Biannual Report

Department of Mathematics

2007 and 2008

Contents

Preface

Ladies and Gentlemen,
Dear Friends of our Department of Mathematics:

In recent years significant new developments, structures and ideas in academia have been established with the goal to strengthen science and teaching in Germany. With the "Initiative for Excellence" the Federal Government promotes top-class university research and has the aim to establish internationally visible research beacons in Germany. By funding Elite Universities, Clusters of Excellence and Graduate Schools, a secure basis for world-class research is provided. The Excellence Initiative LOEWE of Hesse provides initial funding for research centers that promote cooperations between Hessian universities, research institutes, industry and economics. Within the "Bologna process" the diploma programs are currently being replaced by consecutive bachelor's and master's programs.
As a consequence, subject areas and the activities of institutions and individuals are under discussion and are to be evaluated. In this context, the university as a whole and the individual scientists have to meet the challenge and to position themselves in a new perspective. This applies also to the Department of Mathematics at Technische Universität Darmstadt. We want to demonstrate the importance of our subject within and beyond the university, we want to be visible for students within and beyond Hesse, and we seek recognition from other institutes and researchers within and beyond Germany. Our task therefore is to present a picture of the activities and developments of our department in a suitable way to satisfy all these requirements. This biannual report is meant to be one facet of this picture. The report presents the activities of the department in research and teaching during the last two years, 2007 and 2008.
The department almost completed its change of generations. Within the last five years offers from other universities were extended to eleven colleagues and ten new colleagues accepted an offer from our university. The department has used this opportunity to undertake a major reorganisation into eight focal research areas, with two or three professors in each research group. The new structure allows us to better organise our teaching and facilitates the formation of groups aiming for research grants. The success of our research activities is demonstrated by the list of publication in international reviewed journals, presentations at scientific conferences as well as by many cooperations with other universities and with industry. Several members of our department are principal investigators in the successful projects "Center of Smart Interfaces (CSI)" and the "Graduate School Computational Engineering" of TU Darmstadt within the Initiative for Excellence, the LOEWE-Center "Adaptronics: Research, Innovation, Application (AdRIA)", and the newly established Collaborative Research Center SFB 805. In addition, under the coordination of Prof. M. Hieber, the department successfully applied for the International Graduate School IRTG 1529 "Mathematical Fluid Dynamics", which started in 2009. In teaching the master's program was introduced with the start of the academic year 2006/07. The new bachelor's program runs very successfully since the academic year 2007/2008. Besides these new corner stones, the department has continued its long standing tradition in implementing special features for the improvement in teaching and teacher training.

These are just some topics from a long list of activities mentioned in the report. We hope you will enjoy reading this document, and that you will find many interesting facts about our department, and maybe even some new insights into aspects of our department. If you have any suggestions for improvement please let us know. If you arrive at the conclusion that we are a department to cooperate with or to study mathematics at, please go ahead and contact us or tell others.

Sincerely Yours,

Prof. Dr. Stefan Ulbrich
(Dean of the Department of Mathematics)

1 The Department of Mathematics

With over 1,100 students, more than 20 professorships and approximately 80 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 last years have been characterized on the one hand by a number of offers colleagues received from other universities and on the other hand by welcoming new colleagues from other universities at new positions in our department. As a consequence, the average age of the professors reduced significantly and the department has been restructured. Originating from twelve working groups in the past we have now focused our research interests on eight groups. 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 800 students in the mathematics programs and some 300 in the teacher training program. A survey of all students in the last years is tabulated on page 95 as well as the alumni in Table on page 96.
In addition to the forty research assistants supported by the university we have more than thirty further PhD students in mathematics supported by the the German Science Foundation (DFG), the Federal Ministry of Education and Research (BMBF) and others. All PhD theses are listed in section 4.8.
The department is well integrated in the university. Concerning teaching the department organizes the whole education in mathematics for all departments, starting from all students of engineering departments, over those from natural sciences up to the students in humanity. 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. M. 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 the double are associate editors.

The third-party funds increased up to 1.5 million Euros in the years 2007 and 2008. This amount was mostly granted by the DFG. In particular we want to mention in this context several scholarships for PhD students and Postdocs as well as two Heisenberg fellowships.
In addition, the contracts to industry have been steadily improved. In the meantime the department can call as their partners companies such as Deutsche Bahn, eon, Linde, SAP, Schenck, Siemens, Texas Instruments, Wincor Nixdorf and others.

2 Research

2.1 Research Groups

2.1.1 Algebra, Geometry and Functional Analysis

This group has two main research areas. On the one hand we investigate infinite dimensional symmetries, i.e. the structure and representation theory of infinite dimensional Lie groups and Lie algebras. On the other hand we work on number theory and algebraic geometry. Both directions are closely connected by automorphic forms.
Symmetries are a fundamental subject in mathematics and also an essential tool in many areas. For example the Kepler problem, i.e. the motion of two masses interacting by gravitation, can only be solved when the rotational symmetry of the problem is taken into account. Symmetries are described by groups. Of particular interest are Lie groups. These are groups which have a compatible manifold structure. Their geometric properties are largely described by their Lie algebras, i.e. the tangent space at the identity. The characters of their representations connect Lie groups and Lie algebras to automorphic forms.
Automorphic forms can be viewed as functions on real Lie groups which are invariant under left translations by an arithmetic subgroup. They are of fundamental importance in number theory and algebraic geometry, for instance in the study of quadratic forms and elliptic curves. Moreover, they provide a link between analysis and arithmetic via the Langlands program.

Project: Harmonic Weak Maass Forms

We investigate the Fourier coefficients of harmonic weak Maass Forms. We show that an integral weight weak Maass Form f of weight $2-k$ which is related to a CM Hecke eigenform of weight $k \geq 2$ 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.

Partner: K. Ono, University of Wisconsin at Madison, R. Rhoades, Ecole Polytechnique Federale de Lausanne

Contact: Jan Hendrik Bruinier.

References

[1] J. H. Bruinier and K. Ono. Heegner divisors, L-functions and harmonic weak Maass forms. *Annals of Mathematics*, 2008, accepted for publication.

[2] J. H. Bruinier, K. Ono, and R. C. Rhoades. Differential operators for harmonic weak Maass forms and the vanishing of Hecke eigenvalues. *Mathematische Annalen*, 342:673–693, 2008.

Project: Arithmetic intersection theory on Shimura varieties

We study the Faltings height pairing of arithmetic Heegner divisors and CM cycles on Shimura varieties associated to orthogonal groups. We compute the

Archimedian contribution to the height pairing and derive a conjecture relating the total pairing to the central derivative of a Rankin L-function. We prove the conjecture in certain cases where the Shimura variety has dimension 0, 1, or 2. In particular, we obtain a new proof of the Gross-Zagier formula.

Partner: T. Yang, University of Wisconsin at Madison

Contact: Jan Hendrik Bruinier.

References

[1] J. H. Bruinier. The Gross-Zagier formula and the Borcherds lift. *Proceedings of the National Institute of Mathematical Sciences*, 3:1–8, 2008.

[2] J. H. Bruinier and T. Yang. Faltings heights of CM cycles and derivatives of L-functions. Preprint, TU Darmstadt, 2008.

Project: CM values of automorphic products

We study the values at CM points of automorphic forms that are obtained by the Borcherds lift or generalizations of it. With T. Yang we considered this problem for twisted Borcherds products on Hilbert modular surfaces. We did some numerical computations, derived some conjectures for the prime factors that occur in the factorization, and we studied the field extensions generated by the CM values. In work in progress with T. Yang and S. Kudla we compute CM values of Borcherds products and automorphic Green functions on Hilbert modular surfaces at "big" CM cycles.

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

Support: NSF

Contact: Jan Hendrik Bruinier, Stephan Ehlen

References

[1] J. H. Bruinier and T. Yang. Twisted Borcherds products on Hilbert modular surfaces and their CM values. *American Journal of Mathematics*, 129:807–841, 2007.

Project: The Structure of Pro-Lie Groups

A pro-Lie group is a complete topological group which is approximated by Lie groups in the sense that there are arbitrarily small normal subgroups N such that the factor group G/N is a Lie group. All connected locally compact groups are pro-Lie groups, all locally compact abelian group are pro-Lie groups as are all products of families of finite dimensional Lie groups and their closed subgroups. Each Pro-Lie group comes along with a pro-Lie algebra, that is, a complete real topological algebra such that every neighborhood of 0 contains a cofinite-dimensional closed ideal.
The goal of the project is to determine the Lie theory and the structure theory of pro-Lie algebras and pro-Lie groups as explicitly as possible. In general, pro-Lie algebras and pro-Lie groups are infinite dimensional. The status of the theory has been presented in the monograph [1], and it has been enhanced and complemented in the articles listed in the References.

Partner: —Professor Sidney A. Morris, Graduate School of Information Technology and Mathematical Sciences, University of Ballarat, Victoria, Australia.
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—Professor Karl-Hermann Neeb, TU Darmstadt.
E-mail: neeb@mathematik.tu-darmstadt.de
URL: `http://www.mathematik.tu-darmstadt.de/fbereiche/AlgGeoFA/staff/neeb.php`

Contact: Karl Heinrich Hofmann

References

[1] K. H. Hofmann and S. A. Morris. *The Lie Theory of Connected Pro-Lie Groups - A Structure Theory for Pro-Lie Algebras, Pro-Lie Groups and Connected Locally Compact Groups.* pages xvii+678. EMS Publishing House, Zürich, 2007.

[2] K. H. Hofmann and S. A. Morris. Open mapping theorems for topological groups. *Topology Proceedings*, 31:533–551, 2007.

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[5] K. H. Hofmann and S. A. Morris. On the pro-Lie group theorem and the closed subgroup theorem. *J. of Lie Theory*, 18:383–390, 2008.

[6] K. H. Hofmann and K.-H. Neeb. On the compact generation of closed subgroups of locally compact groups, 2008.

[7] K. H. Hofmann and K.-H. Neeb. Pro-Lie groups as infinite dimensional Lie groups. *Math. Proc. Cambridge Philos. Soc.*, 146:351–378, 2008.

Project: Infinite-Dimensional Lie Groups (Monograph)

Lie groups arise most naturally as symmetry groups or automorphism groups of algebraic or geometric structures. In many cases the symmetry groups are infinite-dimensional, even if the structures under consideration are finite-dimensional. In particular, this is the case for the group Diff(M) of all diffeomorphisms of a compact manifold or the group Aut(P) of automorphisms of a fiber bundle P over a compact manifold.
The main point of this text book is to provide a streamlined introduction to infinite-dimensional Lie theory accessible to advanced graduate students. Since the natural setup for infinite-dimensional Lie theory is the context of manifolds modelled on locally convex spaces, this requires in particular a brief introduction to calculus in this setting. Our point of view is that once the reader is acquainted with the concept of a locally convex space, essentially all constructions familiar from finite-dimensional calculus work in the infinite-dimensional setting as well. The most severe difference is that the results on existence and uniqueness of ordinary differential equations and the inverse function theorem fail on infinite-dimensional spaces which are not Banach.

In this book we discuss several classes of infinite-dimensional Lie groups and the extent to which the translation process between group and Lie algebra works for them. Of fundamental importance is the integrability problem: Which locally convex Lie algebras are the Lie algebra of a global Lie group? This question leads us to the extension theory of infinite-dimensional Lie groups, the corresponding Lie group cohomology and other geometric integrability problems.

Partner: Prof. Dr. Helge Glöckner, Universität Paderborn

Contact: Karl-Hermann Neeb

References

[1] W. Bertram, H. Glöckner, and K.-H. Neeb. Differential calculus over general base fields and rings. *Expo. Math.*, 22(3):213–282, 2004.

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[4] K.-H. Neeb. Infinite-dimensional groups and their representations. In *Lie theory*, volume 228 of *Progr. Math.*, pages 213–328. Birkhäuser Boston, Boston, MA, 2004.

[5] K.-H. Neeb. Non-abelian extensions of topological Lie algebras. *Comm. Algebra*, 34(3):991–1041, 2006.

[6] K.-H. Neeb. Towards a Lie theory for infinite-dimensional groups. *Jap. J. Math. 3rd series*, 1:291–468, 2006.

Project: Infinite dimensional spherical analysis

The goal of this project is to understand the unitary representations of the isometry group G of an infinite dimensional Hilbert–Riemannian symmetric space G/K which can be realized in the space of continuous functions on G/K. Important examples of such spaces are those of rank 1, which are projective spaces of Hilbert spaces (positive curvature), affine Hilbert spaces (flat spaces) and infinite dimensional hyberbolic spaces (negative curvature). For the affine Hilbert space and real spheres, the corresponding results follow from the classical work of Schoenberg on rotation invariant positive definite functions on Hilbert spaces and spheres.

Presently we are working on a parameterization of the irreducible representations on finite rank symmetric spaces such as the Grassmannian of finite dimensional subspaces of an infinite dimensional Hilbert space.

Partner: Prof. Dr. Bent Ørsted (Aarhus University, Denmark); Prof. Dr. J. Hilgert (Paderborn)

Contact: Karl-Hermann Neeb

References

[1] K.-H. Neeb. Infinite-dimensional groups and their representations. In *Lie theory*, volume 228 of *Progr. Math.*, pages 213–328. Birkhäuser Boston, Boston, MA, 2004.

[2] K.-H. Neeb and B. Ørsted. Representation in L^2-spaces on infinite-dimensional symmetric cones. *J. Funct. Anal.*, 190(1):133–178, 2002. Special issue dedicated to the memory of I. E. Segal.

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Project: Quantization of gauge theories

Unitary representations of Lie groups play a central role in quantum theory, where Lie groups (finite and infinite-dimensional) arise as symmetry groups of physical systems. Their unitary representations describe states and behaviour of systems with the prescribed symmetry group. Classically, this theory has been developed with great success for locally compact groups and finite-dimensional Lie groups, but our knowledge of representations of infinite-dimensional Lie groups is very rudimentary.
In this project we address this problem by studying infinite-dimensional Lie groups acting as multipliers on certain C^*-algebras, which provides interesting applications of C^*-algebra techniques beyond the classical context of locally compact groups; the main drawback being that not all unitary representations can be covered by a single C^*-algebra. A first major step is our construction of such a C^*-algebra for the regular representations of the canonical commutation relations (CCR) of countably many generators.
Another branch of this project is concerned with infinite-dimensional Lie groups acting by automorphisms of certain topological algebras, which leads to a Lie theoretic approach to many constructions in non-commutative geometry. It is our hope to melt these techniques with the representation theoretic aspects to provide a bridge between non-commutative geometry and the classical geometric representation theory.

Partner: Prof. Dr. Hendrik Grundling (University of Sydney)

Contact: Karl-Hermann Neeb

References

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[3] K.-H. Neeb. Infinite-dimensional groups and their representations. In *Infinite dimensional Kähler manifolds (Oberwolfach, 1995)*, volume 31 of *DMV Sem.*, pages 131–178. Birkhäuser, Basel, 2001.

[4] K.-H. Neeb. Infinite-dimensional groups and their representations. In *Lie theory*, volume 228 of *Progr. Math.*, pages 213–328. Birkhäuser Boston, Boston, MA, 2004.

[5] K.-H. Neeb. Lie group extensions associated to projective modules of continuous inverse algebras. *Archivum Mathematicum (Brno)*, 44:339–363, 2008.

Project: Semi-bounded unitary representations of infinite dimensional Lie groups

Infinite dimensional Lie groups and their representations show up in all areas of mathematics and other sciences, wherever symmetries depending on infinitely many parameters arise. The goal of this project is to develop a geometric approach to the important class of semi-bounded unitary representations for groups which are so-called double extensions of pre-Hilbert–Lie groups (groups whose Lie algebra carries an invariant scalar product). Typical examples of such groups are oscillator groups, double extensions of Hilbert–Lie groups and affine Kac–Moody groups.
Semiboundedness of a unitary representation is a stable version of the "positive energy" condition which characterizes many representations arising in mathematical physics, resp., field theories. For a unitary representation of a Lie group it means that the self-adjoint operators from the derived representation are uniformly bounded below on some open subset of the Lie algebra. Our long term goal is to understand the decomposition theory and the irreducible representations for this class.
The focus of the present project lies on geometric (complex and symplectic) aspects of the theory, such as realizations in holomorphic bundles over Kähler manifolds, momentum maps, and their convexity properties, which in turn determine the spectral properties of the representations.

Partner: DFG-Mitarbeiter: Chr. Zellner

Support: German Research Foundation (DFG).

Contact: Karl-Hermann Neeb

References

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[4] K.-H. Neeb. A complex semigroup approach to group algebras of infinite dimensional Lie groups. *Semigroup Forum*, 77(1):5–35, 2008.

[5] K.-H. Neeb. Semi-bounded unitary representations of infinite-dimensional Lie groups. In J. H. et al, editor, *Infinite Dimensional Harmonic Analysis IV*, pages 209–222. World Scientific, 2009.

Project: Geometric representation theory of root graded Lie groups

Lie groups arise most naturally as symmetry groups or automorphism groups of algebraic or geometric structures. In many cases the symmetry groups are infinite-dimensional, even if the structures under consideration are finite-dimensional. Since there is no structure theory of infinite-dimensional groups and their Lie algebras comparable to the strong finite-dimensional theory, one has to restrict ones attention to specific classes of groups containing important types of examples and permitting a reasonably powerful uniform theory. Root graded Lie groups form one such class, containing in particular affine Kac–Moody groups, playing a central role in string theory and conformal field theory. The goal of this project is to develop a systematic theory of those representations of root graded Lie groups which can be realized as holomorphic sections of line bundles in the spirit of Borel-Weil theory. Since root graded Lie groups contain certain subgroups showing many analogies to parabolic subgroups of algebraic groups, the corresponding homogeneous spaces G/P are of particular interest.
A central part of the project deals with the structure of the representation in the space of sections of a holomorphic line bundle over G/P for a root graded Banach–Lie group G. Here one is interested in necessary and sufficient conditions for this space to be non-trivial and the fact that the corresponding representation is actually a Banach representation.

Partner: Postdoc: Henrik Seppänen

Support: Swedish Research Council

Contact: Karl-Hermann Neeb

References

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[2] K.-H. Neeb. Borel-Weil theory for loop groups. In *Infinite dimensional Kähler manifolds (Oberwolfach, 1995)*, volume 31 of *DMV Sem.*, pages 179–229. Birkhäuser, Basel, 2001.

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Project: Classification of automorphic products

Borcherds' singular theta correspondence is a map from vector valued modular forms on $SL_2(\mathbb{Z})$ to automorphic forms on orthogonal groups. Since these automorphic forms can be written as infinite products they are called automorphic

products. A famous example is the function

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

where Δ is Dedekind's Delta function. This function is an automorphic form of weight 12 for a discrete subgroup of $O_{26,2}(\mathbb{R})$. Automorphic products have found various applications in geometry, arithmetic and in the theory of Lie algebras. One of the main open problems in the theory of automorphic products is to derive classification results. In the squarefree level case this problem can be approached by pairing reflective modular forms with vector valued Eisenstein series [1]. This method can and shall also be applied to the general case.

Contact: Nils Scheithauer

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

Project: Classification of infinite-dimensional Lie algebras

Generalized Kac-Moody algebras are natural generalizations of the finite-dimensional simple Lie algebras. They are defined by generators and relations. It turned out that their denominator identities are sometimes automorphic forms on orthogonal groups. Using the results from the first project classification results for generalized Kac-Moody algebras whose denominator identities are automorphic products can be derived. For example there are exactly 10 generalized Kac-Moody algebras whose denominator identities are completely reflective automorphic products of singular weight on lattices of squarefree level [1]. One of them is the fake monster algebra with denominator identity

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

The next step is to prove similar results for arbitrary level.

Contact: Nils Scheithauer

References

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

Project: Realization of infinite-dimensional Lie algebras as strings

Some generalized Kac-Moody algebras whose denominator identities are automorphic products describe bosonic strings moving on suitable target spaces [1, 2]. This result shall be extended to further examples by constructing suitable vertex algebras as orbifolds of lattice vertex algebras. The goal is to find a uniform realization of the generalized Kac-Moody algebras whose denominator identities are automorphic products similar to the affine case in Kac-Moody theory.

Partner: G. Höhn, T. Creutzig, A. Klauer

Contact: Nils Scheithauer

References

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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 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. This is proved for the elements of squarefree level in [1, 2]. The general case shall be established by similar methods.

Contact: Nils Scheithauer

References

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2.1.2 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 12 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. By close contact to the departments of engineering and natural sciences the group of analysis at TU Darmstadt is open to new mathematical problems and scientific challenges.

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

A second focus is put on the 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, the research group organizes once or twice a year a workshop called "Analysistag" with speakers from Germany and abroad covering a wide spectrum of fields in analysis and its applications. Several members of this research group are principal investigators of the German Research Foundation-Excellence Cluster "Smart Interfaces", where fluid interfaces and boundaries are investigated in an interdisciplinary environment.

Project: Models for Diffusionless Phase Transitions in Solid

In this project models for phase transitions in elastic solids are studied. The main interest lies on the approximation of sharp interface models for diffusionless phase transitions by phase field models. For diffusionless phase transitions (which are also called martensitic transitions) the interface energy is negligibly small. consequently, in the sharp interface model the curvature of the interface is not part of the driving force for the evolution of the interface. The well known Allen-Cahn phase field model is not suitable to approximate such sharp interface model, since in the limit model of this phase field model the curvature is always present in the driving force. In the project a new phase field model based on a Hamilton-Jacobi transport equation is studied, which, as is shown in the project, can be used to approximate sharp interface models without curvature terms in the driving force. The project is focused on proving existence results for the new model and on studying the asymptotic convergence to the sharp interface model. Moreover, a related phase field model is studied, which can be used to approximate a sharp interface model for interface motion by diffusion along the interface.

Support: German Research Foundation (DFG).

Contact: Hans-Dieter Alber, Peicheng Zhu

Project: Homogenization of microstructures

In this project the mathematical theory of homogenization of microstructures in solids is studied in cooperation with a working group of the Academy Institute for Low Temperature Physics in Charkow (Ukraine), which is led by Professor E. Y. Khruslov. Within this project, the German Academic Exchange Service (DAAD) supports stays for a month or longer of young Ukrainian scientists from this working group in Darmstadt (Leonhard-Euler-Studienprogramm).

Partner: Prof. Dr. E.Y. Khruslov, Karazin Kharkiv National University

Support: German Academic Exchange Service (DAAD)

Contact: Hans-Dieter Alber

Project: Inverse problems and homogenization in problems from hydrodynamics and acoustics

Professor A. G. Ramm from Kansas State University stayed in 2007 for eight months as an exchange professor at the department of mathematics. This professorship was funded by the German Research Foundation (DFG) in the frame of the Mercator-Programm. Professor Ramm is a specialist for scattering problems. During his visit H. Heck from the department of mathematics cooperated with him in the investigation of an inverse problem for the Stokes system, and H.-D. Alber studied jointly with him a homogenization problem in the field of scattering of acoustic waves.

Partner: Prof. Dr. A. G. Ramm

Support: German Research Foundation (DFG)

Contact: Hans-Dieter Alber

Project: On class of hypoelliptic operators with unbounded coefficients in $\mathbb{R}^N$

In the last decades the interest towards elliptic and parabolic operators with unbounded coefficients on unbounded domains grew considerably due to their application to stochastic analysis and mathematical finance. The literature on *uniformly elliptic* operators with unbounded coefficients on $\mathbb{R}^N$ is nowadays rather complete. Whereas for degenerate elliptic operators the picture changes drastically. The prototype of such operators is the degenerate Ornstein-Uhlenbeck operator, which consist of a diffusion term and *linear* drift. In general, replacing the assumption of uniform ellipticity we only assume that our operators are *hypoelliptic* in the sense of Hörmander. A typical feature of such (degenerate) operators is the different regularity properties in different space directions of the solutions to the corresponding elliptic problem. Continuing the work of Lorenzi [2], we investigated in [1] the more general situation, and proved the existence of an associated semigroup and optimal Schauder estimates both for the parabolic and the elliptic problems belonging to the second-order operator

$$\mathcal{A}\varphi(x) = \sum_{i,j=1}^{p_0} q_{ij}(x) D_{ij}\varphi(x) + \sum_{i,j=1}^{N} b_{ij} x_j D_i\varphi(x) + \sum_{j=1}^{p_0} F_j(x) D_j\varphi(x), \qquad x \in \mathbb{R}^N,$$

where the growth of the diffusion and the drift coefficients is quadratic respectively linear.

Partner: Luca Lorenzi (University of Parma)

Contact: Bálint Farkas

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Project: Ergodic Theory: An Operator Theoretic Approach

After the breakthrough results of T. Tao and B. Green on arithmetic progressions among the primes — using among also ergodic theory —, connections of the already flourishing field of ergodic theory to various other areas of mathematics have been studied with increasing élan. In the year 2008, together with T. Eisner, M. Haase and R. Nagel, we offered a course in the framework of the international Internet Seminar [1] on ergodic theory via operator (semigroup) theoretic approach (based partly on the material [2]). The notes of the course have been so welcome that it is to be formed into a monograph and is planned to be submitted for publication. The approach we have followed puts emphasis on operator theoretic techniques (a basic ingredient is the Jacobs-de Leeuw-Glicksberg decomposition) and thus provides new proofs to classical results, such as Roth's Theorem or some elementary multiple ergodic theorems.

Partner: T. Eisner (Universität Tübingen), R. Nagel (Universität Tübingen), M. Haase (Delft University of Technology)

Contact: Bálint Farkas

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Project: Periodic Decomposition of Functions

Let A be an arbitrary nonempty set and consider an invertible (bijective) transformation $T : A \to A$. To such a mapping we associate a *difference operator* $\Delta_T f := f \circ T - f$. A function is called then T-*periodic* (or T-invariant), if $\Delta_T f = 0$. Take now pairwise commuting, invertible transformations $T_1, T_2, \dots, T_n : A \to A$. We say that a function $f : A \to \mathbb{R}$ has a $(T_1, T_2, \dots, T_n)$-*periodic (or invariant) decomposition*, if

$$f = f_1 + f_2 + \cdots + f_n \quad \text{with } f_j \text{ being } T_j\text{-periodic for } j = 1, \dots, n.$$

Clearly if such a decomposition exists, then the difference equation

$$\Delta_{T_1} \Delta_{T_2} \dots \Delta_{T_n} f = 0 \qquad \text{holds.} \tag{DE}$$

It is a problem posed by I. Z. Ruzsa to characterise by means of difference equations of the type (DE) those functions that admit a periodic decomposition (with preliminary given periods). Partial answers have been obtained by M. Wierdl [4] and S. Mortola and P. Peirone [3] concerning the case of shifts on $\mathbb{R}$. With Sz. Révész [2] we investigated the general problem of non-invertible transformations and found a set of difference equations that are both necessary and sufficient for the existence of a periodic decomposition, this however only for the case when the number of the transformations is $n \leq 3$. In a joint work

[1] with V. Harangi, T. Keleti and Sz. Révész we settled the case of invertible transformations irrespective of their number. A particularly important special case is when the set A is a torsion free Abelian group and the transformations T_i are translations by given elements $a_i \in A$. We also studied existence of integer-valued periodic decompositions which has application in crystallography.

Partner: V. Harangi (Eötvös Loránd University, Budapest), T. Keleti (Eötvös Loránd University, Budapest), Sz. Gy. Révész (Rényi Institute, Budapest),

Contact: Bálint Farkas

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Project: Mathematical Modeling of Fluid Flow in Unbounded Domains

This Czech-German project of members of the Department of Mathematics at TU Darmstadt and the Mathematical Institute of the Czech Academy of Sciences as well as the Technical University Prague, financed from the German side by the German Academic Exchange Service (DAAD) ("Projektbezogener Personenaustausch") in 2007/08, concerns fluid flow in unbounded domains in general, but in particular viscous, incompressible flow around or past rotating obstacles. The topics include among others Boussinesq approximation problems in whole and half spaces (concentration effects, behavior of the fluid and heat transfer near rough boundaries), the theory of very weak, weak and strong solutions of the Navier-Stokes system in general unbounded domains and the analysis of the Stokes system with non-Dirichlet boundary conditions in general unbounded domains (resolvent estimates, maximal regularity). The main problems concern flow around or past rotating obstacles with given constant or time-dependent angular velocities, the analysis of the spectrum of related linear differential operators of Stokes and Oseen type and the discussion of the fundamental solution; here it is important to describe the wake behavior as in the classical Oseen problem.

Partner: S. Kračmar, M. Krbec, Š. Nečasová, J. Neustupa, M. Pokorný, M. Hieber; V. Fišerová, F. Riechwald, C. Komo, R. Schulz, K. Götze

Support: German Academic Exchange Service (DAAD)

Contact: Reinhard Farwig

Project: Regularity Theory of Instationary Navier-Stokes Equations

One of the seven Millennium Problems of Clay Mathematics Institute (2000) concerns the question of global existence of smooth solutions to the Navier-Stokes equations for arbitrarily large smooth data and the global uniqueness of weak solutions. Up to now, these problems are solved only under additional assumptions of the given weak solution yielding results of so-called conditional regularity. The classical condition due to J. Serrin states that a weak solution on a domain $\Omega \subset \mathbb{R}^3$ is regular if it lies in the space $L^s(0,\infty;L^q(\Omega))$ where $\frac{2}{s}+\frac{3}{q}=1$. In this respect, we discuss new conditions for regularity beyond Serrin's barrier. i.e., when $\frac{2}{s}+\frac{3}{q}>1$. An even more sophisticated analysis is needed for local in space regularity results for so-called suitable weak solutions; this question is related to the problem of partial regularity in the sense of Caffarelli, Kohn and Nirenberg. Another question concerns the optimal condition on initial values to yield local in time strong solutions. The answer for the nonlinear Navier-Stokes system is based on linear theory only and can be formulated in the framework of Besov spaces of solenoidal vector fields.

Partner: Profs. Drs. H. Sohr (University of Paderborn), H. Kozono (Tohoku University Sendai)

Contact: Reinhard Farwig

Project: Fundamental Solutions for Linearized Equations of Fluid Flow past Rotating Obstacles

In the analysis of viscous incompressible fluid flow around rotating obstacles a globally acting coordinate transform yields a modified Navier-Stokes system with terms which are not perturbations of the Laplacian. The corresponding fundamental solutions in the linear case is explicitly known in terms of convolutions with the 3D-heat kernel and improper Riemann integrals, however, in view of oscillating terms difficult to discuss. In the particular case of flow past an obstacle where the limit velocity, $u_\infty \neq 0$, is not parallel to the axis of rotation, the perturbed equations contain a time-dependent Oseen term which should show a wake behavior in the original inertial coordinate system. The aim of the project is to generalize a recent result of Thomann and Guenther on the fundamental solution in the case where u_∞ and the axis of rotation are parallel to more general situations.

Partner: Profs. Drs. E.A. Thomann and R.B. Guenther (Oregon State University, Corvallis, OR), Prof. Dr. Š. Nečasová (Academy of Sciences, Prague)

Contact: Reinhard Farwig

Project: Navier-Stokes Equations with Nonhomogeneous Data

The classical energy inequality and a subsequent energy estimate of weak solutions of the Navier-Stokes equations is an important tool in the construction and analysis of weak and strong solutions to the instationary Navier-System with the homogeneous Dirichlet boundary conditions $u=0$ on $\partial\Omega$. Inhomogeneous Dirichlet boundary data for weak/strong solutions are widely used only in the 2D-case for applications in control theory and optimization. Except for results by A.V. Fursikov, M.D. Gunzburger and L.S. Hou and more recently by J.-P. Raymond the three-dimensional case has not been investigated thoroughly so far. Our aim is to discuss the existence of global in time weak solutions of

the Navier-Stokes equations of Leray-Hopf type with inhomogeneous boundary data for arbitrarily large time-dependent boundary data as weak as possible, including a prescribed non-zero divergence. The construction of these solutions is based on results for a perturbed Navier-Stokes system to be solved by semigroup theory, Yosida approximation arguments and the theory of very weak solutions. The behavior of the kinetic and dissipation energy for large times of Leray-Hopf type solutions will be related to the famous open Leray problem of existence of stationary solutions to the Navier-Stokes system in multiply connected domains.

Partner: Profs. Dr. H. Sohr (University of Paderborn), Prof. Dr. H. Kozono (Tohoku University Sendai)

Contact: Reinhard Farwig

Project: Viscous Fluid Flow past Rotating Obstacles

The analysis of time-periodic flow past a rotating obstacle poses - even in the linear case - new challenges in the analysis of weak and strong solutions of the Navier-Stokes equations. Some of the difficulties lie in transport terms of hyperbolic character which occur when introducing a coordinate system rotating with the obstacle. In the case of a non-vanishing velocity u_∞ at infinity parallel to the axis of rotation there appears also the Oseen term $u_\infty \cdot \nabla u$ leading to different up- and downstream behaviors of solutions. Whereas strong L^q-estimates are known in the whole space case (see R. Farwig, T. Hishida, D. Müller 2004) and an L^2-theory can easily be built up by the classical Galerkin approach or Plancherel's theorem, the aim of this project is to discuss an L^q- or $L^{q,\infty}$-theory of strong solutions in exterior domains for the Oseen as well as for the corresponding Navier-Stokes system and to discuss the dependence of a priori constants on viscosity, angular speed and the norm of u_∞.

Partner: Profs. Drs. G.P. Galdi (Pittsburgh University), T. Hishida (Nagoya University)

Contact: Reinhard Farwig

Project: Asymptotic Analysis of Viscous Fluid Flow Around Rotating Obstacles

Although the fundamental solution of linearized equations modeling viscous fluid flow past a rotating obstacle is explicitly known, its analysis is difficult in the instationary as well as stationary case. One reason lies in an improper Riemann integral using an integration over a time variable in $(0, \infty)$, another in two matrices of rotation containing cos- and sin-terms and leading to cancellation effects. An important question concerns the asymptotic decay of solutions as $|x| \to \infty$ and their leading profile. In the linear Stokes case, the leading term uses only that component of the Stokes fundamental solution matrix which is obtained by multiplying this matrix with the angular velocity vector. Hence the rotation of the obstacle determines the leading term, to be more precise, its main flow direction, but it produces no term of rotation. Effects of rotations are observed in the second term. As for the classical Navier-Stokes system, the Laplacian term $-\Delta u$ and the nonlinear term $u \cdot \nabla u$ formally lead to the same rate of decay of order $|x|^{-3}$ so that more general similarity solutions and not the Stokes fundamental solution have to be used. These self-similar solutions are given by the family of Landau solutions as found by Šverák and Korolev in 2007 for the usual Navier-Stokes system.

