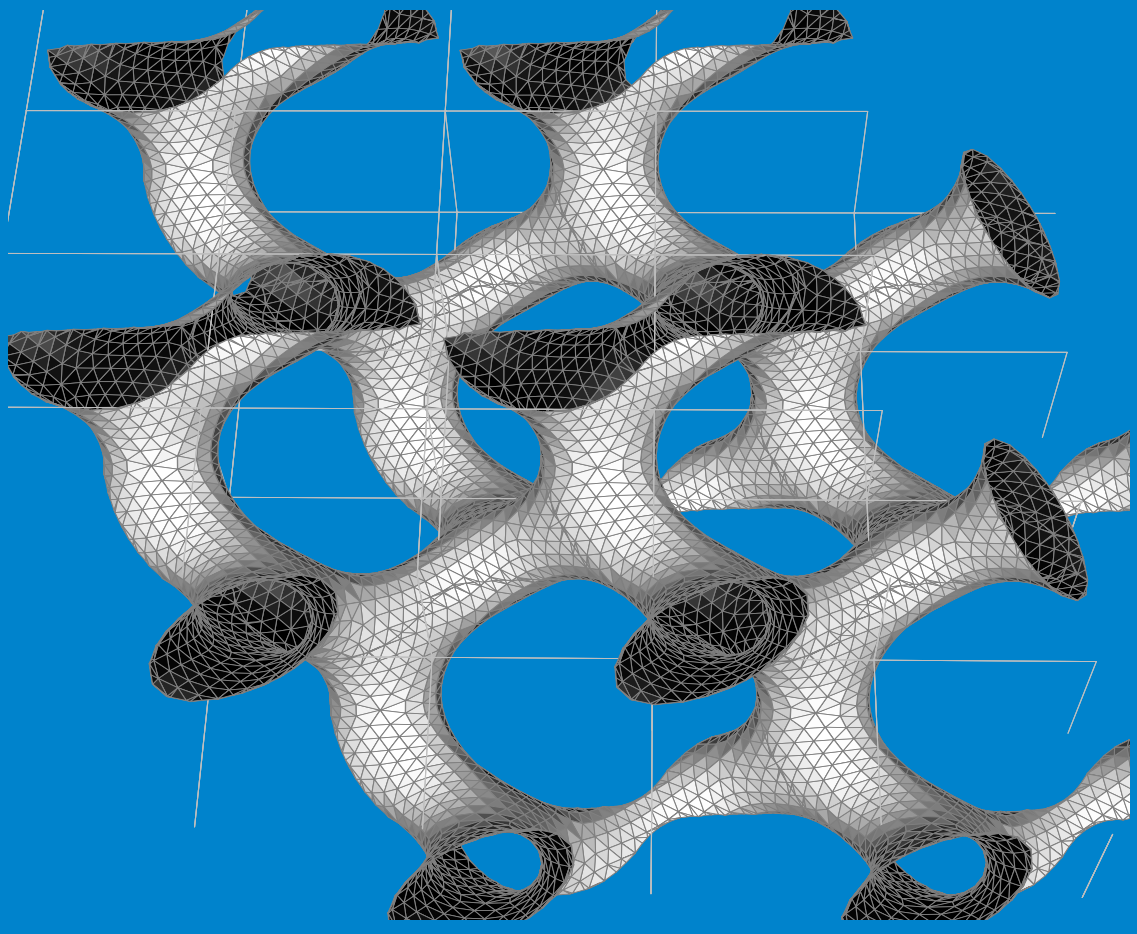
Biannual Report

Department of Mathematics
2009 and 2010

TECHNISCHE
UNIVERSITÄT
DARMSTADT



Contents

Dear reader, dear friend of the Department of Mathematics at TU Darmstadt!
Seven outstanding open mathematical problems were selected by the Clay Institute on the occasion of the millenium in 2000, and a million dollars were allocated to each problem. Only 10 years later, in March 2010, the Institute awarded the first prize to Grigoriy Perelman from St. Petersburg for his solution of the Poincaré conjecture (he did not accept).
This is one of many time-honoured mathematical problems which has been solved recently. They have in common that success was achieved by combining techniques of distinct disciplines, so Poincaré's topological statement is only proved using analysis and differential geometry. Moreover, progress is driven by individuals, but required the previous work of many other mathematicians. And, as an aside, Perelman published his work on a website, not in a traditional journal.
The Fachbereich Mathematik at Technische Universität Darmstadt is well-positioned in this quickly progressing academic world. It continued successful work in 2009/10. Our department has a large scientific scope with a particular emphasis on some applied areas. Nevertheless, it has overcome the traditional antipodes of pure and applied by inspiring and fruitful combinations.
The department is proud of a successful application at Deutsche Forschungsgemeinschaft for an International Graduate School. The School *Mathematical Fluid Dynamics* is joint with the two Japanese Universities Waseda and Tokyo University. Prof. M. Hieber is the Speaker of the School at TU Darmstadt. The school started operating in 2009 and the first funding period lasts for 5 years.
The department is also actively involved in various initiatives which are joint with other departments. Let me first mention the *Center for Smart Interfaces* funded by the Federal Government as a Cluster of Excellence for the period 2007–12. The activity is joint with the department of Mechanical Engineering. Prof. D. Bothe joined the faculty on a position supported by the Center. Also supported by the Exzellenz-Initiative is the Graduate School *Computational Engineering*, joint with the engineering and computer science departments, with a funding period from 2007 to 2017.
Department members are also involved as principal investigators in three Sonderforschungsbereiche of our University, funded by Deutsche Forschungsgemeinschaft (DFG): SFB 805 *Control of Uncertrainties in Load-Carrying Structures in Mechanical Engineering*, SFB 666 *Integral Sheet Metal Design with Higher Order Bifurcations*, and SFB 568 *Flow and Combustion in Future Gas Turbine Cobustion Chambers*, The department is also active in one of the Loewe initiatives, funded by the State of Hessen, and in several smaller initiatives funded by DFG.
As our Report indicates, beyond these large-scale initiatives our department has an even larger number of indiviual activities and collaborations with mathematicians all over the world.
Teaching has a good tradition at the department. Built on many years of experience with an earlier specialized Bachelor programme, the department introduced the compulsory Bachelor/Master degree system in 2006 and 07. The permanent faculty of 22.5 professors is not particularly large when compared to other mathematics departments. Nevertheless, the department takes a significant teaching load: According to figures published in the Mitteilungen of the Deutsche Mathematiker-Vereinigung (19/2011), regarding the number of students admitted to Bachelor of Mathematics in 2009 Darmstadt was third among German Universities, and regarding the number of degrees awarded in 2009 it was second. In addition, the department has a considerable teaching load for engineering and further departments. Given this situation, it is comforting that the quality of the teaching often gets praise in rankings, such as the one by CHE.

Also, the reputation built over years explains why many mathematics applicants prefer Darmstadt to the many competing departments in the area. We want to keep these high standards in a time of an ever-increasing number of students.
We hope that the present biannual report contains the information that you, the reader, are interested in and thank for your interest in our work.
Prof. Dr. Karsten Grosse-Brauckmann
(Dean of the Department of Mathematics)

1 The Department of Mathematics

With almost 1,300 students, more than 20 professorships and approximately 100 scientific staff members the department of mathematics at TU Darmstadt is one of the bigger mathematics departments in the country. This allows us to offer several degree schemes and a wide variety of courses.
The department's research activities are structured within eight research areas that cover a wide range of mathematical research and expertise.
In its teaching, the department of mathematics caters for the basic mathematical education in all other subjects at TU Darmstadt. Through lively scientific exchange with other subjects—in engineering sciences, in natural sciences and in humanities—the mathematics department is well positioned within the spectrum of the university and the wider academic landscape.

The department is currently focused on filling a number of professorships which have been open as colleagues received and accepted offers from other universities. The process of reorganising the former twelve research groups into eight has been completed. This new structure improves our visibility and profile within and outside the university and simplifies the organization of our teaching responsibilities.

The department currently educates more than 600 students in the mathematics B.Sc.-programs, almost 150 in the M.Sc.-programs and some 450 in the teacher training program. A survey of all students in the last years is tabulated on page 70.
In addition to the forty research assistants supported by the university we have more than fifty further PhD students in mathematics supported by the German Science Foundation (DFG), the Federal Ministry of Education and Research (BMBF) and others. All PhD theses are listed in section 5.2.
The department is well integrated in the university. Concerning teaching, the department organizes the entire education in mathematics for all departments, ranging from all students of engineering departments, over those from natural sciences to the students in the humanities. In total, these are more than 8,000 participants in lectures per year.
Concerning research, the department is a member of several Centres of Research Excellence of the university including Computational Engineering, Integrated Traffic and Transport Systems, E-Learning and others. In addition, the department is participating in the projects "Center of Smart Interfaces" and "Graduate School Computational Engineering" within the Excellence Initiative, in the LOEWE-center AdRIA, in three Collaborative Research Centres and in two Research Training Groups that are located at the university. Moreover, under the coordination of Prof. Matthias Hieber the department has successfully applied for the International Graduate School IRTG 1529 "Mathematical Fluid Dynamics".
Internationally, the department makes an appearance in several ways. We have scientific cooperations with colleagues from more than 35 universities spread all over the world including the US, Brazil, Japan, Australia, South Africa and Russia just to name a few. The department has published more than 200 papers in international reviewed journals of high quality. Eight colleagues are managing editors of international journals and more than twice as many are associate editors.
The third-party funds increased up to 3.2 million Euros in the year 2009 and almot 5 million Euros in 2010. This amount was mostly granted by the DFG. In particular, in this context we want to mention several scholarships for PhD students and Postdocs as well as a Heisenberg fellowship.

In addition, the contracts to industry have been steadily improved. In the meantime, the department can call, among others, companies such as Deutsche Bahn, eon, Linde, SAP, Schenck, Siemens, Texas Instruments and Wincor Nixdorf their partners.

2 Research

2.1 Overview

Besides the research done in the eight working groups, 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 projects.

2.1.1 Center of Smart Interfaces

The Center of Smart Interfaces (CSI) is a Cluster of Excellence (EXC 259), funded by the German Research Foundation (DFG). The initial funding period started in November 2008 and runs for five years, having a total volume of 34.6 Million EUR. The CSI is an international center for interdisciplinary research, focusing on the scientific areas “static and dynamic wettability”, “heat 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, Numerics and Optimization. This enabled 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. The relevance of mathematics within the research at the CSI is also underlined by the fact that Herbert Amann, one of the leading experts in analysis of nonlinear partial differential systems was a fellow of the CSI in the initial phase.
At the CSI, a seminar on the mathematical modeling and theory of contact line dynamics was organized by of the mathematics group. Furthermore, together with the IRTG "Mathematical Fluid Dynamics" the International Conference on Evolution Equations was organized by Bothe and Hieber which took place at Schmitten, from October 11-15, 2010. The main speakers being Herbert Amann, Pascal Auscher, Charles Batty, Yoshihiro Giga, Jerome A. Goldstein, Nicolai V. Krylov, Felix Otto, Michel Pierre, Michael Renardy, Yoshihiro Shibata and Edriss Titi, this was a top-class international event.

2.1.2 Collaborative Research Centre SFB 568

The Collaborative Research Centre SFB 568 “Flow and Combustion in Future Gas Turbine Combustion Chambers" started in 2001 and aims at the formulation of an integral model for the

development and optimization of new gas turbine combustion chamber concepts which make more efficient use of rare resources in the conversion of energy compared to today's technology. The main points that have to be regarded are the occuring and highly complex coupled and interacting physico-chemical processes such as turbulent transport, two- or multi-phase flows, materials transport, chemical reactions/combustion and radiation. The integral model comprises four main elements:

1. submodels of physical/chemical mechanisms and interactions

2. suitable numerical methods

3. consideration of basic conditions and neighboring components and interactions

4. implementation of targeted validation experiments

The Department of Mathematics contributes to the SFB 568 within two subprojects (Lang, Ulbrich). The topics under investigation are the control of errors of the numerical simulation, model reduction techniques and the numerical optimization of gas turbine relevant problems. To control and estimate errors of the complex numerical simulations, grid refinement strategies based on suitable error estimators are investigated. To reduce the cost of the simulations, model reduction techniques are further developed to account for turbulence (Lang). Since the simulation itself is a challenging task, new mathematical techniques for the optimization have to be developed that make optimization applicable in reasonable time (Ulbrich).

2.1.3 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 technique linear flow splitting and develops methodical tools to integrate this technique into the product development processes. The investigated technologies, 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 product development, production, evaluation and application. In each of these units, new methodologies, techniques and proceedings arise. They cope with all occurring unique requirements of this new product category. Engineers are involved in the research center as well as mathematicians and material scientists. This interdisciplinary research environment has lead to novel product development methodologies by combining engineering expertise with mathematical modelling and optimization methods. The Department of Mathematics participates in the SFB 666 within three sub-projects (Kohler, Martin, Ulbrich). The mathematical research is concentrated on the product 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.

2.1.4 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. 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 lifecycle—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, whereas the mathematical research assesses the influence and effects of uncertainty and its interdependencies and derives from this optimal solution strategies for processes with minimal uncertainty and optimal design concepts for load-carrying systems. The Department of Mathematics is involved in three projects of SFB 805 (Lorenz, Martin, Ulbrich). 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.

2.1.5 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 often 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 is becoming challenging. With the Graduate School of Computational Engineering, the Technische Universität (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, sim-

ulation 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. Five professors of the Department of Mathematics are principal investigators within the Graduate School Computational Engineering (Joswig, Lang, Martin, Stannat, Ulbrich) with expertise in Discrete Algortihmic Mathematics, Numerical Analysis, Discrete Optimization, Stochastics, Nonlinear Optimization and Optimal Control. They supervise more than 10 interdiciplinary PhD projects within the Graduate School in close cooperation with a co-supervisor from Engineering or Computer Science.

2.1.6 International Research Training Group

The International Research Training Group “Mathematical Fluid Dynamics" (IRTG 1529) is funded by the Deutsche Forschungsgemeinschaft (DFG) and the Japan Society for the Promotion of Science (JSPS) and started in 2009. It is associated with TU Darmstadt and with two Universities located in Tokyo, Japan, Waseda University and University of Tokyo.
The research of the program focuses on analytical, stochastic and geometric aspects as well as on 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 at Darmstadt are Dieter Bothe, Reinhard Farwig, Matthias Geissert, Horst Heck, Matthias Hieber, Karl-Hermann Neeb, Klaus Ritter, Wilhelm Stannat, Cameron Tropea, and Stefan Ulbrich. The participating colleagues in Tokyo are Tadahisa Funaki, Yoshikazu Giga, Takaaki Nishida, Shinishi Oishi, Yoshihiro Shibata and Masao Yamazaki.
IRTG 1529 is organizing seminars, short courses, workshops and conferences on a regular basis in Darmstadt and Tokyo. The list of speakers in 2009 and 2010 includes leading experts of the field, e.g., Marco Cannone (Marne la Vallee), Peter Constantin (Chicago), Guiseppe Da Prato (Pisa), Giovanni Galdi (Pittsburgh), Nicolai Krylov (Minnesota), Hideo Kozono (Sendai), Felix Otto (Leipzig), Tudor Ratiu (Lausanne), Maria Schoenbeck (Santa Cruz), Adelia Sequeira (Lisbon) and Edriss Titi (Irvine and Weizmann). Highlights of the program were several conferences, e.g., the “International Workshop on Mathematical Fluid Dynamics" at Waseda University, Tokyo, from March 8 - 16, 2010 and the “International Conference on Evolution Equations", Schmitten, from October 11 - 15, 2010.
The opening ceremony took place on October 21, 2009 at TU Darmstadt. Prof. Matthias Kleiner, president of DFG, had agreed to deliver the official opening address of this program and on the occasion of a workshop in Tokyo. Scientific talks were then given by the particularly distinguished speakers A. Cannone, P. Constantin and G. Galdi.
Gender issues of this program are considered in special workshops entiteled “Career Opportunities for Women in Mathematical Fluid Dynamics", see e.g., the workshop on October 20, 2009.

2.2 Research Groups

2.2.1 Algebra, Geometry and Functional Analysis

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

Project: Harmonic Weak Maass Forms

We investigate the Fourier coefficients of harmonic weak Maass Forms. We show that a weak Maass Form f of integral weight $2-k$, which is related to a CM Hecke eigenform g of weight k, has algebraic Fourier coefficients. It is conjectured that in the non CM case, the coefficients are transcendental.
We also 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 algebraicity of the Fourier coefficients of the holomorphic part of f is dictated by the vanishing of the central derivatives of quadratic twists of the Hecke L-function of the Shimura lift of g.
Numerical algorithms for the computation of the Fourier coefficients of harmonic Maass forms are developed. They are based on a variant of the automorphy method due to Hejhal and Stark for the computation of classical Maass cusp forms. The numerical data is used to derive (and predict) identities relating the coefficients of weight $1/2$ harmonic Maass forms to periods of algebraic differential on modular and elliptic curves.

Partner: K. Ono, Emory University, Atlanta; R. Rhoades, Stanford University; Fredrik Strömberg, TU Darmstadt

Support: DFG, NSF

Contact: J. H. Bruinier, F. Strömberg, C. Alfes

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[3] J. H. Bruinier and F. Strömberg. Computation of harmonic weak Maass forms. *preprint*, 2010.

Project: Regularized theta lifts over totally real fields

R. Borcherds constructed a regularized theta lift from weakly holomorphic modular forms to meromorphic modular forms on orthogonal groups of quadratic spaces over the rationals. It has been an open problem how this construction could be generalized to ground fields other than $\mathbb{Q}$. The main obstacle has been that there are no non-trivial weakly holomorphic Hilbert modular forms because of the Koecher principle.
We propose a regularized theta lift that takes "Whittaker forms", which are certain formal analogues of weakly holomorphic modular forms, to meromorphic modular forms on orthogonal

groups over totally real fields. This map reduces to the Borcherds lift if the ground field is $\mathbb{Q}$, and over arbitrary totally real ground fields it gives the desired generalization.

Partner: T. Yang, University of Wisconsin at Madison

Support: DFG

Contact: J. H. Bruinier

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[1] J. H. Bruinier. Regularized theta lifts for orthogonal groups over totally real fields. *Journal für die reine und die angewandte Mathematik*, accepted for publication.

[2] J. H. Bruinier and T. Yang. CM values of automorphic Green functions on orthogonal groups over totally real fields. Preprint, TU Darmstadt, 2010.

Project: Special values of automorphic Green functions and automorphic products

We study the values at special points of automorphic forms that are obtained by the Borcherds lift or generalizations of it. With S. Kudla and T. Yang, we considered this problem for the values of automorphic Green functions on orthogonal groups at 'big' CM points. This leads to conjectures on arithmetic intersection numbers and height pairings for such CM points.
In joint work with T. Yang, we computed the CM values of automorphic Green functions on orthogonal groups over totally real fields. As an application, we proved predictions of N. Elkies on values of certain rational functions on Shimura curves at CM points.

Partner: S. Kudla, University of Toronto and T. Yang, University of Wisconsin at Madison

Support: DFG, NSF

Contact: J. H. Bruinier, S. Ehlen

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Project: Topological and Lie Groups

A topological group is simultaneously a group, algebraically, and a topological space (geometrically) such that all functions involved in the algebraic structure are continuous. In the case of a Lie group, an analytic structure is also present, giving rise to an associated Lie algebra, an algebraic structure from the domain of linear algebra. Inside mathematics, the project is multidisciplinary. Recent attention was given to pro-Lie groups and pro-Lie algebras, that is, structures which are approximated in a suitable sense by Lie groups and Lie algebras, respectively.

Partner: Coauthors: Professor Sidney A. Morris, Melbourne, Australia, Professor Michael Mislove, Tulane University, New Orleans, USA

Support: Foundation “Eigene Tasche”

Contact: Prof. Dr. Karl H. Hofmann

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[10] K. H. Hofmann and K.-H. Neeb. On the compact generation of closed subgroups of locally compact groups. *J. Group Theory*, 12:555–559, 2009.

Project: Polar actions on complex hyperbolic space and other non-compact symmetric spaces

Polar actions are isometric Lie group actions on Riemannian manifolds where a submanifold, called section, exists which intersects all orbits orthogonally. One may think of a polar action as a system of polar coordinates on the manifold, or one can interpret the points in the section as canonical representatives of the orbits. The classification of polar actions on compact symmetric spaces has recently been completed. However, on non-compact spaces there are only partial results available so far. This is due to the fact that the isometry group is non-compact and new phenomena, such as polar foliations, arise that do not have counterparts in the compact setting. Our joint work is aiming at a classification of polar actions on non-compact symmetric spaces.

Partner: J.C. Díaz Ramos (Universty of Santiago de Compostela)

Contact: A. Kollross

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[3] A. Kollross. Duality of symmetric spaces and polar actions. *Journal of Lie Theory*, 4:961 – 986, 2011.

Project: Nonnegatively curved homogeneous metrics obtained from Riemannian submersions

The study of manifolds with prescribed curvature is one of the classical fields of Riemannian geometry. However, there are only a few methods known which produce, for instance, Riemannian metrics of nonnegative curvature. We study invariant Riemannian metrics on compact homogeneous spaces where an intermediate subgroup between a group acting transitively and its isotropy subgroup exists. While shrinking the fibers of the submersion given in this way is well-known to retain the non-negative curvature of a normal homogeneous metric by a construction of Cheeger, it depends on the groups involved whether scaling up the intermediate subalgebra will maintain the nonnegative curvature. Using a criterion recently proved by Schwachhöfer and Tapp, we study the Lie-algebraic conditions which lead to metrics of non-negative curvature.

Partner: M.M. Kerr (Wellesley College, Wellesley, Massachusetts)

Contact: A. Kollross

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Project: Modular forms for the Weil representation

Borcherds' singular theta correspondence is a map from vector valued modular forms on $\mathrm{SL}_2(\mathbb{Z})$ to automorphic forms on orthogonal groups. Since these automorphic forms have nice product expansions they are called automorphic products. They play an important role in algebra, geometry and arithmetic. A famous example is the function

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

where Δ is Dedekind's delta function. This function is an automorphic form of weight 12 for a discrete subgroup of $\mathrm{O}_{26,2}(\mathbb{R})$. The input data for the singular theta correspondence are vector valued modular forms for the Weil representation. Such forms can be induced from scalar valued modular forms on congruence subgroups [1, 2]. In [2] it is shown that on a discriminant form D of squarefree level N every modular form which is invariant under $\mathrm{Aut}(D)$ is induced from $\Gamma_0(N)$. This motivates the question whether an analogous result holds for arbitrary discriminant forms without the assumption on the level. This includes, for example, determining the orbits of $\mathrm{Aut}(D)$ on D.

Contact: N. Scheithauer

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[2] N. Scheithauer. Some constructions of modular forms for the Weil representation of $SL_2(\mathbb{Z})$. Preprint, TU Darmstadt, 2010.

Project: Moonshine for Conway's group

The fake monster algebra is a generalized Kac-Moody algebra describing the physical states of a bosonic string moving on a 26-dimensional torus. Its real simple roots correspond to the Leech lattice. The automorphism group of the Leech lattice acts by diagram automorphisms on the fake monster 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, 2].

Contact: N. Scheithauer

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[1] N. Scheithauer. The Weil representation of $SL_2(\mathbb{Z})$ and some applications. *International Mathematical Research Notices*, pages 1488–1545, 2009.

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Project: Classification of automorphic products

Automorphic products are sometimes the denominator identities of infinite-dimensional Lie algebras. The corresponding vector valued modular forms have some special properties, i.e., their Fourier coefficients are nonnegative rational integers and they have only poles of order one corresponding to roots. In the squarefree level case, it is possible to classify these vector valued modular forms by pairing them with Eisenstein series [1]. The result is that there are only 10 such functions. They are in one-to-one correspondence with the solutions of the equation

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

The goal of this project is to classify the modular forms with the specified properties for arbitrary discriminant forms. The problem can be approached by generalizing the above argument. This includes, for example, finding explicit formulas for the Fourier coefficients of the vector valued Eisenstein series.

Contact: N. Scheithauer

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2.2.2 Analysis

The research group Analysis consists of six professors, H.-D. Alber, D. Bothe, R. Farwig, M. Hieber, S. Roch (apl.) and B. Farkas (J.-Prof.), and about 15 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 the Clay Mathematics Institute.
A second focus is put on the modelling 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.
The third 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, once or twice a year, the research group organizes a workshop called "Analysistag" with speakers from Germany and abroad covering a wide spectrum of fields in analysis and its applications.
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 (IGK 1529) (Internationales Graduiertenkolleg) “Mathematical Fluid Dynamics" funded by DFG and JSPS and associated with TU Darmstadt, Waseda University in Tokyo and University of Tokyo in Japan. The program seeks to combine methods from several mathematical disciplines such as analysis, stochastics, geometry and optimization to pursue fundamental research in Fluid Dynamics.

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 Arbeitsgruppe that we call hybrid models. The analytical results obtained thus far 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.
Therefore, In cooperation with B. Markert from the Institut für Angewandte Mechanik of Universität Stuttgart we 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: Regularity of weak solutins of the Navier-Stokes equations

The famous open problem for weak solutions of the instationary Navier-Stokes equations in a three-dimensional domain Ω concerns the question whether weak solutions which can be constructed globally in time are regular or even smooth. This problem is solved up to now only under additional assumptions such as the classical Serrin condition $u \in L^s(0,\infty;L^q(\Omega))$ where $\frac{2}{s}+\frac{3}{q}=1$ whereas a weak solution satisfies a similar but weaker condition of the type $u \in L^s(0,\infty;L^q(\Omega))$ with $\frac{2}{s}+\frac{3}{q}=\frac{3}{2}$. The aim of the project is to find—beyond Serrin's barrier—new conditions of local type or even of a one-sided local type. Further conditions can be related to assumptions on the temporal behavior of the kinetic energy or the validity of the energy equality.

Partner: Prof. Dr. H. Sohr (Universität Paderborn), Prof. Dr. H. Kozono (Tohoku University, Sendai, Japan)

Contact: R. Farwig

Project: Fluid flow in unbounded domains

The flow of a viscous incompressible Newtonian fluid in unbounded domains poses new technical problems since the classical Helmholtz projection well-defined on $L^q(\Omega)$, $1 < q < \infty$, for bounded and exterior domains Ω does not exist in general unbounded domains unles $q = 2$. One possibility to solve this problem is the use of the function spaces $\tilde{L}^q(\Omega) = L^q(\Omega) \cap L^2(\Omega)$ when $2 \le q < \infty$ and $\tilde{L}^q(\Omega) = L^q(\Omega) + L^2(\Omega)$ when $1 < q < 2$. In this setting, the Helmholtz projection is bounded on every space $\tilde{L}^q(\Omega)$, $1 < q < \infty$, and the Stokes operator is a well-defined closed operator generating a holomorphic semigroup. By this theory, weak solutions were constructed satisfying even the localized energy inequality; this property is important to get partial regularity results, the strong energy inequality and Leray's Structure Theorem. The aim of the project is to apply the $\tilde{L}^q$-theory to the construction of strong solutions and—by duality arguments—to very weak solutions. Then a combination of the classical L^2-theory and the theory of very weak solutions can be used to prove new regularity results beyond Serrin's condition.

Partner: Prof. Dr. H. Kozono (Tohoku University, Sendai, Japan)

Contact: R. Farwig, F. Riechwald

Project: Fluid flow around rotating obstacles

We consider the flow of a viscous incompressible fluid around or past a rotating bounded obstacle. In a coordinate system attached to the rotating body the modified Navier-Stokes system includes additional terms which cannot be considered as a perturbation of the Laplacian and require more sophisticated analytical tools. In our project, the asymptotic behavior of stationary solutions at space infinity is analyzed. The result depends on whether we consider the linear or nonlinear problem. In the linear case the leading term in an asymptotic expansion is given by the component of the fundamental solution of the Stokes sytem in the direction of the axis of revolution. Hence, it does not show any rotational behavior. The second order term is strongly related to the rotation of the obstacle and produces a rotation of particles around the axis of revolution. In the nonlinear case the leading term is given by Landau's explicit solution of the Navier-Stokes system with a force of distributional type parallel to the axis of revolution.

Partner: Prof. Dr. T. Hishida (Nagoya University, Japan)

Contact: R. Farwig

Project: Spectral problems of fluid problems

We consider the spectrum of the Stokes operator in the whole space or an exterior domain in L^q-spaces. As is well known in the L^2-case, the spectrum equals the nonpositive real line and is a purely continuous one. However, for $q \neq 2$ and the whole space case, the spectrum is the same set, but the open negative half line is either a residual spectrum, a continuous one or a point spectrum consisting of eigenvalues of infinite multiplicity. The situation of a modified Stokes operator occurring in the analysis of fluid flow around a rotating obstacle is more complicated. Here the spectrum (in the whole space case) consists of the countable union of parallel equidistant half lines in the left complex half plane. Again, the type of the spectrum depends on q. For an exterior domain which is not axially symmetric with respect to the axis of rotation, the results are less complete. By abstract theory, there could exist additional eigenvalues of finite multiplicities between the above-mentioned set of half lines. It is still an open problem whether such eigenvalues exist or can be excluded.

Partner: Prof. Dr. J. Neustupa (Czech Academy of Sciences, Prague)

Contact: R. Farwig

Project: Fundamental problems for fluid flow around moving obstacles

We are looking for the fundamental solution of instationary flow of a viscous incompressible fluid past a rotating obstacle. Working in a coordinate system attached to the moving obstacle we are lead to a modified (Navier-)Stokes system with several additional terms, some of which are not subordinate to the Laplacian or are time-dependent. Nevertheless, using a special transformation defined by an auxiliary ODE system, the problem can be simplified to the classical Stokes or Oseen system. Then the fundamental solution can be found explicitly in terms of classical functions including Kummer functions. By these means, we are able to find the more or less explicit fundamental solution in several special physical situations of moving and rotating obstacles. The next step will be to analyze an asymptotic expansion and to prove the existence and describe the shape of the wake region behind the obstacle.

Partner: Šarká Nečasová (Czech Academy of Sciences, Prague)

Contact: R. Farwig.

Project: IRTG 1529: Mathematical Fluid Mechanics

One of the projects of the IRTG 1529 deals with the asymptotic structure of solutions of the Boussinesq equations in the whole space $\mathbb{R}^n$ and the half space. The Boussinesq equations describe the flow of a viscous incompressible and heat-conductive Newtonian fluid where the momentum equation and the heat equation are coupled mainly by the buouancy term $g\vartheta$ in the momentum equation; here ϑ is the temperature and g, the gravity force, is assumed to decay like $|x|^{n-1}$. In this setting we construct mild and strong solutions and get a decay for the velocity u as $|x|^{-n}$ when $\int g\vartheta \neq 0$—in contrast to the usual Navier-Stokes case where the decay $|x|^{-n-1}$ is optimal. Moreover, under special symmetry assumptions we find initial values u_0, ϑ_0 and a set of epochs such that the decay of u changes from $|x|^{-n}$ to $|x|^{-n+1}$ consecutively, thus showing a concentration-diffusion phenomenon. In this project, similar results are under investigation for the half space case.

Partner: International Research Training Group (IRTG 1529) on Mathematical Fluid Mechanics, TU Darmstadt - Waseda University Tokyo

Contact: R. Farwig, R. Schulz

Project: Smart Interfaces: Understanding and Designing Fluid Boundaries

Considering the flow of a viscous incompressible fluid in a domain Ω the regularity or roughness of the boundary has a crucial impact on the flow field. For the Boussinesq equations, a model for heat-conductive fluids, the heat flux through the boundary is an important physical quantity which should be controlled, either maximized or minimized depending on the physical problem at hand. In this project we discuss the change of the boundary conditions for a sequence of domains Ω_k with oscillating boundary behavior when the amplitude is decreasing, but the frequency is increasing. A consequence of the boundary oscillations in the case of Robin boundary conditions for the temperature is a new weight factor in the Robin condition depending on the way of convergence of Ω_k to Ω. This result for perturbed half spaces will be generalized to bounded domains and coupled with methods from optimal control theory. Moreover, several special cases with degeneracies in the roughness are under investigation.

Partner: Cluster of Excellence at TU Darmstadt: Smart Interfaces: Understanding and Designing Fluid Boundaries

Contact: R. Farwig, C. Komo

Project: Spin-Coating

The production of modern LEDs with functional layers like semi-conducting polymers requires the construction of thin layers of uniform height of polymers. One possibility to accomplish this goal is the so-called spin-coating. The idea is to put a drop of polymer solution on a rotating disc. Due to centrifugal force, the drop spreads until the solvent is evaporated and—hopefully—we end up with a thin layer of uniform height. As a first step we investigate a simplified model to describe the process of spin coating. Indeed, local existence and uniqueness of a strong L^p solution to the Navier-Stokes equation with free boundary in a layer with surface tension in a rotating framework is shown in [1]. Unfortunately, this approach does not allow to describe all aspects of spin-coating, since for instance polymers are non-Newtonian. Moreover, some important aspects, for example chemical properties or evaporation, are not yet included in our model. Therefore, in the future, we investigate the Navier-Stokes equation coupled with a transport equation for the stress tensor. The stress tensor thus has a Newtonian part and a viscoelastic part (cf. Oldroyd-B) which describes the properties of the fluid more accurately.

Partner: R. Denk, Universität Konstanz, M. Hieber, J. Saal and O. Sawada, Gifu University, Japan

Contact: M. Geißert

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[1] R. Denk, M. Geissert, M. Hieber, J. Saal, and O. Sawada. The spin-coating process: Analysis of the free boundary value problem. *Comm. PDE, to appear*.

Project: The square root of divergence operators

Elliptic regularity of divergence operators in non-smooth situations, i.e., bounded measurable coefficients, Lipschitz domains and mixed boundary conditions is a delicate matter. For instance, it is possible to construct for every $p > 2$ such an operator of second order whose domain on the corresponding $W^{-1,p}$-space is not contained in a Sobolev space of type $W^{1,p}$, i.e., the gain in regularity when solving the corresponding equation is not 2.
The aim of this project is to show that, nevertheless, the square root of such an operator behaves nicely, which means that its domain on the same $W^{-1,p}$-space is L^p, i.e., the gain in regularity is 1.
Applications of this result to parabolic linear and quasilinear equations and a generalisation for systems of equations are also planned.

Partner: Pascal Auscher (University of Paris Sud), Nadine Badr (University of Lyon I), Joachim Rehberg (Weierstraß Institut, Berlin)

Contact: R. Haller-Dintelmann

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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 (University of Valenciennes)

Contact: R. Haller-Dintelmann

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[2] F. Ali Mehmeti, R. Haller-Dintelmann, and V. Régnier. Expansions in generalized eigenfunctions of the weighted Laplacian on star-shaped networks. In H. Amann, W. Arendt, M. Hieber, F. Neubrander, S. Nicaise, and J. von Below, editors, *Functional Analysis and Evolution Equations – The Günter Lumer Volume*, pages 1 – 16. Birkhäuser, 2008.

Project: Operator theory and numerical analysis

On the operator theory side, our main interest is 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 well understood, the known formulas for the Fredholm index of these operators are quite involved and hard to use. One goal of this project is to derive a handy index formula, which is based on the recent observation that several Hankel operators belong to the Banach algebra generated by Toeplitz operators.
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 and reduced group C^*-algebras and plan to extend them to multi-dimensional disk algebras and other algebras generated by isometries.

Partner: Bernd Silbermann

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Contact: S. Roch

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 also allow 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 pseodo-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

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Contact: S. Roch

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 have this property. Fredholm properties of band-dominated operators can be studied via their limit operators, which reflect the behaviour of the operator at infinity. For example, 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. One goal of the project is to study the Fredholm properties of Schrödinger operators (and other operators of mathematical physics) and the decay of their eigenfunctions, the extension of the index formula to multi-dimensional band-dominated operators, and applications to numerical analysis of band-dominated operators.
A second line of research concerns the Fredholm theory and numerical analysis of discretized differential operators acting on periodic nano-structures (like honeycomb structures and nanotubes). These operators can also be considered as band-dominated in the above sense. This part of the project is closely related to (reduced) group C^*-algebras and (reduced) crossed products of C^*-algebras.

Partner: Vladimir S. Rabinovich

Support: CONACYT, DFG

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[9] V. S. Rabinovich and S. Roch. Finite sections of band-dominated operators on discrete groups. Preprint, TU Darmstadt, 2010.

Contact: S. Roch

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 $L^p(R)$ 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 some serious difficulties since localization techniques do not apply in the standard way. Also, the spectra of the generators become massive, which makes it harder to verify the inverse closedness of the considered algebras in the algebra of all bounded linear operators on $L^p(R)$. On the other hand, a consequence of including the flip is that then all Wiener-Hopf + Hankel operators with piecewise continuous generators belong to the algebra under consideration. Recently, this class of operators received considerable interest.

Partner: Pedro dos Santos, Bernd Silbermann

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Contact: S. Roch

Project: Szegö limit theorems

The classical Szegö theorems study the asymptotic behaviour of the determinants of the finite sections $P_nT(a)P_n$ of Toeplitz operators, i.e., of operators which have constant entries along each of their diagonals. 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 for which we not only expect the most satisfying generalizations of the classical theorems, but which are also of immense importance in applications (the prominent Almost Mathieu operator is an example of a band operator with almost periodic coefficients). Whereas the generalization of the so-called first Szegö limit theorem to this context is clear now, and also an appropriate generalization of the strong Szegö theorem is available, some serious questions are still open. For example, there is an inverse closedness assumption which is not yet clearly understood, and also the case of operators with more than one "irrationality" is largely open.

Partner: Torsten Ehrhardt, Bernd Silbermann

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Contact: S. Roch

2.2.3 Applied Geometry

The research group "Geometry and Approximation" investigates foundations and applications of geometric objects 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 be minimal. Other interfaces minimize functionals involving curvatures. Such problems lead to complicated non-linear partial differential equations. Our goal is to establish new solutions or properties of solutions, using 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.
Both the surfaces considered in Differential Geometry and Geometric Modeling have typically a fairly complicated structure which requires approximation in a function space of reduced complexity, say a spline space, for further processing. 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.

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.

Support: DFG

Partner: Rob Kusner (Amherst, MA)

Contact: K. Große-Brauckmann

References

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Project: Triply periodic surfaces

Triply periodic surfaces play an important role for modelling purposes. Geometric interfaces with specific curvature properties explain items as varied as butterfly wings and polymer surfaces. We want to establish the existence of families of surfaces which model the interfaces. We are also interested in the relationship between the surface families and their Schoen skeletal graphs.

Contact: K. Große-Brauckmann

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

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Project: B-splines on domains

In a long term effort, we try to clarify approximation properties of polynomials and tensor product B-splines on bounded subsets of $\mathbb{R}^n$. Recent results concern:

- Bramble-Hilbert Lemma. The range of applicability of the fundamental Bramble-Hilbert Lemma was extended significantly to domains which are bounded by diffeomorphic images of graphs.
- Condensed B-splines. In the bivariate case, this new class of spline functions yields a uniformly stable basis and provides full approximation order in anisotropic Sobolev spaces with constants independent of the aspect ratio of grid cells.
- Two-stage methods with extended B-splines. The well-known concept of two-stage methods was generalized to bounded domains. In the case of scattered data approximation, a new approximation scheme was suggested which yields error bounds with constants independent of the number of data sites.

Partner: B. Mößner, N. Sissouno, K. Höllig, O. Davydov

Contact: Ulrich Reif

Project: Nonlinear subdivision

Since the analysis of linear stationary subdivision schemes has reached a state of completeness, nonlinear schemes are attracting more and more attention. In this project, we try to define new schemes, which work in the spirit of the Catmull-Clark algorithm, but use rules derived from geometric rather than algebraic principles. Various approaches have been devised, implemented, and analyzed. Current results are promising, but still indicate a need for further optimization.

Partner: R. Hartmann, N. Lehmann

Contact: Ulrich Reif

Project: Evaluation of the JSR

The joint spectral radius (JSR) generalizes the standard spectral radius to families of matrices. Its exact evaluation is known to be an, in general, NP-complete problem. However, in many cases of practical relevance, exact evaluation is possible by verifying a specific finite product of matrices to be spectrum maximizing. We develop a new approach to that issue which is based on depth first search on set-valued trees. Our method proved to be useful when determining the precise range of tension parameters yielding C^1 convergence for the four-point scheme.

Partner: B. Mößner, J. Hechler, C. Möller

Contact: Ulrich Reif

2.2.4 Didactics and Pedagogics of Mathematics

Research in the Didactics and Pedagogics of Mathematics

The working group Didactics of Mathematics deals with different questions on how to teach and learn mathematics. In 2009-2010 the research activities concentrated on

1. constructing and testing competence models (part of the Priority Research Program "Competence Models")
2. developing and testing instruments for measuring diagnostic competences of teachers
3. the development and evaluation of integrated teaching concepts as well as corresponding training and further training concepts for math teachers on the computer-based teaching and learning of math within the scientific framework of different model tests in three Federal States in Germany and
4. the development and evaluation of e-learning - activities in research and development (e-learning-label by TU Darmstadt, participation in the postgraduate program on e-learning at TU Darmstadt) and in the teacher further training (`www.proLehre.de`).

The DFG priority program "Competence Models" not only allowed us to gain valuable insight into the possibilities of further development of maths lessons but also to develop new survey tools for the collection of ideas on the teaching and learning of maths which were presented on national and international conferences 2009 and 20010. New computer-based learning and teaching arrangements for Mathematics and Didactics of Mathematics have been developed and tested.

Research Group in Operator Algebras and Mathematical Physics
Quantum probability is an extension of classical probability theory that allows to also treat 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.), or 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 field of quantum information.

