake: *Software for Geometric Combinatorics*

polymake started out as a tool for the algorithmic treatment of convex polyhedra. By now it also deals with toric varieties, tropical polytopes, and other objects. The software is jointly developed by the polymake team, lead by Ewgenij Gawrilow (TomTom) and Michael Joswig.
For more information, see `www.polymake.org`

Contributor at TU Darmstadt: Benjamin Assarf, Katrin Herr, Silke Horn, Michael Joswig, Andreas Paffenholz, Benjamin Schröter

SCIP: *Software for Solving Constraint Integer Programs*

SCIP is a framework for solving constraint integer programs and performing branch-cut-and-price. It allows total control of the solution process and the access of detailed information. SCIP is also currently one of the fastest non-commercial mixed integer programming (MIP) solvers. It is developed together with the Zuse Institut Berlin and the Universität Erlangen-Nürnberg.
For more information, see `scip.zib.de`

Contributor at TU Darmstadt: Tobias Fischer, Marc Pfetsch

donlp2: *Solving general smooth nonlinear optimization problems, last version January 2015*

donlp2 is a software for the solution of general nonlinear programming problems. Different versions exist concerning the programming language (strict f77, f90, C99), the user interface and some options (for example elimination of redundant linear equality constraints and an interfacing known as "reverse communication"). donlp2 is free for research, whereas commercial use requires licensing by TU Darmstadt. In the period under review the technique of taking numerical gradients has been revised again and several minor flaws were removed. Three commercial licenses have been sold during this period and 38 academic (free) licenses were given. For more information, see `www.mathematik.tu-darmstadt.de/fbereiche/numerik/staff/spellucci/DONLP2/`

Contributor at TU Darmstadt: Peter Spellucci

numawww: *Interactive computing exercises for numerical methods and continuous optimization*

Numawww is a cgi/html-based computing device for general numerical methods and methods of continuous optimization. It may be used for exercises during a numerical methods course, as a self teaching aid or even as a small scale computing device, requiring minimal knowledge of programming. It is accessible from anywhere in the world and indeed users from about 80 countries are visiting it. Any application comes with predefined test cases which can be used without programming knowledge at all. Presently only the English version receives further development, but the German version will be maintained. This English version has been extended by 14 newly implemented methods and many other implementations were completely redesigned. There were about 28500 visits in 2013 and 36000 in 2014 compared to 6000 in 2011 and 12000 in 2012. For more information, see `numawww.mathematik.tu-darmstadt.de`

Contributor at TU Darmstadt: Peter Spellucci

HOC Suite: *Matlab package: Heuristic Optimality Checks for ℓ_1-norm minimization problems.*
For more information, see `http://wwwopt.mathematik.tu-darmstadt.de/spear/`

Contributor at TU Darmstadt: Andreas Tillmann

ISAL1: *Matlab implementation of a subgradient solver for Basis Pursuit.*
For more information, see `http://wwwopt.mathematik.tu-darmstadt.de/spear/`

Contributor at TU Darmstadt: Andreas Tillmann

L1-Testset: *Data set and handling methods for rigorous Basis Pursuit solver benchmarking.*
For more information, see `http://wwwopt.mathematik.tu-darmstadt.de/spear/`

Contributor at TU Darmstadt: Andreas Tillmann

5 Theses

5.1 Habilitations

2014

Paffenholz, Andreas, *Lattice Polytopes in Geometry and Algebra* (Michael Joswig)

5.2 PhD Dissertations

2013

Albert, Christoph, *On Stability of Falling Films: Numerical and Analytical Investigations* (Dieter Bothe)

Bausch, Isabell, *TELPS - Ein Instrument zur Erforschung und Förderung von mathematikdidaktischem Wissen in Bezug auf die Planung und Gestaltung von Mathematikunterricht* (Regina Bruder)

Clever, Debora, *Adaptive Multilevel Methods for PDAE-Constrained Optimal Control Problems* (Jens Lang)

Ehlen, Stephan J., *CM values of regularized theta lifts* (Jan Hendrik Bruinier)

Fischer, André, *Well-Posedness and Asymptotic Behavior in Reactive and Electro-Kinetic Flow Processes* (Jürgen Saal)

Furer, Dmytro, *Regressionsschätzung unter Verwendung von künstlich erzeugten Daten* (Michael Kohler)

Herr, Katrin, *Core Sets and Symmetric Convex Optimization* (Michael Joswig)

Janoschek, Andreas, *Algorithmic uniform rates of convergence for interacting particle filter* (Wilhelm Stannat)

Komo, Christian, *Weak solutions of the Boussinesq equations in domains with rough boundaries* (Reinhard Farwig)

Lehmann, Nicole, *Modeling with Ambient B-Splines* (Ulrich Reif)

Reußwig, Walter, *Ein darstellungstheoretischer Zugang zu Verschränkungseigenschaften endlich korrelierter Zustände* (Burkhard Kümmerer)

Rosteck, Veronika, *The Stokes System with the Navier Boundary Condition in General Unbounded Domains* (Reinhard Farwig)

Safarik, Pavol, *On the extraction of computational content from noneffective convergence proofs in analysis* (Ulrich Kohlenbach)

Schöchtel, Georg, *Motion of Inertial Particles in Gaussian Fields Driven by an Infinite-Dimensional Fractional Brownian Motion* (Wilhelm Stannat)

Sichau, Adrian, *Robust Nonlinear Programming with Discretized PDE Constraints using Second-order Approximations* (Stefan Ulbrich)

Tillmann, Andreas M., *Computational Aspects of Compressed Sensing* (Marc Pfetsch)

2014

von Below, Lorenz, *The Stokes and Navier-Stokes equations in layer domains with and without a free surface* (Matthias Geißert)

Frankenbach, Matthias, *An Adjoint Based A Posteriori Error Estimator for Moving Meshes in Large Eddy Simulation* (Jens Lang)

Ghiglieri, Jane, *Optimal Flow Control based on POD and MPC and an Application to the Cancellation of Tollmien-Schlichting Waves* (Stefan Ulbrich)

Göllner, Thea, *Geometry Optimization of Branched Sheet Metal Structures with a Globalization Strategy by Adaptive Cubic Regularization* (Stefan Ulbrich)

Gärtner, Andreas, *Recurrence, Transience, and Poisson Boundaries in Operator Algebras* (Burkhard Kümmerer)

Habermehl, Kai, *Robust optimization of active trusses via Mixed-Integer Semidefinite Programming* (Stefan Ulbrich)

Hertel, Ida, *Schätzung des optimalen Designs eines nichtlinearen parametrischen Regressionsproblems mittels Monte-Carlo-Experimenten* (Michael Kohler)

Kürsten, Susanne, *Das Einbettungsproblem für periodische Flächen in* $\mathbb{R}^n$ (Karsten Große-Brauckmann)

Kuhn, Karen, *Stability and applications of higher-order multirate Rosenbrock and Peer methods* (Jens Lang)

Nitsch, Renate, *Diagnose von Lernschwierigkeiten im Bereich funktionaler Zusammenhänge* (Regina Bruder)

Rösnick, Carsten, *Parametrisierte uniforme Komplexität geometrischer, topologischer und numerischer Operationen im normierten Raum* $\mathbb{R}^d$ (Martin Ziegler)

Ullmann, Sebastian, *POD-Galerkin Modeling for Incompressible Flows with Stochastic Boundary Conditions* (Jens Lang)

Werner, Fabian, *Vector Valued Hecke Theory* (Nils Scheithauer)

Wälti, Beat, *Alternative Leistungsbewertung in der Mathematik* (Regina Bruder)

2013

Christiansen, Sascha Oliver, *Implementierung eines Verfahrens zur Schätzung von Geschwindigkeitsfeldern mit Hilfe von Smoothing-Splines im Matlab* (Michael Kohler)

Do Dinh, Erik-Lân, *Automatische Identifizierung neuartiger Metaphern* (Iryna Gurevych)

Ederer, Thorsten, *Entwicklung eines Frameworks zur Optimierung von Thermofluidsystemen am Beispiel einer Heizungsanlage* (Ulf Lorenz)

Hartung, Lion, *Schätzung der Dichte von Residuen* (Michael Kohler)

Jacobi, Elisabeth, *Weak Monadic Second-Order Logic on Infinitely Branching Trees* (Achim Blumensath)

Kluge, Anne, *L_1-konsistente Schätzung der Dichte von Residuen* (Michael Kohler)

Koch, Matthias, *Finite sections of truncated Toeplitz operators with continuous symbol* (Steffen Roch)

Kolvenbach, Philip, *Ein ableitungsfreier Online-Optimierungsalgorithmus zur Auslöschung von Tollmien-Schlichting-Wellen* (Stefan Ulbrich)

Linhart, Daniel, *Analytizität der Lösung des Stefan-Problems mit Gibbs-Thomson-Korrektur* (Matthias Geißert)

Lüdicke, Nina Maria, *Optimization for Joint Modulation and Coding Scheme (MCS) Selection and Beamforming in Multiuser Downlink Systems* (Stefan Ulbrich)

Madmar, Mohamed, *Anwendung mathematischer Optimierung zur optimalen Budgetallokation im Direktmarketing* (Alexander Martin)

Miteva, Diana Mitkova, *Konsistenz und Konvergenzgeschwindigkeit bei der Schätzung der Dichte von Residuen* (Michael Kohler)

Pfeffer, Saskia, *Mulitivariate Analysemethoden im Marketing* (Wilhelm Stannat)

Pluemacher, Dominik Oliver, *Dynamische Systeme und Poisson-Ränder* (Ralf Gramlich)

Polkehn, Maurice, *Graphen-Clustering für medizinische Netzwerke* (Marc Pfetsch)

Reiffert, Michel, *Eine Momentenmethode zur Bewertung von pfadunabhängigen und pfadabhängigen Optionen* (Stefan Ulbrich)

Riehl, Volker, *Risk assessment of German Mittelstand bonds with Value-at-Risk-based models and a comparative analysis with other financial assets* (Volker Betz)

Schröter, Benjamin Frederik, *Harmonische Maaß-Formen und meromorphe Jacobi-Formen* (Jan Hendrik Bruinier)

Schulz, Alexander, *Numerische Lösung der Black-Scholes PDE* (Jens Lang)

Sehrt, Cedric Gregor, *Optimale Steuerung partieller Differentialgleichungen im Rahmen linearer Elastizität mit punktweiser Beschränkung des Zustands* (Christian Meyer)

Sokoli, Florian Moritz, *Der innere Radius in der Quantenverschränkung* (Burkhard Kümmerer)

Sokoli, Johanna, *Komplexität des Erfüllbarkeitsproblems von Kreuzprodukt-Termen* (Martin Ziegler)

Straube, Ruben, *Konfliktanalyse für quantifizierte binäre Programmierung* (Ulf Lorenz)

Terentiev, Boris, *Ressourceneinsatzplanung im Projektmanagement* (Marc Pfetsch)

Wiebeck, Julia, *Entwicklung erweiterter Fließfunktionen in der mikropolaren Plastizität* (Charalampos Tsakmakis)

Zieleniewicz, Andreas, *The d'Alembert-Lagrange principle for deriving interface conditions* (Dieter Bothe)

2014

Chalghoumi, Sari, *Nichtparametrische Schätzung des maximalen Quantils* (Michael Kohler)

Fabritius, Norbert, *Solving linear programs with complementarity constraints using an indicator approach* (Marc Pfetsch)

Hesse, Robin Geronimo, *Spieltheoretische Betrachtungen zur Abschreckung* (Martin Ziegler)

Ivanova, Boyana, *Optimale Ausübung Amerikanischer Optionen in diskreter Zeit im Falle von Lévy-Modellen* (Michael Kohler)

Lazarova, Aleksandra, *The relationship between EuroStoxx50 Index Future and the DAX30 Index Future on Eurex* (Dirk Schiereck)

Sohns, Moritz, *Darstellungseigenschaft von Sigma-Martingalen und Anwendung in der Finanzmathematik* (Frank Aurzada)

5.4 Master Theses

2013

Arikan, Cennet, *Semiparametrische Schätzung von Discrete-Choice-Modellen* (Jens Krüger)

Bauer, Rachel, *Optimale Platzierung von Aktuatoren zur Dämpfung schwingender Strukturen* (Stefan Ulbrich)

Bitterlich, Julian, *Fractional Isomorphism and Its Sherali-Adams Relaxation* (Martin Otto)

Burg, Daniela, *Regressionsschätzung basierend auf realen und künstlichen Daten* (Michael Kohler)

Burkhardt, Sina, *Optimale Lagerhaltung unter autoregressiver Nachfrage: Modellierung am Beispiel der Medikamentenversorgung in der Katastrophenlogistik* (Gernot Kaiser, Marc Pfetsch)

Buschbacher, Alwin, *Adaptive Multilevel-Verfahren für die optimale Steuerung der Stahlhärtung* (Jens Lang)

Dick, Christoph Ruthard, *"Ägyptische Brüche" und deren Behandlung im Mathematikunterricht* (Werner Krabs)

Dittmann, Moritz Christopher, *Classification results for automorphic products of singular weight* (Nils Scheithauer)

Djipie, Bokaha Guy Roger, *Empirial comparison of nonparametric regression estimates using real data* (Michael Kohler)

Farsad, Vanda, *Arvesons Verschränkungsmaß auf vollständig positiven Abbildungen* (Burkhard Kümmerer)

Fickinger, Till, *Optimierung von Flugplänen im Störfall unter Berücksichtigung von Passagierinformationen* (Hans-Christian Pfohl, Marc Pfetsch)

Fischer, Michael Helmut, *Formoptimierung elastischer Strukturen mit Kontaktbedingung* (Stefan Ulbrich)

Gally, Tristan, *Semidefinite Relaxierungen für RIP und NSP im Compressed Sensing* (Marc Pfetsch)

Günzel, Daniel, *Logical Metatheorem in the Context of Families of Abstract Metric Structures* (Ulrich Kohlenbach)

Heyse, Ann-Kathrin, *Synthesis of tileable textures using image decompostion and neighborhood synthesis* (Ulrich Reif)

Hildmann, Valentina, *Robuste Optimierung aktiver Stabwerke als Min-Max-Formulierung* (Stefan Ulbrich)

Hinkel, Karin, *Analyse von Lernschwierigkeiten in der zweijährigen Berufsfachschule zu funktionalen Zusammenhängen* (Regina Bruder)

Hojny, Christopher, *Polyhedral description of star colourings* (Marc Pfetsch)

Huang, Zizhen, *Consistency of regression based Monte Carlo methods for pricing Bermudan options in case of estimated financial models* (Michael Kohler)

Kamlah, Iris, *Optimale Steuerung von Plasma-Aktuatoren zur Dämpfung von Tollmien-Schlichting-Wellen auf Basis von reduzierten Modellen basierend auf Balanced POD und Model Predictive Control* (Stefan Ulbrich)

Keilich, Janina Christine, *Förderung des selbstorganisierten Lernens durch E-Learning. Eine Analyse bestehender Konzepte im Blick auf ihre potenzielle Übertragbarkeit in die Berufsschule.* (Petra Grell)

Kopp, Sonja, *Semiglatte Mehrgitter-Newton-Verfahren für elastische Kontaktprobleme* (Stefan Ulbrich)

Kozacki, Martin, *Medienkompetenzförderung in der Schule – Analyse von pädagogischen Medienkonzepten* (Petra Grell)

Kuttich, Anja, *Optimierung von robusten Stabwerken mit lokalen Knickbedingungen* (Stefan Ulbrich)

Lescevska, Elzbieta, *Evaluierung und Erweiterung geometrischer Schnittebenen* (Marc Pfetsch)

Lück, Stefanie, *Optimales Downlink Beamforming mit IC: Globale und lokale Lösung nichtkonvexer QCQPs mittels Momentenmethode und SOCP* (Stefan Ulbrich)

Mack, Julia Katharina, *Wege in Zellzerlegungen von Flächen* (Michael Joswig)

Neis, Ilona, *Diskrete Darstellung von Vektoren unter Sektor- und Abstandsnebenbedingungen* (Marc Pfetsch)

Opitz, Sebastian, *Diskriminantenformen und vektorwertige Modulformen* (Nils Scheithauer)

Rausch, Lea, *Optimale Planung des Energieeinsatzes eines aktiv gedämpften Elektro-Fahrzeugs* (Ulf Lorenz)

Reiß, Kristina, *Spektraltheorie des Laplace- und Stokes-Operators in L^q-Räumen auf Außenraumgebieten* (Reinhard Farwig)

Reitz, Thomas, *Selbstorganisiertes Lernen und die Auswirkung auf die Förderung der Sozialkompetenz* (Josef Rützel)

Ristl, Konstantin, *Portfoliooptimierung unter diskreten Bedingungen des realen Marktes* (Stefan Ulbrich)

Schmieg, Alexander, *Das Bramble-Hilbert Lemma in anisotropen Sobolev-Räumen* (Ulrich Reif)

Schmitt, David Gleb, *Probabilistische Methode zur Schätzung von Kunden- und Produkteigenschaften* (Ulf Brefeld)

Schmitt, Felix Martin, *Nonlinear Model Predictive Control with Probabilistic Models* (Jan Peters)

Schulz, Xenia, *Adaptive Dichteschätzung basierend auf realen und künstlichen Daten* (Michael Kohler)

Schwagenscheidt, Markus, *Ein neues automorphes Produkt singulären Gewichts* (Nils Scheithauer)

Schwan, Lena Maria, *Konstruktion von Fahrplänen mit Hilfe der Recoverable Robustness Techniken* (Ulf Lorenz)

Schwarzkopf, Stefan, *Lösungsansätze für quantifizierte gemischt-ganzzahlige Probleme* (Ulf Lorenz)

Siebert, Sandra Maria, *Finite-Elemente-Methoden für konvektionsdominante Probleme* (Jens Lang)

Sit, Gee Fung, *Deformation der Schwarzschen P-Fläche in konstanter mittlerer Krümmung* (Karsten Große-Brauckmann)

Sowadzki, Claudia, *Faltbare Triangulierungen von Gitterpolytopen* (Michael Joswig)

Späth, Johannes, *Gerichtete Kreise in der tropischen Geometrie* (Michael Joswig)

Tent, Reinhard, *Schätzung einer Verteilung ausgehend von einer Stichprobe mit zusätzlichen kleinen Messfehlern* (Michael Kohler)

Tolksdorf, Patrick, *The Kato square root problem for mixed boundary conditions* (Robert Haller-Dintelmann)

Uhl, Florian Hans Eckehard, *Linienplanung auf speziellen zugrundeliegenden Netzstrukturen* (Marc Pfetsch)

Völz, Fabian, *Vector valued lifts of newforms* (Jan Hendrik Bruinier)

Walter, Philipp, *Erweiterung eines QIP-Solvers durch Schnittebenenverfahren* (Ulf Lorenz)

Wegmann, David, *Eine verbesserte Energieungleichung für schwache Lösungen der Navier-Stokes-Gleichungen in allgemeinen Gebieten* (Reinhard Farwig)

Weisgerber, Tim Norbert, *Empirischer Vergleich von Verfahren zur nichtparametrischen Regressionsschätzung* (Michael Kohler)

Will, Alexander, *Selbstwirksamkeit als Mediator zwischen (effizienter) Klassenführung und dem Belastungsempfinden von Lehrkräften* (Birgit Ziegler)

Zinovyeva, Alexandra, *Optimierung von "Fare Families" und ähnlichen Preisstrukturen im Airline Revenue Management* (Ulf Lorenz)

2014

Alex, Jerome, *Der n-dimensionale Gömböc* (Karsten Große-Brauckmann)

Atanasov, Nikolay Atanasov, *IT-driven Text-clustering with Respect to Different Thematic Areas* (Johannes Fürnkranz)

Barbehön, Janine, *The car sequencing problem under uncertainty* (Ulf Lorenz)

Berst, Milena, *Rekursive Schätzung von Quantilen in einem Simulationsmodell* (Michael Kohler)

Biehl, Johanna Katharina, *Die Alternating Direction Method of Multipliers mit Anwendung auf Kommunikationsnetzwerke* (Stefan Ulbrich)

Brechtel, Joachim Gerhard, *Nichtparametrische Schätzung von stationären und ergodischen Zeitreihen* (Michael Kohler)

Dalinger, Alexander, *Zufällige Grenzflächen* (Volker Betz)

Debski, Piotr, *Robuste Portfoliooptimierung mit Wertpapieren und Optionen: Ein mehrstufiger Ansatz* (Stefan Ulbrich)

Dück, Viktor, *Schätzung von Sprungstellen einer Regressionsfunktion mit Anwendung auf reale Daten* (Michael Kohler)

Heßler, Katrin, *Modelle für Störungsmanagement im ÖPNV* (Marc Pfetsch)

Horn, Benjamin Manfred, *Formoptimierung für Kontaktprobleme* (Stefan Ulbrich)

Kaske, Christian, *Profile von Schülerinnen und Schülern der Berufsfachschule* (Ralf Tenberg)

Knieling, Tobias, *E-Learning an berufsbildenden Schulen: Eine kritische Analyse aktueller Fachdiskurse anhand der Veröffentlichungen in den Fachzeitschriften von 2011 bis 2014* (Petra Grell)

Kodja, Joe-Loic, *Simulation of fluid flow and heat transfer in a heat exchanger* (Herbert Egger)

Kristl, Lisa, *Rekursive Schätzung eines Quantils unter Verwendung von importance sampling* (Michael Kohler)

Lenz, Lukas, *Bewertung von Amerikanischen Optionen mit regressionsbasierten Monte Carlo Verfahren mit geschätzten Preisprozessen* (Michael Kohler)

Lettmann, Michael, *Anwendung der Methode von Coquand und Hofmann auf das unendliche Schubfachprinzip und ähnliche Prinzipien* (Ulrich Kohlenbach)

Löbrich, Steffen, *A gap in the spectrum of the Faltings height* (Philipp Habegger)

Lübbers, Jan Erik, *A chain of interacting Brownian particles under strain* (Volker Betz)

Lukassen, Axel Ariaan, *Nichtlineare CG-Verfahren für restringierte Optimierungsprobleme* (Irwin Yousept)

Lumpp, Jennifer, *Wahrscheinlichkeitsrestriktionen mit Überdeckungsformulierungen* (Marc Pfetsch)

Lupp, Daniel Paul, *On equations of elliptic curves in* P^4 *from smooth to tropical* (Jan Hendrik Bruinier)

Matos Ribeiro, Patrick, *Das Außenraumproblem der stationären Boussinesq-Gleichungen in Lorentzräumen* (Reinhard Farwig)

Müller, Sabrina, *Power Minimization in Wireless Networks with Probabilistic Constraints* (Stefan Ulbrich)

Nattler, Stefanie, *Density of prime ideals in arithmetic dynamics* (Philipp Habegger)

Neumann, Eike Frederic, *Berechenbarkeitstheoretische Probleme in der metrischen Fixpunkttheorie und deren Weihrauchgrade* (Ulrich Kohlenbach)

Nietz, Sandra, *Kombinierte Optimierung von Zugrouten und Fahrplänen mit Orientierungsbedingungen* (Marc Pfetsch)

Paul, Eva, *Entwicklung, aktueller Stand und Perspektiven der Modularisierungsdebatte* (Bettina Siecke)

Probst, Stephan, *Modellierung für Preisprozesse im Rohstoffsektor* (Volker Betz)

Rammelt, Kristin, *Modellierungskompetenz im MINT-Bereich in einem Schülerworkshop zur 3D-Raumgeometrie* (Jens Gallenbacher)

Rebakovski, Aljona, *Adaptive density estimation based on real and artificial data* (Michael Kohler)

Reiser, Thomas, *Untersuchung des mehrstufigen RWA-Problems unter Unsicherheit* (Ulf Lorenz)

Ripp, Sascha, *Konzepte beruflicher Identität im Vergleich* (Birgit Ziegler)

Ritter, Christian Peter, *Untersuchung des stationären Zustandes eines Slotted-Aloha-Systems* (Frank Aurzada)

Rothenbächer, Ann-Kathrin, *Standortplanung und Netzwerkdesign im kombinierten Güterverkehr* (Marc Pfetsch)

Ruhmann, Iris, *Analyse von XOR-Polytopen* (Marc Pfetsch)

Saa Djimi, Beaudelaire, *Estimation of a Density in a Simulation Model* (Michael Kohler)

Schäfer, Helge, *W-Theoretische Modelle für Quanten-Gittergase* (Volker Betz)

Schemschat, Ruth Malin, *Vorwärtsdynamiksimulation von biomechanischen Systemen* (Oskar Stryk)

Schmid, Stefan, *Modular units and automorphic products* (Jan Hendrik Bruinier)

Schmitt, Michael Johann, *Multilevel Verfahren mit Modellen reduzierter Ordnung* (Stefan Ulbrich)

Schneider, Natascha, *"Ich wollte das! Und dann wars auch gut! – Aber daran muss man ja nicht festhalten . . . "* (Olga Zitzelsberger)

Sieber, Jessica, *Konvergenzanalyse und Numerische Tests für die Prothero-Robinson-Gleichung* (Jens Lang)

Stang, Olga, *Untersuchung des elementaren Abschlusses von {0,1/2}-Ungleichungen* (Marc Pfetsch)

Stanzel, Florian, *Diagnose- und Förderkonzept zu algebraischen Grundkönnen* (Regina Bruder)

Talebi, Taher, *Optimale Steuerung nichtlinearer Erwärmungsprozesse* (Irwin Yousept)

Theuer, Katharina, *Self-attracting random walks* (Volker Betz)

Utz, Marlene Luka, *Algorithmische Optimierung von Fluidsystemen* (Ulf Lorenz)

Vizev, Nikolay Vasilev, *Stock returns following large price jumps and drops – Evidence from Bulgarian market* (Dirk Schiereck)

Wenz, Sebastian Claus, *Optimale Konvergenzraten in der fehlerfreien Regression bei adaptiv gewähltem Design* (Michael Kohler)

Will, Karsten, *Optimierungsverfahren für dünne Rekonstruktion in der Bildverarbeitung* (Irwin Yousept)

Zhou, Li, *Prognose von Verteilungsquantilen – Das Beispiel Value-at-Risk* (Jens Krüger)