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

Contact: Reinhard Farwig

Project: Drag, Lift and Heat Transfer Control for Fluid Flow in Domains with Rough Boundaries

The overall aim of this project is to control and optimize the drag and lift of bodies like air wings by changing their shape, and to enhance heat transfer through boundaries. These aims will not only be achieved by considering smooth surfaces, but also by analyzing surfaces with rough periodic structures when the rugosity tends to zero. Typical examples of rugosity are given by a periodic setting of pyramids or cylinders. Of particular interest is the case when the roughness has a one-dimensional structure in order to prevent transition to turbulence in the Oseen case. Concerning heat transfer we consider the Boussinesq equations in (perturbed) half spaces together with a main flow field parallel to the boundary of the half space. To construct weak solutions of the Boussinesq-Oseen system we have to use the Galerkin approximation method since the corresponding Oseen operator for the Stokes part of the system is not self-adjoint. For the limit procedure when the rugosity measure tends to zero, Young measures and Γ-convergence techniques will be applied to determine the limiting boundary conditions.

Partner: Dipl.-Math. C. Komo (TU Darmstadt, FB Mathematik)

Support: Center of Smart Interfaces: Understanding and Designing Fluid Boundaries

Contact: Reinhard Farwig

Project: Spectral Theory of Stokes and Oseen Operators with Rotation Effect

In the analysis of viscous fluid flow around or past rotating obstacles we encounter modified Stokes and Oseen equations including additional terms which cannot be considered as perturbations of the Laplacian. These terms describe transport phenomena due to rotation and prevent the modified Stokes and Oseen operators from generating an analytic semigroup. Actually, it is known that these operators generate C^0-semigroups so that a semigroup approach to the instationary nonlinear problem only yields the existence of mild solutions. This problem is reflected by the spectra of the modified Stokes and Oseen operators in L^2 as well as in any L^q-space, $1 < q < \infty$. In recent papers we proved that in the L^2-case the spectrum of the modified Stokes operator consists of an infinite set of equally spaced half lines in the left complex half plane. To be more precise, this set is the continuous spectrum in case that the rotating obstacle is axially symmetric; the point spectrum as well as the residual one are empty. If the obstacle is not axially symmetric, then the existence of eigenvalues of finite multiplicities in the left complex half plane cannot be excluded. For the modified Oseen operator we get similar results, however, the set of half lines must be replaced by parabolae tangent to the imaginary axis. The ongoing research deals with problems of spectra in an L^q-setting. First results indicate that the spectrum as a set in $\mathbb{C}$ is independent of the exponent q, but that its type changes with the exponent q ranging from a residual one for small q to a continuous one for q close to 2 to a point spectrum for large q.

Partner: Prof. Dr. J. Neustupa, Technical University Prague

Contact: Reinhard Farwig

Project: Compressible Fluid Flow Around Rotating Obstacles

We consider the flow of a compressible viscous fluid around a rotating obstacle with fixed angular velocity. Simplifying the equations for momentum and density in the whole space we arrive at a linear iterative scheme which can be solved explicitly in terms of the Fourier variable ξ. However, in contrast to the case of an incompressible flow, the solution in Fourier space is based on much more complicated multiplier functions involving square roots with real and complex values depending on the value of ξ; this reflects the strong hyperbolic influence of compressibility. Terms of the form $\sqrt{1-|\xi|^2}$, $\xi \in \mathbb{R}^3$, indicate that three cases ($|\xi| < 1$, $|\xi \sim 1$ and $|\xi| > 1$) have to considered separately. Moreover, the theory of Bochner-Riesz operators in L^q-spaces is needed so that a priori estimates will hold only for exponents q close to 2.

Partner: Prof. Dr. M. Pokorný, Charles University Prague

Contact: Reinhard Farwig

Project: Harmonic Analysis and Weighted Estimates for Fluid Flow Problems

Weighted estimates help to understand the behavior of solutions to partial differential equations in unbounded domains. Of particular importance are Muckenhoupt weights since they are compatible with classical tools from harmonic analysis such as Calderón-Zygmund integral operators and multiplier theory. The aim of the project is to generalize results on the L^q-theory of viscous fluid flow around and past rotating obstacles to a weighted setting using the space L^q_w where $\int |u|^q w\, dx < \infty$, e.g., in order to describe the occurrence of a wake region behind the obstacle. Due to special maximal operators used in recent proofs the Muckenhoupt weights w should be radially symmetric with respect to the axis of rotation and satisfy certain structural conditions. Moreover, the theory of one-sided Muckenhoupt weights and one-sided maximal operators due to E.T. Sawyer is needed to model the wake behavior of solutions. Concerning the spectrum of modified Stokes and Oseen operators in this area of research we guess that the spectrum changes its type with the L^q-weight function, but that the set itself is independent of q and of the Muckenhoupt weight. As is well known from Ornstein-Uhlenbeck operators, this is no longer true when considering weights beyond the Muckenhoupt class such as exponential weight functions.

Partner: Prof. Dr. M. Krbec, Prof. Dr. Š. Nečasová, Mathematical Institute, Academy of Sciences Prague

Contact: Reinhard Farwig

Project: Oseen Equations in Half Spaces

The Oseen equations are a linearized version of the Navier-Stokes system modeling viscous incompressible fluid flow past an obstacle with prescribed velocity at infinity, $u_\infty \neq 0$, and contain the transport term $u_\infty \cdot \nabla u$ in the momentum equation. This system of equations is well understood in the whole space using multiplier theory, and for exterior domains. Much less results are available for the half space where the direction of the vector u_∞ with respect to the tangential plane of the half space plays a crucial role We have to distinguish between the case that u_∞ is tangential to the tangential plane and the case that u_∞ is

orthogonal or even oblique to it. Since in contrast to the Poisson problem with Dirichlet or Neumann boundary conditions the Stokes and the Oseen system for Dirichlet boundary data do not allow for a reflection principle, more sophisticated tools must be used to establish an L^q-theory. Moreover, integrability properties may depend on the particular partial derivative to be considered. Finally, the unboundedness of the domain suggests to use weighted estimates to model the behavior of solutions at infinity more precisely.

Partner: Prof. Dr. Ch. Amrouche, University of Pau and Pays de l'Adour

Contact: Reinhard Farwig

Project: Weighted Estimates for Singular Integral Operators Arising from Fluid Flow

The L^q-analysis of the linearized equations of viscous fluid flow around a three-dimensional rotating obstacle in the whole space setting requires the simultaneous use and composition of several maximal operators of 1D- and 3D-type. However, this approach is not suitable to get weak estimates in L^1 and a complete theory in weighted spaces; indeed, recent results by M. Krbec, Š. Nečasová and R. Farwig require strong assumptions on weight functions and a new version of Jones' factorization theorem for a subclass of Muckenhoupt weights to deal with this problem. The aim of the project is to use the theory of singular operators in homogeneous spaces adapted to the problem, to extend previous results to a larger class of weight functions and to simplify previous proofs in a more general setting.

Partner: Prof. Dr. D. Müller, Dipl.-Math. H. Bloch, Universität Kiel

Contact: Reinhard Farwig

Project: Analysis of the spincoating process

The spin-coating process is a method of placing a small drop of coating material, in liquid form, on the center of a disc, which is then spun rapidly about its axis. The drop is then driven by two competing forces: centrifugal force cause the liquid to be thrown radially outwards, whereas surface tension forces work against this spreading. For large centrifugal forces, the coating material thins. Of particular interest is the situation where the coating material is a polymer dissolved in a solvent. As the film thins, the solvent evaporates and the solution viscosity increases, reducing the radial flow. Eventually, the viscosity becomes so large that relative motion virtually ceases and the process is completed by evaporating the residual solvent.
Spin-coating has many applications. The process is used, for example, in manufacturing micro-electronic devices, magnetic storage discs or organic LEDS. In all cases a uniform layer is required and essential.
It has to be stressed that complete mathematical models describing all the above effects do not seem to exist. In order to develop accurate models and to investigate them rigorous from an analytical point of view, we describe the spin-coating process as a one-phase free boundary value problem for a Newtonian fluid subject to surface tension and rotational effects. Further developments concern generalizations to the non-Newtonian setting and two-phase systems.

Partner: R. Denk (University of Konstanz), Y. Shibata (Waseda University, Tokyo)

Support: German Research Foundation (DFG)

Contact: Matthias Hieber

Project: Stability properties of the Ekman spiral

The Ekman spiral u_E is an explicit stationary solution of the Navier-Stokes equation with rotation in the halfspace $\mathbb{R}^3_+$. Perturbing this spiral by an L^p-function u yields an evolution equation for $w = u - u_E$ involving the so called Stokes-Coriolis-Ekman operator.
In order to determine the longtime behavior of w and hence the stability of u_E one needs to know first for which Reynolds numbers the solution of the linear part of this evolution equation remains bounded. Energy methods are only able to prove this in the L^2-setting and for Reynolds numbers which are close to 1. Numerical results, however, show that the critical Reynolds number for stability of the linear problem is expected to be much higher. No rigorous results at all seem to be known for the fact that the flow really becomes instable for large Reynolds numbers, and the existing approaches for stability work so far only for Reynolds numbers less than 1. Further progress in this direction is based on a deeper understanding of the spectral behaviour of the Stokes-Coriolis-Ekman operator first in L^2 and then in other function spaces.
We plan to do examine this problem in cooperation with the Center of Fluid Mechanics at the Arizona State University in Phoenix.

Partner: Prof. Dr. Alex Mahalov (ASU, Phoenix, USA)

Contact: Matthias Hieber

Project: Wettability, Moving Contact Lines and Quasilinear Parabolic Equations on Nonsmooth Domains

Wettability describes the behavior of a liquid in contact with a solid surface. In particular, when a liquid droplet is placed on a solid surface, it will assume a certain shape, dictated by the solid surface, surface tension of the fluid and gravitational forces. Wettabilty processes play a major role in a wide range of applications; we here only refer to microfluids and the inhibition of liquids into porous media. The expertise of the Center of Excellence 259 in Darmstadt will be central for building accurate mathematical models of these phenomena.
Mathematically, problems of this kind are formulated as free boundary value problems for the Navier-Stokes equations or more generally for non-Newtonian fluids with boundary contacts. From a mathematical point of view, these problems are not well understood. Based on fluid mechanics, the correct model for the boundary between a moving viscous fluid and a stationary wall is a "no-slip" condition, i.e. a Dirichlet boundary condition. While this makes good sense for prescribed boundaries, its relevance for free boundary value problems is dubious. Mathematically and experimentally the no-slip condition has been questioned since several years. The problem is that a moving contact line coupled with a no slip condition results in a multivalued velocity field, which is physically impossible. Hence, many theories based on modifications of the no-slip condition have been developed. In the case where there are no boundary contacts of the free surface with the solid, the no-slip condition is often replaced by the so called *Navier* condition. However, in the case of boundary contacts, many accepted models are based on the idea that the additional degree of freedom is determined by a prescribed contact angle α.
On the other hand, quasilinear parabolic problems on nonsmooth domains have been investigated in detail by the group of J. Rehberg at the Weierstraß Institute

in Berlin. We thus plan to combine expertises from modelling, free boundaries and analysis in nonsmooth domains to obtain mathematical progress for this problem.

Partner: D. Bothe, Center Smart Interfaces, Darmstadt, J. Rehberg, Weierstraß Institute, Berlin, Y. Shibata, Waseda University, Tokyo

Support: German Research Foundation (DFG)

Contact: Matthias Hieber

Project: C^*-algebras and numerical analysis

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 are now planning to extend these results to spatial discretizations of several classes of C^*-algebras of infinite type (Cuntz algebras, (restricted) group C^*-algebras, (reduced) crossed product C^*-algebras, and other general algebras generated by or related with isometries).

Partner: Bernd Silbermann

Contact: Steffen Roch

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Project: Band-dominated operators and the limit operators method

A band-dominated operator is the norm limit of a sequence of band operators, i.e., of operators which have a band matrix as their representation with respect to a fixed basis. For example, pseudodifferential operators on $L^2(\mathbb{R}^N)$ with symbols in $S^0_{0,0}$ and several classes of convolution operators own this property. Fredholm properties of band-dominated operators can be studied via their limit operators, which reflect the behaviour of the operator at infinity. 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 are 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 nano-tubes). These operators can also be considered as band-dominated in the above sense. This part of the project is closely related with (reduced) group C^*-algebras and (reduced) crossed products of C^*-algebras.

Partner: Vladimir S. Rabinovich

Support: CONACYT, German Research Foundation (DFG)

Contact: Steffen Roch

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Project: Numerical analysis for convolution-type operators with non-continuous coefficients

The goal of this project is to investigate the stability of spline 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

Contact: Steffen 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 quite 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.

Partner: Torsten Ehrhardt, Bernd Silbermann

Contact: Steffen Roch

References

[1] T. Ehrhardt, S. Roch, and B. Silbermann. A strong Szegö-Widom limit theorem for operators with almost periodic diagonals. Preprint, TU Darmstadt, 2008.

[2] S. Roch and B. Silbermann. Szegö limit theorems for operators with almost periodic diagonals. *Operators and Matrices*, 1:1–29, 2007.

2.1.3 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: Degeneracy of constant mean curvature surfaces

A solution of a nonlinear equation is called degenerate if the linearisation of the equation has a nontrivial kernel. We study this problem for the case of finite topology constant mean curvature surfaces. At non-degenerate points, the moduli space of these surfaces is known to be a manifold, while at degenerate points it may have bifurcations. For the case of embedded finite topology surfaces between two parallel planes, non-degeneracy has been established [2], while for simple non-embedded examples like the nodoids it fails [1]. Thus it is an interesting problem to decide for which class of surfaces nondegeneracy can hold.

Support: German Research Foundation

Contact: Karsten Große-Brauckmann

References

[1] K. Grosse-Brauckmann and Y. He. Bifurcations of the nodoids. In *Oberwolfach Reports*, volume 4, pages 1327–1328. EMS, 2007.

[2] K. Grosse-Brauckmann, N. Korevaar, R. B. Kusner, J. Ratzkin, and J. M. Sullivan. Coplanar k-unduloids are nondegenerate. *International Mathematics Research Notices*, to appear, accessible under doi: 10.1093/imrn/rnp058, 2009.

Project: Minimal surfaces in homogeneous 3-manifolds

Minimal and constant mean curvature surfaces in Euclidean space are a very traditional subject of differential geometry; they have also been considered in space forms like hyperbolic space. More recently, homogeneous 3-manifolds have received interest as ambient spaces. To construct minimal surfaces in spaces like the Heisenberg group or Berger spheres we investigate minimal surfaces in Riemannian fibrations. We also consider their so-called sister surfaces in Riemannian product spaces.

Support: German Research Foundation, Impa

Partner: Robert Kusner (Amherst, MA)

Contact: Karsten Große-Brauckmann

References

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

[2] K. Grosse-Brauckmann and R. B. Kusner. Conjugate plateau constructions for homogeneous 3-manifolds. *in preparation.*

Project: Multivariate Approximation on Domains

In a long term effort, we try to clarify approximation and stability properties of multivariate splines on arbitrary domains. After the web-spline concept has demonstrated the possibility to construct stable spline-bases on domains, the results in [2] verify an alternative setup, which is based on a skip-and-scale strategy. Applications in the simulation of chaotic billiards were studied together with the research group of Prof. Achim Richter [1]. Local approximation schemes, so-called two-stage methods are investigated together with Oleg Davydov, who spent four months at the department as a scholar of the Humboldt foundation. Further lines of research include error estimates for interpolation with tensor product polynomials [3], generalizations of the Bramble-Hilbert Lemma [4], and extension theorems in anisotropic Sobolev spaces.

Partner: Oleg Davydov, Klaus Höllig, Bernhard Mößner, Achim Richter

Contact: Ulrich Reif

References

[1] B. Dietz, B. Mößner, T. Papenbrock, U. Reif, and A. Richter. Bouncing ball orbits and symmetry breaking effects in a three-dimensional chaotic billiard. *Physical Review E*, 77(4):id. 046221, 2008.

[2] B. Mößner and U. Reif. Stability of tensor product B-splines on domains. *Journal of Approximation Theory*, 154(1):1–19, 2008.

[3] B. Mößner and U. Reif. Error bounds for polynomial tensor product interpolation. *Computing*, 2009.

[4] U. Reif. Polynomial approximation on domains bounded by diffeomorphic images of graphs, 2009.

Project: Subdivision Algorithms

The year 2007 was almost entirely devoted to finishing a research monograph on subdivision surfaces [2]. In this book, twenty years of intense research on linear stationary subdivision algorithms, such as the famous schemes of Catmull-Clark and Doo-Sabin, are summarized and completed. Another research project concerned the investigation of the generalized four-point scheme. Together with Jochen Hechler and Bernhard Mößner, we were able to determine the precise range of tension parameters yielding C^1-limits, thus solving of a notorious problem posed thirty years ago [1].

Partner: Jörg Peters

Contact: Ulrich Reif

References

[1] J. Hechler, B. Mößner, and U. Reif. C^1-continuity of the generalized four-point scheme. *Linear Algebra and Applications*. to appear.

[2] J. Peters and U. Reif. *Subdivision Surfaces*. volume 3 of *Geometry and Computing*. Springer, New York, 2008.

Project: Discrete Differential Geometry

The embedded Weingarten map, which is a variant of the standard shape operator, was introduced in [2] to analyze smoothness properties of subdivision algorithms. Meanwhile, it turned out that this operator is ideally suited for applications in discrete differential geometry, such as fairing of facetted surfaces or filling holes. First most promising results are presented in the thesis [1]. Currently, the approach is developed further together with a research group of the Fraunhofer IGD.

Partner: Fraunhofer IGD, Darmstadt

Contact: Ulrich Reif

References

[1] N. Lehmann. Flächenglättung mittels der eingebetteten Weingartenabbildung, 2009.

[2] U. Reif. An appropriate geometric invariant for the C^2-analysis of subdivision surfaces. In R. Martin, M. Sabin, and J. Winkler, editors, *IMA Conference on the Mathematics of Surfaces*, pages 364–377, 2007.

2.1.4 Didactics and Pedagogics of Mathematics

Research in the Didactics and Pedagogics of Mathematics

The working group Didactics of Mathematics deals with different questions how to teach and learn mathematics. In 2007-2008 the research activities concentrated on

1. constructing and testing competence models (part of the Priority Research Program "Competence Models")
2. the development and evaluation of integrated teaching concepts as well as corresponding training and further training concepts for math teachers
   - on the learning of mathematical problem-solving in connection with self-regulation (conclusion of a six-year German Research Foundation-project and follow up studies) and
   - the computer-based teaching and learning of math within the scientific framework of different model tests in three Federal States in Germany and
3. the development and evaluation of e-learning - activities in research and development (e-learning-label by TU Darmstadt, participation in the post-graduate program on e-learning at TU Darmstadt) and in the teacher further training (`www.proLehre.de`).

The German Research Foundation (DFG) priority program school's education quality 2005-2006 not only allowed to gain valuable insight into the possibilities of further development of math lessons but also to develop new survey tools for the collection of ideas on the teaching and learning of math which were presented on national and international conferences 2007 and 2008. 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 treat also probabilistic effects of quantum systems. Operator algebras allow a unified treatment of both cases, classical probability as well as probability in quantum systems. All basic notions of probability like expectations, random variables, stochastic processes, martingales, etc. can be formulated in the language of operator algebras in such a way that they reduce to the notions of classical probability whenever the operator algebra is commutative.
Our **research interests** range from theoretical mathematical investigations to physical applications. Consequently, the members of our research group as well as our research partners range from pure mathematicians to physicists.
Common to most of our research is its focus on certain **dynamical behaviour**, be it the dynamics of classical and quantum stochastic processes (Markov processes, noise, quantum trajectories, filtering, etc.), be it the dynamics generated by completely positive maps (ergodic properties, existence and numerical computation of equilibrium states, quantum state preparation, etc.). Our investigations on the long time behaviour of Markov processes have opened the door to our recent research on quantum coding. It links quantum probability in a new and unexpected way with the field of quantum information.

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

The project aims at constructing and testing a competence model for mathematical problem-solving and modeling lower secondary level students in 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 fundamental mathematical representations, numerical, graphic, symbolic, verbal and the change between them as a significant determinant of problem-solving and modeling competence. We operationalise theoretical models of ability in mathematical didactics that have proven successful at a national as well as an international level, and assess them empirically. (s. `http://www.kompetenzmodelle.dipf.de/`)

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

Support: German Research Foundation (Priority Research Program "Competence Models")

Contact: Regina Bruder

Project: Research Training Group on Feedback Based Quality Management in eLearning

The main focus of the research programme e-learning at the TU Darmstadt is oriented on interdisciplinary applications of e-learning at the university.

The Research Training Group pursues a targeted improvement of quality in and through e-learning. Along with the development of concepts related to quality and its measurability, the issue of feedback loops takes up a central place, and fans out in, for instance, automatic, computer-based feedback loops, feedback loops related to individuals and communities, or a combination of both. On a more general level implicit and explicit feedback loops, and their effects on educational processes and learning progress are also examined.
Particularly in our didactical part of this project we investigate which e-learning tools have a high potential of learning and how the transferability and reusability of e-learning tools can be ensured (s. `http://www.gkel.tu-darmstadt.de/`).

Partner: Prof. Mühlhäuser, Prof. Sesink, Prof.Lange, Prof. Gehring, Prof. Buxmann, Prof. Schmitz, Prof. Gurevich a.o.

Support: German Research Foundation (Priority Research Program "Competence Models")

Contact: Svetlana Polushkina

References

[1] R. Bruder, S. Polushkina, B. Benz, and B. Schmit. Developing learning software for the self-regulated learning of mathematics. In *M.B. Nunes & M. McPherson (ed.*, pages 200–204. IADIS Multi Conference on Computer Science and Information Systems. IADIS International Conference e-Learning. IADIS Press., 2007.

[2] R. Bruder, S. Polushkina, B. Benz, and B. Schmit. Scaffolding competency acquisition: Maps mossaic. In *Proceedings of the Joint Meeting of the International Group and the North American Chapter of Psychology of Mathematics Education*. Morelia, Michoacan, Mexico, 2008.

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: J. Reibold

Support: TEXAS Instruments and Ministry of Education Lower Saxony

Contact: Julia Reibold

Project: CALiMERO 2005-2010

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

Partner: Dr. Guido Pinkernell, Dr. Maria Ingelmann

Support: TEXAS Instruments and Ministry of Education Lower Saxony

Contact: Guido Pinkernell

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[1] R. Bruder and M. Ingelmann. Appropriate cas-use in class 7 and 8. In J.-H. Woo, H.-C. Lew, K.-S. Park, and D.-Y. Seo, editors, *Proceedings of the 31th Conference of the International group for the Psychology of Mathematics Education*, 2007.

[2] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht. Band 3 and Band 4: Arbeitsmaterialien für Schülerinnen und Schüler: Entdeckungen an Dreiecken und Vierecken - Mehrstufige Zufallsexperimente - Einführung mit dem Taschencomputer (TC) - Kopfübungen- Basiswissen.* Texas Instruments, 2008.

Project: Calculators in math lessons in Rhineland-Palatinate (TIM)

TIM is a project to improve math lessons and the curriculum by using hand held computers with a CAS system. The aim is the development of materials by the teachers and the collection of experiences by using these materials in the lessons. The project is limited for a period of two years and sponsored by Texas Instruments and the Ministry of Education of the German Federal State Rhineland-Palatinate. The project begins in the school year 2005/2006 with six 7th classes and six 9th classes and end 2008. The evaluation of the project will be executed by Prof. Dr. Regina Bruder , TU Darmstadt. Details on `www.math-learning.com`.

Support: TEXAS Instruments and Ministry of Education Rhineland-Palatinate

Contact: R. Bruder

References

[1] R. Bruder. Posterpresentation - tim - a two-year model test on the pocket calculator use from class 7 and 9. In *Proceedings of PME 32*, page 1. Morelia, Michoacan, Mexico, 2008.

Project: Use of calculators in math lessons of higher classes in Hamburg (CIMS)

CIMS is a model project to develop materials for the appropriate use of calculators with CAS in higher classes of the Gymnasium. The project initiated by the City of Hamburg has been supporting by CASIO and TEXAS Instruments. It is also intended to prepare central examines with allowed use of computers. The scientific consultation has been taken over by Prof. Dr. Regina Bruder, TU Darmstadt. The materials developed by the teachers are discussed and improved on meetings every half year. The project ends 2008. Details on `www.proLehre.de`.

Support: Ministry of Education Hamburg

Contact: Regina Bruder

References

[1] R. Bruder. Wege zum nachhaltigen lernen von mathematik mit unterstützun g digitaler technologien - erkenntnisse und erfahrungen aus aktuellen modellproj ekten. In B. von der CASIO-Veranstaltung "Round Table" vom 13. bis 14. April 2007 in Hamburg, editor, *Mathematikunterricht mit digitalen Medien und Werkzeugen. Unte rricht, Prüfungen und Evaluation*, pages 34–44. Münster: MV Business, 2007.

Project: Internet based professional training for math teachers

Internet based professional training courses for math teachers in the German Federal State of Hesse with the focus on "Educational Standards for Math" have been developing since 2005. The 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 these courses already about 300 teachers have been trained. 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). The sustainability of this professional training will be investigated in the frame of a part project. Details on `www.proLehre.de`

Partner: J. Reibold

Support: Ministry of Education Hesse 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 `www.elc.tu-darmstadt.de` and `www.tud-guetesiegel.de`

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

Support: TU Darmstadt

Contact: Julia Sonnberger

References

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[2] J. Sonnberger. *Das E-Learning-Label an der TU Darmstadt - Entwicklung, Einführung und Auswertung eines Modells zur Qualitätssicherung und Qualitätsentwicklung von E-Learning-Veranstaltungen.* Logos, Berlin, 2008. TU Darmstadt, PhD-Thesis.

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 $B(\mathcal{H})$ of all bounded operators on a Hilbert space. They may be viewed as a quantum version of Markovian semigroups on countably many states.

Partner: F. Haag, R. Gohm (Aberystwyth)

Contact: Burkhard Kümmerer, Andreas Gärtner

References

[1] F. Haag. *Asymptotisches Verhalten von Quanten-Markov-Halbgruppen und Quanten-Markov-Prozessen.* PhD thesis, TU Darmstadt.

Project: Ergodic Theorems for Repeated Measurement and Quantum Trajectories

The algebra of observables of a finite quantum system is given by the algebra M_n of all $n \times n$-matrices. A measurement of such a system causes a state change. In the case of a perfect measurement with k possible outcomes $\{1, \dots, k\}$ this state change is modelled (in the Heisenberg picture) by a completely positive identity preserving operator $T : M_n \to M_n$ of the form $T(x) = \sum_{i=1}^{k} a_i^* \cdot x \cdot a_i$ $(x, a_i \in M_n)$. The i-th summand describes the reaction of the system to such a measurement under the condition that the outcome was i. If the state of the system before the measurement was given by φ with $\varphi(x) = \mathrm{tr}(\mathrm{x}\rho)$, ρ a density matrix, then the probability for the outcome i is given by $\pi_i = \varphi(a_i^* a_i)$. Since T is identity preserving, $(\pi_1, \dots, \pi_n)$ induces a probability distribution on the set $\{1, \dots, k\}$ of all possible outcomes.
Similarly, if we repeat the same measurement again and again, then an initial state φ induces a probability measure μ on the set $\Omega := \{1, \dots, k\}^{\mathbb{N}}$ of all possible sequences of outcomes. Generically, this measure is not Markovian. To a path $\omega = (\omega_1, \omega_2, \dots) \in \Omega$ there is associated a sequence of operators $(T_{\omega,m})_{m \in \mathbb{N}}$ with $T_{\omega,m}(x) := a_{\omega_m}^* \dots a_{\omega_1} \cdot x \cdot a_{\omega_1} \dots a_{\omega_m}$, describing a quantum trajectory. There is also a continuous time version of this reasoning which is based on the Lindblad form of the generator of a semigroup of completely positive maps. Quantum trajectories are frequently used as a model for the time behaviour of open quantum systems as well as for numerical simulations of the semigroup evolution $(T^m)_{m \in N}$.
In the present project we investigate the pathwise ergodic properties of these paths and their associated quantum trajectories. In particular, we ask for quantum versions of the Wiener-Chintchin theorem and study the problem, whether equilibrium states can already be computed from a single trajectory (almost surely).

Partner: H. Maassen (Nijmegen)

Contact: Burkhard Kümmerer

References

[1] B. Kümmerer and H. Maassen. An ergodic theorem for quantum counting processes. *J. Physics A: Math. Gen.*, 36:2155 – 2161, 2003.

[2] B. Kümmerer and H. Maassen. A pathwise ergodic theorem for quantum trajectories. *J. Physics A: Math. Gen.*, 37:11889 – 11896, 2004.

[3] H. Maassen and B. Kümmerer. Purification of quantum trajectories. *IMS Lecture Notes-Monograph Series Dynamics & Stochastics*, 48:252 – 261, 2006.

Project: Completely Positive Operators and Their Stochastics

State changes of quantum systems are described by completely positive operators. Depending on the particular context such operators can describe, e.g., the dynamics of an open quantum system, transition probabilities of quantum Markov processes, quantum measurement processes (cf. the description of the project above) or quantum channels in quantum information. Their study is a central topic in modern quantum physics. The observables of a finite quantum system are self-adjoint elements in the algebra M_n of all $n \times n$-matrices. On such a system a completely positive operator $T : M_n \to M_n$ can always be decomposed into a sum $T(x) = \sum_{i=1}^{k} a_i^* \cdot x \cdot a_i$ for $x \in M_n$ and elements $a_i \in M_n$. However, such a decomposition is not uniquely determined by the operator T. As in the classical case of a transition matrix such an operator has always a stationary state φ (it may be called an equilibrium state) and in the irreducible aperiodic case this state φ is faithful and uniquely determined, and the powers of T converge to φ in the sense that $T^n(x) \to \varphi(x)\mathbf{1}$ as $n \to \infty$.
If n is large, it may be difficult to compute the equilibrium state φ explicitly. Therefore, we study in this project stochastic simulations of the dynamics $(T^k)_k$ in order to obtain approximations for the equilibrium state φ. According to ergodic results obtained in the previous project, quantum trajectories can be used for such simulations. In particular, we focus on the question: How should one choose the decomposition of T in order to obtain a good speed of convergence.

Partner: N. Ay (Leipzig), A. Knauf (Erlangen), R. Seiler (TU Berlin)

Contact: Burkhard Kümmerer, Kay Schwieger, Nadiem Sissouno

Support: Deutsche Forschungsgemeinschaft

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, R. Hillier (Department of Physics, TU Darmstadt)

Contact: Burkhard Kümmerer

References

[1] G. Alber, R. Hillier, and B. Kümmerer. Stochastic dynamical decoupling as an application of convolution semigroups. 2008.

Project: Quantum Brownian Motion and Quantum White Noise

Brownian motion is generally viewed to be the most important stochastic process in probability theory. Indeed, Brownian motion has at least three important properties, each of which is interesting in its own: It is a Markov process, hence its transition probabilities satisfy Chapman Kolmogorov equations; it is a Gaussian process, hence it is determined by its second order moments and the higher order moments can be computed from them; and it is a martingale, hence a stochastic integral can be defined with respect to the increments of Brownian motion. There are various characterizations of Brownian motion. In many of these characterizations its property of being a stochastic process with stationary independent increments plays a crucial role. Its (formal) derivative is the (generalized) stochastic process of Gaussian white noise.
Similarly, non-commutative Brownian motion is expected to play a central role in non-commutative probability. The family of random variables is now given by a family of (non-commuting) self-adjoint operators on some Hilbert space. The problem is: What properties make such a family of operators a good candidate for non-commutative Brownian motion? It is a typical feature of non-commutative probability that there is no unique notion of stochastic independence, hence the notion of independent increments has not only one generalization.
In this project we study notions of stochastic independence, construct corresponding candidates for Brownian motion an white noises, and investigate their properties.

Partner: R. Gohm (Aberystwyth), C. Köstler (Ottawa)

Contact: Burkhard Kümmerer

References

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[2] J. Hellmich, R. Honegger, C. Köstler, B. Kümmerer, and R. Rieckers. Couplings to classical and non-classical squeezed white noise as stationary markov process. *Publ. Res. Inst. Math. Sci.*, 28:1 – 31, 2002.

[3] B. Kümmerer. Quantum markov processes driven by white noise. In *Analysis on Infinite Dimensional Lie Groups and Algebras*, pages 216 – 228, 1998.

Project: Quantum Stochastic Differential Equations

A dynamics in continuous time is most suitably described and discussed as the solution of a differential equation. This is true, in particular, for the dynamics of a stochastic process.
However, for many important stochastic processes it can be shown that the trajectories of the random variables are generically not differentiable, hence the

classical theory of differential equations can not be applied. To overcome this difficulty one has developed a generalized theory of differential equations, called stochastic differential equations. It is based on the notion of a stochastic integral, and it has become a basic tool in analyzing stochastic behaviour in time. Similarly, one should describe time evolutions of stochastic quantum systems by stochastic differential equations. A first such theory was developed in the early eighties of the last century by R. Hudson and K.R. Parthasarathy by imitating the classical stochastic Ito-integral on Fock space. Here a typical feature of quantum probability comes in: The notion of stochastic independence, which is basic for defining a stochastic integral, has many non-commutative or quantum generalizations. Consequently, there were developed various theories of stochastic integration and stochastic differential equations. They deal with different types of independence like Fermionic independence, free independence or the type of independence as realized by the squeezed quantized electromagnetic field.
From the mathematical point of view one would like to have a unified approach based on a generalized notion of stochastic independence, comprising all the above examples and more. This is the content of the present research project: Indeed, we could introduce an operator algebraic notion of stochastic independence, which reduces to the unique classical notion if the algebras are commutative, but allows many realizations in the non-commutative case; in particular, the above mentioned examples are covered. Based on this notion we succeeded in defining a stochastic integral. It allows to obtain Markovian dynamics as solutions of quantum stochastic differential equations.