Project: Heuristic work with representations of functional coherencies - Diagnosis of the mathematical competencies of students (HEUREKO)

The project aims at the construction and empirical testing of a model for mathematical problem-solving concerning competencies of students of lower secondary level (8^{th} and 9^{th} grade). The object of interest concerns situations where processes of growth and change are mathematically assessed (overarching idea “change"). In this context, the focus of relevance lies on the heuristic use of different fundamental mathematical representations, namely numerical, graphic, algebraic, and verbal, and the change between them as a significant determinant of problem-solving and modeling competence. We operationalize theoretical models of ability in mathematical didactics that have proven successful at a national as well as an international level, and assess

them empirically. The latter was done by employing methods from Item Response Theory. (cf. www.kompetenzmodelle.dipf.de)

Partner: Prof. Timo Leuders and Prof. Markus Wirtz Freiburg

Support: GRF (Priority Research Program "Competence Models"

Contact: R. Bruder

Project: MABIKOM 2008-2012

The project MABIKOM (technology supported mathematics classes with a competency development that considers individual student differences) is based on the results of the school trial CALiMERO, a joint project of the TU Darmstadt, Texas Instruments and the ministry of education in Niedersachsen. The school trial CALiMERO develops and tests a teaching concept for using CAS-able pocket computers in mathematics classes in secondary schools, classes 7 to 10 in Niedersachsen. The project showed the need for other measures for considering individual student differences combined with the use of new technologies. Therefore the MABIKOM-project was established in 2008. The growing demand for individualization and differentiation of teaching and learning processes needs an adequate instrument for checking the progress in learning and educational diagnostics. A useable repertoire of methods for a flexible organization of the learning environment is also needed. These requirements are connected to a high standard of teaching and they need many preparations that can be managed by a teacher only in a very limited scale. This shows the need of adequate supporting instruments like teaching-models and elaborated, tested and flexible topic-specific teaching and learning materials. This means a teaching concept is needed that is adequate for daily use and appropriate for considering individual differences in mathematics classes (grade 5 to 10, starting to use technologies in grade 7). It has to meet the claims that many students in a heterogeneous study group are appealed cognitive and motivational and that an effective learning progress is possible. Details: www.proLehre.de

Partner: Tanja Wehrse (Niedersachsen)

Support: TEXAS Instruments and Ministry of Education Niedersachsen

Contact: Julia Reibold

Project: CALiMERO 2005-2010

On the basis of the experiences made with graphics calculators in the German Federal State of Niedersachsen 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, already 50 schools are using 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 Niedersachsen 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: Dr. Guido Pinkernell, Dr. Maria Ingelmann

Support: TEXAS Instruments and Ministry of Education Niedersachsen

Contact: Dr. Guido Pinkernell

Project: Internet based professional training for math teachers

The Department of Mathematics at the TU Darmstadt currently provides six Internet based professional training courses for math teachers in the German Federal State of Hesse with the focus on “Educational Standards for Math".The first half year course “Problem solving" started in the school year 2005/2006 followed by the course “Basics" in 2006/2007 and “Mathematical Modeling" in 2007/2008. In the school year 2010/11 two courses “Mathematical Arguing" and “Within Differentiation" were established. In the school year 11/12, a new course “Long-Term Building-Up of Competence" is going to start. Already about 500 teachers have been trained in these courses. Two internet platforms developed at the TU Darmstadt (Prof. Dr. Regina Bruder et al) are used as supporting systems for the courses: www.madaba.de (structured collection of math tasks) and www.problemloesen.de (materials for problem solving). An evaluation and investigation of the sustainability of the professional trainings is proceeding in the frame of a part project. Research questions are how the teachers estimate the increase of their knowledge, which elements of the competences are conversant to the teacher after half respectively one year and how the teachers estimate the effects of the courses. Details on www.proLehre.de

Partner: Julia Reibold

Support: Ministry of Education Hessen and Project SINUS-Transfer in Hessen

Contact: Julia Reibold

Project: E-Learning Label and third party certification of E-Learning-Quality for computerbased learning environments (TUD-Gütesiegel)

Details on http://www.elc.tu-darmstadt.de/ and http://www.tud-guetesiegel.de.

Partner: Antje Müller, Svetlana Polushkina, Dr. Julia Sonnberger (Research Training Group on Feedback Based Quality Management in eLearning)

Support: TU Darmstadt

Contact: Dr. Julia Sonnberger

Project: PEDALE (PEer-based Diagnostic And Learning Environment) (2009-2012)

In the context of the Research Training Group on Feedback Based Quality Management in eLearning (GRK E-Learning) an interdisciplinary research cooperation was established. The project was launched with Prof. Regina Bruder (Working Group Didactic of Mathematics, FB 4) and Prof. Ralf Steinmetz (Working Group Serious Games, FB 18) as heads of the project and Kristina Richter (FB 4) and Johannes Konert (FB 18) as project members. The conceptual and technical development as well as the evaluation is realised in this cooperation.
The research project PEDALE (PEer-based Diagnostic And Learning Environment) adresses the

topic of instructional support for mathematics classes with appropriate eLearning conceptions. The scope of PEDALE is the development of a computer-supported learning and diagnosis environment for secondary school mathematics. The learning environment is designed to provide and distribute tasks, combined with semiautomatic diagnoses of task solutions. Furthermore the learning environment triggers peer review processes among students through providing solution approaches within the classroom network. Peer Review processes are supported by an according feedback guide. The project is in progress.
Website: http://www3.mathematik.tu-darmstadt.de/index.php?id=1480

Support: DFG - GK E-Learning (2009-2011)

Contact: Prof. Dr. Regina Bruder, Kristina Richter

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Project: Exploring mathematical pedagogical content knowledge via a repertory grid 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 lesson plans in terms of those characteristics they thought were important. They estimated 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.

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

Contact: Prof. Dr. Regina Bruder, Isabell Bausch

Project: DisKoLaMa (2009-2012)

The goal of this project is the development and testing of instruments to measure diagnostic competences of (future) mathematics teachers at secondary schools (Gymnasium) and at vocational secondary schools (Berufliche Schulen). Furthermore, the aim is to describe individual diagnosing skills and competences of students and student teachers and to uncover

their progress in developing these skills and competences. The measured objects are diagnostic competences of processes and results of individual competence acquisition of students in mathematics lessons with a focus on “mathematical basic knowledge" and “problem-solving competence". First of all, a model to measure diagnostic competence of (future) mathematics teachers with the elements of knowledge, action competence and meta competence will be developed and then put into practice in form of questionnaires and guided interviews. A part of the survey will be developed and tested in form of an online questionnaire. All instruments developed are to serve the uncovering of diagnostic competence of students wanting to become teachers at the beginning and end of their studies as well as for student teachers at the beginning and end of their practice teaching period. With this evaluation, a cross-sectional as well as a longitudinal look at things will unfold so that different developments will be observed. Competences will be measured at the TU Darmstadt of student beginners who want to become teachers in secondary schools for mathematics (general secondary schools and vocational) and with student trainees doing their practice teaching seminar in the Darmstadt area. The results of the questionnaires will be added to the competence portfolio of students becoming teachers and are meant to contribute to the self-assessment of students and student trainees. The evaluation results will form the basis for measures of targeted support and diagnosis competences for teacher education and continuing training. In addition, one can use the results to describe the respective effects for teacher education and continuing training. The results will be published on relevant national and international conferences.
http://www.empirische-bildungsforschung-bmbf.de/zeigen.html?seite=8285

Support: BMBF

Contact: Prof. Dr. Regina Bruder, Heiko Fey

Project: DisKoLaMa (2009-2012)

The goal of this project is the development and testing of instruments to measure diagnostic competences of (future) mathematics teachers at secondary schools (Gymnasium) and at vocational secondary schools (Berufliche Schulen). Furthermore, the aim is to describe individual diagnosing skills and competences of students and student teachers and to uncover their progress in developing these skills and competences. The measured objects are diagnostic competences of processes and results of individual competence acquisition of students in mathematics lessons with a focus on "mathematical basic knowledge" and "problem solving competence". First of all, a model to measure diagnostic competence of (future) mathematics teachers with the elements of knowledge, action competence and meta competence will be developed and then put into practice in form of questionnaires and guided interviews. A part of the survey will be developed and tested in form of an online questionnaire. All instruments developed are to serve the uncovering of diagnostic competence of students wanting to become teachers at the beginning and end of their studies as well as for student teachers at the beginning and end of their practice teaching period. With this evaluation, a cross-sectional as well as a longitudinal look at things will unfold so that different developments will be observed. Competences will be measured at the TU Darmstadt of student beginners who want to become teachers in secondary schools for mathematics (general secondary schools and vocational) and with student trainees doing their practice teaching seminar in the Darmstadt area. The results of the questionnaires will be added to the competence portfolio of students becoming teachers and are meant to contribute to the self-assessment of students and student trainees. The evaluation results will form the basis for measures of targeted support and diagnosis competences for

teacher education and continuing training. In addition, one can use the results to describe the respective effects for teacher education and continuing training. The results will be published on relevant national and international conferences.
http://www.empirische-bildungsforschung-bmbf.de/zeigen.html?seite=8285

Support: BMBF

Contact: Prof. Dr. Regina Bruder, Heiko Fey

Project: Stationary States, Recurrence and Transience for Quantum Dynamics

Probabilistic Markovian behaviour 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 behaviour of such a dynamics. For finite systems a Perron-Frobenius type theory is available, for infinite systems, notions of recurrence and transience become crucial.
In this project we introduce suitable quantum versions of recurrence and transience and apply them to the above mentioned problems. Presently, our interest focusses on the paradigmatic case of semigroups on the algebra $B(\mathscr{H})$ of all bounded operators on a Hilbert space. They 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: Eliminating Errors by Dynamical Decoupling

Avoiding errors is a main issue in quantum information. Errors by uncontrolled changes of quantum states can be caused by dissipative effects or by an unknown internal dynamics of the quantum system. A common method to avoid errors is to introduce error correcting codes. Recently (2005), an alternative method, called dynamical decoupling, has been introduced by L. Viola and E. Knill.
The idea is to superimpose the unknown internal dynamics with an external dynamics in such a way that, by cancelling out, the resulting dynamics is close to the identity: For a finite quantum system the observable algebra is given by the algebra M_n of all $n \times n$-matrices and the inner dynamics is given by $e^{i\mathbb{H}_0 t}$ for some unknown Hamiltonian $\mathbb{H}_0 \in M_n$. Now one chooses unitaries $u_1, \ldots, u_k \in M_n$ such that $\sum_{i=0}^{k} u_i^* \mathbb{H}_0 u_i = 0$. Since the unitary group in M_n is compact and thus has finite Haar measure, one can always find unitaries with this property, independently of the particular Hamiltonian $\mathbb{H}_0$. If one applies to the system the dynamics as described by the unitaries u_i in short pulses ("bang bang method"), then after such a sequence of pulses the system will be close to its initial state.
In this project we investigate error estimates for dynamical decoupling. Using central limits we

can approximate the sequence of pulses by a (classical) Brownian motion on the compact Lie group $SU(n)$ and use this information for obtaining good error estimates.

Partner: G. Alber (FB Physik, TU Darmstadt), R. Hillier (Univ. Tor Vergata, Rome)

Contact: B. Kümmerer

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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. However, 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: Propp Wilson Algorithms for Quantum Markov Chains

In the theory of Markov chains it is one of the major tasks to determine stationary probability distributions. Important applications are, for example, statistical physics or image analysis. For

large state spaces, stationary distributions can be determined only numerically by various Monte Carlo methods. They produce random samples distributed according to the unkown stationary distribution. The disadvantage of most such methods is that the samples are only approximately distributed like the required distribution; longer running time results in better approximation. Hence, the decision on the so called 'burn-in-period' is left to the user. In 1995, J. D. Propp and D. B. Wilson published the Coupling from the Past algorithm, which drew the most attention among the exact sampling algorithms. It reaches the target distribution in finite time almost surely and then stops automatically.
For quantum Markov chains—they are used in quantum information, quantum optics, or quantum statistical mechanis—such types of algorithms have hitherto been unkown. Due to the lack of path representations for such processes, they have even been considered impossible by some authors.
Based on a quantum version of the idea of synchronising words, we succeeded in developing a Coupling from the Past algorithm for aperiodic, irreducible quantum Markov chains. It can, in particular, be applied to relevant open quantum systems from quantum optics such as the micro-maser.

Contact: B. Kümmerer, N. Sissouno

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[1] R. Gohm, B. Kümmerer, and T. Lang. Noncommutative symbolic coding. *Ergodic Theory and Dynamical Systems*, 26:1521 – 1548, 2006.

[2] N. Sissouno. *A Non-commutative Version of the Coupling from the Past Algorithm*. PhD thesis, TU Darmstadt.

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 past decade, the coupling method was 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 noncommutative 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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2.2.5 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 (Herrmann, Ihringer, 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.

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.”

Project: Classifying recursively presented Polish spaces up to Δ^1_1-isomorphism.

The primary object of study is the class of recursively presented Polish spaces, c.f. [1]. My research on the subject originated in a construction in my Ph.D. Thesis which assigns to every tree on ω a Polish space $\mathscr{X}^T$. The effective structure of $\mathscr{X}^T$ depends on the combinatorial properties of $\mathscr{X}^T$. For particular choices of T, well-known theorems of effective theory on perfect Polish spaces do fail on the space $\mathscr{X}^T$. In particular, there is a recursive tree T such that the space $\mathscr{X}^T$ is uncountable but not Δ^1_1-isomorphic with the Baire space, showing thus that the effective analogue of the well-known statement “every uncountable Polish space is Borel-isomorphic with the Baire space" is not true. On the other hand every recursively presented

Polish space is Δ^1_1 isomorphic with a space of the form $\mathscr{X}^T$ and therefore one could say that spaces $\mathscr{X}^T$ are the correct effective analogue of the Baire space. The primary focus is studying the structure of the spaces $\mathscr{X}^T$ and to classify them up to Δ^1_1-isomorphism.

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Contact: V. Gregoriades

Project: New frontiers in proof mining

During the last decade a program of 'proof mining' evolved and has successfully applied to a number of areas of core mathematics. This program is concerned with the extraction of hidden finitary and combinatorial content from proofs that make use of highly infinitary principles and has turned out to be particularly successful in the context of abstract functional analysis and ergodic theory. In this project we extend the currently existing proof mining machinery to proofs that use highly ineffective principles that have not been covered so far. This concerns, for example, proofs that make use of Banach limits and hence—for all that is known—some substantial use of the axiom of choice. In [1] we develop a method for eliminating such uses of Banach limits from strong convergence proofs in nonlinear analysis. We apply this method for the extraction of quantitative bounds from a proof of a nonlinear ergodic theorem in the context of CAT(0)-spaces due to Saejung. Another instance of this machinery is provided in [2] where we analyze the proof of a corresponding result in the context of Banach spaces with a uniformly Gâteaux differentiable norm due to Shioji and Takahashi.

Support: John Templeton Foundation.

Partner: Laurenţiu Leuştean, Romanian Academy, Bucharest

Contact: U. Kohlenbach.

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[2] U. Kohlenbach and L. Leustean. On the computational content of convergence proofs via Banach limits. Preprint, submitted, TU Darmstadt, 2011.

Project: Effective bounds on the asymptotic behavior of pseudocontractive mappings in Banach space

This project is concerned with explicit and effective rates of convergence for an asymptotic regularity result $\|Tx_n - x_n\| \to 0$ due to Chidume and Zegeye in 2004 where (x_n) is a certain perturbated Krasnoselski-Mann iteration schema for Lipschitz pseudocontractive self-mappings T of closed and convex subsets of a real Banach space. For the bounded case, our bound is polynomial in the data. Current research aims at extracting a rate of metastability for the strong convergence of (x_n) in the case of uniformly smooth Banach spaces.

Contact: D. Körnlein, U. Kohlenbach.

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Project: Term extraction and Ramsey's Theorem for pairs

This project studies with proof-theoretic methods the function(al)s provable recursive relative to Ramsey's theorem for pairs and the (strong) cohesive principle (COH). Our main result on (COH) is that the type 2 functionals provable recursive from $\mathrm{RCA}_0+\mathrm{COH}$ are primitive recursive and that there is a proof-theoretic method to extract primitive recursive bounds from proofs that use COH. As a consequence we also obtain a new proof of the fact that over RCA_0 the principle COH is Π^0_3-conservative over RCA_0 (see [3]). In [2], moreover, it is shown that COH is equivalent to a weak variant of the Bolzano-Weierstraß principle. This makes it possible to use our results to analyze not only combinatorial but also analytical proofs.
In [1] similar term extraction results are obtained for the 'chain antichain principle' which is stronger than COH and implies that every sequence of reals has a monotone subsequence.
For Ramsey's theorem for pairs and two colors (RT^2_2) we obtain ([3]) that the type 2 functionals provable recursive relative to RCA_0 are in T_1. This is the fragment of Gödel's system T containing only type 1 recursion — roughly speaking it consists of functions of Ackermann type. With this we also obtain a uniform method for the extraction of T_1-bounds from proofs that use RT^2_2.

Support: German Research Association (DFG) as part of project KO 1737/5-1.

Contact: U. Kohlenbach, A. Kreuzer

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Project: Effective metastability in nonlinear ergodic theory

In this project we extract explicit effective rates of metastability (in the sense of Tao) for the famous von Neumann mean ergodic theorem and various nonlinear generalizations of this theorem due to Baillon and Wittmann. An effective rate of metastability for the von Neumann theorem (generalized to uniformly convex spaces) has been established in [6]. In the absence of linearity, the strong convergence of the ergodic mean fails to hold in general while weak convergence is still true due to the famous Baillon nonlinear ergodic theorem. In [5], we extract a rate of metastability for the weak Cauchy property for Baillon's theorem in the Hilbert space case (based on a computational analysis of weak compactness from [2] which in turn is based on [1] and [8]). While strong convergence in general fails, there are important cases where it

is still true, e.g., for odd operators (Baillon) or even more general operators satisfying a condition due to Wittmann. In this situation, an explicit primitive recursive rate of the metastability of the strong convergence is extracted in [7]. For related results obtained in this project, see [4]. Another important nonlinear generalization of the von Neumann theorem is again due to Wittmann who proved that a so-called Halpern iteration—which in the linear case coincides with the Cesàro mean from the mean ergodic theorem—strongly converges in Hilbert space. Again we extract a primitive recursive rate of metastability from Halpern's highly ineffective convergence proof based on weak compactness (see [3]).

Support: German Science Foundation (DFG) as part of project KO 1737/5-1

Contact: U. Kohlenbach, P. Safarik

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Project: Proof interpretations: theoretical and practical aspects

We gave three theoretical contributions to proof theoretic tools called proof interpretations.

1. A proof interpretation gives information about a theorem, but changes the theorem in the process. To get information about the unchanged theorem, we hardwire truth in the proof interpretation. Jaime Gaspar and Paulo Oliva [4] presented heuristics on how to hardwire truth and applied them.

2. The ω-rule says that we can infer $\forall n\, P(n)$ from $P(0), P(1), P(2), \ldots$. Gaspar [2] used a variant of two proof interpretations, Aczel's and Kleene's slashes, to prove that Peano arithmetic with the ω-rule is a complete theory.

3. Gödel-Gentzen's, Kolmogorov's, Krivine's and Kuroda's negative translations are embeddings of the logic of the usual mathematics into the logic of constructive mathematics. They are all equivalent, suggesting that there is a unique way of embedding. Gaspar [1] showed that this is not the case by presenting non-equivalent embeddings.

We also gave two practical contributions by means of proof interpretations.

1. Terence Tao investigated the finitisation of statements in analysis: to transform infinitary qualitative statements into finitary quantitative statements. Gaspar and Kohlenbach [3] gave a counterexample to a mistaken finitisation and compared, in the context of reverse mathematics, their correction (motivated by a proof interpretation) with Tao's correction.

2. Bruce Hillam's theorem characterises the convergence of (certain) fixed point iterations. Gaspar [2] proof mined Hillam's proof and extracted (with a proof interpretation) its computational content: a "finitary rate of convergence" of the fixed point iteration.

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Partner: P. Oliva, Queen Mary, University of London, the UK.

Contact: J. Gaspar, U. Kohlenbach.

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Project: Boundedness issues in fixed-point recursion

Relational least fixed-point recursion provides an important extension beyond first-order logic. A key decision issue in connection with fixed-point recursions is the question whether they are bounded in the sense of admitting a fixed finite bound on their iteration depth. This problem is decidable for only a very limited number of natural classes of formulae and/or over only very restricted classes of structures. One long-term goal in this direction is a classification of first-order formula classes that have a decidable boundedness problem. Progress on decidability in a new direction was made in [3], where the boundedness problem was shown to be decidable for arbitrary monadic first-order recursions in restriction to acyclic relational structures. Pursuing this shift in emphasis, new methods were brought to bear in [1] to show the decidability of the boundedness problem for arbitrary recursions in monadic second-order over finite linearly ordered monadic structures (word structures). Considerable further extensions towards the class of all tree structures in [2] have brought this approach to full fruition. Through reductions

and model-theoretic interpretations, the general result in [2] not only settles the most salient classical boundedness issues for fragments of first-order logic in a uniform manner, but also shows decidability of boundedness for the guarded fragment, which had been open.

Partner: Achim Blumensath, Mark Weyer

Contact: M. Otto

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Project: Model Constructions and Model-Theoretic Games in Special Classes of Structures

This four-year project, which comes to a close in 2011, emphasises the relationship between the model theory of well-behaved classes of structures, combinatorial techniques for model constructions within these classes, and the manageability of Ehrenfeucht-Fraïssé techniques, cf. [9]. Among the key aspects of the game related model theoretic analysis are locality phenomena in the spirit of Gaifman's locality theorem.
Two main thematic tracks have emerged within this overarching project:
(A) The study of configuration graphs of pushdown systems (of first and second order, and with non-local link structure, as in nested trees or collapsible pushdown systems) through structural analysis and Ehrenfeucht–Fraïssé techniques. Alexander Kartzow's dissertation [5] and his publications [3] and [4] witness the decidability of first-order logic over interesting classes of finitely presented infinite structures, thus pushing the boundaries of first-order decidability.
(B) The investigation of qualified acyclicity in finite hypergraph constructions, based on combinatorial group-theoretic methods. The novel construction of finite Cayley groups that satisfy much stronger acyclicity conditions than a lower bound on their girth in the usual sense have been obtained in [7, 8]. These groups could be used in the constructions of finite hypergraph covers with what seems to be an optimal control of cycles in finite covers. Together with the Ehrenfeucht-Fraïssé analysis of such sufficiently acyclic and highly branching finite hypergraphs, this approach has led to the positive resolution of a long open characterisation of the expressive power of the guarded fragment of first-order logic in finite model theory. A different approach to hypergraph covers with qualified acyclicity properties in joint work with Georg Gottlob (Oxford) and Vince Barany (then Oxford, now Darmstadt) in [1, 2], partly inspired by first attempts in [6], generated a number of optimal decidability and complexity results concerning the guarded fragment and its interaction with conjunctive queries. These results are of interest both theoretically and for applications in database theory. Ramifications of the two entirely different techniques employed in these approaches and links with further potential applications

(e.g., in the model theory of modal logics) are core elements in a new project proposal currently under review.

Support: DFG

Contact: M. Otto

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Project: Classical Realizability

In the last decade J.-L. Krivine introduced his realizability interpretation for various classical systems inclusing Zermelo Fraenkel set theory [1]. It is based on an extended λ-calculus together with a relation between terms and stacks. Propositions are interpreted as biorthogonally closed sets of stacks. Since around 1980, the theory of *triposes* provides a uniform framework for more traditional realizability interpretations of logical systems based on intuitionistic logic, see [2] for a detailed account. We want to investigate to which extent Krivine's classical realizability can be subsumed under the notion of a tripos. This would allow one to replace a lot of *ad hoc* verifications by general results of tripos theory. Moreover, iteration results of A. Pitts might then be used for understanding forcing constructions on top of classical realizability models as needed for realizing stonger and stronger instances of the Axiom of Choice.

Contact: T. Streicher

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Project: Homotopy Type Theory

In [1] we have observed that in intensional Martin-Löf type theory its identity types endow every type with the structure of a weak higher dimensional groupoid. In *loc.cit.* we speculated that this would allow one given an interpretation of equality as isomorphism. Around 2006, V. Voevodsky and T. Streicher independently observed that Kan complexes within the topos of simplicial sets give rise to a model of intensional Martin-Löf type theory. This realizes the above idea, since Kan complexes provide a canonical conceptualization of weak higher dimensional groupoids. Voevodsky could show around 2009 that this model validates his *Univalence Axiom* which essentially claims that $\mathrm{Id}_{\mathrm{Set}}(A,B)$ is weakly equivalent to the type of isomorphism from A to B. It has been shown that the Univalence Axiom entails an Extensionality principle for functions. Moreover, the project of developing homotopy theory in a "synthetic" way inside type theory augmented by the Univalence Axiom has started. One interesting aspect of this endeavour is that proofs can be and actually are formalized within the `Coq` system, a widely used interactive theorem prover for type theory developed at INRIA.

Contact: T. Streicher

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Project: Computability and Computational Complexity in Physical Theories

We investigate for various classes of physical systems the question of whether they can be simulated at all or even efficiently on a digital computer. Our emphasis here lies on (relative) lower bounds.

More precisely, let Φ denote a physical theory in the sense of [3]. If Φ is 'rich' enough for a Turing machine to be 'built' within it, then simulating Φ in the long run would entail a solution to the Halting problem—which is algorithmically impossible.

Similar examples of undecidable physical theories have been devised in the literature [4, 1]; and we wish to delineate the boundary between computability and incomputability in physics in order to gain more understanding on the disputed Church-Turing Hypothesis.

Once computability is asserted, similar questions arise for the computational complexity.

Partner: Prof. Karl Svozil, TU Wien

Support: DFG

Contact: Martin Ziegler

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2.2.6 Numerics and Scientific Computing

The particular strength of the Numerical Analysis and Scientific Computing group is in the development of novel, efficient, and accurate numerical methods that are capable of tackling complex problems of practical interest. Our broad long-term goal is to provide good software for the solution of differential equations and optimization problems, one of the main modelling tools in science and engineering. We are currently engaged in the following specific application areas: computational medicine and meteorology, modelling of aircraft turbines, and optimal control of gas and water networks.

Project: Adaptive Multilevel Methods for PDAE-Constrained Optimal Control Problems With Application to Radiative Heat Transfer

One important step in glass manufacturing is the cooling of molten and already formed glass down to room temperature. To control this process regarding to a good performance of the involved chemical processes and a minimization of internal stresses, the hot glass is put into a preheated furnace. While the temperature inside the oven is carefully decreased towards room temperature, the glass cools down as well. To compute a furnace temperature profile that achieves a preferable cooling at moderate cost, we formulate an optimal boundary control problem which is restricted by an adequate mathematical model of the cooling process and by constraints on the control caused by the operation interval of the furnace. To reduce the complexity of the optimization problem, where the model of the underlying application has to be solved several times, we consider an N-band-SP$_n$ approximation of the full space-, time-, direction- and frequency-dependent radiative heat transfer model for semi-transparent glass. Resulting in a system of space-time-dependent partial differential algebraic equations (PDAEs) in $N+1$ unknowns, with a high nonlinear coupling between temperature distribution and radiative field, this approximation is still not trivial. To solve this and other challenging real-world problems of similar type in two and even in three space dimensions, in this project we develop an all-in-one optimization environment that couples highly efficient optimization techniques (e.g. an adaptive multilevel generalized SQP method from S. Ulbrich and C. Ziems) with the state-of-the-art space-time adaptive PDAE solver KARDOS. The environment is built on the continuous adjoint approach, considering second order derivative information as actings of the reduced Hessian determined by linearized state and a second adjoint system. The involved PDAEs are numerically solved by variable step-size one-step methods of Rosenbrock type in time

and adaptive multilevel finite elements in space. By controlling the inexactness of the reduced gradient with a suitable multilevel strategy, the environment allows for independent time integration schemes and independent spatial meshes. Local and global errors are estimated by applying embedded time formulas and hierarchical basis. Whereas global error estimates are used to determine an adequate accuracy level tailored to the optimization progress, the local estimates are used to adapt space and time grids such that this accuracy can be achieved.

Support: German Research Association (DFG), priority program 1253

Contact: D. Clever, J. Lang

Partner: S. Ulbrich, C. Ziems

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Project: Adaptive Two-Step Peer Methods for Incompressible Navier-Stokes Equations

Accuracy and efficiency of high order two-step methods of Peer-type up to order five are to be analysed in CFD computations using pressure correction methods. Beside good stability properties, Peer-methods have shown no order reduction even in the application to PDEs, which makes them a promising tool for CFD requiring a high resolution.
We support a common flow solver with high order Peer-methods, test their performance in a LES context compared to second-order methods and analyse the influence of different pressure treatments. The influence of variable time steps will also be taken into account. This will help rating the potential of linearly implicit methods as time discretizations in LES to solve practically relevant fluid flow problems.

Partner: A. Gerisch, H. Podhaisky, R. Weiner (Martin-Luther-Universität Halle-Wittenberg), Rolls-Royce Deutschland

Support: German Research Association (DFG) doctorate program GRK1344 “Instationäre Systemmodellierung von Flugtriebwerken”, Graduate School of Computational Engineering (CE).

Contact: M. Frankenbach, B. Peth, J. Lang.

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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: Prof. Dr. K. Raum (Charité Universitätsmedizin Berlin), Prof. Dr. Q. Grimal (Université Paris VI, France)

Support: DFG grants GE1894/4 and Ra1380/7

Contact: S. Tiburtius, A. Gerisch

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Project: Mathematical modelling and simulation of cancer invasion

The process of tissue invasion by cancer cells is crucial for metastasis (secondary spread). During the invasion process, adhesion, both cell-cell and cell-matrix mediated, plays an extremely important role. In this project, we develop PDE models of different aspects of cancer cell invasion of the extracellular matrix. In particular, we focus on models (i) which account for the intricate network of proteolytic enzyme systems, (ii) which incorporate the effects of cell-cell and cell-matrix adhesion through non-local (integral) terms, (iii) which combine both features.

The computational focus is on the development of reliable and efficient simulation tools for the model equations. Here we follow the method of lines with finite volumes in space. Of particular interest is the approximation and evaluation of the non-local terms representing adhesive effects. They represent the computational bottleneck and FFT techniques are utilized in order to considerably reduce the computational cost due to these terms.

Partner: Prof. Dr. M. Chaplain (University of Dundee, Scotland)

Contact: A. Gerisch

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Project: Peer methods and their application in the Finite Element system Kardos

Linearly-implicit two-step peer methods are successfully applied in the numerical solution of ordinary differential and differential-algebraic equations. One of their strengths is that even high-order methods do not show order reduction in computations for stiff problems. With this property, peer methods commend themselves as time-stepping schemes in finite element calculations for time-dependent partial differential equations (PDEs).

We include a class of linearly-implicit two-step peer methods in the finite element software Kardos. There PDEs are solved following the Rothe method, i.e. first discretised in time, leading to linear elliptic problems in each stage of the peer method. We investigate the construction of the methods and how they fit into the finite element framework. We also discuss the starting procedure of the two-step scheme and questions of local temporal error control.

The implementation is tested for two-step peer methods of orders three to five on a selection of PDE test problems on fixed spatial grids. No order reduction is observed and the two-step methods are more efficient, at least competitive, in comparison with the linearly implicit one-step methods provided in Kardos.

Partner: Prof. Dr. R. Weiner and Dr. H. Podhaisky (Martin-Luther-Universität Halle-Wittenberg)

Contact: A. Gerisch, J. Lang

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[1] A. Gerisch, J. Lang, H. Podhaisky, and R. Weiner. High-order linearly implicit two-step peer–finite element methods for time-dependent PDEs. *Appl. Numer. Math.*, 59:624–638, 2009.

Project: Modelling and simulation of cartilage production in a perfused bioreactor

Recent generations of bioreactors for cartilage production allow for multiparametric monitoring of the production process. It is a challenge to proceed from online-monitoring of the production to steering the production on the basis of some control parameter. The project aims at optimising the oxygen supply for cartilage transplants generated in a novel type of bioreactor equipped with a non-invasive online-monitoring system, which is based on acoustic microscopy.

For this purpose we develop a 3D mathematical model of a typical transplant in the bioreactor which enables us i) to calculate the oxygen distribution within the system in dependence of the cell density, the perfusion velocity and the oxygen concentration within the supplied medium and ii) to analyse the changes of this distribution during cultivation time. The model utilizes data generated by the monitoring system of the bioreactor. Information about the transplant density and elasticity and on local oxygen concentrations is used to extract parameters which i) define initial conditions for the model simulations and which ii) enable a comparison of the model simulation with actual transplant behaviour. Simulation results are summarized in protocols for the control of oxygen supply in terms of the perfusion velocity and the oxygen concentration of the medium. In this way the project provides a method that allows online steering of the bioreactor by use of the non-invasive monitoring system. This will support the suitability of the bioreactor with acoustic measuring sections for cartilage production.

Partner: Dr. J. Galle (Interdisziplinäres Zentrum für Bioinformatik Leipzig)

Support: Grant I2375, TRM Leipzig

Contact: A. Gerisch

Project: Discrete-Continuous Optimization of Gas and Water Supply Networks

Today's demands in the management of gas and water supply networks require the close collaboration between industry and scientists from engineering and applied mathematics. The aim of this project is to tackle recent problems in gas and water management with state-of-the-art numerical methods and to develop new adapted algorithms.
The given tasks include the solution of hyperbolic partial differential algebraic equations on networks as well as discrete-continuous optimal control problems. The numerical methods for the solution of the underlying partial differential algebraic equations and continuous optimization problems are implemented in our software package ANACONDA. Discrete decisions can be (partially) given a-priori or determined via a penalization approach.

Partner: Prof. Dr. Kathrin Klamroth (Bergische Universität Wuppertal), Prof. Dr. Günter Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. Alexander Martin (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. Martin Oberlack (TU Darmstadt), Prof. Dr. Manfred Ostrowski (TU Darmstadt), Hessenwasser GmbH & Co. KG, Siemens AG

Support: Federal Ministry of Education and Research (BMBF)

Contact: O. Kolb, J. Lang

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Project: Higher-order multirate methods for transient multi-physics problems Many physical phenomena can be described by a set of coupled ordinary differential equations (ODEs) in time. A normal singlerate time integrator solves all ODEs with the same time step sizes, which are determined by taking all the components into account. This might produce very small time steps that also have to be applied to components with much less activity. The idea of multirate methods is to use different time step sizes for different components, depending on the individual activity of the solution, which means there will be a differentiation between active and latent components. The coupling can be managed by interpolation/extrapolation.

Multirate methods using Rosenbrock methods are well known in literature, but have the problem that due to the order reduction phenomenon of one step methods in the case of stiff problems, higher-order methods are difficult to obtain. To gain higher-order multirate methods the idea of this project is the development of multirate methods using two-step Peer-methods. Since for Peer-methods no order reduction was observed in the singlerate case, a similar behaviour in the multirate case is expected.
Also stability investigations of multirate Rosenbrock- and multirate Peer-methods are part of this project.

Support: Graduate School of Computational Engineering, TU Darmstadt (DFG)

Contact: Karen Kuhn, Jens Lang

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Project: Space-time adaptive magnetic field computation

The discretization of transient magnetic field problems using a finite element method results in nonlinear differential-algebraic systems of equations of index one. The efficient transient computation of magnetic fields in induced eddy current layers as well as in regions of ferromagnetic saturation that may appear or vanish depending on the external current excitation may require adapting the mesh at each time step. Hence we are interested in developing a three-dimensional numerical code which provides higher order solutions to magneto-quasistatic problems, adaptively both in time and in space. For this purpose we extend the already existing KARDOS library, that employs adaptive classical finite elements in space, to use the so-called $H(curl)$-conforming Whitney elements which are more suitable for solving electromagnetic problems. For the time discretization we use adaptive linearly implicit one-step Rosenbrock methods up to 4th order accuracy in time. To control the adaptive mesh refinement we develop a hierarchical error estimator.

Partner: M. Clemens, G. Wimmer (Helmut Schmidt University of the Federal Armed Forces Hamburg).

Support: German Research Association (DFG)

Contact: D. Teleaga, J. Lang

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Project: KARDOS - Software Package for Solving Nonlinear Evolution Problems

The code KARDOS was originally developed at ZIB Berlin to solve systems of non-linear mixed parabolic-elliptic partial differential equations by means of adaptive space and time discretizations. Linearly implicit one-step methods of Rosenbrock type are coupled with standard Finite Elements of various orders. KARDOS uses unstructured grids in one, two, and three space dimensions.
A large portion of the current work is carried out in close collaboration with ZIB Berlin. Extensions that we are working on include: incorporation of computational fluid dynamics (CFD), electromagnetics, optimisation and moving finite elements.
Although this software is mainly used for scientific and educational purposes, we are interested in cooperations with external organisations (industry, goverment research laboratories, etc) or other university departments (particularly engineering departments).

Partner: P. Deuflhard, B. Erdmann, R. Roitzsch (ZIB)

Contact: J. Lang.

Project: Anisotropic Mesh Adaptation Based upon A Posteriori Error Estimates

Error estimates are frequently used for mesh adaptation, especially for refinement strategies as well as in connection with the moving finite element method, but so far they have been used mostly for isotropic mesh adaptation. The objective of this project is to study the use of *a posteriori* error estimates in anisotropic mesh adaptation and compare it with commonly used Hessian-recovery-based adaptation methods. A key idea in the new approach is the use of the global hierarchical error estimator for reliable directional information of the solution.

Partner: W. Huang and L. Kamenski (University of Kansas)

Support: DFG (SFB568/3, SPP1276 MetStroem), NSF (DMS-0410545, DMS-0712935)

Contact: J. Lang

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Project: Large-Eddy Simulation with Adaptive Grids for Meteorological Applications

The aim of this project is to design mathematical and numerical methods of dynamical grid adaption for Large Eddy Simulations (LES). Therefore, we apply LES combined with the moving mesh PDE (MMPDE) approach to problems with meteorological background, like the turbulent flow over periodic hills.
The moving mesh method continuously redistributes a fixed number of grid points due to a grid refinement criterion. The main advantage of the moving mesh method is that during the integration process the mesh topology is preserved and no new degrees of freedom are added and therefore the data structures are preserved as well. The criterion due to which the grid points are moved forms the heart of the moving mesh method. It can be mathematically motivated, like the solution gradient or an error estimator, as well as physically motivated, e.g., the turbulent kinetic energy or the Reynolds stresses. In this project we are mainly concerned with developing such refinement criteria particularly for LES of turbulent flows. Various physically motivated quantities of interest have been successfully employed as well as different methods

of combining multiple criteria. The utilisation of adjoint sensitivities as criterion for the mesh adaptation is being investigated.

Partner: J. Fröhlich, C. Hertel (TU Dresden).

Support: German Research Association (DFG), priority programme (SPP) 1276 MetStröm.

Contact: S. Löbig, J. Lang.

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[2] S. Löbig, A. Dörnbrack, J. Fröhlich, C. Hertel, C. Kühnlein, and J. Lang. Towards large eddy simulation on moving grids. *PAMM*, 9:445 – 446, 2009. doi: 10.1002/pamm.200910195.

Project: Global Error Estimation for Finite Element Methods for Parabolic Differential Equations

Modern solvers for partial differential equations of parabolic type gain in efficiency by adaptivly optimizing their grids based on local error control. However, the accuracy imposed by the user applies to the global error of the approximation. In this project we focus on efficient and reliable estimation and control of the global errors in finite element methods.
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 appearing subproblems in the method of lines our strategies are based on the concepts of B-stability and B-convergence.

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

Contact: A. Rath, J. Lang

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Project: Unsteady Adaptive Stochastic Collocation Methods on Sparse Grids

Numerical simulations become more reliable if random effects are taken into account. To this end, the describing parameters can be expressed by correlated random fields, which leads to partial differential equations (PDEs) with random parameters. Common numerical methods to solve such problems are spectral methods of Galerkin type and stochastic collocation on sparse grids. We focus on stochastic collocation, because it decouples the random PDE into a set of deterministic equations that can be solved in parallel. By mean of interpolation, the procedure provides a functional dependency between random input parameters and response of the system.
The aim of this work is to derive error estimates for adaptive strategies in order to gain efficiency for the more and more complex problems arising in Computational Engineering. We want to combine stochastic collocation with an adjoint approach in order to estimate and control the error of some stochastic quantity, such as the mean or variance of a solution functional.

Contact: B. Schieche, J. Lang.

Support: German Research Foundation (DFG): Graduate School of Computational Engineering, TU Darmstadt.

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Project: Galerkin reduced modeling of the flow around a cylinder

Reduced-order models promise speed-up of orders of magnitude for applications where flow problems have to be solved multiple times for different parameters. In this project Galerkin models based on the proper orthogonal decomposition (POD) and the centroidal Voronoi tessellation (CVT) are explored as means of order reduction for the flow past a circular cylinder.
The differences of the POD and CVT methods are studied for a two-dimensional realization of the test case at a low Reynolds number, for which the solution becomes periodic. The accuracy of the reduced models with respect to the original finite element simulation are studied as well as the long-term behavior of the reduced solutions.
The number of degrees of freedom necessary to compute flow fields accurately increases quickly with a rising Reynolds number, which makes direct numerical simulations of relevant turbulent flows very expensive in terms of computational cost. The large-eddy simulation (LES) tackles this problem by resolving only the larger scales of the flow and modeling the effect of the subgrid scales, e.g. by introducing an artificial eddy viscosity. It is investigated how POD reduced models based on LES snapshots can be improved using LES techniques.