5.5 Staatsexamen Theses

2013

Cipura, Tobias, *Grundwissen und Grundkönnen in den Bereichen Potenzfunktionen und trigonometrische Funktionen* (Regina Bruder)

Ferchland-Fischer, Anna Catharina, *Diagnose von Fehlvorstellungen zu linearen Gleichungen* (Regina Bruder)

Fuhrmann, Romy, *Mathematisches Modellierungstraining für die 9. und 10. Jahrgangsstufe* (Regina Bruder)

Göbel, Yannick, *Digitale Lernmodule zum Ausbilden korrekter Grundvorstellungen im Themenfeld funktionaler Zusammenhang (SII)* (Regina Bruder)

Groh, Alexander, *Ein binnendifferenzierendes Aufgabenformat zur linearen Algebra* (Regina Bruder)

Hartmann, Patrick, *Erkenntnisstand zu Lernpotential und Qualitätsanforderungen bzgl. Mathematiktutorials* (Regina Bruder)

Milev, Diana, *Fächerübergreifend mathematische Kompetenz entwickeln – am Thema "Wasser"* (Regina Bruder)

Neuenfeld, Julia, *Schülerschwierigkeiten im Umgang mit quadratischen Funktionen* (Regina Bruder)

Rösch, Miriam, *Grundwissen und Grundkönnen in den Bereichen lineare und quadratische Funktionen* (Regina Bruder)

Salomon, Julian, *Eine LimeSurvey-basierte Testumgebung für mathematische Grundhandlungen* (Regina Bruder)

Santner, Christoph, *Pilotierung des Lernspiels "Der Wechsel" im Mathematikunterricht der Klassen 8 und 9* (Regina Bruder)

Schaub, Marcel, *Grundwissen und Grundkönnen in der Integralrechnung* (Regina Bruder)

Scheuermann, Steffen, *Grundwissen und Grundkönnen in der Differentialrechnung* (Regina Bruder)

Stricker, Eva, *Grundwissen und Grundkönnen im Bereich der Exponentialfunktionen* (Regina Bruder)

2014

Dautfest, Jakob, *Videospiele als Anwendungsfeld für mathematisches Modellieren* (Regina Bruder)

Freiherr von Lindenfels, Albrecht, *Logarithmen im historischen und didaktischen Kontext* (Burkhard Kümmerer)

Klöppinger Lisa, *Untersuchungen von Zusammenhängen zwischen Lernschwierigkeiten und Lernmotivation* (Regina Bruder)

Koch, Jens, *Fundamentale Ideen der Linearen Algebra und die Eingliederung historischer Aspekte in den Mathematikunterricht* (Regina Bruder)

Marycz, Karina, *Eine interaktive Lernumgebung zu Anwendungen von Matrizen* (Regina Bruder)

Mesewinkel, Yvonne, *Selbstlernumgebungen zur Wiederholung funktionaler Zusammenhänge* (Regina Bruder)

Rieger, Timo, *Eine digitale Hausaufgabenumgebung zu funktionalen Zusammenhängen* (Regina Bruder)

Rose, Rebecca, *Probleme und Ansätze zur Lese- und Schreibförderung im Mathematikunterricht* (Regina Bruder)

Tost, Daniela, *Potenzialanalyse von Abituraufgaben zur Kompetenzerfassung im Bereich Lineare Algebra* (Regina Bruder)

Weschler, Verena, *Reflexionspotenzial von Schulbuchaufgaben zur Linearen Algebra* (Regina Bruder)

5.6 Bachelor Theses

2013

Abt, Fabian Ferdinand Erich, *Projektionen zur Lösung von ℓ_1-Problemen* (Marc Pfetsch)

Adami, Thomas, *Robuste Portfoliooptimierung* (Stefan Ulbrich)

Aissa, Benjamin, *The Hasse principle and Selmer's counter example* (Nils Scheithauer)

Akman, Tugba, *Die Fouriertransformation und die Plancherel-Gleichung* (Matthias Hieber)

Beian, Abraham, *Der Kern eines kooperativen Spiels* (Werner Krabs)

Bethcke, Johannes, *Production Planning under Uncertainty using Quantified Integer Programming* (Ulf Lorenz)

Bitter, Vitali, *Homogene Bessel-Potentialräume* (Reinhard Farwig)

Brahm, Nadine Lisanne, *Pricing and Hedging of Options in the Cox-Ross-Rubinstein Model* (Volker Betz)

Buck, Micha, *Positiv-operatorwertige Maße und Spektraldarstellungen selbstadjungierter Operatoren* (Burkhard Kümmerer)

Butschek, Christian, *Untersuchung der Eindeutigkeit der dünn besetztesten Lösungen linearer Gleichungssysteme* (Marc Pfetsch)

Comis, Martin, *Adaptive Constraint Reduction for Training Support Vector Machines* (Stefan Ulbrich)

Diehl, Elisabeth Andrea Gertrud, *Vergleich des Orthogonal Matching und Basis Pursuit* (Marc Pfetsch)

Dittmann, Philip, *Ultraproducts as a tool for first-order Inexpressibility* (Martin Otto)

Erbenich, Vanessa Ines Philine, *Representations of Natural Numbers as Sums of Squares* (Jan Hendrik Bruinier)

Fenrich, Daniel Marcel, *Modellierung eines Heizungskreislaufs* (Ulf Lorenz)

Fischer, Carsten, *Local Central Limit Theorem* (Volker Betz)

Frank, Isabelle, *Bewertung Amerikanischer Optionen als Lösung eines optimalen Stoppproblems unter Berücksichtigung auftretender Messbarkeitsprobleme* (Michael Kohler)

Geiß, Daniel, *Vergleich von Blum-Shub-Smale Maschinen über den komplexen Zahlen* (Martin Ziegler)

Gnegel, Franziska, *The Peano Curve* (Robert Haller-Dintelmann)

Göttmann, Sabrina, *Interior-Point Methods and Smoothing-Type Methods for Semidefinite Programs* (Stefan Ulbrich)

Grab, Sabrina Rita, *Optimales Schätzen von OD-Matrizen* (Marc Pfetsch)

Griebe, Nils, *Hidden-Variable-Interpretationen der Quantenmechanik und das Kochen-Specker-Theorem* (Gernot Alber)

Gries, Mathis Yannik, *Dilatationstheorien in Kategorien von Banachräumen* (Burkhard Kümmerer)

Grimm, Vanessa Rebecca, *Abelsche Kategorien und Derivierte Funktoren* (Philipp Habegger)

Gu, Oliver, *European Option Pricing under Jump Diffusion* (Volker Betz)

Habeck, Oliver, *Einführung in die Morse-Theorie* (Karsten Große-Brauckmann)

Heeg, Simon, *Minimax-Konvergenzraten – Untere Schranken* (Michael Kohler)

Herbst, Alexander, *Analyse und praktische Tests für Nesterov's Algorithmus (NESTA)* (Marc Pfetsch)

Herrmann, Sabine Johanna, *Paritätsbedingungs-Codes mit geringer Dichte und Compressed Sensing* (Marc Pfetsch)

Heun, Sebastian, *Robuste Optimierung von mehrstufigen Portfolios* (Stefan Ulbrich)

Hoffmann, Anna-Lena, *Die Weylsche Charakterformel* (Nils Scheithauer)

Horn, Benjamin Manfred, *Dünnbesetzte Repräsentationen in Paaren von Basen* (Marc Pfetsch)

Huyen, Chan Bao, *Der Test von Kolmogoroff-Smirnow* (Michael Kohler)

Islam, Chris-Gabriel, *The Proof of the Glivenko-Cantelli Theorem* (extern, anerkannt)

Kettner, Marvin, *Der Ergodensatz von Birkhoff mit zahlentheoretischen und stochastischen Anwendungen* (Burkhard Kümmerer)

Kilian, Johannes, *Konvergenzratenresultat für den Kernschätzer bei unbeschränkter Prädiktorvariable* (Michael Kohler)

Kirmse, Sascha, *Dual methods for pricing American options based on kernel regression estimates* (Michael Kohler)

Knebel, Dominik, *On the rate of convergence of the partitioning regression estimate* (Michael Kohler)

Knof, Albrun, *The Road Coloring Problem* (Burkhard Kümmerer)

Kreis, Mathias, *Robuste Optimierung von Kreditportfolios* (Stefan Ulbrich)

Kristl, Lisa, *Der χ^2-Anpassungstest* (Michael Kohler)

Krüger, Thomas, *Octonions and Triality* (Nils Scheithauer)

Kugler, Thomas, *Entropie und der Komprimierungsalgorithmus von Lempel-Ziv* (Burkhard Kümmerer)

Landmann, Philipp, *Box-Counting-Dimension makroskopischer Zykel von Zufallspermutationen* (Volker Betz)

Lang, Mirko, *Das Rademacher-Theorem* (Robert Haller-Dintelmann)

Li, Qiaochu, *Regressionsbasierte Monte-Carlo-Verfahren zur Bewertung Amerikanischer Optionen bei geschätztem Preisprozess* (Michael Kohler)

Löbrich, Steffen, *Generators for Congruence Subgroups* (Nils Scheithauer)

Loch, Svana, *The Calderón-Zygmund decomposition and the boundedness of the maximal function* (Robert Haller-Dintelmann)

Loo, Jolyn Jia Lian, *Estimation of Univariate Regression Function Using Least Squares Splines* (Michael Kohler)

Maliqi, Beqir, *Robuste Lösungen von unsicheren linearen Programmen* (Stefan Ulbrich)

Mayer, Christoph Manuel, *Ein Vergleich von algebraischen Gruppen und Lie-Gruppen* (Walter Freyn)

Mindt, Pascal, *Konvergenzgeschwindigkeit des 1NN-Schätzers im L_2* (Michael Kohler)

Möller, Jens-Henning, *H-Maße* (Hans-Dieter Alber)

Mühlbauer, Julia, *Tests bei monotonen Dichtequotienten* (Michael Kohler)

Müller, Fabian, *Theoretische und numerische Untersuchungen an einem Modell der Lymphangionese* (Jens Lang)

Munkelberg, Dennis, *Über die Verteilung der Prüfgröße beim Test von Kolmogorow-Smirnow* (Michael Kohler)

Nickel, Fenja, *Partitionen und Modulformen* (Jan Hendrik Bruinier)

Otterbein, Markus, *Preprocessing für Robuste Stabwerksoptimierung* (Stefan Ulbrich)

Penzel, Nils, *Verallgemeinerung geometrischer Schnittebenen* (Marc Pfetsch)

Pötz, Christian, *Ein uniformes starkes Gesetz der großen Zahlen* (Michael Kohler)

Rebakovski, Aljona, *Empirical Comparison of Nonparametric Regression Estimates on Real Data* (Michael Kohler)

Röchner, Philipp, *Fourier transform of tempered distributions and Sobolev's lemma* (Robert Haller-Dintelmann)

Rothermel, Nina Karin, *f-Vektoren von Minkowski-Summen konvexer Polytope* (Michael Joswig)

Rückbeil, Marcia Viviane, *Der L_1-Fehler des Kerndichteschätzers* (Michael Kohler)

Schäfer Aguilar, Paloma, *Die Eta-Funktion als automorphes Produkt* (Nils Scheithauer)

Schönherr, David Hans Alfred, *Profinite Galois groups* (Jan Hendrik Bruinier)

Schürr, Jonathan Armin Heinrich, *Oszillatordarstellungen von Lie-Superalgebren* (Nils Scheithauer)

Schwinn, Sebastian, *Robuste Stabwerksoptimierung mit lokalen Knicknebenbedingungen* (Stefan Ulbrich)

Sedlaczek, Johannes, *Introduction to the Representation Theory of Finite Groups* (Nils Scheithauer)

Seib, Bianca Mercedes, *Experimentelle Untersuchung des Verfahrens von Juditsky und Nemirovski* (Marc Pfetsch)

Seyfert, Anton, *Die Navier-Stokes-Gleichungen in homogenen Sobolevräumen* (Reinhard Farwig)

Smolarek, Nadine, *Optimalität des einseitigen Gauß-Test* (Michael Kohler)

Stähler, Maximilian, *Global Minimization of Nonconvex Functions* (Stefan Ulbrich)

Stock, Christian, *Kreditrisiko Optimierung mit Conditional Value at Risk* (Stefan Ulbrich)

Stumpf, Johanna, *Operationen zwischen geordneten Graphenklassen* (Achim Blumensath)

Suo, Yun, *Universelle Konsistenz des Partitionenschätzers* (Michael Kohler)

Syed, Hissam Aziz, *Challenges in Mobile Cloud Gaming - An Analytical and Empirical Examination with Focus on Energy Consumption* (Ralf Steinmetz)

Thies, Holger, *Komplexitätstheorie und Praxis der Integration Lipschitz-stetiger Funktionen in der exakten reellen Arithmetik* (Martin Ziegler)

Tichai, Alexander, *Kombinatorische Flächen mit hohem Geschlecht* (Karsten Große-Brauckmann)

Tsiolas, Christos, *Terminierungskriterien bei SPGL1 und CPLEX* (Marc Pfetsch)

Ulsenheimer, Fabian, *Empirischer Vergleich des Tests von Kolmogoroff-Smirnow und dessen nicht asymptotischer Variante* (Michael Kohler)

van Spankeren, Moritz, *The Spectral Theorem for Self-Adjoint Operators* (Reinhard Farwig)

Vonk, Johannes Cornelis, *Ein nichtlineares Best-Approximationsproblem mit Unterschranken aus der Industrie und ein Lösungsansatz durch Nichtlineare Optimierung* (Stefan Ulbrich)

Wasmayr, Viktoria, *Primal-dual Interior-Point Methods with Redundancy Control* (Stefan Ulbrich)

Wiegand, Constanze Maria, *Lower Bounds in Nonparametric Regression Estimation* (Michael Kohler)

Windemuth, Arthur, *Diskrete Flächen mit konstanter negativer Gaußkrümmung* (Karsten Große-Brauckmann)

Zhu, Zhu, *Universelle Konsistenz des Kernschätzers* (Michael Kohler)

2014

Adner, Robin, *Paritätsbeschränkte Triangulierungen von Punktmengen der Ebene* (Matthias Mnich)

Aegerter, Arvid Stefan, *Mathematische Grundlagen beim Beweis der starken universellen Konsistenz des Kerndichteschätzers* (Michael Kohler)

Alaca, Sevda, *Das kollektive Modell in der Schadenversicherungsmathematik* (Michael Kohler)

Alt, Lukas Sebastian, *Individuelle Minimaxkonvergenzraten in der nichtparametrischen Regression* (Michael Kohler)

Althaus, Lea, *Modellierung kollektiver Zellbewegung* (Herbert Egger)

Antons, Yannic, *Grundlagen und Vergleich von Innere-Punkte-Methoden, Glättungsverfahren und semiglatten Newton-Verfahren in Anwendung auf lineare Optimierungsprobleme* (Stefan Ulbrich)

Ball, Johannes, *Adaptive Dichteschätzung in einem Simulationsmodell* (Michael Kohler)

Bauer, Benedikt, *Adaptive Wahl der Bandbreite des Kerndichteschätzers bei Daten mit kleinen Messfehlern* (Michael Kohler)

Bauer, Sascha, *Die Konvergenzgeschwindigkeit des Kernschätzers mit naivem Kern* (Michael Kohler)

Beisenherz, Fabian, *Der Satz von Stone und seine theoretischen Grundlagen* (Michael Kohler)

Bergen, Christoph, *Der Hardy-Raum der oberen Halbebene* (Robert Haller-Dintelmann)

Berndt, Aileen, *Der Algorithmus von Truemper für verallgemeinerte Netzwerke* (Marc Pfetsch)

Bier, Lisa, *Konsistenz und Konvergenzgeschwindigkeit des Kernschätzers in der nichtparametrischen Regression* (Michael Kohler)

Birx, Alexander Marcel, *Das Theorem von Riemann-Roch* (Nils Scheithauer)

Bischof, Daniel, *Finanzderivate unter stochastischer Volatilität* (Volker Betz)

Bonin, Julian, *Kombinatorische Aspekte der VC-Theorie* (Michael Kohler)

Bridi, Michelle Germaine, *Mathematische Grundlagen zum Beweis der universellen Konsistenz des Kerndichteschätzers* (Michael Kohler)

Brunning, Katharina, *Incremental Network Design with Shortest Paths* (Stefan Ulbrich)

Bube, Georg, *Consistency of Peano Arithmetic and E0-induction* (Ulrich Kohlenbach)

Bugge, Sebastian Rainhard, *Beweis der Fermat-Vermutung für reguläre Primzahlen* (Anna-Maria von Pippich)

Cakkalkurt, Sezan Dila, *Das Submartingalkonvergenztheorem und sein Beweis* (Michael Kohler)

Carkit, Ercan, *Innere-Punkte-Methoden und Glättungsverfahren* (Stefan Ulbrich)

Carmesin, Ellen Angelika Dagmar, *Jordan's Theorem on Finite Subgroups of Matrix Groups* (Philipp Habegger)

Chojnowska, Lars, *Semiglatte Methoden für lineare und nichtlineare Second Order Cone Programme* (Stefan Ulbrich)

Dincer, Faruk, *Optimalität von Aussagen zur universellen Konsistenz in der nichtparametrischen Regressionsschätzung* (Michael Kohler)

Dörig, Bastian, *Mathematical Treatment of Grover's Algorithm from Quantum Information* (Burkhard Kümmerer)

Dosch, Christina, *Neue Algorithmen für verallgemeinerte Netzwerkflüsse* (Marc Pfetsch)

Eckardt, Antonia, *Theoretical and practical approaches to wildlife corridor design* (Matthias Mnich)

Ehlert, Johannes Florian, *LOCC-Transformationen von reinen bipartiten Quantenzuständen und Majorisierung* (Burkhard Kümmerer)

Eiter, Thomas Walter, *Der Satz von Mihlin und H^∞-Kalkül für elliptische Operatoren* (Matthias Hieber)

Erle, Christine Marleen, *Der Satz von Stone* (Michael Kohler)

Eryasar, Gülay, *Das Fundamentallemma von Neyman und Pearson* (Michael Kohler)

Fladung, Marc, *Optimales Stabwerksdesign unter einer nichtkonvexen globalen Knick-Nebenbedingung* (Stefan Ulbrich)

Follert, Felix, *Dekompositionsmethoden zur parallelen Optimierung von Multiagenten-Systemen* (Stefan Ulbrich)

Fricke, Mathis, *Der Satz von Noether und seine Anwendungen* (Karsten Große-Brauckmann)

Füchtenhans, Marc, *Brickpolytope und Zerlegungen von Assoziadern* (Andreas Paffenholz)

Fürnstall, Lena, *Die Wärmeleitungsgleichung mit Dirichlet- und Neumannrandbedingung im Vergleich* (Robert Haller-Dintelmann)

Getrost, Marco, *Adaptive Wahl der Bandbreite des Kerndichteschätzers* (Michael Kohler)

Göbel, Rebecca, *Approximation von diskreten Kurven mit Helices* (Ulrich Reif)

Gorges, Marco, *Der Hilbertsche Nullstellensatz* (Priska Jahnke)

Görich, Daniel, *Der Satz von Stone und seine Anwendung auf den Partitionenschätzer* (Michael Kohler)

Grohmann, Leonard, *Laplacian Eigenpolytopes* (Andreas Paffenholz)

Hahn, Jens, *Das Theorem von McDiarmid und seine Anwendung in der Dichteschätzung* (Michael Kohler)

Hasler, Daniel, *Ein uniformes starkes Gesetz der großen Zahlen* (Michael Kohler)

Heckwolf, Jan, *Der Spektralsatz für selbstadjungierte Operatoren* (Matthias Hieber)

Heldmann, Anica, *Inkrementelles Netzwerk-Design mit kürzesten Wegen* (Stefan Ulbrich)

Herzog, Janine, *Algorithmen für Flüsse über die Zeit* (Marc Pfetsch)

Holzer, Patrick, *Konstruierbarkeit mit Origami im Vergleich zu Zirkel und Lineal mit Winkeldreiteilung* (Philipp Habegger)

Hopf, Jonathan, *Die Konvergenzgeschwindigkeit des Kernschätzers in der nichtparametrischen Regression* (Michael Kohler)

Hubert, Daniela Katharina, *Optimierung des Conditional Value at Risk unter Unsicherheit als robustes Optimierungsproblem* (Stefan Ulbrich)

Kalsen, Ali, *Separable Semidefinite Optimierung mit Anwendung auf Optimales Downlink Beamforming* (Stefan Ulbrich)

Kang, Ji-Young, *Optimization of Conditional Value-at-Risk for General Loss Distributions Based on Robust Solutions of Uncertain Linear Programs* (Stefan Ulbrich)

Kersting, Sebastian, *Empirischer Vergleich von Verfahren zur nichtparametrischen Regressionsschätzung* (Michael Kohler)

Kertels, Fabian, *Eine rationale elliptische Kurve vom Rang 1* (Nils Scheithauer)

Keukoua Wantiep, Guenole, *Robust Portfolio Selection Problems* (Stefan Ulbrich)

Kinz, Monika, *Decomposition by Partial Linearization: Parallel Optimization of Multi-Agent Systems* (Stefan Ulbrich)

Knauf, Nils, *Nichtparametrische Quantilschätzung unter Verwendung von Importance Sampling* (Michael Kohler)

Knoff, Peter, *Lösung von konvexen Mehrgüterflussproblemen* (Marc Pfetsch)

Kocamer, Veysel Didier, *Der Satz von Stone und seine Anwendung auf den Nächste-Nachbarn-Schätzer* (Michael Kohler)

Köhler, Jan, *Glättungsverfahren für Semidefinite Optimierungsprobleme* (Stefan Ulbrich)

Kohrt, Nils, *Der Kaplan-Meier Schätzer* (Michael Kohler)

Kolb, Ann-Kathrin, *Numerische Simulation des Stoffübergangs in einer Blasenströmung auf Grundlage der Hadamard-Rybczynski-Lösung mit Volumenänderung* (Dieter Bothe)

Kreß, Klaus, *Der Satz von Alaoglu und schwache Topologien* (Matthias Hieber)

Kunz, Johannes Georg, *Schwache universelle Konsistenz des Nächsten-Nachbarn-Schätzers* (Michael Kohler)

Lam, Mekong, *Various Aspects of the Feigenbaum Scenario* (Ulrich Reif)

Lang, Florian, *Numerische Methoden zur Bestimmung der Karhunen-Loève-Entwicklung von Zufallsfeldern* (Alf Gerisch)

Lange, Jan-Hendrik, *Reducing Linear Programs to Basis Pursuit* (Marc Pfetsch)

Laschow, Stefan, *Dual methods for pricing American options based on nearest neighbour estimate* (Michael Kohler)

Lautenbach, Stefan, *Zur Abschätzung von Stichprobenmitteln durch Erwartungswerte* (Michael Kohler)

Lehr, Ines, *Der Satz von Pollard* (Michael Kohler)

Loiero, Mirjam, *Ägyptische Brüche* (Werner Krabs)

Luckhaupt, Lars, *INGARCH-Modelle für Zähldatenzeitreihen und eine Anwendung in der Epidemiologie* (Michael Kohler)

Luksch, Kathrin, *Universelle Gatter in zweidimensionalen Quantenregistern* (Burkhard Kümmerer)

Luu, Thuy Linh, *Theorie von Compressive Sensing via ℓ_1-Minimierung: eine RIP-freie Analyse und Erweiterung* (Stefan Ulbrich)

Mauthe, Axinja Laura, *Robust Portfolio Optimization with Value-At-Risk Adjusted Sharpe Ratios* (Stefan Ulbrich)

Menche, Julian, *Robuste Modellierung von mehrstufigen Portfolio-Problemen* (Stefan Ulbrich)

Miller, Philip, *Trennung und Kompaktheit in topologischen Hyperräumen* (René Bartsch)

Nguyen, Mau Duong, *Der Core eines Produktionsspieles* (Werner Krabs)

Nowak, Tara Selina, *Arnold's Cat Map and its application in cryptography* (Burkhard Kümmerer)

Pantalia, Preetkamal Singh, *Eine Anwendung des Lemmas von Fatou in der nichtparametrischen Regressionsschätzung* (Michael Kohler)

Park, Sung-Ho, *Robust Modeling of Two-periodic Option Portfolios* (Stefan Ulbrich)

Pavlovic, Gabriel, *Der Chi-Quadrat-Anpassungstest* (Michael Kohler)

Pfeifer, Markus, *Topologische Vektorräume und Distributionen* (Matthias Hieber)

Pfifferling, Lena, *Sectorial sesquilinear forms on Hilbert spaces* (Robert Haller-Dintelmann)

Pohl, Daniel, *Eine duale Sicht auf separierbare Semidefinite Programmierung im optimalen Downlink Beamforming* (Stefan Ulbrich)

Prager, Monika Simone Renate, *Applications of Minimal Cuts in Graphs in Image Segmentation* (Marc Pfetsch)

Prause, Manuel, *Schwache universelle Konsistenz des Partitionsschätzers* (Michael Kohler)

Radu, Bogdan, *Compressive Sensing and Signal Reconstruction Algorithms* (Stefan Ulbrich)

Rauls, Anne-Therese, *The Bochner Integral* (Robert Haller-Dintelmann)

Rieß, Susanne, *Factorization Algorithms* (Priska Jahnke)

Rohleder, Mischa, *Der Partitionenschätzer für zensierte Daten* (Michael Kohler)

Roopra, Harneet Singh, *Minimax Lower Bounds – A Topic from the Field of Nonparametric Regression* (Michael Kohler)

Rössler, Maximilian, *Darstellungstheorie kompakter Gruppen* (Nils Scheithauer)

Ruppert, Simon Moritz, *Two Point Boundary Value Problems and the Shooting Method* (Herbert Egger)

Schempp, Matthias, *Der Satz von Bézout und das Gruppengesetz auf elliptischen Kurven* (Priska Jahnke)

Schließmann, Felix, *Eine Einführung in die Kerndichteschätzung* (Michael Kohler)

Schmidt, Carsten, *Determinante von Operatoren* (Steffen Roch)

Schmidt, Dominik, *Der Satz von Pollard* (Michael Kohler)