Partner: N. Gebhardt (Stuttgart), J. Hellmich (Tübingen), C. Köstler (Ottawa)

Contact: Burkhard Kümmerer

Support: European Union

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Project: Quantum Coding

From a mathematical point of view information is encoded in sequences of symbols which are taken from some finite set A, called the alphabet. Ideally, such sequences are two-sided infinite, hence elements in $A^{\mathbb{Z}}$. A code maps sequences in $A^{\mathbb{Z}}$ to sequences in $B^{\mathbb{Z}}$, where B is some further alphabet. Depending on the situation the code map should enjoy further properties. There are at least two different approaches to coding theory: In algebraic coding theory a string in $A^{\mathbb{Z}}$ is usually decomposed into blocks of fixed size and is translated blockwise into

the other alphabet. Here the translation depends only on the block itself but not on the blocks which have been previously translated. In the symbolic dynamics approach the code map is defined on a shift invariant subset of $A^{\mathbb{Z}}$, and it is required to intertwine the shifts on $A^{\mathbb{Z}}$ and $B^{\mathbb{Z}}$. This allows to include memory effects into the translation procedure. Our approach to non-commutative or quantum coding theory follows the second approach.
In this project we investigate quantum codes which can be obtained from quantum Markov processes by a scattering method:
In the early days of quantum probability it had turned out that the classical reconstruction of a Markov process from its transition probabilities is not suitable for generalization to the quantum case. Thus a different construction scheme had to be developed. It has led to Markov processes in coupling form: The algebra of all observables (or random variables) decomposes into the tensor product of the algebra of observables at time zero and a noise algebra. On the noise algebra there is a free time evolution turning it into a white noise process. The time evolution of the composed system is a perturbation of the free time evolution by a coupling of the observables at time zero to the time zero component of the noise algebra. This special form of the time evolution allows to look at it from the point of view of scattering theory; in particular, it is useful to study asymptotic completeness and existence of Møller operators.
It turns out that in the commutative discrete time case such a Markov process in coupling form can be identified with a Markov process which is obtained from a road coloured graph. Moreover, the time evolution of this process is asymptotically complete if and only if the road coloured graph has a synchronizing word. In this case the corresponding Møller operator induces a code map between the Markov process and the noise process. Asymptotic completeness can be verified also for many non-commutative Markov processes. This leads to non-commutative versions of synchronizing words and code maps which we investigate in this project.

Partner: R. Gohm (Reading)

Contact: Burkhard Kümmerer, W. Reußwig, K. Schwieger

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Project: Quantum Convolutional Codes

Convolutional codes are a special type of sliding block codes which allow an efficient decoding. In combination with error correcting block codes they are often used if information is transferred through very noisy channels like, for instance, from an interplanetary spacecraft. Due to decoherence, noise is an even bigger problem in quantum channels. Only recently first suggestions for the definition of a quantum convolutional code have appeared in the literature. They still lack, however, important features of classical convolutional codes such as time translation invariance.

In this project we develop notions of quantum convolutional codes and study their properties. Our approach uses the theory of operator algebras, where infinite tensor products are available. This allows to formulate non-commutative analogs of two-sided infinite sequences of symbols and time translation invariance.

Contact: Burkhard Kümmerer, Lisa Steiner

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Project: Quantum State Preparation

A quantum Markov process in coupling form (cf. the project "Quantum Coding") can also be interpreted as the description of an open quantum system in contact with its stochastic environment, where the dynamics of the environment is white noise. A typical example of such a system is a radiating atom coupled to the quantized electromagnetic field. Another important example is the micro-maser. Here the open system is a mode of the electromagnetic field, i.e. a quantum harmonic oscillator, which is coupled to the chain of two-level atoms passing through the cavity which contains the field mode. In this interpretation asymptotic completeness of the Markov process means the following: It is possible to prepare an arbitrary quantum state of the open system by a suitable preparation of the state of the noise system. This can be done even if the initial state of the open system is not known. Since we could prove asymptotic completeness for the micro-maser system, we can also prepare the state of the field mode (it is not directly accessible to preparation) by a suitable preparation of the states of the incoming atoms.
In this project we concentrate on the question of how such a preparation can be done most efficiently. In practice some states of the incoming atoms can be prepared more easily than others. So "efficient" means: Use only a small number of incoming atoms and use states of these atoms which can be easily prepared.

Partner: T. Wellens (Freiburg)

Contact: Burkhard Kümmerer

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Project: Observability, Quantum Filtering, and Quantum Control

As in the previous project we consider a quantum system which is described by a Markov process in coupling form, like the micro-maser. In the previous project we prepare the state of the incoming noise in order to prepare the state of the

open quantum system. Dually to this we can perform repeated measurements on the outgoing noise in order to obtain information on the state of the open quantum system (cf. also the second project).
In this project we study the problem: What can we learn about the state of the open system from the outcomes of the repeated measurement? In particular, we ask for conditions under which this state can be completely determined by such measurements on the outgoing noise (observability). As a next step one would like to find the optimal design of such measurements in order to obtain this information efficiently.
If the observables to be measured do pairwise commute, then the state of the open system, conditioned on the outcome of the measurement process, obeys a quantum filtering equation. This is a stochastic differential equation which is known as Belavkin equation. In order to understand the behaviour of the state of the open system one has to solve and to discuss these filtering equations for systems of interest.
Finally, if the behaviour of the open system can be influenced by changing some exterior parameters (like the speed of atoms in the micro-maser experiment) then one can change these parameters, depending on the outcomes of the measurements. This is the idea of quantum control. It opens further possibilities to control quantum states, one of the main issues in the experimental realization of the ideas of quantum information.

Partner: H. Maassen (Nijmegen), L. Bouten (Pasadena)

Contact: Burkhard Kümmerer, Walter Reußwig

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2.1.5 Logic

The research group in *Mathematical Logic and Foundations of Computer Science* primarily 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 (with proof theory, recursion theory and model theory) this involves constructive type theory, categorical logic, universal algebra, domain theory, lattice theory, finite model theory, and algorithmic issues.
Within mathematics, a primary field of applications in the proof- and recursion-theoretic setting (Kohlenbach) is the extraction of new information from proofs in algebra, analysis, functional analysis, hyperbolic geometry and numerical mathematics (proof mining). This involves 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, exact real arithmetic, "computational mathematics":

Kohlenbach/Streicher) Model theoretic investigations (Herrmann/Otto) make intra-mathematical links with algebra and discrete mathematics (Ihringer).
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 model theory, 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, as well as type theory and category theory.
Overall, the unit 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 continues to be pursued in particular in co-operation with the "Ernst Schröder Zentrum für Begriffliche Wissensverarbeitung e.V.".

Project: Abstract semantics of set theory

Topos theory is arguably the most successful chapter of categorical logic, in that it subsumes essentially all known interpretations of intuitionistic formal systems (Kripke models, forcing, topological and more general sheaf models, as well as realizability models) and develops a rich theory around them. The purpose of algebraic set theory [2] is to make make topos-theoretic techniques available to the study of (intuitionistic) set theories. The key notion of algebraic set theory, replacing that of a topos, is that of a "category of small maps", which is essentially a Heyting pretopos with a selected class of small maps. A key result tells us that a model of set theory has to exist in such a category with small maps, provided the small maps satisfy a minimal set of axioms. In a series of papers [5, 3, 4] we are developing a structure theory for such categories of small maps, with the aim of making the interpretations mentioned above applicable to constructive set theories, in particular Peter Aczel's set theory **CZF** [1]. Currently we are working on sheaf models and derived rules for **CZF**.

Partner: I. Moerdijk (University of Utrecht).

Contact: Benno van den Berg.

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Project: Homotopy-theoretic models of type theory

Martin-Löf type theory [1, 2] exists in two forms, differing in the formalisation of the identity types. In the "extensional" version, the identity types are easy to understand, but have undesirable computational properties: in particular, they make type checking undecidable. In the "intensional" version, the identity types have the desired computational properties, but are much harder to understand. It has been suggested by various researchers that this is because the structure is essentially homotopy-theoretic. In a first paper [3], we have shown that this intuition is correct: the intensional identity types give every type the structure of a weak ω-groupoid. The same structure arises in algebraic topology, if one organises a topological space together with its higher homotopy groups in what one may call its fundamental weak ω-groupoid. Currently we are taking this result as a starting point for developing homotopy-theoretic models of type theory.

Partner: R. Garner (University of Cambridge).

Contact: Benno van den Berg.

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Project: Model Theory of Monadic Second-Order Logic

In the investigation of monadic second-order logic we focus on two areas. On the one hand, we study decision procedures for monadic second-order theories. Such procedures are based on either automata-theoretic or logical techniques. The goal consists in finding large classes of structures with a decidable theory. Well-known examples of such classes are prefix-recognisable structures, the Caucal hierarchy, automatic structures. More recent developments include configuration graphs of collapsible pushdown automata and higher-order automatic structures. We also look at extensions of monadic second-order logic, for instance, by boundedness quantifiers. The second emphasis is on algebraic

and model-theoretic questions. We try to give algebraic characterisations of the classes that arose above. A particularly interesting open question consists in a characterisation of those structures with a manageable monadic theory. It is conjectured that there exists a dichotomy between tree-like structures with a simple theory and grid-like structures with a highly complex theory.

Partner: B. Courcelle (LaBRI, Bordeaux), T. Colcombet (Liafa, Paris)

Contact: Achim Blumensath.

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Project: Effective Metric Fixed Point Theory

We investigate certain quantitative and effective aspects of metric fixed point theory, with particular emphasis on finding explicit and highly uniform rates of convergence for iteration sequences for classes of selfmaps of metric spaces. The project is connected to the program of proof mining, as developed by Kohlenbach and various collaborators since the early 1990s. In connection with applications in nonlinear functional analysis Kohlenbach and Gerhardy have established logical metatheorems which allow the systematic extraction of (highly uniform) effective bounds from proofs of certain kinds of $\forall\exists$-statements in formal systems for classical analysis with various abstract spaces added as new ground types. We study how and to what extent these methods can be used to obtain effective full rates of convergence for iteration sequences in metric spaces. In two case studies [2, 4] we construct such full rates of convergence for the Picard iteration sequences for certain selfmaps of metric spaces, and we explain this in logical terms (restricted to the setting of bounded spaces) by extending the use of one of the metatheorems due to Kohlenbach [1]. This gives us a general method for finding, under general conditions, explicit and highly uniform rates of convergence for the Picard iteration sequences for selfmaps on bounded metric spaces from ineffective proofs of convergence to a unique fixed point – through giving general conditions under which we in this setting can transform a $\forall\exists\forall$-sentence into a $\forall\exists$-sentence via an argument involving product spaces. The ensuing reduction in logical complexity allows us to use the existing machinery to extract quantitative bounds of the sort we need. In addition to employing these methods to further concrete cases we aim at establishing to what extent this general approach can be lifted out of the specific setting of Picard iteration sequences in bounded metric spaces converging to a unique fixed point.

Support: German Research Foundation (DFG)

Contact: Eyvind Martol Briseid.

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Project: Equational theory and representation of complemented modular lattices with involution

The principal result is that the equational theory of the ortholattice of projections of any finite von Neumann-algebra factor A coincides with the equational theory of the class of projection lattices of finite-dimensional unitary spaces. As a consequence, one obtains a decision procedure for this equational theory and a representation of A as a homomorphic image of a subalgebra of an ultraproduct of *-rings $\mathbb{C}^{n\times n}$ (resp. an ultrapower of the hyperfinite factor). Here, the ultrapower is in the sense of Model Theory, so the result can be seen as a weak version of the Connes' Conjecture. The main objective is a further analysis of this representation. In addition, analoguous questions for complemented modular lattices with involution are studied.

Partner: L. Giudici, M.S.Roddy (Brandon University), M.Semenova (Russsian Academy of Science, Novosibirsk), F.Wehrung (CNRS Caen)

Support: German Research Foundation (DFG)

Contact: Christian Herrmann.

Project: Applied Proof Theory

This project has been concerned with writing the first comprehensive monograph on the novel form of applied proof theory that has developed during the last 10-20 years ([3]). This kind of proof theory focusses on the development of general logical methods (and their applications to concrete proofs in mathematics) which guarantee the extractability of effective uniform bounds from large classes of proofs in functional analysis and geodesic geometry. 'Uniform' here refers to the fact that the bounds are largely independent from parameters dealing with the abstract classes of structures considered but only depend on bounds of certain metric distances between these parameters ([1]). Structures covered include: metric, hyperbolic, CAT(0), normed, uniformly convex and

inner product spaces. The theorems are based on a monotone functional interpretation which uses a novel concept of majorization. The latter is parametrized by an arbitrary reference point taken from the space under consideration. The results have had numerous applications in metric fixed point theory, nonlinear analysis, geodesic geometry, ergodic theory and topological dynamics (see also [2, 4]).

Support: Springer, Max-Planck-Society (MPIM Bonn)

Contact: Ulrich Kohlenbach.

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Project: Gödel's functional interpretation and its use in current mathematics

This project develops new applied aspects of Gödel's functional ('Dialectica') interpretation which originally was designed for foundational purposes. The reorientation of proof theory towards applications to concrete proofs in different areas of mathematics which started in the 50's by G. Kreisel's pioneering work on the 'unwinding of proofs' also led to a re-assessment of possible uses of functional interpretations. Since the 90's this resulted in a systematic development of specially designed versions of functional interpretation and their use in numerical analysis, functional analysis, metric fixed point theory and geodesic geometry. In In [1, 2] the underlying logical aspects of these developments are analyzed and pushed further.

Support: Kurt Gödel Society (Wien), The John Templeton Foundation.

Contact: Ulrich Kohlenbach.

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Project: Methods of Proof Theory in Fixed Point Theory and Ergodic Theory

We apply proof-theoretic transformations to ineffective convergence proofs in fixed point theory and ergodic theory. In these applications, the so-called *monotone* functional interpretation is crucially used, since it systematically transforms any statement in a given proof into a new version for which explicit bounds are provided. In the case of convergence statements, this coincides with what recently has been advocated under the name *metastability* or *finite convergence* in an essay on *hard analysis* (as opposed to *soft analysis*) published by Terence Tao in 2008.
In this project we obtain new effective bounds in metric fixed point theory:

1. rates of metastability for the Krasnoselski-Mann iterations of asymptotically nonexpansive mappings in uniformly convex hyperbolic spaces.

2. rates of asymptotic regularity for the Halpern iterations of nonexpansive self-mappings of nonempty convex sets in normed spaces.

By unwinding a proof due to Birkhoff of a generalization of von Neumann's Mean Ergodic Theorem, we obtain effective rates of metastability for the Cesaro means of nonexpansive linear operators in uniformly convex Banach spaces, generalizing with better bounds results of Avigad, Gerhardy and Towsner (2007).

Support: Max-Planck-Society, MPIM Bonn: Trimestre on 'Methods of Proof Theory in Mathematics', March 1-June 10, 2007.

Contact: Ulrich Kohlenbach, Laurentiu Leuştean.

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Project: Logical analysis of sequential compactness

In this project methods developed in the field of 'proof mining' are used to give a computational interpretation of the Bolzano-Weierstraß theorem BW and calibrate the computational contribution of uses of this theorem in a proof of a combinatorial statement. Using a specially designed proof based on weak König's lemma (analyzed by W. A. Howard) and arithmetical comprehension (analyzed by C. Spector) we develop an explicit solution of the Gödel functional interpretation as well as the monotone functional interpretation of BW for $[-1,1]$ as well as the product space $\prod_{i\in\mathbb{N}}[-k_i,k_i]$ for a given sequence of rational numbers $(k_i)\subseteq\mathbb{Q}$ (with the standard product metric). In fact, we use this result to get optimal program and bound extraction theorems for proofs based on fixed

instances of BW, i.e. for BW applied to fixed sequences in $\prod_{i\in\mathbb{N}}[-k_i, k_i]$. The latter is used in recent work of Kohlenbach on 'proof mining' in connection with proofs based on weak compactness in (nonseparable) Hilbert space theory. Future work will study other sequential compactness principles such as Helly's theorem on functions of bounded variation.

Support: German Research Foundation (DFG)

Contact: Pavol Safarik, Ulrich Kohlenbach

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[2] P. Safarik and U. Kohlenbach. *The Interpretation of the Bolzano-Weierstraß Principle Using Bar Recursion.* To be submitted, 2009.

Project: Ramsey's Theorem for pairs and provably recursive functions

Ramsey's Theorem is an important tool in combinatorics and logic. Its logical strength was subject of research since the 70's. However the strength of Ramsey's Theorem for pairs is not fully classified yet. We prove that fixed sequences of instances of Ramsey's theorem for pairs and a fixed number of colors n (RT^2_n) at most cause primitive recursive provably recursive function(al)s relative to certain fragments of analysis containing e.g. WKL^*_0. We also establish a number of conservation results for such uses of RT^2_n.

Support: German Research Foundation (DFG).

Contact: Alexander Kreuzer, Ulrich Kohlenbach.

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Project: Novel forms of functional interpretations and Tao's 'finitary' infinite pigeonhole principle

In 1958 Kurt Gödel presented a two-step interpretation of Peano arithmetic into Heyting arithmetic that extracts exact witnesses for existential statements. Latter, Shoenfield presented a one-step interpretation. Recently, Thomas Streicher and Ulrich Kohlenbach showed that the two interpretations are equivalent. Parallelizing this, in 2005 Fernando Ferreira and Paulo Oliva presented a two-step bounded interpretation that extracts bounds instead of exacts witnesses. Latter, Ferreira presented a one-step bounded interpretation. In this project it is shown that the two bounded interpretations are equivalent (J. Gaspar).

In 2007 and 2008 Terence Tao wrote on his blog essays about finitizing statements in analysis, i.e. to find for infinitary qualitative statements equivalent finitary quantitative statements. One of his prime example is an almost finitization of the infinitary pigeonhole principle. It turned out that there was a

mistake in the finitization and a counterexample has been given by J. Gaspar. One way to correct this is suggested by monotone functional interpretation (U. Kohlenbach). Subsequently, Tao proposed a different corrected version. This project investigates in detail the strength of these two corrections in the context of reverse mathematics.

When we use a proof interpretation to extract computational information about the proof of a formula, we actually get information about the interpreted formula. Then we face the problem of transferring the information from the interpreted formula back to the original formula. One way of doing this is to hardwire truth in the proof interpretation, i.e. to change it in such a way that the interpreted formula implies the original formula. This was successfully done for realizabilities, but not for functional interpretations. By case studying realizability, two heuristics on how to hardwire truth in functional interpretations are being developed (J. Gaspar, P. Oliva).

Support: Portuguese Foundation for the Science and the Technology (FCT).

Partner: Dr. Paulo Oliva, Queen Mary, University of London

Contact: Jaime Gaspar, Ulrich Kohlenbach.

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Project: Proof mining in ergodic theory and metric fixed point theory

By *proof mining* we mean the logical analysis, using proof-theoretic tools, of mathematical proofs with the aim of extracting relevant information hidden in the proofs. This new information can be both of quantitative nature, such as algorithms and effective bounds, as well as of qualitative nature, such as uniformities in the bounds or weakening the premises. Thus, even if one is not particularly interested in the numerical details of the bounds themselves, in many cases such explicit bounds immediately show the independence of the quantity in question from certain input data.

The most systematic development of proof mining took place in connection with applications to approximation theory, metric fixed point theory, as well as ergodic theory and topological dynamics. A comprehensive reference for proof mining is Kohlenbach's recent book (2008).

In this project we analyze, using proof mining techniques, convergence results for important classes of iterations in metric fixed point theory of nonexpansive mappings and (nonlinear) ergodic theory.

Partner: Mathematisches Forschungsinstitut Oberwolfach; Oberwolfach Leibniz Fellows Programme (OWLF), October 2008 - February 2009.

Contact: Laurentiu Leuştean.

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

This German Research Foundation (DFG) funded research project emphasises the close 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. Among the key aspects of the game related model theoretic analysis are locality phenomena in the spirit of Gaifman's locality theorem. Considerable progress has been achieved, for instance, in the work of Alexander Kartzow, with extensions of Ehrenfeucht-Fraïssé techniques similar to those employed in Gaifman's Theorem, to certain classes of configuration graphs (second-order collapsible pushdown graphs). Gaifman locality analysis does not apply directly, because of long-range connections that may trivialise Gaifman locality; yet decidability of the first-order theory of such structures could be shown in [1], both through by adaptations of a quasi-local Ehrenfeucht-Fraïssé analysis, and through model theoretic interpretations and tree-automaticity. Other current themes concern the algebraic and combinatorial construction of finite hypergraph covers with some measure of acyclicity, with considerable impact on the finite model theory of, for instance, the guarded fragment (cf. [2]).

Support: German Research Foundation (DFG)

Contact: Martin Otto.

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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 seems to be 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 formula classes that have a decidable boundedness problem. Recent progress on decidability was made in [3] and in [2], 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, entirely new methods were brought to bear in co-operation with Achim Blumensath and Mark Weyer in [1] to show the boundedness problem decidable for arbitrary recursions in monadic second-order over finite linearly ordered monadic structures (word structures). Further work in this direction is hoped to yield generalisations of these new techniques to tree structures – a generalisation which would settle several (known and conjectured) classical boundedness issues for fragments of first-order logic in a uniform manner.

Partner: Achim Blumensath, Stephan Kreutzer (University of Oxford), Nicole Schweikardt (Goethe-Universität Frankfurt), Mark Weyer (Humbold Universität Berlin)

Contact: Martin Otto.

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[1] A. Blumensath, M. Otto, and M. Weyer. Boundedness of monadic second-order formulae over finite words. Technical report, 2008. To appear in ICALP 09.

[2] S. Kreutzer, M. Otto, and N. Schweikardt. Boundedness of monadic FO over acyclic structures. In Arge et al., editor, *Proceedings of International Colloquium on Automata, Languages and Programming, ICALP 2007*, volume 4596 of *LNCS*, pages 571–582. Springer, 2007.

[3] M. Otto. The boundedness problem for monadic universal first-order logic. In *Proceedings of 21st IEEE Symposium on Logic in Computer Science LICS'06*, pages 37–46, 2006.

Project: Model theory of modal logics over special frames

Modal logics occur as restricted fragments of first-order logic that combine very good model theoretic and algorithmic properties with an expressiveness that ideally suits typical applications in, for instance, knowledge representation, temporal specification, analysis of multi-agent systems and games [2]. It would often be natural to consider classes of structures with special requirements on the underlying frames, which cannot be dealt with easily unless the relevant constraints are first-order definable. Examples of interesting non-elementary frame classes include the class of finite frames or classes of rooted transitive frames. Expressive completeness of suitable modal logics for the class of all bisimulation invariant first-order properties relative to such restricted classes can be shown with specially adapted techniques that combine the analysis of the bisimulation game with bisimulation respecting model transformations. In [1], we develop a variety of new results along these lines. Among these is the emergence of a novel modality that is necessary for expressive completeness over transitive frames without strict infinite paths but not bisimulation safe over the class of all frames. Further generalisations of the proof techniques used here show that over various classes of transitive frames without infinite strict paths, monadic second-order logic is no more expressive than first-order logic as far as bisimulation invariant properties are concerned. These results lead to ramifications of a classical theorem of de Jongh and Sambin in modal logic.

Partner: The co-operation with Anuj Dawar (Cambridge University) was partly supported by a joint German Academic Exchange Service (DAAD) and Royal Society grant.

Contact: Martin Otto.

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Project: Models for Intuitionistic and Constructive Set Theories

It is well known that both Grothendieck toposes and realizability toposes give rise to models of the intuitionistic set theory IZF. Some of these models validate principles inconsistent with classical logic like Church's Thesis or Brouwer's Continuity Principle. In previous work [1] we have shown how every model of HAH (Higher Order Intuitionistic Number Theory) as given by an elementary topos with a natural numbers object can be transformed into a categorical model of a weak intuitionistic set theory BIST where the separation scheme is restricted to bounded formulas. In ongoing research we want to adapt this method for obtaining models of the predicative set theory CZF which refute both the powerset axiom and the unbounded separation schema. This way we hope to obtain a better understanding of the predicative nature of CZF from the point of view of a purely classical metatheory.

Partner: A. Simpson (Univ. Edinburgh)

Contact: Thomas Streicher.

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[1] S. Awodey, C.Butz, A. Simpson, and T. Streicher. Relating first order set theories and elementary toposes. *Bulletin of Symbolic Logic*, 13:340 – 358, 2007.

Project: Sequential Synthetic Domain Theory

Synthetic Domain Theory (SDT) as suggested by D. Scott and developed from 1990 onwards is an axiomatization of models of functional programming languages within an intuitionistic set or type theory. It has been successful in axiomatizing those aspects which are common to most models. Martin Hyland, one of the founders of SDT, has suggested to develop axiomatizations of various particular kinds of domain theories. A typical such domain theory tries to capture the essence of sequential functional computation, namely J. Laird's locally boolean domains. These have proved to provide fully abstract models for a sequential functional programming language SPCF as shown in [1]. These locally boolean domains give rise to a typed partial combinatory algebra over which one may construct a realizability model for higher order arithmetic and set theory. We use this model as a source of inspiration for axioms giving a synthetic account of sequential domains. In this process it has turned out as

crucial to revise the notion of a "dominance" which has been essential in previous accounts. Instead we postulate a type O of observations consisting of $\bot$ (nontermination) and $\top$ (termination with error) satisfying some appropriate axioms guaranteeing that O^O contains a dominance Σ. In this process it has turned out that O is more basic and easier to axiomatize than the derived notion Σ.

Partner: B. Reus (Univ. Sussex)

Contact: Thomas Streicher.

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2.1.6 Numerics and Scientific Computing

Scientific Computing has evolved as a strategic key technology in modern scientific research. The demand of continuously higher levels of details and realism in computer simulations requires new concepts in mathematical modelling and numerical simulation of real-life problems. The focus of our research group lies in the development of efficient numerical methods to solve ordinary and partial differential equations, and nonlinear optimization problems.

Project: Hierarchical Modelling and Model Adaptivity for Gas Flow on Networks

Recent demands for gas transmission companies are to satisfy the customers' requirements at designated times. Therefore, one needs to react fast and flexibly to short-term changes in the requested quantity and quality of gas. To meet the demands, reliable mathematical models as a basis for decisions on changing the configuration of the network are needed. Realistic problems in practice necessitate the consideration of thousands of pipes which makes global optimization with high resolution impossible. We develop a strategy to automatically employ different models in different regions of the network according to actual measurements of the gas flow using adjoint techniques.

Partner: German Research Foundation (DFG) under the grant LA1372/5-1

Contact: Pia Bales, Jens Lang.

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

To explore the fundamental scientific issues of high dimensional complex engineering applications such as optimal control problems with time-dependent partial differential algebraic equations (PDAEs) scalable numerical algorithms are requested. This means that the work necessary to solve increasingly larger problems should grow all but linearly – the optimal rate.

In this joint project we combine modern solution strategies to solve time-dependent systems of partial differential algebraic equations with state-of-the-art second order optimization techniques. The essential derivative information is determined by the continuous adjoint approach. The resulting correlated PDAEs are solved with the software package KARDOS using error-controlled Rosenbrock methods of higher order for the time integration and adaptive multilevel finite elements in space. Local and global errors are estimated by applying embedded time formulas and hierarchical basis. Whereas local error estimates are used to adapt space and time grids such that a given accuracy can be achieved, the global estimates give rise to the accuracy itself with respect to the optimization progress. Successful adaptive methods lead to substantial savings in computer time and memory requirements. We include an efficient handling of control, state and state gradient constraints by interior-point or semismooth Newton strategies.
An optimal boundary control problem of the cooling down process of glass modelled by radiative heat transfer serves as highly nonlinear showcase engineering application where restrictions on state gradient and control variables are essential.

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

Contact: Debora Clever, Jens Lang, Stefan Ulbrich, Jan Carsten Ziems.

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Project: B-series analysis of stochastic Runge-Kutta and Taylor methods

In the modeling of many applications, e.g., in chemical reaction systems and electrical circuits, taking stochastic effects into account often leads to stochastic differential equations (SDEs) of the form

$$X(t) = x_0 + \int_{t_0}^{t} g_0(X(s))ds + \sum_{l=1}^{m} \int_{t_0}^{t} g_l(X(s)) \star dW_l(s)$$

which can be stiff, i. e., explicit approximation methods do not work efficiently, and implicit methods have to be considered. An important class of derivative free approximation methods for solutions of SDEs are stochastic Runge–Kutta (SRK) methods. In the last years, implicit SRK methods have been developed

both for strong and weak approximation. For these methods, the stage values are only given implicitly. However, in practice these implicit equations are solved by iterative schemes like simple iteration, modified Newton iteration or full Newton iteration. Using the theory of B-series and rooted trees, it has been proven in [2] that the iteration error can be accurately described in terms of certain growth functions defined on trees, allowing to determine precisely how many iterations are needed to achieve a certain order of convergence. In this project, we are extending this theory to the case of implicit Taylor methods. In particular, we are developing a B-series theory for implicit Taylor methods which can also be used for the construction of new methods, both for weak and strong convergence.

Partner: A. Kværnø (Norwegian University of Science and Technology, Trondheim)

Contact: Kristian Debrabant.

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Project: Numerical analysis of multilevel Monte Carlo path simulation using the Milstein discretisation

The multilevel Monte Carlo method has been introduced previously by Mike Giles for estimating the value of path-dependent options. Previous work analysed its efficiency when using the Euler-Maruyama discretisation, and also demonstrated its improved efficiency using the Milstein method with its improved strong convergence properties. In this project we analyse its efficiency for scalar and multidimensional SDEs using the Milstein discretisation, determining or bounding the order of convergence of the variance of the multilevel estimator, and hence the computational complexity of the method.

Partner: M. Giles (Oxford University)

Contact: Kristian Debrabant, Andreas Rößler.

Project: Weak second order stochastic Runge-Kutta methods

Often one is not interested in approximating the solution of an SDE pathwise (strong convergence), but in the expectation of functionals of the solution, which leads to weak convergence. In this project, we construct explicit and implicit stochastic Runge-Kutta schemes of weak second order, including continuous schemes.

Contact: Kristian Debrabant, Andreas Rößler.

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Project: Global error control for parabolic PDEs

In this project we investigate efficiency and reliability questions for finite difference approximations of parabolic problems. Existing popular codes focus on efficiency by adaptively optimizing time grids in accordance to local error control. The reliability question, that is, how large are the global errors, has received much less attention. Therefore, we are developing strategies for global error estimation, based on the solution of linearized error transport equations, and global error control, based on the property of tolerance proportionality.

Partner: J. Verwer (CWI)

Contact: Kristian Debrabant, Jens Lang.

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Project: Simulation of geometrically exact viscoelasticity

In this project we investigate a novel geometrically exact formulation of viscoelasticity due to P. Neff. Instead of a memory kernel, an evolution equation is coupled into the model which takes values in SO(3). We develop stable numerical algorithms which couple geometric numerical integration on SO(3) with an FEM-discretization of the equilibrium problem. As application we model the viscoelasticity of bone, metal etc.

Partner: P. Neff (Universität Duisburg-Essen)

Contact: Kristian Debrabant, Jens Lang.

Project: Monotone schemes for the Bellman equation of optimal control

The HJB Equations we consider are written in the following form,

$$u_t + \sup_{\alpha \in \mathcal{A}} \left\{ \mathcal{L}^\alpha(t, x, u, Du, D^2u) \right\} \ , = 0 \qquad \text{in} \quad Q_T := (0, T] \times \mathbb{R}^N, \tag{1}$$

$$u(0, x) = u_0(x) \qquad \text{in} \quad \mathbb{R}^N, \tag{2}$$

where

$$\mathcal{L}^\alpha(t,x,r,p,X) := -\mathrm{tr}[a^\alpha(t,x)X] - b^\alpha(t,x)p - c^\alpha(t,x)r - f^\alpha(t,x).$$

The coefficients a^α, b^α, c^α, f^α and the initial data u_0 take values respectively in $\mathbb{S}^N$, the space of $N \times N$ symmetric matrices, $\mathbb{R}^N$, $\mathbb{R}$, $\mathbb{R}$, and $\mathbb{R}$. Under suitable assumptions, the initial value problem (1)-(2) has a unique, bounded, Hölder continuous viscosity solution u which is the value function of a finite horizon, optimal stochastic control problem. Classical FDM approximations of (1) are not monotone, unless the matrix a^α satisfies additional assumptions, which is often not the case. Non-monotone methods need not converge or can even converge to false solutions. That's why we are developing consistent and easy to implement monotone schemes.

Partner: E. R. Jakobsen (Norwegian University of Science and Technology, Trondheim)

Contact: Kristian Debrabant

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

The aim of this project is to analyze the potential of adaptive linearly implicit time integrators of higher order in CFD computations. We consider classical one-step Rosenbrock methods of order three and four as well as modern two-step methods of Peer-type up to order five. These new peer methods show good stability properties, but the main advantage over one-step methods lies in the fact that even in the application to PDEs no order reduction is observed. Therefore, they are good candidates for CFD computations that demand for high resolution.
We compare the accuracy and efficiency of the new methods equipped with variable time steps to second-order methods and investigate whether the higher order of convergence of the two-step peer methods pays off in practically relevant CFD computations. 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 Foundation (DFG).

Contact: Bettina Gottermeier, Jens Lang.

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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 up to now 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 (University of Kansas)

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

Contact: Lennard Kamenski, Jens Lang.

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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 (TU Darmstadt), Hessenwasser GmbH & Co. KG, Siemens AG

Support: German Research Foundation (DFG), Federal Ministry of Education and Research (BMBF)

Contact: Oliver Kolb, Jens Lang.

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[5] O. Kolb, J. Lang, and P. Bales. Adaptive linearization for the optimal control problem of gas flow in pipeline networks. Preprint, TU Darmstadt, 2008.

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 to adapt 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-Universität/Universität der Bundeswehr Hamburg).

Support: German Research Foundation (DFG)

Contact: Delia Teleaga, Jens 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 proportion 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, government research laboratories, etc) or other university departments (particularly engineering departments).

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

Contact: Jens Lang.

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

The aim of this project is to design elementary 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, using the finite-element software KARDOS. In this project we are collaborating with two groups from different disciplines: meteorology (Oberpfaffenhofen) and mechanical engineering (Dresden).
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, e.g. the solution gradient or an error estimator, as well as physically motivated. In this project we are mainly concerned with developing such refinement criteria particularly for LES of turbulent flows.

Partner: J. Fröhlich, C. Hertel (TU Dresden); A. Dörnbrack, C. Kühnlein (German Aerospace Center Oberpfaffenhofen).

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

Contact: Stefan Löbig, Jens Lang.