Support: Collaborative Research Centre (SFB) 568 “Flow and Combustion in Future Gas Turbine Combustion Chambers”. Speaker: Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by the German Research Foundation (DFG), 2008-2011

Contact: S. Ullmann, J. Lang

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2.2.7 Optimization

The research group **Optimization** consists of the groups **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.

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 study and solution of 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: facility location problems, network design problems, production planning and supply chain management, optimal charging of automatic teller machines, public mass transportation, energy optimization, or optimization in mechanical engineering, see 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., and 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) 568 *Flow and Combustion in Future Gas Turbine Combustion Chambers*, 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 LOEWE-Center *AdRIA: Adaptronik: Research, Innovation, Application*, the International Research Training Group IGK 1529 *Mathematical Fluid Dynamics*, and the German Research Foundation (DFG) Priority Programme SPP 1253 *Optimization with Partial Differential Equations*. In addition, the group has various industry partners, including cooperations with Deutsche Bahn, EON Gastransport, Lufthansa, Schenck, and Siemens.

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 using a body force which is induced by a plasma actuator. Experiments in [Grundmann08] and numerical investigations in [Quadros09] show that plasma actuators can successfully be used to cancel Tollmien-Schlichting waves. The quality of the cancellation depends on the body force. Therefore, an algorithm is needed to adjust the plasma actuator parameters optimally, so that the incoming artificially introduced Tollmien-Schlichting

waves are cancelled.
We use a Model Predictive Control (MPC) approach for the cancellation of Tollmien-Schlichting waves in the boundary layer of a flat plate. The idea of Model Predictive Control (MPC) is to replace the open-loop optimal control problem on the full time horizon by a sequence of optimal control problems on short control horizons that move forward in time.
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 description is used to perform the optimization. Thus, the computational cost can be reduced significantly. The reduced-order model is obtained with a Galerkin projection and an appropriate basis. We use Proper Orthogonal Decompositon (POD) in which the basis functions are generated from numerical solutions or from experimental measurements.

Partner: Institute of Fluid Mechanics and Aerodynamics (SLA), Institute of Numerical Methods in Mechanical Engineering (FNB)

Contact: Jane Ghiglieri, Stefan Ulbrich

Support: Graduate School of Computational Engineering

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[2] S. Grundmann and C. Tropea. Active cancellation of artificially introduced Tollmien-Schlichting waves using plasma actuators. *Exp. Fluids, 44: 795-806*, 2008.

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 optimization of sheet metal products.
The project is divided in two parts.
The subject of the first part is to find the optimal design for profiles consisting of several chambers. To this end, an integrated approach combining topology and geometry optimization is developed. The underlying idea is to use a branch and bound algorithm where in each of its nodes a nonlinear optimization problem has to be solved.
The second part is concerned with the geometry optimization of branched and hydroformed sheet metal products using PDE constrained optimization techniques. For describing the product behaviour the three dimensional elasticity equations 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.

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: German Research Foundation (DFG).

Contact: Thea Göllner, Ute Günther, Wolfgang Hess, Alexander Martin, Stefan Ulbrich.

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[2] U. Günther. *Integral Sheet Metal Design by Discrete Optimization*. PhD thesis, 2010.

[3] W. Hess. *Geometry Optimization with PDE Constraints and Applications to the Design of Branched Sheet Metal Products*. PhD thesis, 2010.

Project: Optimal combination of active and passive components via mixed integer semidefinite programming (project A4 of Collaborative Research Centre (SFB) 805)

This project is part of the Collaborative Research Centre (SFB) 805: Control of uncertainty of load carrying systems 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 (e.g., piezo-elements) 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 several types of uncertainty, e.g. uncertainty in loadings, material, production processes or malfunction of complete bars. 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. For example, ellipsoidal and polyhedral sets will be used to integrate uncertainty in different loading scenarios. All of this includes interdisciplinary communication to mechanical engineers to achieve realistic models.

Partner: Collaborative Research Centre (SFB) 805: ?Control of uncertainty of load carrying systems in mechanical engineering?. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt), Support: German Research Foundation (DFG)

Contact: Stefan Ulbrich, Sonja Friedrich, Kai Habermehl

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[2] M. Wiebel, R. Engelhardt, and K. Habermehl. Uncertainty in process chains and the calculation of their propagation via monte-carlo simulation. July 22, 2010.

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 2.9.6 can be downloaded freely from `wwwopt.mathematik.tu-darmstadt.de/polymake`.

Partner: Ewgenij Gawrilow (Tom Tom)

Contact: M. Joswig

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[2] M. Joswig, B. Müller, and A. Paffenholz. Polymake and lattice polytopes. In C. Krattenthaler, V. Strehl, and M. Kauers, editors, *DMTCS Proceedings of the FPSAC 2009*, pages 491–502, 2009.

Project: Non-positive curvature and cubical surfaces

The main goal of this project is to exhibit and to analyze high genus surfaces that appear embedded (or immersed) in higher-dimensional cubical manifolds. For this we build on techniques from discrete differential geometry such has combinatorial holonomy and discrete curvature.

Partner: Günter M. Ziegler (TU Berlin), Silke Möser

Support: DFG, Forschergruppe FOR565: Polyhedral Surfaces.

Contact: M. Joswig

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[1] M. Joswig. Projectivities in simplicial complexes and colorings of simple polytopes. *Math. Z.*, 240(2):243–259, 2002.

[2] M. Joswig. Tropical convex hull computations. In *Tropical and idempotent mathematics*, volume 495 of *Contemp. Math.*, pages 193–212. Amer. Math. Soc., Providence, RI, 2009.

Project: Decompositions of Lattice Polytopes

Lattice polytopes are the convex hull of a finite subset of points in a lattice in $\mathbb{R}^d$. They 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 (Aardal et. al 2002), statistics (Sullivant 2007), and algorithmic biology (Sturmfels and Sullivant 2005).

In this project we want to systematically study decompositions of lattice polytopes from a combinatorial viewpoint. In particular, we consider (1) existence and structure of unimodular triangulations of lattice polytopes and their implications on the associated toric ideals, (2) k-splits and their connection to tropical geometry, and (3) combinatorial and geometric interpretations of h^*-polynomials.
For classifications and computational experiments polyhedral decomposition methods will be implemented in `polymake`. Computations in the associated ideals and varieties are done in cooperation with the `Singular` team.

Partner: K. Altmann (FU Berlin), W. Decker (TU Kaiserlautern), C. Haase (Universität Frankfurt), S. Herrmann (University of East Anglia)

Support: German Research Association (DFG).

Contact: M. Joswig, A. Paffenholz

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Project: Symmetries in Linear and Integer Linear Programming

It is a known fact that many standard (integer) linear programming formulations of relevant problems in optimization exhibit a lot of symmetry. In this situation, a standard branch-and-cut framework repeatedly enumerates symmetric solutions, and sometimes this renders such methods useless. To address these issues, the last decade saw a number of approaches to devise algorithms specialized to symmetric optimization problems, see, e.g., Ostrowski et al. [2].
We tackle the problem from a geometric and group theoretic view point. Basic properties of linear representations of finite groups can be used to reduce symmetric linear programming to solving linear programs of lower dimension. Combining this approach with knowledge of the geometry of feasible integer solutions yields an algorithm for solving highly symmetric integer linear programs which only takes time which is linear in the number of constraints and quadratic in the dimension.

Support: Studienstiftung des deutschen Volkes

Contact: M. Joswig, K. Herr

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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 parabolic partial differential equations an adjoint based Trust-Region SQP method has shown good results, we want 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, will be in the weak form of the FSI problem considered in an Arbitrary-Lagrangian-Eulerian (ALE) framework.
Instead of transforming each integral on the time dependent spatial domain $\Omega(t)$ to a certain reference domain we make use of the discretization in time. On each temporal sub interval $[t_i, t_{i+1}]$ we transform each integral on the time dependent spatial domain $\Omega(t)$ to the domain we have on the lower bound of the sub interval, that is to $\Omega(t_i)$. Hence, in each time step we have a different domain to compute on. Despite this fact, the transformed integrals are simpler in the sense that the fluid part of the Fluid-Structure Interaction problem is very similar to a standard Navier-Stokes equation. Since the solution method we employ for the coupled Fluid-Structure Interaction system in each time step will be based on a block-SOR method, we have to solve fluid and solid part with changing boundary conditions separately. Here, the similarity to the Navier-Stokes equation simplifies solving the fluid part considerably.

Partner: Graduate School GSC 233: “Computational Engineering”.

Support: Graduate School GSC 233: “Computational Engineering”.

Contact: S. Kessler, S. Ulbrich, M. Schäfer

Project: Simulation-based optimization methods for the hydro-forming 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 hydro-forming 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. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).

Support: German Research Foundation (DFG).

Contact: D. Koller, S. Ulbrich.

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Project: SFB 805, project B1, Optimization of process chains under uncertainty

The aim of this project is to determine optimal process chains, as well as mastering uncertainties which occur in process chains and process networks. Uncertainties occur, for example, when non-deterministic variations of geometry or material influence the strength of a stick in a stick system. Uncertainties also occur in form of imprecise sales-forecasts. These imprecisions have direct consequences on production techniques.

In the context of this subproject, optimal process chains for the production of devices are to be determined. We can examine various objectives for this purpose, e.g., the minimization of production costs subject to compliance with certain tolerances of quality. Another objective may be to maximize the profits under consideration of variations in the market.

In the SFB 805, we find on various levels process chains flawed with uncertainties. The first task is to develop mathematical models that embrace the problems of practice. In this project, we assume that we can model the inherent uncertainties of process chains with the help of distributions over future random scenarios. A discretization of a distribution leads us to a model described by high dimensional mixed-integer linear programs. These programs have block-structured constraint-matrices, where blocks represent possible scenarios which are coupled via some decision variables. The number of scenarios can be reduced with the help of suited reduction methods so that the resulting mixed-integer program turns out to be manageable in many cases.

Additionally, approximation algorithms and heuristic procedures, which can work without constructing the enormously large stochastic programs, are to be examined. A more efficient description of the multi-stage stochastic problems can be exploited in these cases. The resulting slim problems are often PSPACE-hard, and have strong similarities to non-stochastic 2-person games. The aim, however, is to avoid an exponential blow up in the size of the input description as it occurs, when stochastic programs are transformed to their deterministic equivalents.

Partner: SFB 805

Contact: Dr. Ulf Lorenz, Thorsten Ederer

Project: GOmputer: the Go machine

The ability to compete with humans in playing games, most prominently chess, has been a long-standing touchstone for machine intelligence. In 1997, IBM’s chess machine Deep Blue defeated

Garry Kasparov, the highest-rated chess player ever [1]. Since then, several chess machines have been developed that are able to compete with human top players; the world's strongest one presumably being our own development Hydra [2, 3]. In contrast, computer programs for the Asian board game GO are still rather weak, which is often attributed to GO's orders of magnitude greater complexity - in terms of possible board positions and moves. While cracking GO remains an open challenge [4], in the last years GO programs also began to serve as test beds for the evaluation of developments in areas such as game tree search, pattern recognition, and machine learning.

The GOmputer project aims at the investigation of novel algorithmic approaches for playing GO and the development of a parallelized and hardware-accelerated GO machine prototype. From our previous work and experience, especially the world's strongest chess machine Hydra, we know that the interplay of research and development efforts between game algorithms and modern parallel computing architectures is a necessity to achieve a competitive GO machine. On the longer term, this project should lay the foundation for the development of the world's strongest GO machine.

The proposed PhD project is co-supervised by Ulf Lorenz, TU Darmstadt, and Marco Platzner, Universität Paderborn.

Partner: Prof. Dr. Marco Platzner, Lars Schaefers

Support: Microsoft, Universität Paderborn

Contact: Ulf Lorenz

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

The aim of this project is the analytical study and numerical approximation of optimal control problems for networks of nonlinear hyperbolic conservation laws under modal switching. Such switching is considered at the boundary nodes and junctions of the network as well as in the source terms and fluxes, leading to a hybrid system of PDEs. Networks of this type arise for example in traffic flow models as well as in water and gas network models. Since entropy solutions of conservation laws may develop shocks, the analysis and numerical solution of control problems for conservation laws is difficult. Nevertheless, encouraging progress has been achieved recently for the optimal control of conservation laws. Switching may lead to additional discontinuities in the solution, which is quite natural in the context of entropy solutions. On one hand

a careful analysis of these optimal control problems shall be conducted, in particular existence of optimal controls, differentiability properties of the objective function with respect to controls (switching times, boundary controls, etc.), corresponding sensitivity and adjoint equations, optimality conditions. On the other hand the appropriate numerical discretization of optimal control problems for switched networks of conservation laws shall be considered. The project will start with networks of scalar conservation laws and then proceed to 2×2-systems in one space dimension. The project is part of the DFG-Priority Program SPP 1253 "Optimization with Partial Differential Equations".

Partner: G. Leugering (Universität Erlangen-Nürnberg)

Support: German Research Association (DFG)

Contact: S. Pfaff, S. Ulbrich

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Project: Efficient Numerical Multilevel-Methods for the Optimization of Gas Turbine Combustion Chambers

In the past few years, there has been a lot of development regarding the optimization of flows. This field of research is among the most challenging tasks from a numerical and also theoretical point of view. With todays computational power and algorithmic developments, the optimization of the flow and combustion in a gas turbine chamber is within reach. In this project, we tackle the task of efficient optimization with a sophisticated numerical code for flow solving, while combining them with state of the art optimization techniques.
The basis for the numerical calculations is the parallel multi-grid flow solver FASTEST-3D, which has been developed in the past few years and has various flow and combustions models incorporated.
Via automatic differentiation, we obtain a linear system for the adjoint equations, with which the gradients for the optimization routines are obtained. This has already been done for various kinds of optimization problems including LES and RANS of unsteady three dimensional flows, heat transfer and shape optimization.
For the optimization, a multilevel optimization environment has been implemented. Here, one makes use of a hierarchical order of models describing a problem. Examples for these models are discretization levels or models with increasing physical fidelity.

Support: Collaborative Research Centre (SFB) 568 of the German Research Association (DFG)

Contact: R. Roth, S. Ulbrich

Project: Optimal design and control of adaptronic systems

This project is part of the LOEWE-Center AdRIA, which a collaborative reserach initiative of the Fraunhofer Institute for Structural Durability and System Reliability LBF, the TU Darmstadt and

the Fachhochschule Darmstadt to create a leading international research center for adaptronic systems.
As part of the project "quiet office" we develop cost-effective system solutions to optimize the sound insulation in office buildings to the prototypical market for flat building elements (windows, facades, partition walls), building services (plumbing, heating and air conditioning), and office equipment (projector, printer, copier). The demonstrator "acoustic aquarium" provides an appropriate platform to interpret, implement and evaluate the approaches, methods and solutions for vibration reduction.
An FE model of the acoustic demonstrator was developed and approximated by model order reduction. Based on this model, a method for optimal placement of sensors and actuators is developed. Afterwards we deal with the optimization of controller parameters and the development of linear and nonlinear model predictive control (MPC) algorithms. With the MPC approach, we plan to reduce the noise and vibration by an online optimization method at the acustic demonstrator. The developed methods will be tested and compared with existing methods.

Partner: LOEWE-Zentrum AdRIA: Sven Herold

Contact: Stefan Ulbrich, Carsten Schäfer

References

[1] F. Kartzow, L. Schewe, and O. Janda. Simultaneous optimization of damper parameters on a truss. *DAGA*, 2010.

[2] M. Kurch, H. Atzrodt, F. Kartzow, L. Schewe, and O. Janda. On model order reduction for parameter optimisation of vibration absorbers. *RASD*, 2010.

Project: Mathematical Programming in Robust Design (project 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. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt)

Support: German Research Foundation (DFG)

Contact: S. Ulbrich, A. Sichau

References

[1] R. Engelhardt, J. Koenen, G. Enss, A. Sichau, R. Platz, H. Kloberdanz, H. Birkhofer, and H. Hanselka. A Model to Categorise Uncertainty in Load-Carrying Systems. In *Proceedings of the 1st International Conference on Modelling and Management of Engineering Processes, MMEP 2010, Cambridge, UK*, 2010.

Project: SPP 1253 – Adaptive Multilevel SQP-Methods for PDAE-Constrained Optimization with Restrictions on Control and State

This is a joint project of Prof. Dr. Jens Lang and Debora Clever from the numerics group and Prof. Dr. Stefan Ulbrich and Dr. J. Carsten Ziems from the optimization group.
The aim of this project is to develop, analyze and apply highly efficient optimization methods for optimal control problems with control- and state-constraints governed by time-dependent PDAEs. To this end, we want to combine in a modular way modern space-time adaptive multilevel finite element methods with linearly implicit time integrators of higher order for time-dependent PDAEs and modern multilevel optimization techniques. The aim is to reduce the computational costs for the optimization process to the costs of only a few state solves. This can only be achieved by controlling the accuracy of the PDAE state solver and adjoint solver adaptively in such a way that most of the optimization iterations are performed on comparably cheap discretizations of the PDAE. We will focus on two exemplary applications.

Partner: D. Clever, J. Lang (TU Darmstadt).

Support: German Research Foundation (DFG).

Contact: S. Ulbrich, J. C. Ziems.

References

[1] D. Clever, J. Lang, S. Ulbrich, and J. C. Ziems. Combination of an adaptive multilevel SQP method and a space-time adaptive PDAE solver for optimal control problems. *Procedia Computer Science*, 1:1429–1437, 2010.

[2] D. Clever, J. Lang, S. Ulbrich, and J. C. Ziems. Generalized multilevel SQP-methods for PDAE-constrained optimization based on space-time adaptive PDAE solvers. In G. Leugering, S. Engell, A. Griewank, M. Hinze, R. Rannacher, V. Schulz, M. Ulbrich, and S. Ulbrich, editors, *Constrained Optimization and Optimal Control for Partial Differential Equations*, pages 37–60. International Series of Numerical Mathematics, accepted 2010, Vol. 160, Basel, 2012.

[3] J. C. Ziems. *Adaptive Multilevel SQP-Methods for PDE-constrained Optimization*. Verlag Dr. Hut, 2010.

[4] J. C. Ziems and S. Ulbrich. Adaptive multilevel inexact SQP-methods for PDE-constrained optimization. *SIAM J. Optim., accepted 2010*, 21:1–40, 2011.

2.2.8 Stochastics

Research in the stochastics group is focused on mathematical statistics (i.e., on the mathematical analysis of randomly disturbed data) and stochastic processes (i.e., on mathematical models for random phenomena that evolve in time and space). We are interested in the theoretical analysis of methods of mathematical statistics, the mathematical analysis and the efficient simulation of stochastic processes, as well as in applications in various fields of science, engineering, and in the insurance and finance industries.
Specifically, we work on curve estimation, stochastic evolution equations and stochastic (partial) differential equations with contributions to stochastic analysis and filtering theory as well as to numerical analysis. Furthermore, we study Monte Carlo methods for financial engineering and stochastic optimization algorithms.
The members of the research group stochastics are involved in joint projects and organization of international workshops and conferences with colleagues working in probability and statistics, as well as from neighboring disciplines like econometrics, psychology, signal processing, partial differential equations and numerical analysis. Furthermore, we are carrying out a number of research projects in applied stochastics with well-known industrial partners.

Project: Optimal exercising of American options in discrete time

The purpose of this project is to develop a methodology to exercise a given American option in discrete time in an optimal way based on observed values of the underlying from the past. As a more general problem, the problem of optimal stopping with finite horizon in discrete time is considered in view of maximizing the expected gain is considered. The algorithm developed in this project is completely nonparametric in the sense that it uses observed data from the past of the process up to time $-n+1$, not relying on any specific model assumption. Kernel regression estimation of conditional expectations and prediction theory of individual sequences are used as tools. It is shown that the algorithm is universally consistent: the achieved expected gain converges to the optimal value for $n \to \infty$ whenever the underlying process is stationary and ergodic. An application to exercising American options is given, and the algorithm is illustrated by simulated data.

Partner: H. Walk, Universität Stuttgart

Contact: M. Kohler.

References

[1] M. Kohler and H. Walk. On data-based optimal stopping under stationarity and ergodicity. Preprint, TU Darmstadt, 2010.

Project: Regression based Monte Carlo methods for pricing American options

The purpose of this project is to study numerical methods for the evaluation of American options in discrete time. It is assumed that the price processes of the underlyings are given Markov processes. We use the Monte Carlo approach to generate artificial sample paths of these price processes, and then we use nonparametric regression estimates to estimate from this data so-called continuation values, which are defined as mean values of the American option for given values of the underlying stocks at time t subject to the constraint that the option is not exercised at time t. As nonparametric regression estimates we use least squares estimates with complexity penalties, which include as special cases least squares spline estimates, least squares neural

networks, smoothing splines and orthogonal series estimates. General results concerning rate of convergence are derived and applied to prove results for the special cases mentioned above. Furthermore the pricing of American options is illustrated by simulated data.

Partner: A. Krzyżak, Concordia University (Montreal)

Support: Humboldt Foundation

Contact: M. Kohler.

References

[1] M. Kohler and A. Krzyżak. Pricing of American options in discrete time using least squares estimates with complexity penalties. Preprint, TU Darmstadt, 2009.

Project: Nonparametric estimation of non-stationary velocity fields from 3D particle tracking velocimetry data

The purpose of this project is to estimate nonstationary velocity fields from 3D particle tracking velocimetry data. The velocities of tracer particles are computed from their positions measured experimentally with random errors by high-speed cameras observing turbulent flows in fluids. Thus, captured discrete data is plugged into a smoothing spline estimate which is used to estimate the velocity field at arbitrary points. The estimate is further smoothed over several time frames using fixed design kernel regression estimate. Consistency of the resulting estimate is investigated. Its performance is validated on the real data obtained by measuring a fluid flow of a liquid in a (rotating) squared tank agitated by an oscillating grid.

Partner: A. Krzyżak, Concordia University (Montreal)

Support: Humboldt Foundation

Contact: M. Kohler.

References

[1] M. Kohler and A. Krzyżak. Nonparametric estimation of non-stationary velocity fields from 3D particle tracking velocimetry data. Preprint, TU Darmstadt, 2010.

Project: Efficient estimation of fatigue parameters

The purpose of this project is to estimate the optimal design of an experimental fatigue test. To do this, a general Monte Carlo method for estimation of the optimal design of a nonlinear parametric regression problem is developed. The basic idea is to produce via Monte Carlo values of the error of a parametric regression estimate for randomly chosen designs and randomly chosen parameters and to use nonparametric regression to estimate from this data the design for which the maximal error with respect to all possible parameter values is minimal. A theoretical result concerning consistency of this estimate of the optimal design is presented, and the method is used to find an optimal design for the above mentioned experimental fatigue test.

Partner: SFB 666 (TU Darmstadt)

Support: DFG

Contact: I. Hertel, M. Kohler.

Project: Estimation of the essential supremum of a regression function

Given an independent and identically distributed sample of the distribution of an $R^d \times R$-valued random vector (X, Y) the problems of uniform consistency of the kernel regression estimate and of estimation of the essential supremum of the corresponding regression function $m(x) = E\{Y|X = x\}$ are considered. Estimates of the essential supremum are constructed which converge almost surely to this value whenever the dependent variable Y satisfies some weak integrability condition.

Partner: A. Krzyżak, Concordia University (Montreal), H. Walk, Universität Stuttgart

Contact: M. Kohler.

References

[1] M. Kohler, A. Krzyżak, and H. Walk. Estimation of the essential supremum of a regression function. Preprint, TU Darmstadt, 2010.

Project: Empirical comparison of nonparametric regression estimates based on real data

The purpose of this project is to compare nonparametric regression estimates empirically on several real data sets. To do this, we select together with our project partner suitable data sets of sample size approximately 10.000, which have been made anonymous such that they can be published. Several standard regression estimates are trained on a learning part of those data sets and their error is computed on the evaluation part of these data sets. As a final result of this currently still ongoing project we will be able to present errors of many different regression estimates on these data sets, which enables an easy comparison of any new method with well established methods by just computing the error of the new method on our data sets.

Partner: Research Data Center of the statistical office of Hessen

Support: HMWK

Contact: D. Jones, M. Kohler.

Project: CUSUM Monitoring of Serially Dependent Processes of Counts

Real-world count data processes usually show serial dependence, which has to be considered while designing control charts for monitoring such processes. Cumulative sum (CUSUM) control charts are widely considered in research and practice because they are known to be sensitive already to small changes in the process model compared to the given in-control scenario. Our project aims to develop CUSUM charts for count data processes with different types of dependence structure (e.g., AR(1)-like dependence), different types of marginal distribution (e.g., equi- or overdispersed), and concerning different types of process changes (e.g., mean shifts). We first considered the upper-sided CUSUM chart for the equidispersed Poisson INAR(1) model. We also analyzed the effect of violations of model assumptions and of estimated (instead of true) parameters. Currently, we are working on CUSUM charts based on different types of residuals (designed for diverse out-of-control scenarios), CUSUM charts for overdispersed counts (e.g., stemming from an INARCH(1) process) and a two-sided CUSUM chart for both positive and negative mean shifts.

Partner: Prof. M.C. Testik, PhD (Hacettepe University, Ankara)

Contact: C. H. Weiß.

References

[1] C. H. Weiß and M. C. Testik. CUSUM Monitoring of First-Order Integer-Valued Autoregressive Processes of Poisson Counts. *Journal of Quality Technology*, 41(4):389–400, 2009.

[2] C. H. Weiß and M. C. Testik. The Poisson INAR(1) CUSUM Chart under Overdispersion and Estimation Error. *IIE Transactions*, 43(11):805–818, 2011.

Project: Parameter Estimation for Binomial AR(1) Processes

The binomial AR(1) model is a counterpart to the Gaussian AR(1) model for a process of binomial counts. Because of its intuitive structure, it applies well to many real-world situations. We develop approaches for estimating the two model parameters p and ρ and analyze the stochastic properties of the resulting estimators. For analyzing their asymptotic behaviour, we use results from the large sample theory of finite-state Markov chains, while the analysis of finite-sample properties requires simulations. Once we have established a repertoire of estimation approaches, we plan to consider diagnostic tests as a next step of our joint research.

Partner: Prof. H.-Y. Kim, PhD (Korea University, Seoul)

Contact: C. H. Weiß.

References

[1] C. H. Weiß and H.-Y. Kim. Binomial AR(1) Processes: Moments, Cumulants, and Estimation. *Statistics*, 2011. To appear.

Project: Count Data Time Series and Metapopulation Models

We establish a connection between a class of chain-binomial models of use in ecology and epidemiology and binomial autoregressive processes. We started our project by first focussing on two types of chain-binomial model, extinction-colonisation and colonisation-extinction models, which can be related to the binomial AR(1) model in the case of density-independence. As an application, we can take advantage of estimation approaches already established for this type of model. Furthermore, we consider the relation to the Gaussian AR(1) model. Our next steps aim at weakening the above assumptions by, e.g., allowing varying patch probabilities or forms of density dependence. The latter approach should allow to develop new time series models for marginal distributions showing under- or overdispersion compared to the binomial distribution.

Partner: Prof. P. Pollet, PhD (University of Queensland)

Contact: C. H. Weiß.

Project: EWMA Control Charts for Monitoring Binary Processes

We consider the problem of monitoring a binary process in situations of different extends of knowledge about the in-control "success" probality. We require a unique approach that is also easily implemented in a semi-automatic component for monitoring such data. As a concrete example and practical motivation for our work, we consider the data obtained from the diagnostic expert system SonoConsult. We recognized that the exponentially weighted moving average (EWMA) approach is sufficiently flexible to be adapted to the situations sketched above. To be able to automatize the chart design, we propose an improvement of the simple 3-σ rule that adjusts for the skewness of the EWMA statistics.

Partner: Dr. M. Atzmüller (Universität Kassel)

Contact: C. H. Weiß.

References

[1] C. H. Weiß and M. Atzmüller. EWMA Control Charts for Monitoring Binary Processes with Applications to Medical Diagnosis Data. *Quality and Reliability Engineering International*, 26(8):795–805, 2010.

Project: Modelling and Analysis of Categorical Time Series

While methods for analyzing and modelling real-valued time series have found much research interest in the past, only few articles consider categorical time series, i.e., time series with a range of finitely many and unordered categories. The project aims at developing new models for such time series, and, in particular, at providing tools for analyzing categorical time series. These include both exploratory tools, e.g.,for a visual analysis of the time series, and approaches for estimating characteristics like marginal dispersion or types of serial dependence. Current research tasks are to analyze the (asymptotic) stochastic properties of such estimators and to develop goodness-of-fit tests.

Contact: C. H. Weiß.

References

[1] C. H. Weiß. Visual analysis of categorical time series. *Statistical Methodology*, 5(1):56–71, 2008.

[2] C. H. Weiß. Continuously Monitoring Categorical Processes. *Quality Technology & Quantitative Management*, 2010. To appear.

[3] C. H. Weiß. Empirical Measures of Signed Serial Dependence in Categorical Time Series. *Journal of Statistical Computation and Simulation*, 81(4):411–429, 2011.

[4] C. H. Weiß. Generalized Choice Models for Categorical Time Series. *Journal of Statistical Planning and Inference*, 141(8):2849–2862, 2011.

[5] C. H. Weiß and R. Göb. Discovering Patterns in Categorical Time Series using IFS. *Computational Statistics and Data Analysis*, 52(9):4369–4379, 2008.

[6] C. H. Weiß and R. Göb. Measuring serial dependence in categorical time series. *Advances in Statistical Analysis*, 92(1):71–89, 2008.

Project: Time Series of Counts with Overdispersion

The Poisson distribution is one of the most popular models for count data random variables, and also time series models with Poisson marginals have been studied extensively in literature. Real-world count data time series, however, often exhibit overdispersion such that the Poisson assumption is inappropriate. Therefore, the aim is to develop sparsely parametrized models for time series of such overdispersed counts. It is necessary to analyze the stochastic properties of such models, and to develop and evaluate approaches for parameter estimation.

Contact: C. H. Weiß.

References

[1] C. H. Weiß. Serial dependence and regression of Poisson INARMA models. *Journal of Statistical Planning and Inference*, 138(10):2975–2990, 2008.

[2] C. H. Weiß. Thinning Operations for Modeling Time Series of Counts – A Survey. *Advances in Statistical Analysis*, 92(3):319–341, 2008.

[3] C. H. Weiß. Modelling Time Series of Counts with Overdispersion. *Statistical Methods and Applications*, 18(4):507–519, 2009.

[4] C. H. Weiß. INARCH(1) Processes: Higher-Order Moments and Jumps. *Statistics and Probability Letters*, 80(23-24):1771–1780, 2010.

[5] C. H. Weiß. The INARCH(1) Model for Overdispersed Time Series of Counts. *Communications in Statistics – Simulation and Computation*, 39(6):1269–1291, 2010.

2.3 Memberships in Scientific Boards and Committees

Dieter Bothe

- Designated member of the ProcessNet committee Computational Fluid Dynamics
- Designated member of the ProcessNet committee Multiphase Flows
- Designated member of the ProcessNet committee Mixing Processes

Regina Bruder

- Member of the international group for PME (Psychology of Mathematics Education)
- Member of the group "Arbeitskreis Vergleichsuntersuchungen" 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 Evaluation-Board of the institute IPN Kiel

Jan H. Bruinier

- Associate Member of the Pohang Mathematics Institute (PMI), Postec, Korea

Reinhard Farwig

- Scientific Committee of the Mathematical Section of UNIFEPRESS (University of Ferrara)

Michael Joswig

- Scientific Advisory Board: “Oberwolfach References on Mathematical Software”

Ulrich Kohlenbach

- President of ‘Deutsche Vereinigung für Mathematische Logik und Grundlagen der exakten Wissenschaften (DVMLG)’ (since 2008)

- Corresponding member of 'Wissenschaftliche Gesellschaft an der J.W. Goethe Universität'
- Member of Executive Committee of the Association for Symbolic Logic (ASL, since 2011)
- Member of Standing Committee 'Logic in Europe' of the Association for Symbolic Logic (ASL, since 2010)
- Speaker of 'Fachgruppe Logik' of the DMV (since 2009)
- Member of Advisory Board of Springer book series 'Theory and Applications of Computability Theory'

Jens Lang

- Member of board of directors of the research centre Computational Engineering, TU Darmstadt (since 2004)
- Member of board of deans of the DFG Graduate School of Excellence, TU Darmstadt (since 2008)
- Member of the DFG Cluster of Excellence Smart Interfaces: Understanding and Designing Fluid Boundaries, 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)
- Member of GAMM Activity Group "Optimization with PDE constraints" (since 2008)
- Member of SIAM Activity Group "Optimization" (since 2003)

2.4 Awards and Offers

Awards

Hans-Dieter Alber, Ehrendoktorwürde der Mongolischen Universität für Wissenschaft und Technik in Ulaanbaatar, June 15, 2010

Benno van den Berg, Fellowship at the Intitut Mittag-Leffler, Stockholm

Bálint Farkas, György Alexits Prize awarded by the Department of Mathematics of the Hungarian Academy of Sciences

Karoline Götze, Ruth-Moufang-Preis

Matthias Hieber, DFG Forschungssemester, April - September 2010

Ulrich Kohlenbach, Gödel Research Prize Fellowship 2011. Personal award of 100,000 EUR

Nicole Lehmann, Datenlotsenpreis 2009

Werner Schindler, Best Paper Award at the International Workshop CHES 2009 for joint work with Thomas Finke and Max Gebhardt

Werner Schindler, Best Paper Award Candidate at the Internationa Conference FPT 2010 for joint work with Michael Kasper and Marc Stöttinger

Martin Ziegler, Best Paper Award at the *32nd Annual Conference on Artificial Intelligence* (2009) for joint work with Florentin Neumann and Andrea Reichenberger

Offers of Appointments

Matthias Hieber, Professorship (W3) Analysis, TU Berlin

Michael Joswig, Professorship, Kyushu University, Fukuoka

3 Teaching

All teaching at the department of mathematics is divided into three parts: teaching in degree programmes in mathematics, educating teachers, and teaching science and engineering students, often described as service teaching. All these are different from each other in mathematical content, customs and study regulations.

3.1 Degree Programmes in Mathematics

There are currently three mathematics programs: the Diplom program in mathematics, the Bachelors program in mathematics (since 2007) and the Masters program in mathematics (since 2005). The current Bachelors program incorporates the old Bachelors program "Mathematics with Computer Science". The following tables show the number of students enrolled in the last 8 years:

Students in Mathematics programs

Program	2003	2004	2005	2006	2007	2008	2009	2010
Diplom	1180	791	750	760	571	443	341	260
Bachelor incl. MCS	182	221	230	207	264	363	502	624
Master			1	7	16	25	41	68
Teacher (sec. sch.)	229	187	213	233	267	297	363	410

The significant change in student numbers between 2003 and 2004 is due to the introduction of legislation ("Studienguthabengesetz") that forces students to pay fees, if they exceed the regular study time of a program by more than three or four semester or if they have a first academic degree already. Starting with the academic year 2008/09 all fees have been abolished.

New students - enrolled

Program	2003	2004	2005	2006	2007	2008	2009	2010
Diplom	441	230	183	194	75			
Bachelor incl. MCS	117	95	54	31	114	167	235	277
Master			1	6	11	18	22	36
Teacher (sec. sch.)	71	81	50	59	80	80	104	116

The above mention legislation also caused a drop in the number of enrollments. But we observed that the number of students who turned up for their courses remained almost constant in these years. This indicates that legislation discourages people from enrolling without intention to study.

With the start of the Masters program in mathematics, accredited and started in the year 2005, and with the Bachelors program in mathematics, accredited and started in the year 2007, the department completed the implementation of the Bologna Accord. The new program structure replaces the Diplom program and incorporates the previous Bachelors program "Mathematics with Computer Science".

The main aspects in the design of the current program structure could be described as both modern and conservative at the same time. Looking at both programs in detail resolves this seeming contradiction. They combine proven and tested components of the Diplom program with new aspects such as modularization and a credit point system. The new program retains the idea that mathematics should be studied together with an area in which mathematics is applied. The minor subject can be one of computer science, economics, physics, electrical engineering, chemistry and mechanics with further subjects by 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 Bachelors program has a duration of 6 semesters and finishes with a Bachelor thesis on a mathematical topic. A unique feature of our Bachelors program are the optional bilingual courses. Both options "Mathematics" (with arbitrary minor) and "Mathematics with Economics" can also be studied as a bilingual program since 2009. According to the numbers in the campus management system TUCaN (read on September 29, 2011), the fraction of bilingual Bachelors students in the winter semester 2010/11 was about 21 %.

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

The Master program has a duration of 4 semesters. Students complete their studies with a Master thesis on a research related topic in mathematics. The program offers the choice to focus studies on an area in which mathematics is applied such as computer science, economics, mechanical engineering, physics or chemistry. In this case, the topic of the Master thesis has to be related to mathematics but may be chosen from one of these areas.

Graduates of the Bachelor program (incl. MCS)

Term	Total	Female students	Study time $\leq$ 7 semesters
s. s. 2009	9	2	4
w. s. 2009/10	11	5	4
s. s. 2010	39	8	32
w. s. 2010/11	16	9	14

Graduates of the Master program

Term	Total	Female students	Study time $\leq$ 5 semesters
s. s. 2009	1	0	1
w. s. 2009/10	3	1	3
s. s. 2010	3	3	2
w. s. 2010/11	2	0	1

Graduates of Education for secondary schools

Term	Total	Female students	Study time ≤ 9 semesters
s. s. 2009	10	5	5
w. s. 2009/10	15	9	7
s. s. 2010	10	4	6
w. s. 2010/11	11	5	9

Many students choose to study for a year at a university abroad. This usually happens in their third year. Close cooperation between the students and the department ensures that students can transfer their credits from abroad into their study program in Darmstadt. This avoids any possible negative effects on the length of the students' study time.

Academic year	02/03	03/04	04/05	05/06	06/07	07/08	08/09	09/10
Erasmus places	24	24	27	34	35	35	35	36
Erasmus outgoer	15	16	18	21	14	14	15	12
Further outgoer		12	15	12	16	11	13	9
Incomer	2	4	8	8	11	14	13	6

3.2 Teaching for other Departments

Students in almost all study programs of this university have to take at least one course in an area of 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 lectures courses providing a solid foundation in mathematics covering subjects such as basic analysis, differential equation numerical methods and stochastics. For example, this is the case in the four semester cycle for electrical engineering students with 4 hour of lectures and 2 hour of exercise groups each week. Then there are smaller courses, concentrating on a special area in mathematics used in a particular area. Example of this are one-semester statistics courses for students in biology or social sciences.

Service courses, No. participants, winter semester 2010/11
(Source: TUCaN, 29.09.2011.)

Darstellende Geometrie	622
Höhere Mathematik I	126
Lineare Algebra I für Physik	238
Mathematik I für Bauwesen	1193
Mathematik I für Elektrotechnik	698
Mathematik I für Informatik	806
Mathematik I für Maschinenbau	892
Mathematik III für Bauwesen	523
Mathematik III für Elektrotechnik	446
Mathematik III für Maschinenbau	824
Mathematik und Statistik für Biologie	122
Statistik I für Human- und Sozialwissenschaft	104
Statistik I für Wirtschaftsingenieurwesen	638
Treffpunkt Mathematik für Maschinenbau	333

3.3 Characteristics in Teaching

The efforts of the department of mathematics were rewarded by the following statement in the report of an external teaching evaluation in 2004: “The Department of Mathematics impresses with extraordinary dedication in supporting the students.”. According to the “CHE-HochschulRanking Mathematik”, published in May, 2009, the department of mathematics holds one of the top positions among all universities in Germany, with excellent rates especially for “mentoring by lecturers” (1.7) and “overall course situation” (2.0). This mirrors the teaching methods at the department of mathematics. Teaching should encourage and motivate students to actively pursue the understanding of the lecture material. Learning is an activity that should include working both in teams and by oneself.

Lectures present mathematical knowledge and methods through a personal presentation. Evolving the theory 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 ratio between lecture time and tutorial time is 2:1.

Students are expected to work on and solve the weekly set of home work problems and hand in their solution to their tutor for marking. In exercise groups, students work on problems and topics from the lecture with the support of a tutor and they are encouraged to do small presentation of solutions to homework problems. The students have the opportunity to apply the contents of the lecture to the given problems. Thereby they test their knowledge and understanding of the material. In the tutorial groups the students work on basic problems and examples in order to understand the core content and fill gaps in the basic understanding.

The department supports students in their learning process by the following measures:

- teaching assistants and tutors are experienced and specially trained
- exercise groups are limited to a size of 20 students in first year and 25 students from the second year onwards
- providing an open learning environment with small learning groups
- weakly consultation hours for individual help and support by all teaching staff
- altogether 13 student rooms (opened or closed) with altogether about 160 places for students meeting in learning groups or, respectively, working on their thesis or preparing for the final exams
- the Mathematics Learning Center (Lernzentrum Mathematik) where during the opening hours there is an assistant or professor present for answering questions; in addition textbooks and up-to-date material of the current teaching courses is provided
- there are 32 places for working and reading in the library of the mathematics department
- the department is equipped with three opened computer labs (total of 43 Linux machines) and two closed computer labs (total of 15 Linux machines)

All these important and recognized elements of teaching and learning have been transferred in the new study programs.

3.4 E-Learning/E-Teaching in Academic Training

E-Learning in the department of mathematics is present in research and teaching. We got about 150,000€ external funds for E-Learning projects. Regina Bruder is the reference person for E-Learning in our department and she is a member of the post graduate programme "E-Learning" (since 2006-2010) and a member of the scientific advisory board of the elc (E-learning Center TU Darmstadt).