Schmidt, Robert Paul, *Der Satz von Glivenko-Cantelli und sein Beweis* (Michael Kohler)

Schmitt, Andreas, *Empirischer Vergleich des Nächste-Nachbar- und des Partitionenschätzers anhand realer Daten* (Michael Kohler)

Schneider, Moritz, *Finite element methods for the one dimensional obstacle problem* (Herbert Egger)

Schneider, Sarah, *Untersuchung der anomalen intramolekularen Diffusion in Proteinen unter Zuhilfenahme fraktionaler Infinitesimalrechnung und molekulardynamischer Simulation* (extern, anerkannt)

Schöbel-Kröhn, Lucas Wilfried, *The Hille-Yosida Theorem and Semigroups of Operators* (Matthias Hieber)

Schorr, Robert, *Ein Innere-Punkte-Verfahren mit adaptiver Nebenbedingungsreduktion für das Training von Support Vector Machines* (Stefan Ulbrich)

Spohn, Nadine Fabienne, *Minimax Lower Bounds for Nonparametric Regression Estimates* (Michael Kohler)

Stern, Alexandra, *Directed Feedback Vertex Sets in Fast Exponential Time* (Matthias Mnich)

Tabbert, Anne Nicola, *The Stone-Čech-Compactification - properties and several constructions* (René Bartsch)

Teschner, Gabriel Christian, *Zur Implementierung der kombinatorischen Wahl der Bandbreite des Kerndichteschätzers* (Michael Kohler)

Vetter, Marco, *Das Cape-Cod-Verfahren in der Schadenversicherungsmathematik* (Michael Kohler)

Vogt, Katja, *Heuristische Ansätze zum Auffinden von Cliquen* (Ulf Lorenz)

Weber, Marcel, *Individual Minimax Lower Bounds* (Michael Kohler)

Weinberger, Jonathan, *Splitting the Classical Model Category Structure on Simplicial Sets* (Thomas Streicher)

Werner, David, *Robuste Lösung unsicherer linearer Programme* (Stefan Ulbrich)

Werner, Johannes Manuel Friedemann, *Rangbeschränkte, separable, semidefinite Programmierung mit Anwendung beim optimalen Beamformingproblem* (Stefan Ulbrich)

Wickel, Sebastian, *Globale Minimierung mittels linearer und quadratischer Approximation* (Stefan Ulbrich)

Wittmann, René Marc, *Removing local minima in node-weighted graphs* (Matthias Mnich)

Wolf, Felix, *Topological properties of* $\beta\omega \setminus \omega$ (René Bartsch)

Wolf, Franziska Doris, *Die kombinatorische Methode zur adaptiven Wahl eines Dichteschätzers* (Michael Kohler)

Wrona, Marc, *Heat kernel bounds by Davies' trick* (Robert Haller-Dintelmann)

Zelch, Christoph, *Sparsification of matrices* (Marc Pfetsch)

Zender, Sebastian, *Pearson's chi-squared Test* (Michael Kohler)

Zimmer, Petra, *Stabilität gewöhnlicher Differentialgleichungen* (Herbert Egger)

6 Presentations

6.1 Talks and Visits

6.1.1 Invited Talks and Addresses

Hans-Dieter Alber

15/07/2013 *-26/07/2013 Theory and numerical simulation of phase transformations in solids*
CIMPA Research School on partial differential equations in mechanics, Mongolian University of Science and Technology, Ulaanbaatar

05/06/2014 *Hybride Phasenfeldmodelle und Eshelby-Flüsse von Flächen*
Colloquium talk, Department of Mathematics, Universität Konstanz

25/06/2014 *Degenerate parabolic phase field models – properties and open problems*
INdAM workshop on singular and degenerate evolution problems, Palazzone della Scuola Normale, Cortona

09/09/2014 *A degenerate parabolic phase field model – properties and numerical simulations*
XIXth Symposium on trends in application of mathematics to mechanics, Université de Poitiers

Tristan Alex

15/03/2013 *A Vertical Half-Space Theorem in Heisenberg Space*
Seminario de Geometría, Granada

Claudia Alfes

23/05/2014 *Harmonic weak Maass forms and elliptic curves*
Moduli and Automorphic Forms: a Meeting for Young Women in Mathematics, Berlin

Frank Aurzada

08/06/2013 *First passage times of Lévy processes over a one-sided moving boundary*
Deutsch-Polnische Stochastik-Tage, Torun

24/11/2013 *Exit times with moving boundaries for Lévy processes*
Workshop Hitting times and exit problems for stochastic models, Dijon

09/12/2013 *Bitte hinten anstellen. Einige Resultate der Warteschlangentheorie*
Universität Stuttgart

06/02/2014 *Exit times with moving boundaries for Lévy processes*
Workshop Jumps 2014, Dresden

24/03/2014 *Persistence Probabilities*
University of Delaware

28/03/2014 *Persistence Probabilities*
Columbia University, New York

10/10/2014 *How much information is contained in a random picture?*
Workshop Probabilistic and geometric facets of high dimensions, Bochum

René Bartsch

01/03/2014 *Hyperstructures in topological Categories*
14th Colloquiumfest, University of Saskatchewan, Saskatoon

19/12/2014 *Fractals and Hyperspaces*
Workshop on Interactions between Algebra and Functional Analysis, Academy of Sciences of the Czech Republic, Prague

Volker Betz

14/03/2013 *Geometry of spatial random permutations*
Seminar on Statistical Mechanics, Warwick

03/05/2013 *Superadiabatic transitions in molecular quantum dynamics*
Workshop on mathematical methods in quantum chemistry, Banff

07/05/2013 *Planar spatial random permutations*
Workshop on Random Combinatorial Structures and Statistical Mechanics, Venice

14/07/2013 *Planar spatial random permutations*
Workshop on stochastic models in the sciences, Bielefeld

06/05/2014 *Superadiabatic transitions in molecular quantum dynamics*
COST workshop on quantum chemistry, Bad Homburg

06/06/2014 *Spatial random permutations*
Rhein-Main Kolloquium, Frankfurt

04/09/2014 *Long cycles of spatial random permutations*
Seminar on probability theory, Bonn

28/11/2014 *Zufällige räumliche Permutationen und Bose-Einstein-Kondensation*
Kolloquium, Universität Tübingen

Dieter Bothe

05/03/2013 *A thermodynamically consistent model for chemically reacting multicomponent fluid systems*
International Conference on the Mathematical Fluid Dynamics on the occasion of Professor Yoshihiro Shibata's 60th birthday, Nara

26/04/2013 *Direct Numerical Simulations of binary droplet collisions*
On the occasion of the 60th birthday of Prof. Dr.-Ing. Martin Sommerfeld, Universität Halle

23/07/2013 *Global existence and asymptotic behavior for an electro-hydrodynamics model*
Solid State Electrochemistry Workshop, Heidelberg

28/08/2013 *VOF-based techniques for simulation transport processes at fluid interfaces*
Euromech Colloquium 555, Bordeaux

27/09/2013 *Direct numerical simulation of interfacial flow phenomena - a survey*
8th ITTW Two-Phase Systems for ground and space applications, Bremen

26/11/2013 *Continuum thermodynamics of chemically reacting multicomponent fluid systems*
MORE Workshop Implicitly constituted materials: Modeling, Analysis an Computing, Liblice

04/03/2014 *Detailed Modeling and Simulation of Mass Transfer across Fluid interfaces*
Seminar IMFT, Toulouse

16/04/2014 *VOF-based simulation techniques for transport processes at fluid interfaces*
CISM Course, Udine

12/05/2014 *Continuum thermodynamics of chemically reacting fluid mixtures*
Nečas Seminar for Continuum Mechanics, Prague

23/05/2014 *Transportprozesse an Fluidgrenzflächen: Modellierung, Analysis und numerische Simulation*
Institutskolloquium, Köln

30/07/2014 *Continuum thermodynamics of multicomponent fluid mixtures and implications for modeling electromigration of ionic species*
Fields Institute, Toronto

Daniela Bratzke

12/09/2013 *Optimal control of hydroforming processes based on reduced order models*
IFIP TC7 Conference on System Modelling and Optimization, Klagenfurt

Regina Bruder

02/03/2013 *Grundwissen und Grundkönnen: Was gehört dazu, wie erwirbt man es und wie bleibt es verfügbar?*
Teacher further training talk at "Tag der Mathematiks", Darmstadt

16/03/2013 *Chancen und Risiken digitaler Werkzeuge für die mathematische Kompetenzentwicklung – Erfahrungen aus Langzeitprojekten*
Keynote talk at the T^3-Conference, Bielefeld

26/03/2013 *Gute Argumente für mathematisches Argumentieren*
Talk at 104. MNU-Federal-Conference, Hamburg

06/05/2013 *Mathematisches Problemlösen kann man lernen – aber wie?*
Teacher further training, Graz

10/07/2013 *CAS use in secondary school mathematics – teaching style and mathematical achievement*
ICTMT 11, Bari

05/09/2013 *Mit Binnendifferenzierung zum Mathematikabitur. Wege zur Implementierung der Abiturstandards in Hessen*
Talk at the MNU-Regional-Conference Hessen, Fulda

10/09/2013 *MAM-Kurs zu einem Unterrichtskonzept zur Binnendifferenzierung*
Münster

16/09/2013 *Lehren und Lernen von Mathematik aus der Makroperspektive – Beiträge quantitativ empirischer Forschung*
Input talk at the Summerschool of GDM, Klagenfurt

19/09/2013 *Grundwissen und Grundkönnen (Basiskompetenzen) zu funktionalen Zusammenhängen in den Sekundarstufen ausbilden und wachhalten*
Teacher trainung as part of Felix Klein Workshops, Berlin

23/09/2013 *Mathematisches Problemlösen kann man lernen – aber wie?*
Talk at the Meeting of the Subject Supervisors for Mathematics, Würzburg

26/09/2013 *Basiskompetenzen*
Talk at the Conference of MNU heads of subjects, Fuldatal

27/09/2013 *Fachdidaktisch und lerntheoretisch begründete Modelle zum Lehren und Erlernen von Heurismen im Mathematikunterricht*
Talk at the Conference on Problem Solving, Braunschweig

08/10/2013 *Die Abiturstandards implementieren – Konzepte und Gelingensbedingungen*
Talk at the Conference of the Transition-Group School-University of DMV, GDM and MNU, Münster

28/10/2013 *Ein Unterrichtskonzept zu einem binnendifferenzierten Mathematikunterricht mit Erprobungsergebnissen aus dem Projekt MABIKOM*
Talk at the Didactical Colloquium, Universität Halle

06/11/2013 *Mathematisch Modellieren, Argumentieren und Problemlösen lernen – aber wie?*
Talk in Schwandorf

11/11/2013 *Langfristiger Kompetenzaufbau zum mathematischen Problemlösen in den Sekundarstufen*
Talk at the Didactical Colloquium, Leuphana-Universität, Lüneburg

15/11/2013 *Lerntypen*
Talk as part of the MUED Annual Meeting, Fuldatal

30/04/2014 *Wege zum langfristigen Kompetenzaufbau im Unterricht*
Keynote talk within eLearning Cluster at Spring-Conference 2014, Wien

22/05/2014 *MABIKOM- ein Unterrichtskonzept mit Elementen offener Differenzierung*
Talk at the Didactical Colloquium, Universität Bamberg

04/07/2014 *Technologie stützt intelligentes Wissen und Handlungskompetenzen fördern*
Keynote talk at Time2014, Krems

25/09/2014 *Mit Unterschieden kann man rechnen ⋯*
Talk at the Mathematikum, Gießen

27/09/2014 *Argumentieren lernen im Mathematikunterricht*
Keynote talk "Mathematik für alle", Conference, Dortmund

25/11/2014 *Kompetenzaufbaus im Tätigkeitskonzept*
Talk at the research seminar, Universität des Saarlandes, Saarbrücken

18/12/2014 *Wie kann man mathematisches Problemlösen lehren und lernen? Konzepte zu einem langfristigen Kompetenzaufbau*
Talk at the Didactical Colloquium, Ludwig-Maximilians-Universität München

Jan H. Bruinier

08/03/2013 *Heights of Kudla-Rapoport divisors and derivatives of L-functions*
Postech Number Theory Workshop, Pohang

09/04/2013 *Erzeugende Reihen und Schnittpaarungen von arithmetischen Divisoren*
Research Seminar Arithmetic Geometry, HU Berlin

04/06/2013 *Kongruente Zahlen und elliptische Kurven – von Fermat bis heute*
Ringvorlesung Was steckt dahinter?, TU Darmstadt

12/02/2014 *Special cycles on Shimura varieties and modular forms*
Conference Automorphic forms and Arithmetic, Göttingen

26/03/2014 *Special cycles on Shimura varieties and modular forms*
Conference Explicit Theory of Automorphic Forms, Tongji University, Shanghai

26/06/2014 *Kudla's modularity conjecture and formal Fourier-Jacobi series*
Oberseminar Algebraische und Arithmetische Geometrie, Universität Hannover,

10/07/2014 *Kudla's modularity conjecture and formal Fourier-Jacobi series*
Workshop Algebraische Zahlentheorie, Mathematisches Forschungsinstitut, Oberwolfach

11/12/2014 *Borcherds products*
Winter school Modular functions in one and several variables, University of Goa

Pia Domschke

12/05/2014 *Mathematical modelling of cancer invasion: Implications of cell adhesion variability for tumour infiltrative growth patterns*
International Workshop on Numerical Methods and Emerging Computational Challenges in Mathematical Biology 2014, Dundee

Herbert Egger

27/02/2013 *Explicit Time Stepping for Radiative Transfer based on Mixed Variational Formulations*
SIAM CSE, Boston

14/03/2013 *An explicit time stepping method for radiative transfer*
MIRAN Inverse Problems in Transport, Manchester

28/03/2013 *Optical Tomography: Models, Analysis, Numerics and Inverse Problems*
10 Years Johann Radon Institute, RICAM

17/04/2013 *Stabilität, Konsistenz, Approximation: Fehlerhaft Rechnen mit System*
Mathematisches Kolloquium, TU Darmstadt

28/06/2013 *Radiative Transfer: Analysis, Numerics and Inverse Problems*
Rhein-Main-Arbeitskreis, Universität Mainz

27/05/2014 *Inverse Probleme: Mathematische Antworten auf praktische Fragen*
Was steckt dahinter, TU Darmstadt

11/07/2014 *An inverse problem in nonlinear heat conduction*
Mathematisches Seminar, Universität Saarbrücken

12/09/2014 *A posteriori estimates for hybrid discontinuous Galerkin methods*
Workshop on Recent advances in discontinuous Galerkin methods, University of Reading

26/09/2014 *Computational Methods, Inverse Problems and Optimization in Radiative Transfer*
IPTA Recife

30/10/2014 *Computational Inverse Problems*
Toyota-CSI Workshop, TU Darmstadt

Christoph Erath

20/06/2013 *Advanced Finite Volume Methods - Theory and Practical Applications*
Numerik und Wissenschaftliches Rechnen, TU Darmstadt

20/05/2014 *Finite-Volume-Based Semi-Lagrangian Schemes for the Community Atmosphere Model CAM-SE*
Meteorological-Geophysical Kolloquium, Universität Wien

Reinhard Farwig

30/01/2013 *Regulär oder singulär - das ist die Frage bei den Navier-Stokes-Gleichungen*
Kolloquium, Universität Regensburg

07/03/2013 *How (fast) do solutions of the Boussinesq system decay?*
International Conference on the Mathematical Fluid Dynamics, Nara

22/05/2013 *How (fast) do solutions of the Boussinesq system decay?*
Workshop on Navier-Stokes Equations, RWTH Aachen

17/06/2013 *Besov space regularity conditions for weak solutions of the Navier-Stokes equations*
8th Japanese-German International Workshop on Mathematical Fluid Dynamics, Tokyo

28/08/2013 *Optimal initial values and regularity conditions of Besov space type for weak solutions to the Navier-Stokes system*
EQUADIFF 13, Prague

18/11/2013 *Optimal initial values and regularity conditions of Besov space type for weak solutions to the Navier-Stokes system*
Nagoya University

20/11/2013 *Optimal initial values and regularity conditions of Besov space type for weak solutions to the Navier-Stokes system*
Shizuoka University

23/11/2013 *Optimal initial values and regularity conditions of Besov space type for weak solutions to the Navier-Stokes system*
University of Tokyo

09/02/2014 *Optimal initial values and regularity conditions of Besov space type for weak solutions to the Navier-Stokes system*
Centro Internazionale per la Ricerca Matematica (CIRM), Levico Terme

08/03/2014 *How (fast) do solutions of the Boussinesq system decay?*
Ajou University, Suwon

21/03/2014 *Optimal initial values and regularity conditions of Besov space type for weak solutions to the Navier-Stokes system*
Yonsei University, Seoul

12/03/2014 *How (fast) do solutions of the Boussinesq system decay?*
Chung-Ang University, Seoul

04/06/2014 *A Linearized Model for Compressible Flow past a Rotating Obstacle*
Centro Internazionale per la Ricerca Matematica (CIRM), Levico Terme

18/06/2014 *The fundamental solution of compressible and incompressible fluid flow past a rotating obstacle*
JSPS-DFG Japanese-German Graduate Externship Kickoff Meeting, Tokyo

09/07/2014 *A Linearized Model for Compressible Flow past a Rotating Obstacle*
10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid

29/09/2014 *The Fundamental Solution of Compressible Viscous Fluid Flow Past a Rotating Obstacle*
Classical Problems and New Trends in Mathematical Fluid Dynamics, Ferrara

24/10/2014 *Are Weak Solutions of the Navier-Stokes Equations Regular?*
International Workshop on Functional Analysis, Operator Theory and Applications, Mainz

04/12/2014 *Optimale Anfangswertbedingungen für die Navier-Stokes-Gleichungen*
Universität Zürich

Alf Gerisch

08/11/2013 *Modellieren und passendes Simulieren*
Festkolloquium für Rüdiger Weiner, Martin-Luther-Universität Halle-Wittenberg

13/05/2014 *An adaptive stochastic collocation approach to uncertainty quantification*
ICMS Workshop on Numerical Methods and Emerging Computational Challenges in Mathematical Biology, Dundee

17/07/2014 *Numerical techniques for non-local models of cancer invasion*
Oberseminar der Numerik, Universität Mainz

14/10/2014 *Numerical challenges in models of tissue-scale tumour cell invasion*
Workshop Metastasis and Angiogenesis, Mathematical Biosciences Institute, Columbus, Ohio

Vassilios Gregoriades

01/10/2013 *Classes of Polish spaces under effective Borel isomorphism*
ESI 2013 Set Theory: Forcing, Large Cardinals and Descriptive Set Theory, Erwin-Schrödinger-Institut Wien

16/12/2013 *A recursive theoretic view to the decomposability conjecture*
Descriptive Set Theory in Paris, Paris

15/02/2014 *On effective descriptive set theory and its applications*
Matsuyama Seminar on Topology, Geometry, Set Theory and their Applications, Matsuyama University, Ehime

30/05/2014 *A recursive theoretic view to the decomposability conjecture*
Oberseminar of the Logic Group of the Mathematical Institute, Universität Bonn

01/07/2014 *Uniformity functions in descriptive set theory*
Logic Seminar of the Mathematical Institute, Universität Freiburg

08/12/2014 *Effectivity and Polish group actions*
Descriptive Set Theory in Paris, Paris

Karsten Grosse-Brauckmann

31/01/2013 *Flächen konstanter mittlerer Krümmung*
Kolloquium Mainz

31/05/2013 *Minimal Surfaces in Homogeneous Spaces*
Oberwolfach Surface Theory

11/07/2014 *Minimal Surfaces in Riemannian Fibrations*
Differentialgeomterie-Kolloquium

Philipp Habegger

14/03/2013 *Small Height and Infinite Non-abelian Extensions*
New York Joint Number Theory Seminar at CUNY, New York City

22/03/2013 *Non-Archimedean Approximatoins by Special Points*
Evelyn Nelson Lecture, McMaster University, Hamilton

28/03/2013 *Non-Archimedean Approximations by Special Points*
Joint IAS, Princeton University Number Theory Seminar, Princeton

04/04/2013 *Small Height and Infinite Non-abelian Extensions*
Algebra and Number Theory Seminar, Pennsylvania State University, University Park

08/04/2013 *Small Height and Infinite Non-abelian Extensions*
Members Seminar, Institute for Advanced Study, Princeton

17/05/2013 *Divisible Points on Curves*
Number Theory Seminar, Universität Basel

14/07/2013 *Divisible Points on Curves*
Model Theory 2013, Ravello

05/07/2013 *Unlikely Intersections and o-minimal Structures*
SFB-Kolloquium Universität Mainz

08/07/2013 *Diophantine Properties of Torsion Points and Special Points*
London Mathematical Society Short Course, Manchester

20/09/2013 *Unlikely Intersections and Diophantine Geometry*
Symposium on Mathematics, Universität Basel

04/10/2013 *Unlikely Intersections and o-Minimal Structures*
Thue 150 Conference, Bordeaux

08/10/2013 *Small points in big fields I, II, III*
École diophantienne, Université Besançon

12/11/2013 *Unlikely Intersections and o-Minimal Structures*
Number Theory Seminar, University of Colorado, Boulder

14/11/2013 *Unlikely Intersections and o-Minimal Structures*
Number Theory Seminar, University of Texas at Austin

20/01/2014 *Intersections atypique et structures o-minimale*
Séminaire théorie des nombres, Paris VI/VII

03/03/2014 *Mini-course Unlikely Intersections in Diophantine Geometry*
On Lang and Vojta's Conjecture CIRM, Luminy

17/03/2014 *Intersections atypique et structures o-minimale*
Séminaire tournant Grenoble/Lyon/St. Etienne

20/03/2014 *Unlikely Intersections and o-Minimal Structures*
Oberseminar Algebraische Geometrie, Universität Zürich

24/07/2014 *Unlikely Intersections and O-minimality*
Second ERC Research Period on Diophantine Geometry, Cetraro

03/10/2014 *Curves of Genus 2 with Bad Reduction and Complex Multiplication*
Clay Research Conference and Workshop, Oxford

27/10/2014 *Complex Multiplication or is $e^{\pi\sqrt{163}}$ an Integer?*
Mathematisches Kolloquium, Universität Bern

18/11/2014 *O-minimalité et intersections atypiques*
Séminaire d'Arithmétique et de Géométrie Algébrique, Orsay, France

Robert Haller-Dintelmann

18/07/2013 *Wurzeln von Divergenzform-Operatoren auf L^p-Räumen*
Universität Ulm

01/10/2013 *Square roots of divergence form operators on L^p spaces*
University of Kentucky, Lexington

Robin Hesse

26/07/2014 *Game-theoretic Approaches to Deterrence*
26th International Summer Symposium on Science and World Affairs, Princeton

Matthias Hieber

17/02/2013 *The Stokes equation on spaces of bounded functions*
International Conference Fluid Dynamics, Nara

10/04/2013 *Analysis of nematic liquid crystals*
Newton Institute, Cambridge

12/05/2013 *Dynamics of liquid crystls*
International Conference on Complex Fluids, Hangzhou

26/05/2013 *Bounded analyticity of the Stokes semigroup on* $L^\infty_\sigma(\Omega)$
Evolution Equations and Control Theory, Cortona

23/08/2013 *Liquid crystals and quasilinear parabolic equations*
Real Analysis Seminar, University of Tokyo

26/08/2013 *Complex Fluids*
Colloquium, University of Tokyo

30/09/2013 *The Navier-Stokes equations*
Clay Institute, Oxford

12/10/2013 *Analysis of liquid crystal flow*
GAMM-meeting on PDE, Regensburg

14/11/2013 *Free boundary value problems for fluids*
IRTG1529 Workshop, Waseda University, Tokyo

26/11/2013 *Fluide mit Mikrostruktur*
Kolloquium, Universität Augsburg

10/12/2013 *On the Ericksen-Leslie model*
SIAM-PDE Meeting, Orlando

18/12/2013 *Presentation IRTG 1529*
IRTG Darmstadt

24/03/2014 *Navier-Stokes equations with linearly growing data*
International Conference of Navier-Stokes, Bedlewo

01/04/2014 *Hyperbolic-Parabolic systems in fluid dynamics*
International Conference on Multicomponent flows, Halle

08/04/2014 *The Maximal regularity approach to free boundary value problems, part I-VI*
Lecture Series, IMPA, Rio de Janeiro

16/05/2014 *L^∞-type estimates for the Stokes equation*
Special Program on Harmonic Analysis and PDE, Bonn

26/06/2014 *Bounded analyticity of the Stokes semigroup on spaces of bounded functions*
PDE Seminar, Dortmund

09/07/2014 *Liquid crystal models*
AIMS Conference, Madrid

23/09/2014 *New perspectives on the Stokes semigroup*
European-Maghreb Workshop, Marrakech

01/10/2014 *Analysis of the Ericksen-Leslie model*
International Conference Fluid Dynamics, Ferrara

27/11/2014 *Thermodyamics of liquid crystals*
Workshop on Fluid-Structure Interaction, Nancy

Karl H. Hofmann

06/03/2013 *Transitive actions of a compact group on a piecewise contractible space: a Theorem of Janoś Szenthe revisited and recast*
Seminar on Algebra and Combinatorics, Tulane University, New Orleans

25/07/2014 *The Bourbaki-Chabauty-Vietoris space of closed subgroups of a locally compact group*
NSF Conference on Representation Theory, Universität Bielefeld

15/09/2014 *The Bourbaki-Chabauty-Vietoris space of closed subgroups of a locally compact group: Conclusive results*
Seminar on Algebra and Combinatorics, Tulane University, New Orleans

Klaus Keimel

06/03/2013 *Betting, probabilities and imprecise probabilities*
University of Brunei Darussalam

12/03/2013 *The upper Vietoris topology, Smyth powerdomains and quasicontinuous domains*
Nanyang Technological University, Singapore

14/03/2013 *Quasification of Domain Theory*
Nanyang Technological University, Singapore

26/10/2013 *On the equivalence of state transformer and predicate transformer semantics*
International Symposium on Domain Theory, Hunan University, Changsha

05/05/2014 *(-16/05/2014) Ten Lectures on the Foundations of Functional Programming*
Department of Information Technology, Al-Farabi Kazakh National University, Almaty