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Project: Derivative free optimization

In the last decade methods for minimization of general nonlinear and possibly nonconvex functions without using derivatives have found increased interest. Among these the "classical" method published by Nelder and Mead is mostly used by practitioners, despite its known mathematical incorrectness. This, since in "real life" it often provides good solutions with comparably little effort. There are known several "corrections" of this method, which however deviate considerably from the original concept and often strongly increase the necessary effort, which here is measured via the number of function evaluations only. In

2007/2008 a PhD-student of the department, A. Witzel, published in here dissertation a modified Nelder Mead method which is provably convergent and deviates only minimally from the original one. It has however the disadvantage of a strong algebraic step complexity of $\mathcal{O}(n^3)$, n =number of variables, such that, although successful also in higher dimensions, this makes the method prohibitively slow for larger n. This project follows two aims. Firstly the algebraic effort should be reduced to an order of $\mathcal{O}(n^2)$. Secondly the information gained in the progress of the method should be incorporated to speed up convergence. The first step has successfully been finished. The second one is under work.
Finally the method will be used for general constrained optimization via an exact penalty function. In order to achieve this, a method of adaptation of the penalty parameters must be found which works without requiring monotonicity of the penalty term, which would render this inefficient due to overestimation effects.

Contact: Peter Spellucci.

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Project: Model Reduction for Large-Eddy Simulation

The project aims at model reduction for problems in computational fluid dynamics. In flow optimization often a Navier-Stokes model has to be solved consecutively using slightly different settings. The numerical solution of the incompressible Navier-Stokes equations is usually the computationally most demanding part of such an optimization process. Using the proper orthogonal decomposition (POD) or the centroidal Voronoi tessellation (CVT) it is possible to create a low-dimensional reduced model from snapshots of the solution of the original flow model. With this technique only a single run of the full model is required to create the snapshots, the other solutions can be obtained efficiently with the reduced model. Research is done on model reduction in the context of large-eddy simulation (LES) of turbulent flows with the finite-element software KARDOS.

Support: German Research Foundation (DFG) – Collaborative Research Centre (SFB) 568 "Flow and Combustion in Future Gas Turbine Combustion Chambers".

Contact: Sebastian Ullmann, Jens Lang.

2.1.7 Optimization

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 set up as 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 Inititative) 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 BMBF network on *Decentralized Regenerative Energy Supply*, 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, Linde, Lufthansa, Schenck, and Siemens.

Project: Advanced Numerical Methods for PDE Constrained Optimization with Application to Optimal Design and Control of a Racing Yacht in the America's Cup

The goal of this project is the development, analysis, and implementation of robust and efficient optimization algorithms for the optimal design and control

of a racing yacht competing in the America's Cup. The project focuses on the optimization of the hull-keel-winglet configuration toward drag minimization. This involves shape optimization problems including PDE constraints in form of the instationary incompressible Navier-Stokes equations with high Reynolds numbers in 2D and 3D.
Research topics of the project include:

- Computation of exact discrete reduced gradients based on a continuous adjoint approach.
- Multilevel optimization methods using a hierarchy of adaptive discretizations in time and space based on the goal oriented approach.
- Semismooth Newton and interior point methods to handle inequality constraints for design and state variables.
- Parallel processing for the optimization schemes via space and time domain decomposition.
- Arbitrary parametrizations of the object boundary, e.g. B-splines, boundary displacements, free-form deformation.

Partner: V. Heuveline (Universität Karlsruhe (TH)); M. Ulbrich (TU München).

Support: SPP 1253, German Research Foundation (DFG).

Contact: Stefan Ulbrich, Christian Brandenburg.

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Project: Solving Copositive Programs

Copositive programs are linear optimization problems over the cone of copositive matrices, i.e. the cone of those matrices which induce a quadratic form that is nonnegative on the nonnegative orthant. They can be viewed as the next step of generalization starting from ordinary linear programs and semidefinite programs. Copositive programs arise in many applications: Combinatorial problems like max clique, graph partitioning or the quadratic assignment problem can be stated in this form. Moreover, every quadratic problem with binary constraints also fall into this framework. From a complexity point of view, copositive problems are NP-hard, and even to decide whether a given matrix has this property is an NP-hard problem. Based on polyhedral inner and outer approximations of the copositive cone necessary and sufficient conditions for copositivity were formulated and, based on this theory, an algorithm to solve these problems were developed and implemented. First numerical results are promising.
The approach can be extended to take advantage of semidefinite approximations and nonlinear optimization algorithms. Furthermore, it can be generalized to

solve problems where the constraints are given by polynomials and it is not only useful to solve optimization problems but has also applications in the field of dynamic systems.

Contact: Stefan Bundfuss.

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Project: Mixed Integer Second Order Cone Programming

Mixed Integer Second Order Cone Programs (MISOCPs) are characterized by a linear objective function that is minimized over the intersection of an affine subspace and the cartesian product of second order cones of various dimensions and the additional constraint that a subset of the variables have to attain integer values.
These problems have various applications in finance or engineering, for example turbine balancing problems. Further applications are simplified optimization models in the context of gas networks or cardinality-constrained portfolio optimization problems Another class of problems arises for example when designing a minimum length connection network also known as the **e**uclidean **S**teiner **t**ree **p**roblem (ESTP).
We develop algorithms to solve MISOCPs. For this purpose we put together results about solving SOCPs and cut generation that are then applied in the context of a nonlinear branch&cut as well as a subgradient based outer approximation approach.
The latter is an extension of the branch&bound based outer approximation approach for continuously differentiable problems to subdifferentiable second order cone constraint functions. Convergence is guaranteed, since subgradients satisfying the KKT conditions are identified using the dual solution. We also present a version of this algorithm that converges if one of the convergence assumptions is violated, which leads to a robust applicability of this algorithm.
We develop cutting techniques based on a hierarchy of lift-and-project relaxations of the binary feasible set for mixed 0-1 SOCPs. Apart from that, we show finiteness for the general formulation of the Chvátal-Gomory procedure for bounded pure integer second order cone programs. Furthermore, we motivated some constructions for both pure and mixed integer Gomory cuts.
We also present a convergence analysis for an interior point algorithm for SOCP that is convergent even for infeasible starting points. This algorithm is enhanced by a penalty approach for problems with empty interior and a reliable feasibility

test.
An implementation of this SOCP solver was then used in the branch&cut as well as the branch&bound based outer approximation framework. Computational results for small test problems and application problems are given. Both algorithms are able to solve all test problems to optimality. We investigate the performance of different node selection and branching rules and most of all, the impact of the different cutting techniques. A comparison of both approaches yields that regarding running times, the branch&bound based outer approximation approach is in almost all test cases preferable, since the occurring linear problems stay moderately in size and can thus be solved very fast.

Contact: Sarah Drewes

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 mechanical trusses and their design. These trusses are found in many applications (undercarriages of airplanes, bicycles, electrical towers, etc.). And they 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. Collaborative Research Centre (SFB) 805 introduces new technologies to handle uncertainty in load carrying systems. The aim of the 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 a mixed-integer semi-definite problem. For this kind of problem there exists no solver that exploits the structure of the semi-definite matrix.
Besides the development of an appropriate solver another focus lies in a mathematical handling of uncertainties. For example, ellipsoidal and polyedral 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: Alexander Martin, Stefan Ulbrich, Sarah Drewes, Sonja Friedrich, Kai Habermehl, Lars Schewe

Project: Gas Network Optimization

The problem of gas network optimization is as follows. Gas flows through the network and due to friction with the pipe walls, pressure gets lost. This pressure loss has to be compensated. Therefore there are machines, the so called compressors. A running compressor always consumes some amount of the gas flowing through it as fuel gas. Further, there are consumers that need a certain amount of gas at a specified pressure level, and sources where some gas is fed into the network with a certain pressure. The goal of the so called Transient Technical Optimization (TTO) is to operate the gas network in such a

way that the consumer demands are satisfied and the compressors are set in cost-efficiently. This TTO problem leads to a complex mixed integer nonlinear optimization problem. In a first step we treat the stationary case of gas network optimization where just one time step is considered. We develop techniques for a piece-wise linear approximation of the nonlinearities, where we generalize the so called SOS Type 2 constraints. This results in a large mixed integer linear program. We study sub-polyhedra linking these piece-wise linear approximations and show that the number of vertices is computationally tractable yielding exact separation algorithms. Suitable branching strategies complement the separation algorithms and guarantee the SOS conditions. Our computational results demonstrate the success of this approach. In a next step we consider the time-dependent case which is also called transient case. At first we need an appropriate modeling of the gas dynamics in pipes. Again we approximate nonlinearities by piece-wise linear functions. In the transient case we also get further conditions. For example we have min-up and min-down times as well as switching costs for compressors. We compare several modeling techniques for the approximations and study sub-polyhedra in order to strengthen our model by adding valid or even facet-defining inequalities. Finally we need a feasible solution for an upper bound in our branch-and-cut algorithm. Therefore we develop a simulated annealing algorithm.

Partner: S. Dymkou, G. Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg); P. Domschke, O. Kolb, J. Lang (TU Darmstadt)

Contact: Björn Geißler, Alexander Martin.

Support: German Research Foundation (DFG)

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Project: Mixed Integer Nonlinear Programming in SCIP

Mixed Integer Nonlinear Programming (MINLP) generalizes classical Mixed Integer Programming (MIP) by allowing nonlinearities in the objective function and constraints.
Classical solvers for Mixed Integer Programming apply a Branch & Bound scheme on the problem by relaxing the integrality to achieve linear programs and successively bound tightening.
To adopt this well understood technologies to the MINLP case at least two issues has to be negotiated. First of all, only relaxing integrality leads to nonconvex nonlinear programs. Several techniques are known to solve such problems globally, but all of them are also quite enumerative and computationally costly. To negotiate this fact, the problem has to be relaxed further by computing convex enclosures of the original constraints.
Secondly, convex nonlinear relaxations, has to be solved either. Therefore, a nonlinear nearly active set SQP algorithm is adopted and integrated into SCIP as a replacement for the simplex algorithm. The main advantage of those algorithms over Interior Point methods are the fast resolve capabilities and higher numerical precision. Further they do not require local convexity of the problem which is important for the use in MINLP heuristics called during the Branch & Bound process. Classical primal-dual implementations of active set SQP algorithms like SNOPT fail to handle problems with high degrees of freedom which is crucial in global optimization.
The central idea is to keep the power of SCIP as a well engineered MIP solver and combine it with a reliable NLP solver and techniques from global optimization.
Partner: Zuse-Institut Berlin (ZIB)

Support: Siemens AG

Contact: Thorsten Gellermann

Project: Abstraction Layer for Mixed Integer Programming Solvers

The aim of this project is to maintain and enhance a lightweight C++ library which allows a unified interface to different algorithmic strategies and different commercial implementations.
Instead of using matrix representations that are hard to handle during development and experimentation phase of an application, the model is designed by variables and constraints. Further access to algorithmic structures like branch variable selection and abilities to generate cutting planes are opened to the user. Supplementary functionality was added to the interface to detect equivalent LP-relaxations quickly, exploiting sparsity of the constraint matrix. For general mixed integer linear programs this problem is NP-complete. A tracing tool, to detect flaws in the attached solvers is currently in development.

Partner: Siemens AG, München

Support: Siemens AG, München

Contact: Michael Hofmeister, Alexander Martin, Sebastian Pokutta.

Project: Optimizing branched structures considering manufacturing restrictions (Subproject A3 of Collaborative Research Centre (SFB) 666)

This project is incorporated into the Collaborative Research Centre (SFB) 666 (Integral sheet metal design with higher order bifurcations – development, production, evaluation) and deals with the integration of manufacturing restrictions in the design process of branched sheet metal products. Using the new technique *linear flow splitting*, which is developed in the Collaborative Research Centre (SFB) 666, combined with traditional forming techniques for sheet metal such as roll forming processes and joining techniques it is possible to produce branched sheet metal profiles out of one piece of sheet metal. With every additional branch, the number of possible ways to produce the component, i.e., the number of unrollings, increases exponentially. Moreover, various manufacturing constraints must be taken into account. The problem can be transformed into the problem of finding a directed Steiner tree in a certain graph. The manufacturing constraints result in additional restrictions on the tree such as on the diameter or the degree of the tree. We use two different approaches to solve the problem. First, it is modeled as a mixed integer program. The underlying polyhedra is investigated in order to identify facets which are then used to decrease the running time for solving the model. In a second approach, methods from graph theory are applied and further developed in order to tackle the actual graph 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: Ute Günther, Alexander Martin.

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Project: Mathematical Models for Algorithm Driven Product Development (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 is concerned with the optimization of sheet metal products. Using sheet metal forming a wide variety of different profiles can be manufactured. Each additional branch leads to a higher degree of freedom for the product design. Handling the large amount of possible product variants thus requires an algorithmic approach. The project is divided into two parts: Firstly we apply methods from discrete optimization in order to find the optimal product topology. To this end models using mixed-integer linear as well as mixed-integer nonlinear programming have been developed. In order to strengthen the MIP formulations polyhedral studies were conducted. The optimal topology is then used as an input to the second step which further refines the product geometry using PDE constrained optimization techniques. We use the linear elasticity equations as a detailed model of the product behaviour and solve the arising non-convex geometry optimization problems using an efficient multilevel SQP-method.

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: Armin Fügenschuh, Ute Günther, Wolfgang Hess, Alexander Martin, Stefan Ulbrich.

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Project: Optimizing Aircraft Rotation in Passenger Transport

Scheduling planes to planned flights alone has high optimization potential. Combining this with the permission to make small changes on the departure times (time windows) makes it even more promising – though much harder to solve. The aim of this project was to verify given solutions of aircraft rotations with mathematical methods. Even better solutions were found when allowing small time windows for the departure times. Constraints such as curfew times, minimal ground times or overnight trips where taken care of.

Partner: ECAD

Support: Lufthansa Direct Services

Contact: Alexander Martin, Armin Fügenschuh, Henning Homfeld.

Project: Optimization and Simulation of Duty Rosters for Railway Crews

Employees of transportation companies typically work in shifts at irregular times. These shifts have to be served every day of the year including weekends and bank holidays. Also, a lot of shift changes occur at short notice, which may result from construction sites or illness of the drivers. These lead to changes in the crew members' duties, which again narrows their possibility to reliably plan their free time. However, the latter is of highest importance for the employees. The aim of our work was to generate cost-efficient duty rosters that are valid with respect to the regulations of the labor agreements and more stable with respect to real-life influences. The complexity of the problem has been broken down by means of techniques like moving horizon or partitioning of large crews into smaller ones. Simulating illness of staff members as well as interferences like construction sites based on statistical data, founded conclusions concerning the robustness of the duty plans.

Support: DB Regio AG

Contact: Alexander Martin, Armin Fügenschuh, Henning Homfeld, Andrea Peter, Christine Hayn.

Project: OVERSYS – Optimierung der Transport- und Ressourcenplanung spezifischer Schienen- und Straßenverkehrssysteme

One of the most significant measures for costs in rail freight transportation is the number of train miles, that is, the number of trains times the distance they travel. In order to reduce the number of trainmiles, the aim is to find routes for the cars through the network from their origin via possibly visited intermediate shunting yards to their destination, such that the cars travel as a bundle and the utilization of the trains is as high as possible. The problem is a variety of the well known blocking problem. The aim in this project is to find optimal routes for the cars through a network under a wide range of hard side constraints which reflect today's operation of the German railroad system. Among them are constraints on the structure of the routes of the cars as well as several different types of capacity constraints. Different priority classes of shipments that use the routes are considered, as well as a nonlinear waiting time aspect.

Partner: TU Braunschweig, TU Dortmund, TU Chemnitz, U Heidelberg, U Duisburg, DB Mobility Logistics AG

Support: German Federal Ministry of Education and Research

Contact: Alexander Martin, Armin Fügenschuh, Henning Homfeld.

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: Michael Joswig.

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Project: Electronic Geometry Models

The archive Electronic Geometry Models is a new electronic journal for the publication of digital geometry models from a broad range of mathematical topics. The geometry models are distinguished constructions, counter example, or results from elaborate computer experiments. Each submitted model has a self-contained textual description and is peer reviewed. Electronic Geometry

Models is based on XML techniques. It is freely accessible at `www.eg-models.de`.

Partner: Konrad Polthier (FU Berlin)

Contact: Michael Joswig.

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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)

Support: German Research Foundation (DFG), Forschergruppe FOR565: Polyhedral Surfaces.

Contact: Michael Joswig.

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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.
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: Sarah Kessler, Stefan Ulbrich, Michael Schäfer.

Project: Optimization of process chains under uncertainty (project B1 of Collaborative Research Centre (SFB) 805)

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 e.g. occur when non-deterministic variations of geometry or material influence the strength of a bar in a truss. 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 Collaborative Research Centre (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: 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: Prof. Dr. Alexander Martin, Dr. Ulf Lorenz, Dr. Sebastian Pokutta

Project: GOmputer: the Go machine

The ability to compete with humans in playing games, most prominently chess, has been a longstanding 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, University of Paderborn.

Partner: Prof. Dr. Marco Platzner, Lars Schaefers

Support: Microsoft, Paderborn University

Contact: Ulf Lorenz

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[3] C. Donninger and U. Lorenz. The hydra project. *Xcell Journal*, 2005.

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Project: Optimal Use of Energy Storages and Power Plants in Power Generation including Regenerative Energy Supply

This project deals with the integration of offshore wind parks into an electricity network. Yet there are some regions in Germany where in times of strong wind

more energy is generated than needed. In order to balance the fluctuating wind energy supply and the consumers' demand we consider energy storages as well as conventional power plants. The installations involved are an offshore wind park, a pumped hydro storage, a compressed-air storage, a coal-fired power plant, and a gas turbine power plant. Furthermore, the consumers' demand can be satisfied through the public supply network. The question is how to couple the charge and discharge of the storages with the control of the power plants over the period of one day, with the objective of minimizing the electricity price per kWh.

Support: Federal Ministry of Education and Research (BMBF)

Partner: R. Schultz, C. Weber (Universität Duisburg-Essen), E. Handschin (Universität Dortmund), H.-J. Wagner (Universität Bochum), W. Römisch (Humboldt-Universität Berlin), M. Lucht (Fraunhofer Institute UMSICHT)

Contact: Debora Mahlke, Alexander Martin, Andrea Zelmer.

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[1] A. Epe, D. Mahlke, A. Martin, H.-J. Wagner, C. Weber, O. Woll, and A. Zelmer. Betriebsoptimierung zur ökonomischen Bewertung von Speichern. In R. Schultz and H.-J. Wagner, editors, *Innovative Modellierung und Optimierung von Energiesystemen*, volume 26 of *Umwelt und Ressourcenökonomik*, pages 153–178. LIT Verlag, 2009.

Project: Operational Management of Water Supply Networks

Water supply networks basically consist of pumps, valves and storage tanks connected by pipelines. Water should be delivered from reservoirs or suppliers to satisfy customer's demands. In such pressurized systems water always flows from points of high pressure to those of low pressure. Thus, the pressure must be increased at certain points to ensure the water reaches all customers. This task is done by pumps. The aim of an operational management is to find pump controls and switching decisions for valves to deliver water sufficiently. If additionally a minimum cost management is preferred, e.g. electricity consumption of pumps, this problem leads mathematically to a mixed-integer nonlinear program (MINLP). One the one hand, nonlinearities are necessary to reproduce the physical behavior correctly, and on the other hand binary variables arise, because one have to decide whether certain components (e.g. pumps and valves) are switched on or off. Nonlinear optimization problems combined with discrete decisions are only solvable for small problem instances. Furthermore, available state-of-the-art MINLP solvers can commonly find only locally optimal solutions. Within this project techniques for determining globally optimal solutions of water supply network problems are developed.

Partner: O. Kolb, J. Lang (TU Darmstadt); Hessenwasser GmbH & Co. KG; Siemens AG; Steinhardt GmbH Wassertechnik

Support: Federal Ministry of Education and Research (BMBF) – Joint project ODYSSEUS

Contact: Alexander Martin, Antonio Morsi.

Project: Free Flight Optimization

Based on the increasing relevance of aviation as a crucial component of the modern traffic, the use of optimal flight paths gains in importance.
There have been severe instructions ascertaining on which path a plane is allowed to fly which have constrained the possible flight paths. The so-called Air Traffic Network (ATN) consists of arterial roads and it was only permitted to fly along these specified streets. The ATN describes all segments of possible paths in the structure of a graph. By means of this graph, the best possible flight path could be determined, for example with the help of a shortest path algorithm like Dijkstra's Algorithm.
On the one hand, air traffic is increasing and close to exceeding. On the other hand, the accuracy of the navigation has been improved. Therefore, it can be done without the demand of an ATN and flight paths can be chosen more freely in the airspace. We call the possibility of finding flight paths independent from the ATN *free flight*. This gives the possibility to compute and fly shorter and more efficient routes. From this approach it is also expected that delays and charges caused by the ATN could be reduced.
In our work we show how good flight paths can be computed. Therefore, it is important to specify the setting:
There are a predetermined start and destination point of the path. Furthermore, the underlying situation is known. There are areas over which it is not allowed to fly. We call them restricted airspaces. They occur for instance because of war or atomic power plants. To some of them he restrictions only apply at certain times, e.g., curfews. Every country can charge an amount for flying over it. There are several cost models for different countries. In addition, some information about the wind is known. In our computation we want to avoid headwind and utilize the tailwind, especially the JetStream. This saves time and kerosine. For a given number of time steps we compute the position and the velocity of the plane at that point of time on that position. The final flight path is then composed of the linear concatenation of these waypoints. It is possible to consider diverse objectives: The computed path can be fast, short, cheap, energy-saving, environment-friendly or a combination of these aims.
The setting leads to a nonlinear problem which is tackled by a MINLP approach, a MILP approach with piecewise linear approximations and with a time extended Dijkstra's Algorithm.

Partner: Fraunhofer IGD, Darmstadt

Support: Lufthansa Systems

Contact: Alexander Martin, Armin Fügenschuh and Andrea Peter

Project: Efficient Numerical Multilevel-Methods for the Optimization of Gas Turbine Combustion Chambers (project D5 of Collaborative Research Centre (SFB) 568)

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 today's 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 constantly developed over last decades and has various flow and combustion models incorporated.
Via automatic differentiation, we obtain a linear system for the adjoint, with which the gradients for the optimization routines are calculated.
This procedure has been applied on various kinds of optimization problems including LES of unsteady three dimensional flows and shape optimization.
The next steps will be to incorporate a combustion model and use techniques that reduce the cost of optimization. To cut down the computational effort, we will use POD models and multilevel techniques. These will be combined with new approaches for the optimization.

Partner: 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).

Support: German Research Foundation (DFG)

Contact: R. Roth, S. Ulbrich

Project: Optimization of Gas Transportation Networks

The project is concerned with the analysis and optimization of gas transportation networks. The project investigates nonlinear flow and network design problems under stochastic uncertainties. The main approach to tackle these problems is to approximate the nonlinearities through piecewise linear functions. These can then be tackled using standard mixed integer programming tools. The problems we obtain this way are extremely challenging to solve with the tools available today, so the development of new techniques is required.

Partner: Martin Grötschel (Zuse Institute Berlin), Armin Fügenschuh (Zuse Institute Berlin), Thorsten Koch (Zuse Institute Berlin), René Hernion (Weierstrass Institute for Applied Analysis and Stochastics), Werner Römisch (Humboldt Universität Berlin), Marc Pfetsch (TU Braunschweig), Marc Steinbach (Universität Hannover), Rüdiger Schultz (Universität Duisburg-Essen), E.ON Gastransport GmbH

Contact: Alexander Martin, Björn Geißler, Christine Hayn, Antonio Morsi, Lars Schewe.

Project: LOEWE-AdRIA – Adaptronik-Research, Innovation, Application

The research group optimization is part of the new LOEWE-center AdRIA, which is funded through the LOEWE-program of the state government of Hesse. Its goal is to make progress in the development and design of adaptronic systems, i.e., to build optimized integrated autonomous structural systems that adapt to changing surroundings. One of the main application areas is vibration damping in cars and buildings. The research group optimization is engaged in developing new algorithms for various subproblems of the design and production of adaptronic components:

- Placement of actuators and sensors on mechanical structures
- Optimal online control for vibration control
- Placement and routing of printed electronics on sheet metal subject to manufacturing restrictions

Partner: Fraunhofer LBF; various groups at TU Darmstadt from the departments of Mechanical Engineering, Materials Science, Electrical Engineering, and Computer Science; Hochschule Darmstadt

Contact: Alexander Martin, Stefan Ulbrich, Franziska Plehn, Lars Schewe.

Project: Edge-Graph Diameter Bounds for Convex Polytopes with few Facets

Bounding the diameter of the edge-graph of a polytope is an old problem in convex geometry. Even for small dimensions not much is known about exact upper bounds. We could show that the so-called d-step conjecture holds also in the case $d = 6$ – it was known up to dimension 5 before. This implies that for all d-dimensional polytopes with at most $d + 6$ facets that the diameter of the edge-graph is bounded by 6 as predicted by the Hirsch conjecture.

Partner: David Bremner

Contact: Lars Schewe

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[1] D. Bremner and L. Schewe. Edge-graph diameter bounds for convex polytopes with few facets. Technical report, 2008. `arXiv:0809.0915`.

Project: Point-Line-Configurations

The study of point-line-configurations is a classical topic in discrete geometry. We studied configurations (n_4), i.e. n points and n lines in the plane such that each point lies on 4 of the lines and each line goes through 4 of the points. It was an open question whether there exists such a configuration for $n < 20$. We could answer the question in the negative for $n \leq 17$ and find a geometric configuration (18_4).

Partner: Branko Grünbaum

Contact: Jürgen Bokowski, Lars Schewe

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[2] J. Bokowski and L. Schewe. On the finite set of missing configurations (n_4). 2009. in preparation.

Project: Nonrealizability of polyhedral surfaces

The question whether certain combinatorial surfaces can be realized as polyhedral surfaces is difficult to decide. This holds even for the case of relatively small vertex numbers and genera. Using oriented matroids we could reformulate instances of this problem as satisfiability problems. We could show this way to no polyhedral realization of a combinatorial surface of genus 6 with 12 vertices can exist in $\mathbb{R}^3$

Contact: Lars Schewe

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Project: Solving discrete-continuous nonlinear optimal control problems with linear mixed-integer programming techniques

We investigate optimal control problems on networks which we try to tackle using mixed-integer programming techniques. Part of the research was carried out during a three months stay at the Hausdorff Research Institute for Mathematics in Bonn.

Partner: Martin Frank (TU Kaiserslautern), Armin Fügenschuh (ZIB), Michael Herty (RWTH Aachen)

Contact: Lars Schewe.

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Project: Layout and Process Optimization in Recovered Paper Production

Recovered paper nowardays is the most important resource in the paper production. Before waste paper can be used to produce new paper from it, it has to be prepared in various steps. First, it is freed from larger contaminations, then it is resolved in water, the so-called pulp. This suspension then has to be cleaned in several steps. One such cleaning process is the so-called fine screening aiming to free the pulp from tacky particles called stickies. In industry this process is performed by multi-stage screening systems consisting of three up to six fine screens. The process within each screen can be described mathematically by a nonlinear function of the process parameter that can be set at each machine separately. There are various possibilities for interconnecting the single screens to multi-stage screening systems. The aim of this project is to simultaneously optimize the layout and setting of such a multi-stage screening system. The separation process itself can be described by nonconvex functions. Including the layout decision then results in a mixed-integer nonlinear problem (MINLP). We solve the model using piecewise linear approximations of the nonlinear functions and compare the so obtained results with the output of (mixed-integer) nonlinear solvers.

Partner: Dr. Armin Fügenschuh, ZIB Berlin; Prof. Dr.-Ing. S. Schabel, Dipl.-Ing. K. Villforth, PMV TU Darmstadt

Contact: Christine Hayn, Alexander Martin.

Support: partially supported by Graduate School GSC 233: “Computational Engineering”.

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.
To this end we use simulation-based optimization of geometry, topology and the placement of piezoelectric actuators, whereat we want to apply and extend modern robust optimization techniques. In particular we choose a worst-case approach to incorporate the presence of uncertainty into our optimization model. This generally leads to a computationally intractable problem formulation since we consider nonlinear, nonconvex objective functions and complex PDE constraints. Thus to find suitable approximations and to develop efficient solution algorithms for these approximations is the main task in the first phase of this project.

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, S. Drewes, A. Sichau

Project: Balancing of Axle-elastic Rotors

Dynamic balancing of rotors is important in applications like noise minimization of turbo chargers in automotive industry, or in wheel balancing of large-scale (electric) generators. However, this problem is not solved to complete satisfaction up to date. A particular difficulty lies in the fact that the equation systems modelling dynamic balancing are overdetermined, due to modern measurement technology and data acquisition as employed by Schenck RoTec GmbH. Additional complications arise from restrictions on the maximum balancing mass, specification of the range of speeds and/or tolerance limits. Moreover, for some applications a certain minimal unbalance is explicitly wanted while on the other hand the unbalance should not exceed a given tolerance, which leads to highly nonconvex optimization problems.
The purpose of this project is to develop algorithms for solving the dynamic balancing problem. To this end, we make use of second order cone programming techniques and combine it for nonconvex problems with Branch & Bound algorithms.

Partner: Schenck RoTec GmbH

Contact: Stefan Ulbrich, Alexander Martin.

Project: Optimal Design of Dispersed Generation Systems

The increasing utilization of dispersed generation systems requires the planning of adapted supply networks, considering multiple energy carriers simultaneously.

Due to the interaction between different energy carriers such as electricity, natural gas, and local heat, a coupled optimization of the network design is reasonable. This interaction arises because of conversions from one energy carrier to another, which appear for example in dispersed combined heat and power plants. In this project, we consider a network of one public supplier and several consumers, which can be connected to a dispersed combined heat and power plant, a gas furnace, or a heat exchanger. The consumers' demand can be satisfied by the public supply network as well as by the dispersed energy conversion units. The problem of the optimal network planning consists of determining the topological design on the one hand and the dimensioning of the components used on the other hand. Hence, for each section of the network the decision of laying and dimensioning an electric cable, a gas pipe, or a heat pipe has to be made. In order to meet the consumers' demand, line losses occurring within each energy carrier system have to be taken into account. Due to the decisions within the network design and the consideration of the physical characteristics involved, this problem leads to a complex nonlinear mixed integer program.

Support: Federal Ministry of Education and Research (BMBF)

Partner: R. Schultz, C. Weber (Universität Duisburg-Essen), E. Handschin (Universität Dortmund), H.-J. Wagner (Universität Bochum), W. Römisch (Humboldt-Universität Berlin), M. Lucht (Fraunhofer Institute UMSICHT)

Contact: Debora Mahlke, Alexander Martin, Andrea Zelmer.

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[2] E. Handschin, D. Mahlke, A. Martin, D. Waniek, and A. Zelmer. Gekoppelte optimale Auslegung von Strom-, Gas- und Wärmenetzen. In *VDIBerichte 2018, Optimierung in der Energiewirtschaft*, pages 133–145, 2007.

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Project: 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 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. We combine in a modular way modern space-time adaptive multilevel finite elements 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.
From the optimization part, we have developed two classes of adaptive multilevel trust-region SQP-methods for the efficient solution of optimization problems governed by nonlinear elliptic, parabolic partial differential equations or nonlinear PDAEs. In both algorithms we start with a coarse discretization of the underlying optimization problem and combine an efficient trust-region SQP-method with an implementable adaptive refinement strategy for the current discretization based on a posteriori error estimators such that the infinite dimensional problem is sufficiently well represented in each iteration to ensure progress towards the optimal solution of the original infinite dimensional problem. These algorithms are designed such that most optimization iterations are carried out on coarse meshes. Hence, a substantial save of computational time can be accomplished. Moreover, the accuracy of the optimization result is controlled by a posteriori error estimators while the mesh adaptation is tailored to the needs of the optimization method. This offers the possibility to obtain optimization results of high accuracy by an effort of a few simulation runs. Convergence of these two algorithms was proven.

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

Support: S. Ulbrich supported by SPP1253, German Research Foundation (DFG).

Contact: S. Ulbrich, C. Ziems.

References

[1] J. C. Ziems and S. Ulbrich. Adaptive Multilevel Inexact SQP-Methods for PDE-constrained Optimization. Preprint, TU Darmstadt, accepted for publication in SIOPT pending on revision, 2008.

2.1.8 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 and complexity theory. Furthermore, we study Monte Carlo methods for financial engineering, high-dimensional integration 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, signal processing, partial differential equations, numerical analysis, and information-based complexity. Furthermore, we are carrying out a number of research projects in applied stochastics with well-known industrial partners.

Project: Estimation of a regression function by maxima of minima of linear functions

In this project estimation of a regression function from independent and identically distributed random variables is considered. Various estimates are defined by minimization of the empirical L_2 risk over a class of functions, which are defined as maxima of minima of linear functions. The first estimate is the standard least squares estimate with complexity of the function space chosen by splitting of the sample. For the second estimate, boosting is used to fit a linear combination of maxima of minima of linear functions to the sample. Results concerning consistency and the rate of convergence of the estimates are derived. In particular it is shown that for smooth regression functions satisfying the assumption of single index models, the estimate is able to achieve (up to some logarithmic factor) the corresponding optimal one-dimensional rate of convergence. Hence under these assumptions the estimate is able to circumvent the so-called curse of dimensionality. An optimization algorithm has been developed which is able to compute the least squares estimate approximately. Using this algorithm in order to compute the estimates, the small sample behaviour of the estimates is illustrated by applying them to simulated data.

Partner: A. Bagirov (University of Ballarat, Australia), C. Clausen (Universität des Saarlandes).

Contact: Michael Kohler.

References

[1] A. Bagirov, C. Clausen, and M. Kohler. An $L2$-boosting algorithm for estimation of a regression function. Preprint, TU Darmstadt, 2008.

[2] A. Bagirov, C. Clausen, and M. Kohler. An algorithm for the estimation of a regression function by continuous piecewise linear functions. *Computational Optimization and Applications*, 2009. To appear.

[3] A. Bagirov, C. Clausen, and M. Kohler. Estimation of a regression function by maxima of minima of linear functions. *IEEE Transactions on Information Theory*, 55:833–845, 2009.

Project: Regression based Monte Carlo methods for pricing of 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 least squares splines regression estimates, least squares neural networks regression estimates and smoothing spline regression estimates to estimate from this data the so-called continuation values, which are defined as mean values of the American options for given values of the underlyings at time t subject to the constraint that the options are not exercised at time t. Without any constraint on the structure of the underlying Markov process or on the underlying continuation values we show that the newly defined estimates are consistent. Furthermore, we analyze the rate of convergence of the estimates. In case of least squares and smoothing spline estimates we show that the estimates of the continuation

values achieve up to a logarithmic factor the usual optimal rate of convergence for (p, C)–smooth continuation values. For neural network estimates we derive under an assumption on the Fourier transform of the continuation values a rate of convergence, which does not depend on the number of underlying assets. Results with simulated data show that the newly proposed nonparametric estimates are superior to traditional estimates based on parametric regression.