Research and research-based development

The developed concept of labeling E-Learning-lectures (ed. by Regina Bruder and Julia Sonnberger 2006) is now well established in all departments of our university and has been used for more than 200 lectures in 10 departments in the past two years. The labeling according to a catalogue of criteria for the evaluation of the lectures is linked to the course evaluation of the elc.
In connection with the VEMA project (cooperation between TU Darmstadt (Bruder, Bausch), Universität Paderborn (Biehler) and with Universität Kassel (Hochmuth, Kroepf)) some new E-Learning elements were developed for the preparatory courses for beginning students. Since 2009, the preparatory course has been presented each winter semester online via Moodle for nearly 800 student beginners of the faculties 4,13,16 and 20.[1] Further research rooted research training group 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 to the working group Serious Games at TU Darmstadt was established.
In the German-Japanese post graduate 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 the winter semester 2008/09 as well as in the summer semester 2009, Bálint Farkas organized an internet seminar together with T. Eisner, R. Nagel and M. Haase (Universität Tübingen). At the end, there was a concluding workshop. More information can be found here:
`http://isem.mathematik.tu-darmstadt.de/isem`

E-Learning/E-Teaching in the academical training

The majority of all professors are already using digital content in different formats and communication via E-Mail or Newsletter. 80% of all professors use their own websites or Moodle-plattform for presenting digital content. 4 lecture courses got the “Label E-Learning" `http://www.elc.tu-darmstadt.de/`. Different lecture recordings took place in mathematics as well: Mr. Kohler recorded his stochastics lectures and presents them on the mathematical homepage of the elc in the OpenLearnware section: Summer semester 09: Introduction to stochastics, Winter semester 09/10: Calculus of probabilities, Winter semester 10/11. The acquisition of software skills in special mathematical tools in the study of mathematics is taken for granted since several years. The working-group numerics supports these aims with an attractive proposition: `http://numawww.mathematik.tu-darmstadt.de/`.

[1] `http://www3.mathematik.tu-darmstadt.de/fb/mathe/startseite/studienanfaengerinnen-und-anfaenger/mathematikvorkurs.html`.
VEMA project: `http://www.mathematik.uni-kassel.de/~vorkurs/Willkommen1.html`, `http://www.vemada.de`.

ELKOPOS

Based on the E-learning Label the project ELKOPOS was concerned with the certification of the E-learning competences that the students could achieve in the respective E-learning lectures. The certification process is designed to be generated semiautomatically using the information of the labeling criteria and the evaluation results. The goal of the project is to improve academic teaching by supporting competence orientation. The project was funded by TU Darmstadt (QSL) and is planned to be integrated in the activities of elc and TUCaN. For further information please see:
http://www3.mathematik.tu-darmstadt.de/ags/didaktik/forschung/didaktik/projekte/elkopos-2005-2010/einfuehrung.html

dikopost: Digital Competence Portfolio for students

In 2010, 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 support academic teaching and learning through 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 use for students studying to become a teacher. For dikopost, the used platform is Mahara, which will also work well with Moodle in the future. The pilot project runs for two years on QSL funds with a budget of 250,000 Euros and will be implemented in the elc and HDA for a sustainable use. In December 2010, there were more than 300 registered users that used the E-Portfolio in courses or on their own. While the project started with 14 lecturers in the Winter semester 2010/11, the number for the Summer semester 2011 is about to increase to 21 courses. 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 products.
More information can be found here:
http://www.zfl.tu-darmstadt.de/dikopost_projekt/dikopost_begruessung.de.jsp
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, new online programmes for further education were developed for the learning platform “MOODLE" (http://www.prolehre.de): half-year-course "Internal differentiation in mathematical teaching" and a half-year course "Arguing in math teaching". The four blended learning courses were carried out in the last four semesters with about 150 participants in total.
For additional support, a database for exercises with about 300 new tasks and a platform for materials were developed. (http://www.madaba.de, http://www.problemloesenlernen.de)

3.5 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 us 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 maths 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 maths 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 socialise among themselves.
We hope that this rather brief introduction helps give an impression of our work.

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* (Associate editor)
- *Journal of Multiscale Modelling* (Member of the editorial board)

Dieter Bothe

- *Editorial Advisory Board International Journal of Multiphase Flow* (Editor)

Regina Bruder

- *mathematik lehren* (Associate Editor)

Reinhard Farwig

- *Annali dell'Università di Ferrara, Sez. VII, Sc. Mat.* (Associate Editor)
- *Mathematica Bohemica* (Associate Editor)

Matthias Hieber

- *Journal of Mathematical Fluid Mechanics* (Editor)
- *Advances Differential Equations* (Editor)

Karl H. Hofmann

- *Journal of Lie Theory* (Deputy Managing Editor)
- *Semigroup Forum* (Honorary Editor)
- *Topology and Applications* (Guest Editor of a Special Issue in honor of Dikran Dikranian, July 2010f.)

Michael Joswig

- *Electronic Geometry Models* (Managing Editor)

Klaus Keimel

- *Order* (Associate Editor)
- *Beiträge zur Algebra und Geometri (Contributions to Algebra and Geometry)* (Editorial Board)

Ulrich Kohlenbach

- *Annals of Pure and Applied Logic* (Managing Editor)
- *Notre Dame Journal of Formal Logic* (Associate Editor)
- *Mathematical Logic Quarterly* (Associate Editor)
- *Computability* (Associate Editor)

Michael Kohler

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

Jens Lang

- *Applied Numerical Mathematics* (Editor)

Martin Otto

- *The Bulletin of Symbolic Logic* (Editor)

Ulrich Reif

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

Thomas Streicher

- *Applied Categorical Structures* (Associate Editor)

Stefan Ulbrich

- *Optimization Methods and Software* (Regional Editor Europe)
- *SIAM Journal on Optimization* (Associate Editor)

4.1.2 Editors of Proceedings

Reinhard Farwig

- *Annali dell'Università di Ferrara 55 (2009)* (jointly with J. Neustupa, P. Penel)

Michael Joswig

- *Mathematical Software — ICMS 2010* (jointly with Komei Fukua and Nobuki Takayama)

Klaus Keimel

- *Proceedings of the Workshop Domains IX, University of Sussex. In: Mathematical Structures in Computer Science, vol. 20 (2010), pages 105–318* (jointly with Klaus Keimel, Achim Jung, Bernhard Reus, Thomas Streicher)

Ulrich Kohlenbach

- *Proceedings of Logic Colloquium 2007, Cambridge University Press 2010* (jointly with F. Delon, P. Maddy, F. Stephan)
- *Proceedings of Joint Workshop DOMAINS VIII and Computability over Continuous Data Types, Special Issue of Ann. Pure Appl. Logic vol.159, 2009* (jointly with Y. Ershov, K. Keimel, A. Morozov)

Michael Kohler

- *Proceedings of the Workshop on Recent Developments in Applied Probability and Statistics, April 23-24, 2009, Springer 2010* (jointly with Luc Devroye, Bülent Karasözen and Ralf Korn)

Thomas Streicher

- *special issue of Mathematical Structures in Computer Science on Domain Theory Workshop 2008* (jointly with Jung. Keimel, Reus)

4.1.3 Editors of a Festschrift

Matthias Hieber

- *Nonlinear Parabolic Problems: The Herbert Amann Festschrift, to appear* (jointly with Matthias Hieber with J. Escher, P. Guidotti, P. Mucha, J. Prüss, G. Simonett, Ch. Walker)

4.2 Monographs and Books

[1] W. Arendt, C. Batty, M. Hieber, and F. Neubrander. *Vector Valued Laplace Transforms and Cauchy Problems. Monographs in Mathematics, 2nd edition* . Birkhäuser, to appear.

[2] R. Bruder and W. Weiskirch. *CALiMERO - Computer-Algebra im Mathematikunterricht: Entdecken, Rechnen, organisieren. Band 5: Arbeitsmaterialien für Schülerinnen und Schüler*. Universität Münster Zentrale Koordination Lehrerausbildung, 2009.

[3] R. Bruder and W. Weiskirch. *CALiMERO - Computer-Algebra im Mathematikunterricht: Entdecken, Rechnen, Organisieren. Band 6: Arbeitsmaterialien für Schülerinnen und Schüler*. Universität Münster Zentrale Koordination Lehrerausbildung, 2009.

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[10] J. C. Ziems. *Adaptive Multilevel SQP-Methods for PDE-constrained Optimization*. Verlag Dr. Hut, 2010.

4.3 Publications in Journals and Proceedings

4.3.1 Journals

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4.5 Reviewing and Refereeing

4.5.1 Reviewing

Pia Domschke International Journal of Mathematical Modelling and Numerical Optimisation, Computational Optimization and Applications in Engineering and Industry

Bálint Farkas Mathematical Reviews

Reinhard Farwig Mathematical Reviews

Matthias Geissert Mathematical Reviews

Karsten Große-Brauckmann Mathematical Reviews

Horst Heck Mathematical Reviews

Michael Joswig Zentralblatt

Oliver Kolb International Journal of Mathematical Modelling and Numerical Optimisation, Computational Optimization and Applications in Engineering and Industry

Steffen Roch Mathematical Reviews

Fredrik Strömberg Zentralblatt

4.5.2 Refereeing

Dieter Bothe Advances in Colloid and Interface Science,Aiche Journal, Atomization and Sprays Chemical Engineering Science, Colloids and Surfaces A: Physicochemical and Engineering Aspects, Discrete and Continuous Dynamical Systems, European Journal of Mechanics - B/Fluids, Heat and Mass Transfer, International Journal for Numerical Methods in Fluids, International Journal of Multiphase Flow, Topological Methods in Nonlinear Analysis, Zeitschrift für angewandte Mathematik und Physik (ZAMP)

Regina Bruder Didaktik der Mathematik, mathematik lehren

Jan H. Bruinier DFG, NSF (USA), NSERC (Kanada), Invent. Math., Ann. of Math., Acta Math., Journal of the AMS, Math. Ann., Duke Math. Journal, Crelle, Advances in Mathematics, Compositio Mathematica, etc.

Bálint Farkas Semigroup Forum, Acta. Math. Hung., Math. Nachr.

Reinhard Farwig manuscripta mathematica, SIAM J. Mathematical Analysis, Mathematische Annalen, Archiv der Mathematik, J. Math. Fluid Mechanics, Zeitschrift für die Reine und Angewandte Mathematik, J. Evolution Equations, Electronic J. Differential Equations, Annali dell'Università di Ferrara, Sez. VII, Sc. Mat., Nagoya Mathematical Journal

Jaime Gaspar Continuity, Computability, Constructivity: From Logic to Algorithms 2009 Annals of Pure and Applied Logic Post Proceedings

Matthias Geissert Applicable Analysis, Journal of Differential Equations, Mathematical Modelling and Numerical Analysis, Herbert Amann Festschrift, SIAM Journal on Mathematical Analysis

Alf Gerisch Applied Numerical Mathematics, Journal of Applied Mathematics and Computing, Journal of Biological Dynamics, Journal of Theoretical Biology, Mathematical Modelling of Natural Phenomena, SIAM Journal of Scientific Computing

Vassilios Gregoriades 4th Indian Conference on Logic and its Applications

Karsten Große-Brauckmann Journal of Geometry and Physics, Analysis, Annals of Global Analysis and Geometry

Ute Günther Mathematical Methods of Operations Research

Robert Haller-Dintelmann Analysis and Applications

Horst Heck Journal of Evolution Equations, Positivity, SIAM Journal on Mathematical Analysis

Christian Herrmann Algebra Universalis, Central European Journal of Mathematics, Journal of Pure and Applied Algebra, Order

Sven Herrmann Journal of Combinatorial Theory - Series A, European Journal of Combinatorics

Karl H. Hofmann Advances in Mathematics, Acta Math. Sinica, Mathematische Nachrichten, Topology and Applications, Bull. Belgian Math. Soc., Crelle's Journal (J.f.d Reine u. Angew. Math), Results in Mathematics, Note di Matematica, Lecture Notes of Mathematics, Springer Verlag, Verlag Walter DeGruyter, Berlin

Michael Joswig Adv. Geometry, International J. Combin., J. Combin. Th. (Series A), European J. Combin., Hacettepe J. Math. Stat., J. Algebra, Discrete Comput. Geometry, J. Alg. Combin., FPSAC 2010, Betr. Algebra und Geometrie, Linear Algebra Appl.

Klaus Keimel Electronic Notes in Theoretical Computer Science, ESF (European Science Foundation), Book Manuscript for Birkhäuser Verlag, Theoretical Computer Science, Fundamenta Informaticae, Semigroup Forum, CiE'09, CONCUR'09, ISDT'09, Indian Journal of Pure and Applied Mathematics, Order, International Journal of Information Technology and Decision Making, Acta Mathematicae Sinica, Demonstratio Mathematicae, Topology and its Applications, Positivity, Kyungpook Journal of Mathematics

Ulrich Kohlenbach Annals of Pure and Applier Logic, Cambridge University Press, Computer Science Logic 2011, Demonstratio Mathematica, Fundamenta Mathematicae, Journal of Symbolic Logic, Mathematical and Computer Modelling, Nonlinear Analysis, Mathematical Logic Quarterly, Notre Dame Journal of Formal Logic

Michael Kohler Annals of Applied Probability, Finance and Stochastics,IEEE Transactions on Information Theory, Journal of Statistical Planning and Inference, Mathematical methods in the Applied Science, Metrika, Statistics

Andreas Kollross Geometriae Dedicata, International Journal of Mathematics, Journal of Differential Geometry, London Mathematical Society

Burkhard Kümmerer Journal of Functional Analysis, Communications in Mathematical Physics, Journal of Operator Theory, Journal of Statistical Physics, SEMIGROUP FORUM, 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, Springer, Birkhäuser

Andrew Linshaw Communications in Mathematical Physics, Journal of Physics A: Mathematical and Theoretical

Ulf Lorenz International Journal of Computer Games, Advances in Computer Games, Theorectical Computer Science, Computers and Operations Research, NWO, Computers and Games, WADS, The Computer Journal

Martin Otto Annals of Pure and Applied Logic, ACM Transactions on Computational Logic, Archive for Mathematical Logic, Bulletin of Symbolic Logic, Central European Journal of Mathematics, Logical Methods in Computer Science, Information Processing Letters, Conference on Theory and Applications of Models of Computation, IEEE Symposium on Logic in Computer Science, International Conference on Automata, Languages and Programming, Symposium on Theoretical Aspects of Computer Science, Journal of Computer and System Sciences, Computability in Europe

Andreas Paffenholz International Mathematics Research Notices, Canadian Mathematical Bulletin, Jornal of Combinatorial Theory A

Ulrich Reif Journal of Approximation Theory, SINUM, Constructive Approximation, CAGD, IEEE TVCG, Journal of Mathematical Analyis and Applications, ...

Steffen Roch Int. Eq. Oper. Theory, Appl. Math. Inf. Sci., Oper. Th.: Adv. Appl., J. Ineq. Appl., J. Appl. Numer. Math., Operators and Matrices, Topology Appl., Proc. ICNAAM 2010

Pavol Safarik Computability in Europe (CiE Proceedings 2009)

Nils Scheithauer Duke Mathematical Journal, International Journal of Number Theory, Journal für die reine und angewandte Mathematik, Journal of Lie Theory, Mathematische Zeitschrift

Werner Schindler Eurocrypt 2009, Sicherheit 2010, CHES 2010

Wilhelm Stannat Probability Theory & Related Fields, Stochastics and Dynamics, Proceedings Royal Acad. Science of Edinburgh, Potential Analysis, Electronic Journal of Probability (EJP), Forum Math., Infinite Dimensional Analysis, Quantum Probability and Related Topics (IDAQP), Studia Math.

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

Fredrik Strömberg NSA Mathematical Sciences Grants Program (USA)

Stefan Ulbrich Inverse Problems, Mathematical Methods of Operations Research, Mathematical Programming, Mathematics of Computation, Numerische Mathematik, Optimization, Optimization and Engineering, Optimization Methods & Software, SIAM Journal on Control and Optimization, SIAM Journal on Optimization, SIAM Journal on Scientific Computing

Christian H. Weiß Advances in Statistical Analysis, Applied Stochastic Models in Business and Industry, IIE Transactions, Journal of Applied Statistics, Journal of Medical Systems, Methodology and Computing in Applied Probability, Metrika, Quality & Reliability Engineering International, Quality Technology & Quantitative Management, Statistics, Stochastic Models, Technometrics

Andrea Zelmer Discrete Optimization

Martin Ziegler Physics Letters A, Journal of Universal Computer Science, IET Circuits, Devices and Systems, Theory of Computing Systems, Logical Methods in Computer Science, Mathematical Structures in Computer Science

4.6 Software

polymake Software for Geometric Combinatorics
polymake started out as a tool for the algorithmic treatment of convex polyhedra. By now it also deals with finite simplicial complexes, tight spans of finite metric spaces, polyhedral surfaces, and other objects. The software is jointly developed by Ewgenij Gawrilow (TomTom) and Michael Joswig. For more information, see `www.polymake.org`

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. The software is jointly developed by Oliver Kolb, Björn Geißler and Antonio Morsi (all TU Darmstadt).

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. The software is jointly developed by Bodo Erdmann, Rainer Roitzsch (both ZIB) and Jens Lang. For more information, see `www.zib.de`

fqm-devel Computation of the Weil representation for finite quadratic modules
A package in SAGE for computing with Finite Quadratic modules, and in particular to compute the Weil representation. The package is open source and released under the GNU GPL. It is jointly developed by Fredrik Strömberg and N.-P. Skoruppa et al. (Siegen). See `http://hg.countnumber.de/fqm-devel`.

maass Computations with Maass waveforms in Fortran 90
Package for computing with Maass waveforms in Fortran 90 (version 0.99v2). The software is open source and released under GNU GPL v3. It is developed by Fredrik Strömberg. See `http://www.mathematik.tu-darmstadt.de/~stroemberg/prog/maasswf-src-0.99v2.tar.gz`

poincare Computation of holomorphic Poincaré series for the Weil representation
A SAGE program for computing a basis of holomorphic vector-valued Poincaré series for the Weil representation. The software is open source and released under the GNU GPL v3. It is developed by Fredrik Strömberg.

hmwf Sage program to compute harmonic weak Maass forms
Sage program to compute Harmonic Weak Maass forms for the Weil representation corresponding to rank one lattices. The software is open source and released under the GNU GPL v3. It was developed by Fredrik Strömberg and is available as a stand-alone sage program from `http://www3.mathematik.tu-darmstadt.de/fileadmin/home/users/149/hmwf.tar.gz`. It is also included in the more general PSAGE repository described below.

fredrik314-working Computing with general automorphic forms
This is a clone of purple sage (PSAGE) dedicated to the computation of various kinds of general automorphic forms (in particular Harmonic weak Maass forms). This software is open source, released under GNU GPL v2 (and partly v3). It is currently developed by Fredrik Strömberg and will later be included in the stable branch of PSAGE. see `http://code.google.com/r/fredrik314-working/`.

ipfilter An NLP Solver based on a primal-dual interior-point filter algorithm
ipfilter is a state-of-the-art solver for nonlinear programming problems (defined by the minimization of an objective function in a feasible region defined by equality and inequality constraints).
See `http://www.mat.uc.pt/ipfilter/`

5 Theses

5.1 Habilitations

2009

Komech, Andrey, *Global Attraction to Solitary Waves* (Hans-Dieter Alber)

Leustean, Laurentiu, *Proof mining in metrix fixed point theory and ergodic theory* (Ulrich Kohlenbach)

Rößler, Andreas, *Rooted Tree Analysis of Weak and Strong Approximation Methods for Stochastic Differential Equations* (Klaus Ritter)

2010

Debrabant, Kristian, *Consistency analysis of stochastic Runge-Kutta and and Taylor methods* (Jens Lang)

5.2 PhD Dissertations

2009

Briseid, Eyvind Martol , *On Rates of Convergence in Metric Fixed Point Theory* (Ulrich Kohlenbach)

Bundfuss, Stefan, *Copositive Matrices, Copositive Prgramming, and Applications* (Mirjam Dür)

Collet, Christina, *Wirkungsanalysen von Lehrerfortbildungen zu Problemlösen in Verbindung mit Selbstregulation* (Regina Bruder)

Drewes, Sarah, *Mixed Integer Second Order Cone Programming* (Stefan Ulbrich)

Götze, Karoline, *Strong Lp-solutions for fluid-rigid body interaction problems* (Matthias Hieber)

Herrmann, Sven, *Splits and Tight Spans of Convex Polytopes* (Michael Joswig)

Heß, Matthias, *Analysis of the Navier-Stokes equations for geophysical boundary layers* (Matthias Hieber)

Horn, Max, *Involutions of Kac-Moody groups* (Ralf Gramlich)

Ingelmann, Maria, *Evaluation eines Unterrichtskonzeptes für einen CAS-gestützten Mathematikunterricht in der Sekundarstufe I* (Regina Bruder)

Kamenski, Lennard, *Anisotropic Mesh Adaption Based on Hessian Recovery and A Posteriori Error Estimates* (Jens Lang)

Kraynyukova, Nataliya, *Existence theory for mathematical models of ferroelectric material behaviour* (Hans-Dieter Alber)

Küpper, Dominique, *Runge-Kutta Methods for Stochastic Differential-Algebraic Equations* (Klaus Ritter)

Mehnert, Jens, *Using Unlabeled Data for Text Classification* (Michael Kohler)

Prasiswa, Jennifer, *Lokale und globale Algorithmen zur Approximation mit erweiterten B-Splines* (Ulrich Reif)

2010

Frisch, Dennis, *Classification of Immersions which Bound Curves in Surfaces* (Karsten Große-Brauckmann)

Fuchssteiner, Martin, *Transformation Groups and (Co)homology* (Karl-Herrmann Neeb)

Günther, Ute, *Integral Sheet Metal Design by Discrete Optimization* (Alexander Martin)

Hagemeier, Heike, *Automorphe Produkte singulären Gewichts* (Jan H. Bruinier)

He, Yong, *Constant Mean Curvature Surfaces bifurcating from Nodoids* (Karsten Große-Brauckmann)

Hess, Wolfgang, *Geometry Optimization with PDE Constraints and Applications to the Design of Branched Sheet Metal Products* (Stefan Ulbrich)

Mahlke, Debora, *A Scenario Tree-Based Decomposition for Solving Multistage Stochastic Programs with Application in Energy Production* (Alexander Martin)

Peth, Bettina, *Adaptive Two-Step Peer Methods for Incompressible Flow Problems* (Jens Lang)

Rosenbusch, Artus Philipp, *Fairness Considerations in Cooperative Games* (Werner Krabs)

Zelmer, Andrea, *Designing Coupled Energy Carrier Networks by Mixed-Integer Programming Methods* (Alexander Martin)

Ziems, Jan Carsten, *Adaptive Multilevel SQP-Methods for PDE-constrained Optimization* (Stefan Ulbrich)

5.3 Diplom Theses

2009

Arendt, Gregor, *Rating Leveraged Buyout Financings* (Stefan Ebenfeld)

Armbruster, Manuel, *Nash-Gleichgewichte in Potentialspielen* (Raymond Hemmecke)

Axmann, Theresa, *Einflussfaktoren auf die Wahl des Abschlussprüfers - eine empirische Analyse börsenorientierter Unternehmen* (Reiner Quick)

Baatarkhuu, Sansar, *Asymptotische Verfahren zur Quantilsbestimmung der Verlustverteilung im CreditRisk$^+$ Modell* (Wilhelm Stannat)

Bärmann, Andreas, *Ein neues Modell zur Leitwegeoptimierung im Schienengüterverkehr* (Alexander Martin)

Becker, Johannes, *Globale Fehlerkontrolle für semi-explizite differential-algebraische Gleichungen vom Index 1* (Jens Lang)

Brunswicker, Julia, *Entwicklung und Verifizierung eines dynamischen Portfoliomodells für die optimale Altersvorsorge von Individuen mit Epstein und Zin Nutzen* (Stefan Ebenfeld)

Cholemkery, Jim, *Bewertung Amerikanischer Optionen mit Hilfe von GARCH Modellen und regressionsbasierten Monte-Carlo-Verfahren* (Michael Kohler)

Dagdelen, Özgür, *Parallelisierung von Gitterbasisreduktionen - Paralleler BKZ Algorithmus* (Johannes Buchmann)

Davy, James, *Minimale Gleichgewichtsflächen* (Karsten Große-Brauckmann)

Dimitrov, Lachezar, *Das n-dimensionale Katenoid in* $\mathbb{R}^{n+1}$ (Karsten Große-Brauckmann)

Elsemüller, Jane, *Optimierung von Plasmaaktuator-Parametern zur Auslöschung von Tollmien-Schlichting-Wellen mit NEWUOA* (Stefan Ulbrich)

Fink, Sebastian, *Exploiting Heuristics for the vehicle Routing Problem to estimate Gas Delivery Costs* (Alexander Martin)

Fischer, Jens, *Zentrale Erweiterungen von Kac-Moody-Gruppen* (Ralf Gramlich)

Förster, Tobias, *Zufallsbasierte Heuristik für gekoppelte Netzwerke in der dezentralen Energieversorgung* (Alexander Martin)

Franz, Matthias, *Minimierung der Krümmung des zentralen Pfades bei Innere-Punkte-Verfahren der linearen Optimierung* (Stefan Ulbrich)

Fröhn, Daniel, *Lösungsmethoden für das Pin Assignment Problem* (Alexander Martin)

Girlich, Michael, *Ein dynamisches Kreditrisikomodell* (Wilhelm Stannat)

Göllner, Thea, *Preprocessing-Techniken für die Optimierung stationärer Gasnetzwerke* (Alexander Martin)

Griesche, Stefan, *Untersuchungen zur numerischen Approximation des Differenzenquotienten für wert- und zeitdiskrete Sensorsignale* (Martin Kiehl)

Grinberg, Yuriy, *Klassifikation von Stratonovich SRK Verfahren der Ordnung 2 zur schwachen Approximation von Lösungen von SDGLn* (Jens Lang)

Groß, Kerstin, *Regelung kohärenter longitudinaler Schwingungen eines gebunchten Strahls in einem Schwerionensynchrotron* (Jürgen Adamy / Martin Kiehl)

Grunwald, Sven, *Sekundärpolytope* (Michael Joswig)

Hein, Jens, *Bewertung Amerikanischer Optionen mit Hilfe von Lévy-Prozessen und regressionsbasierten Monte-Carlo-Verfahren* (Michael Kohler)

Hrubes, Ferdinand, *Das Plateau-Problem* (Karsten Große-Brauckmann)

Jost, Florian, *Approximation einer Hyperbel in der diskreten Optimierung* (Alexander Martin)

Kascha, Matthäus, *Credibility-Theorie* (Michael Kohler)

Kelbin, Olga, *Inviscid stability analysis of Hagen-Poiseuille flow using Lie group theory* (FB Mechanik anerkannt)

Khabbazeh, Suphi, *Untersuchung verschiedener Verfahren zur Mehrzieloptimierung bei der Modellierung mit rekurrenten Fuzzy-Systemen* (Jürgen Adamy / Balint Farkas)

Kiesl, Rebecca, *Lie-Algebren nilpotenter topologischer Gruppen* (Karl-Hermann Neeb)

Koller, Daniela, *Numerische Lösung retardierter stochastischer Differentialgleichungen* (Jens Lang)

Komo, Christian, *Regularität von schwachen Lösungen der Navier-Stokes-Gleichungen im Außengebiet* (Reinhard Farwig)

Kreuzer, Alexander, *Der Satz von Ramsey für Paare und beweisbar rekursive Funktionen* (Ulrich Kohlenbach)

Kuhn, Juliane, *Model-Predictive Control of Cooperative Multi-Vehicle Systems Based on Discrete-Time Linear Systems* (Oskar von Stryk / Stefan Ulbrich)

Kuhn, Karen, *Mehrgitterverfahren zur numerischen Behandlung von dreidimensionaler Integralgleichungstheorie* (Stefan Kast / Jens Lang)

Leonardos, Stafanos, *Stabilität von positiven C_0 - Halbgruppen* (Balint Farkas)

Lu, Nade, *Bewertung von Amerikanischen Multi-Asset-Optionen mit dem Semiglatten Newton-Verfahren* (Stefan Ulbrich)

Maul, Sabine, *Kontrolle von Lösungsfunktionalen für gewöhnliche Differentialgleichungen* (Jens Lang)

Möller, Claudia, *Parametrische und geometrische Ansätze zur Erzeugung von Class A-Kurven* (Ulrich Reif)

Müller, Johannes, *Portierung des FlexiProviders auf Java ME* (Johannes Buchmann)

Nalliah, Neslyn Jesica, *Der Zahlbegriff im Spiegel der Multiplikation* (Burkhard Kümmerer)

Napiralla, Sebastian, *Robuste Portfoliooptimierung anhand des Conditional Value-at-Risk* (Stefan Ulbrich)

Petsch, Stephan, *Verfahren zur Lösung des soft rectangle packing problem* (Alexander Martin)

Pfarr, Michael, *Sehr schwache Lösungen der stationären Stokes-Gleichung auf Aperture-Gebieten* (Reinhard Farwig)

Reble, Felix, *Statistische Verfahren in der Prozessoptimierung* (Michael Kohler)

Richter, Thomas, *Azylische Fahrzeugeinsatz- und Instandhaltungsoptimierung im Schienenpersonennahverkehr* (Alexander Martin)

Rudel, Mark, *Ganzzahlige Optimierung zur Bestimmung konsistenter Eröffnungspreise von Futures Kontrakten und ihrer Kombinationen* (Alexander Martin)

Sauer, Martin, *Invariante Maße für semilineare SPDE* (Wilhelm Stannat)

Schäfer, Hendrik, *Konvergenzanalyse von Approximationsverfahren für das optimale Filter in stetiger Zeit* (Wilhelm Stannat)

Schieche, Bettina, *Stochastische Finite Elemente* (Jens Lang)

Schmidt, Christian, *Beste Konstanten für die L^2 -Approximation mit Polynomen* (Ulrich Reif)

Schmitz, Sarah K., *Statistische Untersuchung von Konnektivitäts-Matrizen* (Wilhelm Stannat)

Sponsel, Julia, *Das maximale Cliquen-Problem als kopositives Programm* (Mirjam Dür)

Thiel, Jennifer, *Test Sets for Spanning Tree Problems with Side Constraints* (Alexander Martin)

Tiburtius, Sara, *Globale Fehlerschätzung und Fehlerkontrolle für gewöhnliche Differentialgleichungen mithilfe der Richardson-Extrapolation* (Jens Lang)

Velyanova, Veneta, *Vergleichende Darstellung klassischer und moderner Verfahren der aktuariellen Schadenreservierung und deren Software - gestützte Implementierung* (Michael Kohler)

Voß, Nicole, *Die Riemannsche Minimalfläche* (Karsten Große-Brauckmann)

Wang, Huai Ying, *Begriffliche Wissensverarbeitung mit Toscana- Eine Einführung in die Praxis* (Rudolf Wille)

Werner, Christian, *Lipschitz'sche Optimierung unterstützt durch lokale Suche auf Ersatzfunktionen* (Oskar von Stryk / Stefan Ulbrich)

Winter, Christian, *Asymptotische Liftings auf Hilberträumen und von-Neumann-Algebren* (Burkhard Kümmerer)

Woitscheck, Johannes, *Parameterschätzverfahren zur Modellierung operationeller Risiken von Finanzdienstleistern* (Michael Kohler)

2010

Ahlers, Peter, *International Climate Contracts and Cooperation* (Carsten Helm / Ulf Lorenz)

Albert, Christoph, *Stabilität von Ekman- und Ekman-Hartmann-Grenzschichten* (Matthias Hieber)

Alesinskyy, Yevgen, *Geometrische Numerische Integration für Elasto-Plastische Gleichungen* (Jens Lang)

Armakola, Angela, *Wahl von Glättungsparametern in der nichtparametrischen Regression durch Kombination von Experten* (Michael Kohler)

Boiadjieva, Lora, *Deterministische und stochastische Verfahren zur nichtparametrischen Effizienzanalyse - Formale Grundlagen und empirische Anwendung auf deutsche Energieverteilerstationen* (Jens Krüger / Michael Kohler)

Bücher, David, *Zerlegungen von Generatoren von Halbgruppen vollständig positiver Operatoren auf C^*-Algebren* (Burkhard Kümmerer)

Döhring, Nicolas, *Parameterschätzung bei zeitinhomogenen Poissonprozessen* (Wilhelm Stannat)

Dörner, Jan, *Perron-Frobenius-Theorie vollständig positiver Operatoren* (Burkhard Kümmerer)

Ebert, Karl Ferdinand, *Ein mathematisches Modell zur Bestimmung der Zuverlässigkeit von Netzwerken zur Datenübertragung* (Wilhelm Stannat)

Eberts, Mona, *Einsatz der nichtparametrischen Regressionsschätzung zur Analyse des Verhaltens eines Verbrennungsmotors* (Michael Kohler)

Fassing, Daniel, *Branch and Cut Verfahren in der Standortplanung* (Wolfgang Domschke / Alexander Martin)

Felber, Tina, *Analyse der Konvergenzgeschwindigkeit von Monte-Carlo-Schätzern von oberen Schranken zur Bewertung Amerikanischer Optionen* (Michael Kohler)

Fischer, Alexandra, *Die Schätzung der Regressionsfunktion unter Verwendung des L_2 - Boostings* (Michael Kohler)

Fleckenstein, Stefan, *Stabilität von Ekman-Grenzschichten im Halbraum und in einer Schicht* (Matthias Hieber)

Frankenbach, Matthias, *Ein echtzeitalgorithmus für Nonlinear Model Predictive Control* (Stefan Ulbrich)

Friedrich, Sören, *Bewertung Amerikanischer Optionen mit Hilfe von regressionsbasierten Monte-Carlo-Verfahren, dualen Methoden und Binomialbäumen* (Michael Kohler)

Hechler, Nailya, *SOCP mit zusätzlichen nicht konvexen Nebenbedingungen* (Stefan Ulbrich)

Hertel, Ida, *Schätzung des Geschwindigkeitsfeldes einer Strömung mittels nichtparametrischer Regressionsschätzung* (Michael Kohler)

Heuser, Annelie, *Chess Reduction* (Johannes Buchmann)

Hoffmann, Franz Michael, *Numerical Analysis of Hysteresis Effects for Two Simplified Elasto-Plastic Models* (Jens Lang)

Hoss, Julian, *Prognosefehlerevaluierung bei asymmetrischer Verlustfunktion* (Jens Krüger / Michael Kohler)

Jones, Daniel, *Einsatz der Regressionsschätzung zur Tiefenrekonstruktion von monokularen Fotografien* (Michael Kohler)

Kirchner, Sarah, *Ein Branch-and-Price-Verfahren für den Straßenwinterdienst* (Marco Lübbecke)

Kraus, Christian, *Größer, stärker, schneller - Modellierung und Simulation von Coevolution* (Martin Kiehl)

Kübert, Michael, *Evolution of the Performance of Separate Scheduling Solvers Forced to Cooperate* (Alexander Martin)

Landvogt, Jean-Luc, *Statistics of Hecke eigenvalues* (Jan Hendrik Bruinier / Fredrik Strömberg)

Malacarne, Angelo, *Die Verbreitung von Instrumenten der Kosten- und Leistungsrechnung in Unternehmen: Empirische Untersuchung mittels einer Onlinebefragung* (Reiner Quick / Michael Kohler)

May, Manuel, *Parameterwahl bei der Bewertung Amerikanischer Optionen mit Hilfe von Lévy Prozessen und regressionsbasierten Monte-Carlo-Verfahren* (Michael Kohler)

Nowak, Stefanie, *Implementierung und Validierung der Sensitivitäten für das k-ϵ-Turbulenzmodell* (Michael Schäfer / Stefan Ulbrich)

Öhmke, Erdmute Carmen Verena, *Optimale bedarfsorientierte Schichtenerstellung* (Alexander Martin)

Ojansivu, Juha Paavo, *Decidability and Complexity of Fragments of Seperation Logic* (Martin Otto)

Pakladok, Natalija, *Heuristische Ansätze für den Umgang mit Fertigungs-Restriktionen in der Herstellung von Blechprofilen* (Alexander Martin)

Pascalau, Aurora, *Stochastical and heuristical approaches for a sensor network localization problem* (Stefan Ulbrich)

Paul, Christian, *Obere Schranken bei der Bewertung Amerikanischer Optionen mit reduzierter Zahl an geschachtelten Monte-Carlo-Schritten* (Michael Kohler)

Pfaff, Sebastian, *Minimierung polynomialer und rationaler Zielfunktionen über semialgebraischen Mengen mittels SDP-Relaxierungen* (Stefan Ulbrich)

Pfuhl, Agnetha, *Schätzung des Maximalwertes einer Regressionsfunktion* (Michael Kohler)

Pisch, Tobias, *Eine dynamische Methode zur Berechnung von Nash-Gleichgewichten in n-Personen-Spielen* (Werner Krabs)

Rath, Alexander, *Simulation und Optimierung von Wasserversorgungsnetzwerken* (Jens Lang)

Rempel, Eugen, *Symmetrie in der linearen Optimierung* (Marco Lübbecke)

Saadati, Maral, *Robust Portfolio Optimization with Derivatives* (Stefan Ulbrich)

Sanden, Matthias, *Rotationseffekte in der Kristallplastizität* (Charalampos Tsakmakis / Hans-Dieter Alber)

Schäfer, Stephanie, *An overview of algorithms for graph reliability and possible transfer to dynamic graph reliability* (Alexander Martin)

Schelbert, Jakob, *Eine Verallgemeinerung des Quadratic Bottleneck Assignment Problem und Anwendung* (Alexander Martin)

Schmitt, Oliver, *Der Satz von Nagao* (Ralf Gramlich)

Schöchtel, Georg, *Invariante Maße im unendlichdimensionalen Heath-Jarrow-Morton Modell* (Wilhelm Stannat)

Schupp, Markus, *The Manin Drinfeld Theorem and Eta Quotients* (Jan Hendrik Bruinier)

Seib, Florian, *Stabilität der Ein-Schritt-Vorhersage des Optimalen Filters* (Wilhelm Stannat)

Shafei, Behrang, *Energieoptimale Steuerung von Industrierobotern* (Oskar von Stryk / Stefan Ulbrich)

Siebert, Uwe, *An integrated approach for the throuput optimization of mixed-mode runways* (Alexander Martin)

Sommer, Norbert, *Optimales Ausüben von Amerikanischen Optionen in Diskreter Zeit* (Michael Kohler)

Tan, Linwen, *Interior Regularity of Initial-Boundary Value Problems of Viscoplasticity* (Hans-Dieter Alber)

Thoma, Oliver, *Optimal Control of the Obstacle Problem- Regularization and Algorithms* (Christian Meyer)

Trischmann, Marco, *Nichtparametrische Schätzung von Ableitungen einer Regressionsfunktion mit Kernschätzern* (Eva Herrmann)

Völker, Dennis, *Erzeuger und Relationen von Quantentori* (Ralf Gramlich)

Wagner, Sebastian, *Credit Portfolio Optimization - Branching and bounds tightening techniques for non-convex MINLP* (Stefan Ulbrich)

Wehrlin, Michael, *Semidefinite Modellierung von Aktoren im Robust Truss Topology Design* (Stefan Ulbrich)

Wirnharter, Robert, *Anpassung diskreter Lagerungsrandbedingungen von Schwingungsmodellen mittels mathematischer Optimierung* (Christian Meyer)

Zimmerling, Nina, *Polyedrische Untersuchungen von Knapsack Ungleichungen in Mehrgüter-Fluss-Problemen* (Alexander Martin)

5.4 Master Theses

2009

Bechtloff, Nils, *Polyhedral Surfaces and Willmore Energy* (Karsten Große-Brauckmann)

Bergner, Martin, *Ein pfadbasiertes Modell für das Routing von Güterwagen im Einzelwagenverkehr* (Alexander Martin)

Ekici, Abdullah, *Kinderarmut in der Bundesrepublik Deutschland* (Angela Paul-Kohlhoff)

Jüttner, Ingrid, *Gerechtigkeit der Geschlechter und Schule am Beispiel des Mathematikunterrichts* (Angela Paul-Kohlhoff)

Kocak, Asir, *Didaktische-Methodische Planung einer Projektarbeit zum Thema Arbeitssicherheit des Lernfeldes* (Alfred Neudörfer)

Plehn, Franziska, *A Branch and Bound Algorithm for Indefinite Quadratic Programs* (Stefan Ulbrich)

Trunk, Christof, *Über die Navier-Stokes-Gleichungen mit Oseenbedingungen im Außenraum eines rotierenden oder sich bewegenden Hindernis* (Matthias Hieber / Robert Haller-Dintelmann)

Wierschem, Jürgen, *Berufsausbildung in außerbetrieblichen Einrichtungen* (Angela Paul-Kohlhoff)

2010

Becker, Meike, *Parametrisierung und Rekonstruktion einer Fläche vom Geschlecht 1 im Rahmen der Segmentierung mit statistischen Formmodellen* (Ulrich Reif / Stefan Ulbrich)

Blum, Jens, *Leistungsentwicklungen in rechnerfreien mathematischen Fertigkeiten im Projekt MABIKOM* (Regina Bruder)

Brzuska, Christina, *Thrall's Third Conjecture - On Reflexive Subspace Lattices* - (Christian Herrmann)

Jakob, Patrick, *Finite-Elemente-Vergleichsrechnung von Wandscheiben in Holztafelbauweise unter besonderer Berücksichtigung des lokalen Verbundverhaltens mechanischer Verbindungsmittel* (Martin Kiehl / Regina Bruder)

Kappei, Ulrich, *Eine Längsschnittmethode zur Planungskompetenz von Lehramtsstudenten im Fach Mathematik* (Regina Bruder)