Daniel Körnlein

18/11/2014 *Proof-theoretic Methods in Nonlinear Analysis, Part 2: Fixed Point Theory*
Workshop on Mathematical Logic: Proof Theory, Constructive Mathematics, Oberwolfach

Ulrich Kohlenbach

04/03/2013 *Fluctuations, effective learnability and metastability in analysis*
3rd Workshop on Proof Theory and Rewriting, Kanazawa

19/03/2013 *Fluctuations, effective learnability and metastability in analysis*
PPS Seminar, Université Paris Diderot

22/04/2013 *Types in proof mining*
Types 2013, Toulouse

26/04/2013 *Proof theory: from the foundations of mathematics to applications in core mathematics*
Workshop CSPM Computer Science, Philosophy, Mathematics, Toulouse

19/07/2013 *Fluctuations, effective learnability and metastability in analysis*
Proof Theory in Lisbon

04/09/2013 *On the computational content of proofs that use ideal elements*
Workshop in connection with honory doctorate for Prof. H. Friedman, Gent

12/09/2013 *On the finitary content of proofs in nonlinear analysis*
Humboldt-Kolleg Proof, Bern

23/09/2013 *Proof-theoretic methods in ergodic theory and topological dynamics*
HIM Trimester on "Universality and Homogeneity", Bonn

25/11/2013 *Proof Mining*
Royal Society International Scientific Seminar: Computational Interpretations of Mathematical Theorems, Chicheley

28/11/2013 *From the foundations of mathematics to applications in core mathematics*
Mathematical Colloquium, LMU München

27/01/2014 *Proof mining in nonlinear analysis*
IRTG 1529 Winter Seminar, La Clusaz

16/06/2014 *Proof-theoretic methods in nonlinear analysis*
Sendai Logic Seminar, Sendai

17/06/2014 *Logical extraction of effective bounds in nonlinear analysis*
Kickoff Meeting JSPS-DFG IRTG 1529, Tokyo

18/11/2014 *Proof-theoretic methods in nonlinear analysis*
Oberwolfach Workshop on Mathematical Logic, Oberwolfach

Michael Kohler

21/11/2014 *Effiziente Bewertung von Unsicherheit mit Hilfe von Monte-Carlo-Simulationen*
Kolloquium SFB 805, TU Darmstadt

Christian Komo

11/11/2013 *Boussinesq-Gleichungen in Gebieten mit rauen Rändern*
Oberseminar Analysis und Anwendungen, Universität Kassel

08/05/2014 *Influence of surface roughness to solutions of the Boussinesq equations with Robin roundary condition*
International conference on Fluid Dynamics at CIRM, Luminy

Angeliki Koutsoukou-Argyraki

07/11/2014 *Proof mining and partial differential equations; Rates of convergence and metastability for abstract Cauchy problems generated by accretive operators*
Sendai Logic Seminar, Tohoku University, Sendai

20/11/2014 *Proof-theoretic Methods in Nonlinear Analysis, Part 4: Rates of convergence and metastability for abstract Cauchy problems generated by accretive operators*
Oberwolfach Workshop on Mathematical Logic: Proof Theory, Constructive Mathematics, Mathematical Research Institute Oberwolfach, Nov. 16-22, 2014

Burkhard Kümmerer

23/01/2014 *Mathematik zwischen Anschauung und Sprache*
Universität Bielefeld

Susanne Kürsten

21/06/2013 *Periodische Minimalflächen in* $\mathbb{R}^4$
36. Süddeutsches Kolloquium über Differentialgeometrie, Konstanz

Jens Lang

22/04/2013 *Higher Order and Adaptive Methods in Computational Fluid Dynamics*
Mathematical Seminar, CWI, Amsterdam

26/06/2013 *Adaptive Moving Meshes in Large Eddy Simulation for Turbulent Flows*
25th Biennial Numerical Analysis Conference, Glasgow

23/09/2013 *Convergence and Adaptivity at the PDE/Stiff ODE Interface*
26th Chemnitz FEM Symposium, Annaberg-Buchholz

22/05/2014 *Adaptivity in Numerical Methods for ODEs and PDEs*
Mathematical Seminar, Dundee

13/06/2014 *Adaptive Modelling, Simulation and Optimization of Water and Gas Supply Networks*
ECMI 2014, Taormina

22/07/2014 *Adaptive Surrogate Modelling in Unsteady Transport Systems*
World Congress of Computational Mechanics, Barcelona

29/09/2014 *On the design and Use of Adaptive PDAE Solvers*
Modelling, Simulation and Optimization Tools 2014, Berlin

02/10/2014 *Adaptive Moving Meshes in Large Eddy Simulation for Turbulent Flows*
Mathematical Seminar, WIAS Berlin

Davorin Lešnik

27/06/2013 *Unified Approach to Real Numbers in Various Mathematical Settings*
Constructive Mathematics Conference, Niš

Matthias Meiners

22/04/2013 *Generalized equations of stability*
University of Oxford

26/11/2013 *Classical limit theorems for branching processes*
Theoretical and Applied Aspects of Cybernetics, Kyiv

27/11/2013 *Smoothing transforms with negative coefficients*
Taras Shevchenko National University of Kyiv

10/06/2014 *Solutions to multivariate smoothing equations*
The Third Bath-Paris Branching Structures Meeting, Bath

09/07/2014 *Solutions to multivariate smoothing equations*
Universität Frankfurt

Hannes Meinlschmidt

03/07/2013 *Das Thermistor-Problem in 3D: Analysis und ein wenig optimale Steuerung*
Oberseminar Angewandte Analysis, Martin-Luther Universität Halle-Wittenberg

Christian Mönch

25/06/2013 *Sublogarithmic Distances in Preferential Attachment Networks*
EPSRC Workshop "Analysis on Graphs and its Applications", Loughborough University

15/01/2014 *Typische Distanzen in komplexen Netzwerken*
Oberseminar Stochastik, Universität des Saarlandes

Martin Otto

10/01/2013 *Bisimulation and Coverings for Graphs and Hypergraphs*
5th Indian Conference on Logic and its Applications, ICLA 2013, Chennai

04/02/2013 *Tutorial: Bisimulation and Games for Graphs and Hypergraphs*
Games Winter School, Champéry

15/07/2014 *Hypergraphs and Groupoids: From Local to Global Symmetries in Finite Structures*
Kolloquium Mathematische Informatik, Universität Frankfurt

17/09/2014 *Finite Global Realisations of Local Overlap Specifications*
DMV-PTM Joint Annual Meeting, Special Session on Computational Logic, Poznan

Andreas Paffenholz

25/05/2013 *Polyhedral Adjunction Theory*
Colloquium of the Graduate School “Methods in Discrete Structures”, FU Berlin

21/03/2014 *Structure and Classifications of Fano Polytopes*
Oberseminar Gruppen und Geometrie, Universität Bielefeld

25/06/2014 *Structure and Classifications of Fano Polytopes*
Oberseminar Diskrete Mathematik, Universität Frankfurt

26/10/2014 *Finiteness of the polyhedral Q-codegree spectrum*
AMS Western Sectional Fall Meeting, San Francisco

Raimondo Penta

16/12/2014 *An asymptotic homogenization approach for multiphase linear elastic composites with discontinuous material properties*
Biomox Seminar, Politecnico, Milan

Sebastian Pfaff

21/02/2013 *Optimal boundary control for nonlinear hyperbolic conservation laws with source terms*
Symposium on Variational Inequalities and PDE-constrained Optimization (VIS), HU Berlin

Marc Pfetsch

27/03/2013 *Compressed Sensing and Discrete Optimization*
Colloquium, IASI, Rome

29/10/2013 *Compressed Sensing and Discrete Optimization*
Colloquium, Erlangen

Jan-Frederik Pietschmann

23/10/2014 *Motion and Size Exclusion - Derivation and Properties of non-linear Cross-Diffusion Models*
WIAS, Berlin

04/12/2014 *Identification of chemotaxis models with volume filling*
RICAM, Gruppe Dr. Wolfram, Linz

Anna-Maria von Pippich

03/05/2013 *Eisenstein series and moduli spaces*
Conference First meeting of young women in mathematics: cohomological methods in geometry, Universität Freiburg

13/06/2013 *Towards an arithmetic Riemann–Roch theorem for weighted pointed curves*
Workshop Heights and moduli spaces, Lorentz Center, Leiden

04/02/2014 *An arithmetic Riemann–Roch theorem for weighted pointed curves*
Workshop Arithmetic intersection theory and Shimura varieties, Hausdorff Center for Mathematics, Bonn

11/02/2014 *An arithmetic Riemann–Roch theorem for weighted pointed curves*
Arithmetic Geometry Seminar, HU Berlin

16/04/2014 *Summen natürlicher Zahlen – unendlich einfach oder einfach unendlich?*
Antrittsvorlesung, Mathematisches Kolloquium, TU Darmstadt

11/12/2014 *An arithmetic Riemann–Roch theorem for weighted pointed curves*
SFB Transregio 45 Kolloquium, Universität Mainz

Ulrich Reif

27/08/2013 *Approximation on Manifolds with Ambient B-Splines*
IMACS 2013 World Congress, Madrid

28/09/2013 *Analysis of Geometric Subdivision Schemes*
MAIA 2013, Erice

03/10/2014 *Analysis of Geometric Subdivision Schemes*
SMART 2014, Pontignano

Martin Saal

28/10/2014 *Integro-Differential Equations of Second Order*
Autumn School and Workshop on Mathematical Fluid Dynamics, Bad Boll

Jonas Sauer

17/01/2014 *Strong Stability of 2D Viscoelastic Poiseuille-Type Flows*
Waseda University, Tokyo

05/02/2014 *Maximal Regularity of Periodic-in-Space Stokes Equations in Weighted Spaces*
Shinshū University, Matsumoto

Nils Scheithauer

09/07/2013 *On the classification of automorphic products*
Beyond the moonshine, Sendai

04/03/2014 *Automorphic products of singular weight*
Automorphic forms, Lie algebras and string theory, Lille

26/06/2014 *Automorphic products of singular weight*
Algebras, groups and geometries 2014, Tokyo

Werner Schindler

22/11/2013 *When Should an Implementation Attack be Viewed as Successful*
Conference on the occasion of Johannes Buchmann's 60th birthday, Darmstadt

05/02/2014 *Grenzen der algorithmischen Kryptographie*
SIT SmartCard Workshop 2014, Darmstadt

22/05/2014 *Zufallszahlen für kryptographische Anwendungen*
Berliner Kolloquium für Sicherheitsforschung, TU Berlin

Matthias Schlottbom

14/03/2013 *Analysis of a forward problem in optical tomography*
MIRAN Inverse Problems in Transport, Manchester

02/07/2013 *Preconditioning of complex symmetric linear systems with applications in optical tomography*
Applied Inverse Problems, KAIST, Daejeon

05/07/2013 *Simultaneous identification of diffusion and absorption coefficients in a quasilinear elliptic problem*
Applied Inverse Problems, KAIST, Daejeon

24/03/2014 *Numerical Methods for Parameter Identification in Stationary Radiative Transfer*
Seminar Talk, Universität Münster

06/08/2014 *Diffusion asymptotics for linear transport with low regularity*
Seminar Talk, RWTH Aachen

25/11/2014 *Analysis of the diffuse domain method for second order elliptic problems*
IRTG Seminar, TU Darmstadt

01/12/2014 *Simultaneous identification of diffusion and absorption coefficients in a quasilinear elliptic problem*
Seminar talk, Universität Duisburg-Essen

Alexandra Schwartz

05/06/2014 *Mathe-Professorin – Wie kam es dazu?*
Series of Talks "I did it my way", Internatsschule Schloss Hansenberg, Geisenheim

03/09/2014 *A Reformulation of Mathematical Programs with Cardinality Constraints using a Complementarity-type Condition*
International Conference on Operations Research, RWTH Aachen

Thomas Streicher

09/04/2013 *Introduction to Categorical Logic*
Tutorial talk at PhDs in Logic, Munich

10/09/2013 *A Model of Control Operators in Coherence Spaces giving rise to a New Boolean Topos.*
Workshop on the Occasion of P.-L. Curien's 60th Anniversary, Venice

23/09/2013 *How intensional is homotopy type theory?*
Conference on Type Theory, Homotopy Theory and Univalent Foundations, Barcelona

12/06/2014 *Computability in Basic Quantum Theory*
Semantics of Proofs and Programs, IHP Paris

Stefan Ulbrich

29/01/2013 *Robust optimization with PDE-constraints based on linear and quadratic approximations*
Oberwolfach Workshop

22/03/2013 *Multilevel methods for PDE-constrained optimization based on adaptive discretizations and reduced order models*
Plenary Talk, 84th GAMM Annual Meeting, Novi Sad

07/05/2013 *Combining multilevel and time domain decomposition techniques for time-dependent PDE-constrained optimization*
Invited Talk, Multiple Shooting and Time Domain Decom-position Methods (MuS-TDD), IWR, Heidelberg

04/07/2013 *Multilevel methods for PDE-constrained optimization based on adaptive discretizations and reduced order models*
Colloquium, Konstanz

18/07/2013 *Multilevel methods for PDE-constrained optimization based on adaptive discretizations and reduced order models*
Invited Minisymposium, EUCCO 2013, Chemnitz

30/07/2013 *Optimization of deep drawing processes*
Invited Minisymposium, ICCOPT 2013, Lisbon

11/09/2013 *Multilevel methods for PDE-constrained optimization based on adaptive discretizations and reduced order models*
Invited Minisymposium, IFIP 2013, Klagenfurt

30/09/2013 *Multilevel methods for PDE-constrained optimization based on adaptive discretizations and reduced order models*
Colloquium, BMBF-DGHPOPT, Trier

06/04/2014 *Multilevel methods for PDE-constrained optimization based on adaptive discretizations and reduced order models*
Invited Minisymposium, 13th Copper Mountain Conference on Iterative Methods, Copper Mountain

24/04/2014 *Multilevel methods for PDE-constrained optimization based on adaptive discretizations and reduced order models*
Colloquium, IWR, Heidelberg

19/05/2014 *Multilevel methods for very large scale NLPs resulting from PDE constrained optimization*
Invited Minisymposium, SIAM OP14, San Diego

04/08/2014 *Short course on multilevel methods for PDE-constrained optimization and variational inequalities*
Invited Short Course, ICCP 2014, Berlin

07/08/2014 *Multigrid semismooth Newton methods for elastic contact problems*
Invited Talk, ICCP 2014, Berlin

11/09/2014 *Convergence of discrete adjoints for flows with shocks*
Dagstuhl Workshop

Sebastian Ullmann

24/01/2013 *POD-Galerkin reduzierte Modelle für Strömungsprobleme mit stochastischen Randbedingungen*
Seminar Numerische Mathematik, WIAS Berlin

Miroslav Vrzina

21/06/2013 *Singly-periodic surfaces of constant mean curvature in* $\mathbb{H}^2 \times \mathbb{R}$
Universität Konstanz

Irwin Yousept

21/02/2013 *Numerical Analysis of Optimal Control of Electromagnetic Processes*
Universität Würzburg

13/03/2013 *Optimal Control of quasilinear H(curl)-elliptic PDEs arising from electromagnetic phenomena*
Workshop on Numerical Methods for Optimal Control and Inverse Problems (OCIP), Garching

06/05/2013 *Optimization of magnetic fields and its advanced applications*
Universität Konstanz

15/05/2013 *Nonlinear electromagnetic field control*
IFIP TC7.2 Workshop "Electromagnetics – Modelling, Simulation, Control", WIAS Berlin

06/06/2013 *Optimal control of nonlinear magnetostatic field problems*
9th International Conference on "Large-Scale Scientific Computation", Sozopol

03/07/2013 *Mathematische Analyse nichtlinearer Magnetfeldoptimierung*
Analysis Oberseminar, TU Darmstadt

09/07/2013 *Optimal control of quasilinear H(curl)-elliptic partial differential equations in magnetostatic field problems*
6th Workshop on Analysis and Advanced Numerical Methods for PDEs, St. Wolfgang

20/08/2013 *Helmholtz-Zerlegung*
TU Berlin

31/08/2013 *Optimal control of quasilinear H(curl)-elliptic PDEs*
International Conference on Continuous Optimization (ICCOPT), Lisbon

03/09/2013 *Optimal control of quasilinear H(curl)-elliptic partial differential equations in magnetostatic field problmes*
Domain Decomposition Methods for Optimization with PDE constraints, Monte Verità, Ascona

05/11/2013 *Magnetfeldoptimierung im H(curl)-Funktionenraum*
TU Chemnitz

12/03/2014 *Optimal control of electromagnetic processes governed by Maxwell's equations*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Richard-von-Mises Lecture, Erlangen

09/05/2014 *Optimale Steuerung elektromagnetischer Felder*
Special Colloquium "Control and Optimization" in honor of Prof. Dr. Werner Krabs' 80th birthday, Erlangen

Shaul Zemel

28/05/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
HU Berlin

27/11/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
Bar-Ilan University, Ramat Gan

28/11/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
The Technion, Haifa

03/12/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
University of Haifa, Haifa

04/12/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
Ben-Gurion University, Beer Sheva

09/12/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
The Hebrew University, Jerusalem

11/12/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
Weizmann Institute, Rehovot

18/12/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
Tel-Aviv University, Tel-Aviv

25/12/2013 *A Gross–Kohnen–Zagier Theorem for Higher Codimensional Heegner Cycles*
Ariel University, Ariel

03/06/2014 *Theta Lifts and Universal Families*
AKLS Seminar, RWTH Aachen

24/12/2014 *On Lattices over Valuation Rings of Arbitrary Rank*
Bar-Ilan University, Ramat Gan

25/12/2014 *On Lattices over Valuation Rings of Arbitrary Rank*
The Hebrew University, Jerusalem

31/12/2014 *On Lattices over Valuation Rings of Arbitrary Rank*
Tel-Aviv University, Tel-Aviv

Martin Ziegler

21/02/2013 *Real Benefit of Promises and Advice*
ELC Seminar, University of Tokyo

03/05/2013 *Logik: mathematische Introspektion und Informatik*
5. Tagung des GDM-Arbeitskreises Vernetzungen im Mathematikunterricht, Darmstadt

08/07/2013 *Real Parameterized and Second-Order Complexity Theory: from Computability in Analysis to Numerical Practice*
10th International Conference on Computability and Complexity in Analysis, Nancy

29/07/2013 *Henkin Continuity of multivalued functions*
Logic Activities in and around JAIST, Nomi

13/09/2013 *Introduction to parameterized and second-order real complexity theory*
Universität der Bundeswehr München

04/11/2013 *Real complexity theory: a numerical view on P vs. NP*
NII Shonan Meeting Seminar 033, Kanagawa

08/11/2013 *Wahrheit und Beweisbarkeit: Einführung in die mathematische Logik*
Wissenschaftlicher Gesprächskreis, DAAD Tokyo

09/12/2013 *Parameterized Rigorous Complexity in Real Computation*
Computable Analysis and Rigorous Numerics, Maastricht

22/01/2014 *Introduction to Real Complexity Theory: Numerical Approaches to P-vs-NP and beyond*
Heinz Nixdorf Institut der Universität Paderborn

01/04/2014 *Expressiveness, Computability, and Computational Complexity of Quantum Propositional and First-Order Quantum Logic*
Amsterdam Quantum Logic Workshop, Amsterdam

17/09/2014 *Real Complexity Theory: from Computability to Implementations, from Heuristics to Rigorous and Provably Optimal Algorithms*
Continuity, Computability, Constructivity 2014; University of Ljubljana

28/10/2014 *Computability and Complexity Theory of PDEs*
Autumn School Mathematical Fluid Dynamics, Bad Boll

6.1.2 Contributed Talks

Hans-Dieter Alber

21/02/2013 *Comparison of the Allen-Cahn and hybrid phase field models – Theoretical asymptotics*
Workshop on phase field modeling, Freudenstadt

02/10/2013 *A phase field model for multiphase materials*
9th international workshop direct and inverse problems on piezoelectricity, Bauhaus-Universität Weimar

05/05/2014 *A precise formula for the propagation speed of interfaces in the Allen-Cahn phase field model*
Second seminar on the mechanics of multifunctional materials, Physikzentrum Bad Honnef

Tristan Alex

04/04/2014 *Konvexität und Multigraphen*
AG-Workshop, Höchst

Claudia Alfes

13/05/2014 *Harmonic weak Maass forms and elliptic curves*
AG Seminar Algebra, TU Darmstadt

09/12/2014 *CM values and Fourier coefficients of harmonic Maass forms*
AG Seminar Algebra, TU Darmstadt

Achim Blumensath

27/09/2013 *Recognisability for infinite trees*
23. Theorietag "Automaten und Formale Sprachen", Ilmenau

Vera Bommer

02/12/2013 *A-priori-Fehlerabschätzung für ein parabolisches Optimalsteuerungsproblem*
Optimization Seminar, TU Darmstadt

03/03/2014 *A Priori Error Estimates for Parabolic Optimal Control Problems with Sparsity in Time*
Workshop on Numerical Methods for Optimal Control and Inverse Problems (OCIP), Garching

Dieter Bothe

28/06/2013 *Investigations of elementary spray processes by means of Direct Numerical Simulations: Interaction of viscous and non-Newtonian droplets*
ICMF, Jeju

07/02/2014 *Mixture Continuum Thermodynamics employing Partial Momenta*
1st GAMM-Seminar on Phase Field Models, Darmstadt

31/03/2014 *Continuum thermodynamics of chemically reacting fluid mixtures*
Workshop Maxwell-Stefan meets Navier-Stokes, Halle

Stefanie Bott

18/03/2013 *Adaptive Multilevel SQP Methods for PDAE-constrained Optimization with Restrictions on Control and State. Theory and Applications*
Final Meeting of SPP 1253, Banz

10/09/2013 *Adaptive Multilevel SQP Method for State Constrained Optimization with Navier-Stokes Equations*
International Conference on Continuous Optimization (ICCOPT), Lisbon

05/03/2014 *Convergence Results for an Adaptive Multilevel SQP Method for Problems with State Constraint*
Workshop on Numerical Methods for Optimal Control and Inverse Problems (OCIP), Garching

08/04/2014 *Convergence Results for an Adaptive Multilevel SQP Method for Problems with State Constraints*
Graduate School CE Retreat, Seeheim-Jugenheim

12/05/2014 *Multilevel Methods for PDE-constrained Optimization with State Constraints*
Graduate School CE Research Colloquium, Darmstadt

19/05/2014 *Adaptive Multilevel SQP Method for State Constrained Optimization with Navier-Stokes Equations*
SIAM Conference on Optimization (SIOPT), San Diego

Daniela Bratzke

19/03/2013 *Optimal control of hydroforming processes based on POD*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Novi Sad

15/04/2013 *Optimierung im SFB 666 - Teil 1*
Joint talk with T. Göllner and H. Lüthen, Optimization Seminar, TU Darmstadt

22/04/2013 *Optimierung im SFB 666 - Teil 2*
Joint talk with T. Göllner and H. Lüthen, Optimization Seminar, TU Darmstadt

29/07/2013 *Reduced order models for the optimal control of contact problems*
International Conference on Continuous Optimization (ICCOPT), Lisbon

03/03/2014 *Reduced order models for the optimal control of deep drawing processes*
Workshop on Numerical Methods for Optimal Control and Inverse Problems (OCIP), Garching

Alexander Dalinger

25/03/2014 *The* $\nabla\varphi$ *Interface Model*
IRTG Seminar, Darmstadt

30/10/2014 *On the hydrodynamic behavior of a 1D system with next neighbour interactions*
Autumn School and Workshop, Bad Boll

26/11/2014 *Iterierte Funktionensysteme*
Seminar “What is . . . ?”, Darmstadt

Pia Domschke

16/06/2014 *Modelling the role of adhesion in the heterogeneous dynamics of cancer invasion*
European Conference on Mathematical and Theoretical Biology (ECMTB) 2014, Göteborg

29/09/2014 *Adaptive Modelling and Simulation for the Optimization of Gas and Water Supply Networks*
Workshop MSO-Tools 2014, Berlin

Thorsten Ederer

11/03/2013 *Optimierung der Heizungsanlage im Darmstadtium*
Optimization Seminar, TU Darmstadt

Herbert Egger

19/02/2013 *Explicit Time Stepping for Radiative Transfer based on Mixed Variational Formulations*
Numa Workshop, Hirschegg, TU Darmstadt

18/07/2013 *Iterative methods for nonlinear tomography*
EUCCO, TU Chemnitz

Christoph Erath

11/02/2013 *New Finite Volume based Tracer Transport Schemes for CAM-SE*
Atmosphere Model Working Group (AMWG) meeting, Boulder, Colorado

27/02/2013 *A new multi-tracer-efficient semi-Lagrangian transport scheme for the Community Atmosphere Model*
SIAM Conference on Computational Science and Engineering (CSE13), Boston, Massachusetts

01/03/2013 *A conservative semi-Lagrangian transport scheme on spectral element cubed-sphere grids (SPELT)*
SIAM Conference on Computational Science and Engineering (CSE13), Boston, Massachusetts

05/03/2013 *Future tracer transport in CAM-SE: Finite Volume based Semi-Lagrangian schemes in HOMME*
CISL Seminar Series at the National Center for Atmospheric Research, Boulder, Colorado

27/05/2014 *Non-Conforming a Posteriori Estimates for the FVM-BEM Coupling*
Austrian Numerical Analysis Day 2014, Vienna

20/06/2014 *Comparison of two couplings of the finite volume method and the boundary element method*
7th International Symposium on Finite Volumes for Complex Applications, Berlin

Tobias Ewald

01/03/2013 *Parametrisierung von Dreiecksnetzen über Mannigfaltigkeiten*
AG-Seminar, Höchst

31/01/2014 *Hölder-Regularität von geometrischen Subdivisionsalgorithmen*
24. Rhein-Ruhr-Workshop, Bestwig

03/03/2014 *Hölder Regularity of Geometric Subdivision Schemes*
New Trends in Applied Geometry 5, Bernried

04/04/2014 *Hölder-Regularität von geometrischen Subdivisionsalgorithmen*
AG-Seminar, Höchst