Partner: D. Egloff (Züricher Kantonalsbank), A. Krzyżak (Concordia University, Montreal).

Contact: Michael Kohler.

References

[1] D. Egloff, M. Kohler, and N. Todorovic. A dynamic look-ahead Monte Carlo algorithm for pricing American options. *Annals of Applied Probability*, 17:1138–1171, 2007.

[2] M. Kohler. A regression based smoothing spline Monte Carlo algorithm for pricing American options. *AStA Advances in Statistical Analysis*, 92:153–178, 2008.

[3] M. Kohler, A. Krzyżak, and N. Todorovic. Pricing of high-dimensional American options by neural networks. *Mathematical Finance*, 2009. To appear.

Project: Upper bounds for Bermudan options

In this project we derive upper bounds on the price of Bermudan options. To do this, we use the dual approach, where the maximal difference between the payoff and a martingale is minimized. We use techniques from nonparametric regression to estimate so-called continuation values, and nested Monte Carlo to compute the optimal martingale approximately. Furthermore, we combine the resulting estimate with another estimate computed by using only a reduced number of nested Monte Carlo steps. The expectations of the resulting estimates are upper bounds on the option price. We show that the resulting upper bounds on the option price tend to the true price regardless of the structure of the continuation values. Furthermore we illustrate by simulated data that in this context nonparametric regression leads to better bounds than linear regression.

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

Contact: Michael Kohler.

References

[1] M. Kohler. Universally consistent upper bounds for Bermudan options based on Monte Carlo and nonparametric regression. Preprint, TU Darmstadt, 2008.

[2] M. Kohler, A. Krzyzak, and H. Walk. Upper bounds for Bermudan options on Markovian data using nonparametric regression and a reduced number of nested Monte Carlo steps. *Statistics and Decision*, 2009. To appear.

Project: Textbook on Statistics

Based on numerous courses held at the Universities of Stuttgart, Jena, Saarbrücken and Darmstadt we develop an introductory textbook on Statistics. The book, which is written in German, will be useful for students studying in the second year mathematics or in the first year any subject with relation to Statistics (like Psychology or Biology) at German universities. It gives a systematic introduction into Statistics and its applications. Topics include: controlled experiment and oberservational studies, descriptive statistics, introduction to probability theory and basic concepts of mathematical statistics.

Partner: Springer (Heidelberg)

Contact: Michael Kohler.

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[1] J. Eckle-Kohler and M. Kohler. *Eine Einführung in die Statistik und ihre Anwendungen*. pages 265. Springer, 2009. To appear.

Project: Optimal Approximation of Stochastic Evolution Equations

We study algorithms for approximation of stochastic evolution equations. The latter are used, e.g., for modelling population dynamics, kinetics of chemical reactions, and interest rate dynamics in mathematical finance, and they may be considered as infinite-dimensional counterparts to systems of ordinary stochastic differential equations. We wish to determine algorithms that optimally related error and cost. In order to establish optimality, lower bounds, i.e., the following kind of results are needed: the error of any algorithm with computational cost at most N is at least $e(N)$. Here $e(N)$ does not depend on the specific algorithm but only on the evolution equation under consideration. The use of non-uniform time discretizations is crucial for construction of almost optimal algorithms, i.e., for algorithms with cost at most N and error close to $e(N)$. The asymptotic analysis is supplemented by simulation experiments.

Partner: Prof. Dr. Thomas Müller-Gronbach, Uni Passau

Support: German Research Foundation

Contact: Klaus Ritter.

Project: Constructive Quantization and Multilevel Algorithms for Quadrature of Stochastic Differential Equations

Different views on quadrature problems for SDEs lead to rather different algorithmic approaches, e.g., PDE methods based on the Fokker-Planck equation, deterministic or randomized high-dimensional numerical integration for explicitly solvable SDEs, and Monte Carlo simulation of SDEs. In this project we employ the concept of approximation of probability distributions as the basis for quadrature of SDEs, both, for constructing new deterministic and randomized algorithms, as well as or establishing optimality results. Our work programme consists of the following three packages: (A) Constructive Quantization of SDEs, (B) Quantization and Random Sampling of Multiple Itô Integrals, (C) Nonlinear Approximation for Lévy-driven SDEs. In (A) we will use quantization to construct quadrature formulas for SDEs. We do not only analyze the quantization error (quadrature error), but we also study the computational cost for

construction of almost optimal quantizations (quadrature formulas). This issue is particularly relevant in the context of SDEs, since here the distributions are only given implicitly. In (B) quantization will be studied for multiple Itô integrals. We intend to build up data bases via quantization and to develop randomization techniques that offer a new way to efficiently use higher-order Itô Taylor schemes in multilevel Monte Carlo methods for quadrature of SDEs. In (C) we will use nonlinear approximations for Lévy processes and scalar SDEs driven by it, to develop efficient multilevel Monte Carlo methods for quadrature of Lévy-driven SDEs.

Partner: Jun.-Prof. Dr. Jakob Creutzig, TU Darmstadt, PD Dr. Steffen Dereich, TU Berlin, Prof. Dr. Thomas Müller-Gronbach, Uni Passau, Prof. Dr. Michael Scheutzow, TU Berlin

Support: German Research Foundation (DFG) Priority Programme 1324

Contact: Felix Heidenreich, Klaus Ritter.

Project: Adaptive Wavelet Methods for Stochastic Partial Differential Equations

This project is concerned with the numerical treatment of complex stochastic dynamical systems which are described by stochastic partial differential equations of parabolic type on piecewise smooth domains. These equations are driven by a (cylindrical) Wiener process W and may be interpreted as abstract Cauchy problems in a suitable function space. We study the pathwise approximation of the solution process, and the aim of our joint research project of numerical analysts and probabilists is to derive a fully adaptive numerical scheme in time and space. By using a variant of the Rothe method, we intend to use a semi-implicit time discretization scheme involving a suitable step-size control. Then, in each time step, an elliptic subproblem has to be solved. To this end, suitable variants of recently developed adaptive wavelet/frame schemes will be employed. Moreover, alternative noise representations based on biorthogonal wavelet or bi-frame wavelet expansions will be derived. We intend to establish the optimal convergence of the scheme, and we also want to ensure that adaptivity really pays for these problems. Therefore our investigations will be accompanied by regularity estimates for the exact solutions in specific scales of Besov spaces. Another central goal is the implementation and testing of the resulting algorithms. This part will be based on the Marburg software library.

Partner: Prof. Dr. Stephan Dahlke, Uni Marburg, Prof. Dr. René Schilling, TU Dresden

Support: German Research Foundation (DFG) Priority Programme 1324

Contact: Klaus Ritter, Tiange Xu.

Project: Sales Forecasting for Food Retailers

Automated supply of food retailers has been implemented by REWE, the leading German company for food retailing and wholesaling, already 10 years ago. Meanwhile sales forecasting is based on the daily sales data of every single item in every single store, which is automatically provided by the tills. For a single store the number of transferred daily sales data lies in the range of several thousands. Consequently, there is a strong need for forecasting methods that are able to simultaneously processing large groups of items in reasonable time with

satisfactory results. In the second period of the project, particular emphasis is given to the impact of the weather history and forecast.

Partner: REWE-Informationssysteme GmbH, Roßbach v.d.H

Contact: Klaus Ritter.

Project: Estimation of Vehicle-Pedestrian Collision Risk

We determine the collision risk between a vehicle and a pedestrian in simple traffic scenarios over short periods of time. The underlying stochastic model is based on a deterministic model, which has been developed by Continental Safety Engineering and which describes a pedestrians ability to move in a physically meaningful and experimentally verified way. Our new approach permits to determined the time-dependence of the collision risk via stochastic simulation and to take into account the uncertainty in sensor-based position measurements.

Partner: Continental Safety Engineering GmbH, Alzenau

Contact: Daniel Henkel, Klaus Ritter.

Project: Forecast-Algorithms for Replenishment of Large Systems of Cash Points

Partner: Wincor-Noxdorf International GmbH, Neu-Isenburg

Contact: Klaus Ritter.

Project: Statistical Modelling and Analysis of Pharmaceutical Production Processes

We develop a model for a multi-stage pharmaceutical production process, aiming at a control of quality parameters and taking into account regulatory approaches under Process Analytical Technology (PAT). Our work includes statistical modelling and analysis as well as stochastic simulation.

Partner: Merck KGaA, Darmstadt

Contact: Yulia Mordashova, Klaus Ritter.

Project: Stability and sensitivity in Bayesian estimation

Estimating a signal X, observed through a noisy observation $Y = G(X, e)$, is a basic statistical problem. The mean $\hat{X} = \int x\, \mu^Y(dx)$ of the posterior distribution $\mu^Y(A) = P[\, X \in A | Y\,]$ provides the optimal estimate for X in the L^2-sense. The stability properties of $\hat{X}$, and more general of the posterior distribution μ^Y, w.r.t. the prior distribution of X, as well as its sensitivity w.r.t. the coefficients of the problem, are crucial for the correctness and efficiency of numerical algorithms, e.g. Sequential Markov Chain Monte Carlo methods (SMCMC), approximating the posterior. Techniques from Stochastic Analysis, in particular functional inequalities, have recently been applied to understand this dependence in the context of stochastic filtering of a signal observed within additive noise in both, discrete and continuous time, including explicit quantitative estimates. One goal of this project is to extend these methods to signals observed with multiplicative noise (which could then be applied to stochastic volatility models). A second goal is to obtain a simplified description of the asymptotic fluctuations of SMCMC approximating the posterior which is important to understand their efficiency.

Partner: D. Crisan (Imperial College, London), A. Eberle (U Bonn).

Contact: Wilhelm Stannat.

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[2] W. Stannat. On the convergence of genetic algorithms - a variational approach. *Probab. Theory Relat. Fields*, 129:113–132, 2004.

[3] W. Stannat. On the stability of feynman-kac propagators. In R. D. et al., editor, *Seminar on Stochastic Analysis, Random Fields and Applications V, May 2005*, pages 345–362. Birkhäuser, 2007.

[4] W. Stannat. Stability of the optimal filter for nonergodic signals - a variational approach. Preprint, TU Darmstadt, 2008.

Project: L^p-Analysis of stochastic partial differential equations

Stochastic partial differential equations (SPDE) are used in various fields of mathematics, the natural sciences and engineering to model large size stochastic dynamical systems with complex interactions. The recent development of the theory was very successful, however, many interesting applications, e.g. to stochastic equations in fluid dynamics, are still out of its scope. Within this project we follow a new approach proposed by Da Prato and Röckner to study these equations via the associated Kolmogorov operator. Particular emphasize is put on

- existence, uniqueness and further properties of invariant measures
- existence and uniqueness of (stationary) martingale solutions
- functional inequalities for the Kolmogorov operator (e.g. Poincaré- and logarithmic Sobolev inequalities).

In joint work with V.I.Bogachev, G. Da Prato and M. Röckner almost optimal results on the uniqueness of invariant measures are obtained in the finite dimensional case, including explicit counterexamples. Recent progress concerning the analogues for the parabolic case can be found in [ref1]. In joint work with A. Es-Sarhir almost optimal conditions for the existence of invariant measures of semilinear spde with local Lipschitz drift coefficients are obtained, as well as a priori moment estimates. A major goal for the near future will be to extend these results to spde arising in fluid dynamics (also partly within the IRTG 1529 on mathematical fluid dynamics) and to SPDE with multiplicative noise.

Partner: V.I. Bogachev (Moscow State University), G. Da Prato (SNS Pisa), A. Es-Sarhir (TU Berlin), M. von Renesse (TU Berlin), M. Röckner (U Bielefeld)

Contact: Wilhelm Stannat.

References

[1] V. Bogachev, G. D. Prato, M. Röckner, and W. Stannat. Uniqueness of solutions to weak parabolic equations for measures. *Bull. London Math. Soc.*, 39:631–640, 2007.

[2] M. Döring and W. Stannat. The logarithmic sobolev inequality for the wasserstein diffusion. *Probab. Theory Relat. Fields*, 145:189–209, 2009.

[3] A. Es-Sarhir and W. Stannat. Invariant measures for semilinear spde's with local lipschitz drift coefficients and applications. *Journal of Evolution Equations*, 8:129–154, 2008.

[4] A. Es-Sarhir and W. Stannat. Maximal dissipativity of kolmogorov operators with cahn-hilliard type drift term. *Journal of Differential Equations*, 247:424–446, 2009.

[5] W. Stannat. A new a priori estimate for the kolmogorov operator of a 2d-stochastic navier-stokes equation. *Infin. Dimens. Anal. Quantum Probab. Relat. Top.*, 10:483–497, 2007.

[6] W. Stannat. Functional inequalities for the wasserstein dirichlet form. Preprint, TU Darmstadt, 2008.

2.2 Memberships in Scientific Boards and Committees

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

Michael Joswig

- Scientific Advisory Board: "Oberwolfach References on Mathematical Software"
- Member of the Programme Committee: "Symposium on Computational Geometry," 2007, College Park, MD, U.S.A.

Ulrich Kohlenbach

- President of "Deutsche Vereinigung für Mathematische Logik und für Grundlagen der Exakten Wissenschaften(DVMLG)", since 2008
- Corresponding member of "Wissenschaftliche Gesellschaft an der J.W.Goethe-Universität zu Frankfurt am Main", since 2008
- Speaker of "DMV-Fachgruppe Logik", since 2009
- External member of two evaluation committees for full professorships in computer science at Aarhus University, Aarhus, Denmark, 2008

Jens Lang

- Member of board of directors of the research centre Computational Engineering, TU Darmstadt, 2004 -

- Member of board of deans of the German Research Foundation (DFG) Graduate School of Excellence, TU Darmstadt, 2008 -

- Member of the DFG (German Research Foundation) Cluster of Excellence Smart Interfaces: Understanding and Designing Fluid Boundaries, TU Darmstadt, 2008 -

Alexander Martin

- Member of the advisory board of the "Gesellschaft für Operations Research (GOR)", 2004 - today.

- Web Editor of Mathematical Programming Society (MPS), 2001 - 2007.

- Honory appointment to the BMBF advisory board "Mathematics", 2007 - 2010.

Karl-Hermann Neeb

- Member of the Scientific Board of "Workshop on Infinite-Dimensional Lie Groups and Related Functional Analysis", Paderborn, November 2008

- Member of the Steering Committee of the "Schwerpunktprogramm Darstellungstheorie" of the German Research Foundation (DFG)

Steffen Roch

- AMS

- Auswahlausschuß Bundeswettbewerb Mathematik

Stefan Ulbrich

- Member of the IFIP Technical Committee TC 7, WG 7.2 "Computational Techniques in Distributed Systems", 2003 -

- Member of GAMM Activity Group "Optimization with PDE constraints", 2008 -

2.3 Awards and Offers

Awards

Stefan Bundfuss, Best Student Paper Award at FRICO 2007

Birgit Debrabant, First poster price of the congress " Medicine and Mobility 2007" of the German Society of Aerospace Medicine

Kristian Debrabant, First poster price of the congress "Medicine and Mobility 2007" of the German Society of Aerospace Medicine

Karl Heinrich Hofmann, Prize for Excellence in Teaching of the Association of Friends of the TU Darmstadt, 2007

Ulrich Kohlenbach, Elected as Corresponding Member of the "Wissenschaftliche Gesellschaft an der J.W.Goethe-Universität zu Frankfurt am Main", 19.07.08

Laurenţiu Leuştean, 16.10.08-13.02.09 Oberwolfach Leibniz Fellowship, Mathematisches Forschungsinstitut Oberwolfach, Germany.

Alexander Martin, Honory appointment to the BMBF advisory board "Mathematics", 2007 - 2010.

Alexander Martin, Third Prize of the "Hessischen Kooperationspreis 2007" for a very innovative and successful cooperation between Hessian companies and universities.

Klaus Ritter, Information-based Complexity Award 2007

Andreas Rößler, The Carl-Erik Fröberg Prize 2008 for Young BIT Authors

Offers of Appointments

Matthias Hieber, Professorship (W3) for Analysis, TU Berlin, 2008

3 Teaching and Learning

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

3.1 Study Programs 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 new 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	2001	2002	2003	2004	2005	2006	2007	2008
Diplom incl. MCS	926	1031	1180	791	750	755	571	443
Bachelor		100	182	221	230	207	264	363
Master					1	7	16	25
Teacher	155	183	229	187	213	233	267	297

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	2001	2002	2003	2004	2005	2006	2007	2008
Diplom incl. MCS	476	357	441	230	183	194	74	
Bachelor		100	117	95	54	31	114	167
Master					1	6	11	18
Teacher	30	33	71	81	50	59	80	80

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

New students - attended

Program	2001	2002	2003	2004	2005	2006	2007	2008
Diplom incl. MCS	196	121	140	133	124	156		
Bachelor		94	101	80	40	33	140	154
Teacher	25	27	45	48	48	48	74	73

With the start of the Masters program in mathematics, accredited and started in the year 2005, and with the new 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 new 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.
The Bachelors program has a duration of 6 semesters and finishes with a Bachelor thesis on a mathematical topic. 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 semester. 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

Program	2001	2002	2003	2004	2005	2006	2007	2008
Diplom	29	28	30	42	34	47	56	64
Diplom MCS			2	3	11	13 15	14	
Bachelor MCS	2	8	4	11	28	11	17	31

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.

Median of study times in semesters

Program	2001	2002	2003	2004	2005	2006	2007	2008
Diplom	11,59	11,29	12,3	11,52	12,07	10,15	10,24	9,78
Diplom MCS			7,95	7,46	9	10,38	8,8	9,78
Bachelor MCS							10,72	8,5

3.2 Service Teaching

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.

Students in Service Courses 2007	
Architecture	143
Biology	86
Chemistry	106
Civil Engineering	417
Computer Science	950
Electrical Engineering	360
Industrial Engineering	960
Material Sciences	120
Mechanical Engineering	940
Physics	470
Psychology	80
Social Science	140

3.3 Characteristics in Teaching

The efforts of the department of mathematics was 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."
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 and tutorial groups. The ratio between lecture time and tutorial time is 1:1 during the first year and 2:1 in later on.
In exercise groups students work on problems and topics from the lecture with the support of a tutor. 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.
The tutorial groups are a special form of exercises that in the first year. 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.
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.
A new element introduced in 2005 is that students are encouraged to do small presentation of solutions to homework problems in their exercise group. This

way students get used to presenting mathematical material to others and they can extends and improve their communicational skill.
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
- five rooms with about 50 places for individual learning and meetings in learning groups open to all students
- closed student rooms with about 60 places for students 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 four computer labs with a total of 33 Linux machines and 12 Windows 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 teachings. We got about 100000€ external funds for E-Learning projects. In 2007 Regina Bruder got the Best E-Teaching Award of the TU Darmstadt. She is the reference person for E-Learning in our department and she is a member of the post graduate programme "E-Learning" (since 2006) 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 well known in all departments of our university and is used for about 150 lectures in the last two years. The labeling project was concerned with the development of a criteria catalogue for the evaluation of the quality of learning software, CBT and WBT (see `http://www.tud-guetesiegel.de`). For a systematic review of the state of the art in mathematics learning software, a list of quality criteria was developed and applied

to a number of selected software products. This catalogue was also used for a review of new training tools by LUFTHANSA.
In connection with the project VEMA (cooperation between TU Darmstadt (Bruder, Nickel, Kuhnke-Lerch) and University of Kassel (Biehler, Kroepf)) some new E-Learning-elements for the bridgecourse for beginners in the MCS-study path and for teacher students were developed (`http://www.vemada.de`).
The use of blended-learning concepts is an important trend in further training for teachers. Based on the results of research projectsnew online programmes for further education were developed for the learning platform "MOODLE" (`http://www.prolehre.de`): A half-year-course "Modeling" and a half-year-course "Computer based learning Mathematics". The four blended learning courses were carried out in the last four semesters with about 200 participants in total.
For additional support,

`http://www.madaba.de` a data base for exercises with about 300 new tasks and

`http://www.problemloesenlernen.de` a platform for materials
were developed.

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 for presenting digital content. Eight lecture courses got the "Label E-Learning" (`http://www.elc.tu-darmstadt.de/`).
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/`.

3.5 Student Body of the Department

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 freshers, 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.
But to tell the truth, 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 did help to convey an impression of our work.

4 Publications

4.1 Co-Editors of Publications

4.1.1 Editors of Journals

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)

Regina Bruder

- *Mathematik lehren* (Associate Editor)

Reinhard Farwig

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

Reinhard Farwig

- *UnifePress, Matematica* (Comitato Scientifico)

Matthias Hieber

- *Journal of Mathematical Fluid Mechanics* (Associate Editor)

Karl Heinrich Hofmann

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

Michael Joswig

- *Electronic Geometry Models* (Managing Editor)

Klaus Keimel

- *Beiträge zur Algebra und Geometrie (Contributions to Algebra and Geometry)* (Editorial Board)
- *Semantic Structures in Computation* (Editorial Board)
- *ORDER* (Associate Editor)

Ulrich Kohlenbach

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

Jens Lang

- *Applied Numerical Mathematics* (Editor)

Alexander Martin

- *Mathematical Methods of Operations Research (MMOR)* (Managing Editor)
- *Operations Research Letters (ORL)* (Area Editor)
- *Optimization Methods and Software (OMS)* (Associate Editor)
- *Discrete Optimization* (Associate Editor)
- *Mathematical Programming C* (Associate Editor)
- *Optimization Online* (Area Coordinator)

Karl-Hermann Neeb

- *Journal of Lie Theory* (Managing Editor; this journal is produced in Darmstadt)
- *Forum Mathematicum* (Editor)

Martin Otto

- *The Bulletin of Symbolic Logic* (Editor)

Ulrich Reif

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

Klaus Ritter

- *Journal of Complexity* (Associate Editor)

Peter Spellucci

- *Computational Optimization and Applications* (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

Klaus Keimel

- *Proceedings of the Joint Workshop Domains VIII and Computability over Continuous Data Types, Annals of Pure and Applied Logic vol. 159, no. 3 (2009)* (jointly with Y. Ershov, K. Keimel, U. Kohlenbach, A. Morozov)

Ulrich Kohlenbach

- *Joint Workshop Domains VIII - Computability over Continuous Data Types, Novosibirsk, September 11-15, 2007. Volume 159, issue 3 of Annals of Pure and Applied Logic 2009, pp. 249-356* (jointly with (jointly with Yu. L. Ershov, K. Keimel and A. Morozov))
- *Proceedings Proceegings of the ASL Logic Colloquium 2007, Wroclaw. July 14-19, 2007, ASL, Cambridge University Press, to appear* (jointly with (jointly with F. Delon, P. Maddy, F. Stephan))
- *Report on Oberwolfach Conference on "Mathematical Logic: Proof Theory, Constructive Mathematics", April 6-12, 2008. In: Oberwolfach Reports vol. 5, pp. 907-952* (jointly with (jointly with S. Buss and H. Schwichtenberg))

4.1.3 Editors of a Festschrift

Matthias Hieber

- *The Günter Lumer volume, Functional analysis and evolution equations* (jointly with Amann, Herbert and Arendt, Wolfgang and Hieber, Matthias and Neubrander, Frank and Nicaise, Serge and von Below, Joachim)

4.2 Monographs and Books

[1] J. Borwein and K. Devlin; Illustrator: Karl H. Hofmann. *The Computer as Crucible - An Introduction to Experimental Mathematics*. pages xi+158. A K Peters Ltd, Natick, Massachusetts, USA, 2009.

[2] R. Bruder, A. Büchter, and T. Leuders. *Mathematikunterricht entwickeln. Bausteine für kompetenzorientiertes Unterrichten*. Cornelsen Scriptor, 2008.

[3] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht. Band 1: Methodische und Didaktische Handreichung: Problemlösen lernen - Längen, Flächen- und Rauminhalte, Terme und Termumformungen - Einführung mit dem Taschencomputer (TC) - Kopfübungen- Basiswissen*. Texas Instruments, 2007.

[4] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht. Band 1 und Band 2: Arbeitsmaterialien für Schülerinnen und Schüler: Problemlösen lernen - Längen, Flächen- und Rauminhalte, Terme und Termumformungen - Einführung mit dem Taschencomputer (TC) - Kopfübungen- Basiswissen. Sek I*. Texas Instruments, 2007.

[5] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht. Arbeitsmaterialien für Schülerinnen und Schüler: Lineare Zusammenhänge, TC-Hilfen, Kopfübungen- Basiswissen. Sek I, Band 3.* Texas Instruments, 2008.

[6] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht. Band 3 and Band 4: Arbeitsmaterialien für Schülerinnen und Schüler: Entdeckungen an Dreiecken und Vierecken - Mehrstufige Zufallsexperimente - Einführung mit dem Taschencomputer (TC) - Kopfübungen- Basiswissen.* Texas Instruments, 2008.

[7] R. Bruder and W. Weiskirch. *CAliMERO - Computer-Algebra im Mathematikunterricht: Entdecken, Rechnen, organisieren. Arbeitsmaterialien für Schülerinnen und Schüler, Band 4.* Texas Instruments, 2008.

[8] J. H. Bruinier, G. van der Geer, G. Harder, and D. Zagier. *The 1-2-3 of Modular Forms.* pages 266. Springer, 2008.

[9] J. Eckle-Kohler and M. Kohler. *Eine Einführung in die Statistik und ihre Anwendungen.* pages 265. Springer, 2009. To appear.

[10] K. Hathout; Illustrator: Karl H. Hofmann. *Crimes and Mathdemeanors.* pages ix+197. A K Peters Ltd, Natick, Massachusetts, USA, 2007.

[11] M. Hinze, R. Pinnau, M. Ulbrich, and S. Ulbrich. *Optimization with PDE constraints.* pages 270. Mathematical Modelling: Theory and Applications 23. Dordrecht: Springer., 2008.

[12] K. H. Hofmann and S. A. Morris. *The Lie Theory of Connected Pro-Lie Groups - A Structure Theory for Pro-Lie Algebras, Pro-Lie Groups and Connected Locally Compact Groups.* pages xvii+678. EMS Publishing House, Zürich, 2007.

[13] M. Joswig and T. Theobald. *Algorithmische Geometrie.* Vieweg, 2007.

[14] U. Kohlenbach. *Applied Proof Theory: Proof Interpretations and their Use in Mathematics.* pages xx+536. Springer Monographs in Mathematics. Springer, 2008.

[15] J. Peters and U. Reif. *Subdivision Surfaces.* volume 3 of *Geometry and Computing.* Springer, New York, 2008.

[16] S. Roch. *Finite sections of band-dominated operators.* pages 87. Memoirs AMS, Providence R.I., 2008.

4.3 Publications in Journals and Proceedings

4.3.1 Journals

[1] A. Abouqateb and K.-H. Neeb. Integration of locally exponential Lie algebras of vector fields. *Ann. Global Anal. Geom.*, 33(1):89–100, 2008.

[2] H.-D. Alber and K. Chelmiński. Quasi-static problems in viscoplasticity theory II: Models with nonlinear hardening. *Math. Models Meth. Appl. Sci.* (M^3AS), 17,2:189–213, 2007.

[3] H.-D. Alber, P. Neff, and K. Chelmiński. Notes on strain gradient plasticity: Finite strain covariant modelling and global existence in the infinitesimal rate–independent case. *Math. Models Meth. Appl. Sci.* (M^3AS), 19,2:307–346, 2009.

[4] H.-D. Alber and S. Nesenenko. Justification of homogenization in viscoplasticity: From convergence on two scales to an asymptotic solution in $L^2(\Omega)$. *Journal of Multiscale Modelling*, accepted for publication.

[5] H.-D. Alber and S. Nesenenko. Local H^1–regularity and $H^{1/3-\delta}$–regularity up to the boundary in time dependent viscoplasticity. *Asymptotic Analysis*, accepted for publication.

[6] H.-D. Alber and A. Ramm. Asymptotics of the solution to Robin problem. *J. Math. Anal. Appl.*, 349,1:156–164, 2009.

[7] H.-D. Alber and P. Zhu. Evolution of phase boundaries by configurational forces. *Arch. Rational Mech. Anal.*, 185,2:235–286, 2007.

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4.5 Reviewing and Refereeing

4.5.1 Reviewing Articles and Books

Regina Bruder Siemens Award 2008 for MINT-EC-schools

Bálint Farkas Mathematical Reviews

Reinhard Farwig Mathematical Reviews, Zentralblatt

Karsten Große-Brauckmann Mathematical Reviews

Michael Joswig Mathematical Reviews, Zentralblatt

Laurenţiu Leuştean Mathematical Reviews

Karl-Hermann Neeb Math. Reviews, Jahresbericht der DMV

Klaus Ritter Mathematical Reviews

Steffen Roch Mathematical Reviews

Andreas Rößler Mathematical Reviews

Wilhelm Stannat Mathematical Reviews

Fredrik Strömberg Zentralblatt

Stefan Ulbrich Mathematical Reviews

4.5.2 Refereeing for Journals, Proceedings, and Publishers

Benno van den Berg Applied Categorical Structures, Proceeding of the Logic Colloquium 2006, Logical Methods in Computer Science, Journal of Symbolic Logic, Logic and Analysis, Communications in Algebra

Achim Blumensath Journal of Symbolic Logic, Logical Methods in Computer Science, ACM Transactions on Computational Logic, Discrete Mathematics, Discrete Applied Mathematics, Information and Computation, Transactions on Database Systems, Fundamenta Informaticae, Theoretical Computer Science, Logic in Computer Science LICS, Computer Science Logic CSL, International Colloquium on Automata, Languages and Programming ICALP, Foundations of Software Technology and Theoretical Computer Science FSTTCS, Symposium on Theoretical Aspects of Computer Science STACS.

Jan H. Bruinier German Research Foundation (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, Math. Reviews, etc.

Kristian Debrabant SIAM Journal on Scientific Computing (SISC), Applied Numerical Mathematics (APNUM), Journal of Computational and Applied Mathematics (Journal CAM), Mathematics and Computers in Simulation (MATCOM), Numerical Algorithms, Annali dell'Università di Ferrara (ADUF)

Bálint Farkas Journal of Evolution Equations, Mathematische Nachrichten, Studia Mathematica Hungarica, Acta Mathematica Hungarica, Semigroup Forum, Journal of Mathematical Analysis and Applications

Reinhard Farwig Mathematische Zeitschrift, SIAM J. Mathematical Analysis, Mathematische Annalen, Nonlinear Analysis, Archiv der Mathematik, J. Mathematical Fluid Mechanics, Zeitschrift für Angewandte Mathematik und Mechanik, J. Differential Equations, J. Mathematical Analysis and Applications, Annali dell'Università di Ferrara, Mathematical Models and Methods in Applied Sciences, Journal of Functional Analysis, J. London Mathematical Society, Acta Applicandae Mathematicae, Czechoslovak Mathematical J., Banach Center Publications, Proceedings of Hermann Weyl Conference

Karsten Große-Brauckmann Mathematische Nachrichten, Mathematische Annalen, Experimental Mathematics, Manuscripta Mathematica

Karl H. Hofmann American Mathematical Monthly, Forum Mathematicum, General Topology and Applications, Journal of Group Theory, Journal of Lie Theory, Lecture Notes in Mathematics (Springer), Mathematische Nachrichten, Mathematische Zeitschrift, Topology Proceedings

Michael Joswig Discrete Mathematics, Proceedings MEGA 2007, Journal of Algebraic Combinatorics, Journal of Combinatorial Theory A, SIAM Journal Discrete Mathematics, Beiträge zur Algebra und Geometrie, Discrete and Computational Geometry, Jahresbericht der DMV, Experimental Mathematics, Proceedings ESA 2008, Topology and its Applications, Linear Algebra and Applications, Documenta Mathematica, Advances in Geometry

Klaus Keimel Demonstratio Mathematica, International Journal of Mathematics and Mathematical Sciences, Topology and its Applications, Order, Frontiers in Computer Science, Computers and Mathematics with Applications, Journal of Pure and Applied Algebra,Periodica Matematica Hungarica, Houston Journal of Mathematics, Electronic Notes in Theoretical Computer Science, ESF (European Science Foundation), Information Sciences, three book manuscripts for Springer, FOSSACS 08, Theoretical Computer Science, Fundamenta Informaticae, Semigroup Forum, Acta Mathematica Sinica

Ulrich Kohlenbach Annals of Pure and Applied Logic, Mathematical and Computer Modelling, Transactions of the Amer. Math. Soc., International Journal of Mathematics and Mathematical Sciences, Journal of Mathematical Analysis and Applications, Journal of Symbolic Logic, Mathematical Logic Quaterly, Notre Dame Journal of Formal Logic, Springer Lecture Notes in Computer Science, numerous proceedings

Michael Kohler Annals of Statistics, Finance and Stochastics, IEEE Transactions on Information Theory, International Journal of Statistics and Management System, Journal of the American Statistical Association

Burkhard Kümmerer Journal of Functional Analysis, Communications in Mathematical Physics, Journal of Operator Theory, Memoirs of the AMS, Springer Lecture Notes in Mathematics, Journal of Mathematical Analysis and Applications.

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

Laurenţiu Leuştean Acta Applicandae Mathematicae, Computers and Mathematics with Applications, Nonlinear Analysis, Soft Computing - A Fusion of Foundations, Methodologies and Applications

Ulf Lorenz International Journal of Computer Games, Parallel Computing, Advances in Computer Games, The Computer Journal

Alexander Martin Discrete Applied Mathematics, Discrete Optimization, European Journal of Operational Research, Mathematical Methods of Operations Research, Mathematical Programming A and C, Operations Research Letters, Optimization Methods and Software

Karl-Hermann Neeb Ergebnisse der Mathematik, Progress in Mathematics, manuscripta mathematica, Differential Geometry and its Applications, Journal of Lie Theory, Mathematische Nachrichten, Acta Mathematica, Memoirs of the American Math. Soc., Reviews of Mathematical Physics, Journal of Geometry and Physics, Forum Mathematicum, Annals of Global Analysis and Geometry, Canadian J. Math., International Math. Res. Notices

Martin Otto Journal of Symbolic Logic, Annals of Pure and Applied Logic, ACM Transactions of Computational Logic, Journal of the ACM, Journal of Logic and Computation, Bulletin of Symbolic Logic, Siam Journal of Computation, Theoretical Computer Science, Information and Computation, Logical Methods in Computer Science, Journal of Computer and System Sciences, Studia Logica, Springer Lecture Notes in Computer Science, IEEE LICS, ICALP, Computability in Europe

Ulrich Reif Journal of Approximation Theory, Computer Aided Geometric Design, SIAM Journal on Numerical Analysis, SIAM Journal on Scientific Computing, ACM Transactions on Graphics, Graphical Models, Computer Graphics Forum, SIGGRAPH, Eurographics

Klaus Ritter Finance and Stochastics, Foundations of Computational Mathematics, Journal of Complexity, Numerical Algorithms, Numerische Mathematik, Proceedings MCQMC 2006 and 2008

Steffen Roch Complex Anal. Oper. Theory, Frontiers in Math. (Birkhäuser), Indian J. Pure Appl. Math., Integral Eq. Oper. Theory, J. Math. Anal. Appl., J. Oper. Theory, Lecture Notes Math. (Springer), Linear Alg. Appl., Oper. Theory: Adv. Appl.