Kaul, Florian, *Ein Evaluationskonzept für digitale mathematische Unterstützungsangebote an den Hochschulen* (Regina Bruder)

Kirchner, Manuel, *Zum Umgang mit Lernerunterschieden in der beruflichen Teilzeitausbildung Fachschule Technik* (Regina Bruder)

Moock, Verena, *Point-Line Configuration (184)* (Jürgen Bokowski)

Pfästerer, Henning, *Beiträge zur Modellierung der diagnostischen Kompetenz von Mathematiklehrkräften* (Regina Bruder)

Pistner, Matthias, *Entwicklung einer Selbstlernumgebung für Ausbildungsberufe im Technischen Bereich zum Thema "Toleranz und Passungen"* (Alfred Neudörfer / Regina Bruder)

Puchert, Christian, *Primal Heuristics for Branch-and-Price Algorithms* (Marco Lübbecke)

Rashidova, Hyuliya, *Wealth Effects of Oscar Prize Awards* (Dirk Schiereck / Wilhelm Stannat)

5.5 Staatsexamen Theses

2009

Amend, Madeleine, *Schülersichten auf den Stochastikunterricht in Klasse 9 im Projekt CALiMERO* (Regina Bruder)

Buggle, Daniel, *Die Statik eines Flachdaches - Ein Modellierungsprojekt für die Schule* (Martin Kiehl)

Catta, Tobias, *Didaktische Hilfestellungen zur rechnergestützten Einführung von Funktionstypen in der Sekundarstufe I* (Regina Bruder)

Finster, Ronja, *Schülersichten auf die Unterichtseinheit Potenzen in Klasse 9 im Projekt CALiMERO* (Regina Bruder)

Hain, Dorothea, *Langfristiger Kompetenzaufbau zum räumlichen Vorstellungsvermögen im Mathematikunterricht* (Regina Bruder)

Hammer, Matthias, *Mathematischer Kompetenzaufbau in den Themenfeldern Kongruenz und Ähnlichkeit* (Regina Bruder)

Hirschberger, Sabine, *Mathematische Anwendungen in der Bautechnik für die berufliche Schule* (Regina Bruder)

Kern, Marlon, *Rechnergestützte mathematische Kompetenzentwicklung in Klasse 8* (Regina Bruder)

Kirchner, Viktor, *Zur Entwicklung eines binnendifferenzierenden Konzeptes für den gymnasialen Mathematikunterricht - MABIKOM* (Regina Bruder)

Lotter, Anke, *Aufgabenmaterialien zum Argumentieren und Beweisen in der Sekundarstufe 1* (Regina Bruder)

Roth, Tabea, *Leistungsentwicklung im Projekt CALiMERO in Klasse 9* (Regina Bruder)

Schreyer, Thomas, *Langfristiger Kompetenzaufbau zum Argumentieren und Beweisen in der Sekundarstufe I* (Regina Bruder)

Steinfeld, Vincent, *Ein Lehrerfortbildungskurs zum langfristigen Kompetenzaufbau beim mathematischen Problemlösen* (Regina Bruder)

Stoklas, Tobias, *Analyse von Akzeptanzbefragungen zum Unterrichtskonzept im Projekt CALiMERO* (Regina Bruder)

Wetzel, Florian, *Langfristiger Kompetenzaufbau im Stochastikunterricht der Sekundarstufe I* (Regina Bruder)

2010

Herrmann, Michael, *Entwicklung von Problemlösekompetenzen in der linearen Algebra in der Gymnasialen Oberstufe* (Regina Bruder)

Klemen-Geiger, John, *Dynamische Programmierung in der Gasnetzwerksoptimierung* (Alexander Martin)

Kovacs, Miriam, *Aufgabenanalysen für einen rechnergestützten kompetenzorientierten Algebraunterricht in der Sekundarstufe II* (Regina Bruder)

Pusch, Carola, *Problemlösen im Analysisunterricht der Oberstufe* (Regina Bruder)

Schulz, Karolin, *Binnendifferenzierend mathematisch Modellieren lernen mit langfristigen Hausaufgaben* (Regina Bruder)

Sözgen, Muhammet, *Ein computergestütztes Lernmodul zur Graphentheorie* (Regina Bruder)

Wahl, Timo, *Problemlösen im Stochastiklehrgang der Oberstufe* (Regina Bruder)

Wondra, Tetyana, *Umgang mit unendlich kleinen Größen bei Leibniz, Newton und im heutigen Schulunterricht* (Burkhard Kümmerer)

Wunderlich, Vesna, *Logisches Denken fördern mit formaler Begriffsanalyse* (Regina Bruder)

Zienert, Isabell, *Kompetenzorientierte Lernumgebung zu quadrtischen Funktionen* (Regina Bruder)

5.6 Bachelor Theses

2009

Andreeva, Adriana, *DoS Resistant Live Streaming Networks* (Karsten Weihe)

Bengyuzov, Georgi, *Optimale Bewertung einer Amerikanischen Option in diskreter Zeit* (Michael Kohler)

Bruse, Florian, *Model Checking in Modallogik und Zwei-Variablen-Logik erster Stufe* (Martin Otto)

Dimitrov, Dimitar Iliev, *Ein Algorithmus zur Berechnung oberer Schranken für die Preise Amerikanischer Optionen* (Michael Kohler)

Hristov, Angel, *Bewertung Amerikanischer Optionen mit Hilfe von regressions-basierten Monte-Carlo-Verfahren* (Michael Kohler)

Kolev, Velizar, *Optimization Algorithms in Medical Image Registration* (Alexander Martin)

Lin, Jia, *A Greedy Randomized Search Procedure for the Minimum Graph Bisection Problem* (Alexander Martin)

Nold, Andreas, *Refined Discrete Models for Topology Optimization of Sheet Metal Design* (Armin Fügenschuh)

Nordheim, Jens Christoph, *Durchmessergewichtete Spannbäume* (Alexander Martin)

Petrov, Lyuben, *Brep-Based Translation between the JT and ACIS CAD Formats* (Ulrich Reif)

Roos, Stefanie, *Genetische Programmierung zur Vorhersage von medizinischen Daten* (Karsten Weihe)

Ruseva, Desislava, *Security Analysis of Quaternion Signatures* (Johannes Buchmann)

Schreiber, Daniel, *Implementierung eines Algorithmus zur Segmentation von Follikeln in Ultraschallbildern des Eierstocks* (Ulrich Reif)

Straube, Ruben, *Fairness in kooperativen Spielen* (Werner Krabs)

Tomov, Pavlin Tsvetkov, *Analyzing and modeling of selected parameters of the facade construction of a building with respect to the sustainability and efficiency of the building* (Alexander Martin)

Valkova, Preslava, *Quantil-approximation bei Leptokurtische Finanzdaten* (Michael Kohler)

2010

Atanasov, Nikolay, *Branching Regeln für einen OBB-basierten Branch & Bound Algorithmus für MINLPs* (Alexander Martin)

Bartsch, Stefanie, *Planung von Formationswechseln in Mehrfahrzeugsystemen durch diskret-kontinierliche lineare Optimierung* (Oskar von Stryk)

Gogova, Martina, *Consistency of Regression-based Monte Carlo Methods for Pricing American Options in case of errors in Modelling the Price Process* (Michael Kohler)

Hartung, Lion, *Über den Swendgen-Wang-Algorithmus und seine Anwendung auf das Ising-Modell* (Wilhelm Stannat)

Ivanov, Bozhidar, *Numerische Integrationsverfahren für einen OBB-basierten Branch & Bound Algorithmus* (Alexander Martin)

Ivanov, Vladimir, *Scharfe OBBs zum Lösen von MINLPs durch Branch & Bound* (Alexander Martin)

Ivanova, Vanya, *Lattice Basis Reduction in Infinity Norm* (Johannes Buchmann)

Lang, Eva Maria, *Grenzwertsätze für Galton-Watson Prozesse* (Wilhelm Stannat)

Markert, Melanie Heidrun, *Robuste Optimierung von Stabwerken mit Aktoren durch semidefinite Optimerung* (Stefan Ulbrich)

Maslarova, Magdelina, *The Dual Method for Pricing American Options* (Michael Kohler)

Richter, Juliane, *Dynamic Peephole Pointing in One-Dimensional Space* (Max Mühlhäuser)

Sauer, Jens, *Aktivitätsorientierte Korrelationsmaße - Modellierung und Implementierung* (Bernt Schiele)

Schünemann, Sascha, *Bewertung von amerikanischen Optionen mittels regressionsbasierten Monte-Carlo-Verfahren mit Hilfe von additiven Modellen basierend auf Splines* (Michael Kohler)

Toshev, Todor Plamenov, *Parameterschätzung in Finanzzeitreihen* (Wilhelm Stannat)

Zhu, Xiaoyan, *Regressionsbasierte Monte-Carlo-Verfahren zur Bewertung Amerikanischer Optionen basierend auf lokal polynomialen Kernschätzen* (Michael Kohler)

Dimitrov, Ivaylo, *Algorithmus zur Berechnung der impliziten Volatilität von amerikanischen Optionen* (Stefan Ulbrich)

Günzel, Daniel, *The Transduction Hierarchy for Infinite Structures* (Achim Blumensath)

Hristov, Asparuh Ventsislavov, *Robust Linear Optimization* (Stefan Ulbrich)

Körnlein, Daniel, *Logische Extraktion von Schranken für die asymptotische Regularität von Pseudo-Kontraktionen* (Ulrich Kohlenbach)

Schade, Katharina Clara, *Rediscovering Finitism* (Ulrich Kohlenbach)

Guliyev, Zaur, *The Banach-Tarski Paradox* (Bálint Farkas)

Bauer, Lars, *Analyse einer Heuristik zur Reihenfolgeplanung paralleler Maschinen* (Marco Lübbecke)

Burkholz, Rebekka, *Verschränkungsberechende Abbildungen* (Burkhard Kümmerer)

Ewald, Tobias, *Totalkrümmung von verknoteten Raumkurven* (Karsten Große-Brauckmann)

Heyse, Ann-Kathrin, *Routing-Spiele zur Minimierung von Staus* (Marco Lübbecke)

Hufler, Tobias Holger, *Rationale Adele* (Ralf Gramlich)

Kontny, Markus Matthias, *Darstellung der Grundlagen von regressionsbasierten Monte-Carlo-Verfahren zur Bewertung Amerikanischer Optionen unter Verwendung von multivariaten Smoothing-Splines. Implementierung des Schätzers in R* (Michael Kohler)

Küppers, Sebastian, *Darstellung der Grundlagen von regressionsbasierten Monte-Carlo-Verfahren zur Bewertung amerikanischer Optionen unter Verwendung von neuronalen Netzen - Implentierung in R* (Michael Kohler)

Lebisch, Lukas, *A functional analytic approach to the heat equation: Monotonicity properties of weak solutions* (Robert Haller-Dintelmann)

Möller, Sven, *Satz von Stone und Anwendungen* (Burkhard Kümmerer)

Müller, Florian, *Euler´s Approximation for Semigroups* (Robert Haller-Dintelmann)

Sauer, Jonas, *Analysis der Landau-Lösung* (Reinhard Farwig)

Schmieg, Alexander, *Die isoperimetrische Ungleichung in der Ebene* (Karsten Große-Brauckmann)

Schwarzkopf, Stefan, *Ein Approximationsalgorithmus für die zeitliche Einteilung unabhängiger parallel laufender Maschinen* (Marco Lübbecke)

Sit, Gee Fung, *Ballistische feedforward-gesteuerte Bewegungen eines gelenkelastischen Leichtbau-Roboterarms* (Oskar von Stryk)

Werner, Fabian, *Ringe von Modulformen* (Nils Scheithauer)

Wiedenmann, Stefan, *Arvesons Beschreibung der Quantenverschränkung* (Burkhard Kümmerer)

Achard, Dominique, *Fahrplanoptimierung* (Marco Lübbecke)

Acker, Christoph Werner, *Aufspannende Teilgraphen mit kürzesten Umwegen* (Marco Lübbecke)

Beierlein, Christian, *Darstellung der Grundlagen von regressionsbasierten Monte-Carlo Verfahren zur Bewertung Amerikanischer Optionen unter Verwendung von neuronalen Netzen - Implementierung des Schätzers in MATLAB* (Michael Kohler)

Borchert, Frank, *Bestimmung eines aufspannenden Baumes mit annähernd minimalen Max-Stretch* (Marco Lübbecke)

Gann, Elena, *Mathematische Optimierung von Gebäudefassaden unter Nachhaltigkeitsaspekten* (Alexander Martin)

Gietl, Benedikt, *Vorstellung von gemischt-ganzzahligen Optimierungsverfahren in der Kreditportfoliooptimierung* (Stefan Ulbrich)

Kaffenberger, Grete, *Optimale Wassernetzwerke in Hochhäusern - Ein Ansatz mit diskreter Optimierung auf Graphen* (Ulf Lorenz / Martin Ziegler)

Kehr, Benedikt, *Effizienter Algorithmus für das beschränkte zweidimensionale Zuschneideproblem* (Marco Lübbecke)

Schwan, Lena Maria, *Ein Schnittebenenverfahren zur Färbung von Graphen* (Marco Lübbecke)

Tent, Reinhard, *Untersuchung von Verfahren zur Bewertung amerikanischer Optionen mit Hilfe von Bäumen* (Michael Kohler)

Uhl, Florian Hans Eckehard, *Ein Approximationsalgorithmus für das metrische unkapazitierte Facility Location Problem* (Marco Lübbecke)

Vock, Sebastian Erik, *Flottenplanung von Flugzeugen* (Marco Lübbecke)

Weinbender, Dennis, *Nonparametric Regression via Local Averaging* (Michael Kohler)

Weisgerber, Tim Norbert, *Modellieren und Lösen eines gemischt-ganzzahligen linearen Programms für die Erstellung eines kostenminimalem Luftverkehrsnetz* (Marco Lübbecke)

6 Presentations

6.1 Talks and Visits

6.1.1 Invited Talks and Addresses

Benno van den Berg

29.10.09 *Constructive set theory*
Workshop on Constructive Mathematics/Boca Raton, Florida

07.05.10 *Constructive set theory and derived rules*
Set Theory, Classical and Constructive/Amsterdam

03.12.10 *Algebraic set theory*
Tutorial on Algebraic Set Theory, Glasgow

Achim Blumensath

06.01.09 *On the Monadic Second-Order Transduction Hierarchy*
ASL Winter Meeting, Special Session on Model Theoretic Methods in Finite Combinatorics

12.03.10 *A Pumping Lemma for Higher-order Pushdown Automata*
Higher-Order Recursion Schemes & Pushdown Automata

28.08.10 *The boundedness problem for monadic second-order logic on trees*
Logic, Combinatorics and Computation

Dieter Bothe

05.02.09 *Modeling and simulation of two-phase flows with mass-transfer*
4th workshop Micro-macro modeling and simulation of liquid-vapour flows, RWTH Aachen

07.04.09 *Sharp interface models for fluidic particles*
Oberseminar Institut für Analysis, Universität Halle-Wittenberg

29.04.09 *Nonlinear evolution equations with applications to reaction-diffusion systems*
Berliner Oberseminar Nichtlineare partielle Differentialgleichungen (Langenbach-Seminar), Berlin

05.05.09 *On the Maxwell-Stefan approach to multicomponent diffusion*
ENS Cachan, Antegne des Britagne, University of Rennes

24.06.09 *Sharp interface models for fluidic particles*
Oberseminar AG Modellierung und PDEs, Universität Bremen

05.02.10 *Transport Processes at Fluidic Interfaces*
New Directions in Simulation, Control and Analysis for Interfaces and Free Boundaries, Oberwolfach Conference

01.07.10 *Sharp-interface models for transport processes at fluidic interfaces*
Workshop on Interfaces in Multiphase Flow, Universität Stuttgart

07.09.10 *Sharp-interface models for two-phase fluidic systems*
Deutsch-Französische Sommerschule "Modellierung, numerische Simulation und Optimierung in der Strömungsmechanik: Theorie und Praxis" der DFH

Eyvind Martol Briseid

22.09.10 *Proof Mining for Rates of Convergence in Metric Fixed Point Theory*
Colloquium Logicum 2010(Tagung der Deutschen Vereinigungi für Mathematische Logik und für Grundlagen der Exakten Wissenschaften)/Münster

Regina Bruder

03.02.09 *Langfristige Kompetenzentwicklung im Mathematikunterricht*
Vortrag auf dem 14. Dresdner Kolloquium zur Mathematik und ihrer Didaktik, Dresden

13./14.02.09 *Online-Lehrerfortbildungskurse und Unterstützungsinstrumente für einen kompetenzorientierten Mathematikunterricht*
Vortrag im Hochschulforum der didacta 2009, Hannover

03.03.09 *Hauptvortrag auf der GDM-Tagung*
Oldenburg

14./19.03.09 *Vortrag zum Thema "Wege zu einem langfristigen Kompetenzaufbau im Mathematikunterricht", Workshop zum Thema "Problemlösenlernen- aber wie?"*
SINUS-Tagung, Lüneburg

31.08.09 *Projektvorstellung gemeinsam mit C. Collet "Zur Entwicklung und Erprobung eines Unterrichtskonzeptes zum Problemlösenlernen im Mathematikunterricht - Wirkungsanalysen bei den Lehrenden und Lernenden"*
GFD-Tagung, Berlin

28.08.09 *Symposiums-Vortrag gemeinsam mit C. Collet zum Thema "Problem solving - a teaching concept for heuristic strategies to support mathematical problem solving competencies"*
EARLI, Amsterdam

31.08.09 *GFD-Methodenworkshop zum Repertory-Grid*
Berlin

03.09.09 *Binnendifferenzierte Kompetenzentwicklung*
Hessische Fachleitertagung in der Reinhardswalschule, Fuldatal

23.09.09 *Lernaufgaben im Mathematikunterricht*
Vortrag und Workshop in der Pädagogischen Woche, Universität Oldenburg

30.10.09 *Wege zu einem langfristigen Kompetenzaufbau*
Vortrag auf der Tagung des Evangelischen Schulbundes Nord e.V, Magdeburg

03.11.09 *Binnendifferenzierung im Mathematikunterricht*
Vortrag an der Johannes Gutenberg - Universität, Mainz

06.11.09 *Verpackungsoptimierung – ein Thema für einen langfristigen Kompetenzaufbau im mathematischen Modellieren*
Hauptvortrag auf dem Lehrerfortbildungstag zur ISTRON-Tagung, Wien

16.11.09 *Problemlöseprozesse im unterrichtlichen Kontext*
Vortrag im didaktischen Kolloquium, Universität Hannover

20.11.09 *Binnendifferenzierung im Mathematikunterricht*
Hauptvortrag auf der t^3-Tagung "Sharing Inspiration", Frankfurt

18.01.10 *Förderung leistungsstarker Schüler/innen im Mathematikunterricht der Sekundarstufe I des Gymnasiums*
Vortrag zur Lehrerfortbildungsveranstaltung, Steinatal

19.01.10 *Kompetenzorientierte und technologiegestützte Konzepte im Mathematikunterricht*
Vortrag im didaktischen Seminar, Universität Freiburg

22.01.10 *"CAS ab Klasse 7? Konzept und Ergebnisse von CAliMERO"*
Vortrag auf der Jahrestagung des RP Karlsruhe für technologieinteressierte Mathematiklehrkräfte, Karlsruhe

18.02.10 *Auf welche Unterschiede der Lernenden können wir im Mathematikunterricht eingehen*
Vortrag auf dem Lehrerfortbildungstag in Berlin

01.03.10 *Vorstellung eines rechnergestützten Unterrichtskonzeptes zur mathematischen Kompetenzentwicklung anhand des niedersächsischen Modellprojektes CAliMERO (ab Kl.7)*
Hauptvortrag auf der Tagung zu "Digitalen Medien im Mathematikunterricht", Friedberg (Hessen)

05.03.10 *Auf welche Unterschiede der Lernenden können wir im Mathematikunterricht eingehe*
Vortrag und Workshop auf dem Mathematik-Fachtag in Marburg

11.03.10 *Stand und Perspektiven fachdidaktischer Theorieentwicklung*
Vortrag auf der Jahrestagung von GDM und DMV, München

15.-18.03.10 *Langfristiger Kompetenzaufbau im Mathematikunterricht. Individualisierung - das jetzt auch noch (Hauptschule)*
Vortragsreise durch Tirol (Reutte, Innsbruck, Fieberbrunn)

11.05.10 *Qualitätsbeurteilung von computergestützten Lernarrangements mit dem TU Gütesiegel: Hintergrund, Konzept und Entwicklungsperspektiven*
Vortrag im Rahmen der Ringvorlesung im GK "Rückgekoppelte Prozesse im E-Learning", TU Darmstadt

07.05.10 *Einsatz neuer Medien im Mathematikunterricht. Das Beispiel CAliMERO: Rechnereinsatz mit Konzept im Mathematikunterricht*
Vortrag zum Technologietag, Hildesheim

03.06.10 *CALiMERO: Rechnereinsatz mit Konzept*
Vortrag zur Multiplikatorenschulung CAS-Einsatz in Thüringen, Apolda

07.06.10 *Die etwas andere mündliche Prüfung mit einem veranstaltungsbegleitenden Portfolio*
Vortrag in der HDA der TU Darmstadt

15.06.10 *Langfristiger Kompetenzaufbau im Mathematischen Modellieren in den Sekundarstufen*
Vortrag im Didaktischen Kolloquium, Universität Bielefeld

08.07.10 *CALiMERO: Rechnereinsatz mit Konzept*
Vortrag zur Multiplikatorenschulung CAS-Einsatz auf der Brandenburgischen t^3-Tagung, Luckenwalde

05.11.10 *An Verpackungen kann man (nicht nur, aber besonders effektiv) Mathematisches Modellieren lernen*
Lehrerfortbildungsvortrag ISTRON-Tagung, Hamburg

22.11.10 *Langfristiger Kompetenzaufbau im mathematischen Modellieren in den Sekundarstufen - ganz konkret*
Regionalkonferenz zur Lehrerfortbildung, Fulda

06./07.12.10 *Langfristiger Kompetenzaufbau im Mathematikunterricht. Individualisierung im MU – das nun auch noch!*
Lehrerfortbildungsseminar, St. Georgen, Schweiz

Jan H. Bruinier

16.12.10 *Ableitungen von L-Funktionen und unendliche Produkte*
Mathematisches Kolloquium, Universität Freiburg

02.12.10 *Harmonic Maass forms and periods*
Number Theory seminar, Emory University, USA

12.07.10 *CM values of modular functions*
Conference of the Canadian Number Theory Association, *CNTA XI*, Acadia University, Wolfville, Canada

24.06.10 *The Gross-Zagier formula and Borcherds products*
Oberseminar Algebra, Geometrie und Zahlentheorie, Universität Essen

01.06.10 *Die Gross–Zagier-Formel und Borcherds-Produkte*
Oberseminar "Computational Mathematics", Universität Kassel

21.05.10 *Ableitungen von L-Funktionen und unendliche Produkte*
Mathematisches Kolloquium, Universität des Saarlandes, Saarbrücken

03.05.10 *Derivatives of L-functions and infinite products*
Pure Maths Colloquium, Durham University

28.04.10 *Mock modular forms and infinite products*
Number Theory Seminar, University College, Dublin

09.03.10 *Coefficients of harmonic Maass forms*
Workshop *Mock modular forms in combinatorics and arithmetic geometry*, American Institute of Mathematics, Palo Alto, 08.03.10–12.03.10

28.01.10 *Ableitungen von L-Funktionen und harmonische Maass-Formen*
Mathematisches Kolloquium, Universität Heidelberg

19.01.10 *Ableitungen von L-Funktionen und unendliche Produkte*
Mathematisches Kolloquium, Universität Hamburg

13.01.10 *Regularized theta lifts for orthogonal groups over totally real fields*
Department of Mathematics, Postech, Pohang, Korea

16.12.09 *The Gross-Zagier formula and the Borcherds lift*
Workshop on *Cycles and Special Values of L-series*, CRM Barcelona, 14.12.09–18.12.09

19.11.09 *Regularized theta lifts for orthogonal groups over totally real fields*
Number Theory Seminar, University of Wisconsin at Madison

10.07.09 *Borcherds products and their applications to arithmetic geometry*
10 hour lecture series, summer program on *Shimura Varieties*, Morningside Center of Mathematics, Beijing, China, 10.07.09–31.07.09

22.06.09 *Faltings heights of CM cycles and derivatives of L-functions*
Tagung *Algebraische Zahlentheorie*, Mathematisches Forschungsinstitut, Oberwolfach, 22.06.09–26.06.09

25.05.09 *Mock theta functions and infinite products*
Conference *Mock theta functions and applications in combinatorics, algebraic geometry, and mathematical physics*, Max Planck Institute for Mathematics, Bonn, 25.05.09–29.5.09

03.05.09 *Borcherds products and their applications to arithmetic geometry*
10 hour lecture series, *The Bellairs Workshop in Number Theory*, The Bellairs Research Institute (of McGill University), Barbados, 03.05.09–10.05.09

09.03.09 *Faltings heights of CM cycles and derivatives of L-functions*
Séminaire de théorie des nombres de Chevaleret, Paris

06.02.09 *Ableitungen von L-Funktionen und unendliche Produkte*
Mathematisches Kolloquium, Universität Frankfurt

28.01.09 *Faltings heights of CM cycles and derivatives of L-functions*
ALKS-Seminar, Aachen

Pia Domschke

12.07.10 *An adaptive model switching and discretization algorithm for gas flow on networks*
24th European Conference on Operational Research EURO 2010, Lissabon

Bálint Farkas

14.10.10 *Operator splitting for non-autonomous equations*
International Conference on Evolution Equations in Honor of the 60th Birthdays of Wolfgang Arendt, Jan Prüß, Lutz Weiß

01.07.10 *Almost periodicity almost everywhere*
Conference on Semigroups, Evolution Equations and Boundary Conditions, in honor of Silvia Romanelli, Tübingen

Reinhard Farwig

15.01.09 *Das Millenniumsproblem der Navier-Stokes-Gleichungen*
Mathematisches Kolloquium, Münster

19.02.09 *Weak Solutions of the Navier-Stokes equations with nonhomogeneous boundary data*
Research Seminar, Nečas Center for Mathematical Modeling, Prague

12.05.09 *Weak Solutions of the Navier-Stokes equations with nonhomogeneous boundary data*
International Conference: Nonlinear Parabolic Problems, Banach Center Bedlewo (Poland)

05.06.09 *Weak Solutions of the Navier-Stokes equations with nonhomogeneous boundary data*
Workshop on Navier-Stokes Equations, RWTH Aachen

04.09.09 *Flow Around Rotating Bodies – Basic Questions and Surprising Results*
PDE Seminar, Ferrara

09.09.09 *Asymptotic profile of Stokes and Navier-Stokes flow around a rotating obstacle*
International Center for Mathematics Research of Trento (CIRM), Levico Terme (Trento, Italy)

27.11.09 *On the Spectrum of a Stokes Operator with Rotation Effect in L^q-spaces*
PDE Seminar, Waseda University, Tokyo

30.11.09 *Global Weak Solutions of the Navier-Stokes Equations with Nonhomogeneous Data*
PDE Seminar, University of Nagoya

08.12.09 *Asymptotic Profile of Stokes and Navier-Stokes Flow Around a Rotating Obstacle*
International Conference 2009, Mathematical Analysis on the Navier-Stokes Equations and Related Topics, Past and Future, Kobe University

11.12.09 *The Millennium Problem of the Navier–Stokes Equations*
PDE Seminar, Women's University, Nara

27.01.10 *Asymptotic profile of Stokes and Navier-Stokes flow around a rotating obstacle*
Polish Academy of Sciences, Warsaw

12.03.10 *Spectral Properties of the Stokes and Oseen Operator with Rotation Effect in L^q-spaces*
International Workshop on Mathematical Fluid Dynamics, Waseda University Tokyo

12.05.10 *Regulär oder singulär - das ist die Frage bei den Navier-Stokes-Gleichungen*
Mathematisches Kolloquium, Dresden

26.05.10 *Asymptotic behavior of fluid flow around a rotating obstacle*
8th AIMS Conference on Dynamical Systems, Differential Equations and Applications Dresden

18.12.10 *Flow Around Rotating Obstacles – Basic Questions and Surprising Results*
Nečas Center for Mathematical Modeling, Prague

Matthias Frankenbach

27.05.10 *Adaptive Zweischritt-Peer-Methoden für inkompressible Navier-Stokes Gleichungen*
Rolls Royce Deutschland

Jaime Gaspar

15.07.09 *A logical view on Tao's finitizations in analysis*
Continuity Computability Constructivity: From Logic to Algorithms, Köln

16.07.10 *A logical view on Tao's finitizations in analysis*
O Gosto pela Matemática — Uma Década de Talentos, Calouste Gulbenkian Foundation, Lisbon, Portugal

Matthias Geissert

09.07.09 *Weak Neumann implies Stokes*
Universität Konstanz

01.10.10 *A free boundary problem related to the spin-coating process*
Waseda University, Tokyo

Alf Gerisch

14.09.09 *Peer-Methods for Time-Dependent Finite Element Computations*
NUMDIFF-12, Martin-Luther-Universiät Halle-Wittenberg, Halle, Germany

20.05.10 *Cellular adhesion: Modelling and numerical simulation*
Journées Numériques de Besançon, Besançon, France

Karoline Götze

10.05.10 *Strong solutions for fluid-rigid body interaction problems*
PDE Seminar, Tohoku University, Sendai

18.05.10 *Strong solutions for the free movement of a rigid body in an Oldroyd-B fluid*
PDE Seminar, Waseda University, Tokyo

11.11.10 *Strong solutions for the free movement of a rigid body in a viscoelastic fluid*
Oberseminar Partielle Differentialgleichungen, Universität Konstanz

Vassilios Gregoriades

17.05.10 *Effective Descriptive Set Theory and Applications in Analysis*
Universität Bonn

Karsten Große-Brauckmann

06.05.09 *Minimal and CMC surfaces in homogeneous 3-manifolds*
Colloquium, Amherst

05.06.09 *Moduli spaces of constant mean curvature surfaces and projective structures*
Geometry and Topology conference 2009, Lehigh

09.10.09 *The Halfspace theorem in Nil*
Oberwolfach

11.12.09 *Moduli spaces of constant mean curvature surfaces and projective structures*
Geometrie-Kolloquium, Tübingen

12.02.10 *Sind Seifenblasen immer rund?*
Kolloquium, Regensburg

12.02.10 *Moduli spaces of constant mean curvature surfaces and projective structures*
Analysis-Oberseminar, Regensburg

01.03.10 *Homogeneous 3-manifolds and minimal surfaces*
Arbeitsgruppentagung

17.03.10 *Constant mean curvature surfaces in theory and application*
Colloquium, Federal University of ABC, St. Andre, Brasil

26.03.10 *Constructing minimal and constant mean curvature surfaces via conjugate surface constructions*
Colloquium, St.Carlos, Brasil.

08.04.10 *Conjugate Plateau constructions in homogeneous spaces*
Conference Algebraic, Geometric and Analytic Aspects of Surface Theory, Buzios, Brasil

07.06.10 *Constant mean curvature surfaces and projective structures*
Oberseminar Differentialgeometrie, Münster

29.08.10 *Mathematics of Minimal Surfaces*
MaThCryst Conference of European Crystallographic Meeting, Darmstadt

Robert Haller-Dintelmann

22.01.09 *Problèmes elliptiques dans des polyèdres à plusieures matériaux (Elliptic problems in multi-material polyhedra)*
University of Valenciennes, France

05.05.09 *Maximale Regularität für Divergenzformoperatoren in unglatten Situationen*
Universität Karlsruhe

12.05.09 *Maximal regularity for divergence form operators in Sobolev spaces*
Conference "Nonlinear Parabolic Equations" in Bedlewo, Poland

06.-09.07.09 *Lecture series on "Maximale Regularität für parabolische Probleme" (4 talks)*
Johannes Gutenberg-Universität Mainz

01.12.09 *Coercivity for elliptic operators and positivity of solutions on Lipschitz domains*
International Conference on Elliptic and Parabolic Problems, Berlin

29.09.10 *The square root of divergence form operators with mixed boundary conditions*
Berliner Oberseminar "Nichtlineare partielle Differentialgleichungen" (Langenbach-Seminar)

Tobias Hansel

25.02.10 *On the Navier-Stokes flow past a rotating obstacle*
University of Salerno (Italy)

11.05.10 *The Navier-Stokes flow past a rotating obstacle: Time-dependent angular velocities and general outflow conditions*
Tohoku University Sendai (Japan)

21.05.10 *On the boundedness of the Stokes semigroup in exterior domains*
Waseda University Tokyo (Japan)

Horst Heck

16.06.09 *Nichtlineare Modelle: von Strömungsmechanik bishin zur Parameteridentifizierung*
Universität Leipzig

24.07.09 *Maximale Regularität von Evolutionsgleichungen*
Universität Mainz

11.05.10 *Rotierende Fluide*
Universität Paderborn

19.10.10 *Fluids Under the Influence of Rotation*
Cardiff University

Katrin Herr

24.08.10 *Symmetries in Linear and Integer Linear Programming*
Mini-Workshop: Exploiting Symmetry in Optimization, Oberwolfach

15.12.10 *Symmetries in Linear and Integer Linear Programming*
Algebra and Geometry Seminar, Rostock

Christian Herrmann

22.07.10 *On the equational theory of projection lattices of finite von Neumann algebras*
International Conference on Algebra and Logic, Prague

Sven Herrmann

08.05.09 *Fans of tropical linear spaces*
The North German Plain Goes Tropical, Göttingen

05.06.09 *Splits and tight spans of metrics and convex polytopes*
Centrum Wiskunde & Informatica (CWI), Amsterdam

Matthias Hieber

04.03.09 *Fluid Structure Interaction*
German-Chinese Conference on PDEs, TU Konstanz

14.04.09 *My best jokes*
Workshop on Fluid Mechanics, Waseda University

03.06.09 *Stability of the Ekman spiral*
Workshop on Navier-Stokes equations, RWTH Aachen

19.06.09 *Spin-Coating and Free-Boundary Value Problems*
Workshop on Two-Phase Flows, Berlin

21.07.09 *Two-Phase Flow Free Boundary Value Problems*
Workshop on Navier Stokes, Oberwolfach

01.12.09 *Weak Neumann implies Stokes*
Conference on Elliptic and Parabolic Equations, Berlin

12.03.10 *Boundary Layers in Fluid Mechanics*
Workshop on Mathematical Fluid Mechanics, Tokyo

14.07.10 *Stability for Semigroups related to energy in equalities*
IWOTA, Berlin

01.09.10 *Strong solutions to certain fluid-solid interaction problems*
Workshop on PDEs, semigroup theory and inverse problems, Bologna

05.09.10 *The Stokes equations in unbounded domains*
Workshop on Regularity Aspects of PDEs, Bedlewo

16.11.10 *Asymptotic properties and stability problems related to the Ekman spiral*
Workshop on Analysis and Discretisation Methods, Bielefeld

Michael Joswig

28.04.09 *Bees and Trees*
Kolloquium, TU Kaiserslautern

20.05.09 *Tropical Convexity*
Kolloquium, Universität Osnabrück

16.06.09 *The Software System* `polymake`
IBM Research Lab, Rüschlikon

28.-30.09.09 *Tropical Combinatorics*
Séminaire Lotharingien, Bertinoro

16.10.09 *Coarse Tropical Convexity and Cellular Resolutions*
Tropical Geometry in Combinatorics and Algebra, MSRI

11.03.10 *Crosscuts and Alexander Duality in Tropical Convexity*
DMV Tagung, Minisymposium "Discrete Geometry", München

16.07.10 *Tropical Linear Spaces, Matroid Decompositions, and Tropical Grassmannians*
Workshop "Tropical Geometry", Universität Frankfurt/Main

28.10.10 *Tropical Combinatorics*
Kolloquium, Universität Münster

20.11.10 *Split Decompositions of Convex Polytopes*
Baer-Kolloquium, Universität Stuttgart

Ulrich Kohlenbach

12.03.09 *Applied Proof Theory: Proof Interpretations and Their Use in Mathematics*
CHOCO Seminar, EHS, Lyon

31.07.09 *Applied Proof Theory (invited tutorial)*
ASL Logic Colloquium, Sofia

06.08.09 *Recent Applications of Proof Theory in Fixed Point and Ergodic Theory*
Conference on Logic and Mathematics, York

28.08.09 *Recent Applications of Proof Theory to Core Mathematics*
Malcev Meeting 2009, Novosibirsk

15.09.09 *Recent Applications of Proof Theory to Core Mathematics*
Colloquium Lecture, Lisbon

03.10.09 *Applied Proof Theory*
Workshop in Honor of Mogens Nielsen, Aarhus

30.10.09 *Recent Applications of Proof Theory in Metric Fixed Point and Ergodic Theory*
Workshop on Ergodic Theory, London

06.11.09 *Recent Applications of Proof Theory in Metric Fixed Point and Ergodic Theory*
Reverse Mathematics, Chicago

18.02.10 *Applied Proof Theory (invited tutorial)*
Workshop PhD's in Logic II, Tilburg

22.08.10 *Analyzing Proofs based on Weak Compactness*
CL and C'2010, Brno

08.10.10 *Proof Mining and Nonlinear Ergodic Theorems*
Colloquium Logicum: Proofs and Structures, PPS 2010, Paris

07.01.11 *Uniform Bounds from Proofs in Nonlinear Ergodic and Fixed Point Theory (invited talk at special session on 'Logic and Analysis')*
Joint Mathematics Meeting, New Orleans

01.04.11 *Proof Interpretations and Their Use in Nonlinear Analysis*
Logic Seminar, Bucharest

06.04.11 *Logical Extraction of Bounds from Proofs in Nonlinear Analysis*
Colloquium Lecture, Romanian Academy, Bucharest

28.04.11 *Proof Interpretations and Their Application to Current Mathematics*
Conference honoring the Winners of the Kurt Gödel Research Prize Fellowships 2008 and 2011, Vienna

18.05.11 *Proof Interpretations and Their Use in Nonlinear Analysis and Ergodic Theory*
Logic Seminar Talk, Freiburg

25.05.11 *Functional Interpretation of Proofs in Ergodic Theory and Combinatorics*
Ramsey Theory in Logic, Combinatorics and Complexity 'RaTLoCC 2011', Bertinoro

23.06.11 *Logical Extraction of Effective Bounds from Proofs in Nonlinear Ergodic Theory*
Logic Seminar Talk, Carnegie Mellon University, Pittsburgh

29.06.11 *Logical Extraction of Effective Bounds from Proofs in Nonlinear Ergodic Theory*
Talk at Logic and Computation Seminar, University of Pennsylvania, Philadelphia

05.07.11 *Logical Extraction of Effective Bounds from Proofs in Nonlinear Ergodic Theory*
Talk at New York Logic Colloquium and Computational Logic Seminar, Graduate Center of CUNY, New York City

Michael Kohler

23.04.09 *Regression-based Monte Carlo Methods for Pricing American Options*
Workshop on Recent Developments in Applied Probability and Statistics, Middle East Technical University (Ankara)

26.06.09 *Pricing of American options by regression-based Monte Carlo methods*
Rhein-Main Arbeitskreis Mathematics of Computation, Universität Marburg

Oliver Kolb

28.08.09 *Discrete-continuous optimal control with PDEs on networks*
International Symposium of Mathematical Programming (ISMP) 2009, Chicago

Andreas Kollross

31.03.09 *Low cohomogeneity and polar actions on symmetric spaces*
University of Luxembourg

14.10.09 *Polar actions and symmetric spaces I-III*
Vortragsreihe, 14.10.09–17.10.09, University of Santiago de Compostela

22.11.10 *Polare Wirkungen*
Friedrich-Alexander-Universität Nürnberg-Erlangen

Alexander Kreuzer

27.10.09 *Ramsey's Theorem for pairs and provably recursive functions*
RaTLoCC 2009 - Ramsey Theory in Logic, Combinatorics and Complexity, Bertinoro, Italy

Burkhard Kümmerer

2.7.09 *Auch Quanten sind vergesslich: Klassische und Quanten-Markovketten*
Universität Ulm

15.9.10 *Mathematik zwischen Anschauung und Sprache*
ETH Zürich

Jens Lang

07.05.09 *On Global Error Estimation and Control for ODEs and Parabolic PDEs*
Numerical Seminar at University of Utrecht, The Netherlands

07.07.09 *W-Methods for Optimal Control*
Numerical Seminar at Martin-Luther-Universität Halle-Wittenberg, Germany

06.10.10 *On Global Error Estimation and Control for ODEs and Parabolic PDEs*
Numerical Seminar at University of Lugano, Switzerland

25.11.10 *Transport in Gas and Water Supply Networks*
Numerical Seminar at Goethe-Universität Frankfurt, Germany

Andrew R. Linshaw

19.06.09 *Invariant theory and the $\mathscr{W}_{1+\infty}$-algebra*
VIII. International Workshop "Lie Theory and its Applications in Physics," Bulgarian Academy of Sciences, INRNE, Varna, Bulgaria

17.08.09 *Invariant theory and the $\mathscr{W}_{1+\infty}$-algebra*
Mini Conference on Chiral Differential Operators, IPMU, University of Tokyo

18.08.09 *Chiral equivariant cohomology*
Mini Conference on Chiral Differential Operators, IPMU, University of Tokyo

18.08.09 *Invariant chiral differential operators*
Mini Conference on Chiral Differential Operators, IPMU, University of Tokyo

23.03.10 *Chiral equivariant cohomology*
Groups, Geometry, and Topology, Universität Stuttgart

Ulf Lorenz

25.10.10 *Searching for Solutions of Hard Problems*
ZiF Workshop Search Methodologies II, Bielefeld