29/09/2014 *Analysis of Geometric Subdivision Schemes*
SMART 2014, Pontignano

Michael Fischer

20/12/2014 *The adjoint approach for shape optimization with an example on the Boussinesq equations*
2014 Joint Conference on Applied Mathematics, Ryukoku Universität, Kyoto

Tobias Fischer

08/04/2013 *Discrete Optimization and Applications in Communication Technology*
Joint talk with Alexey Buzuverov, Graduate School CE Retreat, Seeheim-Jugenheim

11/11/2013 *Optimierung mit Komplementaritätsnebenbedingungen*
Optimization Seminar, TU Darmstadt

15/11/2013 *Optimization with Complementarity Constraints*
Graduate School CE Research Colloquium, Darmstadt

28/07/2014 *Optimization with Complementarity Constraints: Structure and Algorithms*
Graduate School CE Research Colloquium, Darmstadt

01/08/2014 *Optimization with Complementarity Constraints: Structure and Algorithms*
Future Research in Combinatorial Optimization (FRICO), Magdeburg

02/10/2014 *Using SCIP to Solve Linear Programs with Complementarity Constraints*
SCIP Workshop, Berlin

Tristan Gally

02/10/2014 *Mixed integer semidefinite programming with SCIP*
SCIP Workshop, Berlin

17/11/2014 *Behandlung von Unsicherheit mit robuster mathematischer Optimierung am Beispiel von Stabwerken*
Joint talk with A. Kuttich, Optimization Seminar, TU Darmstadt

21/11/2014 *Behandlung von Unsicherheit mit robuster mathematischer Optimierung am Beispiel von Stabwerken*
Joint talk with A. Kuttich, Kolloquium SFB 805, Darmstadt

Alf Gerisch

26/04/2013 *Mathematical modelling and numerical simulation in mechanobiology*
Treffen des MSB-Net Clusters Numerische Simulation, Hannover

08/05/2013 *Assessment of collagen fibril orientation in human lamellar bone with scanning acoustic microscopy and polarized Raman microscopy (presented by S. Schrof)*
5th European Symposium on Ultrasonic Characterization of Bone, Granada

14/05/2013 *Uncertainty Quantification Using Stochastic Collocation Method and Application in a Model of Mineralized Turkey Leg Tendon*
18th International Symposium on Computational Biomechanics, Ulm

16/06/2014 *Uncertainty quantification in a model of tumour invasion*
European Conference on Mathematical and Theoretical Biology (ECMTB) 2014, Göteborg

Jane Ghiglieri

12/03/2014 *Optimal Flow Control based on POD and MPC and an Application to the Cancellation of Tollmien-Schlichting Waves*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Erlangen

08/10/2014 *Optimal Flow Control based on POD and MPC and an Application to the Cancellation of Tollmien-Schlichting Waves*
International Workshop on Computational Engineering (ICCE), Universität Stuttgart

Thea Göllner

20/03/2013 *Optimizing the Geometry of Branched Sheet Metal Structures*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Novi Sad

15/04/2013 *Optimierung im SFB 666 - Teil 1*
Joint talk with D. Bratzke and H. Lüthen, Optimization Seminar, TU Darmstadt

22/04/2013 *Optimierung im SFB 666 - Teil 2*
Joint talk with D. Bratzke and H. Lüthen, Optimization Seminar, TU Darmstadt

01/08/2013 *Optimizing the Geometry of Branched Sheet Metal Structures using Cubic Regularization*
International Conference on Continuous Optimization (ICCOPT), Lisbon

20/10/2014 *Geometrieoptimierung verzweigter Blechbauteile mit Adaptiven Kubischen Regularisierungstermen als Globalisierungsstrategie*
Optimization Seminar, TU Darmstadt

Vassilios Gregoriades

08/07/2013 *Effective refinements of classical theorems in descriptive set theory*
Tenth International Conference on Computability and Complexity in Analysis, Nancy

14/02/2014 *A recursive theoretic view to the decomposability conjecture*
Logic Seminar, TU Darmstadt

Daniel Günzel

04/10/2013 *Logical Metatheorem: Background and practice*
Logic seminar, Tokyo Institute of Technology

28/02/2014 *Connecting ultrapowers of metric structures and proof mining*
IRTG 1529 Research Seminar: Proof Mining and Nonlinear Analysis, Darmstadt

Philipp Habegger

12/02/2014 *Komplexe Multiplikation - oder ist $e^{\pi\sqrt{163}}$ eine ganze Zahl?*
Mathematisches Kolloquium, TU Darmstadt

Robert Haller-Dintelmann

05/10/2013 *Square roots of divergence form operators on L^p spaces*
AMS Fall Southeastern Sectional Meeting in Louisville

Karl H. Hofmann

13/09/2013 *An excursion into locally compact abelian groups*
Algebra Seminar, Tulane University New Orleans

27/03/2014 *The Bourbaki-Chabauty-Vietoris space of closed subgroups of a locally compact group*
Algebra Seminar, Tulane University New Orleans

Christopher Hojny

10/02/2014 *Polyedrische Beschreibung von Sternfärbungen*
Optimization Seminar, TU Darmstadt

30/07/2014 *Polyhedral description of star colorings*
Future Research in Combinatorial Optimization (FRICO), Magdeburg

Benjamin Horn

10/11/2014 *Formoptimierung für Kontaktprobleme*
Optimization Seminar, TU Darmstadt

Imke Joormann

21/01/2013 *Analyzing infeasibility in natural gas networks*
Optimization Seminar, TU Darmstadt

07/07/2014 *On the Relation of Flow Cuts and Irreducible Infeasible Subsystems*
Optimization Seminar, TU Darmstadt

17/07/2014 *On the Relation of Flow Cuts and Irreducible Infeasible Subsystems*
Conference of the International Federation of Operational Research Societies (IFORS), Barcelona

Klaus Keimel

24/06/2013 *Quasicontinuous domains and the Smyth powerdomain*
Conference on Mathematical Foundations of Programming Semantics (MFPS 29), Tulane University, New Orleans

Daniel Körnlein

28/02/2014 *Rates of Metastability for Iterations of Accretive and Nonexpansive Mappings*
IRTG 1529 Research Seminar: Proof Mining and Nonlinear Analysis, Darmstadt

Angeliki Koutsoukou-Argyraki

29/01/2014 *Proof Theory and PDEs*
IRTG 1529 Winter Seminar and Klausurtagung Fluids and Snow, Chalet Giersch, La Clusaz

27/02/2014 *Proof mining for Cauchy problems generated by accretive operators*
IRTG 1529 Research Seminar: Proof Mining and Nonlinear Analysis, Darmstadt

25/04/2014 *Proof mining and Partial Differential Equations*
PhDs in Logic, Utrecht

Susanne Kürsten

28/02/2013 *Konstruktion der Schwarz-D-Fläche*
AG-Seminar, Höchst

Anja Kuttich

28/10/2013 *Optimierung von robusten Stabwerken mit lokalen Knickbedingungen*
Optimization Seminar, TU Darmstadt

17/11/2014 *Behandlung von Unsicherheit mit robuster mathematischer Optimierung am Beispiel von Stabwerken*
Joint talk with T. Gally, Optimization Seminar, TU Darmstadt

21/11/2014 *Behandlung von Unsicherheit mit robuster mathematischer Optimierung am Beispiel von Stabwerken*
Joint talk with T. Gally, Kolloquium SFB 805, Darmstadt

Jens Lang

27/08/2013 *Anisotropic Finite Element Meshes for Linear Parabolic Equations*
ENUMATH 2013, Lausanne

20/05/2014 *Transport in Wassernetzwerken*
EWAVE-Treffen Nürnberg

Michelle Lass (Vallejos)

20/06/2013 *A multigrid approach to PDE constrained optimal control problems*
The 10th Korean Women in Mathematical Sciences International Conference, Seoul

22/09/2014 *A multigrid approach to obstacle problems and to optimal control of obstacle problems*
27th FEM Symposium, TU Chemnitz

Oliver Lass

17/06/2014 *Parameter identification for nonlinear elliptic parabolic systems with application in lithium-ion battery modeling*
European Conference on Mathematics for Industry, Taormina

23/06/2014 *Modellreduktion und Parameteridentifikation für gekoppelte nichtlineare Systeme von partiellen Differentialgleichungen*
Optimization Seminar, TU Darmstadt

08/10/2014 *Parameter identification for nonlinear elliptic parabolic systems*
3rd International Workshop on Computational Engineering (ICCE), Universität Stuttgart

Stéphane Le Roux

22/07/2014 *Weihrauch degrees of finding equilibria in sequential games*
11th International Conference on Computability and Complexity in Analysis

20/09/2013 *Infinite sequential Nash equilibrium*
Highlights of Logic, Games and Automata, Paris

Davorin Lešnik

26/07/2013 *Power Series in Synthetic Differential Geometry*
Samuel Eilenberg Centenary Conference, Warszawa

Madeline Lips

07/03/2013 *Stochastic Optimization – a short introduction*
Math across the Main workshop, Darmstadt

Hendrik Lüthen

15/04/2013 *Optimierung im SFB 666 - Teil 1*
Joint talk with D. Bratzke and T. Göllner, Optimization Seminar, TU Darmstadt

22/04/2013 *Optimierung im SFB 666 - Teil 2*
Joint talk with D. Bratzke and T. Göllner, Optimization Seminar, TU Darmstadt

Sonja Mars

25/02/2013 *Lösen von gemischt-ganzzahligen semidefiniten Problemen*
Optimization Seminar, TU Darmstadt

Matthias Meiners

06/06/2013 *Power and exponential moments of the number of visits and related quantities for perturbed random walks*
German-Polish Joint Conference on Probability and Mathematical Statistics, Toruń

05/03/2014 *Smoothing transforms with negative coefficients*
11th German Probability and Statistics Days, Ulm

30/04/2014 *Verallgemeinerte stabile Verteilungen*
TU Darmstadt

Hannes Meinlschmidt

11/02/2013 *Optimalsteuerung von PDAEs (und Thermistoren)*
Optimization Seminar, TU Darmstadt

30/07/2013 *Optimal Control of PDAEs*
International Conference on Continuous Optimization (ICCOPT), Lisbon

10/09/2013 *Optimal Control of PDAEs*
IFIP TC7 Conference on System Modelling and Optimization, Klagenfurt

10/02/2014 *Das Thermistorproblem in 3D*
Chemnitzer Seminar zur Optimalen Steuerung, Haus im Ennstal

19/05/2014 *Optimal Control of Index 1 PDAEs*
SIAM Conference on Optimization (SIOPT), San Diego

Claudia Möller

21/02/2013 *Connecting the Joint Spectral Radius (JSR) to set-valued trees*
New Trends in Applied Geometry, Bad Herrenalb

Christian Mönch

14/11/2013 *Typische Distanzen in komplexen Netzwerken*
Oberseminar AG Stochastik, TU Darmstadt

27/02/2014 *Typical Distances in Scale-free Random Networks*
Winter School "Spatial Models in Statistical Mechanics", TU Darmstadt

06/03/2014 *Typical distances in scale free random networks at criticality*
German Probability and Statistics Days 2014, Ulm

Martin Otto

26/02/2013 *Finite groupoids, acyclicity & symmetries*
Workshop on Algorithmic Model Theory, AlMoTh 2013, Berlin

25/06/2013 *Groupoids, hypergraphs, and symmetries in finite models*
ACM/IEEE Symposium on Logic in Computer Science, LICS 2013, New Orleans

Andreas Paffenholz

20/03/2013 *Fano Polytopes with Many Vertices*
Annual conference of the DFG Priority Project SPP 1489, Konstanz

Raimondo Penta

04/09/2014 *The role of microvascular tortuosity in tumor transport phenomena*
CIME-CIRM course on Mathematical Models and Methods for Living Systems, Levico Terme

Sebastian Pfaff

30/07/2013 *Optimal Control of Nonlinear Hyperbolic Conservation Laws at a Junction*
International Conference on Continuous Optimization (ICCOPT), Lisbon

10/09/2013 *Optimal Control of Networks of Nonlinear Hyperbolic Conservation Laws*
IFIP TC7 Conference on System Modelling and Optimization, Klagenfurt

03/02/2014 *Hyperbolische Erhaltungsgleichungen und Straßenverkehr*
Optimization Seminar, TU Darmstadt

19/05/2014 *Optimal Control of Nonlinear Hyperbolic Conservation Laws with Switching*
SIAM Conference on Optimization (SIOPT), San Diego

31/07/2014 *Optimal Control of a Nonlinear Hyperbolic Conservation Law with Switching*
International Conference on Hyperbolic Problems (HYP), Rio de Janeiro

Marc Pfetsch

25/06/2013 *Vom Simulieren zum Optimieren*
Workshop “Langfristige Kapazitätsberechnung”, Berlin

Anne Philipp

31/07/2013 *Mixed integer nonlinear models in wireless networks*
International Conference on Continuous Optimization (ICCOPT), Lisbon

09/05/2014 *Multiuser downlink beamforming with interference cancellation using a SDP-Based Branch-and-Bound Algorithm*
IEEE Int. Conf. on Acoustics, Speech and Signal Process. (ICASSP), Florence

21/05/2014 *Quadratically Constrained Quadratic Programs with On/off Constraints and Applications in Signal Processing*
SIAM Conference on Optimization (SIOPT), San Diego

Jan-Frederik Pietschmann

04/04/2013 *Identification of non-linearities in transport-diffusion models of crowded motion*
Inverse Problems and Applications, Linköping

05/07/2013 *Identification of non-linearities in transport-diffusion models of crowded motion*
Applied Inverse Problem Conference

19/09/2014 *Identification of chemotaxis models with volume filling*
Chemnitz Symposium on Inverse Problems, Chemnitz

Anna-Maria von Pippich

11/04/2014 *Elliptische Kurven und Datensicherheit*
Landrat-Gruber-Schule, Dieburg

07/05/2014 *Faszination Primzahlen!*
Schülernachmittag, TU Darmstadt

09/07/2014 *Lauschen zwecklos!*
Summer school Faszination Mathematik for mathematically talented pupils, Erbach

24/07/2014 *Der RSA-Algorithmus*
Workshop for mathematically motivated pupils of the Albertus-Magnus-Schule Viernheim, TU Darmstadt

Carsten Rösnick

30/06/2013 *Parameterized Uniform Complexity in Numerics*
Continuity, Computability, Constructivity 2013; Swansea University, Gregynog

10/07/2013 *Closed Sets and Operators thereon: Representations, Computability and Complexity*
10th International Conference on Computability and Complexity in Analysis, Nancy

04/11/2013 *About Representations of and Operators on Sets*
NII Shonan Meeting Seminar 033, Kanagawa

24/06/2014 *Smoothness+epsilon: Real Complexity on Gevrey's Hierarchy*
10th Conference on Computability in Europe, Budapest

06/09/2014 *On Type-2 Complexity of some Operators in Geometry, Topology and Analysis*
Colloquium Logicum 2014, Munich

Jonas Sauer

12/02/2013 *Very Weak Solutions of the Stationary Stokes Equations in Unbounded Domains of Half Space Type*
IRTG Seminar, TU Darmstadt

28/05/2013 *Navier-Stokes Flow in Infinite Cylinders with Non-Constant Cross Section*
Mathematical Theory in Fluid Mechanics, Kácov

19/06/2013 *Navier-Stokes Flow in Infinite Cylinders with Non-Constant Cross Section*
The 8th Japanese-German International Workshop on Mathematical Fluid Dynamics, Waseda University, Tokyo

05/11/2013 *Navier-Stokes Flow in Spatially Periodical Domains*
The 9th Japanese-German International Workshop on Mathematical Fluid Dynamics, Waseda University, Tokyo

30/01/2014 *Strong Stability of 2D Viscoelastic Poiseuille-Type Flows*
IRTG 1529 Winter School, La Clusaz

15/10/2014 *Was sind... Navier-Stokes-Gleichungen?*
Seminar “What is...?”, TU Darmstadt

28/10/2014 *Strong Stability of 2D Viscoelastic Poiseuille-Type Flows*
Autumn School and Workshop, Bad Boll

Katharina Schade

12/02/2013 *Dynamics of Nematic Liquid Crystal Flows: the Quasilinear Approach*
IRTG Seminar, TU Darmstadt

20/02/2013 *Dynamics of Nematic Liquid Crystal Flows: the Quasilinear Approach*
Geophysical Fluid Dynamics Workshop, Oberwolfach

17/04/2013 *Flussdynamik nematischer Flüssigkristalle: Der quasilineare Ansatz*
Analysis Seminar, Martin-Luther-Universität, Halle-Wittenberg

19/06/2013 *Dynamics of nematic liquid crystal systems: The quasilinear approach*
The 8th Japanese-German International Workshop on Mathematical Fluid Dynamics, Waseda University, Tokyo

05/11/2013 *A thermodynamically consistent extension of the simplified Ericksen-Leslie model*
The 9th Japanese-German International Workshop on Mathematical Fluid Dynamics, Waseda University, Tokyo

30/01/2014 *Strong Stability of 2D Viscoelastic Poiseuille-Type Flows*
IRTG 1529 Winter School, La Clusaz

31/03/2014 *Strong Stability of 2D Viscoelastic Poiseuille-Type Flows*
Maxwell-Stefan meets Navier-Stokes Workshop, Halle (Saale)

02/07/2014 *Strong Dynamics of the Ericksen-Leslie Equations: The Quasilinear Approach*
Young Researchers in Mathematics, University of Warwick

28/10/2014 *Strong Stability of 2D Viscoelastic Poiseuille-Type Flows*
Autumn School and Workshop, Bad Boll

Carsten Schäfer

20/03/2013 *Optimal Actuator Placement for Dynamic Systems*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Novi Sad

29/07/2013 *Optimal Actuator and Sensor Placement for Dynamical Systems*
International Conference on Continuous Optimization (ICCOPT), Lisbon

20/01/2014 *Attenuation of Dynamical Systems using Model Predictive Control*
Optimization Seminar, TU Darmstadt

14/03/2014 *Optimal Actuator and Sensor Placement for Dynamical Systems*
Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Erlangen

21/05/2014 *Optimal Actuator and Sensor Placement for Dynamical Systems*
SIAM Conference on Optimization (SIOPT), San Diego

Werner Schindler

25/06/2013 *When Should A Side-Channel Attack or a Fault Attack Be Considered As Successful*
CryptArchi 2013, Fréjus

30/06/2014 *Optimal CPA Attack*
CryptArchi 2014, Annecy

Matthias Schlottbom

02/04/2013 *Analysis of a forward problem in optical tomography*
Inverse Problems and Applications, Linköping

18/09/2014 *Identification of nonlinear heat conduction laws in heat transfer problems*
Chemnitz Symposium on Inverse Problems, TU Chemnitz

Dirk Schröder

18/07/2013 *Adaptive Multilevel Optimization of a 3D glass cooling problem with boundary control*
EUCCO 2013, Chemnitz

Tobias Seitz

14/05/2014 *Optimal Control of Navier-Stokes Equations: An Introduction*
Seminar Numerik, TU Darmstadt

27/08/2014 *Flow Reconstruction from MRV Measurements*
Particles in Flows Summer School and Workshop, Prague

28/10/2014 *Flow reconstruction from MRV measurements*
Autumn School and Workshop on Mathematical Fluid Dynamics, Bad Boll

Adrian Sichau

31/07/2013 *Robust nonlinear programming with discretized PDE constraint using quadratic approximations*
International Conference on Continuous Optimization (ICCOPT), Lisbon

21/10/2013 *Robust Nonlinear Programming with Discretized PDE Constraints using Second-order Approximations*
Optimization Seminar, TU Darmstadt

Florian Sokoli

19/03/2013 *A Universal Measure for Genuine Multipartite Entanglement*
DPG Spring Meeting, Hannover

11/03/2014 *Comparing Usual and Genuine Multipartite Entanglement*
Conference on entanglement detection and quantification, Bilbao

Florian Steinberg

27/06/2013 *Computable analytic functions in iRRAM*
Continuity, Computability, Constructivity 2013; Swansea University, Gregynog

10/07/2013 *On the Computational Complexity of Laplaces and Poissons Equation*
10th International Conference on Computability and Complexity in Analysis, Nancy

22/07/2013 *Complexity of Laplace's and Poisson's Equation compared to ordinary integration*
Logic Colloquium 2013, Évora

23/07/2014 *Analytic Functions in iRRAM*
11th International Conference on Computability and Complexity in Analysis, Darmstadt

Thomas Streicher

08/09/2014 *Observationally Induced Algebras in Domain Theory*
Workshop Domains XI, Paris 7

Sara Tiburtius

23/01/2013 *Effektive elastische Eigenschaften muskuloskelettaler mineralisierter Gewebe - Sensitivitätsanalyse*
Seminar Numerik, TU Darmstadt

18/06/2013 *Finite element methods and numerical homogenization*
SPP 1420 PhD- and Postdoc-Workshop on theoretical and computational methods, TU Darmstadt

12/09/2013 *Elastic properties of the mineralized turkey leg tendon: experiment and model*
International Conference on Computational Bioengineering, Leuven

11/12/2014 *Homogenization for the multiple scale analysis of musculoskeletal mineralized tissues*
Seminar Numerik, TU Darmstadt

Andreas Tillmann

14/01/2013 *Branch & Cut for L0-Minimization*
Optimization Seminar, TU Darmstadt

08/07/2013 *The Computational Complexity of Spark, RIP, and NSP*
Signal Processing with Adaptive Sparse Structured Representations (SPARS), EPFL, Lausanne

16/12/2013 *Computational Aspects of Compressed Sensing*
Optimization Seminar, TU Darmstadt

Stefan Ulbrich

12/03/2014 *Optimization of deep drawing processes*
85th GAMM Annual Meeting, Erlangen

Sebastian Ullmann

26/02/2013 *Large-Eddy-Simulation mit adaptiven bewegten Gittern zur Lösung meterologischer Fragestellungen*
Metström Jahrestreffen, Berlin

26/05/2014 *POD-Galerkin Modeling for a Steady Thermally Driven Flow in a Cavity with Stochastic Boundary Conditions*
Workshop on Uncertainty Quantification in Computational Fluid Dynamics, Pisa

08/08/2014 *POD-Galerkin reduced-order modeling and stochastic collocation for natural convection under uncertainty*
Advances in Simulation-Driven Optimization and Modeling, Reykjavik

12/11/2014 *What is a finite element fictitious boundary method?*
Seminar "What is . . . ?", TU Darmstadt

Fabian Völz

11/11/2014 *Hyperbolic and elliptic Eisenstein series as theta lifts*
AG Seminar Algebra, TU Darmstadt

Lisa Wagner

18/06/2014 *Optimal control in cancer therapy*
Seminar Numerik, TU Darmstadt

Mirjam Walloth

30/08/2013 *An efficient and reliable residual-type a posteriori error estimator for the Signorini problem*
ENUMATH 2013, Lausanne

03/09/2013 *Adaptive numerical simulation of contact problems. Resolving local effects at the contact boundary in space and time*
ECCOMAS YIC 2013, Bordeaux

13/03/2014 *Residual-type a posteriori error estimators for Signorini problems*
GAMM 2014, Erlangen

David Wegmann

31/07/2013 *Eine verbesserte Energieungleichung für schwache Lösungen der Navier-Stokes-Gleichungen*
Offenes Seminar AG Analysis/Partielle Differentialgleichungen, TU Darmstadt

Martin Ziegler

20/02/2013 *Parameterized Uniform Complexity in Numerics: from Smooth to Analytic, from NP-hard to Polytime*
Computability Theory and Foundations of Mathematics, Tokyo Institute of Technology

02/07/2013 *Real benefit of promises and advice*
9th Conf. on Computability in Europe, Milano

06/11/2013 *The computational complexity of Laplace's equation*
NII Shonan Meeting Seminar 033, Kanagawa

05/08/2014 *From Calculus to Algorithms without Errors*
4th International Congress on Mathematical Software, Hanyang University, Seoul

6.1.3 Visits

Frank Aurzada, American Institute of Mathematics, March 2014

Achim Blumensath, University of Paris 7, August 2013

Achim Blumensath, University of Warsaw, January 2014

Achim Blumensath, University of Paris 7, September 2014

Vera Bommer, TU München, November 2013

Dieter Bothe, Oberwolfach, March 2013

Dieter Bothe, Universität Halle - Wittenberg, April 2013

Dieter Bothe, University Rennes, June 2013

Dieter Bothe, Charles University Prague, September 2013

Dieter Bothe, University Rennes, September 2013

Dieter Bothe, Charles University Prague, November 2013

Dieter Bothe, Universität Hannover, February 2014

Dieter Bothe, University Rennes, March 2014

Dieter Bothe, Charles University Prague, May 2014

Pia Domschke, University of Dundee, September 2013 - September 2014

Herbert Egger, RICAM Linz, March 2013

Herbert Egger, TU München, September 2013

Herbert Egger, ETH Zürich, December 2013

Herbert Egger, ETH Zürich, July 2014

Herbert Egger, University Reading, September 2014

Tristan Gally, Zuse-Institut Berlin, May 5–9, 2014

Vassilios Gregoriades, Japan Advanced Institute of Science and Technology, April 2014

Karsten Grosse-Brauckmann, Centre de Recerca Matemática, March 2013

Philipp Habegger, Institute for Advanced Study, Princeton, September - December 2014

Robert Haller-Dintelmann, University of Kentucky, October 2013

Matthias Hieber, MFO Oberwolfach, February 2013

Matthias Hieber, Waseda University, Tokyo, March 2013

Matthias Hieber, Newton Institute, Cambridge, April 2013

Matthias Hieber, Zheijang University, Hangzhou, June 2013

Matthias Hieber, Cortona, June 2013

Matthias Hieber, University of Tokyo, Tokyo, August 2013

Matthias Hieber, Clay Institute, Oxford, September 2013

Matthias Hieber, Universität Regensburg, September 2013

Matthias Hieber, Waseda University, Tokyo, November 2013

Matthias Hieber, Universität Augsburg, November 2013

Matthias Hieber, SIAM-PDE, Orlando, December 2013

Matthias Hieber, Tulka-meeting, KIT, February 2014

Matthias Hieber, Universität Erlangen, March 2014

Matthias Hieber, MFO Oberwolfach, March 2014

Matthias Hieber, Universität Halle, April 2014

Matthias Hieber, IMPA, Rio de Janeiro, April 2014

Matthias Hieber, Universität Bonn, May 2014

Matthias Hieber, Universität Dortmund, June 2014

Matthias Hieber, University Autonoma de Madrid, July 2014

Matthias Hieber, University Marrakech, September 2014

Matthias Hieber, University Ferrara, September 2014

Matthias Hieber, INRIA, Nancy, November 2014

Karl H. Hofmann, Tulane University, March and September 2013, March and September 2014