Andreas Rößler Stochastics and Dynamics, Mathematics and Computers in Simulation, JNAIAM, Journal of Computational and Applied Mathematics, Computer Physics Communications, Applied Mathematics and Computation

Nils Scheithauer International Journal of Number Theory, Journal für die reine und angewandte Mathematik, SIGMA

Peter Spellucci Computational Optimization and Applications (COAP)

Wilhelm Stannat Annali della Scuola Normale Superiore di Pisa, Annals of Probability, Annals of Applied Probability, Applied Probability Trust, Bulletin London Mathematical Society, IEEE Signal Processing Magazine, Journal of Physics A, Metrika, Potential Analysis

Thomas Streicher Annals of Pure and Applied Logic, Logical Methods in Computer Science, Logic and Analysis, Pure and Applied Algebra

Fredrik Strömberg Experimental Mathematics, Mathematics of Computation.

Stefan Ulbrich Computational Optimization and Applications, IEEE Transactions on Automatic Control, Inverse Problems, IMA Journal of Numerical Analysis, Mathematical Methods of Operations Research, Mathematical Programming, Mathematics of Computation, Optimization, Optimization Methods & Software, SIAM Journal on Control and Optimization, SIAM Journal on Optimization, SIAM Journal on Scientific Computing

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 (TU Berlin) and Michael Joswig. For more information, see `www.opt.tu-darmstadt.de/polymake`

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`

SCIP Solving Integer and Constraint Programming Problems
SCIP is a software for the solution of general mixed integer programming problems with additional capabilities to handle constraint programming constraints. The software is jointly developed by the discrete optimization groups at ZIB (under the head of Thorsten Koch), at TU Braunschweig (under the head of Marc Pfetsch) and TU Darmstadt (under the head of Thorsten Gellermann and Alexander Martin). For more information, see `www.zib.de`

NUMAWWW Interactice Numerical Analysis Code
NUMAWWW is a large collection of numerical algorithms prepared for interactive use via the internet. In the time period reported it has been completely moved from an HP RISC with HP/UX to LINUX on a 32-Bit PC. A lot of algorithms has been extended in its functionality and new algorithms have been added. A second move to 64 bit architecture is under work

Maasswf Computations of Maass waveforms
Maasswf is a Fortran 90 program for computing with Maass waveforms, e.g. locating eigenvalues, computing Fourier expansions and generating plots. For more information and download, see `http://www.mathematik.tu-darmstadt.de/~stroemberg/`

SelbergZHecke Computation of the Selberg zeta function for Hecke triangle groups
SelbergZHecke is a MuPAD program for computing values of the Selberg zeta function for Hecke triangle groups. For more information and download, see `http://www.mathematik.tu-darmstadt.de/~stroemberg/`

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/`

4.7 Postdoctoral lecture qualification (Habilitationen)

2007

Simon King, *Verschiedene Anwendungen kombinatorischer und algebraischer Strukturen der Topologie* (Jürgen Bokowski)

Horst Heck, *Three Aspects of Evolution Equations: Parabolic Equations, Navier-Stokes Equations and Inverse Problems* (Matthias Hieber)

2008

Steffen Fröhlich, *Über zweidimensionale nichtlineare elliptische Systeme der geometrischen Analysis* (Karsten Große-Brauckmann)

Matthias Geißert, *Evolution Equations: Theory and Applications in Fluid Dynamics and Numerical Analysis* (Matthias Hieber)

Robert Haller-Dintelmann, *L^p–Regularity Theory for Linear Elliptic and Parabolic Equations* (Matthias Hieber)

Achim Blumensath, *Simple Monadic Theories* (Martin Otto)

4.8 Dissertations

2007

Oliver Stein, *Hecke-Operatoren und vektorwertige Modulformen zur Weildarstellung* (Jan Hendrik Bruinier)

Katrin Schumacher, *The Navier-Stokes Equations with Low-Regularity Data in Weighted Function Spaces* (Reinhard Farwig)

Eva Dintelmann, *Fluids in the exterior domain of several moving obstacles* (Mathias Hieber)

Julian Wiedl, *Analysis of Ornstein-Uhlenbeck Operators* (Matthias Hieber)

Nikolaus Witte, *Foldable Triangulations* (Michael Joswig)

Michael Holderbaum, *Discretization and Approximation of Images and Morphological Image Operators* (Klaus Keimel)

Michael Godzierz, *Globale Optimierung extrem aufwendiger Funktionen mit hochparallelen und sequentiellen Methoden* (Martin Kiehl)

Nebojsa Todorovic, *Bewertung Amerikanischer Optionen mit Hilfe von regressionsbasierten Monte-Carlo-Verfahren (Universität des Saarlandes)* (Michael Kohler)

Lisa Steiner, *A C*-algebraic Approach to Quantum Coding Theory* (Burkhard Kümmerer)

Daniel Kirchner, *Adaptive Moving Finite Elements on Time Dependent Domains* (Jens Lang)

Marzena Fügenschuh, *Relaxations and Solutions for the Minimum Graph Bisection Problem* (Alexander Martin)

Daniel Junglas, *Optimised Grid-Partitioning for Block-Structured Grids in Parallel Computing* (Alexander Martin)

Susanne Moritz, *A Mixed Integer Approach for the Transient Case of Gas Network Optimization* (Alexander Martin)

Christoph Müller, *Borel–Weil Theory for Root Graded Banach–Lie Groups* (Karl-Hermann Neeb)

Matthias Hofmann-Kliemt, *The Invariant Complex Structure on the Homogeneous Space* $Diff(S^1)/Rot(S^1)$ (Karl-Hermann Neeb)

Jochen Hechler, *Optimierung von Freiformflächen mittels Raumdeformation* (Ulrich Reif)

Tim Wagner, *Optimal One-Point Approximation of Stochastic Heat Equations with Additive Noise* (Klaus Ritter)

Lars Schewe, *Satisfiability Problems in Discrete Geometry* (Jürgen Bokowski)

Jan Ch. Wehrstedt, *Shape optimization governed by variational inequalities and an application in oral surgery* (Stefan Ulbrich)

2008

Julia Sonnberger(Dr.phil), *Das "E-Laerning-Label" an der TU-Darmstadt - Entwicklung, Einführung und Auswertung eines Modells zur Qualitätssicherung und Qualitätsentwicklung von E-Learning-Veranstaltungen* (Regina Bruder)

Niklas Niemann, *On Representations of *-Regular and Regular Involutive Rings in Endomorphism Rings of Vector Spaces* (Christian Herrmann)

Max Horn, *Involutions of Kac-Moody Groups* (Ralf Gramlich, Bernhard Mühlherr)

Conny Clausen, *Estimation of a regression function by maxima of minima of linear functions (Universität des Saarlandes)* (Michael Kohler)

Birgit Debrabant, *Point processes with a generalized order statistic property* (Jürgen Lehn)

Annett Keller, *Applying Robust Scale M-Estimators to Compute Credibility Premiums in the Large Claim Case* (Jürgen Lehn)

Agnes Dittel, *Protein Folding and Self-Avoiding Walks - Polyhedral Studies and Solutions* (Alexander Martin)

Mahmood Alam, *Cartan subalgebras of locally finite Lie algebras* (Karl-Hermann Neeb)

Alexandra Witzel, *CNM - A convergent method of Nelder and Mead type* (Peter Spellucci)

4.9 Master Theses and Theses for the State Board Examinations

2007

Vivien Ammoser, *Konzeption einer E-Learning Fortbildung für Mathematiklehrkräfte zu EXCEL* (Regina Bruder)

Andreas Zöller, *Lehrerperspektiven beim Einsatz von Computer-Algebra-Systemen im Projekt CALiMERO* (Regina Bruder)

Christine Brenner, *Entwicklung einer Aufgabensammlung für Lehrkräfte zur Gestaltung eines anwendungsorientierten Mathematikunterricht* (Regina Bruder)

Daniel Wolf, *Unterrichtseinstiege zur Leitidee Raum und Form* (Regina Bruder)

Walter Friesen, *Vergleichsstudie zur Interpretation von Bildungsstandards für Mathematik* (Regina Bruder)

Isabell Kuhnke-Lerch, *Entwicklung eines webbasierten Analysismoduls für die Studieneingangsphase* (Regina Bruder)

Anna Schwarz, *Lehrerperspektiven beim Einsatz von Computer-Algebra-Systemen im Projekt CALiMERO* (Regina Bruder)

Paul Jägemann, *Schülerwahrnehmungen von CAS-gestütztem Mathematikunterricht in Klasse 7* (Regina Bruder)

Oliver Morcziniez, *Der Mathematikunterricht im Projekt TIM aus Schülersicht* (Regina Bruder)

Michele Ciani, *Qualitätsbeurteilung des Moduls "Terme und Termumformungen" im Projekt CALiMERO* (Regina Bruder)

Dirk Zimmermann, *Der Mathematikunterricht im Projekt CALiMERO aus Schülersicht* (Regina Bruder)

Martin Hövel, *Poincaré-Reihen und die Shimura-Korrespondenz* (Jan Hendrik Bruinier)

Daniel D'Abramo, *Hilbertsche Modulflächen und orthogonale Gruppen* (Jan Hendrik Bruinier)

Bettina Gottermeier, *Rosenbrock-Verfahren für elektro-quasistatische Gleichungen* (Jens Lang)

Britta Michael, *Fortsetzbarkeit für Immersionen* (Karsten Große-Brauckmann)

Tabea Grebe, *Kristallographische Gruppen in Ebene und Raum* (Karsten Große-Brauckmann)

Julia Plehnert, *Minimalflächen im Heisenberg-Raum* (Karsten Große-Brauckmann)

Lachezar Krumov, *Degree and Diameter Bounded Minimum Spanning Trees* (Alexander Martin, Ute Günther)

Thilo Schang, *Bounded Diameter Minimum Spanning Tree* (Alexander Martin, Ute Günther)

Atanas Ayarov, *Implementation and Analysis of the Bounded Degree Minimum Diameter Spanning Tree Problem (Bachelor thesis)* (Alexander Martin, Ute Günther)

Karoline Götze, *Die Lojasiewicz-Simon-Ungleichung bei Evolutionsgleichungen* (Hieber, Farkas)

Julia Wiskandt, *Asymptotische Vollständigkeit und Beobachtbarkeit von Quanten-Markov-Prozessen* (Burkhard Kümmerer)

Bianka Luther, *Geometrie- und Wirklichkeitsverständnis im didaktischen Ansatz von Tatjana Ehrenfest* (Burkhard Kümmerer)

Marcus Page, *Mathematical Approaches to Speech Recognition (Bachelor thesis)* (Jens Lang)

Stefan Löbig, *Linearly Implicit Methods for Linear Poroelastic Equations* (Jens Lang)

Regina Braniek, *A Heuristic Approach for the Optimal Planning of Locally Coupled Supply Networks* (Alexander Martin, Debora Mahlke, Andrea Zelmer)

Tsvetan Penev, *Supporting Geo-based Routing in Pub/Sub Middleware* (Alejandro Buchmann, Alexander Martin)

Yuan Zhi, *Solving Real-World Vehicle Routing Problems using MILP and PGreedy Heuristics* (Alexander Martin, Armin Fügenschuh)

Andreas Sewe, *Towards Adaptive Optimization of Advice Dispatch* (Alexander Martin, Mira Mezini)

Andrea Peter, *Ein MILP, ein MINLP und ein graphentheoretischer Ansatz für die Free-Flight Optimierung* (Alexander Martin, Armin Fügenschuh)

Christine Schönberger, *Linearization Methods for the Optimzation of Screening Processes in the Recovered Paper Production* (Alexander Martin, Armin Fügenschuh)

Björn Geissler, *Pin Assignment im Multilayer Chip Design* (Alexander Martin, Karsten Weihe)

Antonio Morsi, *Augmentierende Vektoren mit beschränktem Support* (Alexander Martin, Karsten Weihe)

Henning Homfeld, *Optimierung von Lokumläufen im Schienengüterverkehr* (Armin Fügenschuh, Alexander Martin)

Johanna Mazur, *Examples of Continuum Contragredient Lie Algebras* (Karl-Hermann Neeb)

Viktoria Miller, *Kontinuierlich kontragrediente Lie-Algebren* (Karl-Hermann Neeb)

Hasan Gündogan, *Lie algebras of smooth sections* (Karl-Hermann Neeb)

Stefan Wagner, *Coverings of non-connected Lie groups* (Karl-Hermann Neeb)

Steffen Kionke, *Sieve Methods in the Gaussian Ring (Bachelor thesis)* (Karl-Hermann Neeb)

Rebecca Lukas, *Modallogische Charakterisierungssätze über speziellen Klassen endlicher Strukturen* (Martin Otto)

Alexander Kartzow, *Locality and First-Order Definability on Tree-Like Structures* (Martin Otto)

Daniel Gürth, *Triangulierung von Flächen mittels orthogonaler Hutfunktionen* (Ulrich Reif)

Aleksandra Lazarova, *The Black-Scholes Model for Pricing Asian Options (Bachelor thesis)* (Klaus Ritter)

Charlotte Kuhn, *Zeitintegrationsverfahren höherer Ordnung für Plastizitätsmodelle mit Fließfläche* (Peter Spellucci, Bernhard Eidel)

Nicole Dienstl, *Berechnung der Carathéodory-Darstellung eines komplexen Vektors* (Peter Spellucci)

Rolf Roth, *Ein FSQP-Algorithmus für nichtlineare Optimierungsprobleme mit Ungleichungsrestriktionen* (Peter Spellucci)

Willy Fongue, *Experimental investigation of some variants of the SR1-minimization method (Bachelor thesis)* (Peter Spellucci)

Verena Moock, *An efficient method of conjugate directions for large scale quadratic unconstrained optimization (Bachelor thesis)* (Peter Spellucci)

C. Regimbeau, *On the pricing of Parisian type options* (Wilhelm Stannat)

Pierre Amessi, *Rekursive Multilevel Trust-Region SQP Methods for Hierarchical Approximations of Infinite Dimensional Optimization Problems* (Stefan Ulbrich)

Marie-Angela Ehmann, *Adaptive Semismooth Newton Methods for Elastic Contact Problems with Application to Fractures of the Mandible* (Stefan Ulbrich)

Matthias Ruppert, *Numerical Algorithms for Mixed-Integer Nonlinear Programming* (Stefan Ulbrich)

Eric Nges, *Portfolio Optimization and Efficient Frontier Tracking under Conditional Value-at-Risk Constraints* (Stefan Ulbrich)

Matthias Heidrich, *Risk-Return Optimization of Credit Portfolios by Mixed Integer Nonlinear Programming with Respect to Securization* (Stefan Ulbrich)

Dörte Beigel, *Primal-dual Interior Point Methods for Nonconvex Nonlinear Optimization with Application to Shape Design* (Stefan Ulbrich)

2008

Stefanie Burczyk, *Selbstreguliert mathematisch argumentieren lernen* (Regina Bruder)

Timo Dupke, *Softwareeinsatz im Mathematikunterricht der beruflichen Schulen - Eine Lernumgebung mit Arbeitsblättern zum Thema "Differentialrechnung"* (Regina Bruder)

Ralf Schneider, *Unterrichtseinstiege zur Leitidee "Funktionale Zusammenhänge" 2008* (Regina Bruder)

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

Michaela Willmann, *Zur Messung von Kompetenzzielen im Themenfeld "Lineare Zusammenhänge" (Projekt HEUREKO)* (Regina Bruder)

Nina Raabe, *Drehbuch einer Lehrerfortbildung zur Begutachtung von E-Learning-Angeboten mit dem TUD-Gütesiegel* (Regina Bruder)

Sven Remdisch, *Kompetenzdiagnostik zu funktionalen Zusammenhängen in Klasse 7/8* (Regina Bruder)

Saskia Utsch, *Ein Wiederholungskonzept zur Leitidee "Funktionaler Zusammenhang"* (Regina Bruder)

Verena Szagartz, *Eine Lernumgebung zu trigonometrischen Zusammenhängen* (Regina Bruder)

Tanja Seitel, *Mathematische Begabung - Hintergrund, Konzepte, Förderung* (Regina Bruder)

Jan Peter Schupp, *Pilotstudie zum funktionalen Denken in Klasse sieben und acht (Projekt HEUREKO)* (Regina Bruder)

An Hoa Nguyen, *Die Weildarstellung und Siegelsche Thetareihen* (Jan Hendrik Bruinier)

Oliver Krause, *Vektorwertige Eisensteinreihen zur Weildarstellung* (Jan Hendrik Bruinier)

Johannes Bedke, *Fourierkoeffizienten von Modul- und Jacobiformen modulo ℓ* (Jan Hendrik Bruinier)

Stephan Ehlen, *Twisted Borcherds Products on Hilbert Modular Surfaces* (Jan Hendrik Bruinier)

Jan-Christoph Aumann, *Entwicklungen von Skalaren für effiziente Skalarmultiplikation auf algebraischen Varietäten* (Jan Hendrik Bruinier)

Tobias Hansel, *Sums of Closed Operators: Applications to the Ornstein-Uhlenbeck Operator* (Bálint Farkas)

Stefanos Leonardos, *Stabilität von positiven C_0-Halbgruppen* (Bálint Farkas)

Andreas M. Rosteck, *Abschätzung der Fundamentallösung einer modifizierten Stokes-Gleichung* (Reinhard Farwig)

P. Felix Riechwald, *The Largest Possible Class of Data for Very Weak Solutions to the Instationary Navier-Stokes Equations* (Reinhard Farwig)

Raphael Schulz, *Global Solvability of Two-dimensional Boussinesq Equations with Non-decaying Initial data* (Reinhard Farwig)

Sonja Odathuparambil, *Branchingstrategien für stückweise lineare Funktionen (Bachelor thesis)* (Mirjam Dür, Björn Geißler)

Adrian Krion, *Optimierungsmethoden zur Berechnung von Cross-Border-Flow beim Market-Coupling im europäischen Stromhandel* (Alexander Martin, Antonio Morsi, Björn Geißler)

Frank Goldeck, *Algorithmische Behandlung des Alldifferent Constraints im Branch & Cut* (Alexander Martin, Thorsten Gellermann)

Tatjana Nath, *Empiric Analysis of Convex Underestimators* (Alexander Martin, Thorsten Gellermann)

Michael Fichtner, *Minimalflächen mit 4 Enden* (Karsten Große-Brauckmann)

Nicole Voss, *Die Riemannsche Minimalfäche* (Karsten Große-Brauckmann)

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

Laura von der Au, *Polyedrische Untersuchungen zur Kostenoptimierung der Geldautomatenbefüllung* (Alexander Martin, Ute Günther)

Tanja Jekel, *Über die Riemannsche Vermutung* (Hieber, Kümmerer)

Hanno Schülldorf, *Optimierung der Leitwegeplanung im Schienengüterverkehr* (Alexander Martin, Armin Fügenschuh, and Henning Homfeld)

Silke Möser, *Cubical Projectivities and Blow-ups* (Michael Joswig)

Tanja Treffinger, *Geometrische Interpretation des Gröbner-Walks* (Michael Joswig)

Sascia Petit, *Tight-Spans endlicher metrischer Räume und das Consensus-Tree-Problem* (Michael Joswig)

Pavol Safarik, *The Interpretation of the Bolzano-Weierstrass Principle Using Bar Recursion* (Ulrich Kohlenbach)

Christian Geist, *On a Good Representation of the Reals in Terms of Computability and Algorithmic Randomness (Bachelor thesis)* (Ulrich Kohlenbach)

Christoff Eisinger, *Nichtparametrische Regressionsschätzung mit zusätzlichen Messfehlern in beiden Variablen (Universität des Saarlandes)* (Michael Kohler)

Christian Warnken, *Regressionsschätzung mit Hilfe von neuronalen Netzen mit zwei verdeckten Schichten (Universität des Saarlandes)* (Michael Kohler)

Daniel Pieter, *Robustheit bei der Bewertung Amerikanischer Optionen mit Hilfe von regressionsbasierten Monte-Carlo-Verfahren (Universität des Saarlandes)* (Michael Kohler)

Medini Ciftci, *Bewertung Amerikanischer Optionen mi Hilfe von Maxima von Minima von linearen Funktionen (Universität des Saarlandes)* (Michael Kohler)

Olga Kliatchko, *Bewertung Amerikanischer Optionen mit Hilfe von neuronalen Netzen mit zwei verdeckten Schichten (Universität des Saarlandes)* (Michael Kohler)

Simona Helmsmüller, *Bestimmung von Marginalfaktoren in der Versicherungsmathematik mittels nichtparametrischer Regressionsschätzung - Konsistenzanalyse (Universität des Saarlandes)* (Michael Kohler)

Christian Sörensen, *Bestimmung von Marginalfaktoren in der Versicherungsmathematik mittels nichtparametrischer Regressionsschätzung - Konvergenzanalyse (Universität des Saarlandes)* (Michael Kohler)

Christian Brittnacher, *Ein Algorithmus zur Bestimmung von Marginalfaktoren in der Versicherungsmathematik mit Hilfe von Verfahren der nichtparametrischen Regressionsschätzung (Universität des Saarlandes)* (Michael Kohler)

Walter Reußwig, *C*-Dynamische Systeme und ihre K-Gruppen mit Anwendung auf symbolische Dynamik* (Burkhard Kümmerer)

Christina Cerny, *A Beurling-like Theorem for Multi-Shifts* (Burkhard Kümmerer)

Andreas Gärtner, *Rekurrenz und Transienz bei vollständig positiven Operatoren* (Burkhard Kümmerer)

Sandra Hartwich, *Laplaceschw Wahrscheinlichkeitsräume: Ihr historischen Ursprung und ihre Stellung im heutigen Stochastik-Unterricht* (Burkhard Kümmerer)

Anne Lebhardt, *Globale Fehlerschätzung und Kontrolle für differentiell-algebraische Anfangswertprobleme* (Jens Lang)

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

Tobias Förster, *Zufallsbasierte Heuristik für ein gekoppeltes Netzwerkdesignproblem* (Alexander Martin, Debora Mahlke, Andrea Zelmer)

Thorsten Hanßmann, *Optimaler Einsatz von Energiespeichern bei Integration von regenerativer Energie: Polyedrische Untersuchungen* (Alexander Martin, Debora Mahlke, Andrea Zelmer)

Martin Richter, *Relax-and-Fix Heuristik für ein stochastisches Problem aus der regenerativen Energieversorgung* (Alexander Martin, Debora Mahlke, Andrea Zelmer)

Björn Schuhmacher, *The 3-Steiner Ratio in Octilinear Geometry* (Karsten Weihe, Alexander Martin)

Yang Cao, *An empirical investigation of local search algorithms to minimize the weighted number of tardy jobs in Single Machine Scheduling* (Thomas Stützle, Alexander Martin)

Laura Schultes, *Optimization of Collateralization concerning Large Exposures* (Sanjay Dewal, Alexander Martin)

Theresa Stang, *Optimierungsmodelle zur Linienbündelung im ÖPNV* (Alexander Martin, Armin Fügenschuh)

Adrian Krion, *Optimierungsmethoden zur Berechnung von Cross-Border-Flow beim Market-Coupling im europäischen Stromhandel* (Alexander Martin)

Alexander Hoffmann, *Solving dynamic Scheduling Problems with Unary Resources* (Alexander Martin)

Paul Kmiecik, *Parameteranalyse in der Optimierungssoftware Carmen-PAC* (Armin Fügenschuh, Alexander Martin)

Carmen Nagy, *Ein Data Mining Ansatz zur Abschätzung von zyklischen Werkstoffkennwerten* (Armin Fügenschuh, Alexander Martin)

Frieder Noah, *Automatische Parameteroptimierung im Crew Assignment System Carmen* (Armin Fügenschuh, Alexander Martin)

Patrick Semm, *Branch and Price-Verfahren für Losgrössenprobleme* (Wolfgang Domschke, Alexander Martin)

Dimitar Mechev, *Simulation of the Bubblestorm Peer-to-PeerNetwork (Bachelor thesis)* (Alejandro Buchmann, Alexander Martin)

Zhihong Guo, *Experience of Moore-Bellmann Algorithm and Improvement (Bachelor thesis)* (Armin Fügenschuh, Alexander Martin)

Miroslav Zlatkov, *Optimierung von Benutzerschnittstellen (Bachelor thesis)* (Max Mühlhäuser, Alexander Martin)

Katharina Wolski, *Gemischt-ganzzahliges Modell zur Entwicklung optimaler Erneuerungsstrategien für Wasserversorgungsnetze* (Antonio Morsi and Alexander Martin)

Michael Klotz, *Banach Symmetric Spaces* (Karl-Hermann Neeb)

Robert Piro, *Lindströmsche Sätze für modale Logiken* (Martin Otto)

Tobias Ruppert, *Vector field reconstruction by radial basis functions* (Ulrich Reif)

Sonja Knierim, *Lineare Approximation von trivariaten Funktionen auf Tetraedernetzen mittels Orthogonalitätsrelationen* (Ulrich Reif)

Lyuben Petrov, *Brep-based translation between the JT and ACIS CAD format (Bachelor thesis)* (Ulrich Reif and Sebastian Pena)

Stephan Toussaint, *Konstruktive Quantisierung skalarer Diffusionsprozesse* (Klaus Ritter)

Thomas Ehlenz, *Free-Knot Linear Interpolation of the Brownian Motion* (Klaus Ritter)

Simone Graubner, *Multilevel Monte Carlo Methoden für stochastische partielle Differentialgleichungen* (Klaus Ritter)

Marko Wombacher, *Das Reduktionsverfahren für band-dominierte Operatoren mit semi-fastperiodischen Koeffizienten* (Steffen Roch)

Andreas Weinert, *Lie algebras, vertex algebras and automorphic forms* (Nils Scheithauer)

Sonja Friedrich, *Partial Reverse Search* (Lars Schewe, Alexander Martin)

Markus Domschke, *Lösung der Modenkopplungsgleichung mit Methoden für Integrodifferentialgleichungen* (Peter Spellucci)

Johannes Koch, *Untersuchungen zur SLP/EQP-Methode von Byrd, Gould, Nocedal und Waltz* (Peter Spellucci)

Steve Kenmoe, *Sensitivity Analysis of a Nonlinear Ordinary Differential Equation Using Optimization (Bachelor thesis)* (Peter Spellucci)

J. Stürmann, *Konvergenzanalyse von Approximationsverfahren des optimalen Filters* (Wilhelm Stannat)

B. Birkmeier, *An Aviation Risk Model Using Maximum Likelihood Estimation for Poisson Processes* (Wilhelm Stannat)

J. Linke, *Bewertung von Forward Starting Optionen im Heston Modell mit zeitabhängigen Koeffizienten* (Wilhelm Stannat)

D. Tusheva, *Pricing of Mortgage Backed Securities* (Wilhelm Stannat)

G. Bachvarov, *A non linear explicit Filter for estimating stochastic volatility (Bachelor thesis)* (Wilhelm Stannat)

D. Hristova, *Pricing of double-barrier knock-out options - The pathwise binomial approach of Rogers and Stapleton (Bachelor thesis)* (Wilhelm Stannat)

A. Gerigk, *Pricing European Options - Speed of Convergence in the Approximation via Binomial Trees (Bachelor thesis)* (Wilhelm Stannat)

Jane Elsemüller, *Optimization of Plasma Actuator Parameters for the Cancellation of Tolmien-Schlichting Waves with NEWUOA* (Stefan Ulbrich, Rolf Roth)

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

Kai Habermehl, *Index Tracking - Minimization of the Tracking Error by Mixed-Integer Quadratic Optimization* (Stefan Ulbrich)

Adrian Sichau, *Robust Nonlinear Optimization - Application for the Optimal Design of Load Carrying Structures* (Stefan Ulbrich)

Elena Maronova, *Efficient Frontier Construction for CVaR Portfolio Optimization* (Stefan Ulbrich)

Bork Bröker, *Credit Portfolio Optimization regarding Risk Transfer Instruments by an extended Outer Approximation Algorithm* (Stefan Ulbrich)

Harald Fritsch, *Estimation of the Implied Volatility of American Options by Mathematical Programming with Equilibrium Constraints* (Stefan Ulbrich)

Sara Wulf, *Semismooth Multigrid Methods for the Pricing of American Options* (Stefan Ulbrich)

Stephen Sachs, *Form Optimization of the Navier-Stokes Equations using Free Form Deformation* (Stefan Ulbrich, Christian Brandenburg)

Sarah Kessler, *An Adaptive Inexact SQP-Method for Parabolic PDE-Constrained Optimization* (Stefan Ulbrich, Jan Carsten Ziems)

5 Presentations

5.1 Talks and Visits

5.1.1 Invited Talks and Addresses

Pia Bales

11.03.08 *Hierarchical modelling and optimal control on gas networks*
Workshop "MIP & PDE", Hausdorff Research Institute for Mathematics, Bonn

28.07.08 *Model adaptivity on gas networks*
Symposium "Applied Mathematics in Industry and Science", Friedrich-Alexander Universität Erlangen-Nuremberg, Erlangen

Achim Blumensath

28.10.07 *Simple Monadic Theories*
Algorithmic Logical Theory of Infinite Structures, Dagstuhl

21.07.08 *The interpretation hierarchy for guarded second-order logic*
Logic and Algorithms, Edinburgh

Eyvind Martol Briseid

25.09.08 *Noen anvendelser av bevisteoretiske metoder i metrisk fikspunktteori (Some applications of proof-theoretic methods in metric fixed point theory)*
Seminar on Mathematical Logic, University of Oslo

Regina Bruder

16.01.07 *Konzepte für nachhaltiges Lernen*
Didaktisches Kolloquium, Universität Göttingen

05.02.07 *Methoden und Techniken zum Problemlösen*
SINUS-Transfer, Waldfischbach

14.02.07 *Diagnose und Förderung von Basiskompetenzen in Mathematik*
Lehrerfortbildungsveranstaltung, Frankfurt

06.03.07 *Internetfortbildungskursen "Basics" und "Problemlösen"*
SINUS-Workshop, Friedberg

14.03.07 *Mathematisches Grundkönnen und Umgehen mit Fehlern*
SINUS-Workshop, Darmstadt

15.03.07 *Konzepte nachhaltigen Lernens von Mathematik*
Lehrerfortbildungsveranstaltung, Saarbrücken

19.03.07 *Diagnose und Förderung von Problemlösekompetenzen*
Lehrerfortbildungsveranstaltung, Frankfurt

22.03.07 *Langfristiger Kompetenzaufbau im Mathematikunterricht*
Lehrerfortbildungsveranstaltung, Erfurt

24.03.07 *Was macht das Mathematiklernen oft so schwer?*
Mathematiktagung, CH-Bern

28.03.07 *Zur Nachhaltigkeit von Mathematikunterricht*
GDM/DMV-Tagung, Berlin

28.03.07 *Sinnvoller Einsatz von CAS in den Klassen 7 und 8*
DMV/GDM-Tagung 2007, Berlin (with Maria Ingelmann)

16.4.07 *"PISA -Tests und Standards in der Mathematikausbildung - Welche Vorstellungen von Unterricht stehen dahinter?" im Rahmen der Ringvorlesung: "Was steckt dahinter?"*
Vorlesung, TU Darmstadt

26.4.07 *Wege zu einem langfristigen Kompetenzaufbau im Mathematikunterricht*
Didaktisches Kolloquium, Dortmund

14.5.07 *Wege zu einem langfristigen Kompetenzaufbau im Mathematikunterricht*
Didaktisches Kolloquium, Bad Soden-Salmünster

23.5.07 *Wege zu einem langfristigen Kompetenzaufbau im Mathematikunterricht*
Didaktisches Kolloqium, Freiburg

27./28.9.07 *Langfristiger Kompetenzaufbau im Mathematikunterricht*
MNU Hessen, Stuttgart

13.11.07 *Langfristige Kompetenzentwicklung im Mathematikunterricht*
Hessisches Fachberatertreffen Mathematik, Frankfurt

21.11.07 *Kollaboratives Mindmapping und Vorstellung des Lehrprojektes: Aufgabenpraktikum Mathematik - online*
5. Darmstädter E-Learning Tag

13.02.08 *Methoden zum eigenverantwortlichen Lernen*
Pädagogischer Tag, Gymnasium Michelstadt

15.2.07 *Module zur Fachdidaktik Mathematik an der TUD*
AK Fachdidaktik, Karlsruhe

25.2.08 *Kompetenzmodelle in der Mathematik- Hintergründe und Entwicklungsrichtungen*
AK Fachdidaktik Informatik, Königsstein

20.05.08 *Didaktisches zum Jahr der Mathematik: Förderung von Problemlösekompetenz im Mathematikunterricht (auch Oberstufe)*
Tag der Mathematik, Merck-Schule Darmstadt

27.05.08 *Ein Unterrichtskonzept zum Problemlösenlernen im Mathematikunterricht*
Kolloquium, Universität Münster

18./19.07.08 *TIM - a two-year model test on the pocket Calculator use from class 7 and 9*
Posterpresentation PME 32, Morelia (Mexico)

26.08.08 *Teilstandardisierte Stundenprotokolle von Lernenden als Monitoringinstrument in Interventionsstudien*
AEPF-Tagung, Kiel

18.09.08 *Die Qualität steckt im Detail - kreative Aufgabengestaltung und ihre Umsetzung mit E-Learning-Lösungen*
GMW-Tagung, A-Krems (with Dr. Julia Sonnberger)

01.11.08 *Binnendifferenziert unterrichten - das nun auch noch?*
Tagung zum Jahr der Mathematik, Großburgwedel

17.11.08 *Unterrichtskonzept zum Problemlösenlernen*
Lehrerfortbildung, Waldfischbach