16.07.10 *Polyhedral and algorithmic properties of quantified linear programs, COGA Doktorandenseminar*
Berlin

Martin Otto

06.11.09 *Methods For Deciding Boundedness of Least Fixed Points*
Fachgruppentreffen Logik in der Informatik, Frankfurt

09.12.09 *Methods For Deciding Boundedness of Least Fixed Points*
Computer Laboratory, Oxford

26.08.10 *Expressive Completeness*
Advances in Modal Logic, Moscow

Andreas Paffenholz

25.04.09 *Lattice Polytopes in Polymake*
AMS Spring Meeting 2009, San Francisco, USA

Guido Pinkernell

04.06.09 *Funktionales Denken mit einem CAS vielseitig fördern*
Vortrag vor dem Didaktischen Arbeitskreis Schule, Universität in Hannover

16.09.09 *CAliMERO: Computeralgebra im Mathematikunterricht Entdecken – Rechnen – Organisieren. Entwicklung und Erprobung eines technologie- und kompetenzorientierten Unterrichtskonzepts für die gesamte Sekundarstufe I*
Hauptvortrag auf der 8. Thüringer Regionaltagung T^3, Bad Berka

14.11.09 *Einsatz von CAS und anderen digitalen Medien im Mathematikunterricht*
Hauptvortrag auf dem gemeinsamen Lehrertag von T^3 und dem Erlebnisland Mathematik, Dresden

05.03.10 *CAliMERO – A German Project on CAS in Secondary Schools: Concepts, Materials, Results*
Vortrag auf der T3 International Conference in Atlanta, USA

20.10.10 *Unterrichten mit einem CAS-Handheld – besser als nur gute Ideen ist ein Konzept.*
Vortrag vor dem Didaktischen Kolloquium des IEEE an der Technischen Universität Dortmund

Julia Plehnert

09.01.09 *CMC surfaces in* $\mathbb{S}^2 \times \mathbb{R}$
Workshop on geometry and approximation, TU Darmstadt

09.10.09 *Minimal surfaces in $M^2 \times \mathbb{R}$*
Arbeitsgemeinschaft Minimal Surfaces, Oberwolfach

17.03.10 *The geometry of 3-dimensional homogeneous manifolds*
Federal University of ABC, Santo André, Brazil

26.03.10 *Ruled minimal surfaces in homogeneous manifolds*
Federal University of São Carlos, Brazil

Ulrich Reif

01.07.09 *35 Years of Subdivision*
Conference on Geometry – Theory and Applications, Pilsen

13.10.09 *Three New Challenges in Subdivision*
Subdivision and Refinability, Pontignano

04.02.10 *Orthogonale Polynome und orthogonale Splines*
Festvortrag des Gedenkkolloquiums für Prof. Lesky, Universität Stuttgart

20.05.10 *Subdivision Algorithms - Part I*
Survey Talk at INDAM Meeting, Bertinoro

21.05.10 *Subdivision Algorithms - Part II*
Survey Talk at INDAM Meeting, Bertinoro

22.05.10 *Subdivision Algorithms - Part III*
Survey Talk at INDAM Meeting, Bertinoro

23.05.10 *Subdivision Algorithms - Part IV*
Survey Talk at INDAM Meeting, Bertinoro

09.09.10 *Multivariate Polynomial Interpolation and Approximation*
MAIA Workshop, Edinburg

Steffen Roch

15.06.09 *Spatial discretization of C^*-algebras*
International Summer School “Operator Algebras and Applications”, IST Lisbon, 4 lectures

24.09.09 *Spatial discretization of Cuntz algebras*
Plenary talk at IWOTA, Guanajuato, Mexico

30.09.09 *Finite sections of operators in reduced group C^*-algebras*
IPN Mexico/City

03.09.10 *Spatial discretization of restricted group C^*-algebras*
Seminar on Functional Analysis, IST Lisbon

Rolf Roth

06.04.10 *Discrete adjoint techniques for flow optimization*
11^{th} Copper Mountain Conference On Iterative Methods, Copper Mountain

Pavol Safarik

07.11.11 *A Quantitative Nonlinear Strong Ergodic Theorem for Hilbert Spaces*
Mathematical Logic: Proof Theory, Constructive Mathematics, Oberwolfach

Nils Scheithauer

15.04.09 *Exzeptionelle Symmetrien*
Kolloquium, TU Darmstadt

06.06.09 *Lie Algebren und automorphe Formen*
Reinhold-Baer-Kolloquium, Justus-Liebig-Universität Gießen

16.06.09 *Moonshine for Conway's group*
VIII. International Workshop Lie Theory and its Applications in Physics, Institute for Nuclear Research and Nuclear Energy, Varna

13.01.10 *Exzeptionelle Symmetrien*
Kolloquium, TU Dortmund

09.02.10 *Moonshine for Conway's group*
Forschungsseminar Mathematische Physik, Philipps-Universität Marburg

09.03.10 *Moonshine for Conway's group*
Seminar, Graduate School of Mathematics, Nagoya University

17.03.10 *Moonshine for Conway's group*
Workshop Geometry of lattices and infinite dimensional Lie algebras, IPMU, Tokyo

25.03.10 *Moonshine for Conway's group*
Oberseminar Algebra und Geometrie, Goethe-Universität Frankfurt

12.05.10 *Some generalized Kac-Moody superalgebras related to superstrings*
Workshop Explicit constructions in the theory of automorphic forms and applications, Max-Planck-Institut für Mathematik, Bonn

31.08.10 *Some constructions of modular forms for the Weil representation*
Durham Days on Modular Forms, Durham University

04.10.10 *Infinite-dimensional Lie algebras and automorphic forms*
Algebra and Geometry seminar, Korteweg-de Vries Institute for Mathematics, University of Amsterdam

Werner Schindler

03.02.09 *Seitenkanalangriffe gegen Chipkarten und Sicherheitssoftware auf PCs*
19. SIT SmartCard Workshop / Darmstadt

28.05.09 *Stochastik und mathematische Statistik in der Kryptographie und IT-Sicherheit*
Halle University, postgraduate seminar stochastics, Halle

14.12.10 *Security Evaluation of Random Number Generators with an Outlook at the Upcoming New AIS 20 and AIS 31 Evaluation Guidelines*
University of Saint Étienne, Seminar, Saint Étienne, France

Adrian Sichau

12.11.10 *Robuste Optimierung bei der Auslegung lasttragender Strukturen*
1. Zwischenkolloquium SFB 805, Darmstadt

Wilhelm Stannat

10.04.09 *Invariant measures for SPDE - new a priori estimates and applications*
Kyoto

14.04.09 *Stochastic Encounters in Fluid Dynamics*
Mathematical Fluid Dynamics Launching Workshop, Tokyo (Waseda University)

15.04.09 *Invariant measures for SPDE - new a priori estimates and applications*
Tokyo

16.04.09 *Stochastic Navier-Stokes Equations*
Mathematical Fluid Dynamics Launching Workshop, Tokyo (Waseda University)

15.05.09 *Invariant measures for SPDE - new a priori estimates and applications*
Romanian-German Symposium on Mathematics and its Applications, Sibiu

26.05.09 *Improved a priori estimates on invariant measures for SPDE*
Stochastics and Real World Models 2009, Bielefeld

17.06.09 *Stability of the optimal filer - a variational approach*
Workshop on Filtering in Mathematical Finance, TU-Chemnitz

08.01.10 *Stochastic Navier-Stokes-Coriolis Equations*
Stochastic Partial Differential Equations, INI Cambridge

29.01.10 *Functional Inequalities for the Wasserstein Dirichlet form*
Stochastic Analysis, SPDE´s Particle Systems, Optimal Transport,Levico Terme

13.03.10 *Stochastic Navier-Stokes-Coriolis Equations*
International Workshop on Mathematical Fluid Dynamics, Waseda University, Tokyo

15.03.10 *Mini-Kurs "Stochastic Partial Differential Equations"*
3 Vorlesungen, Waseda University, Tokyo

26.04.10 *Stability of the Ekman spiral*
Probability and Statistics Seminar, School of Mathematics, The University of Manchester

06.05.10 *Functional Inequalities for the Wasserstein Dirichlet form*
Chinese-German Meeting on Stochastic Analysis and Related Fields, Academy of Mathematics and Systems Science, Chinese Academy of Sciences, Beijing

19.05.10 *Stochastic FitzHugh-Nagumo Systems*
Bernstein Center for Computational Neuroscience, Berlin

26.05.10 *Stochastic Stability of the Ekman Spiral*
8th AIMS International Conference on Dynamical Systems, Differential Equations and Applications, TU Dresden

15.06.10 *Stability of the optimal filter for nonergodic signals - a variational approach*
Workshop on Filtering, INI, Cambridge

01.09.10 *Stochastische partielle Differentialgleichungen: Kolmogorovoperatoren, invariante Maße, Funktionalungleichungen*
Fakultät für Mathematik und Informatik, Universität Leipzig

09.10.10 *Stochastische partielle Differentialgleichungen: Kolmogorovoperatoren, invariante Maße, Funktionalungleichungen*
Fakultät für Mathematik und Informatik, FSU Jena

11.10.10 *Stochastic Navier-Stokes-Coriolis Equations*
International Conference on Evolution Equations, Schmitten

Thomas Streicher

02.06.10 *Forcing within Classical Realizability*
Realizability Workshop, University of Chambery

09.07.10 *A categorical account of Krivine's Classical Realziability*
Workshop on Partial Combinatory Algebras in Realizability and Computability, University of Edinburgh

12.11.10 *Types as Kan Complexes*
Logique, Catégories, Sémantique, University of Bordeux

Fredrik Strömberg

12.03.09 *A dynamical approach to the Selberg zeta function*
Dynamical Systems and Quantum Mechanics, Queen Mary University of London, UK

22.06.09 *Maass waveforms for $SL_2(\mathbb{Z})$ and subgroups, from a computational point of view*
A lecture series of 4 lectures in the SMS Summerschool "Automorphic Forms and L-functions: Computational Aspects", CRM Montreal, Canada

30.09.09 *On computational aspects of vector-valued Poincaré series for the Weil representation*
AKLS seminar on automorphic forms, Universität Siegen

19.01.10 *On newforms and multiplicity of the spectrum for $\Gamma_0(9)$*
Forschungsseminar "Arithmetische Geometrie", Humboldt Universität, Berlin

06.05.10 *On multiplicities and newforms for $\Gamma_0(9)$*
Seminar talk. Lille University of Science and Technology, France

28.09.10 *On theoretical and computational aspects of the Weil representation*
Colloquium talk. Universität Siegen

31.08.10 *On some liftings from half-integral weight, scalar-valued modular forms to vector-valued modular forms*
Durham Days on Modular Forms, Durham, UK

Stefan Ulbrich

29.11.10 *Optimal Control of Discontinuous Solutions of Hyperbolic Conservation Laws*
CMAP, École Polytechnique, Paris

11.10.10 *Adaptive Multilevel Methods for PDE-Constrained Optimization Based on Adaptive Finite Element or Reduced Order Approximations*
Workshop Model Management and Reduced Order Model Approaches for Simulation Driven Optimization, Rice University, Houston

28.07.10 *Adaptive Multilevel Techniques for PDE-constrained Optimization*
Semiplenary Talk, ICCOPT 2010, Santiago, Chile

18.06.10 *Optimal Control of Discontinuous Solutions of Hyperbolic Conservation Laws: Theory and Numerical Approximation*
, Collège de France, Séminaire P.L. Lions de Mathématiques Appliqués, Paris

04.04.10 *Adaptive Multilevel Methods for Time-dependent PD(A)E-constrained Optimization with Control Constraints*
11th Copper Mountain Conference on Iterative Methods

07.03.10 *Adaptive Multilevel Methods for PDE-constrained and Large Scale Optimization*
Chemnitzer Seminar zur Optimalen Steuerung, Haus, Austria

16.09.09 *An Interior Point Filter Solver for Large Scale Nonlinear Programming*
Invited Minisymposium on Nonlinear Programming (Ph. Toint), 14th Belgian-French-German Conference on Optimization BFG'09, Leuven, Belgium

25.08.09 *Adaptive Multilevel Methods for Large Scale Nonlinear Optimization*
Invited Minisymposium on Nonlinear Programming (S. Leyffer, A. Sartenaer), 20th International Symposium on Mathematical Programming ISMP2009, Chicago.

24.07.09 *Interior Point and Semismooth Methods for PDE-constrained Optimization*
Block Course Mathematical and Computational Optimization, IWR Heidelberg

09.06.09 *Adaptive Multilevel Methods for PDE-constrained Optimization*
WIAS, Berlin

28.01.09 *Convergence of Linearized and Adjoint Approximations for Discontinuous Solutions of Conservation Laws*
Oberwolfach Workshop "Numerical Techniques for Optimization Problems with PDE Constraints"

Sebastian Ullmann

16.12.09 *A POD reduced model for Smagorinsky large-eddy simulation*
Mathematical Physics Seminar, Delft University of Technology

Christian H. Weiß

14.04.09 *Modellierung und Kontrolle von Zähldatenprozessen*
Dresdner Kolloquium zur Stochastik, Institut für Mathematische Stochastik, Technische Universität Dresden

21.06.10 *AR(1)-Modelle für Zähldatenzeitreihen*
Kolloquium der Fächergruppe Mathematik und Statistik, Helmut-Schmidt-Universität Hamburg

14.09.10 *Process Capability Analysis for Serially Dependent Processes of Poisson Counts*
Tenth Annual Conference of ENBIS, Antwerpen

Rudolf Wille

21.05.09 *Continua do not consist of points, points form only boundaries of continua*
Honorary talk, 7th International Conference on Formal Concept Analysis (ICFCA 2009)/Hochschule Darmstadt

30.07.09 *Human Being and Mathematics: Logical and Mathematical Thinking*
17th International Conference on Conceptual Structures (ICCS 2009)/State University Higher School of Economics, Moscow, Russia

10.09.09 *Communicative rationality, logic and mathematics*
Algebra and Logic: A Workshop in Honour of Jürg Schmid on the Occasion of his Retirement, University of Bern, Switzerland

03.12.09 *Mathematik semantologisch verstehen - Perspektiven Allgemeiner Mathematik*
11. Tagung Allgemeine Mathematik, Universität Siegen

15.03.10 *Mathematics, Presenting, Reflecting, Judging*
Honorary Talk, 8th International Conference on Formal Concept Analysis (ICFCA 2010), Agadir, Morocco

21.10.10 *Lifeworld and Mathematics*
The 7th International Conference on Concept Lattices and their Applications (CLA 2010), Seville, Spain

Martin Ziegler

10.09.09 *Skew Church-Turing Hypothesis*
8th Int. Conf. on Unconventional Computation (2009) Azores

Jan Carsten Ziems

27.08.09 *Adaptive multilevel SQP-methods for PDE-constrained optimization with control constraints*
International Symposium on Mathematical Programming (ISMP) 2009, Session Large Scale Nonlinear Programming and PDE-based Problems, Chicago, USA

23.03.10 *Adaptive multilevel SQP-methods for PDE-constrained optimization with control constraints*
81st Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM) 2010, young researchers minisymposium on adaptive approaches in PDE constrained optimization, Karlsruhe, Germany

6.1.2 Contributed Talks

Benno van den Berg

17.02.09 *Homotopy type theory and identity types*
Category Theory Seminar, Cambridge

25.05.09 *Derived rules and constructive set theory*
Mathematical Logic in the Netherlands, Nijmegen

11.07.09 *Homotopy type theory and identity types*
Featured talk at TACL 2009, Amsterdam

05.08.09 *Forcing and nonstandard arithmetic*
Logic and Mathematics, York

21.10.09 *Constructive set theory*
Mittag-Leffler Institute, Stockholm

17.11.09 *Forcing and nonstandard arithmetic*
Constructive mathematics: proof and computation, Uppsala

04.03.10 *Algebraic set theory*
Seminar of the team LIMD, Chambéry

01.06.10 *Herbrand realizability*
Workshop "Réalisabilité Chambéry", Chambéry

28.08.10 *Homotopy type theory and identity types*
International Workshop on Categorical Logic, Brno

Dieter Bothe

04.03.09 *Modellierung und Simulation von Transportprozessen an fluiden Grenzflächen*
Plenarvortrag der ProcessNet Fachausschussitzung Wärme- und Stoffübertragung/Mehrphasenströ
Bad Dürkheim

14.05.09 *On the Maxwell-Stefan approach to multicomponent diffusion.*
Conference on Nonlinear Parabolic Problems on the occasion of Herbert Amann's 70th birthday, Bedlewo

09.12.09 *Sharp-Interface Models for Fluidic Particles*
SIAM Conference on Analysis of Partial Differential Equations, Miami

13.03.10 *On multicomponent two-phase flows with mass transfer*
International workshop on Mathematical Fluid Dynamics, Waseda University, Tokyo

24.03.10 *25. Direct numerical simulation of high Schmidt number mass transfer from rising air bubbles using the Volume of Fluid Method*
12th Workshop on two-phase flow predictions, Halle (Saale)

Christian Brandenburg

28.08.09 *Shape Optimization for the Instationary Navier-Stokes Equations with Goal-Oriented Adaptivity*
ISMP 2009, Chicago

22.10.09 *Shape Optimization for the Instationary Navier-Stokes Equations with Goal-Oriented Adaptivity*
IRTG 1529 opening workshop, Darmstadt

08.03.10 *Goal-oriented adaptivity for shape optimization with the instationary Navier-Stokes equations*
Chemnitz Seminar on Optimal Control 2010, Haus im Ennstal, Austria

28.06.10 *Shape Optimization for the Instationary Incompressible Navier-Stokes Equations*
IRTG 1529 Klausurtagung, Blaubeuren

27.07.10 *Adaptive Shape Optimization for the Instationary Navier-Stokes Equations*
3rd International Conference on Continuous Optimization, Santiago de Chile

28.10.10 *Adaptive Shape Optimization for the Instationary Navier-Stokes Equations*
Waseda University, Tokyo

Eyvind Martol Briseid

19.07.09 *Heuristics of Proof Mining for Fixed Point Theorists*
9th International Conference on Fixed Point Theory and Applications, Changhua, Taiwan

Debora Clever

31.05.10 *Combination of an Adaptive Multilevel SQP Method and a Space-Time Adaptive PDAE Solver for Optimal Control Problems*
ICCS, Amsterdam

23.03.10 *Efficient Verification Tools for Reduced Derivatives Computed by a First-Optimize-Then-Discretize Approach for Optimal Control Problems*
GAMM, Karlsruhe

01.03.10 *Optimal Control for Nonlinear Space-Time-Dependent Partial Differential Algebraic Equations*
Retreat of DFG Graduate School of Excellence Computational Engineering, Heppenheim

05.10.09 *Adaptive Multilevel SQP-Methods for PDAE-Constrained Optimization with Restrictions on Control and State*
Annual Meeting of DFG-SPP1253, Kloster Banz

04.06.09 *Multilevel Optimization Techniques Using the Exact Hessian for PDAE Constrained Optimization Problems*
Workshop on PDE Constrained Optimization of Certain and Uncertain Processes, GAMM Activity Group on Optimization with PDE Constraints, Trier

Pia Domschke

26.05.09 *Hierarchical Modelling and Model Adaptivity for Gas Flow on Networks*
International Conference on Computational Science (ICCS) 2009, Baton Rouge

31.05.10 *An adaptive model switching and discretization algorithm for gas flow on networks*
International Conference on Computational Science (ICCS) 2010, Amsterdam

Stephan Ehlen

02.10.09 *Getwistete Borcherdsprodukte auf Hilbertschen Modulflächen*
DMV Studierendenkonferenz, Bochum

Bálint Farkas

15.07.10 *The periodic decomposition problem for operator semigroups*
IWOTA, Berlin

27.07.09 *Some open problems in abstract potential theory*
9th Summer School in Potential Theory, Nyíregyháza, Hungary

09.07.09 *Chebyshev constant, transfinite diameter and the maximum principle*
8th Summer School in Potential Theory, Budapest

Sonja Friedrich

07.07.09 *Partial Reverse Search*
Euro Conference, Bonn

Jaime Gaspar

27.03.09 *A logical view on Tao's finitizations in analysis*
Arbeitsgruppe Logik Seminar, TU Darmstadt, Germany

05.06.09 *Proof interpretations with truth [version 1]*
Réalisabilité à Chambéry, Bourget du Lac, France

06.08.09 *A logical view on Tao's finitizations in analysis*
Logic and Mathematics Conference, University of York, United Kingdom

12.08.09 *A logical view on Tao's finitizations in analysis*
Queen Mary, University of London, United Kingdom

10.09.09 *A logical view on Tao's finitizations in analysis*
Computer Science Logic, Coimbra, Portugal

09.10.09 *Proof interpretations with truth [version 1]*
Arbeitsgruppe Logik Seminar, TU Darmstadt, Germany

12.02.10 *Slash and completeness*
Arbeitsgruppe Logik Seminar, TU Darmstadt, Germany

05.03.10 *Rule of thumb for truth*
Informal Proof Theory Seminar / Beweistheorie Seminar, TU Darmstadt, Germany

18.03.10 *Slash and completeness*
Mathematical Logic Seminar, Faculty of Sciences of the University of Lisbon / Technical Superior Institute of the Technical University of Lisbon, Portugal

11.05.10 and 18.05.10 *Introduction to the bounded functional interpretation*
Informal Proof Theory Seminar / Beweistheorie Seminar, TU Darmstadt, Germany

15.06.10 and 22.06.10 *Negative translations not equivalent to the usual ones*
Informal Proof Theory Seminar / Beweistheorie Seminar, TU Darmstadt, Germany

25.06.10 *Proof interpretations with truth [version 2]*
Arbeitsgruppe Logik Seminar, TU Darmstadt, Germany

15.07.10 *Proof interpretations with truth [version 2]*
Mathematical Logic Seminar, Faculty of Sciences of the University of Lisbon / Technical Superior Institute of the Technical University of Lisbon, Portugal

30.07.10 *Proof interpretations with truth [version 2]*
Logic Colloquium 2010, Paris, France

23.09.10 *Proof interpretations with truth [version 2]*
Colloquium Logicum 2010, Münster, Germany

Matthias Geissert

11.10.10 *Weak Neumann implies Stokes*
Intern. Conference on Evolution Equations, Schmitten

07.09.10 *Fluid rigid-body interaction*
Intern. Workshop on Fluid Structure Interaction Problems, Foz do Arelho

12.03.10 *Weak Neumann implies Stokes*
International Workshop on Mathematical Fluid Dynamics, Tokyo

21.09.09 *Weak Neumann implies Stokes I*
DMV-Tagung, Graz

12.05.09 *Weak Neumann implies Stokes I*
International Conference Nonlinear Parabolic Problems, Bedlewo

Alf Gerisch

27.11.09 *Multiscale structure-functional modeling of musculoskeletal mineralized tissues*
Kick-off Meeting of DFG SPP 1420 Project Raum/Gerisch, Berlin, Germany

16.06.10 *Modelling the Oxygen Distribution in a Perfused Bioreactor for Cartilage Production (poster)*
TERMIS-EU 2010 Meeting, Galway, Ireland

29.10.10 *Mathematical models from the nanoscale to the microscale*
European Associated Laboratory (LEA) Ultrasound Based Assessment of Bone (ULAB) Meeting, Paris, France

18.11.10 *A Flexible Scheme for the Numerical Homogenisation in Linear Elasticity*
Comsol Conference 2010, Paris, France

Jane Ghiglieri

08.03.10 *Optimierung der Auslöschung von Tollmien-Schlichting-Wellen mit Plasma-Aktuatoren*
Chemnitzer Seminar zur Optimalsteuerung 2010, Haus im Ennstal, Österreich

11.10.10 *Optimal Flow Control Based on POD for the Cancellation of Tollmien-Schlichting Waves by Plasma Actuators*
Workshop Model Management and Reduced Order Model Approaches for Simulation Driven Optimization, Rice University, Houston, Texas

Karoline Götze

11.05.09 *Strong L^p-solutions to a problem of fluid-rigid body interaction*
International Conference on Nonlinear Parabolic Problems in honor of Herbert Amann, Banach Center, Bedlewo, Poland

19.05.09 *Strong L^p-solutions to a problem of fluid-rigid body interaction*
Seminar of the Necas Center for Mathematical Modeling, Mathematical Institute of the Czech Academy of Science, Prague

25.05.09 *Strong L^p-solutions to a problem of fluid-rigid body interaction*
Summer School on Mathematical Theory in Fluid Mechanics, Kacov, Czech Republic

09.06.09 *Analysis of rigid body movements in (non-)Newtonian fluids*
Seed Fund Workshop of CSI, TU Darmstadt

08.03.10 *Free movement of a rigid body in a generalized Newtonian fluid*
International Conference on Mathematical Fluid Dynamics, Waseda University, Tokyo

16.06.10 *Strong solutions for fluid-solid interaction problems*
Mini-Workshop on Fluid-Structure Interaction Problems, TU Darmstadt

13.07.10 *Maximal L^p-regularity for a fluid-solid interaction problem*
International Workshop on Operator Theory and its Applications (IWOTA), TU Berlin

21.09.10 *Strong solutions for the movement of a rigid body in an Oldroyd-B fluid*
Darmstadt-Prague Workshop of the Necas Center for Mathematical Modeling, Mathematical Institute of the Czech Academy of Science, Prague

Vassilios Gregoriades

22.05.10 *The descriptive set-theoretic complexity of the set of points of continuity of a multi-valued function*
CCA 2010, Zhenjiang, China

27.11.10 *The descriptive set-theoretic complexity of the set of points of continuity of a multi-valued function (in Greek)*
Meeting for Young Researchers in Analysis 2010, Athens, Greece

Ute Günther

08.07.09 *Handling manufacturing restrictions in sheet metal design by mixed integer programming*
23rd European Conference on Operational Research, Bonn

27.08.09 *Handling manufacturing restrictions in sheet metal design by mixed integer programming*
20th International Symposium of Mathematical Programming, Chicago, USA

Robert Haller-Dintelmann

14.10.10 *The square root of divergence form operators with mixed boundary conditions*
International Conference on Evolution Equations, Schmitten

Tobias Hansel

14.05.09 *The Navier-Stokes Equations with an unbounded and time-dependent drift*
Nonlinear Parabolic Problems, Bedlewo (Poland)

23.10.09 *On the Navier-Stokes Equations with unbounded and time-dependent drifts*
IRTG 1529 Opening Workshop, Darmstadt

05.03.10 *Non-autonomous Ornstein-Uhlenbeck type operators in exterior domains*
Workshop on the mathematical theory for the Navier-Stokes equations in various domains, Sapporo (Japan)

10.03.10 *Non-autonomous Ornstein-Uhlenbeck type operators in exterior domains*
International Workshop on Mathematical Fluid Dynamics, Tokyo (Japan)

28.06.10 *On the Oseen semigroup in exterior domains*
IRTG 1529 Klausurtagung, Blaubeuren

Horst Heck

12.05.09 *Weak Neumann implies Stokes*
Nonlinear Parabolic Problems, Bedlewo

24.09.09 *Weak Neumann implies Stokes II*
DMV/ÖMG Tagung, Graz

16.03.10 *On the stationary flow of viscous incompressible fluids past an obstacle*
Mathematical Fluid Dynamics, Tokyo

11.10.10 *Stationary solutions of the Navier-Stokes equations in the exterior of a rotating obstacle*
Interational Conference on Evolution Equations, Schmitten

Sven Herrmann

23.02.09 *Splitting polytopes*
62$^{\text{ème}}$ Séminaire Lotharingien de Combinatoire, Heilsbronn

17.03.09 *Tight spans and coarsest subdivisions of convex polytopes*
25th European Workshop on Computational Geometry, Brüssel

14.11.09 *Splitting polytopes*
Kolloquium über Kombinatorik, Magdeburg

Karl H. Hofmann

18.03.09 *The automorphism group of an infinite product of simple real Lie algebras*
Algebra Seminar, Tulane University, New Orleans, LA, USA

02.04.09 *On the automorphism group of pro-Lie algebras and the structure of almost connected pro-Lie groups*
Colloquium, Dalhousie University, Halifax, Nova Scotia, Canada

12.06.09 *Relevant Aspects of the Theory of Compact Groups*
TULKA Seminar on Ergodic Theory, Heinrich Fabri Institute, Blaubeuren

08.03.10 *The Dauns-Hofmann Theorem revisited*
Colloquium, Tulane University, New Orleans, LA, USA

09.03.10 *On the probability that two randomly picked elements in a compact group commute*
Functional Analysis Seminar, Louisiana State University, Baton Rouge, LA, USA

29.03.10 *The Probability that two randomly picked elements commute in a compact group*
Colloquium, Dalhousie University, Halifax, Nova Scotia, Canada

07.06.10 *Affine Compact Semigroups and Haar Measure on Compct Groups: Wendel's Proof Revisited*
Dagstuhl Conference on Quantum Information, Dagstuhl

22.06.10 *Automorphism Groups of Semisimple Pro-Lie Algebras and the Structure of Almost Connected Pro-Lie Groups I, II (with S. A. Morris)*
Conference on Homeomorphism Groups, Ben Gurion University of the Negev, Eilat, Israel

21.07.10 *The probability that two elements commute in a compact group*
Conference "Algebra Meets Topology", Barcelona, Spain

22.09.10 *When is a full homeomorphsm group compact?*
Algebra Seminar. Tulane University, New Orleans, La, USA

24.09.10 *When is a full homeomorphsm group compact?*
Functional Analysis Seminar, Louisiana State University, Baton Rouge, LA, USA

Alexander Kartzow

16.02.09 *FO Model Checking on Nested Pushdown Trees*
AlMoTH 2009, Dortmund

11.03.10 *Collapsible Pushdown Graphs are Tree-Automatic*
Workshop on Higher-Order Recursion Schemes and Pushdown Automata, Paris

Klaus Keimel

09.01.09 *Embedding locally convex ordered cones in topological vector spaces*
Workshop New Interactions between Analysis, Topology and Computation, University of Birmingham

Sarah Kessler

14.10.09 *Fluid-Structure Interaction Optimization*
First International Workshop on Computational Engineering, Herrsching, Germany

Michael Kohler

18.08.10 *On optimal exercising of American options in discrete time for stationary and ergodic data*
28th European Meeting of Statisticians, Piraeus

Oliver Kolb

31.05.10 *Modified QR Decomposition to Avoid Non-Uniqueness in Water Supply Networks with Extension to Adjoint Calculus*
International Conference on Computational Science (ICCS) 2010, Amsterdam

Andreas Kollross

25.11.10 *Nonnegatively curved homogeneous metrics*
Workshop "Analysis, Geometry and Group Representations for Homogeneous Spaces", Lorentz Center, Leiden

Christian Komo

19.05.09 *Regularity of weak solutions to the Navier-Stokes equations in exterior domains*
Necas Center for Mathematical Modelling, Prague

01.07.10 *Regularity of weak solutions to the Navier-Stokes equations in exterior domains*
International Summer School on Mathematical Fluid Dynamics, Levico Terme

21.09.10 *Convergence properties of some special weak solutions to the Boussinesq equations in domains with rough boundaries*
Necas Center for Mathematical Modelling, Prague

Alexander Kreuzer

02.08.09 *Ramsey's Theorem for pairs and provably recursive functions*
ASL Logic Colloquium, Sofia, Bulgaria

Karen Kuhn

09.12.10 *Comparison of the asymptotic stability for recursive ROS-multirate methods*
International Workshop on Multi-Scale Methods in Computational Engineering, Darmstadt

Jens Lang

28.05.09 *Global Error Control for Runge-Kutta-Rosenbrock Methods*
SCiCADE 2009, Beijing, China

15.07.10 *Adaptive Two-Step Peer Methods for Thermally Coupled Incompressible Flow*
Fifth European Conference on Computational Fluid Dynamics, ECCOMAS-CFD2010, Lisbon, Portugal

Nicole Lehmann

30.06.09 *The Embedded Weingarten Map - Theory and Applications*
Conference on Geometry: Theory and Applications, Plzen, Czech Republic

Stefan Löbig

10.02.09 *First Results on the Computation of Turbulent Flows on Moving Grids*
80th Annual Meeting of the International Association of Applied Mathematics and Mechanics (GAMM), Danzig (Poland)

Ulf Lorenz

07.09.10 *Polyhedral and algorithmic properties of quantified linear programs*
European Symposium on Algorithms (ESA), Liverpool

Andreas Mars

07.10.09 *Topological Kac–Moody groups and their twin buildings*
Buildings 2009, WWU Münster

25.06.10 *Central extensions of Kac–Moody groups over rings*
Norddeutsches Gruppentheorie-Kolloquium, MLU Halle-Wittenberg

Martin Otto

11.07.10 *Highly Acyclic Groups, Hypergraph Covers and the Guarded Fragment*
IEEE Symposium on Logic in Computer Science, Edinburgh

Andreas Paffenholz

12.11.10 *Cyclic Permutation Polytopes*
Kolloquium über Kombinatorik 2010, Saarbrücken

Guido Pinkernell

25.-27.09.09 *Qualitatives Modellieren mit der Funktionenbox und anderen schwarzen Kästen*
Arbeitskreistagung des AK Mathematik und Informatik der GDM, Soest

15.09.09 *Funktionales Denken technologieorientiert unterrichten*
Vortrag auf der 37. Hessischen Landestagung des Deutschen Vereins zur Förderung des mathematischen und naturwissenschaftlichen Unterrichts, Darmstadt

Rolf Roth

28.08.09 *Discrete adjoint techniques for flow optimization based on parallel Large Eddy Simulation*
20^{th} International Symposium of Mathematical Programming, Chicago

30.10.09 *Strömungsoptimierung auf Basis von FASTEST mit Adjungierten-basierten Methoden und Multilevel-Verfahren*
SFB 568 Klausurtagung, Seeheim-Jugenheim

08.03.10 *Discrete adjoint techniques for flow optimization*
Chemnitzer Seminar zur Optimalsteuerung, Haus im Ennstal

29.07.10 *Discrete adjoint techniques for flow optimization and POD supported shape optimization*
The International Conference on Continous Optimization 2010, Santiago de Chile

Pavol Safarik

23.07.09 *On the computational content of Bolzano-Weierstrass*
Computability in Europe (CiE 2009), Heidelberg

06.08.09 *On the computational content of Bolzano-Weierstrass*
Logic and Mathematics Conference, York

02.07.11 *A quantitative nonlinear ergodic theorem*
Computability in Europe (CiE 2011), Sofia

Nils Scheithauer

02.09.09. *On the classification of automorphic products and generalized Kac-Moody algebras*
Workshop on Lie algebras, vertex algebras and automorphic forms, ICMS, Edinburgh

Werner Schindler

26.06.09 *The Stochastic Approach in Power Analysis - A Synthesis between Engineer's Expertise and Advanced Stochastics*
CryptArchi 2009, Prague, Czech Republic

07.09.09 *A New Side-Channel Attack on RSA Prime Generation*
CHES 2009, Lausanne, Switzerland

28.06.10 *The Stochastic Approach in Power Analysis – An Efficient Attack and a Useful Tool for Target-Oriented Design*
CryptArchi 2010, Gif-sur-Yvette, France

Nada Sissouno

13.02.10 *Multivariate spline approximation on bounded domains*
20. Rhein-Ruhr-Workshop über Angewandte Analysis, Approximationstheorie, CAGD und Numerische Mathematik, Burg Gemen

Thomas Streicher

16.07.09 *Towards a logic of sequential domains*
CCC 2009, Köln

28.08.10 *A model of type theory in simplicial sets*
International Workshop on Categorical Logic, Brno

Fredrik Strömberg

12.03.09 *On computations of vector-valued Poincaré series for the Weil representation*
Annual workshop on automorphic forms and related topics/Bucknell University, Lewisburg, PA, USA

27.05.10 *On multiplicities and newforms for* $\Gamma_0(9)$
Sweden. Finnish - Swedish Number Theory Conference, Royal Institute of Technology, Stockholm, Sweden

Sebastian Ullmann

16.06.10 *A POD reduced model with updated coefficients for Smagorinsky LES*
V European Conference on Computational Fluid Dynamics ECCOMAS CFD 2010, Lisbon, Portugal

Christian H. Weiß

06.03.09 *CUSUM Monitoring of First-Order Integer-Valued Autoregressive Processes of Poisson Counts*
Ninth Workshop on Stochastic Models and Their Applications, Aachen

04.06.09 *Statistische Kontrolle von Zähldatenprozessen mit Überdispersion*
Pfingsttagung der Deutschen Statistischen Gesellschaft, Merseburg

22.09.09 *EWMA Control Charts for Monitoring Binary Processes with Applications to Medical Diagnosis Data*
Ninth Annual Conference of ENBIS, Gothenburg

05.10.09 *The INARCH(1) Model for Overdispersed Time Series of Counts*
Statistische Woche, Jahrestagung 2009, Wuppertal

23.03.10 *Detecting Mean Increases in Poisson INAR(1) Processes with EWMA Control Charts*
DAGStat-Tagung 2010: Statistik unter einem Dach, Zweite gemeinsame Tagung der Deutschen Arbeitsgemeinschaft Statistik, Dortmund

Rudolf Wille

22.03.09 *Human Being and Mathematics - Logical and Mathematical Thinking*
77. Arbeitstagung Allgemeine Algebra (AAA77), Universität Potsdam

13.06.09 *Formal Concept Analysis of 2-Dimensional Structures*
78. Arbeitstagung Allgemeine Algebra (AAA78), University of Bern, Switzerland

30.01.10 *Kontinua bestehen nicht aus Punkten, Punkte sind nur Grenzen von Kontinua*
66. Ernst-Schröder-Seminar, TU Darmstadt

11.02.10 *Mathematik semantologisch verstehen*
Institut für Algebra, TU Dresden

13.02.10 *Mathematics - presenting, reflecting, judging*
79. Arbeitstagung Allgemeine Algebra (AAA79), Palacky University Olomouc, Czech Republic

16.03.10 *Formal Concept Analysis of Two-Dimensional Convex Continuum Structures*
8th International Conference on Formal Concept Analysis (ICFCA 2010), Agadir, Morocco

06.06.10 *Communicative rationality, logic and mathematics*
80. Arbeitstagung Allgemeine Algebra (AAA80), Mathematical Research and Conference Center Bedlewo, Poland

Andrea Zelmer

27.08.09 *Optimizing a Coupled Network Design Problem Involving Multiple Energy Carriers*
20th International Symposium on Mathematical Programming (ISMP), Chicago

14.06.10 *Vernetzte regenerative Energiekonzepte im urbanen Raum aus mathematischer Sicht*
Expert Meeting, Darmstadt

29.09.10 *Optimale regenerative Energieversorgungkonzepte im Siedlungs- und Landschaftsraum*
BMWi Annual Meeting, Darmstadt

Martin Ziegler

18.07.09 *Real Computation with Least Discrete Advice: A Complexity Theory of Nonuniform Computability*
Continuity, Computability, Constructivity: From Logic to Algorithms (Köln)

24.02.10 *Komplexität des Erfüllbarkeitsproblems in der Quantenlogik*
59. Workshop über Algorithmen und Komplexität, Ilmenau 2010

25.05.10 *Computational Complexity of Geometric Quantum Logic*
7th Workshop on Quantum Physics and Logic, Oxford 2010

23.06.10 *Real Analytic Machines and Degrees*
7th International Conference on Computability and Complexity in Analysis, Zhenjiang 2010

Jan Carsten Ziems

14.09.10 *Goal-oriented refinement in adaptive multilevel generalized SQP-methods for PDE-constrained optimization*
Annual meeting 2010 of SPP 1253 Optimization with Partial Differential Equations, Freising, Germany

6.1.3 Visits

Benno van den Berg, University of Cambridge, Feb. 2009

Benno van den Berg, University of Stockholm, Oct.-Dec., 2009

Benno van den Berg, University of Chambéry, Feb. 2010

Dieter Bothe, Universität Duisburg-Essen, Juli 2010

Dieter Bothe, Universität Halle-Wittenberg, April 2009

Dieter Bothe, University of Rennes, May 2009

Dieter Bothe, WIAS Berlin, April 2009

Debora Clever, RWTH Aachen, 07.05.09

Bálint Farkas, Alfréd Rényi Institute of Mathematics, Budapest, March 2009

Bálint Farkas, UCLA Mathematics Department, Los Angeles, May 2009

Bálint Farkas, Alfréd Rényi Institute of Mathematics, Budapest, September 2009

Reinhard Farwig, Universität Münster, 15.01.2009

Reinhard Farwig, Nečas Center for Mathematical Modeling, Prag, 15.-27.02.2009

Reinhard Farwig, International Conference: Nonlinear Parabolic Problems, Banach Center, Bedlewo (Poland), 10.-16.05.2009

Reinhard Farwig, Workshop on Navier-Stokes Equations, RWTH Aachen, 04.-06.06.2009

Reinhard Farwig, Oberwolfach Conference: Mathematical Aspects of Hydrdynamics, 19.-25.07.2009

Reinhard Farwig, University of Ferrara, 02.-05.09.2009

Reinhard Farwig, Conference on Mathematical Physics and PDE, Centro Internazionale per la Ricerca Matematica of Trento (CIRM), Levico Terme (Trento, Italy), 07.-11.09.2009

Reinhard Farwig, Tohoku University Sendai, 16.-28.11.2009

Reinhard Farwig, Waseda University, Tokyo, 27.11.2009

Reinhard Farwig, University of Nagoya, 30.11.-05.12.2009

Reinhard Farwig, International Conference 2009 on Mathematical Analysis of the Navier-Stokes Equations and Related Topics, Past and Future, Kobe University, 07.-09.12.2009