Klaus Keimel, University of Brunei Darussalam, February 2013

Klaus Keimel, Nanyang Technological University, Singapore, February - March 2013

Klaus Keimel, Louisana State University, Baton Rouge, June 2013

Klaus Keimel, Tulane University, New Orleans, June 2013

Klaus Keimel, Beihang University, Beijing, October 2013

Klaus Keimel, Hunan University, Changsha, October 2013

Klaus Keimel, East China Normal University, Shanghai, October 2013

Klaus Keimel, Al-Farabi Kazakh National University, Almaty, May 2014

Klaus Keimel, Institut Henri Poincaré, Paris, June 2014

Klaus Keimel, Université Paris-Diderot, September 2014

Daniel Körnlein, Universidad de Sevilla, September 2014

Ulrich Kohlenbach, HIM Bonn, September 2013

Angeliki Koutsoukou-Argyraki, Waseda University, Tokyo, September 2014-March 2015

Angeliki Koutsoukou-Argyraki, Tohoku University, Sendai, November 2014

Angeliki Koutsoukou-Argyraki, JAIST, Kanazawa, December 2014

Jens Lang, CWI, Amsterdam, The Netherlands, April-May 2013

Jens Lang, University of Dundee, Scotland, May 2014

Oliver Lass, Universität Konstanz, October 2014

Stéphane Le Roux, A.P. Ershov Institute, Novosibirsk, July - August 2014

Stéphane Le Roux, University of South Africa, February - March 2013

Stéphane Le Roux, A.P. Ershov Institute, Novosibirsk, July - August 2013

Stéphane Le Roux, Goedel Research Centre, Vienna, November 2013

Hendrik Lüthen, RWTH Aachen, March 2014

Hendrik Lüthen, Universität Bonn, June 2014

Matthias Meiners, Taras Shevchenko National University of Kyiv, November 2013

Matthias Meiners, TU München, May 2014

Matthias Meiners, TU München, December 2014

Hannes Meinlschmidt, Martin-Luther Universität Halle-Wittenberg, July 2013

Hannes Meinlschmidt, TU Dortmund, August 2014

Christian Mönch, Universität Münster, August 2013

Andreas Paffenholz, Universität Bielefeld, May 2014

Andreas Paffenholz, SFSU, San Francisco, October 2014

Marc Pfetsch, Georgia Insitute of Technology, Atlanta, May 2013

Marc Pfetsch, ISAI Rome, April 2013

Jan-Frederik Pietschmann, UC Irvine, March 2013

Jan-Frederik Pietschmann, University of Cambridge, March 2014

Jan-Frederik Pietschmann, UC Irvine, November 2014

Jan-Frederik Pietschmann, RICAM Linz, Dezember 2014

Carsten Rösnick, Japan Advanced Institute of Science and Technology, October - November 2013

Carsten Rösnick, University of South Africa, April - June 2014

Jonas Sauer, Waseda University, Tokyo, September 2013 - February 2014

Jonas Sauer, Shinshū University, Matsumoto, February 2014

Katharina Schade, Martin-Luther-Universität, Halle-Wittenberg, April 2013

Katharina Schade, Waseda University, Tokyo, September 2013 to February 2014

Nils Scheithauer, Sendai, July 2013

Nils Scheithauer, University of Lille 1, March 2014

Nils Scheithauer, University of Tokyo, June 2014

Tobias Seitz, UC Irvine, US, November 2014

Florian Steinberg, Waseda University, Tokyo, September 2014 to March 2015

Thomas Streicher, Institut Henri Poincaré, Paris, April - June 2014

Andreas Tillmann, Technion, Haifa, Israel, April 2014

Sebastian Ullmann, WIAS Berlin, January 2013

Mirjam Walloth, USI Lugano, March 2014

Mirjam Walloth, University of Milan, March 2014

Martin Ziegler, The University of Tokyo, Febrary to March 2013

Martin Ziegler, Kyoto University, October to November 2013

6.2 Organization and Program Commitees of Conferences and Workshops

Hans-Dieter Alber

- Workshop on phase field modeling, Freudenstadt, February 20 to 22, 2013 (jointly with R. Müller, Kaiserslautern, B. Markert, Aachen)
- CIMPA Research School on partial differential equations in mechanics, Mongolian University of Science and Technology, Ulaanbaatar, July 15 to 26, 2013 (jointly with Sarantujya Tsedendamba, Doina Cioranescu, Alain Damlamian)
- 9th international workshop direct and inverse problems on piezoelectricity, Bauhaus-Universität Weimar, September 29 to October 2, 2013 (jointly with Tom Lahmer, Nanthakumar Subbiah, Chao Zhang, Frank Zigan)
- 13th GAMM seminar on microstructures, Ruhr-Universität Bochum, January 17 to 18, 2014 (jointly with Klaus Hackl, Alexander Mielke)
- GAMM, 85th annual meeting, Universität Erlangen-Nürnberg, March 10 to 14, 2014 (jointly with Paul Steinmann, Günther Leugering)
- Second seminar on the mechanics of multifunctional materials, Physikzentrum Bad Honnef, May 5 to 9, 2014 (jointly with Doru Lupascu, Jörg Schröder)
- INdAM workshop on singular and degenerate evolution problems, Palazzone della Scuola Normale, Cortona, June 22 to 27, 2014 (jointly with Frank Duzaar, Erlangen and Ugo Gianazza, Pavia)
- XIXth Symposium on trends in application of mathematics to mechanics, Université de Poitiers, September 8 to 11, 2014 (jointly with Alain Miranville)

Frank Aurzada

- Workshop Stochastics and Dynamics (jointly with Jochen Blath (TU Berlin), Steffen Dereich (Universität Münster), September 10-12, 2014, Berlin

Volker Betz

- Winterschool on spatial models in statistical mechanics, Darmstadt, March 2014 (jointly with Matthias Meiners)

Dieter Bothe

- Summerschool on Transport Processes at Fluidic Interfaces, July 16–17, 2013, Aachen (jointly with A. Reusken)

Jan H. Bruinier

- AKLS-Seminar on *Automorphic Forms* (jointly with K. Bringmann, V. Gritsenko, A. Krieg, G. Nebe, N.-P. Skoruppa, D. Zagier), 04.02.13 Aachen, 11.06.13 Köln, 09.10.13 Aachen, 18.12.13 MPI Bonn, 19.02.14 Köln, 03.06.14 Aachen, 03.12.14 Lille
- Winter School on "p-adic families of motives and modular forms" (jointly with Y. Choie, H. Darmon, W. Kohnen, J. Park), Postech, Pohang, Korea, 2013

– Workshop *Modular forms* (jointly with A. Ichino, T. Ikeda, Ö. Imamoğlu), Mathematisches Forschungsinstitut Oberwolfach, 27.04.14–03.05.14

– ICM Satellite Conference *Automorphic forms and arithmetic* (jointly with H. Darmon, Y. Choie, W. Kohnen, J. Park), Postech, Korea, 25.08.14–28.08.14

Herbert Egger

– Summerschool *Reduced Basis Methods – Fundamentals and Applications*, September 16–19, 2013, TU München

Reinhard Farwig

– Section on "Weak solutions to the Navier-Stokes equations and their regularity" at the International Conference EQUADIFF 13, Prague 2013

– The 9th Japanese-German International Workshop on Mathematical Fluid Dynamics, Tokyo 2013 (jointly with Matthias Hieber, Hideo Kozono and Yoshihro Shibata)

– Vorticity, Rotation and Symmetry (III) - Approaching Limiting Cases of Fluid Flow, CIRM Luminy, Marseille 2014 (jointly with Jiři Neustupa, Prague, and Patrick Penel, Toulon)

– Kickoff Meeting of the JSPS-DFG Japanese-German Graduate Externship, Tokyo 2014 (jointly with Matthias Hieber, Hideo Kozono and Yoshihiro Shibata)

– Section on "Fluid flows in unbounded domains" at the 10th AIMS Conference on Dynamical Systems, Differential Equations and Applications, Madrid 2014 (jointly with Jiři Neustupa, Prague)

Jane Ghiglieri

– Minisymposium: Optimal Control Based on Reduced Order Models (jointly with S. Ulbrich) at the 3rd International Workshop on Computational Engineering (ICCE), Oct 6–10, 2014, Universität Stuttgart

Matthias Hieber

– Oberwolfach Workshop on Geophysical Flows (jointly with Y. Giga and E. Titi)

– Klausurtagung IRTG 1529, La Clusaz, France (IRTG 1529)

– Coorganisation International Conference Complex Fluids, Hangzhou, China

– 9th-German-Japanese Workshop on Mathematical Fluid Dynamics, Waseda University, Tokyo (IRTG 1529, jointly with R. Farwig, H. Kozono and Yoshihiro Shibata)

– Winter Workshop "Fluids and Snow", La Clusaz, France (IRTG 1529)

– Applied Operator Theory, GAMM Jahrestagung, Erlangen (jointly with Ch. Tretter)

– The 10th Japanese-German Workshop on Mathematical Fluid Dynamics, Bad Boll (IRTG 1529, jointly with H. Kozono)

Silke Horn

– Math across the Main Workshop, March 7, 2013 (with Timo de Wolff)

Michael Joswig

– Local Committee, MEGA 2013 (Methods for Effective Algebraic Computation), Frankfurt (Main)

Klaus Keimel

– ISDT'13, International Symmposium on Domain Theory and its Applications, Hunan University, Changsha, 25.–29.10.13 (Member of Programme Committee)

– Workshop Domains XI, Université Paris Diderot, 8–10.09.14 (Member of Programme Committee)

Ulrich Kohlenbach

– Logic, Language, Information and Computation (WoLLIC2014), Valparaiso, Chair of Programm Committee

– Oberwolfach Workshop on Mathematical Logic (2014), Organizer together with S. Buss (UCSD) and M. Rathjen (Leeds)

Burkhard Kümmerer

– Program on Mathematical Horizons for Quantum Physics: Quantum Information Theory, NUS (Singapore), August 12-30, 2013 (jointly with Hans Maassen)

– Filmfestival Mathematik und Informatik zum 1. Heidelberger Laureate Forum, September 16-21, 2013 (in Cooperation with Heidelberg Laureate Forum)

Andreas Paffenholz

– Organizing committee, Effective Methods in Algebraic Geometry (MEGA) 2013, June 3–7, Frankfurt (Main)

Marc Pfetsch

– Programm committee, 13th Workshop on Algorithmic Approaches for Transportation Modelling, Optimization, and Systems (ATMOS) 2013, September 5, Sophia Antipolis, France

Anna-Maria von Pippich

– KOSMOS Summer University "Multiple zeta values in mathematics and physics" (jointly with H. Esnault, J. Kramer, and D. Kreimer), HU Berlin, 01.10.2013–05.10.2013

– Conference "Moduli and automorphic forms": a meeting for young women in mathematics (jointly with A. Ortega), HU Berlin, 22.05.2014–24.05.2014

– Summer school "Faszination Mathematik" for mathematically talented pupils, Erbach, 08.07.2014–11.07.2014

Ulrich Reif

– New Trends in Applied Geometry 2013, Bad Herrenalb

– New Trends in Applied Geometry 2014, Passau

Stefan Ulbrich

– Program committee, Fourth International Conference on Continuous Optimization ICCOPT 2013, July 27–August 1, Lisbon

– Program committee, 16th French-German-Polish Conference on Optimization FGP 13, September 23–27, 2013, Krakow

– Invited minisymposium, Advances and Applications in PDE Constrained Optimization, SIAM Conference on Optimization 2014, May 19–22, San Diego

Martin Ziegler

– 12th International Conference on Computability and Complexity in Analysis, Tokyo (Chair of Programme Committee)

– Continuity, Computability, Constructivity 2014 (Member of Programme Committee)

7 Workshops and Visitors at the Department

7.1 The Colloquium

Winter term 2012/2013

17/10/2012 Prof. Dr. Priska Jahnke (TU Darmstadt), *Klassifikation algebraischer Varietäten und ihre Bedeutung in der Kryptographie*

24/10/2012 Prof. Dr. Vasco Brattka (Universität der Bundeswehr München), *Wie kann man mathematische Sätze sortieren?*

31/10/2012 Prof. Dr. Martin Gander (University of Geneva), *Euler, Ritz, Galerkin, Courant: On the road to the finite element method*

07/11/2012 Prof. Dr. Patrizio Neff (Universität Duisburg-Essen), *Neues zur Kornschen Ungleichung in der linearen Elastizitätstheorie*

14/11/2012 Prof. Dr. Christian Haase (Universität Frankfurt), *Diskrete Methoden in Algebra und algebraischer Geometrie*

21/11/2012 Prof. Dr. Isabelle Gallagher (University of Paris Diderot (Paris VII)), *On the geometry of the set of global solutions to the Navier-Stokes equations*

28/11/2012 Prof. Dr. Anton Wakolbinger (Universität Frankfurt), *Zufällige Genealogien*

05/12/2012 Prof. Dr. Robert Denk (Universität Konstanz), *Pseudodifferentialoperatoren und maximale L^p-Regularität*

12/12/2012 Prof. Dr. Manfred Lehn (Universität Mainz), *Der Satz von Grothendieck-Brieskorn-Slodowy und symplektische Hyperflächensingularitäten*

19/12/2012 Prof. Dr. Gerhard Huisken (MPI Potsdam-Golm), *Der Fluss von Flächen entlang der inversen mittleren Krümmung und seine Anwendungen*

16/01/2013 Prof. Dr. Stefan Ufer (LMU München), *Lernen aus Fehlern im Mathematikunterricht*

23/01/2013 Prof. Dr. Martin Möller (Universität Frankfurt), *Kenngrößen für die Dynamik von Billardtischen*

30/01/2013 Prof. Dr. Volker Kaibel (Universität Magdeburg), *Erweiterte Formulierungen ganzzahliger Optimierungsprobleme*

06/02/2013 Prof. Dr. Stefan Volkwein (Universität Konstanz), *A-Posteriori-Fehleranalyse für die Optimalsteuerung von partiellen Differentialgleichungen: Analysis und Numerik*

13/02/2013 Prof. Dr. Irwin Yousept (TU Darmstadt), *Optimal control of electromagnetic processes and its modern applications*

Summer term 2013

17/04/2013 Prof. Dr. Herbert Egger (TU Darmstadt), *Stabilität, Konsistenz, Approximation: Fahlerhaft Rechnen mit System*

26/04/2013 Celebration colloquium on the occasion of 60th Birthday of Prof. Dr. Burkhard Kümmerer: Prof. Dr. Moritz Epple (Universität Frankfurt), *Zur Geschichte der Natur mathematischer Dinge*

26/04/2013 Celebration colloquium on the occasion of 60th Birthday of Prof. Dr. Burkhard Kümmerer: Prof. Dr. Hans Maassen (University of Nijmegen), *Blick in die nichtkommutative Welt*

08/05/2013 Prof. Dr. Max Wardetzky (Universität Göttingen), *Diskrete elastische Kurven*

15/05/2013 Graduation Ceremony for summer term 2012 and winter term 2012/2013: Prof. Dr. Elias Wegert (TU Bergakademie Freiberg), *Der lange Weg zum heiligen Gral – ein Ausflug in komplexe Welten*

22/05/2013 Prof. Dr. Alexey Chernov (Universität Bonn (Hausdorff Center for Mathematics)), *Multilevel Monte Carlo FEM and application for random obstacle problems*

29/05/2013 Prof. Dr. Gitta Kutyniok (TU Berlin), *Mathematische Bildverarbeitung mittels Compressed Sensing*

05/06/2013 Prof. Dr. Grzegorz Karch (University of Wroclaw), *Self-similar solutions of partial differential equations*

12/06/2013 Prof. Dr. Dr. h.c. Wolfgang Thomas (RWTH Aachen), *Zur algorithmischen Theorie unendlicher Spiele*

19/06/2013 Prof. Dr. Ulrich Langer (Universität Linz), *Simulation and Optimal Control of Time-Periodic PDE Problems*

26/06/2013 Prof. Dr. Klaus Hulek (Universität Hannover), *Homogene Gebiete, Modulformen und Modulräume*

03/07/2013 Prof. Dr. Achim Klenke (Universität Mainz), *Spannbäume auf leiterartigen Graphen*

10/07/2013 Prof. Dr. Valentin Blomer (Universität Göttingen), *Eigenfunktionen auf arithmetischen Riemannschen Mannigfaltigkeiten*

17/07/2013 Prof. Dr. Frank Aurzada (TU Darmstadt), *Bitte hinten anstellen! - Ergebnisse der Warteschlangentheorie und Anwendungen auf Telekommunikationsnetzwerke*

Winter term 2013/2014

16/10/2013 Prof. Dr. Matthias Schneider (Universität Mainz), *Der Gömböc - ein mathematisches Stehaufmännchen*

23/10/2013 Prof. Dr. Wolfgang König (TU Berlin und WIAS Berlin), *Geordnete Irrfahrten*

30/10/2013 Prof. Dr. Christian Kanzow (Universität Würzburg), *Zur Lösung von Quasi-Variationsungleichungen*

06/11/2013 Prof. Dr. Klaus Altmann (FU Berlin), *Der universelle Minkowski-Summand eines Polyeders*

13/11/2013 Prof. Dr. Thomas Apel (Universität der Bundeswehr München), *Anisotrope finite Elemente*

20/11/2013 Prof. Dr. Harald Garcke (Universität Regensburg), *Die Mathematik des Wachstums von Schneekristallen*

27/11/2013 Prof. Dr. Hans Niels Jahnke (Universität Duisburg-Essen), *Die hypothetische Seite der Mathematik, und was sie für den Unterricht bedeuten kann*

04/12/2013 Prof. Dr. Joachim Weickert (Universität des Saarlandes), *Bildkompression mit partiellen Differentialgleichungen*

11/12/2013 Prof. Dr. Martin Hanke-Bourgeois (Universität Mainz), *Impedanztomographie mit eingeschränkten Daten*

18/12/2013 Prof. Dr. Andreas Vohns (Universität Klagenfurt), *Zur Dialektik von Kohärenzerfahrungen und Differenzerlebnissen am Beispiel der Vektorrechnung*

15/01/2014 Prof. Dr. Pavel Krejčií (Academy of Sciences of the Czech Republic, Prague), *Dynamic Contact of Elastoplastic Bodies*

22/01/2014 Prof. Dr. Uwe Jannsen (Universität Regensburg), *Auflösung von Singularitäten: Resultate und Probleme*

29/01/2014 Prof. Dr. Peter Mörters (University of Bath, UK), *Münzwürfe, stabile Zuordnungen und Verschiebungen der Brownschen Bewegung*

05/02/2014 Prof. Dr. Anuj Dawar (University of Cambridge, UK), *Tractable Approximations of Graph Isomorphism*

12/02/2014 Prof. Dr. Philipp Habegger (TU Darmstadt), *Komplexe Multiplikation - oder ist* $e^{\pi\sqrt{163}}$ *eine ganze Zahl?*

Summer term 2014

16/04/2014 Prof. Dr. Anna-Maria von Pippich (TU Darmstadt), *Summen natürlicher Zahlen ... unendlich einfach oder einfach unendlich?*

23/04/2014 Prof. Dr. Walter Gubler (Universität Regensburg), *Tropische Geometrie*

30/04/2014 Prof. Dr. Matthias Meiners (TU Darmstadt), *Verallgemeinerte stabile Verteilungen*

07/05/2014 Prof. Dr. Holger Wendland (Universität Bayreuth), *Multiskalen-Modellierung mit radialen Basisfunktionen*

14/05/2014 Prof. Dr. Dr. h.c. Herbert Spohn (TU München), *Die Kardar-Parisi-Zhang Gleichung und zufällige Matrizen*

21/05/2014 Prof. Dr. Johanna Heitzer (RWTH Aachen), *Vom Lotfällen bis zum JPEG-Format*

28/05/2014 Graduation Ceremony for summer term 2013 and winter term 2013/2014: Prof. Dr. Tatjana Eisner (Universität Leipzig), *Schöne Mathematik: Ein Beispiel*

04/06/2014 Prof. Dr. Gert Lube (Universität Göttingen), *Some remarks on stabilized finite element methods for coupled incompressible flow problems*

11/06/2014 Prof. Dr. Klaus Ritter (TU Kaiserslautern), *Multi-level Monte Carlo zur Approximation von Verteilungen*

18/06/2014 Memorial Colloquium in Honour of Prof. Dr. Helmut Mäurer: Prof. Dr. Markus Stroppel (Universität Stuttgart), *Helmut Mäurer - Mensch und Mathematiker*

25/06/2014 Prof. Dr. Marius Tucsnak (Université de Lorraine), *Mathematics and swimming of aquatic organisms*

02/07/2014 Prof. Dr. Dana Scott (UC Berkeley), *Geometry without Points*

09/07/2014 Prof. Dr. Volker Mehrmann (TU Berlin), *Differential algebraic systems: Modelling, Simulation and Control*

16/07/2014 Prof. Dr. Thorsten Theobald (Universität Frankfurt), *Polyeder, Spektraeder und die Frage der Inklusion*

Winter term 2014/2015

15/10/2014 Prof. Dr. Mads Kyed (TU Darmstadt), *Bewegungsgleichungen eines umströmten Körpers: Kann eine Hummel fliegen?*

22/10/2014 Prof. emer. Dr. Adrian R. D. Mathias (Université de la Réunion, z. Zt. Universität Freiburg), *Hilbert, Bourbaki and the Scorning of Logic*

29/10/2014 Prof. emer. Dr. Alexander Wynands (Universität Bonn), *Basiskompetenzen Mathematik: (Un-)Verzichtbares Wissen und Können am Ende der Sek. I, Probleme einer "Allgemeinbildung" in der Sek. II*

05/11/2014 Prof. Dr. Britta Peis (RWTH Aachen), *Nash-Gleichgewichte und Polymatroide*

12/11/2014 Prof. Dr. Stefan Turek (TU Dortmund), *Finite Elemente mit fiktiven Rändern zur numerischen Lösung von komplexen Partikelströmungen*

19/11/2014 Prof. Dr. Frank Heinrich (TU Braunschweig), *"Strategiefehler" beim Bearbeiten mathematischer Probleme*

26/11/2014 Prof. Dr. Gerold Alsmeyer (Universität Münster), *Zum stationären Tail-Index kontraktiver iterierter Funktionensysteme*

03/12/2014 Prof. Dr. David Masser (Universität Basel), *On zeroes of exponential polynomials*

10/12/2014 Dr. habil. Andreas Paffenholz (TU Darmstadt), *Gitterpunkte, Polytope und torische Geometrie*

17/12/2014 Prof. Dr. Marko Lindner (TU Hamburg-Harburg), *Wo ist die Hauptdiagonale einer unendlichen Matrix?*

14/01/2015 Prof. Dr. Ben Schweizer (TU Dortmund), *Dispersionseffekte von Wellen in heterogenen Medien*

21/01/2015 Prof. Dr. Nina Gantert (TU München), *Einsteinrelation und Homogenisierung zufälliger Medien*

28/01/2015 Prof. Dr. Harald A. Helfgott (Ecole Normale Supérieure, Paris), *The ternary Goldbach conjecture*

04/02/2015 Prof. Dr. Barbara Kaltenbacher (Universität Klagenfurt), *Regularisierung in Banachräumen*

11/02/2015 Prof. Dr. Alexandra Schwartz (TU Darmstadt), *Rigging the Game: Spieltheorie und Wettbewerbsdesign*

7.2 Guest Talks at the Department

15/01/2013 Prof. Dr. Keita Yokoyama (Tohoku University), *Combinatorial principles and reverse mathematics* (Ulrich Kohlenbach)

22/01/2013 Prof. Dr. Markus Gahn (Universität Heidelberg), *Homogenisierung von Reaktions-Diffusionsgleichungen in zwei durch ein Netzwerk von Kanälen getrennten Gebieten* (Matthias Hieber)

22/01/2013 Prof. Dr. Ryo Takada (Kyoto University - Universität Bonn), *Dispersive estimates for the Navier-Stokes equations in the rotational framework* (Matthias Hieber)

22/01/2013 Prof. Dr. Yohei Tsutsui (Waseda University - Universität Bonn), *An application of weighted Hardy spaces to the Navier-Stokes equations* (Matthias Hieber)

29/01/2013 Prof. Dr. Michael Dreher (Universität Konstanz), *Large Data Solutions to the viscous quantum hydrodynamic model with barrier potential* (Matthias Hieber)

05/02/2013 Prof. Dr. Muriel Boulakia (Université Pierre et Marie Curie), *Parameter identification for a simplified model of the respiratory tract* (Reinhard Farwig)

08/02/2013 Prof. Dr. Michael Dreyer (Universität Bremen), *The capillary channel flow experiment on the International Space Station* (Dieter Bothe)

15/03/2013 Dr. Jaime Gaspar (University of Paris), *Krivine's classical realisability and the unprovability of the axiom of choice and the continuum hypothesis* (Ulrich Kohlenbach)

17/03/2013 Prof. Dr. Dorian Goldfeld (Columbia University New York), *An orthogonality relation for Fourier coefficients of cusp forms on GL(n)* (Jan H. Bruinier)

17/03/2013 Prof. Dr. Gerard van der Geer (University of Amsterdam), *Picard modular forms and curves of genus three* (Jan H. Bruinier)

17/03/2013 Prof. Dr. Nils Skoruppa (Universität Siegen), *How to turn modular forms into Jacobi forms* (Jan H. Bruinier)

17/03/2013 Prof. Dr. Siegfried Böcherer (Universität Mannheim), *Growth of Fourier coefficients of Siegel modular forms* (Jan H. Bruinier)