02.12.08 *Problemlösenlernen im Mathematikunterricht - ein Unterrichtskonzept*
LISUM Ludwigsfelde für Multiplikatoren/Fachberater, Berlin/Brandenburg

11.12.08 *Langfristiger Kompetenzaufbau im Mathematikunterricht: Konzepte - Methoden - Beispiele*
Regionalkonferenz des Schulamtes, Fulda

15.12.08 *Muss Mathematik immer schwierig sein?*
Jahr der Mathematik, Georg-August-Zinn Schule Reichelsheim

17.12.08 *Muss Mathematik immer schwierig sein?*
Jahr der Mathematik, Landrat-Gruber-Schule Dieburg

Jan H. Bruinier

26.11.08 *Faltings heights of CM cycles and derivatives of L-functions*
Conference *Automorphic Forms, L-Functions and Shimura Varieties*, Inha University, Korea

24.10.08 *Faltings heights of CM cycles and derivatives of L-functions*
Number Theory Seminar, ETH Zürich

05.09.08 *Faltings heights of CM cycles and derivatives of L-functions*
Conference *Explicit structures in Modular Forms and Number Theory*, in honor of the 60th birthday of T. Ibukiyama, Kinki University

11.06.08 *Faltings heights of CM cycles and derivatives of L-functions*
Number Theory seminar, Max Planck Institute for Mathematics, Bonn

21.05.08 *Harmonic weak Maass forms and L-functions*
Workshop on the arithmetic of modular forms, University of Hawaii

12.03.08 *Harmonic weak Maass forms and L-functions*
AKLS-Seminar *Automorphic Forms*, RWTH Aachen

26.02.08 *Heegner divisors, L-functions and harmonic weak Maass forms*
Number Theory seminar, Cambridge University

30.01.08 *L-Funktionern in Geometrie und Arithmetik*
Antrittsvorlesung, Mathematisches Kolloquium, TU Darmstadt

13.12.07 *Ableitungen von L-Funktionen und Borcherds-Produkte*
Mathematisches Kolloquium, Universität Mainz

06.12.07 *Heegner divisors, L-functions and harmonic weak Maass forms*
Number Theory seminar, University of Princeton

30.11.07 *Ableitungen von L-Funktionen und Borcherds-Produkte*
Mathematisches Kolloquium, Universität Bonn

28.10.07 *Heegner divisors, L-functions and harmonic weak Maass forms*
Tagung *Modular Forms*, Mathematisches Forschungsinstitut, Oberwolfach

25.07.07 *Heegner divisors, L-functions and harmonic weak Maass forms*
Conference *Representation Theory*, Max-Planck-Instite for Mathematics, Bonn

10.07.07 *Die Arithmetik von Partitionen*
Mathematisches Kolloquium der Universität Augsburg

20.5.07 *Differentials of the third kind and Heegner divisors*
Conference *L-Functions and Automorphic Forms* (in honor of the 60th birthday of Dorian Goldfeld), Department of Mathematics, Columbia University

12.04.07 *Twisted Borcherds products on modular curves*
Number Theory Seminar, University of Wisconsin at Madison

Stefan Bundfuss

21.09.07 *Solving Copositive Programs*
Heidelberg, Germany

Debora Clever

14.05.07 *Optimale Randsteuerung bei Abkühlungsprozessen in der Glasherstellung*
Advanced seminar, Mathematical Institute der Universität Bayreuth

04.06.07 *Optimale Randsteuerung bei Abkühlungsprozessen in der Glasherstellung*
Seminar, Universität Karlsruhe

11.03.08 *Optimal Boundary Control for Glass Cooling Processes with Restrictions on the Temperature Gradient*
Workshop "MIP & PDE", Hausdorff Research Institute for Mathematics, Bonn

Birgit Debrabant

28.09.07 *A special class of point processes*
NTNU, Trondheim

30.11.07 *Punktprozesse mit einer verallgemeinerten Ordnungsstatistik-Eigenschaft*
Stochastikkolloquium, TU Dresden

Kristian Debrabant

27.09.07 *Runge-Kutta methods for stochastic differential equations*
NTNU, Trondheim

17.06.08 *A unifying B-series approach for the analysis of stochastic Runge-Kutta methods*
Comp. Math. Seminar, Halle (Saale), Germany

08.10.08 *On global error control for parabolic PDEs*
NTNU, Trondheim

Sarah Drewes

21.11.08 *Mixed integer second order cone programming*
IMA Hot Topics Workshop: Mixed-Integer Nonlinear Optimization: Algorithmic Advances and Applications, Institute for Mathematics and its Applications, University of Minnesota, Minneapolis, Minnesota, USA

Bálint Farkas

18.06.08 *Bi-continuous semigroups and some applications*
ISEM Workshop, Blaubeuren, Germany

07.05.08 *Rendezvous numbers, Chebyshev constants and potential theory*
EWorkshop on Distance Geometry, Salzburg, Austria

24.09.07 *Degenerate elliptic operators with unbounded coefficients on* $\mathbb{R}^N$
Zweiter deutsch-mongolsicher Workshop Partielle Differentialgleichungen und Optimierung in Mechanik und Stochastik, Mühltal, Germany

23.03.07 *Degenerate elliptic operators with unbounded coefficients on* $\mathbb{R}^N$
Evolution on Networks, Dobogókő, Hungary

12.04.07 *Periodische Zerlegung von Funktionen*
Funktionalanalysis Seminar, Universität Tübingen

12.02.07 *On the domain of hypoelliptic Ornstein-Uhlenbeck operators*
Analysis Seminar, Universität Ulm

Reinhard Farwig

16.01.07 *Fluid Flow in Unbounded Domains*
Oberseminar Analysis, Universität Magedeburg

17.01.07 *Strömungen um rotierende Hindernisse: Grundlegende Fragestellungen und überraschende Ergebnisse*
Weierstraß–Institut für Angewandte Analysis und Stochastik Berlin

10.03.07 *From the Theory of Very Weak Solutions to Regularity of Weak Solutions of the Instationary Navier-Stokes System*
Lecture Series at the Nečas Center for Mathematical Modeling, Prague

03.05.07 *Strömungen um rotierende Hindernisse: Grundlegende Fragestellungen und überraschende Ergebnisse*
Colloquium, Universität Bayreuth

22.05.07 *Local Space-Time Regularity Criteria beyond Serrin's Condition*
Conference on Mathematical Fluid Mechanics: a Tribute to Giovanni Paolo Galdi, Estoril (Portugal)

20.06.07 *Weak Solutions to the Instationary Navier-Stokes Equations in General Unbounded Domains*
Joint Conference of DMV and UMI, Session on Nonlinear Partial Differential Equations, Perugia

03.09.07 *Regularity of Weak Solutions to the Navier-Stokes System beyond Serrin's Criterion*
Waseda University, Tokio

05.09.07 *Regularity of Weak Solutions to the Navier-Stokes System beyond Serrin's Criterion*
COE Partner Seminar, Tokyo University Tokio

07.09.07 *Regularity of Weak Solutions to the Navier-Stokes System beyond Serrin's Criterion*
Shizuoka University, Hamamatsu

10.09.07 *Flow Around Rotating Bodies – Basic Questions and Surprising Results*
Kyushu University, Fukuoka

12.09.07 *Local and Global in Time Regularity for the Navier-Stokes Equations in Unbounded Domains*
Shinshu University, Matsumoto

14.09.07 *Fluid Flow Past a Rotating Obstacle*
Conference on Mathematical Analysis in Fluid Dynamics and Conservation Laws, Tokyo Institute of Technology

01.10.07 *From the Theory of Very Weak Solutions to Regularity of Weak Solutions*
Lecture Series at Tohoku University, Sendai

03.10.07 *Incompressible Fluid Flow Past or Around Rotating Bodies*
Lecture Series at Tohoku University, Sendai

27.11.07 *Regularität schwacher Lösungen der instationären Navier-Stokes-Gleichungen – Kriterien jenseits der Serrin-Schranke*
Colloquium, Universität Karlsruhe

06.05.08 *L^q-Theory of Navier-Stokes Flows in General Unbounded Domains*
Max-Planck-Institut für Mathematik in den Naturwissenschaften, Leipzig

01.06.08 *Regulär oder singulär - das ist die Frage bei den Navier-Stokes-Gleichungen*
Colloquium, Universität Bielefeld

10.07.08 *Fluid Flow around Rotating Obstacles - Basic Questions and Surprising Results*
University of Pau and Pays de l'Adour

09.09.08 *On the existence of local strong solutions for the Navier-Stokes equations in completely general domains*
Workshop on Mathematical Fluid Dynamics Darmstadt-Tokyo, Darmstadt

06.10.08 *Spectral Analysis of Fluid Flow Around Rotating Obstacles*
6th German-North Korean Seminar 2008, RWTH Aachen

Matthias Geissert

05.2007 *The Navier-Stokes flow in the exterior of a rotating obstacle*
CAM Seminar, Chalmers University of Technology

11.2007 *The Navier-Stokes flow in the exterior of a rotating obstacle*
Analysis / PDE Seminar, Arizona State University

02.2008 *Nonautonomous Ornstein-Uhlenbeck Operators in L^2-spaces with respect to invariant measures*
Oberseminar, Universität Konstanz

07.2008 *Konvergenzraten Finiter Elemente für die Wärmeleitungsgleichung mit und ohne Rauschen*
Forschungsseminar, Universität Tübingen

10.2008 *A free boundary problem related to the spin-coating process*
Analysis/PDE Seminar, Arizona State University

Björn Geißler

19.09.08 *MIP Techniques in Gas Network Optimization*
DMV annual meeting 2008, Erlangen, Minisymposium Optimization of Transportation Networks

Karsten Große-Brauckmann

24.01.07 *On Alexandrov reflection*
Oberseminar Geometrie, Universität Tübingen

01.05.07 *Surfaces branching off the nodoid family*
Tagung Progress in Surface Theory, Oberwolfach

16.07.07 *Flächen konstanter mittlerer Krümmung in Theorie und Praxis*
Kolloquium Tübingen

08.2007 *Constant mean curvature surfaces which bifurcate from the nodoids*
Meeting Minimal and constant mean curvature surfaces, Buzios, Brasil

04.12.07 *Flächen konstanter mittlerer Krümmung*
Kolloquium Ulm

06.2008 *Triply periodic minimal surfaces*
Workshop Aspen Center of Physics

16.10.08 *Flächen konstanter mittlerer Krümmung*
Festkolloquium Heidelberg

09.12.08 *All constant mean curvature surfaces with 3 ends*
Collaborative Research Centre (SFB) Oberseminar, FU Berlin

Ute Günther

06.03.07 *Neue Methoden in der Produktentwicklung*
1. Zwischenkolloquium SFB 666, Darmstadt

10.05.08 *Handling Manufacturing Constraints Using Discrete Optimization*
SIAM Conference on Optimization, Boston

Robert Haller-Dintelmann

09.01.07 *Elliptische Operatoren zweiter Ordnung mit wachsenden Driftkoeffizienten*
Universität Karlsruhe

21.03.07 *Square roots of divergence form operators*
Weierstrass-Institut für Angewandte Analysis und Stochastik, Berlin

18.04.07 *Irreducibility and mixed boundary conditions*
Weierstrass-Institut für Angewandte Analysis und Stochastik, Berlin

28.11.07 *Maximal regularity for divergence form operators on Sobolev spaces*
Weierstrass-Institut für Angewandte Analysis und Stochastik, Berlin

22.01.08 *Problèmes paraboliques sous des conditions au bord de type mixte (Parabolic problems with mixed boundary conditions)*
University of Valenciennes and Hainaut-Cambrésis

27.02.08 *Maximal parabolic regularity for systems with VMO-coefficients*
Weierstrass-Institut für Angewandte Analysis und Stochastik, Berlin

06.05.08 *Solutions continues pour des problèmes elliptiques peu réguliers (Continuous solutions to elliptic problems with low regularity)*
Université Libre de Bruxelles

06.05.08 *Régularité maximale pour des problèmes paraboliques sous forme divergence et non-divergence (Maximal regularity for parabolic problems in divergence and non-divergence form)*
Université Libre de Bruxelles

15.12.08 *Solutions continues pour des problèmes elliptiques peu réguliers (Continuous solutions to elliptic problems with low regularity)*
University of Bordeaux I

Sven Herrmann

26.03.07 *f-Vectors of Tight Spans*
DMV Anual Meeting 2007, Berlin, Minisymposium Discrete Geometry

09.11.07 *Splits: Simple Subdivisions of Convex Polytopes*
San Francisco State University

29.10.07 *Splits: Simple Subdivisions of Convex Polytopes*
University of California, Davis

19.05.08 *Totally Splittable Polytopes*
TU Berlin

19.09.08 *Splits of Convex Polytopes*
DMV Annual Meeting 2008, Erlangen, Minisymposium Discrete Geometry and Topology

Wolfgang Hess

10.05.08 *Shape Optimization Governed by the Linear Elasticity Equations*
SIAM Conference on Optimization, Boston

13.11.08 *Algorithmenbasierte Produktentwicklung für spaltprofilierte Blechprofile*
6. Fachtagung Walzprofilieren, 2. Zwischenkolloquium SFB 666, Darmstadt

Matthias Hieber

24.01.07 *Quasilinear systems on nonsmooth domains*
WIAS, Berlin

20.04.07 *Rotating fluids*
Colloquium, Universität Vienna, Austria

05.06.07 *Stability question in fluid mechanics*
Conference 300th Birthday Euler, St. Petersburg, Russia

26.06.07 *Asymtotics for the Ekman spiral*
Conference PDE, University of Rome II, Italy

20.07.07 *L^p-Estimates for Stokes-Coriolis-Ekman Operators*
Conference on Applied and Industrial Mathematics, Zürich, Switzerland

03.09.07 *Global mild solutions for the Navier-Stokes equations in the rotational setting*
German-Chinese Conference on PDE, Xian, China

31.10.07 *Stability resuls for the Ekman spiral*
Academy of Sciences, Prague, Czech Republic

13.12.07 *Free boundary value problems for the Navier-Stokes equations*
Workshop on Free boundary value problems, Halle

17.12.07 *The Navier-Stokes equations in the rotational setting*
Conference on Evolution Equations, Reisensburg

25.02.08 *Perspectives in Fluid Dynamics*
Colloquium, RWTH Aachen

12.03.08 *L^p-Estimates for geophysical flows*
Arizona State University, Phoenix, USA

30.04.08 *Multiphase Flows*
RWTH Aachen

20.05.08 *Global existence results for rotating fluids*
Luminy, France

26.05.08 *Maximal Regularity for parabolic evolution equations I*
Summer school University of Mostaganem, Algeria

15.07.08 *Spectral problems for the Ekman spiral*
Conference on spectral theory, England

01.09.08 *Maximal regularity techniques in fluid mechanics*
Conference on Navier-Stokes, Banach Center, Bedlewo, Poland

23.09.08 *Fluid-Structure interaction problems*
Conference on PDE, Cortona, Italy

20.10.08 *Maximal regularity techniques for evolution equations I*
Academy of Sciences, Prague, Czech Republic

21.10.08 *Maximal regularity techniques for evolution equations II*
Academy of Sciences, Prague, Czech Republic

Karl Heinrich Hofmann

16.01.07 *Pro-Lie Groups*
Mathem.Kolloquium/Universität Siegen

22.05.07 *Comments on Hellmuth Kneser's Collected Papers in Topology*
Kolloquium zur Didaktik der Mathematik/Westfälische Wilhelms-Universität Münster

06.07.07 *Pickert, Bourbaki und wir*
Key Note Lecture for the celebration of G. Pickert's 90th Birthday/Universität Giessen

25.07.07 *Pro-Lie Groups*
Invited Address at the Summer Conference on Topology 2007/Castelló, Spain

04.09.07 *Bourbaki and T & T*
Mathem. Colloquium, Tulane University/New Orleans

06.09.07 *Why we study Pro-Lie Groups and what we know about them*
Mathem. Colloquium at the University of South Alabama,/Mobile, Alabama, USA

16.11.07 *Bourbaki in Tübingen and in the USA—Erinnerungen an die französische Revolutions in der Mathematik*
Key Note Lecture in "500 Years of Mathematics/Tübingen

07.05.08 *From topological groups to infinite dimensional Lie groups*
Mathem. Kolloquium/Oldenburg

03.07.08 *The Contributions of W.A.F.Ruppert to the Theory of Topological Semigroups*
Seminar Sophus Lie/Cluji, Roumania

13.10.08 *A leisurely walk through the Theory and History of Compact Semigroups*
Invited Lecture at the WIP-Workshop, Tulane University/New Orleans

27.11.08 *Erné's Work on Mathematical Cartoons*
Keynote Lecture at the Opening of an Exhibition of Erne's Work/Hannover

Max Horn

19.07.08 *Involutionen von algebraischen und Kac-Moody Gruppen*
Norddeutsches Gruppentheoriekolloquium, Kiel

16.11.08 *Involutions of algebraic and Kac-Moody groups*
Workshop: Symmetric Varieties and Involutions of Algebraic Groups 2008, Oberwolfach

Michael Joswig

18.01.07 *Extremal Tight Spans of Finite Metric Spaces*
Kolloquium, Dortmund

02.02.07 *Products of Foldable Triangulations and Real Roots of Polynomial Systems*
"Geometric and Topological Combinatorics", Oberwolfach

14.06.07 *Produkte faltbarer Polytop-Triangulierungen und reelle Nullstellen von Polynomen*
Kolloquium, Bayreuth

17.07.07 *Neighborly Cubical Polytopes and Spheres*
"Discrete Differential Geometry", Berlin

09.10.07 *Tropical Convexity in Affine Buildings of Type $\tilde{A}_d$*
"Buildings", Münster

26.11.07 *Tropical and Ordinary Convexity Combined*
Kolloquium, Magdeburg

11.12.07 *Tropical and Ordinary Convexity Combined*
"Tropical Geometry", Oberwolfach

21.06.08 *Combinatorial Holonomy via Projectivities*
"International Conference: Differential Equations and Topology, dedicated to the Centennial Anniversary of L. S. Pontryagin", Moskau

26.06.08 *Tropical Convexity and Affine Buildings*
Kolloquium, Frankfurt

25.09.08 *What Are the Higher-Dimensional Analogs of Trees and How Do They Look Like?*
"Discrete Geometry", Oberwolfach

22.10.08 *Tropical Geometry for Applied Mathematics*
"The Northern German Plane Goes Tropical", Göttingen

20.11.08 *Tropical Convexity and Tropical Grassmannians*
Kolloquium, Konstanz

21.11.08 *Bees and Trees: Geometric Combinatorics for Algorithmic Biology*
IBM Research Lab, Rüschlikon

Lennard Kamenski

02.04.08 *Hessian Recovery Methods for Mesh Adaptation*
University of Kansas, Lawrence

Klaus Keimel

11.04.07 *Predicate Transformers for Semantic Domains Modelling Non-Determinism and Probability*
Conference on Mathematical Foundations of Programming Semantics (MFPS XXIII), Tulane University New Orleans, USA

24.10.07 *Functional Analytic Methods in Semantics*
Math. Kolloquium, Masaryk University, Brno, Tschechische Republik

25.10.07 *Relating direct and predicate transformer semantics for languages combining non-determinism and probability by means of Minkowski functionals*
Seminar, Masaryk University, Brno, Tschechische Republik

22. and 27.05.08 *Domain Theory and Denotational Semantics*
University of Nationalities, Beijing, China

23.05.08 *Semantics for languages combining nondeterminism and probability Relating direct and predicate transformer semantics by means of Minkowski duality*
Tsinghua University, Beijing, China

11.06.08 *Using classical methods in semantics for languages combining probability and nondeterminism*
East China Normal University, Shanghai, China

22.09.08 *Some mathematical problems in Domain Theory*
Workshop Domains IX, University of Sussex, UK

Ulrich Kohlenbach

07.-08.01.07 *Recent Uses of Proof Theory in Nonlinear Analysis and Geodesic Geometry*
Invited plenary lecture at "Winter Meeting of the Association for Symbolic Logic (ASL)", New Orleans, USA

05.01.07 *New Effective Uniformity Results in Fixed Point Theory*
Invited talk at "AMS-ASL Special Session on Logical Methods in Computational Mathematics" as part of the 113th Annual Meeting of the American Mathematical Society, New Orleans, USA

07.03.07 *Gödel's Functional Interpretation and its Use in Current Mathematics*
Seminar Talk at Max Planck Institute for Mathematics, Bonn

13.04.07 *Some Uses of Proof Theory in Nonlinear Analysis and Geodesic Geometry*
Talk in the Mathematics Colloquium, Department of Mathematics, U Bonn

09.06.07 *Improving Constructive Proofs by Interpreting them via Negative Translation*
Invited plenary talk at "Conference on Methods of Proof Theory in Mathematics", Max Planck Institute Bonn

11.-15.09.07 *Recent Applications of Proof Mining in Nonlinear Analysis*
Invited plenary talk at: "Joint Workshop DOMAINS VIII and Computability over Continuous Data Types", Novosibirsk, Russia

12.10.07 *Unwinding the Combinatorial and Computational Content of Proofs*
Invited Lecture at "Workshop Deduction in Semantics", Stuttgart

15.02.08 *Herbrand's Theorem and Extractive Proof Theory*
Invited Lecture at Herbrand Centenary, Ecole normale supérieure (ENS), Paris, France

26.02.08 *Analyzing Proofs based on Sequential Compactness*
Talk in the Stanford Logic Seminar, Stanford University, USA

29.02.08 *Logical Proof Interpretations as a Tool for 'Hard Analysis'*
Talk in the Berkeley Logic Colloquium, University of California at Berkeley, USA

06.03.08 *Logical Proof Interpretations as a Tool for 'Hard Analysis'*
Talk in Mathematics Colloquium, Stanford University, USA

07.03.08 *Finitism and Constructivism in Mathematics Revisited*
Talk in the Philosophy Colloquium, Stanford University, USA

29.08.08 *Proof Interpretions, 'Hard Analysis' and Ergodic Theory*
Invited Lecture at "MAP 2008 Conference", Aug. 25-29, Abdus Salam International Centre for Theoretical Physics, Triest, Italy

05.09.08 *Proof Interpretions, 'Hard Analysis' and Ergodic Theory*
Invited Lecture at "British Logic Colloquium", Nottingham, UK

05.12.08 *Proof Interpretations, 'Hard Analysis' and Ergodic Theory*
Talk at Calgary Peripatetic Research Group in Logic and Category Theory, Department of Mathematics, University of Calgary, Canada

09.12.08 *Tao's Correspondence Principle, a Finitary Ergodic Theorem and Conservation Results for Ramsey's Theorem for Pairs*
Invited Lecture at "Workshop: Computability, Reverse Mathematics, Combinatorics". Banff International Research Station, Banff, Canada

12.03.09 *Applied Proof Theory: Proof Interpretations and their Use in Mathematics*
Talk at CHOCO Seminar, ENS, France

31.07.-05.08.09 *Scheduled: Applied Proof Theory: Proof Interpretations and Their Use in Mathematics*
Invited tutorial (3 times 60 min) at "ASL Logic Colloquium'09", Sofia, Bulgaria

03.-07.08.09 *Scheduled: Recent Applications of Proof Theory in Nonlinear Analysis*
Invited Plenary Lecture at Conference "Logic and Mathematics", University of York, UK

24.-28.08.09 *Scheduled:Recent Applications of Proof Theory to Core Mathematics*
Invited Plenary Lecture at: Maltsev Meeting 2009, Novosibirsk,Russia

Michael Kohler

23.08.2007 *On nonparametric regression with additional measurement errors in the dependent variable and its applications*
56th Session of the International Statistical Institute/Lissabon

03.07.2008 *Pricing of American Options by Regression-based Monte Carlo Methods*
Workshop on Learning Theory and Approximation/Oberwolfach

Oliver Kolb

11.03.08 *Optimal control for gas and water supply networks*
Workshop "MIP & PDE", Hausdorff Research Institute for Mathematics, Bonn

Burkhard Kümmerer

10.09.07 *Asymptotic Behaviour of Quantum Markov Processes*
Conference on Infinite Dimensional Harmonic Analysis, University of Tokyo

19.09.08 *Fehlerunterdrückung durch stochastische dynamische Entkopplung*
DMV-Tagung, Minisymposium, Erlangen

20.11.08 *Dynamical Decoupling or How to Slow Down Unwanted Changes with Multiple Activities*
35 Jahre AGFA - Semigroups and Evolution Equations, Tübingen

13.08.08 *Knot or not Knot*
IMS Public Lecture, National University of Singapore, Singapore

Jens Lang

10.06.07 *On Global Error Control for Parabolic PDEs*
Adaptive Numerical Methods for PDEs, Oberwohlfach

20.06.07 *On Global Error Estimation and Control for ODEs and Parabolic PDEs*
Joint International Meeting UMI-DMV, Perugia

10.03.08 *On Global Error Estimation and Control for ODEs and Parabolic PDEs*
Numerical Seminar at University of Kansas

16.04.08 *Optimal Control for Glass Cooling Processes*
Numerical Seminar at Universität der Bundeswehr, München

07.05.08 *On Global Error Control*
Numerical Modelling of Complex Dynamical Systems, Lorentz Center, Leiden

17.06.08 *On LES Modelling and Numerical Errors*
Workshop VMS, Saarbrücken

15.07.08 *On Global Error Estimation and Control for Runge-Kutta-Rosenbrock Methods*
GLADE2008, John Butcher's 75th Birthday, Auckland

30.10.08 *On Global Error Estimation and Control for Reaction-Diffusion Equations*
Numerical Seminar at University of Linz

Laurenţiu Leuştean

05.-08.01.07 *Proof mining in $CAT(0)$-spaces and $\mathbb{R}$-trees*
AMS-MAA Joint Mathematics Meetings, AMS-ASL Special Session on Logical Methods in Computational Mathematics, New Orleans, USA

04.-09.06.07 *Recent uses of proof mining*
Conference "Methods of Proof Theory in Mathematics", Max-Planck Institute for Mathematics, Bonn, Germany

14.02.08 *Logical methods in nonlinear analysis*
Paul Verlaine University - Metz, France

06.-12.04.08 *Recent results in proof mining*
Oberwolfach Workshop "Mathematical Logic: Proof Theory, Constructive Mathematics", Oberwolfach, Germany

24.06.08 *Logical methods in nonlinear analysis*
Conference on Nonlinear Analysis and Optimization (in celebration of Alex Ioffe's 70th and Simeon Reich's 60th birthdays, Technion, Haifa, Israel

04.07.08 *Logical methods in nonlinear analysis*
WCNA (World Congress of Nonlinear Analysis) 2008, Orlando, USA

Debora Mahlke

18.06.08 *Ein Branch-and-Bound Ansatz zur Lösung von mehrstufigen stochastischen gemischt-ganzzahligen Problemen*
Workshop: Stochastische Optimierung, Geldern-Walbeck

Alexander Martin

04.07.07 *Mixed Integer Programs and Partiel Differential Equations on Networks*
EUROPT OMS 2007 Conference, Prague

18.09.07 *Mixed Integer Programming in Engineering Sciences: Some Case Studies*
13th Czech-French-German Conference on Optimization, Heidelberg

05.11.07 *Solving PDE Problems on Networks by Mixed Integer Programming Techniques*
Optimization and Application Seminar, ETH Zurich

27.10.08 *Energienetze unter Druck*
"Formel M" BMBF Statusseminar 2008, Duisburg

08.11.08 *Diskrete Mathematik diskret in der Praxis*
ISTRON-Tagung, Darmstadt

11.11.08 *MIP Computations on Networks with PDEs*
Oberwolfach Workshop "Combinatorial Optimization"

Karl-Hermann Neeb

29.05.07 *Host algebras for infinite-dimensional Lie groups*
Seminar on Representation Theory, Tokyo University

03.07.07 *Helmut Strade und die Klassifikation der einfachen modularen Lie-Algebren*
Festvortrag zur Verabschiedung von H. Strade, Hamburg

10.07.07 *Gruppenalgebren unendlichdimensionaler Lie-Gruppen*
Kolloquium, Ruhr-Universität Bochum

19.10.07 *Infinite dimensional Lie algebras beyond Kac–Moody and Virasoro algebras*
ESF-Conference "Algebraic Aspects in Geometry", Bedlewo

04.03.08 *Generalizing toroidal Lie algebras and classifying twists*
Tagung "Quantum affine Lie algebras, extended affine Lie algebras, and applications", Banff Centre (Kanada)

24.04.08 *Central extensions of current algebras–old and new aspects*
Math. Seminar, Mulhouse

27.05.08 *Konvexität in der Darstellungstheorie von Lie-Gruppen*
Math. Kolloquium, Paderborn

26.06.08 *Semibounded unitary representations of infinite-dimensional Lie groups*
Tagung "Espaces Symétriques hermitiens, algèbres de Jordan et problèmes associés, Luminy

29.08.08 *Unitary highest weight representations of direct limit Lie groups*
Summer School "Large N limits", Bitche (Frankreich)

22.10.08 *Convexity, coadjoint orbits and unitary representations of infinite dimensional Lie groups*
Math. Seminar, École Polytechnique Fed. Lausanne

24.10.08 *Convexity, coadjoint orbits and unitary representations of infinite dimensional Lie groups*
Séminaire de Physique Mathématique, Claude Bernard University Lyon 1

06.11.08 *Infinite-dimensional Lie groups and semibounded representations*
Minicourse (2 talks) in the "Workshop on Infinite-Dimensional Lie Groups and Related Functional Analysis", Paderborn

09.12.08 Locally affine Lie algebras Köln-Bonn Algebra Seminar, Bonn

Martin Otto

05.12.07 *Bisimulation Invariance over Transitive Frames*
ILLC, Amsterdam

25-28.06.07 *Games and Fragments of FO over Special Classes of (Finite) Structures*
Tutorial, Summer School on Mathematical Logic And Its Applications, Aussois, France

Ulrich Reif

26.01.07 *Analysis of Subdivision Surfaces near Extraordinary Vertices*
Oberwolfach Workshop

02.02.07 *Approximation with Tensor Product Splines*
Universität Giessen

08.03.07 *Spline Approximation on Domains*
University of Texas at Austin

12.06.07 *Splineapproximation auf beschränkten Gebieten*
Universität Ulm

04.09.07 *An Appropriate Invariant for the C^2-Analysis of Subdivision Surfaces*
Mathematics of Surfaces XII, Sheffield

18.09.07 *Orthogonality of Hat Functions in Sobolev Spaces*
Workshop on Polyhedral Surfaces, Strobl

16.01.08 *Piecewise Linear Approximation via Sobolev Orthogonality of Hat Functions*
University of Texas at Austin

24.01.08 *Applications of Sobolev Orthogonality of Hat Functions*
Rice University, Houston

15.05.08 *Analyse und Konstruktion von Subdivisionsalgorithmen*
TU Graz

29.05.08 *Analysis and Construction of Subdivision Algorithms*
Workshop on Geometric Modeling, Schloss Dagstuhl

21.06.08 *Subdivision Surfaces*
Foundations of Computational Mathematics, Hongkong

26.08.08 *Analysis and Construction of Subdivision Algorithms*
Chinese-Korean Joint Conference on Geometric Modeling, Hefei

30.08.08 *Piecewise Linear Approximation via Sobolev Orthogonality of Hat Functions*
Tsinghua University, Beijing

02.09.08 *Piecewise Linear Approximation via Sobolev Orthogonality of Hat Functions*
Shanghai University

22.09.08 *Tensor Product Spline Approximation on Domains*
International Conference on Multivariate Approximation, Bommerholz

Klaus Ritter

18.01.07 *Schwache Approximation und Quantisierung stochastischer Differentialgleichungen*
Oberseminar Finanzmathematik, TU München

25.01.07 *Numerik stochastischer Evolutionsgleichungen*
Mathematisches Kolloquium, Universität Mainz

05.09.07 *Quadrature of Lipschitz Functionals and Approximation of Distributions*
Workshop on Stochastic Processes and Algorithms, Hausdorff Institute Bonn

19.11.07 *Quadrature of Lipschitz Functionals and Approximation of Distributions*
Stochastic Analysis Seminar, University of Oxford

23.11.07 *Quadrature of Lipschitz Functionals and Approximation of Distributions*
Probability and Statistics Seminar, University of Bath

14.12.07 *Quadrature of Lipschitz Functionals and Approximation of Distributions*
Workshop on Nonlinear and Adaptive Approximation in High Dimensions, Physikzentrum Bad Honnef

21.06.08 *Free Knot Spline Approximation of Brownian Motion and SDEs*
Foundations of Computational Mathematics, Hong Kong

09.07.08 *On the Complexity of Infinite-Dimensional Quadrature Problems*
Plenary Talk, MCQMC 2008, Montreal

18.–22.08.08 *Numerical Analysis and Complexity of Stochastic Processes*
Series of Lectures (5 times 90 min) 18th Summer School, University of Jyväskylä

28.08.08 *Non-uniform Time Discretization and Lower Bounds for Stochastic Heat Equations*
Workshop on Numerics and Stochastics, Helsinki

Steffen Roch

08.03.07 *Szegö limit theorems for operators with almost periodic diagonals*
CINVESTAV, Queretaro/Mexico

18.07.08 *The finite sections approach to the index formula for band-dominated operators*
Penn. State Univ., State College/USA

22.07.08 *The Fredholm index of band-dominated operators*
IWOTA 2008, Williamsburg/USA

Andreas Rößler

30.01.07 *Improved stochastic Runge-Kutta methods for SDEs*
Seminar talk, Johann Wolfgang Goethe-Universität Frankfurt

05.06.08 *Efficient Runge-Kutta methods for SDEs and stability analysis*
Seminar talk, Otto-von-Guericke-Universität Magdeburg

Nils Scheithauer

09.01.07 *The Weil representation of $SL_2(\mathbb{Z})$ and some applications*
Algebra Seminar, Maxwell Institute, Edinburgh

26.01.07 *Lie Algebren und automorphe Formen*
Mathematisches Kolloquium, Bonn

29.01.07 *Infinite dimensional Lie algebras, automorphic forms and strings*
Colloquium, University of Edinburgh

10.05.07 *Automorphic products related to genus* 0 *groups*
Jacobi Forms and Applications, Luminy

04.07.07 *Moonshine for Conway's group*
International Conference on Modular Forms and Moduli Spaces, St. Petersburg

30.10.07 *Lie Algebren und automorphe Formen*
Mathematisches Kolloquium, Dortmund