Reinhard Farwig, Women's University, Nara, 10.-11.12.2009

Reinhard Farwig, Polish Academy, Warsaw, 25.-30.01.2010

Reinhard Farwig, International Workshop on Mathematical Fluid Dynamics, Waseda University Tokyo, 10-13.03.2010

Reinhard Farwig, TU Dresden, 12.05.2010

Reinhard Farwig, New Trends in Mathematical Fluid Dynamics, 8th AIMS Conference on Dynamical Systems, Differential Equations and Applications Dresden, 25.-28.05.2010

Reinhard Farwig, Academy of Sciences, Prague, 03.-06.10.2010

Reinhard Farwig, Nečas Center for Mathematical Modeling, Prague, 17.-19.12.2010

Matthias Geissert, Waseda University/Tokyo, Sep 2010 - Oct 2010

Jane Ghiglieri, Rice University, Houston, Texas, USA, October 2010 - February 2011

Karoline Götze, Mathematical Institute of the Czech Academy of Science, 18.05.09-22.05.09

Karoline Götze, Waseda University, 08.03.10-28.05.10

Karoline Götze, Mathematical Institute of the Czech Academy of Science, 20.09.10-24.09.10

Vassilios Gregoriades, Univerität Bonn, May 2010

Vassilios Gregoriades, Jiangsu University, June 2010

Vassilios Gregoriades, University of Athens, November 2010

Karsten Große-Brauckmann, Amherst, University of Massachusetts,, February to August 2009

Karsten Große-Brauckmann, Sao Paolo, Federal University of Sao Paolo, March 2010

Karsten Große-Brauckmann, Oberwolfach, Progress in Surface Theory, May 2010

Robert Haller-Dintelmann, University of Valenciennes, France, January 2009

Robert Haller-Dintelmann, University of Valenciennes, France, June 2009

Robert Haller-Dintelmann, University of Valenciennes, France, May 2010

Robert Haller-Dintelmann, Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS), Berlin, September 2010

Tobias Hansel, University of Salerno, 22.02.10 – 26.02.10

Tobias Hansel, Waseda University Tokyo, March 2010 – August 2010

Tobias Hansel, Tohoku University Sendai, 10.05.10 – 12.05.10

Horst Heck, Tohoku University, August 2010

Horst Heck, Waseda University, August 2010

Horst Heck, Tohoku University, August 2009

Horst Heck, Tohoku University, February 2009

Matthias Hieber, Waseda University, Tokyo, May - June 2010

Matthias Hieber, Waseda University, Tokyo, March - April 2010

Matthias Hieber, Kyoto University, Kyoto, May 2010

Matthias Hieber, Waseda University, Tokyo, December 2010

Alexander Kartzow, University of Bordeaux, March 2010

Klaus Keimel, University of Birmingham, England, January 06 –15, 2009

Klaus Keimel, University of Cape Town, South Africa, February 24 – March 10, 2009

Klaus Keimel, Louisiana State University, Baton Rouge, LA., USA, October 2009

Klaus Keimel, University of Kyoto, Japan, January 3 – March 31, 2010

Klaus Keimel, Beihang University, Beijing, China, November 6 – November 23, 2010

Ulrich Kohlenbach, Romanian Academy, Bucharest, BITDEFENDER Invited Professor, March 15-April 15, 2011

Ulrich Kohlenbach, Carnegie Mellon University, Pittsburgh, June 2011

Andreas Kollross, University of Santiago de Compostela, October 2009

Christian Komo, Necas Center for Mathematical Modelling, Prague, 17.05.09- 21.05.09

Christian Komo, Necas Center for Mathematical Modelling, Prague, 15.02.10- 19.02.10

Christian Komo, Necas Center for Mathematical Modelling, Prague, 20.09.10- 24.09.10

Burkhard Kümmerer, University of Nijmegen, ca. 10 visits in 2009/2010

Burkhard Kümmerer, ETH Zürich, ca. 5 visits in 2009/2010

Karen Kuhn, University of Technology, Eindhoven, April 27 to 28, 2010

Jens Lang, CWI Amsterdam, April-May 2009

Jens Lang, University of Lugano, October 2010

CHEN Zhenyu, Software Institute, Nanjing University, Dezember 2010

Martin Otto, Computer Laboratory, Oxford University, 06.12.2009–12.12.2009

Julia Plehnert, KIAS, Seoul, South Korea, November 2009

Julia Plehnert, National Institute for Pure and Applied Mathematics, Rio de Janeiro, Brazil, February 2010

Julia Plehnert, Federal University of ABC, Santo André, Brazil, March 2010

Steffen Roch, IPN Mexico-City, September - Oktober 2009

Steffen Roch, IST Lisbon, June 2009

Steffen Roch, IST Lisbon, August - September 2010

Pavol Safarik, University of Cape Town, November – December, 2009

Nils Scheithauer, Justus-Liebig-Universität Gießen, July 2009

Nils Scheithauer, Institute for Nuclear Research and Nuclear Energy, Varna, July 2009

Nils Scheithauer, TU Dortmund, January 2010

Nils Scheithauer, Philipps-Universität Marburg, February 2010

Nils Scheithauer, Nagoya University, March 2010

Nils Scheithauer, IPMU, Tokyo, March 2010

Nils Scheithauer, Goethe-Universität Frankfurt, March 2010

Nils Scheithauer, Max-Planck-Institut für Mathematik, Bonn, May 2010

Nils Scheithauer, Durham University, August 2010

Nils Scheithauer, Korteweg-de Vries Institute for Mathematics, University of Amsterdam, October 2010

Bettina Schieche, Politecnico di Torino, May 2010

Wilhelm Stannat, INI Cambridge University, January 2010, April 2010, June 2010

Thomas Streicher, Université Paris VII, PPP, March 2009

Thomas Streicher, Mittag-Leffler Institute, September/October 2009

Fredrik Strömberg, Key West, Florida, Workshop on L-functions and Modular Forms 3, February 9 - 13, 2009

Fredrik Strömberg, MPI Bonn, Mock theta functions and applications, May 25-29, 2009

Fredrik Strömberg, American Institute of Mathematics (AIM), Palo Alto, Noncongruence modular forms, August 17-21, 2009

Fredrik Strömberg, Benasques, Workshop on higher rank L-functions: Theory and Computations, July 19 - 31, 2009

Fredrik Strömberg, CRM, Montreal, Workshop on Computer Methods for L-functions and Automorphic Forms, March 22-26, 2010

Fredrik Strömberg, MPI Bonn, April 29 - April 30, 2010

Fredrik Strömberg, Edinburgh, EU-Young and Mobile Workshop: Dynamical Systems and Number Theory, May 17-19, 2010

Fredrik Strömberg, Paris, Workshop on L-functions and Modular Forms database, Oct 7-16, 2010

Stefan Ulbrich, Rice University, October 2010

Martin Ziegler, TU Wien, Feb-Jul 2009

6.2 Organization of Conferences and Workshops

Dieter Bothe

- Mini-Workshop "Fluid Stucture Interaction", 16.06.2010, Darmstadt
- International Conference "Evolution Equations" July 2010, Schmitten
- Summerschool of SPP 1506 "Transport processes of fluidic interfaces" 2010, Darmstadt

Regina Bruder

- Organization of a group with DMV, GDM and MNU for discussion of the problems between school and university
- Organization of a meeting with the members of the didactic community in Hessen, 12.11.2010

Jan H. Bruinier

- AKLS-Seminar on *Automorphic Forms* (jointly with K. Bringmann, V. Gritsenko, A. Krieg, G. Nebe, N.-P. Skoruppa, D. Zagier), 28.01.09 Aachen, 17.04.09 Utrecht, 30.09.09 Siegen, 09.12.09 Lille, 03.03.10 Aachen, 05.05.10 Köln, 29.09.10 Siegen, 08.12.10 Lille

Bálint Farkas

- June 2009, Internet Seminar Workshop, Ergodic Theory: an Operator Theoretic Approach, Blaubeuren (jointly with T. Eisner, M. Haase, R. Nagel)

- July 2009, 8th International Summer School in Potential Theory, Budapest (jointly with N. Levenberg, B. Nagy, Sz. Révész

Reinhard Farwig

- Special Session ”Navier-Stokes Equations and Related Questions”, 8th AIMS Conference on Dynamical Systems, Differential Equations and Application (jointly with Prof. Dr. J. Neustupa (Prague) and Prof. Dr. W. Varnhorn (Kassel)), Dresden, 25.-28.05.2010

Matthias Geissert

- Mathematical Theory for Navier-Stokes Equations in Various Domains Training-Workshop on Japan-Germany Cooperation: Cultural Aspects and Mathematical Ideas (jointly with Horst Heck, Hisashi Okamoto, Takashi Sakajo and Okihiro Sawada)

Alf Gerisch

- Focus meeting *Simulated cartilage production*, TU Darmstadt, 15.-17.03.10

Karoline Götze

- Workshop "Career Opportunities for Women in Mathematical Fluid Dynamics", 20.10.10, TU Darmstadt

Horst Heck

- Workshop “Mathematical Theory for Navier-Stokes Equations in Various Domains, Training-Workshop on Japan-German Cooperation; Social Aspects and Mathematical Ideas” (jointly with Matthias Geissert, Hisashi Okamoto, Takashi Sakajo, and Okihiro Sawada)

- Session “Computer Science/Engineering/Mathematics: Good Looks” at the 7th Japanese-German Frontiers of Science Symposium 2010 (jointly with Masahiko Inami)

Michael Joswig

- Workshop “Saturday in Discrete Mathematics,” Erlangen 2009 (jointly with Friedrich Knop, Thorsten Theobald und Volker Strehl)

- Program Committee Co-Chair “3rd International Congress on Mathematical Software,” Kobe 2010 (jointly with Komei Fukuda and Nobuki Takayama)

Klaus Keimel

- Mal’tsev Meeting, Sobolev Institute of Mathematics, Novosibirsk, May 2–6,2010

- Member of the Programme Committee

Ulrich Kohlenbach

- Colloquium Logicum (jointly with B. van den Berg, M. Otto and T. Streicher), Münster, Sep. 22-24, 2010, Member of Program Committee

- Logic and Analysis (jointly with J. Avigad and H. Towsner), AMS-ASL Special Session of Joint Mathematics Meeting, New Orleans 06.-09.01.2011

- Oberwolfach Workshop on Mathematical Logic (jointly with S. Buss and M. Rathjen), Mathematisches Forschungsinstitut Oberwolfach, Nov. 6-12, 2011

Michael Kohler

- Workshop on Recent Developments in Applied Probability and Statistics Dedicated to the Memory of Jürgen Lehn (jointly with Luc Devroye, Bülent Karasözen and Ralf Korn)

Jens Lang

- Invited Minisymposium on Adaptivity in Space and Time at NUMDIFF2009, 14-18 September 2009, Halle(Saale), Germany

- International Workshop on Multi-Scale Methods in Computational Engineering, 9-10 December 2010, Darmstadt, Germany

Ulrich Reif

- Industry Challenges in Geometric Modeling, CAD and Simulation - 2009 (jointly with Ewald Quak)

- Industry Challenges in Geometric Modeling, CAD and Simulation - 2010 (jointly with Ewald Quak)

- New Trends in Applied Geometry - 2010 (jointly with Hartmut Prautzsch)

Nils Scheithauer

- Workshop on Lie algebras, vertex algebras and automorphic forms, Aug. 31 - Sep. 4, 2009, ICMS Edinburgh, jointly with G. Höhn and V. Nikulin

- Workshop on Lie theory and physics, July 18, 2009, TU Darmstadt, jointly with K.-H. Neeb

Werner Schindler

- COSADE 2010 (jointly with Sorin Huss)

Wilhelm Stannat

- Workshop on Stochastic Partial Differential Equations, 2009 TU Darmstadt (jointly with S. Dahlke /S. Larsson / K. Ritter / R. Schilling/ J. Zabcyk)

Stefan Ulbrich

- Local Organizer (Chair) and member of Organizing Committee SIAM Conference on Optimization 2011, May 16–19, 2011, Darmstadt

- Member Program Committee of the French-German Conference on Optimization 2009, Leuven, Belgium

- Invited Minisymposium *Large Scale Nonlinear Optimization and PDE-based Problems*, 20th International Symposium on Mathematical Programming ISMP 2009, Chicago, 23.–28. August 23–28, 2009

Martin Ziegler

- *Complexity in Arbitrary Structures* (jointly with Christine Gassner), Workshop 17.-20.02.10 in Greifswald

7 Workshops and Visitors at the Department

7.1 The Colloquium

Winter term 2008/2009

15.10.08. Prof. Dr. Friedemann Schuricht (TU Dresden), *Kontakt elastischer Körper: Schwierigkeiten und deren Behandlung*

29.10.08. Prof. Dr. István Faragó (Eötvös Loránd University Budapest), *How to create qualitatively adequate numerical models to time dependent physical problems?*

05.11.08. Prof. Dr. Jürg Kramer (Humboldt-Universität Berlin), *Zur Irrationalität von* $\sqrt{2}$

12.11.08. Priv.-Doz. Dr. Dorothee Haroske (Universität Jena), *Wie klingt eine fraktale Trommel?*

19.11.08. Prof. Dr. Catharina Stroppel (Universität Bonn), *Super Schur-Weyl-Dualität und wie sie die Lietheorie kontrolliert*

26.11.08. Prof. Dr. Stefan Krauss (Universität Kassel), *Muss der Satz von Bayes schwer verständlich sein?*

03.12.08. Prof. Dr. Stefan Vandewalle (Catholic University of Leuven), *Multigrid methods for stationary and time-dependent partial differential equations with stochastic coefficients*

10.12.08. Prof. Dr. Martin Hofmann (Ludwig-Maximilians-Universität München), *Zeiger als abstrakter Datentyp*

17.12.08. Prof. Dr. Johannes Wallner (TU Graz), *Semidiskrete Differentialgeometrie und Realisierung von Freiformgeometrien in der Architektur*

14.01.09. Prof. Dr. Ruth Kellerhals (University of Fribourg, Switzerland), *Extremalprobleme im hyperbolischen Raum*

21.01.09. Prof. Dr. Ehrhard Behrends (Freie Universität Berlin), *Gewinn plus Gewinn gleich Verlust - neue Paradoxien in der Wahrscheinlichkeitstheorie*

28.01.09. Prof. Dr. Aiso Heinze (Universität Kiel), *Beweisen ist schwer? Beweisen lernen noch viel mehr?! Zur Komplexität des Beweisens aus fachlicher und fachdidaktischer Perspektive*

04.02.09. Prof. Dr. Jens-Peter Kreiß (TU Braunschweig), *Bootstrap-Verfahren und nichtparametrische Modelle für Zeitreihen*

11.02.09. Prof. Dr. Martin Kiehl (TU Darmstadt), *Was Schüler leisten können - Highlights aus 10 Jahren "Mathematische Modellierungswoche"*

Summer term 2009

15.04.09. Prof. Dr. Nils Scheithauer (TU Darmstadt), *Exzeptionelle Symmetrien*

22.04.09. Prof. Dr. emer. Benno Artmann (Universität Göttingen), *Kunst und Mathematik*

29.04.09. Prof. Dr. A. Vershik (Steklov Institute of Mathematics, St. Petersburg), *Infinite dimensional integration and representation theory*

06.05.09. Prof. Dr. Karl-Theodor Sturm (Universität Bonn), *Optimaler Transport, Gradientenflüsse und Wasserstein-Diffusion*

13.05.09. Graduation Ceremony for winter term 2008/2009 and summer term 2009: Prof. Dr. Bernd Kawohl (Universität Köln), *Gleichdicke, oder warum konvexe Geometrie Leben retten kann*

20.05.09. Prof. Dr. Christoph Deninger (Universität Münster), *Entropie algebraischer dynamischer Systeme und nichtkommutative Determinanten*

27.05.09. Prof. Dr. Michael Günther (Universität Wuppertal), *Nanoelektronik – eine Herausforderung für die Angewandte Mathematik*

03.06.09. Prof. Dr. Frank Duzaar (Universität Erlangen-Nürnberg), *Nicht-lineare parabolische Systeme mit polynomialem Wachstum und Regularität*

10.06.09. Prof. Dr. Tomas Sauer (Universität Giessen), *Richtungsweisende Subdivision und eine Shearlet–Multiresolution*

17.06.09. Prof. Dr. Martin Brokate (TU München), *Ratenunabhängige Evolutionen*

24.06.09. Prof. Dr. Bas Spitters (University of Nijmegen), *A topos for algebraic quantum theory*

01.07.09. Prof. Dr. Jürgen Maaß (Universität Linz), *Modellierung mit Computern*

08.07.09. Prof. Dr. Martin Costabel (University of Rennes), *Eckensingularitäten: Herausforderung für Analysis und Numerik*

15.07.09. Prof. Dr. Dieter Bothe (TU Darmstadt), *Warum der Kampfer tanzt und der Wein manchmal weint – Transportprozesse an fluiden Grenzflächen*

Winter term 2009/2010

14.10.09. Prof. Dr. Rolf Krause (University of Italian Switzerland, Lugano), *Zusammenbringen, was zusammengehört – Lösungs- und Diskretisierungsstrategien im Kontext von Multiskalenansätzen*

21.10.09. Opening ceremony for the International Research Training Group 1529 "Mathematical Fluid Dynamics" (Darmstadt-Tokio),

- Prof. Dr. Giovanni P. Galdi (University of Pittsburgh), *The Motion of a Rigid Body in a Viscous Liquid: Recent Results and Open Questions*
- Prof. Dr. Peter Constantin (University of Chicago), *Complex Fluids*
- Prof. Dr. Marco Cannone (University of Paris–Est, Marne–La–Vallée), *Pseudo Measures, Boltzmann and Navier–Stokes Equations*

28.10.09. Prof. Dr. Rainer Kaenders (Universität Köln), *Entwicklung von Mathematikunterricht mit math-il.de–am Beispiel des 'Zahlenteufel'*

04.11.09. Prof. Dr. Harro Walk (Universität Stuttgart), *Nichtparametrische Schätzung und starke Gesetze der großen Zahlen*

11.11.09. Prof. Dr. Michel Pierre (Ecole Normale Supérieure de Cachan), *Does a control of the total mass keep a reaction-diffusion process from blowing up?*

18.11.09. Prof. Dr. Jeremy Avigad (Carnegie Mellon University, Pittsburgh), *Proof mining in ergodic theory*

25.11.09. Prof. Dr. Katrin Wendland (Universität Augsburg), *Eine mathematische Entdeckungsreise zu K3*

02.12.09. Prof. Dr. Axel Munk (Universität Göttingen), *Statistische Multiskalen-Analyse in inversen Problemen – mit Anwendungen in der Biophotonik auf der Nanoskala*

09.12.09. Prof. Dr. Jörg Brüdern (Universität Stuttgart), *Statistik diophantischer Gleichungen*

16.12.09. J.-Prof. Dr. Christian Meyer (TU Darmstadt), *Optimierung nach Maß – Optimalsteuerung partieller Differentialgleichungen mit Zustandsbeschränkungen*

13.01.10. Prof. Dr. Volker Ulm (Universität Augsburg), *Wege zu Innovationen im Mathematikunterricht auf systemischer Ebene*

20.01.10. Prof. Dr. Michael Hintermüller (Humboldt–Universität Berlin), *Optimierung bei partiellen Differentialgleichungen mit punktweisen Nebenbedingungen an die Kontrolle, den Zustand und seine Ableitung*

27.01.10. Prof. Dr. Alexander Mielke (Humboldt–Universität und WIAS Berlin), *Geometrische Nichtlinearitäten und Lie-Gruppen in der Elastoplastizität*

03.02.10. Prof. Dr. John Sullivan (TU Berlin), *Geometric Knot Theory*

10.02.10. Prof. Dr. Stefan Pickl (Universität der Bundeswehr München), *Simulation und Optimierung komplexer Systeme*

Summer term 2010

21.04.10. Inaugural lecture: Prof. Dr. Martin Ziegler (TU Darmstadt), *Berechenbarkeit und Komplexität in Analysis und Physik*

28.04.10. Prof. Dr. Andrew Ranicki (University of Edinburgh), *Manifolds, Quadratic Forms and Bagels*

05.05.10. Prof. Dr. Peter Oswald (Jacobs University Bremen), *Normal results on normal multiresolution*

12.05.10. Graduation Ceremony for summer term 2009 and winter term 2009/2010: Prof. Dr. Stefan Kebekus (Universität Freiburg), *Algebraische Geometrie. Reine Mathematik, wo man sie vielleicht nicht vermutet*

19.05.10. Prof. Dr. Ulrich Kortenkamp (Pädagogische Hochschule Karlsruhe), *Computer und Mathematikunterricht – Ideen und Möglichkeiten für die Nutzung eines kreativen Potentials*

26.05.10. Prof. Dr. Thomas Thiemann (Universität Erlangen–Nürnberg), *Schleifen–Quantengravitation: Eine Einführung*

27.05.10. Prof. Dr. Alexander Meister (Universität Rostock), *Nichtparametrisches Schätzen der Fehlerverteilung bei Software–Tests*

02.06.10. Prof. Dr. Stefan Felsner (TU Berlin), *Darstellung planarer Graphen*

09.06.10. Prof. Dr. Mike Thomas (University of Auckland), *Technology in mathematics learning*

16.06.10. Prof. Dr. Gieri Simonett (Vanderbilt University, Nashville), *Über die Rayleigh–Taylor Instabilität für die zwei Phasen Navier–Stokes Gleichungen*

23.06.10. Prof. Dr. Christian Bär (Universität Potsdam), *Irrfahrten in gekrümmten Räumen*

07.07.10. Prof. Dr. Wolfgang König (Technische Universität and WIAS Berlin), *Die Universalitätsklassen im parabolischen Anderson–Modell*

14.07.10. Prof. Dr. Malte Braack (Universität Kiel), *Strömung im Honigglas und darüber hinaus: Funktionalanalysis, Numerik und Optimale Steuerung*

Winter term 2010/2011

20.10.10. Prof. Dr. Jürgen Saal (Center of Smart Interfaces, TU Darmstadt), *Waschmaschinen, Wirbelstürme und mehr Modellierung und Analysis von rotierenden Flüssigkeiten*

27.10.10. Prof. Dr. Michael Barot (National Autonomous University of Mexico), *Rundgang durch Hyperbolien. Schwierigkeiten und Erstaunliches aus der hyperbolischen Geometrie*

03.11.10. Prof. Dr. Alain Damlamian (University of Paris-Est), *The periodic unfolding method: an approach to homogenization and singular differential equations*

10.11.10. Prof. Dr. Ulrich Stadtmüller (Universität Ulm), *Über einige Entfaltungsprobleme in der Statistik*

17.11.10. Prof. Dr. Tadahisa Funaki (University of Tokyo), *Scaling limits for the interface models and derivation of nonlinear PDEs*

24.11.10. Prof. Dr. Peter Bürgisser (Universität Paderborn), *Über die Wahrscheinlichkeit, dass ein leicht perturbiertes numerisches Problem schwierig ist*

01.12.10. Prof. Dr. Michael Griebel (Universität Bonn), *Ein paralleler Level–Set–Löser für Zweiphasenströmungen mit Oberflächenspannung*

08.12.10. Prof. Dr. Edriss Titi (University of California, Irvine (CA), and Weizmann Institute of Science, Rehovot (Israel)), *Is Dispersion a Stabilizing or Destabilizing Mechanism?*

15.12.10. Prof. Dr. Angelika Bikner-Ahsbahs (Universität Bremen), *Mathematikinteresse fördern – geht das? Einblicke in die Theorie interessendichter Situationen*

12.01.11. Prof. Dr. Friedrich Eisenbrand (Federal Polytechnic School of Lausanne), *Ganzzahlige Optimierung und Geometrie der Zahlen*

19.01.11. Prof. Dr. Otmar Venjakob (Universit"at Heidelberg), *Können ζ–Funktionen Diophantische Gleichungen lösen?*

26.01.11. Prof. Dr. Kunibert Siebert (Universität Duisburg-Essen, Duisburg), *Konvergenz und Optimalität adaptiver Finite Elemente Verfahren*

02.02.11. Prof. Dr. Arnd Rösch (Universität Duisburg-Essen, Duisburg), *Parameteridentifikation und optimale Steuerung bei partiellen Differentialgleichungen*

09.02.11. Prof. Dr. Roland Speicher (Universität Saarbrücken), *Was sind und was sollen Quantenpermutationen?*

16.02.11. Prof. Dr. Annette Werner (Universität Frankfurt), *Gruppen, Gebäude und analytische Räume*

7.2 Seminar Talks

09.06.09. Prof. Dr. Nils Skoruppa (University of Siegen), *Finite quadratic modules, representations of $SL(2,\mathbb{Z})$ and modular forms*

10.12.09. Dipl.-Math. Claudia Alfes (RWTH Aachen), *Kongruenzen für Ramanujans $\omega(q)$*

29.06.10. Dipl.-Math. Eric Hofmann (TU Darmstadt), *Unitary and orthogonal modular forms I*

06.07.10. Dipl.-Math. Eric Hofmann (TU Darmstadt), *Unitary and orthogonal modular forms II*

13.07.10. PhD Fredrik Strömberg (TU Darmstadt), *An introduction to the theory of L-functions*

20.07.10. Dipl.-Math. Eric Hofmann (TU Darmstadt), *Unitary and orthogonal forms III*

09.11.10. Dipl.-Math. Claudia Alfes (TU Darmstadt), *Traces of singular moduli I*

16.11.10. Dipl.-Math. Claudia Alfes / Stephan Ehlen (TU Darmstadt), *Traces of singular moduli II - The theta correspondence*

23.11.10. Dipl.-Math. Stephan Ehlen (TU Darmstadt), *Twisted Borcherd products*

30.11.10. Dipl.-Math. Stephan Ehlen (TU Darmstadt), *Getwistete Spuren singulärer Moduli*

07.12.10. PD Dr. Sören Kraußhar (TU Darmstadt), *Hypercomplex analytic modular forms and their relation to Maaß wave forms I*

14.12.10. PD Dr. Sören Kraußhar (TU Darmstadt), *Hypercomplex analytic modular forms and their relation to Maaß wave forms II*

28.01.10. Dávid Kunszenti-Kovács (Universität Tübingen), *Entangled ergodic theorems*

08.07.09. Prof. Dr. Martin Costabel (University of Rennes), *Eckensingularitäten: Herausforderung für Analysis und Numerik*

21.10.09. Prof. Dr. Peter Constantin (University of Chicago), *Complex Fluids*

03.11.09. Prof. Dr. Gerd Ströhmer (University of Iowa), *About Equilibria of Rotating Gases*

01.06.10. Prof. Dr. Hideo Kozono (Tohoku University, Sendai), *Global compensated compactness for general differential operators of first order*

13.07.10. Prof. Dr. Mariarosaria Padula (University of Ferrara), *On stability of Poiseuille with free boundary*

20.07.10. Prof. Dr. Milan Pokorný (Mathematical Institute of the Charles University, Praha), *On regularity criteria for the incompressible Navier-Stokes equations containing one velocity component*

31.08.10. Prof. Dr. Hiroko Morimoto (Meiji University, Japan), *Leray's inequality for 2-D symmetric domain*

28.10.10. Prof. Dr. Jiří Neustupa (Czech Academy of Sciences, Prague), *On the zero viscosity limit of strong solutions of the Navier-Stokes equations with Navier's boundary condition*

09.11.10. Prof. Dr. Šárka Nečasová (Czech Academy of Sciences, Prague), *A linearized system describing stationary incompressible viscous flow around rotating and translating bodies*

11.11.10. Prof. Dr. Toshiaki Hishida (Nagoya University, Japan), *The plane steady motion of a viscous fluid around a rotating body*

08.12.10. Prof. Dr. Edriss Titi (University of California, Irvine (CA), and Weizmann Institute of Science, Rehovot (Israel)), *Is Dispersion a Stabilizing or Destabilizing Mechanism?*

15.06.10. Dr. Tsuyoshi Yoneda (University of Minnesota), *Long-time solvability of the Navier-Stokes equations in a rotating frame with spatially almost periodic large data: Part II + III*

10.06.10. Dr. Tsuyoshi Yoneda (University of Minnesota), *Long-time solvability of the Navier-Stokes equations in a rotating frame with spatially almost periodic large data: Part I*

01.12.09. Dr. Mihály Kovács (University of Otago/New Zealand), *Finite element approximation of the stochastic wave equation*

21.04.09. Prof. Paul Levy (EPF, Lausanne / CH), *Noncommutative deformations of Kleinian singularities and isomorphism problems*

05.05.09. Prof. Tom de Medts (Univesity of Gent / Belgium), *Edge-transistive groups and automorphisms of trees*

07.07.09. Prof. Peter Abramenko (University of Virginia / USA), *Repräsentanten in Weylgruppenelementen*

21.12.10. Dipl.-Math. Andreas Mars (TU Darmstadt), *Topologische Kac-Moody Theorie*

06.06.10. Prof. Dr. Ana Silvestre (Technical University of Lisbon), *On the unsteady Poiseuille flow in a pipe*

12.03.09. Prof. Dr. Yoshihiro Shibata (Waseda University, Tokyo), *Maximal regularity for certain free Boundary value problems related to the Navier-Stokes equations*

12.03.09. Y. Enomoto (Waseda University), *Decay estimates of Stokes equatoins in an exterior domain*

15.10.09. Prof. Wolfgang Dreyer (WIAS Berlin), *Phasenübergänge mit scharfen Grenzflächen und zugeordnete Phasenfeldmodelle*

03.11.09. Kazuhiro Oeda (Waseda University), *Stationary problem for a Lotka-Volterra cooperative model with nonlinear diffusion*

03.11.09. Noboru Ito (Waseda University), *Reidemeister moves and Khovanov homology*

10.11.09. Shinji Kawano (Waseda University), *On maximum value of ground states of semilinear elliptic equations*

15.12.09. Yuka Naito (Waseda University), *On the L_p-L_q maximal regularity for linear thermoelastic plate equation in a bounded domain.*

15.12.09. Takahiro Okabe (Waseda University), *Asymptotic energy concentration in the phase space of weak solutions to the Navier-Stokes equations*

12.01.10. Prof. Yulii D. Shikhmurzaev (University of Birmingham), *Moving contact lines: Modeling approaches and experimental facts*

19.01.10. Prof. Gerard Misiolek (University of Notre Dame), *L^2 geometry of diffeomorphism groups and equations of hydrodynamics*

19.01.10. Prof. John Billingham (University of Nottingham), *A Critical Review of Shikhmurzaev's Theory of Moving Contact Lines*

28.01.10. David Kunszenti-Kovacs (Universität Tübingen), *Entangled Ergodic theorems*

02.02.10. Norihisa Ikoma (Waseda University), *Uniqueness of positive solutions of coupled nonlinear Schrödinger equations*

04.02.10. Daniel Engeler (Universität Freiburg), *Existenz und Regularität für das Stokes Problem in verallgemeinerten Lebesgueräumen*

09.02.10. Yoichi Enatsu (Waseda University), *Stability analysis of delayed epidemic models with a class of nonlinear incidence rates*

23.02.10. Prof. Yoshiaki Muroya (Waseda University), *Stability analysis for a class of SIR, SIRS epidemic models*

22.04.10. Martin Lippl (Universität Göttingen), *Formation of Singularities for Morse Metrics*

22.04.10. Anton Verbitsky (Universität Konstanz), *Navier-Stokes Equations with High Rotation*

29.04.10. Raphael Wullschleger (ETH Zürich), *Schwache Lösungen der Navier-Stokes-Gleichungen*

17.05.10. Prof. Giovanni P. Galdi (University of Pittsburgh), *Steady-State Interaction of a Liquid with an Elastic Body*

25.05.10. Kohei Soga (Waseda University), *On the representation of solutions to Hamilton-Jacobi equations*

25.05.10. Tobias Nau (Universität Konstanz), *Maximal regularity of cylindrical parameter-elliptic boundary value problems*

01.06.10. Noboru Ito (Waseda University), *On Khovanov complexes*

01.06.10. Atsuhiko Mizusawa (Waseda University), *On the topological invariants*

01.06.10. Ryo Takada (Waseda University), *Counterexamples of commutator estimates in the Besov and the Triebel-Lizorkin spaces related to the Euler equations*

08.06.10. Prof. Giovanni P. Galdi (University of Pittsburgh), *Rigid Body-Liquid Interaction. Formulation of some basic problems*

08.06.10. Prof. Giovanni P. Galdi (University of Pittsburgh), *Rigid-Body-Liquid Interaction. Some results and some open questionsy*

17.06.10. Prof. Giovanni P. Galdi (University of Pittsburgh), *Steady-State Interaction of a Liquid with an Elastic Body*

24.06.10. Prof. Helmut Abels (Universität Regensburg), *Diffuse Interface Models for Viscous Two-Phase Flows*

19.10.10. Ting Zhang (Zhejiang University), *Continuous dependence for NLS in fractional order spaces*

19.10.10. Hajime Koba (Waseda University), *Nonlinear stability of Ekman boundary layers in rotating stratified fluids with oblique rotation*

21.10.10. Prof. Daoyuan Fang (Zhejiang University), *On regularity criteria for the incompressible Navier-Stokes equations containing one velocity component*

26.10.10. Tsukasa Iwabuchi (Waseda University), *Global well-posedness for Keller-Segel system in the homogenous Besov spaces*

26.10.10. Norihisa Ikoma (Waseda University), *Existence of a minimizer for a coupled nonlinear Schrödinger equation*

02.11.10. Michael Pokojovy (Universität Konstanz), *On Existence and Stability for Heat Conducting Reissner-Mindlin Platest*

09.11.10. Šárka Nečásova (Czech academy of Sciences), *A linearized system describing stationary incompressible viscous flow around rotating and translating bodies*

09.11.10. Karen Yeressian (Universität Zürich), *Spatial Asymptotic Behavior of Elliptic Equations and Variational Inequalities*

23.11.10. Prof. Edriss Titi (University of California), *Lectures on Mathematical Analysis of the Euler and Navier-Stokes Equations*

02.12.10. Satoshi Yokoyama (Waseda University), *Existence of L^2-solution of stochastic Navier-Stokes equations appearing in variational settings*

09.12.10. Prof. Paolo Maremonti (Second University of Naples), *On the Stokes problem with an initial data in L^1: an application of the results to a priori estimates*

15.07.09. Prof. Dr. Wolfgang A. F. Ruppert (University of Bodenkultur, Wien / Austria), *Starke und schwache Kompaktifizierungen von Kegeln und anderen dividierbaren Halbgruppen*

17.11.09. Prof. George Willis (University of Newcastle / Australia), *Superrigidity of homomorphisms from arithmetic groups having locally compact targets*

26.01.10. Prof. Francesco Russo (University of Palermo / Italy), *The commuting of x^n and y in compact groups*

16.06.10. Prof. Jimmie D. Lawson (Louisiana State University, Baton Rouge / USA), *Clifford algebras, Möbius transformations, Vahlen metric, and Bruck loops*

11.02.10. Prof. Francesco Russo (University of Palermo, / Italy), *On a theorem of density of probabilities on groups*

27.01.09. Prof. Dr. Bernhard Krötz (MPI Bonn), *Orthogonalisierung*

06.02.09. Prof. Yael Fregier (University of Nantes / France), *Deformation theory of diagrams and application: L_∞ structure on the Gerstenhaber-Shack*

05.06.09. Prof. Dr. Christoph Wockel (Universität Göttingen), *String group models from universality*

16.06.09. Prof. Thomas Quella (University of Luxembourg), *Aspects of affine Lie superalgebras*

23.06.09. Prof. Hendrik Grundling (University of North South Wales / Australia), *Understanding the Bochner-Minlos Theorem through group algebra*

24.06.09. Dipl.-Math. Stefan Wagner (TU Darmstadt), *A geometric approach to noncommutative principal bundles*

30.06.09. Dipl.-Math. Michael Klotz (TU Darmstadt), *Integration of morphisms between Lie triple systems of Banach symmetric spaces*

14.07.09. Dr. Thomas Creutzig (DESY, Hamburg), *Topological conformal field theories and Lie superalgebras*

28.07.09. Prof. Sebastian Spang (Universität Karlsruhe), *Diophantische Gleichungen, Modulformen und elliptische Kurven*

11.10.09. Dipl.-Math. Christoph Zellner (TU Darmstadt), *Halbbeschränkte unitäre Darstellungen unendlich-dimensionaler Heisenberggruppen*

20.10.09. Prof. Dr. Karl-Hermann Neeb (TU Darmstadt), *Glatte Vektoren für Darstellungen unendlichdimensionaler Gruppen*

27.10.09. PD Dr. Thomas Bunke (TU Darmstadt), *Das Klassifikationsproblem irreduzibler Gewichtsmoduln affiner Kac-Moody-Algebren*

02.11.09. Prof. Gestur Olafsson (Louisiana State University / USA), *Reflection Positivity*

03.11.09. Prof. Masha Gordina (University of Connecticut-Storrs / USA), *Heat kernel analysis on infinite-dimensional Heisenberg groups*

7.11.09. Prof. Pralay Chatterjee (University of Tarami / India), *On the surjectivity of $x \mapsto x^n$ on Lie groups*

17.11.09. Prof. George Willis (University of Newcastle / Australia), *Superrigidity of homomorphisms from arithmetic groups having locally compact targets*

25.11.09. Prof. Dr. Katrin Wendland (Universität Augsburg), *Eine mathematische Entdeckungsreise zu $K3$*

01.12.09. Prof. Atsumu Sasaki (Waseda University, Tokyo / Japan), *A characterization of non-tube type Hermitian symmetric spaces by visible spaces*

05.12.09. Prof. Dr. Friedrich Wagemann (University of Nantes / France), *On Hopf 2-algebras*

19.01.10. Prof. Cornelia Visman (University of Timisoara / Romania), *Dual pairs in infinite dimensions with applications*

20.01.09. Prof. Feride Tiglay (Federal Polytechnic School of Lausanne / CH), *Euler-Poincaré equations on Lie groups and homogeneous spaces, their orbit inariants and applications to PDE*

30.01.09. Prof. Gerard Misiolek (University of Paris / France), *L^2 geometry of diffeomorphism groups and equations of hydrodynamics*

02.09.10. Prof. Dr. Barbara Drossel (TU Darmstadt), *Naturwissenschaft und christlicher Glaube - ein Widerspruch?*

13.02.09. Dr. Vince Bárány (University of Oxford, England), *Cardinality Quantifiers in Monadic Second-Order Logic*

25.06.09. Dr. Bas Spitters (Radboud University Nijmegen, The Netherlands), *Constructive theory of Banach Algebras*

03.07.09. Prof. Anuj Dawar (University of Cambridge, England), *Logics with Rank Operators*

14.08.09. Dr. Richard Garner (University of Cambridge, England), *Ionads: A Generalised Notion of Topological Space*

04.09.09. Vassilios Gregoriades, Ph.D. (University of Athens, Greece), *Effective Descriptive Set Theory and Applications in Analysis*

06.11.09. Dr. Stéphane Le Roux (Laboratoire d'Informatique, Ecole Polytechnique, Palaiseau Cedex, France), *Sequential Game Theory: A Formal and Abstract Approach*

13.11.09. Dr. Matthias Schröder (Bundeswehruniversität München), *Topology in Computable Analysis*

27.11.09. Dr. Peter Scheiblechner (Department of Mathematics, Purdue University, West Lafayette, Indiana, USA), *Comparison of Complexity over the Real vs. Complex Numbers*

21.05.10. Priv.-Doz. Dr. Norbert Müller (Universität Trier), *Exakte reelle Arithmetik - reelle Zahlen aus der Sicht der Informatik*

04.06.10. Prof. Dr. Klaus Meer (Brandenburgische TU Cottbus), *On the expressive CNF formulas of bounded Tree- and Clique-Width*

15.06.10. Prof. Dr. Jimmie Lawson (Louisiana State University, Baton Rouge,USA), *Clifford Algebras, Möbius Transformations, Vahlen Matrices, and Bruck Loops*

16.06.10. Michal Stronkowski (Charles University in Prague, Czech Republic), *Finite axiomatization of quasivarieties of relational structures*

18.06.10. Prof. Dr. Hajime Ishihara (Japan Advanced Institute for Science and Technology, Tokyo, Japan), *The monotone completeness theorem in constructive reverse mathematics*

13.07.10. Prof. Dr. Russell Miller (New York City University, USA), *Computable Fields and their Algebraic Closures*

06.08.10. René Hartung (Georg-August-Universtität Göttingen), *Computation with infinitely presented groups*

12.11.10. Carsten Rösnick (Universität Paderborn), *Approximate Real Function Maximization and Query Complexity*

19.11.10. Dr. Vadim Puzarenko (Sobolev Institute of Mathematics, Novosibirsk, Siberia), *A reducibility on structures*

24.11.10. Prof. Dr. Peter Bürgisser (Universität Paderborn), *Über die Wahrscheinlichkeit, dass ein leicht perturbiertes numerisches Problem schwierig ist*

09.12.09. Prof. Dr. Vladimir S. Rabinovich (IPN Mexico/City), *Limit operators and their applications in mathematical physics*

20.01.10. Dr. Marko Lindner (TU Chemnitz), *Zum Spektrum und wesentlichen Spektrum beschränkter Tridiagonaloperatoren*

06.01.09. Dr. Nora Ganter (University of Urbana-Champaign), *Hecke operators in equivariant elliptic cohomology and generalized moonshine*

18.07.09. Prof. Dr. Volker Schomerus (DESY, Hamburg), *The harmonics of gauge theory*

18.07.09. Prof. Dr. Gerald Höhn (Kansas State University), *On McKay's correspondence between E_6, E_7 and E_8 and the three largest sporadic groups*

18.07.09. Prof. Dr. Klaus Fredenhagen (Universität Hamburg), *Algebraic structures in classical quantum field theory*

18.07.09. Prof. Dr. Albrecht Klemm (Universität Bonn), *Lie structures in geometry and string compactifications*

03.11.09. Dr. Stefan Kolb (University of Amsterdam), *From the reflection equation to representation rings*

24.11.09. Dr. Kappagantula Gopala Krishna (University of Chennai), *BKM Lie superalgebras in N=4 supersymmetric string theory*

09.12.09. Prof. Dr. Jörg Brüdern (Universität Stuttgart), *Statistik diophantischer Gleichungen*

02.02.10. Prof. Dr. Nils Scheithauer (TU Darmstadt), *Moonshine for Conway's group*

02.02.10. Prof. Urmie Ray (MPIM, Bonn), *On Cartan subalgebras of locally finite Lie algebras and Borcherds-Kac-Moody algebras*

05.04.10. PhD Andrew Linshaw (TU Darmstadt), *Vertex algebras I*

13.04.10. PhD Andrew Linshaw (TU Darmstadt), *Vertex algebras II*

20.04.10. PhD Andrew Linshaw (TU Darmstadt), *Vertex algebras III*

27.04.10. PhD Andrew Linshaw (TU Darmstadt), *Vertex algebras IV*

26.10.10. Prof. Dr. Peter Fiebig (Universität Erlangen-Nürnberg), *Bruhatgraphen in Geometrie und Darstellungstheorie*

21.12.10. Dipl.-Math. Andreas Mars (TU Darmstadt), *Topologische Kac-Moody Gruppen*

28.06.10. Florian Augustin (Technische Universität München), *Polynomielle Chaosentwicklung zur Approximation der Lösung zufallsabhängiger Differentialgleichungen*

08.07.10. Prof. Dr. Fabio Nobile (Politecnico di Milano), *Stochastic Polynomial Approximations for Partial Differential Equations with Random Input Data*

20.12.10. T. Streicher (University of Ljubljana), *Model of Type Theory in Simplicial Sets*

26.08.10. Prof. Dr. Michael Stingl (Universität Erlangen-Nürnberg), *Structural Optimization. Towards a multiscale approach.*

06.12.10. Prof. Dr. Irwin Yousept (TU Berlin), *Optimal control of Maxwell's equations with regularized state constraints.*

7.3 Visitors

Gulliaume Rolland, University of Rennes, January-February 2010, May 2010.