17/03/2013 Prof. Dr. Youngju Choie (POSTECH Pohang), *Schubert Einstein series* (Jan H. Bruinier)

18/03/2013 Dr. Ben Kane (Universität Köln), *Locally harmonic Maass forms* (Jan H. Bruinier)

18/03/2013 Prof. Dr. Geoffrey Mason (University of California at Santa Cruz), *Some cohomology associated to the Moonshine module and the Monster simple group* (Jan H. Bruinier)

18/03/2013 Prof. Dr. Jyotirmoy Sengupta (TIFR Mumbai), *On effective determination of Maass forms from central values of Rankin-Selberg L-functions* (Jan H. Bruinier)

18/03/2013 Prof. Dr. Ken Ono (Emory University Atlanta), *Ramanujan's last letter revisited* (Jan H. Bruinier)

18/03/2013 Prof. Dr. Riccardo Salvati Manni (University Roma 1), *On Coble's quartic* (Jan H. Bruinier)

18/03/2013 Prof. Dr. Valery Gritsenko (University of Lille), *New applications of Borcherds automorphic products* (Jan H. Bruinier)

19/03/2013 Dr. Jens Funke (University of Durham), *The geometric Shintani lift for weakly holomorphic modular forms* (Jan H. Bruinier)

19/03/2013 Prof. Dr. Don Zagier (MPI Bonn), *Hecke operators and period polynomials for modular forms* (Jan H. Bruinier)

19/03/2013 Prof. Dr. Tomoyoshi Ibukiyama (University of Osaka), *The conjectures of Harder type and Shimura type revisited* (Jan H. Bruinier)

16/04/2013 Prof. Dr. Jan Rozendaal (Delft University of Technology), *Functional calculus for semigroups using transference methods* (Moritz Egert)

23/04/2013 Jethro van Ekeren, PhD (IHES Paris), *Vertex algebras, conformal blocks and superconformal blocks* (Nils Scheithauer)

26/04/2013 Prof. Dr. Hans Maassen (University of Nijmegen), *Ein Blick in die nichtkommutative Welt* (Burkhard Kümmerer)

30/04/2013 Prof. Dr. Christian Rohde (Universität Stuttgart), *Heterogeneous Multiscale Methods for Compressible Two-Phase Flow with Phase Transition* (Dieter Bothe)

06/05/2013 Dipl.-Ing. Paul Bandi (RWTH Aachen), *Experimentelle Bestimmung zweidimensionaler Konzentrationsverteilungen im laminar-welligen Rieselfilm* (Dieter Bothe)

06/05/2013 Dr. Martin Westerholt-Raum (ETH Zürich), *Kudla's modularity conjecture for cycles of codimension 2* (Jan H. Bruinier)

07/05/2013 Prof. Dr. Marcus Waurick (TU Dresden), *On Non-Autonomous Evolutionary Problems* (Matthias Geissert)

14/05/2013 Prof. Dr. Joachim Rehberg (WIAS Berlin), *Sobolev extensions and analysis on non-Lipschitz domains* (Matthias Hieber)

14/05/2013 Prof. Dr. Markus Lange (Universität Münster), *Skalentransformationen in allgemein kovarianter Quantenfeldtheorie* (IRTG 1529)

14/05/2013 Simon Hampe (Universität des Saarlandes), *a-tint: Eine polymake-Erweiterung für tropische Schnitttheorie* (Michael Joswig)

21/05/2013 Dr. Pen-Yuan Hsu (Waseda University), *Liouville problem for the planer Navier-Stokes equation* (IRTG 1529)

21/05/2013 M.Sc. René Olivetto (Universität Köln), *Multivariable Kac-Wakimoto characters* (Jan H. Bruinier)

22/05/2013 Alexey Chernov (University of Reading), *Multilevel Monte Carlo FEM and application for random obstacle problems* (Herbert Egger)

28/05/2013 Prof. Dr. Peter Knobloch (Charles University in Prague), *Stabilized finite element methods for convection-diffusion-reaction equations* (Maria Lukáčová-Medvidova)

05/06/2013 Prof. Dr. Grzegorz Karch (University of Wrocław), *Global asymptotic stability of solutions to Navier-Stokes system* (Reinhard Farwig)

05/06/2013 Prof. Dr. Grzegorz Karch (University of Wrocław), *Self-similar solutions of partial differential equations* (Reinhard Farwig)

07/06/2013 Andreas Döring (University of Oxford), *A new kind of logic for quantum systems* (Ulrich Kohlenbach)

10/06/2013 Takahito Kashiwabara, M.Sc. (University of Tokyo), *Stokes and Navier-Stokes equations under slip or leak boundary conditions of friction type* (Dieter Bothe)

11/06/2013 Prof. Dr. Ben Goddard (Imperial College London), *Statistical mechanics for complex, multiphase fluids* (Volker Betz)

12/06/2013 Dr. Jonathan Spreer (University of Queensland), *Parameterized Complexity of Discrete Morse Theory* (Andreas Paffenholz)

18/06/2013 Prof. Dr. Quentin Grimal (Biomedical Imaging Lab (LIB), UPMC Paris), *Modelling of in-situ strain fields in cortical bone tissue* (Alf Gerisch)

21/06/2013 Angeliki Koutsoukou-Argyraki (University of Copenhagen), *Automorphisms of the Calkin algebra under two different set-theoretic hypotheses; an independence result* (Ulrich Kohlenbach)

25/06/2013 Prof. Dr. Gerald Höhn (Kansas State University), *Konforme Netze* (Nils Scheithauer)

25/06/2013 Prof. Dr. Jesùs Garcia Falset (Universitat de València), *Coincidence results and Applications* (Ulrich Kohlenbach)

26/06/2013 Prof. Dr. Moritz Epple (Universität Frankfurt), *Zur Geschichte der Natur mathematischer Dinge* (Burkhard Kümmerer)

02/07/2013 Dr. Fritz Hörmann (Universität Freiburg), *Fibered Derivators, (Co)homological Descent and the Six-Functor-Formalism* (Philip Habegger)

02/07/2013 Prof. Dr. Mark Veraar (Delft University of Technology), *Maximal gamma-regularity* (Matthias Hieber)

02/07/2013 Prof. Dr. Michel Pierre (ENS Cachan), *An introduction to shape optimization: some mathematical issues* (Dieter Bothe)

05/07/2013 Erkal Aziz Selman (RWTH Aachen), *On Fractional Isomorphisms* (Martin Otto)

09/07/2013 Yuto Imai (Waseda University), *Lie Algebras - Finite and Infinite* (IRTG 1529)

10/07/2013 Prof. Dr. Julian Pfeifle (UPC Barcelona), *A Polyhedral Proof of the Matrix-Tree Theorem* (Michael Joswig)

11/07/2013 Prof. Dr. Alexander Drewitz (Columbia University, New York), *Asymptotics of the critical parameter for level set percolation of the Gaussion free field* (Frank Aurzada)

15/07/2013 Björn Geißler (Universität Erlangen-Nürnberg), *A New Algorithm for MINLP Applied to Gas Transport Energy Cost Minimization* (Marc Pfetsch)

16/07/2013 Naohumi Mori (Waseda University), *Decay structure for the Timoshenko system with heat conduction* (IRTG 1529)

16/07/2013 Tomoyuki Nakatsuka (Waseda University), *On uniqueness of weak solutions to the stationary Navier-Stokes equation in two-dimensional exterior domains* (IRTG 1529)

19/08/2013 Prof. Dr. Ruy de Queiroz (University of Pernambuco), *Propositional equality, identity types, and direct computational paths* (Ulrich Kohlenbach)

16/09/2013 Réne Henrion (WIAS Berlin), *Optimierungsprobleme mit Wahrscheinlichkeitsrestriktionen* (Stefan Ulbrich)

26/09/2013 Sergio Alejandro González Andrade (Escuela Politécnica Nacional), *Numerical simulation of Bingham fluids by semismooth Newton methods: a general survey* (Irwin Yousept)

04/10/2013 Prof. Paul Potgieter (University of South Africa), *The theory of complex oscillations* (Martin Ziegler)

08/10/2013 Prof. Dr. Wolfgang Dreyer (WIAS Berlin), *Coupling Electrodynamics and Thermodynamics* (Dieter Bothe)

11/10/2013 Dr. Rupert Hölzl (Universität der Bundeswehr München), *Absolutely undecidable sets* (Martin Ziegler)

15/10/2013 Dr. Martin Westerholt-Raum (ETH Zürich), *Quadratische Rekursionen von Mock-Theta-Reihen* (Jan H. Bruinier)

22/10/2013 Hirokazu Saito (Waseda University), *How to treat small lambda; some linearized problem arising from a free boundary problem of the Navier-Stokes equations* (IRTG 1529)

22/10/2013 Yuki Kaneko (Waseda University), *Spreading and vanishing behaviors of solutions in a population model with a free boundary* (IRTG 1529)

29/10/2013 Bao Q. Tang (KFU Graz), *Existence and convergence to equilibrium for a class of reaction diffusion system* (Herbert Egger)

29/10/2013 Yikan Liu (University of Tokyo), *Initial-boundary value problems for multi-term time-fractional diffusion equations with positive constant coefficients* (Herbert Egger)

04/11/2013 Dr. Matthias Mnich (MPI Saarbrücken), *Multivariate Algorithmen für schwere Optimierungsprobleme* (Marc Pfetsch)

07/11/2013 Dr. Federico Bassetti (University of Pavia), *Central limit theorems for homogeneous inelastic kinetic equations* (Matthias Meiners)

12/11/2013 Prof. Dr. Kazuo Takeuchi (Waseda University), *Deformations of Contact Metric Structures* (IRTG 1529)

12/11/2013 Tomoya Nakamura (Waseda University), *The Maximal Totally Isotropic Subspaces on Direct Sum of V and V^*, and Courant Algebroids* (IRTG 1529)

14/11/2013 Dipl.-Ing. Wilko Rohlfs (RWTH Aachen), *Thermally induced break-up of regularly excited three-dimensional wavy liquid films* (Dieter Bothe)

19/11/2013 Dr. Yuning Liu (Universität Regensburg), *Initial-Boundary Value Problem for a Navier-Stokes/Q-Tensor System for Nematic Liquid Crystals* (IRTG 1529)

19/11/2013 Prof. Dr. Bastian von Harrach (Universität Stuttgart), *Inverse coefficient problems and shape reconstruction* (Jan-Frederik Pietschmann)

22/11/2013 Anna-Sophie Heinemann (Universität Paderborn), *Boole and Jevons on Logical Method* (Martin Ziegler)

27/11/2013 Prof. Dr. Niels Jahnke (Universität Duisburg-Essen), *Die hypothetische Seite der Mathematik, und was sie für den Unterricht bedeuten kann* (Burkhard Kümmerer)

05/12/2013 Dr. Sebastian Mentemeier (University of Wrocław), *The Fixed Points of the Mulivariate Smoothing Transform* (Matthias Meiners)

06/12/2013 Xuan Cai, M.Sc. (KIT Karlsruhe), *Implementation of a Phase Field Method in OpenFOAM for Simulation of Spreading Droplets and Verification by Test Problems* (Dieter Bothe, Holger Marschall)

09/12/2013 Prof. Dr. Roland Griesmaier (Universität Leipzig), *Enhanced approximate cloaking by optimal change of variables* (Jan-Frederik Pietschmann)

10/12/2013 Prof. Dr. Michael Plum (KIT Karlsruhe), *Computer-assisted existence and multiplicity proofs for semilinear elliptic boundary value problems* (Martin Ziegler)

12/12/2013 Dr. Cécile Mailler (University of Bath), *Smoothing Equations for Large Pólya* (Matthias Meiners)

13/12/2013 Dr. Oliver Gray (University of Bristol), *Classifying superconformal field theories via chiral rings* (Nils Scheithauer)

13/12/2013 Prof. Dr. Hiroshi Yamauchi (TWCU Tokyo), *Transposition automorphisms of vertex operator algebras* (Nils Scheithauer)

13/12/2013 Prof. Dr. Peter Fiebig (Universität Erlangen), *Recent development around Lusztig's conjecture* (Nils Scheithauer)

13/12/2013 Prof. Dr. Yichuan Yang (Beihang University), *Non-commutative logical algebras and algebraic quantales* (Klaus Keimel)

17/12/2013 Ass. Prof. Dr. Aneta Wróblewska-Kamińska (Polish Academy of Sciences), *The Oberbeck-Boussinesq approximation in* $\mathbb{R}^3$ *as a limit of compressible Navier-Stokes-Fourier with low Mach number* (Reinhard Farwig)

17/12/2013 Prof. Dr. Harbir Antil (George Mason University, Fairfax), *Optimal Control of a Free Boundary Problem with Surface Tension Effects* (Irwin Yousept)

17/12/2013 Yasuyuki Tsukamoto (Kyoto University), *A Hausdorff space with a strongly independent dyadic subbase* (Martin Ziegler)

20/12/2013 Yasuyuki Tsukamoto (Kyoto University), *Minimal Oriented Matriods with Disconnected Realization Space* (Martin Ziegler)

21/01/2014 Prof. Dr. Jürgen Hausen (Universität Tübingen), *Fanovarietäten mit Toruswirkung* (Priska Jahnke)

23/01/2014 Dr. Robert Knobloch (Universität des Saarlandes), *An Itō type formula for convoluted Lévy processes* (Research Group Stochastics)

24/01/2014 Prof. Dr. Keita Yokoyama (Japan Advanced Institute of Science and Technology), *On the second-order categoricity of the natural number system* (Ulrich Kohlenbach)

28/01/2014 Prof. Dr. John Duncan (CWR University of Cleveland), *Derived Equivalences of K3 Surfaces and Twined Elliptic Genera* (Nils Scheithauer)

31/01/2014 Prof. Dr. Anton Bovier (Universität Bonn), *Extremal processes in branching Brownian motions* (Frank Aurzada)

31/01/2014 Prof. Dr. Zhan Shi (University Paris VI), *Biased random walks on trees* (Frank Aurzada)

04/02/2014 Prof. Dr. Hirofumi Notsu (Waseda University), *A stabilized characteristics finite element scheme for the Navier-Stokes equations - theory and computations* (Maria Lukacova-Medvidova)

07/02/2014 Prof. Dr. Anuj Dawar (University of Cambridge), *Symmetric Circuits and Fixed-Point Logics* (Martin Otto)

12/02/2014 Alexandra Gilsbach (RWTH Aachen), *Über schwere Minimalflächen mit Area-Nebenbedingung* (Reinhard Farwig)

21/02/2014 Dr. Alexey Ostrovskiy (Universität der Bundeswehr München), *An Alternative Approach to the Decomposition of Functions* (Martin Ziegler)

28/03/2014 Arno Pauly, PhD (University of Cambridge), *On function spaces and polynomial-time computability* (Martin Ziegler)

28/03/2014 Zhonghao Gu (Gurobi), *Disconnected or Almost Disconnected MIP* (Marc Pfetsch)

15/04/2014 Prof. Dr. Christian Elsholtz (TU Graz), *Hilbert cubes in arithmetic sets* (Philip Habegger)

17/04/2014 Prof. Dr. Vladimir Rabinovich (IPN Mexico/City), *Time-frequency integrals and the stationary phase method in problems of waves propagation from moving pulses* (Steffen Roch)

22/04/2014 Dr. Matthias Köhne (Universität Düsseldorf), *Artificial Boundary Conditions for Incompressible Newtonian Flows: Non-Reflecting Outflow Conditions* (Dieter Bothe)

28/04/2014 Prof. Dr. Günther Of (TU Graz), *Coupling of Finite and Boundary Element Methods: Applications and New Developments* (Herbert Egger)

29/04/2014 Dr. Takahito Kashiwabara (University of Tokyo), *A Generalized Robin boundary condition for Stokes equations arising from a fluid-structure interaction problem* (IRTG 1529)

29/04/2014 Prof. Dr. Ekaterina Kostina (Universität Marburg), *Robustheitsaspekte bei Problemen der nichtlinearen beschränkten Optimierung und Optimalen Steuerung unter Unsicherheiten* (Marc Pfetsch)

13/05/2014 Prof. Dr. Eduard Feireisl (Czech Academy of Sciences), *Stability problems in the theory of complete fluid systems, I* (Reinhard Farwig)

15/05/2014 Dr. Andrej Depperschmidt (Universität Mainz), *Directed Random Walk on the Backbone of Oriented Percolation Cluster* (Matthias Meiners)

15/05/2014 Prof. Dr. Eduard Feireisl (Czech Academy of Sciences), *Stability problems in the theory of complete fluid systems, III* (Reinhard Farwig)

15/05/2014 Prof. Dr. Eduard Feireisl (Czech Academy of Sciences), *Stability problems in the theory of complete fluid systems, II* (Reinhard Farwig)

16/05/2014 Felix Canavoi (RWTH Aachen), *Defining Winning Strategies* (Martin Otto)

20/05/2014 Dr. Pen-Yuan Hsu (Waseda University), *A Liouville theorem for the planar Navier-Stokes equations with the no-slip boundary condition and its application to a geometric regularity criterion* (Reinhard Farwig)

22/05/2014 Maite Wilke Berenguer (TU Berlin), *On the stability of a dynamical system arising in telecommunication networks* (Frank Aurzada)

27/05/2014 Dr. Mark Wilkinson (École Normal Supérieure, Paris), *Dynamic Statistical Scaling in Landau-de Gennes Theory* (IRTG 1529)

27/05/2014 Dr. Rafael van Känel (MPI Bonn), *Modularity and integral points on moduli schemes* (Philip Habegger)

10/06/2014 Prof. Dr. Agnieszka Świerczewska-Gwiazda (University of Warsaw), *Polymeric fluids* (Maria Lukáčová-Medvidová, IRTG 1529)

10/06/2014 Prof. Dr. Jürg Kramer (HU Berlin), *Analytic continuation of the hyperbolic heat kernel* (Anna von Pippich)

13/06/2014 Yasuyuki Tsukamoto (Kyoto University), *Imaginary Hypercubes* (Martin Ziegler)

17/06/2014 Prof. Dr. Dirk Hundertmark (Universität Karlsruhe), *Mathematical challenges from nonlinear fiber optics* (Volker Betz)

17/06/2014 Prof. Dr. José Burgos (ICMAT-CSIC Madrid), *The singularities of the invariant metric of the sheaf of Jacobi forms on the universal elliptic curve* (Anna von Pippich)

20/06/2014 Dr. Yuri Faenza (École polytechnique fédérale de Lausanne), *On finding the largest simplex contained in a polytope* (Marc Pfetsch)

24/06/2014 Prof. Dr. Marius Tucsnak (Université de Lorraine), *Analysis and control of particulate flows* (Reinhard Farwig)

25/06/2014 Prof. Dr. Marius Tucsnak (Université de Lorraine), *Mathematics and swimming of aquatic organisms* (Reinhard Farwig)

26/06/2014 Prof. Dr. Franz-Viktor Kuhlmann (University of Saskatchewan), *Ball spaces - a general framework for fixed point theorems I, II* (René Bartsch)

26/06/2014 Prof. Dr. Peter Bastian (Universität Heidelberg), *High-performance Computing for Flows in Porous Media* (Dieter Bothe)

27/06/2014 Dr. Markus Heydenreich (University of Leiden), *Spontaneous breaking of rotational symmetry in the presence of defects* (Volker Betz)

27/06/2014 Prof. Dr. Dana S. Scott (University of California), *Stochastic Lambda-Calculus* (Klaus Keimel)

27/06/2014 Prof. Dr. Erwin Bolthausen (University of Zürich), *Exit distributions for random walks in anisotropic random environments* (Volker Betz)

01/07/2014 Hirokazu Saito (Waseda University), *Strong solutions to a two-phase free boundary problem for a class of non-Newtonian fluids* (IRTG 1529)

01/07/2014 Prof. Dr. Thieu Huy Nguyen (TU Darmstadt), *Invariant and Inertial Manifolds and Asymptotic Behavior of Solutions to Evolution Equations* (IRTG 1529)

03/07/2014 Michelle Vallejos (TU Chemnitz), *A multigrid approach to optimal control of obstacle problems* (Herbert Egger)

08/07/2014 Dr. Miroslav Bacak (Max-Planck-Institut Leipzig), *On gradient flows in Hadamard spaces* (Ulrich Kohlenbach)

10/07/2014 Prof. Dr. Walter Roth (University of Brunei Darussalam), *Lokalkonvexe Kegel: Eine Einführung* (Klaus Keimel)

11/07/2014 Dr. Takayuki Kihara (Japan Advanced Institute of Science and Technology), *Scott Ideals in Infinite Dimensional Topology* (Vassilios Gregoriades)

15/07/2014 Dr. Ruizhao Zi (Zhejiang University, China), *Some results on Oldroyd-B model in critical spaces* (IRTG 1529)

15/07/2014 Miho Murata (Waseda University), *Strong solutions to fluid-rigid body interaction problem for compressible fluids* (IRTG 1529)

18/07/2014 Dr. Matthew de Brecht (Center for Information and Neural Networks; National Institute of Information and Communications Technology), *Compact saturated subsets of quasi-Polish spaces* (Klaus Keimel)

22/07/2014 Yingkun Li, PhD (MPI Bonn), *Real-dihedral harmonic Maass forms and twisted CM values of Hilbert modular functions* (Jan H. Bruinier)

31/07/2014 Daniel Akrapovic (TU Kaiserslautern), *Modellreduktion mithilfe der Proper Orthogonal Decomposition im Bereich des Strahlungstransports* (Herbert Egger)

01/09/2014 Michal Červinka, Ph.D. (Czech Academy of Sciences and Charles University, Prague), *On Stability of Stationary Points in MPCCs* (Alexandra Schwartz)

22/09/2014 Prof. Dr. Massimo Bertolini (Universität Duisburg-Essen), *Beilinson-Flach elements and the Birch and Swinnerton-Dyer conjecture* (Jan H. Bruinier and Anna von Pippich)

22/09/2014 Prof. Dr. Pierre Charollois (Université Paris 6), *Explicit integral cocycles on GL(n) and special values of p-adic partial zeta functions* (Jan H. Bruinier and Anna von Pippich)

22/09/2014 Prof. Dr. Siegfried Böcherer (Universität Mannheim), *On noncuspidal Siegel modular forms of low weight* (Jan H. Bruinier and Anna von Pippich)

22/09/2014 Prof. Dr. Winfried Kohnen (Universität Heidelberg), *Two applications of holomorphic Eisenstein series* (Jan H. Bruinier and Anna von Pippich)

23/09/2014 Dr. Siddarth Sankaran (Universität Bonn), *Special cycles on unitary Shimura varieties and Eisenstein series* (Jan H. Bruinier and Anna von Pippich)

23/09/2014 Prof. Dr. Eyal Goren (McGill University of Montreal), *The Bruinier-Yang conjecture* (Jan H. Bruinier and Anna von Pippich)

23/09/2014 Prof. Dr. Fabrizio Andreatta (Università di Milano), *Orthogonal and CSpin Shimura varieties* (Jan H. Bruinier and Anna von Pippich)

23/09/2014 Prof. Dr. Gerard Freixas (Université Paris 6), *On the Riemann-Roch formula in Arakelov geometry and an exotic analytic class number formula* (Jan H. Bruinier and Anna von Pippich)

24/09/2014 Dr. Maryna Viazovska (HU Berlin), *Siegel Eisenstein series and Heegner cycles* (Jan H. Bruinier and Anna von Pippich)

24/09/2014 Prof. Dr. Athanasios Bouganis (University of Durham), *On special L-values attached to half-integral weight Siegel modular forms* (Jan H. Bruinier and Anna von Pippich)

24/09/2014 Prof. Dr. Benjamin Howard (Boston College), *Cycles on Shimura varieties and applications to Faltings heights* (Jan H. Bruinier and Anna von Pippich)

24/09/2014 Prof. Dr. Tonghai Yang (University of Wisconsin), *Coherent and incoherent Eisenstein series* (Jan H. Bruinier and Anna von Pippich)

25/09/2014 Dr. Jens Funke (University of Durham), *Cycles in degenerate Hilbert modular surfaces and modular forms* (Jan H. Bruinier and Anna von Pippich)

25/09/2014 Prof. Dr. Jay Jorgenson (City College of New York), *Kronecker's limit formula, holomorphic modular functions, and q-expansions on certain moonshine groups* (Jan H. Bruinier and Anna von Pippich)

25/09/2014 Prof. Dr. Jürg Kramer (HU Berlin), *Uniform sup-norm bounds on average for cusp forms of higher weights* (Jan H. Bruinier and Anna von Pippich)

29/09/2014 Dr. Margarita Korovina (Institute of Informatics Systems, Novosibirsk), *Index sets for continuous data* (Martin Ziegler)

14/10/2014 Dr. Huanyao Wen (University of Stavanger), *Compressible Navier-Stokes equations: blow-up criteria and global solutions in a class of large data* (Matthias Hieber)

21/10/2014 Prof. Dr. Tomoyuki Arakawa (RIMS Kyoto), *Localization of affine W-algebras at the critical level* (Nils Scheithauer)

23/10/2014 Prof. em. Dr. Adrian R. D. Mathias (University of Reunion Island), *Rudimentary Recursion, Provident Sets and Forcing* (Thomas Streicher)

27/10/2014 Dr. Tobias Achterberg (Gurobi), *Multi-Row Presolve Reductions in Mixed Integer Programming* (Marc Pfetsch)

28/10/2014 Dr. Larry Rolen (Universität Köln), *Mock theta functions and quantum modular forms* (Anna von Pippich)

31/10/2014 Johannes Schramm (TU Darmstadt, FB Informatik), *Logic Formalization and Automated Deductive Analysis of Business Rules* (Martin Ziegler)

04/11/2014 Prof. Dr. Giovanni P. Galdi (University of Pittsburgh), *Two-dimensional time periodic solutions to the Navier-Stokes equations in exterior domains* (Reinhard Farwig)

04/11/2014 Prof. Dr. Takuya Suzuki (University of Tokyo), *Analyticity of semigroups generated by higher order elliptic operators in spaces of bounded functions on C^1-domains* (Reinhard Farwig)

07/11/2014 Vladislav Amstislavskiy (A.P. Ershov Institute, Novosibirsk), *Decidability Problem for Theories of Continuous and Continuously Differentiable Functions* (Martin Ziegler)

11/11/2014 Bao Q. Tang (Universität Graz), *Well posedness, numerics and quasi-steady-state approximation for a volume-surface reaction-diffusion system* (Herbert Egger)

11/11/2014 Yuki Kaneko (Waseda University Tokyo), *Spreading and vanishing for a free boundary problem in population ecology* (Herbert Egger)

13/11/2014 Dr. Chiranjib Mukherjee (TU München), *Compactness and large deviation* (Research Group Stochastics)

14/11/2014 Svetlana Alexandrova (A.P. Ershov Institute, Novosibirsk), *On Sigma-definability of Hereditarily Finite Superstructures* (Martin Ziegler)

18/11/2014 Dai Noboriguchi (Waseda University), *First-order conservation laws with stochastic perturbation* (IRTG 1529)

25/11/2014 Prof. Dr. Matthias Schlottbom (Universität Münster), *Analysis of the diffuse domain method for second order elliptic boundary value problems* (Stefan Ulbrich)

25/11/2014 Prof. Dr. Ulf Kühn (Universität Hamburg), *On the generators of a certain algebra of q-multiple zeta values* (Anna von Pippich)

25/11/2014 Tomoya Kato (Waseda University), *Solutions to nonlinear higher order Schrödinger equations with small initial data on modulation spaces* (IRTG 1529)

26/11/2014 Prof. Dr. Gerold Alsmeyer (Universität Münster), *Zum stationären Tail-Index kontraktiver iterierter Funktionensysteme* (Matthias Meiners)

02/12/2014 Dr. Camilla Nobili (MPI Leipzig), *Rayleigh-Bénard convection at finite Prandtl number: bounds on the Nusselt number* (Matthias Hieber)

04/12/2014 Dr. Dumitru Trucu (University of Dundee, Scotland), *Novel perspectives in multiscale modelling and analysis: the novel concept of three-scale convergence* (Pia Domschke, Alf Gerisch)

05/12/2014 Dr. Xue-Mei Li (University of Warwick), *Stochastic homogenization on Lie groups* (Volker Betz)

05/12/2014 Prof. Dr. Martin Hairer (University of Warwick), *Weak Universality of the KPZ equation* (Volker Betz)

09/12/2014 Benjamin Assarf (TU Berlin), *On Classification of Smooth Fano polytopes* (Andreas Paffenholz)

09/12/2014 Prof. Dr. Octavio Villagrán (Universidad del Bío-Bío), *Exact solution for a generalized Beney-Lin equation* (Martin Saal)

13/12/2014 Dr. Alexander Lorz (Université Pierre et Marie Curie, Paris), *Population dynamics and therapeutic resistance: mathematical models* (IRTG 1529)

17/12/2014 Prof. Dr. Marko Lindner (TU Hamburg-Harburg), *Wo ist die Hauptdiagonale einer unendlichen Matrix* (Steffen Roch)

7.3 Visitors at the Department

Prof. Dr. Franz-Viktor Kuhlmann (University of Saskatchewan), June 2014.

Prof. Dr. Katarzyna Kuhlmann (University of Silesia at Katowice, Poland), June 2014.

Prof. Dr. Wolfgang Dreyer (WIAS Berlin), January 2013.

Guillaume Rolland (ENS Rennes), June 2013.

Matthias Köhne (Universität Düsseldorf), March – April 2014.

Dr. Dumitru Trucu (University of Dundee, Scotland), December 2014.

Bao Q. Tang (Universität Graz), August – October 2013.

Yikan Liu (University of Tokyo), October – December 2013.

Bao Q. Tang (Universität Graz), October – December 2014.

Yuki Kaneko (Waseda University Tokyo), October – December 2014.

Prof. Dr. Grzegorz Karch (University of Wrocław), June 2013.

Prof. Dr. Aneta Wróblewska-Kamińska (Polish Academy of Sciences), December 2013.

Alexandra Gilsbach (RWTH Aachen), February 2014.

Prof. Dr. Eduard Feireisl (Czech Academy of Sciences), May 2014.

Dr. Pen-Yuan Hsu (Waseda University), May – June 2014.

Prof. Dr. Tomoyuki Nakatsuka (Nagoya University), June 2014.

Prof. Dr. Agnieszka Świerczewska (University of Warsaw), June 2014.

Prof. Dr. Marius Tucsnak (Université de Lorraine), June 2014.

Prof. Dr. Giovanni P. Galdi (University of Pittsburgh), November 2014.

Prof. Dr. Takuya Suzuki (University of Tokyo), November 2014.

Prof. Dr. Quentin Grimal (Biomedical Imaging Lab (LIB), UPMC Paris, France), June 2013.

Dr. Takayuki Kihara (Japan Advanced Institute of Science and Technology), July and December 2014.

Fabien Pazuki (Université Bordeaux I), February 2014.

Lars Kühne (Scoula Normale Superiore di Pisa), August 2014.

Felix Ali Mehmeti and Virginie Régnier (University of Valenciennes, France), April 2013.

Joachim Rehberg (WIAS Berlin), Mai 2013.

Prof. Dr. Takaaki Nishida (Kyoto University), January 2013.

Prof. Dr. Okihiro Sawada (Gifu University), January 2013.

Prof. Dr. Yohei Tsutsui (Waseda University), January 2013.

Prof. Dr. Masahiro Yamamoto (Waseda University), January 2013.

Prof. Dr. Keita Yokoyama (Tokyo Institute of Technology), January 2013.

Prof. Dr. Ryo Takada (Waseda University), January 2013, October 2014.

Prof. Dr. Christian Rohde (University of Stuttgart), April 2013.

Prof. Dr. Jan Rozendaal (Delft University of Technology), April 2013.

Prof. Dr. Joachim Rehberg (WIAS Berlin), May 2013.

Dr. Marcus Waurick (TU Dresden), May 2013.

Prof. Dr. Mark Veraar (Delft University of Technology), July 2013.

Prof. Dr. Michel Pierre (ENS Cachan), June – July 2013.

Prof. Dr. Michael Plum (KIT Karlsruhe), December 2013.

Prof. Dr. Yasuyuki Tsukamoto (Kyoto University), December 2013.

Prof. Dr. Edriss Titi (Irvine & Weizmann Institute), January 2014.

Prof. Dr. Sylvie Monniaux (Université Paul Cezanne), January 2014.

Dr. Erika Ushikoshi (Tohoku University), January 2014.

Dr. Ewelina Zatorska (University of Warsaw), January 2014, October 2014.

Prof. Dr. Hirofumi Notsu (Waseda University), January – February 2014.

Prof. Dr. Asei Tezuka (Waseda University), January – February 2014.

Dr. Mark Wilkinson (École Normal Supérieure, Paris), May 2014.

Dr. Guo Yanqiu (Weizmann Institute), October 2014.

Dr. Camilla Nobili (MPI Leipzig), October 2014.

Prof. Dr. Šarka Nečasová (Czech Academy of Sciences), October 2014.

Prof. Dr. Piotr Mucha (University of Warsaw), October 2014.

Dr. Hideyuki Miura (Tokyo Institute of Technology), October 2014.

Prof. Dr. Takahiro Okabe (Waseda University), October 2014.

Christopher Schmäche (Universität Leipzig), October 2014.

Prof. Dr. Rainer Schumann (Universität Leipzig), October 2014.

Prof. Dr. Yoshihiro Shibata (Waseda University), October 2014.

Prof. Dr. Jan Prüss (Martin-Luther-Universität Halle-Wittenberg), October 2014.

Prof. Dr. László Székelyhidi (Universität Leipzig), October 2014.

Prof. Dr. Yutaka Terasawa (University of Tokyo), October 2014.

Prof. Dr. Huanyao Wen (University of Stavanger), October 2014.

Prof. Dr. Werner Varnhorn (Universität Kassel), October 2014.

Tayuki Suzuki (University of Tokyo), October – November 2014.

Prof. Dr. Bao Q. Tang (KFU Graz), October – December 2014.

Prof. Dr. Matthias Schlottbom (Universität Münster), November 2014.

Prof. Dr. Octavio Villagrán (Universidad del Bío-Bío), December 2014.

Prof. Dr. Thieu Huy Nguyen (Hanoi University of Science and Technology), December 2014.

Professor Sidney A. Morris (LaTrobe University, Melbourne), May 2013, April 2014.

Svetlana Aleksandrova (Ershov Institute of Informatics Systems), November 2014.

Vladislav Amstislavskiy (Ershov Institute of Informatics Systems), November 2014.

Dr. Matthew de Brecht (National Inst. of Inform. and Communications Technology, Japan), July 2014.

Prof. Dr. Anuj Dawar (University of Cambridge), February 2014.

Makoto Fujiwara (Tohoku University), September 2012 – March 2013.

Dr. Jaime Gaspar (University of Paris), March 2013.

Dr. Takayuki Kihara (Japan Advanced Institute of Science and Technology), July 2014.

Dr. Margarita Korovina (Ershov Institute of Informatics Systems, Novosibirsk), July – September 2014.

Angeliki Koutsoukou-Argyraki (University of Copenhagen), June 2013.

Thomas Leventis (École Normale Supérieure de Lyon), January – March 2014.

Dr. Anvar Nurakunov (National Academy of Sciences, Kyrgyzstan), April – June 2014.

Prof. Dr. Paul Potgieter (University of South Africa), September – October 2013.

Prof. Dr. Ruy de Queiroz (University of Pernambuco), August 2013.

Prof. Dr. Dana S. Scott (University of California, Berkeley), June 2014.

Dr. Svetlana Selivanova (Ershov Institute of Informatics Systems, Novosibirsk), July – August 2014.

Yasuyuki Tsukamoto (Kyoto University), December 2013.

Yasuyuki Tsukamoto (Kyoto University), March – September 2014.

Prof. Dr. Keita Yokoyama (Tohoku University), January 2013.

Prof. Dr. Keita Yokoyama (Japan Advanced Institute of Science and Technology), January 2014.

Prof. Dr. Hans Maassen (University of Nijmegen), October and December 2014.

Prof. Dr. Rolf Gohm (Aberystwyth University), July 2014.

Dr. Sebastian Mentemeier (University of Wrocław), December 2013.

Prof. Dr. Alexander Iksanov (Taras Shevchenko National University of Kyiv), July 2014.

Prof. Dr. Benjamin Nill (University of Stockholm), May 2014.

Dr. Yuri Faenza (École polytechnique fédérale de Lausanne), June 2014.

Prof. Dr. Vladimir S. Rabinovich (IPN Mexico City), March – April 2014.

Prof. Dr. O. Vera Villagrán (University of Bío-Bío), December 2014.

Prof. Dr. Gerald Höhn (Kansas State University), May – July 2013.

Jethro van Ekeren, PhD (IMPA), June 2013 – October 2014.

Prof. Dr. Tomoyuki Arakawa (RIMS, Kyoto), December 2013.

Prof. Dr. Hiroshi Yamauchi (Tokyo Woman's Christian University), December 2013.

Prof. John Duncan (CWR University of Cleveland), January 2014.

Prof. Dr. Tomoyuki Arakawa (RIMS, Kyoto), October 2014.

Michal Červinka, Ph.D. (Czech Academy of Sciences and Charles University, Prague), September 2014.

Thomas Leventis (ENS Lyon), January – March 2014.

Prof. Dr. Matthias Heinkenschloss (Rice University, Houston, USA), October 2014.

Svetlana Alexandrova (A.P. Ershov Institute, Novosibirsk), November 2014.

Vladislav Amstislavskiy (A.P. Ershov Institute, Novosibirsk), November 2014.

Yasuyuki Tsukamoto (Kyoto University), April – September 2014.

Prof. Paul Potgieter (Universit of South Africa), October 2013.

Dr. Svetlana Selivanova (A.P. Ershov Institute), July – August 2014.

7.4 Workshops and Conferences at the Department

- 1st GAMM-Seminar on phase field models, February 7-8, 2014 (organized by H.-D. Alber and A. Böttcher)

- Student Conference on Automorphic Forms and Eisenstein Series, September 20-21, 2014 (organized by Claudia Alfes and Fabian Völz)

- Workshop on Persistence probabilities and related fields, July 15-18, 2014 (organized by Frank Aurzada, Matthias Meiners, and Zakhar Kabluchko)

- International Conference on Numerical Methods in Multiphase Flows (ICNMMF-II), June 30-July 2, 2014 (organized by D. Bothe, H. Marschall, M. Hieber, M. Oberlack, A. Reusken, M. Schäfer, P. Stephan, C. Tropea, B. Weigand)

- Conference *Automorphic Forms and L-Functions*, March, 17-19, 2013 (organized by Kathrin Bringmann, Jan Hendrik Bruinier, and Stephan Ehlen)

- Workshop *Arithmetic of Eisenstein series*, September, 22-25, 2014 (organized by Jan Hendrik Bruinier and Anna von Pippich))

- DFG SPP1420 Summer School *Theoretical & Computational Methods*, June 17-18, 2013 (organized by Sara Tiburtius and Alf Gerisch)

- Eleventh International Conference on Computability and Complexity in Analysis, July 21-24, 2014 (organized by Ulrike Brandt, Vassilios Gregoriades and Martin Ziegler (chair))

- Evaluation IRTG 1529, January 10-11, 2013 (organized by International Research Training Group 1529)

- Workshop on Japanese Culture, February 7, 2013 (organized by International Research Training Group 1529)

- Orientation Days on Mathematical Fluid Dynamics, December 18-19, 2013 (organized by International Research Training Group 1529)

- Special Lecture Series by P. Galdi (Pittsburgh) as Mercator Guest Professor, November 3-9, 2014 (organized by International Research Training Group 1529)

- Logic, Language, Information and Computation (WoLLIC 2013), August 20-23, 2013 (organized by Ulrich Kohlenbach)

- IRTG 1529 Research Seminar: Proof Mining and Nonlinear Analysis, February 26-28, 2014 (organized by Ulrich Kohlenbach (with G. Lopez-Acedo))

- Geometrie von verschränkten Zuständen, September 14-17, 2014 (organized by Burkhard Kümmerer)

- Spatial Models in Statistical Mechanics, February 24-28, 2014 (organized by Volker Betz and Matthias Meiners)

- Seminar on Conformal Field Theory, December 13, 2013 (organized by Peter Fiebig, Nils Scheithauer and Katrin Wendland)
- Automorphic Forms and L-Functions, March 17-19, 2013 (organized by Kathrin Bringmann, Stephan Ehlen, and Jan Hendrik Bruinier)
- 11th International Conference on Computability and Complexity in Analysis, July 21-24, 2014 (organized by Martin Ziegler, Vassilis Gregoriades, Ulrike Brandt)
- Cyberpeace: Herausforderungen für Informatik in der Friedenswissenschaft, April 11-12, 2013 (organized by Matthias Englert, Martin Ziegler)

8 Other scientific and organisational activities

8.1 Memberships in Scientific Boards and Committees

Hans-Dieter Alber

- GAMM activity group Phase field models
- GAMM activity group Analysis of Microstructures
- Executive committee of the International Society for the Interaction of Mechanics and Mathematics (ISIMM)
- Auswahlausschuss des Bundeswettbewerbs Mathematik
- Vertrauensdozent der Studienstiftung

Volker Betz

- Fellow in the EPSRC Peer Review College

Dieter Bothe

- Advisory Board of ProcessNet technical committee on Computational Fluid Dynamics
- Advisory Board of ProcessNet technical committee on Multiphase Flows
- Advisory Board of ProcessNet technical committee on Mixing Processes

Regina Bruder

- Member of the international group for PME (Psychology of Mathematics Education)
- Member of the group "Arbeitskreis Empirische Bildungsforschung" of the GDM (Organization for Didactics of Mathematics)
- Member of the ISTRON – group in Germany
- Member of the group "Nationale Standards für die Abiturprüfung in Mathematik"
- Member of the group "Arbeitskreis Problemlösen" of the GDM

Jan H. Bruinier

- Associate Member of the Pohang Mathematics Institute (PMI), Postech, Pohang, Korea

Karl H. Hofmann

- Fellow of the American Mathematical Society

Michael Joswig

- Board Member of the DMV

Ulrich Kohlenbach

- Vice President of Association for Symbolic Logic (ASL)
- Member of ASL Executive Committee
- Member of ASL Standing Committee 'Logic in Europe'
- Member of WoLLIC Steering Committee
- Member of Advisory Board of Springer Book Series 'Theory and Applications of Computability Theory'
- Corresponding member of 'Wissenschaftliche Gesellschaft an der J.W. Goethe Universität Frankfurt am Main'
- PC Chair of WoLLIC 2014, Valparaiso
- PC Member of CCA 2014, Darmstadt
- Member of Scientific Committee of '11th International Conference on Fixed Point Theory and Applications', Istanbul 2015

Jens Lang

- Member of board of deans of the DFG Graduate School of Excellence Computational Engineering, TU Darmstadt, since 2008

Steffen Roch

- Auswahlausschuss Bundeswettbewerb Mathematik

Stefan Ulbrich

- Member of the IFIP Technical Committee TC 7, WG 7.2 "Computational Techniques in Distributed Systems", since 2003
- Chair Selection Committee, MOS Best Paper Prize for Young Researchers in Continuous Optimization 2013, Mathematical Optimization Society

Martin Ziegler

- Deutsche Vereinigung für Mathematische Logik und für Grundlagenforschung der Exakten Wissenschaften (DVMLG), Vorstand
- Interdisziplinäre Arbeitsgruppe Naturwissenschaft, Technik und Sicherheit (IANUS), Sprecher

8.2 Awards and Offers

Awards

Regina Bruder: Price of special salaries in the academic apprenticeship 2013

Regina Bruder and Nora Feldt-Caesar: Best E-Teaching Award 2014

Jane Ghiglieri: Ruth-Moufang-Preis (Fachbereich Mathematik, TU Darmstadt), 2014

Robert Haller-Dintelmann: Athene-Preis für gute Lehre 2013

Anja Kuttich: Datenlotsen-Preis (Datenlotsen Informationssysteme GmbH, Hamburg), November 19, 2014

Ulrich Reif: John Gregory Memorial Award

Thomas Streicher: Test-of-Time Award - LICS (2014) together with M. Hofmann LMU (Munich)

Andreas Tillmann: Best Student Paper Award (SPARS 2013, Lausanne, Switzerland), July 10, 2013

Irwin Yousept: Dimitrie Pompeiu Prize (Academy of Romanian Scientists), 2013

Irwin Yousept: Richard-von-Mises-Preis (85th Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2014, Erlangen), March 12, 2014

Martin Ziegler: JSPS BRIDGE Fellow 2013

Offers of Appointments

Dieter Bothe: Professorship (W3) for Applied Mathematics, Universität Paderborn

Philipp Habegger: Professorship for Number Theory, Universität Basel

Michael Joswig: Professorship (W3) for Discrete Mathematics/Geometry, TU Berlin

Irwin Yousept: Professorship (W3) for Numerical Mathematics, Universität Duisburg-Essen

8.3 Secondary Schools and Public Relations

The Department of Mathematics is involved in various activities for schools, secondary school students, and public relations. In addition to printed information material, the Department of Mathematics presents itself to the public on its web pages. These are clearly structured and provide quick links for several target groups as well as links leading to specific topics in research and teaching at the department.

To inform our students about our study programmes in Mathematics, the department publishes a comprehensive study guide ("Informationsbroschüre"). The guide "Mathematik — Warum? Was? Wozu? Wer? Wie? Wo? Weiteres?", authored by Prof. Kümmerer, informs prospective students about different facets of mathematics and corresponding study programmes. The department also uses programme-specific leaflets (for the standard Bachelor programme, the bilingual Bachelor programme, and the Teacher programme).

Summer school "Faszination Mathematik" for secondary school students
In this yearly summer school, scientists from the mathematics department of TU Darmstadt work with groups of six mathematically talented secondary school students from Hesse on

a subject that is based on mathematics taught at school, but goes far beyond this knowledge and connects with university mathematics.

The daily work of the groups consists in three hours in the morning and three hours in the afternoon. Under the advice of the scientists, the secondary school students work together independently and also have to study mathematical literature. At the end of the week, every group gives a half-hour LaTex-beamer presentation on the results achieved. The scientists are accessible for questions and discussions during the whole summer school. Some of the scientists already establish contacts to their future students at this occasion.

The project summer school *Faszination Mathematik* is lead by A.-M. v. Pippich. The first summer school *Faszination Mathematik* took place from July 8, 2014 to July 11, 2014 in Erbach and was organized by A.-M. v. Pippich and C. Alfes. Six scientist (C. Alfes, S. Horn, H. Lüthen, M. Otto, A.-M. v. Pippich, P. Tolksdorf), one delegated teacher (A. Böhnke), and 24 selected students from 14 secondary schools from Hesse participated and worked together on topics ranging from Analysis, Logic, and Number Theory to Optimization. Further information is available on the webpage

`http://www.mathematik.tu-darmstadt.de/sommerschule-faszination-mathematik/`

The summer school 2014 was supported by the *Carlo und Karin Giersch-Stiftung*.

The following is a list of further public relations activities.

Activities for secondary school students and prospective students

- Presentation of the department with a stall and several talks at the job and study information fair HoBIT, Hochschul- und Berufsinformationstage, three days every January: about 17.500 participants during the fair in 2012; with a booth staffed by professors, academic staff and students and scientific talks from the fields of Analysis and Optimization in 2014 and from the fields of Geometry, Logic and Stochastics in 2015.

- Presentation of the department and its study programmes at the university information day, TUDay, every May: with talks by the student advisor, sample lectures and tutorial classes, meetings with students of the department; about 90 participants over the course of the day in 2014 (lectures from the field of Numerical Analysis in 2014 and from the fields of Logic and Optimization in 2015). In 2014, the TUDay coincided with the Schülerinnen- und Schülernachmittag zur Mathematik (see below).

- Annual organization of an afternoon with several talks about mathematics for secondary school students, "Darmstädter Schülerinnen- und Schülernachmittag zur Mathematik" (organization: Prof. Kohler; in 2014 talks from the fields of Stochastics, Algebra, and Didactics.

- Annual presentation of the department at the information days for female students, "Schnuppertage für Schülerinnen", with a talk by the student advisor, a sample lecture and talks with female mathematicians, about 30 participants in each year (organization: Prof. Jahnke in 2013 and Dr. Alfes in 2014; lectures from the field of Algebra)

- Support of the annual organization of the Mathematikolympiade Hessen (third level) in cooperation with the Zentrum für Mathematik, Bensheim for all grades (about 20 participants per grade each year) (Prof. Kiehl, academic staff and students).

  In the recent years, the department had the opportunity to host the finals. Mathematical afternoon lectures were delivered by Prof. Kiehl and Prof. Bokowski (2013) and Prof. Kiehl and Prof Ziegler (2014).

- Organization of the Mathematical Modeling Week for secondary school students in grade 12 in cooperation with Zentrum für Mathematik, Bensheim each October (40 participants each year) (Prof. Kiehl).

- Involvement in the annual German Maths Contest (Bundeswettbewerb Mathematik) (Prof. Alber, Prof. Roch)

- Annual 3-day special programme including lectures, exercises and supervised group work dedicated to the topics of *LOGIC* (September 2013) and *Game Theory* (September 2014) for the year 12 Mathematik Leistungskurs/Tutorium of Edith-Stein-Schule, Lichtenbergschule, Eleonorenschule, and Alfred-Delp-Schule framework of an annual "Praktikum Wissenschaftswelt" (devised and taught by Prof. Ziegler and tutors).

- In connection with the project course "Teaching in Mathematics: Problem Solving" (Prof. Bruder, StR Böhnke and participating students, winter semesters 2013/14 and 2014/15), diverse mathematical "Knobelstraßen" for secondary schools were developed and conducted at several schools in Darmstadt and Frankfurt.

Other activities

- Talk titled "Elliptische Kurven und Datensicherheit" at the Landrat-Gruber-Schule in Dieburg (April 11, 2014, Prof. v. Pippich, Dr. Seyfferth)

- Annual Graduation Event: celebration with friends and family of the graduated students (organisation: Prof. Kohlenbach and staff).

- Interview with Prof. Blumensath on the occasion of Pi Day (14th of March 2015) in ECHO (local newspaper).

8.4 Student Body (Fachschaft)

Officially, the students at the Department of Mathematics are represented by the five people forming the "Fachschaftsrat". This board is elected once a year during the university elections. However, since there usually is more work to be done than five people can handle, there are many more students participating actively in the Students' Union. Moreover, some of them are members of university-wide committees such as the Senate or the University Assembly.

We, the Students' Union, regard ourselves as representatives inside and outside the mathematics department for all math students. As such, all students are invited to talk to us in order to tell us about problems or suggestions they might have. Furthermore, we organise a lot of orientation events for students and secondary school students throughout the year.

Finally, a student's life does not only consist of attending lectures and exercises, so we additionally offer some extra-curricular activities.

As part of our activities we appoint the student representatives in the committees of the department. Some of us are members of the "Fachbereichsrat" (another important board consisting of professors, assistants and students, elected during the university elections) and its committees, like the committee for learning and studying, the library committee and many more. The evaluation and quality control of teaching done at the department are two of our main objectives. We think that it is essential to hear and consider students' opinions regarding these areas because they are the ones directly affected. We also support the improvement and development of courses and studying in general, a point which every student should be concerned about naturally. We are working on those subjects together with Students' Unions from other departments and with the university administration.

Concerning orientation events, we organise the orientation week for the first semester students, which takes place at the beginning of each semester. During the semester, there is an orientation colloquium for the students in their first two years, which is meant to give them an impression of what the work in the research groups usually is about (meant to support the decision on a thesis subject). After finishing their first two years, students attend another orientation event, the "Introduction to Advanced Studies" (*Einführung ins Hauptstudium*), giving them more information about the research groups, the relevant regulations and much more.

Not all of these events take place in the mathematics department. University-wide orientation events for secondary school students are also part of our work. There we cooperate with the student counsellors.

However, not all our activities concern purely study-related topics. The organisation of games evenings, music evenings, as well as the traditional Christmas party of the department are examples of what we do to help students socialize among themselves.

We hope that this rather brief introduction helps to give an impression of our work.

9 Contact

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