Prof. Dr. Anne-Marie Robertson, University of Pittsburgh, May to July 2010.

Adrian Muntean, University of Technology, Eindhoven, November 2010.

Prof. Dr. Anne Prescott, University of Technology Sydney, Australia, Juni 2010.

Prof. Michael Thomas, The University of Auckland, New Zealand, Juni 2010.

Prof. Dr. Jens Funke, University of Durham / UK, January 2009.

Prof. Dr. Jens Funke, University of Durham / UK, March to April 2009.

Prof. Dr. Nils Skoruppa, University of Siegen, June 2009.

Prof. Dr. Jens Funke, University of Durham / UK, November 2009.

Dipl.-Math. Claudia Alfes, RWTH Aachen, December 2009.

Prof. Dr. Jens Funke, University of Durham / UK, March 2010.

Prof. Dr. Jen Funke, University of Durham / UK, November 2010.

Prof. Dr. Özlem Imamoglu, ETH Zürich / CH, November 2010.

Prof. Dr. Šárka Nečasová, Czech Academy of Sciences, Prague, February and October 2009 and November 2010.

Prof. Dr. Yasushi Taniuchi, Shinshu University, Matsumoto, June 2009 to March 2010.

Ondřej Kreml, Charles University, Prague, June 2009 and November 2010.

Prof. Dr. Milan Pokorný, Charles University, Prague, July 2009 and July 2010.

Prof. Dr. Martin Costabel, University of Rennes, July 2009.

Prof. Dr. Hideo Kozono, Tohoku University, Sendai, July 2009 and June 2010.

Prof. Wojciech Zajaczkowski, University of Warsaw, July 2009.

Prof. Dr. Jiří Neustupa, Czech Academy of Sciences, Prague, October 2009 and October 2010.

Prof. Dr. Ströhmer, University of Iowa, November 2009.

Prof. Dr. Mariarosaria Padula, University of Ferrara, July 2010.

Prof. Dr. Hiroko Morimoto, Meiji University, Japan, September 2010.

Prof. Dr. Miroslav Krbec, Academy of Sciences of the Czech Republic, December 2010.

Prof. Dr. Edriss Titi, University of California, Irvine (CA), and Weizmann Institute of Science, Rehovot (Israel), December 2010.

Prof. Dr. Toshiaki Hishida, Nagoya University, Japan, November 2010.

Prof. Václav Tesař, Academy of Sciences of the Czech Republic, October 2010.

Prof. Stanislav Kračmar, Czech Technical University, Prague, November 2010.

Dr. Tsuyoshi Yoneda, University of Minnesota, June 2010.

Dr. Mihály Kovács, University of Otago/New Zealand, November 2009.

Prof. Dr. Mark Chaplain, University of Dundee, Scotland, July 2010.

Prof. Hendrik van Maldeghem, Univerity of Gent / Belgium, January 2009.

Dipl.-Math. David Hume, University of Birmingham, January 2009.

Prof. Dr. Kai-Uwe Bux, University of Charlottesville, Virginia / USA, January 2009.

Prof. Paul Levy, Federal Polytechnic School of Lausanne / CH, April 2009.

Prof. Tom de Medts, University of Gent / Belgium , April to May 2009.

Prof. Dr. Bernhard Mühlherr, Universität Giessen, May 2009.

Prof. Dr. Kai-Uwe Bux, University of Charlottesville, Virginia / USA, May 2009.

Prof. Peter Abramenko, University of Virginia / USA, July 2009.

Prof. Dr. Kai-Uwe Bux, University of Charlottesville, Virginia / USA, August to September 2009.

PhD David Ghatei, University of Birmingham / UK, December 2009.

Dr. Walter Freyn, Universität Münster, December 2010.

Prof. Dr. Ana Silvestre, Technical University of Lisbon, June 2010.

Prof. Dr. Yoshihiro Shibata, Waseda University, March 2010.

Y. Enomoto, Waseda University, March 2010.

Abdelaziz Rhandi, University of Salerno, July 2009.

Prof. Wolfgang Dreyer, WIAS Berlin, October 2009.

Kazuhiro Oeda, Waseda University, October - December 2009.

Atsumo Sasaki, Waseda University, October - December 2009.

Noboru Ito, Waseda University, October 2009 - December 2009.

Shinji Kawano, Waseda University, October - December 2009.

Yuka Naito, Waseda University, October 2009 - February 2010.

Takahiro Okabe, Waseda University, October 2009 - February 2010.

Prof. Yulii D. Shikhmurzaev, University of Birmingham, January 2010.

Prof. Gerard Misiolek, University of Notre Dame, January 2010.

Prof. John Billingham, University of Nottingham, January 2010.

David Kunszenti-Kovacs, Universität Tübingen, January 2010.

Prof. Yoshihiro Shibata, Waseda University, February 2010.

Prof. Yoshiaki Muroya, Waseda University, February 2010.

Daniel Engeler, Universität Freiburg, February 2010.

Yoichi Enatsu, Waseda University, January - February 2010.

Norihisa Ikoma, Waseda University, January - February 2010.

Martin Lippl, Universität Göttingen, April 2010.

Anton Verbitsky, Universität Konstanz, April 2010.

Raphael Wullschleger, ETH Zürich, April 2010.

Prof. Giovanni P. Galdi, University of Pittsburg, May - June 2010.

Kohei Soga, Waseda University, May - July 2010.

Tobias Nau, Universität Konstanz, May 2010.

Noboru Ito, Waseda University, May - July 2010.

Atsuhiko Mizusawa, Waseda University, May - July 2010.

Ryo Takada, Waseda University, May - July 2010.

Prof. Helmut Abels, Universität Regensburg, June 2010.

Hajime Koba, Waseda University, October - November 2010.

Satoshi Yokoyama, Waseda University, November - December 2010.

Tsukasa Iwabuchi, Waseda University, October - November 2010.

Norihisa Ikoma, Waseda University, October - November 2010.

Prof. Daoyuan Fang, Zhejiang University, October 2010.

Ting Zhang, Zhejiang University, October 2010.

Prof. Šárka Nečásov, Czech academy of Sciences, November 2010.

Michael Pokojovy, Universität Konstanz, November 2010.

Karen Yeressian, Universität Zürich, November 2010.

Prof. Edriss Titi, University of California, November 2010.

Prof. Paolo Maremonti, Seconda University of Naples, December 2010.

Prof. Dr. Wolfgang A. F. Ruppert, University of Bodenkultur, Wien / Austria, July 2009.

Prof. George Willis, University of Newcastle / Australia, November 2009.

Prof. Sidney A. Morris, University of Ballarat / Australia, November to December 2009.

Prof. Francesco Russo, University of Palermo / Italy, January 2010.

Prof. Jimmie D. Lawson, Louisiana State University, Baton Rouge / USA, June 2010.

Prof. Sidney A. Morris, University of Ballarat / Australia, June to July 2010.

Prof. Francesco Russo, University of Palermo / Italy, October to November 2010.

Dr. Richard Bödi, IBM Zurich Research Laboratory, January 2010.

Emerson Leon, TU Berlin, April 2010.

Thomas Cayé, Ècole Polytechnique, May to July 2010.

Dr. Andreas Paffenholz, FU Berlin, July 2010.

Dr. Colin Wilmott, Universtät Düsseldorf, August 2010.

Prof. Dr. Stepháne Gaubert, INRIA and Ècole Polytechnique, October 2010.

Prof. Dr. Stephan Tillmann, University of Queensland, December 2010.

Prof. Dr. Hans Maassen, University of Nijmegen, ca. 10 visits in 2009/2010.

Prof. Dr. Weizhang Huang, University of Kansas, March 2009.

Prof. Dr. Rolf Krause, University of Lugano, October 2009.

Dr. Grigorius Kolios, BASF Ludwigshafen, December 2009.

Prof. Dr. Fabio Nobile, University of Technology Mailand, July 2010.

Prof. Dr. Malte Braack, Universität Kiel, July 2010.

Prof. Dr. Michael Griebel, Universität Bonn, December 2010.

Prof. Dr. Wolfgang Bertram, University of Nancy / France, January 2009.

Prof. Dr. Bernhard Krötz, MPI Bonn, January 2009.

Prof. Dr. Christoph Wockel, Universität Göttingen, May 2009.

Prof. Gestur Olafsson, Louisiana State University / USA, May 2009.

Prof. Dr. Friedrich Wagemann, University of Nantes / France, May to June 2009.

Prof. Yael Fregier, University of Nantes / France, June 2009.

Prof. Thomas Quella, University of Luxembourg, June 2009.

Prof. Hendrik Grundling, University of North South Wales / Australia, June to July 2009.

Dr. Thomas Creutzig, DESY, Hamburg, July 2009.

Prof. Masha Gordina, University of Connecticut-Storrs / USA, November 2009.

Prof. George Willis, University of Newcastle / Australia, November 2009.

Prof. Pralay Chatterjee, University of Tarami / India, November 2009.

Prof. Dr. Katrin Wendland, University of Augsburg, November 2009.

Prof. Atsumu Sasaki, Waseda University, Tokyo / Japan, December 2009.

Prof. Cornelia Visman, University of Timisoara / Romania, January 2010.

Prof. Feride Tiglay, Federal Polytechnic School of Lausanne / CH, January 2009.

Prof. Gerard Misiolek, University of Paris / France, January 2010.

Prof. Dr. Barbara Drossel, TU Darmstadt, February 2010.

Dr. Marina Semenova, Sobolev Institute of Mathematics, Novosibirsk, Siberia, April 2009.

Dr. Vadim Puzarenko, Sobolev Institute of Mathematics, Novosibirsk, Siberia, June to August 2009.

Dr. Richard Garner, University of Cambridge, England, August 2009.

Prof. Dr. Marina Semenova, Sobolev Institute of Mathematics, Novosibirsk, Siberia, March and April 2010.

Prof. Dr. Anvar Nurakunov, Kyrgyz Academy of Sciences, Bishkek, Kirgistan, April to June 2010.

Michal Stronkowski, Charles University in Prague, Czech Republic, June 2010.

Prof. Dr. Jimmie Lawson, Louisiana State University, Baton Rouge, USA, June 2010.

Prof. Dr. Marina Semenova, Sobolev Institute of Mathematics, Novosibirsk, Siberia, September to December 2010.

Dr. Vadim Puzarenko, Sobolev Institute of Mathematics, Novosibirsk, Siberia, October to November 2010.

Prof. Dr. Vladimir S. Rabinovich, IPN Mexico/City, December 2009 to January 2010.

Dr. Marko Lindner, TU Chemnitz, January 2010.

Dr. Nora Ganter, University of Urbaba-Champaign, January 2009.

Prof. Dr. Volker Schomerus, DESY, Hamburg, July 2009.

Prof. Dr. Gerald Höhn, Kansas State University, July 2009.

Prof. Dr. Klaus Fredenhagen, Universität Hamburg, July 2009.

Prof. Dr. Albrecht Klemm, Universität Bonn, July 2009.

Dr. Stefan Kolb, University of Amsterdam, November 2009.

Dr. Kappagantula Gopala Krishna, University of Chennai, November 2009.

Prof. Dr. Jörg Brüdern, Universität Stuttgart, December 2009.

Prof. Dr. Urmie Ray, MPIM, Bonn, February 2010.

Prof. Dr. Peter Fiebig, Universität Erlangen-Nürnberg, October 2010.

Prof. Dr. Matthias Heinkenschloss, Rice University, Houston, June 2010.

Prof. Dr. Bülent Karasözen, METU, Ankara, July 2009, July 2010.

Prof. Dr. Michael Ulbrich, TU München, October 2010.

7.4 Workshops and Conferences

- ISIMM-Workshop on mathematical problems of solid mechanics, TU Darmstadt, October 8 to 9, 2009 (organized by Hans-Dieter Alber)

- Fortbildungsveranstaltung zu einem Unterrichtskonzept für einen binnendifferenzierenden Mathematikunterricht im Rahmen von "Mathe anders machen" der Deutsche Telekom Stiftung, Berlin, October 15, 2010 (organized by Regina Bruder and Julia Reibold)

- Fortbildungsveranstaltung zu einem Unterrichtskonzept für einen binnendifferenzierenden Mathematikunterricht im Rahmen von "Mathe anders machen" der Deutsche Telekom Stiftung, Hannover, October 17, 2010 (organized by Regina Bruder and Julia Reibold)

- Career Opportunities for Women in Mathematical Fluid Dynamics, October 20, 2009 (organized by Karoline Götze)

- Conference on Algebra and Probability in Many-valued Logics, May 7 to 9, 2009 (organized by Christian Herrmann and Ioana Leustean)

- Opening Workshop: International Research Training Group on Mathematical Fluid Dynamics, October 21 - 23, 2009 (organized by Prof. Dr. Matthias Hieber)

- Career Opportunities for Women in Mathematical Fluid Dynamics, October 20, 2009 (organized by IRTG 1529)

- Mini-Workshop on Geometric Fluid Mechanics, January 21, 2009 (organized by IRTG 1529)

- Mini-Workshop on Fluid Structure Interaction, June 16, 2009 (organized by IRTG 1529)

- Workshop on Arveson's Entanglement, Blaubeuren, Jan 17 to 20, 2009 (organized by Burkhard Kümmerer)

- Workshop on Lie theory and physics, July 18, 2009 (organized by K.-H. Neeb and N. Scheithauer)

- 62. ErnstSchröderKolloquium: Diskrete Mathematik diskret in der Praxis, 30.01.09 (organized by Rudolf Wille, Markus Helmerich und Rüdiger Lich)

- 62. ErnstSchröderSeminar: Diskrete Mathematik für die Schule, 31.01.09 (organized by Rudolf Wille, Markus Helmerich und Rüdiger Lich)

- 63. ErnstSchröderKolloquium: Philosophische Reflexion der Mathematisierung, 16.05.09 (organized by Rudolf Wille und Rüdiger Lich)

- 63. ErnstSchröderSeminar: Mathematisierung des Begrifflichen in der realen Welt, 16.05.09 (organized by Rudolf Wille und Rüdiger Lich)

- 64. ErnstSchröderKolloquium: Evolution und Strukturgenese des Wissens, 03.07.09 (organized by Rudolf Wille und Rüdiger Lich)

- 64. ErnstSchröderSeminar: Wissen zwischen Sprache, Information und Bewusstsein, 04.07.09 (organized by Rudolf Wille und Rüdiger Lich)

- 65. ErnstSchröderKolloquium: Hinführung der Informatik zu einer konstruktiven Ingenieurwissenschaft, 27.11.09 (organized by Rudolf Wille und Rüdiger Lich)

- 65. ErnstSchröderSeminar: Informatik als Grundbildung, 28.11.09 (organized by Rudolf Wille und Rüdiger Lich)

- 66. ErnstSchröderKolloquium: Von Grassmanns Ausdehnungslehre zur geometrischen Algebra und Logik, 29.01.10 (organized by Rudolf Wille und Rüdiger Lich)

- 66. ErnstSchröderSeminar: Allgemeine Ansätze zur geometrischen Algebra und Logik, 30.01.10 (organized by Rudolf Wille und Rüdiger Lich)

- 67. ErnstSchröderKolloquium: Über die Struktur des Kontinuums, 28.05.10 (organized by Rudolf Wille und Rüdiger Lich)

- 67. ErnstSchröderSeminar: Formal concept analysis of one-dimensional continuum structures, 29.05.10 (organized by Rudolf Wille und Rüdiger Lich)

- 68. ErnstSchröderKolloquium: Begriffliche Repräsentation temporaler Systeme, 25.06.10 (organized by Rudolf Wille und Rüdiger Lich)

- 68. ErnstSchröderSeminar: Granularität in Raum und Zeit: Was ist ein Zeitpunkt, was ist ein Ort?, 26.06.10 (organized by Rudolf Wille und Rüdiger Lich)

- 69. ErnstSchröderKolloquium: Liniendiagramme in der Wissenskommunikation, 10.12.10 (organized by Rudolf Wille und Rüdiger Lich)

- 69. ErnstSchröderSeminar: Formale Beschreibungen von Daten und Systemen, 11.12.10 (organized by Rudolf Wille und Rüdiger Lich)

7.5 Scientific and Industrial Cooperations

Hans-Dieter Alber

B. Markert (Universität Stuttgart): 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.

Dieter Bothe

Prof. Michele Pierre (University of Rennes): Analysis of rection diffusion systems.

Prof. Anne Marie Robertson (University of Pittsburgh): Computational analysis of bouyant fluidic particles.

Prof. Jan Prüß (Universität Halle Wittenberg): Analysis og fluidic interfaces.

Dr. Bernhard Weigand (ITLR Universität Stuttgart): Development and application of advances Volume of Fluid methods.

Prof. Michael Schlüter (Universität Hamburg-Harburg): Theoretische und numerische Untersuchung des reaktiven Stoffübergangs aus aufsteigenden Gasblasen.

Prof. Wolfgang Dreyer (WIAS Berlin): Rational Thermodynamics of fluid mixtures.

Christian Brandenburg

SPP 1253: Project “Advanced numerical methods for PDE-constrained optimization with application to optimal design and control of a racing yacht in the America’s Cup”.

Regina Bruder

Texas Instruments, Mr. Dirk Ritschel: Evaluation of model-projects in Hessen, Niedersachsen, Rheinland-Pfalz and scientific coaching in Hamburg and Schleswig-Holstein (issue: computerbased learning Mathematics.

Ministry of Education Hessen, Rheinland-Pfalz, Niedersachsen and Hamburg: Development of concepts for further teacher training.

PH Freiburg, Prof. Timo Leuders, Prof. Markus Wirtz: Research project for diagnostic of competencies (modelling, problem-solving).

Universität Kassel, Prof. Biehler: (Department of Mathematics) Development of bridge courses in Mathematics.

Institut für Qualitätsentwicklung in Bildungswesen, Berlin, Frank Weigand: Entwicklung der nationalen Abiturstandards Mathematik.

Department of Teacher Education (Amt für Lehrerbildung) Hessen, Frankfurt, Herr Maitzen: Steuerungsgruppe zur Implementation der Bildungsstandards in Mathematik für das Land Hessen.

University of Technology Sydney, Prof. Anne Prescott: Development of competencies in the inservice training of Math-teachers and measurement of competencies.

Hans-Georg Weigand, University of Würzburg; Lisa Hefendehl-Hebeker, Universität Duisburg-Essen, Barbara Schmidt-Thieme, Universität Hildesheim: Herausgabe eines Didaktikhandbuches bei Springer.

Elschenbroich, Barzel, Weigand, Henn, Pinkernell, Greefrath, Kramer, Koepf: Einrichtung einer Schnittstellengruppe zum Übergang Schule-Hochschule der 3 Verbände GDM, DMV und MNU.

Jan H. Bruinier

Prof. Dr. K. Ono (University of Wisconsin at Madison): Harmonic weak Maass forms.

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. O. Imamoglu (ETH Zürich: Regularized theta lifts.

Prof. Dr. E. Freitag (Universität Heidelberg): Automorphic products.

Prof. Dr. S. Kudla (University of Toronto) and Prof. Dr. T. Yang (University of Wisconsin at Madison): CM values of automorphic products.

Debora Clever

Prof. Dr. Stefan Ulbrich, Dr. Carsten Ziems (TU Darmstadt): Adaptive multilevel SQP-methods for PDAE-constrained optimization with restrictions on control amd state. Supported by DFG, SPP 1253.

Reinhard Farwig

Prof. Dr. H. Sohr (Universtät Paderborn): Regularity of weak solutions of the Navier-Stokes equations.

Prof. Dr. H. Kozono (Tohoku University, Sendai (Japan): Fluid Flow in Unbounded Domains.

Prof. Dr. T. Hisdida (Nagoya University (Japan): Fluid Flow Around Rotating Obstacles Domains.

Prof. Dr. J. Neustupa (Czech Academy of Sciences, Prague): Spectral Properties of Fluid Problems.

Prof. Dr. Š. Nečasová (Czech Academy of Sciences, Prague): Fundamental Problems for Fluid Flow around Moving Bodies.

International Research Training Group TU Darmstadt and Waseda University Tokyo(IRTG 1529): Mathematical Fluid Dynamics.

Cluster of Excellence: Center of Smart Interfaces: Understanding and Designing Fluid Boundaries.

Jaime Gaspar

Prof. Dr. U. Kohlenbach (TU Darsmtadt): On Tao's "finitary" infinite pigeonhole principle [64].

Dr. P. Oliva (Queen Mary, University of London): Proof interpretations with truth [65].

Matthias Geißert

Prof. Dr. S. Larsson (Chalmers University of Technology): Strong convergence of finite element methods for parabolic stochastic equations.

Prof. Dr. A. Lunardi (University of Parma): Non-autonomous Ornstein-Uhlenbeck operators.

Prof. Dr. L. Lorenzi (University of Parma): Non-autonomous Ornstein-Uhlenbeck operators.

Prof. Dr. R. Schnaubelt (KIT): Non-autonomous Ornstein-Uhlenbeck operators.

Prof. Dr. G. P. Galdi (University of Pittsburgh): Stationary solution to a Couette flow.

Prof. Dr. Y. Shibata (Waseda University): Stability of free boundary value problems.

Alf Gerisch

Prof. Dr. K. Raum (Charité Universitätsmedizin Berlin) and Prof. Dr. Q. Grimal (University of Paris VI, France): Multiscale structure-functional modeling of musculoskeletal mineralized tissues (DFG grants GE1894/4 and Ra1380/7).

Prof. Dr. M. Chaplain (University of Dundee, Scotland): Mathematical modelling and simulation of cancer invasion.

Prof. Dr. J. Lang (TU Darmstadt), Prof. Dr. R. Weiner, and Dr. H. Podhaisky (Martin-Luther-Universität Halle-Wittenberg): PEER methods and their application in the Finite Element system KARDOS.

Dr. J. Galle (Interdisciplinary Center for Bioinformatics Leipzig): Modelling and simulation of cartilage production in a perfused bioreactor.

Thea Göllner

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).

Karoline Götze

IRTG 1529: Mathematical Fluid Dynamics (TU Darmstadt): .

Prof. Dr. Y. Shibata (Waseda University): Global existence of solutions for fluid-rigid interaction problems.

Karsten Große-Brauckmann

Prof. Dr. John Sullivan (TU Berlin): Constant mean curvature surfaces.

Dr. Gerd Schröder-Turk (Universität Erlangen): Interfaces.

Prof. Dr. Robert Kusner (University of Massachusetts in Amherst): Constant mean curvature surfaces.

Prof. Dr. Valerio Batista (Federal University of ABC Sao Paulo): Isoperimetric problems.

Ute Günther

CRC 666: “Integral sheet metal design with higher order bifurcations – development, production, evaluation”. Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).

Kai Habermehl

Collaborative Research Center (SFB) 805: “Control of uncertainties of load carrying systems in mechanical engineering“. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Robert Haller-Dintelmann

Prof. F. Ali Mehmeti (University of Valenciennes, France): The Klein-Gordon equation on star-shaped networks.

Dr. J. Rehberg (Weierstraß-Institut für Angewandte Analysis und Stochastik (WIAS), Berlin): Divergence form operators with mixed boundary conditions in non-smooth domains.

Tobias Hansel

International Research Training Group 1529: “Mathematical Fluid Dynamics”, Speaker: Prof. Dr. M. Hieber (Department of Mathematics, TU Darmstadt).

Horst Heck

Prof. Dr. H. Kim (Sogang University): Weak Solutions of the Navier-Stokes equations in the exterior of an obstacle.

Prof. Dr. H. Kozono (Tohoku University): Weak Solutions of the Navier-Stokes equations in the exterior of an obstacle.

Prof. Dr. Ana Silvestre (Technical University of Lisbon): Inverse problems in Fluid-Structure interaction.

Matthias Hieber

Prof. G. Galdi (University of Pittsburgh): DFG-NSF Project on Fluid-Struktur Interaktion.

DFG-NSFC: German-Chinese Project on Analysis of Partial Differential Equations and Applications.

DFG-JSPS (TU Darmstadt, Waseda University, Tokyo University): International Research Training Group on Mathematical Fluid Dynamics Speaker: Prof. Dr. M. Hieber.

Center of Smart Interfaces: Understanding and Designing Fluid Boundaries (TU Darmstadt): Exzellenzcluster.

DAAD (Czech Academy of Sciences and Charles University, Prag): PPP Program on Navier-Stokes Equations.

Karl H. Hofmann

Prof. Michael W. Mislove, Tulane University: Topological Algebra, Domains.

Prof. Sidney A. Morris, University of Balarat and LaTrobe University, Melbourne, Australia: Compact Groups, Pro-Lie Groups.

Dr. Francesco G. Russo, University of Palermo, Italy: Compact Groups.

Sarah Kessler

Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt)..

Ulrich Kohlenbach

Dr. Laurentiu Leustean (Romanian Academy): Proof Mining in Nonlinear Analysis.

Michael Kohler

Prof. Dr. Harro Walk (Universität Stuttgart): Optimal exercising of American options in discrete time.

Prof. Dr. Adam Krzyżak (Concordia University Montreal): Regression based Monte Carlo methods for pricing American Options.

Prof. Dr. Adam Krzyżak (Concordia University Montreal): Nonparametric estimation of nonstationary velocity fields from 3D particle tracking velocimetry data.

SFB 666 (TU Darmstadt): Efficient estimation of fatigue parameters.

Prof. Dr. Harro Walk (Universität Stuttgart), Prof. Dr. Adam Krzyżak (Concordia University Montreal): Estimation of the essential supremum of a regression function.

Oliver Kolb

Prof. Dr. Kathrin Klamroth (Bergische Universität Wuppertal), Prof. Dr. Jens Lang (TU Darmstadt), Prof. Dr. Günter Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. Alexander Martin (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. Martin Oberlack (TU Darmstadt), Prof. Dr. Manfred Ostrowski (TU Darmstadt), Hessenwasser GmbH & Co. KG, Siemens AG: Diskret-kontinuierliche Optimierung komplexer dynamischer Wasserver- und -entsorgungssysteme. Supported by BMBF, 2007-2010.

Daniela Koller

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).

Burkhard Kümmerer

Prof. Dr. H. Maassen (Nijmegen): Quantum Probability.

Prof. Dr. R. Gohm (Aberystwyth): Quantum System Theory.

Dr. C. Koestler (Aberystwyth): Quantum System Theory.

Dr. G. Giedke (MPI for Quantum Optics, Garching): Entanglement.

Dr. T. Wellens (Freiburg): Entanglement.

Prof. Dr. U. Kirchgraber (ETH Zürich): Understanding of Mathematics.

Prof. Dr. R. Kaenders (Köln): Understanding of Mathematics.

Jens Lang

Prof. Dr. Jan Verwer (University of Amsterdam and CWI): W-Methods for optimal control.

Prof. Dr. Weizhang Huang (University of Kansas): Developing anisotropic mesh methods.

Prof. Dr. Rüdiger Weiner (Martin-Luther-Universität Halle-Wittenberg): Developing linearly implicit methods.

Bodo Erdmann (ZIB): Kardos programming.

Prof. Dr. Günter Leugering, Prof. Dr. A. Martin (Universität Erlangen): Modelling, Analysis, Simulation and Optimal Control of Gas Transport in Networked Pipelines. Supported by DFG, 2007-2011.

SFB 568: "Flow and Combustion in Future Gas Turbines". Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by DFG, 2007-2011.

GK 1344: "Instationary System Modelling of Aircraft Turbines", Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by DFG, 2006-2014.

SPP 1253: Optimization with PDEs. Supported by DFG, 2009-2012, jointly with Prof. Dr. Stefan Ulbrich (TU Darmstadt).

Prof. Dr. Jochen Fröhlich (Universität Dresden): Large Eddy Simulation with Adaptive Moving Meshes, Supported by DFG, Metstroem, 2007-2011.

Dr. Nilles, BASF: Numerical Simulation, Modelling and Optimization of Multi-Phase and Multi-Scale Combustion Processes.

Stefan Löbig

Priority Programme (SPP) 1276: "MetStröm: Multiple Scales in Fluid Dynamics and Meteorology", Speaker Prof. Dr. Rupert Klein (Mathematics, FU Berlin). Supported by the German Research Foundation (DFG), 2007-2012, jointly with Prof. Dr. Jochen Fröhlich and Dipl.-Ing. Claudia Hertel (Institute of Fluid Mechanics, TU Dresden).

Ulf Lorenz

Prof. Dr. M. Platzner (Universität Paderborn): PhD Sponsorship within the Micosoft Research PhD Scholarship programme.

Microsoft: PhD Sponsorship within the Micosoft Research PhD Scholarship programme.

Prof. Dr. A. Martin (Universität Erlangen): Quantified Linear Programs.

Prof. Dr. P. Pelz (TU Darmstadt): From components to a system.

Collaborative Research Centre (SFB) 805: Beherrschung von Unsicherheit in lasttragenden Systemen des Maschinenbaus. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

German Research Foundation (DFG): Erweiterung mathematischer Optimierungsmethoden zur Lösung PSPACE-vollständiger Probleme mit Hilfe quantifizierter linearer Programme.

Martin Otto

Prof. Dr. Georg Gottlob and Dr. Vince Barany (University of Oxford): Finite controllability and finite model properties of guarded logics.

Dr. Mark Weyer and Achim Blumensath: Boundedness problems.

Prof. Dr. Anuj Dawar (Cambridge University): Finite and algorithmic model theory.

Ulrich Reif

Prof. Dr. O. Davydov (Stratyhclyde University, Glasgow): Scattered Data Approximation on Domains.

Dr. B. Mößner (Universität Freiburg): Splines auf Gebieten.

Steffen Roch

Prof. Dr. Bernd Silbermann (TU Chemnitz): Operator theory and numerical analysis.

Dr. Marko Lindner (TU Chemnitz): Spectral theory of band operators.

Prof. Dr. Vladimir S. Rabinovich (IPN Mexico/City): Band-dominated operators, their Fredholm properties and finite sections.

Prof. Dr. Pedro A. dos Santos (IST Lisbon): Numerical analysis for convolution-type operators.

Prof. Dr. Torsten Ehrhardt (UC Santa Cruz): Szegö limit theorems.

Rolf Roth

SFB 568: "Flow and Combustion in Modern Gas Turbine Combustion Chambers of the Future". Speaker Prof. Dr. Johannes Jannicka (Department of Mechanical Engineering. TU Darmstadt).

Nils Scheithauer

Prof. Dr. R. E. Borcherds (UC Berkeley): Automorphic forms and vertex algebras.

Prof. Dr. E. Freitag (Universität Heidelberg): Automorphic forms.

Prof. Dr. G. Höhn (Kansas State University): Vertex algebras and infinite-dimensional Lie algebras.

Adrian Sichau

Collaborative Research Centre (SFB) 805: "Control of uncertainty of load carrying systems in mechanical engineering". Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Thomas Streicher

Dr. B. Reus (University of Sussex): Synthetic Theory of Sequential Domains.

Prof. A. Simpson (University of Edinburgh): Sheaf Models for CZF.

Stroemberg

NSF: Computational aspects of L-functions and modular forms. FRG Grant No. DMS-0757627.

Prof. Andreas Strömbergsson (University of Uppsala), Dr. Andrew Booker (University of Bristol): Computations of low eigenvalues for Congruence subgroups.

Prof. Dr. Nils Skoruppa (Universität Siegen): Computations of Weil representation and Finite Quadratic Modules. Dimension formulas for vector-valued Hilbert modular forms of half-integral weight..

PhD Ben Kane (Universität zu Köln) and PhD Zachary Kent (Emory University): Classification and computation of Mock Theta functions.

Prof. Dr. Dieter Mayer (TU Clausthal), Dr. Tobias Mühlenbruch (Fernuniversität Hagen): Symbolic dynamics and transfer operators for Hecke triangle groups.

Sara Tiburtius

SPP 1420: “Biomimetic Materials Research: Functionality by Hierarchical Structuring of Materials”. Supported by the German Research Foundation (DFG), 2009-2011, joint project of Dr. Alf Gerisch (Department of Mathematics, TU Darmstadt) and Prof. Dr. Kay Raum (Julius Wolff Institute and Berlin-Brandenburg School for Regenerative Therapies, Charité-Universitätsmedizin Berlin).

Stefan Ulbrich

Graduate School GSC 233: “Computational Engineering”. German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Excellence Cluster EXC 259: “Center of Smart Interfaces: Understanding and Designing Fluid Boundaries (CSI)”. German Excellence Initiative. Speaker Prof. Dr.-Ing. Cam Tropea (Department of Mechanical Engineering, TU Darmstadt).

Prof. Michael B. Giles (Oxford University): Convergence of linearised and adjoint approximations for discontinuous solutions of conservation laws.

Prof. Dr. Matthias Heinkenschloss (Rice University, Houston): PDE-Constrained Optimization, Model Reduction.

Prof. Dr. Michael Herty (RWTH Aachen), Prof. Dr. Günter Leugering, Dr. Martin Gugat (Universität Erlangen-Nürnberg): Optimal control of switched networks for nonlinear hyperbolic conservation laws. Supported by DFG within SPP 1253.

International Research Training Group IGK 1529: “Mathematical Fluid Mechanics” Speaker Prof. Dr. Matthias Hieber (Department of Mathematics, TU Darmstadt).

Prof. Dr. Bülent Karasözen (METU, Ankara): DAAD Partnership Project “Optimization theory, methods and applications”.

Prof. Dr. Jens Lang (TU Darmstadt): Adaptive multilevel SQP-methods for PDAE-constrained optimization with restrictions on control and state. Theory and Applications. Supported by DFG within SPP 1253.

LOEWE-Center: “AdRIA: Adaptronik - Research, Innovation, Application”. Excellence Initiative of Hesse. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

LOEWE Research Priority Program: “Cooperative Sensor Communication – Cocoon”. Excellence Initiative of Hesse. Speaker Prof. Dr.-Ing. Abdelhak Zoubir (Department of Electrical Engineering, TU Darmstadt).

Schenck RoTec GmbH (Darmstadt): Balancing of axle-elastic rotors.

SFB 568: “Flow and combustion in future gas turbine combustion chambers”. Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt).

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).

SFB 805: “Control of uncertainties in load carrying systems of mechanical engineering”. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Prof. Dr. Michael Ulbrich (TU München): Multilevel Methods for PDE-constrained Optimization.

Prof. Dr. Michael Ulbrich (TU München), Prof. Luis N. Vicente (University of Coimbra, Portugal): Interior point filter methods for nonlinear optimization.

zeb/rolfes.schierenbeck.associates (Frankfurt): Mixed-Integer nonlinear optimization for credit portfolio optimization.

Sebastian Ullmann

Collaborative Research Centre (SFB) 568: “Flow and Combustion in Future Gas Turbine Combustion Chambers”. Speaker: Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by the German Research Foundation (DFG), 2008-2011.

Christian H. Weiß

Prof. M.C. Testik, PhD (Hacettepe University, Ankara): CUSUM Monitoring of Serially Dependent Processes of Counts.

Prof. H.-Y. Kim, PhD (Korea University, Seoul): Parameter Estimation for Binomial AR(1) Processes.

Prof. P. Pollet, PhD (University of Queensland): Count Data Time Series and Metapopulation Models.

Dr. M. Atzmüller (Universität Kassel): EWMA Control Charts for Monitoring Binary Processes.

Andrea Zelmer

Prof. Dipl.-Ing. M. Sc. Econ. M. Hegger (TU Darmstadt): "UrbanReNet: Efficient Regenerative Energy Concepts in Urban Areas", BMWi network.

7.6 Secondary Schools and Public Relations

The Department of Mathematics is involved in several activities for schools, secondary school students, and public relations. In addition to printed information material the department of mathematics appears in public on its web pages, which 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 Mathematics programs, the department publishes a comprehensive study guide (“Informationsbroschüre”), which was completely revised in 2009. To inform prospective students about different facets of Mathematics and corresponding study programs, Prof. Kümmerer published the guide “Mathematik — Warum? Was? Wozu? Wer? Wie? Wo? Weiteres?” in 2010. These guides, together with leaflets on special study programs, are also distributed in schools, on fairs and in our widespread network with student service centers at universities all over Germany and regional employment centers. Furthermore, the web pages

with informations for our (prospective) students have undergone a major revision in 2009 and 2010.

The following is a list of further public relations activities.

Activities for high school students and prospective students

- Presentation of the department with a booth and several talks at the job and study information fair "HoBIT – Hochschul- und Berufsinformationstage", three days each January, about 25.000 participants during the fair in 2010. (booth: student advisor, professors, academic staff and students; talks: Prof. Kohler, Prof. Bruinier, Helmerich in 2009, Prof. Kohler, Prof. Scheithauer, Weiß in 2010)

- Presentation of the department and mathematics study programs at the university information day ("TUDay"), each May with talks by the student advisor, sample lecture and tutorial class and meetings with students of the department, about 80 participants over the course of the day in 2010 (student advisor, lectures: Mars in 2009, Prof. Joswig, Prof. Ziegler in 2010)

- Organization of the "Darmstädter Schülernachmittag zur Mathematik", one afternoon per year with several talks about mathematics for secondary school students (organization: Prof. Kohler; talks: Prof. Alber, Prof. Kiehl, Prof. Kohler, Prof. Kümmerer, Prof. Neeb in 2009, Prof. Bruinier, Prof. Große-Brauckmann, Prof. Kohler, Prof. Reif in 2010)

- Presentation of the department at the information days for female students ("Schnuppertage für Schülerinnen"), an afternoon in each year with a talk by the student advisor, a sample lecture and talks with female mathematicians, 25 participants in 2009 and 27 participants in 2010 (organization: Mrs. Cosulich; talk: student advisor; lectures: Mrs. Plehnert in 2009 and Mrs. Bausch in 2010)

- Organization of the Hessian Mathematics Olympiad (third level) in cooperation with the Center for Mathematics Bensheim each February for all grades (about 25 participants per grade each year) (Prof. Kiehl, Prof. Kümmerer, Prof. Otto, academic staff and students).
  As part of the final round in 2010, mathematical afternoon lectures were delivered by Prof. Kümmerer ("Unendlich: Unglaublich – Unheimlich – Unmöglich") and Prof. Otto ("Diagonalen, die den Rahmen sprengen").

- Hosting of the Internet portal for secondary school students mathe-zirkel.de with information and encouragement for interested secondary school students, including a quarterly contest for secondary school students in grade 7 and upwards (Prof. Bruder, Prof. Roch)

- Organization of the Mathematical Modeling Week for secondary school students in grade 12 in cooperation with Center for Mathematics Bensheim each October (40 participants each year) (Prof. Kiehl)

- Involvement in the yearly German Maths Contest (Bundeswettbewerb Mathematik) (about 200 participants) (Prof. Alber, Prof. Roch)

- Full 2-day special programme of lectures, exercises and supervised group work dedicated to the topic of *Logic and The Modelling of Information and Knowledge* (September 20-21, 2010) for the year 12 mathematics Leistungskurs/Tutorium at the Edith-Stein-Schule in

the framework of an annual “Praktikum Wissenschaftswelt”. (devised and taught by Prof. Otto, tutors: C. Möller, F. Werner)

- several visits at schools by the student advisor

Public Appearances and other activities

- talk at the “21. Schweizerischer Tag über Mathematik und Unterricht”, Rychenberg (Switzerland) about the topic “Mathematik zwischen Anschauung und Sprache” (Prof. Kümmerer)
- graduation celebration with friends and family of the graduated students once per year (Prof. Alber and staff)

In addition there have been many activities at the Ernst-Schröder-Colloquia under the hand of Rudolf Wille.

8 Contact

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