28.11.07 *Lie Algebren und automorphe Formen*
Mathematisches Kolloquium, Köln

15.12.07 *Lie algebras, vertex algebras and automorphic forms*
Prospects in Mathematics, Durham

20.02.08 *Moonshine for Conway's group*
Second Japanese-German Number Theory Workshop, MPIM Bonn

07.06.08 *Lie Algebren und automorphe Formen*
Mini-Symposium Lie-Theorie, Hamburg

09.07.08 *Moonshine for Conway's group*
International Conference on Vertex Operator Algebras and Related Areas, Normal, Illinois

16.10.08 *Moonshine*
Colloquium, University of Bordeaux 1

Lars Schewe

18.09.08 *Computing bounds on polytope diameters using oriented matroids*
DMV-Tagung 2008, Minisymposium Discrete Geometry and Topology, Erlangen

23.06.08 *The Diameter of Polytopes, Oriented Matroids and Satisfiablity Problems*
IMO-Seminar, Otto von Guericke Universität Magdeburg

22.04.08 *The coolest path problem*
Oberseminar Diskrete Mathematik, Institut für Diskrete Mathematik, Bonn

09.06.07 *Showing non-embeddability of triangulated surfaces using satisfiability solvers*
Methods of proof theory in mathematics, MPIM Bonn

Wilhelm Stannat

22.03.07 *Particle filters and the Kushner-Stratonovich equation*
Second Sino-German Meeting on Stochastic Analysis, Beijing

26.03.07 *Particle filters and the Kushner-Stratonovich equation*
Academia Sinica, Taipei

30.05.07 *Asymptotic Stability of Feynman-Kac propagators*
Colloquium on Asymptotic Properties of Stochastic Systems, Nice

22.08.07 *Lipschitz continuity of Feynman-Kac propagators*
Stochastic Filtering and Control, Warwick

06.09.07 *A new a priori estimate for 2D-stochastic Navier-Stokes equations w.r.t. Gaussian measures*
Potential Theory and Stochastics, Albac (Rumania)

26.09.07 *On invariant measures for stochastic partial differential equations*
PDE in Mechanics, Optimization and Stochastics, Second German-Mongolian Workshop, Darmstadt

05.10.07 *A new a priori estimate for 2D-stochastic Navier-Stokes equations w.r.t. Gaussian measures*
Evolution Equations and Kolmogorov Operators, Fisciano (SA), Italy

04.12.07 *A new a priori estimate for 2D-stochastic Navier-Stokes equations w.r.t. Gaussian measures*
Institut Mittag-Leffler, Stockholm

11.01.08 *A new a priori estimate for 2D-stochastic Navier-Stokes equations w.r.t. Gaussian measures*
Stoch. Partial Differential Equations and Applications VIII, Levico Terme

10.04.08 *The logarithmic Sobolev inequality for the Wasserstein diffusion*
Oberseminar Stochastik, Bonn

21.05.08 *The logarithmic Sobolev inequality for the Wasserstein diffusion*
6^{th} Seminar on Stochastic Analysis, Random Fields and Appl., Ascona

08.09.08 *The logarithmic Sobolev inequality for the Wasserstein diffusion*
Stochastic Analysis and Applications, Fukuoka

06.11.08 *Funktionalungleichungen für stochastische partielle Differentialgleichungen und Anwendungen*
Kolloquium, Mainz

04.12.08 *Modellierung von Messfehlern mit stochastischen partiellen Differentialgleichungen*
CE-seminar, Darmstadt

17.12.08 *A priori Abschätzungen zu stochastichen partiellen Differentialgleichungen der Fluiddynamik*
TU Berlin

Thomas Streicher

05.06.07 *Realizability vs. Forcing*
Univ. of Edinburgh

20.11.08 *Direct and Predicate Transformer Semantics for $\mathcal{L}_p$*
TU Dortmund

Fredrik Strömberg

04.04.07 *Hecke operators and Maass waveforms on $PSL(2, Z)$ with integer weight and non-trivial multiplier system.*
AKLS Seminar, Achen, Germany

27.09.07 *Symbolic Dynamics for the Geodesic Flow on Hecke Triangle Surfaces*
Ryukyu University, Japan

21.02.08 *Computations of Selberg Zeta functions on Hecke Triangle Groups*
2nd Japanese-German Number Theory Workshop, MPIM Bonn, Germany

18.08.08 *Computations of (non-holomorphic) automorphic forms on GL2*
Workshop on Computations of Modular forms, Bristol, UK

08.12.08 *On computations of vector-valued Poincaréseries and harmonic weak Maassforms*
Workshop in honour of Dennis A. Hejhal on his 60th birthday, Uppsala University, Sweden

Stefan Ulbrich

22.07.08 *Numerical Methods for PDE-constrained Optimization*
Summer School *Identification, Optimization and Control with Applications in Modern Technologies*, Elitenetzwerk Bayern, Schloss Thurnau

10.05.08 *A Posteriori Error Estimators for Control Constrained Optimization with PDEs based on Interior Point or Semismooth Residuals*
SIAM Conference on Optimization, Boston, USA

08.04.08 *Adaptive Multilevel Methods for PDE-constrained Optimization*
Colloquium, Institute of Applied Mathematics, METU, Ankara

06.03.08 *A Posteriori Error Estimators for Control Constrained Problems based on Interior Point or Semismooth Residuals*
Oberwolfach Workshop 'Optimal Control of Coupled Systems of PDEs"

22.11.07 *Adaptive Multilevel Methods for PDE-Constrained Optimization*
Oxford University Computing Laboratory

18.09.07 *Semismooth Multigrid Newton Methods for Contact Problems in 3D Linear Elasticity*
German-French-Czech Conference on Optimization, Heidelberg

14.09.07 *Adaptive Multilevel Methods for PDE-Constrained Optimization*
ENUMATH 2007, Graz

14.08.07 *Adaptive Multilevel Methods for PDE-Constrained Optimization*
ICCOPT II/MOPTA 07, Hamilton, Canada

04.07.07 *Recent Developments in PDE-Constrained Optimization*
Plenary talk, EUROPT-OMS Meeting 2007, Prag

15.06.07 *Moderne Multilevel-Verfahren für die Optimierung mit partiellen Differentialgleichungen*
Mathematisches Kolloquium, Universität Frankfurt

21.02.07 *Inexact Adaptive Multilevel Methods for PDE-Constrained Optimization*
SIAM Conference on Computational Science and Engineering, Costa Mesa, USA

Rudolf Wille

31.08.07 *Semantologies for concept analysis*
Workshop "Understanding cognitive abilities", Philosophisches Institut, Universität Bonn

03.09.07 *Contextual Logic as support for human thought: Contextual Concept Logic*
Summer school on Algebra and Ordered Sets, Tale, Slovakia

04.09.07 *Contextual Logic as support for human thought: Contextual Judgment Logic*
Summer school on Algebra and Ordered Sets, Tale, Slovakia

28.09.07 *Conceptual Knowledge Processing in Practice: a semantological approach*
Conference on Knowledge Processing in Practice, Hochschule Darmstadt

26.10.07 *Concept graphs as semantic structures for contextual Judgment Logic*
Fifth International Conference on concept lattices and their applications, Montpellier, France

03.11.07 *Generalistic Mathematics as Mathematics for the General Public*
75. Arbeitstagung Allgemeine Algebra, TU Darmstadt

27.02.08 *Communicative Rationality, Logic, and Mathematics*
International Conference on Formal Concept Analysis 2008, Université du Québec à Montréal, Canada

25.04.08 *Logisch denken lernen im Mathematikunterricht*
Institut für Algebra, TU Dresden

06.06.08 *Allgemeine Mathematik - Mathematik für die Allgemeinheit*
60. ErnstSchöderKolloquium, TU Darmstadt

28.10.08 *Bildung und Mathematik*
Gesamtschule Groß Bieberau

17.11.08 *Bildung und Mathematik*
Institut für Algebra, TU Dresden

Jan Carsten Ziems

11.03.08 *Adaptive Multilevel Inexact SQP-Methods for PDE-constrained Optimization and their Relevance in Branch and Bound Algorithms*
Workshop MIP and PDEs, Hausdorff Research Institute for Mathematics, Bonn

12.05.08 *Adaptive Reduced Multilevel SQP-Methods for Parabolic PDE-constrained Optimization*
SIAM Conference on Optimization 2008, Boston, USA

5.1.2 Contributed Talks

Pia Bales

02.07.08 *Hierarchical modelling and optimal control for gas networks*
Minisymposium on PDE Constrained Optimization at the WCCM8/ECCOMAS 2008 conference, Venice

19.08.08 *Model adaptivity on gas networks*
Annual Meeting of the Deutsche Mathematiker-Vereinigung 2008, Erlangen

Benno van den Berg

11.03.08 *Aspects of Algebraic Set Theory*
Category Theory Seminar, Cambridge

08.07.08 *Realizability in algebraic set theory*
Logic Colloquium 2008, Bern

17.09.08 *Aspects of Algebraic Set Theory*
Stockholm-Uppsala Logic Seminar, Uppsala

Achim Blumensath

18.07.07 *Simple Monadic Theories*
Logic Colloquium 2007, Wrocław

03.07.08 *Interpretation degrees for guarded second-order logic*
Logic Colloquium 2008, Bern

10.09.08 *The transduction hierarchy for guarded second-order logic*
Colloquium Logicum 2008, Darmstadt

18.02.08 *Interpretation degrees for guarded second-order logic*
Algorithmic Model Theory 2008, Freiburg

Christian Brandenburg

05.10.07 *Advanced Numerical Methods for PDE-Constrained Optimization with Application to Optimal Design and Control of a Racing Yacht in the America's Cup*
Annual meeting of SPP1253 2007, Bad Honnef

10.05.08 *Goal Oriented Adaptivity and Multilevel Techniques for Shape Optimization with Incompressible Flows*
SIAM Conference on Optimization, Boston

23.09.08 *Advanced Numerical Methods for PDE-Constrained Optimization with Application to Optimal Design and Control of a Racing Yacht in the America's Cup*
Annual meeting of SPP1253 2008, Kloster Banz

Eyvind Martol Briseid

11.01.07 *Proof mining and computable rates of convergence for non-nonexpansive mappings*
MAP ("Mathematics, Algorithms, Proofs") 2007 meeting, Leiden, Netherlands

08.06.07 *Proof mining and effective rates of convergence for Picard iteration sequences*
Workshop "Methods of Proof Theory in Mathematics", Max Planck Institute of Mathematics, Bonn, Germany

17.07.07 *On the fixed point theory of Kirk's asymptotic contractions*
ICFPTA 2007 (8th International Conference on Fixed Point Theory and Applications), Chiangmai, Thailand

13.09.07 *Proof mining and effective metric fixed point theory*
Workshop "Domains VIII and Computability Over Continuous Data Types", Sobolev Institute of Mathematics of the Siberian Branch of the Russian Academy of Sciences, Novosibirsk, Russia

04.11.07 *Effective rates of convergence for Picard iteration sequences*
ILC 2007 (International Conference on Infinity in Logic & Computation), Cape Town, South Africa

07.04.08 *Proof mining in metric fixed point theory*
Meeting: "Mathematical Logic: Proof Theory, Constructive Mathematics", Mathematisches Forschungsinstitut Oberwolfach, Oberwolfach, Germany

12.09.08 *On some applications of proof mining in metric fixed point theory*
Colloquium Logicum 2008 (Tagung der Deutschen Vereinigung für Mathematische Logik und für Grundlagen der Exacten Wissenschaften), Darmstadt, Germany

Stefan Bundfuss

28.02.08 *A Linear Approximation Approach to Copositive Programming*
SIGOPT 2008, Lambrecht, Germany

28.09.07 *Lösen copositiver Programme*
FRICO 2007, Bayreuth, Germany

Debora Clever

04.04.07 *Optimal Boundary Control for Glass Cooling Processes with Restrictions on the Temperature Gradient*
Second European Conference on Computational Optimization, Montpellier

Birgit Debrabant

04.09.08 *Point processes with a generalized order statistic property*
4. Doktorandenkonferenz Stochastik, TU Berlin

Kristian Debrabant

09.07.07 *Convergence of stochastic Runge-Kutta methods that use an iterative scheme to compute their internal stage values*
International Conference on Scientific Computation and Differential Equations SciCADE 2007, Saint-Malo, France

Sarah Drewes

18.09.07 *A Branch-and-cut method for Mixed-0-1 Second-order Cone Programming*
13th Czech-French-German Conference on Optimization, Heidelberg

12.05.08 *A Branch-and-cut method for Mixed-0-1 Second-order Cone Programming*
2008 SIAM Conference on Optimization, Boston, Massachusetts, USA

Bálint Farkas

22.11.08 *Is the identity $\mathbb{R} \to \mathbb{R}$ the sum of periodic functions?*
35 Jahre AGFA, Miniworkshop in honour of Prof. Rainer Nagel, Tübingen, Germany

02.07.08 *Maximum principle, Chebyshev constant and transfinite diameter*
7^{th} Summer School in Potential Theory, Baja, Hungary

27.03.07 *Drei Aspekte von Struktur und Zufälligkeit*
Dynamik am Fachbreich Mathematik, TU Darmstadt

10.07.07 *Introduction to abstract potential theory*
6^{th} Summer School in Potential Theory, Sofia, Bulgaria

Reinhard Farwig

02.03.07 *Local and Global in Time Regularity for the Navier-Stokes Equations in Unbounded Domains*
Conference on Topical Problems of Fluid Mechanics 2007, Prague

18.06.08 *Wenn Flüssigkeiten rotierende Körper umströmen...*
Colloquium, TU Darmstadt

Jaime Gaspar

26.06.08 *Interpretações funcionais e suas factorizações*
Portuguese Mathematical Society National Meeting 2008, Coimbra, Portugal

20.06.08 *Proof interpretations and their factorizations*
AG1 Seminar, TU Darmstadt

18.12.08 *Tao's "finitary" infinite pigeonhole principle*
Mathematical Logic Seminar, organization of the Faculty of Science of the University of Lisbon and the Superior Technical Institute of the Technical University of Lisbon, Portugal

Matthias Geissert

03.2007 *Kolmogorov operators with time depending coefficients*
Budapest-Tübingen Workshop on Evolution Equations, Budapest

04.2008 *Rate of weak convergence of the finite element method for the stochastic heat equation with additive noise*
Workshop Efficiency in and modeling with computational stochastic partial differential,equations: sparse grids, multi-level and adaptive methods, Bonn

05.2008 *A free boundary problem related to the spin-coating process*
Vorticity, Rotation and Symmetry - Stabilizing and Destabilizing Fluid Motion, Luminy

06.2008 *Rate of convergence of the finite element method for the stochastic heat equation with additive noise*
Mini-Workshop Evolution Equations, Karlsruhe

Björn Geißler

22.01.07 *Pin Assignment im Multilayer VLSI Design*
Seminar in Optimization, Darmstadt

19.11.07 *Lambda-/Delta Method and Applications*
Seminar in Optimization, Darmstadt

18.02.08 *Die Delta Methode*
German Research Foundation-Workshop 'Approximation nichtlinearer Dynamiken in der gemischt-ganzzahligen Optimierung', Kloster Schöntal

Thorsten Gellermann

29.05.08 *Nearly Active Set SQP for Mixed Integer Nonlinear Programming*
TUD/ZIB Workshop on Mixed Integer Nonlinear Programming, Darmstadt

Ute Günther

05.07.07 *Branched Sheet Metal Products: Handling Manufacturing Constraints by Discrete Mathematics*
Joint EUROPT-OMS Meeting 2007, Prague, Czech Republic

Robert Haller-Dintelmann

15.07.08 *Optimal elliptic regularity near heterogeneous vertices*
6^{th} Gregynog Workshop on Computation and Analytic Problems in Spectral Theory, Gregynog (Wales)

13.11.08 *Maximal regularity for elliptic operators in a setting with poor regularity*
6^{th} European-Maghreb Workshop on Semigroup Theory, Evolution Equations and Applications, Luminy (France)

Sven Herrmann

14.12.07 *Computing the Tight Span of Unbounded Polyhedra*
Saxon Geometry Day, Magdeburg

02.04.08 *Genocchi Numbers and f-Vectors of Simplicial Balls*
60th Seminaire Lotharingien de Combinatoire, Strobl, Austria

Wolfgang Hess

05.07.07 *Branched Sheet Metal Products: Shape Optimization Governed by the Linear Elasticity Equations*
Joint EUROPT-OMS Meeting 2007, Prague, Czech Republic

18.09.07 *Branched Sheet Metal Products: Shape Optimization Governed by the Linear Elasticity Equations*
13th Czech-French-German Conference on Optimization, Heidelberg

Karl Heinrich Hofmann

07.05.07 *Survey on Pro-Lie Groups*
Workshop on totally disconnected locally compact groups, Blaubeuren

22.07.09 *Pro-Lie Groups*
Seminar Sophus Lie Summer 2007, Bielefeld

10.12.07 *The Lie algebra of topological groups and its application*
Conference on Wilhelm Killing: Lie Theory and Geometry, Münster

Henning Homfeld

26.02.08 *Generierung von Wagenleitwegen im Schienengüterverkehr*
BMBF Workshop zur Optimierung der Transport- und Ressourcenplanung spezifischer Schienen- und Straßenverkehrssysteme, Braunschweig

05.09.08 *Routing Wagons In Freight Transport*
Operations Research 2008, Augsburg

08.09.08 *Routing Wagons In Freight Transport – polyhedral aspects*
Workshop on polyhedral studies, Heidelberg

14.11.08 *Leitwegoptimierung und andere Forschungsschwerpunkte*
Optimierungsworkshop Railion Deutschland AG, Mainz

04.12.08 *Ein arboreszenzbasierendes Modell zur Generierung von Wagenleitwegen im Schienengüterverkehr*
BMBF Workshop zur Optimierung der Transport- und Ressourcenplanung spezifischer Schienen- und Straßenverkehrssysteme, Chemnitz

Max Horn

11.10.07 *Non-standard geometric covering theory*
Buildings 2007, Münster

30.09.08 *Involutions of algebraic and Kac-Moody groups*
Buildings 2008, Münster

Michael Joswig

30.05.07 *Computations with Bounded Subcomplexes of Unbounded Polyhedra*
"Computer-Algebra", Kaiserslautern

15.11.08 *Foldable triangulations and real roots of polynomial systems*
"Kolloquium Kombinatorik", Magdeburg

Klaus Keimel

14.09.07 *Deriving predicate transformer semantics fo pGCL from its direct semantics*
Workshop Domains VIII, Novosibirsk

20.09.07 *Minkowski type functional representations and predicate transformer semantics combining probability and nondeterminism*
Mathematics in the Modern World, Conference at the Occasion of the 50th Anniversary of the Sobolev Institute of Mathematics, Novosibirsk

Michael Kohler

30.03.2007 *Pricing of American Options via regression based Monte Carlo methods*
Statistik unter einem Dach - 2007, Bielefeld

Oliver Kolb

19.07.07 *Adaptive linearized models for optimization of gas networks*
Minisymposium "Optimal control with PDEs on gas networks" der Konferenz ICIAM 07, Zürich

04.07.08 *Optimal control with PDEs on networks*
ECMI 08, London

Burkhard Kümmerer

29.06.07 *Asymptotic Behaviour of Quantum Markov Processes*
Leipzig, MPI for Mathematics in the Sciences

25.09.07 *Auf dem Sofa mit Albrecht Beutelspacher*
Mathematikum, Gießen

30.01.08 *Verknotete Mathematik*
Hobit, Darmstadt

06.11.08 *Unendlichkeit – Aus der Nähe betrachtet*
ETH Zürich

13.11.08 *Verknotete Mathematik*
Dilthey Schule, Wiesbaden

Laurenţiu Leuştean

08.03.07 *Proof mining in fixed point theory*
Max-Planck Institute for Mathematics, Bonn, Germany

25.03.07 *Approximate fixed points of nonexpansive mappings*
Max-Planck Institute for Mathematics, Bonn, Germany

25.05.07 *Proof mining in fixed point theory*
TU Darmstadt, Germany

17.-22.07.07 *Logical methods in fixed point theory*
ICFPTA 2007 (The 8th International Conference on Fixed Point Theory and Applications), Chiang Mai, Thailand

11.-15.09.07 *Proof mining in nonlinear analysis*
Domains VIII and Computability Over Continuous Data Types, Novo-sibirsk, Russia

27.06.08 *Proof mining in ergodic theory and fixed point theory*
TU Darmstadt, Germany

10.-13.09.08 *Recent applications of proof mining in ergodic theory*
Colloquium Logicum 2008, Darmstadt, Germany

28.11.08 *Proof mining in metric fixed point theory and ergodic theory*
TU Darmstadt, Germany

Debora Mahlke

28.09.07 *Einsatzplanung von Speichern und Kraftwerken unter Integration von Windenergie*
BMBF Annual Meeting, Berlin

05.11.07 *Use of Energy Storages to Balance Regenerative Energy Supply and Consumers' Demand*
INFORMS Annual Meeting 2007, Seattle

19.11.07 *Lambda/Delta Method and Applications*
Optimization Seminar, TU Darmstadt

10.04.08 *Betriebsoptimierung zur ökonomischen Bewertung von Speichern unter Berücksichtigung regenerativer Energieeinspeisung*
BMBF Annual Meeting, Bochum

Alexander Martin

11.05.08 *Minimal Arrangements of Clos Networks*
SIAM Conference on Optimization, Boston, USA

Antonio Morsi

12.04.07 *Augmentierende Vektoren mit beschränktem Support*
Seminar on Optimization, Magdeburg

01.10.07 *Betriebsführung und Erneuerungsstrategien in der Wasserversorgung*
BMBF Workshop on Discrete-continuous optimization of complex dynamic water supply and urban drainage systems, Erlangen

12.06.08 *Betriebsführung in der Wasserversorgung*
BMBF Workshop on Discrete-continuous optimization of complex dynamic water supply and urban drainage systems, Wetzlar

29.07.08 *MILP Techniques for solving MINLPs*
Workshop on SCIP and MINLP, Darmstadt

Karl-Hermann Neeb

27.03.08 *Invariant cones in infinite dimensional Lie algebras and unitary representations*
Seminar Sophus Lie, Budapest

22.07.07 *Infinite dimensional Lie algebras beyond Kac–Moody and Virasoro algebras*
E. B. Vinberg's 70. Birthday, Bielefeld

05.07.08 *Invariant cones in infinite-dimensional Lie algebras*
Seminar Sophus Lie, Klausenburg (Rumänien)

18.09.08 *Semibounded representations of infinite-dimensional Lie groups*
Minisymposium Darstellungstheorie, DMV-Tagung, Erlangen

Nicole Nowak

05.09.08 *Production chains: An application from mechanical engineering*
CARIPLO Workshop on Numerical Linear and Nonlinear Stochastic Programming, University of Edinburgh

Martin Otto

24.07.08 *Bisimulation Invariance over Transitive Frames*
Workshop on Logic and Algorithms, Edinburgh

Andrea Peter

04.09.08 *Free-Flight Optimization*
OR 2008, Augsburg

27.09.08 *Free-Flight Optimization*
FRICO 2008, Heidelberg

Andreas Rößler

09.07.07 *Efficient Runge-Kutta methods for stochastic differential equations and mean-square stability analysis*
SciCADE 07, Saint-Malo, France

Rolf Roth

14.11.08 *Adjoint-based optimal control of the Navier-Stokes equations*
Collaborative Research Centre (SFB) 568 Klausurtagung, Seeheim-Jugenheim

Christine Schönberger

04.09.08 *Linearization Methods for the Optimization in Recovered Paper Production*
Operations Research 2008, Augsburg

27.09.08 *Prozess- und Layoutoptimierung in der Altpapieraufbereitung*
FRICO 2008, Heidelberg

Thomas Streicher

08.06.07 *Realizability vs. Forcing*
Methods of Proof Theory in Mathematics, Bonn

12.09.07 *Deriving Predicate Transformer Semantics for pGCL from its Direct Semantics*
Domains VII Workshop, Novosibirsk

08.04.08 *Sheaf Models for CZF Refuting Powerset and Full Separation*
Mathematical Logic: Proof Theory and Constructive Mathematics, Oberwolfach

23.09.08 *Towards a Logic of Sequential Computation: A synthetic account of Sequential Domain Theory*
Domains IX Workshop, Univ. Sussex

Fredrik Strömberg

27.03.07 *Hecke operators for Maass waveforms on $PSL(2, Z)$ with integer weight and eta multiplier.*
DMV Jahrestagung, Minisymposium on automorphic forms and automorphic representations, Berlin, Germany

Rudolf Wille

27.01.07 *Allgemeine Mathematik als Bildungskonzept für die Schule*
54. ErnstSchöderKolloquium, TU Darmstadt

03.02.07 *Capessimus - a game for conceiving concepts*
73. Arbeitstagung Allgemeine Algebra, Universität Klagenfurt

13.02.07 *Semantology as basis for Conceptual Knowledge Processing*
International Conference on Formal Concept Analysis 2007, Clermont-Ferrand, France

13.02.07 *The basic theorem on labelled line diagrams of finite concept lattices*
International Conference on Formal Concept Analysis 2007, Clermont-Ferrand, France

09.06.07 *Implicational concept graphs*
74. Arbeitstagung Allgemeine Algebra, Tampere, Finland

26.07.07 *Towards a semantology of music*
International Conference of Conceptual Structures 2007, Sheffield, England

26.10.07 *Contextual Logic as support for human thought and knowledge*
Fifth International Conference on concept lattices and their applications, Montpellier, France

20.01.08 *Allgemeinbildung und Mathematik. Welche Mathematik sollte in der Schule gelernt werden?*
58. ErnstSchöderKolloquium, TU Darmstadt

25.02.08 *An algebraization of linear continuum structures*
International Conference on Formal Concept Analysis 2008, Université du Québec à Montréal, Canada

24.05.08 *Conceptual Knowledge Processing in Practice*
76. Arbeitstagung Allgemeine Algebra, Universität Linz, Austria

11.07.08 *Transdisciplinarity and Generalistic Sciences and Humanities*
International Conference of Conceptual Structures 2008, University of Toulouse II, France

15.08.08 *Gibt es Sprünge im Kontinuum?*
Roswitha Gymnasium, Bad Gandersheim

22.10.08 *The mathematical in music thinking*
Sixth International Conference on concept lattices and their applications, University of Olomouc, Czech Republic

Andrea Zelmer

28.09.07 *Netzwerkdesign gekoppelter Energieübertragungssysteme*
BMBF Annual Meeting, Berlin

05.11.07 *Design and Dimensioning of Coupled Energy Carrier Networks*
INFORMS Annual Meeting 2007, Seattle

19.11.07 *Lambda/Delta Method and Applications*
Optimization Seminar, TU Darmstadt

10.04.08 *Kostenoptimale Planung gekoppelter Strom-, Gas- und Wärmenetze*
BMBF Annual Meeting, Bochum

Jan Carsten Ziems

17.09.07 *Adaptive Multilevel Inexact SQP-Methods for PDE-constrained Optimization*
CFG 2007, Heidelberg

5.1.3 Visits

Benno van den Berg, University of Sheffield, March 2007

Benno van den Berg, University of Cambridge, March 2008

Benno van den Berg, University of Uppsala, September 2008

Achim Blumensath, University of Paris 7, 2008

Eyvind Martol Briseid, University of Oslo, 25.09.08

Regina Bruder and colleagues, didacta 2007 Köln, presentation of different web-sites for teaching and learning mathematics, 27.02.-03.03.2007

Regina Bruder and colleagues, didacta 2008 Stuttgart, presentation of different web-sites for teaching and learning mathematics, 19.-23.02.2008

Kristian Debrabant, Norwegian University of Science and Technology, Trondheim, Norway, March 2007

Kristian Debrabant, Norwegian University of Science and Technology, Trondheim, Norway, Sept./Oct. 2007

Kristian Debrabant, Norwegian University of Science and Technology, Trondheim, Norway, Sept./Oct. 2008

Reinhard Farwig, Guest professor at Nečas Center for Mathematical Modeling, Prague, March 01 to 14, 2007

Reinhard Farwig, Weierstraß–Institut für Angewandte Analysis und Stochastik Berlin, May 17 to 18, 2007

Reinhard Farwig, Guest professor at Tohoku University Sendai, August 19 to October 06, 2007

Reinhard Farwig, Technical University Niigata, September 15 to 18, 2007

Reinhard Farwig, Nečas Center for Mathematical Modeling, Prague, February 11 to 22, 2008

Reinhard Farwig, Guest professor (professeur invité) at University of Pau and Pays de l'Adour, July 2008

Matthias Geissert, Chalmers University of Technology, May 2007

Matthias Geissert, Arizona State University, November 2007

Matthias Geissert, Chalmers University of Technology, May 2008

Matthias Geissert, University of Pittsburgh, September - November 2008

Matthias Geissert, Arizona State University, November 2008

Björn Geißler, Otto von Guericke Universität Magdeburg, November, December 2007

Bettina Gottermeier, Rolls-Royce plc, Derby, England, June 23 - August 29 2008

Karsten Große-Brauckmann, Oberwolfach, Tagung Progress in Surface Theory, April 2007

Karsten Große-Brauckmann, IMPA, Rio de Janiero, September 2007

Karsten Große-Brauckmann, Matheon/TU Berlin, March 2008

Karsten Große-Brauckmann, Rom, Workshop Submanifolds, May 2008

Karsten Große-Brauckmann, Aspen Center of Physics, CO, USA, June 2008

Robert Haller-Dintelmann, Weierstraß Institute for Applied Analysis and Stochastics (WIAS), Berlin, October 2006 – September 2007 (Weierstraß Fellowship)

Robert Haller-Dintelmann, University of Valenciennes, France, January 2008

Sven Herrmann, University of California, Davis, October/November 2007

Matthias Hieber, WIAS, Berlin, January 2007

Matthias Hieber, Euler Institute, St. Petersburg, Russia , May 2007

Matthias Hieber, Academy of Sciences, Prague, Czech Republic, October 2010

Matthias Hieber, Arizona State University, Phoenix, USA, March 2008

Matthias Hieber, University of Mostaganem, Algeria, May 2008

Matthias Hieber, Academy of Sciences, Prague, Czech Republic, October 2008

Karl H, Hofmann, Tulane University, New Orleans, March 2007

Karl H, Hofmann, Tulane University, New Orleans, September 2007

Karl H, Hofmann, Tulane University, New Orleans, March 2008

Karl H, Hofmann, Tulane University, New Orleans, September 2008

Karl H, Hofmann, Tulane University, New Orleans, October 2008

Max Horn, Université Libre de Bruxelles, Belgium, December 2007

Max Horn, Universiteit Gent, Belgium, February 2008

Michael Joswig, TU Berlin, April 2008 – December 2008

Lennard Kamenski, University of Kansas, March-June 2007

Lennard Kamenski, University of Kansas, February-May 2008

Klaus Keimel, Louisiana State University, Baton Rouge, LA., USA, April 15-25, 2007

Klaus Keimel, Tsinghua University, Peking, China, May 5 – June 2, 2008

Klaus Keimel, East China Normal University, Shanghai, China, June 2–12, 2008

Ulrich Kohlenbach, Max-Planck-Institute for Mathematics, Bonn, March-June 2007

Ulrich Kohlenbach, Department of Philosophy, Stanford University, Stanford, USA, February-March 2008

Michael Kohler, Concordia University, Montreal, March 2008

Burkhard Kümmerer, Friedrich-Alexander-Universität Erlangen-Nürnberg, May 2007

Burkhard Kümmerer, MPI for Mathematics in Sciences, Leipzig, June 2007

Burkhard Kümmerer, MPI for Mathematics in Sciences, Leipzig, October 2007

Burkhard Kümmerer, Univ. of Nijmegen, ca. 5 visits in 2007/2008

Jens Lang, University of Kansas, March 2008

Laurenţiu Leuştean, Max Planck Institute for Mathematics, Bonn, March 1 - April 15, 2008

Antonio Morsi, Otto-von-Guericke-Universität Magdeburg, 14.11.07 - 15.11.07, 03.12.07 - 04.12.07

Karl-Hermann Neeb, EPFL Lausanne, October 2008

Martin Otto, Computer Laboratory, Cambridge, October 26-November 2, 2007

Martin Otto, Oxford University Computing Laboratory, November 5-10, 2007

Martin Otto, Institute of Logic Language and Computation, Amsterdam, December 3-8, 2007

Ulrich Reif, University of Texas at Austin, March 2007

Ulrich Reif, University of Texas at Austin, January 2008

Ulrich Reif, TU Graz, Mai 2008

Ulrich Reif, Tsinghua University at Beijing, September 2008

Klaus Ritter, University of Bath, November 2007

Klaus Ritter, University of Oxford, November 2007

Klaus Ritter, University of Jyväskylä, January-February and August 2008

Steffen Roch, IPN Mexico/City, February-March 2007

Steffen Roch, Penn. State University, College Park/USA, July 2008

Lars Schewe, CWI Amsterdam, October 2007 – December 2007

Lars Schewe, Hausdorff-Insitute Bonn, February 2008 – April 2008

Wilhelm Stannat, Institut Mittag-Leffler, September 2007, December 2007

Wilhelm Stannat, TU Berlin, August 2008

Thomas Streicher, Univ. Paris 7, Januar/February 2007

Stefan Ulbrich, University of Oxford, November 2007

Stefan Ulbrich, Rice University, May to June 2008

Stefan Ulbrich, TU München, June 2008

Stefan Ulbrich, Rice University, September 2008

5.2 Organization of Conferences and Workshops

Regina Bruder

- German ISTRON-Conference, Darmstadt, November 7-9, 2008

Jan H. Bruinier

- AKLS-Seminar on *Automorphic Forms* (jointly with V. Gritsenko, A. Krieg, G. Nebe, N.-P. Skoruppa), 17.01.07 Köln, 04.04.07 Aachen, 06.06.07 Siegen, 21.11.07 Lille, 12.03.08 Aachen, 23.04.08 Bonn, 18.06.08 Siegen, 12.11.08 Lille

Stefan Bundfuss

- FRICO 2008, September 25–28, 2008, Heidelberg, Germany (jointly with Thorsten Bonato and Hanna Seitz)

Bálint Farkas

- Internet Seminar on Ergodic Theory (jointly with Rainer Nagel, Markus Haase, Tanja Eisner)

- Encounters between Discrete and Continuous Mathematics (jointly with Rainer Nagel, Abdelaziz Rhandi, András Bátkai, Marjeta Kramar-Fijavz)

- 7^{th} Summer School in Potential Theory, Baja, Hungary (jointl;y with Árpád Fekete, Béla Nagy, Szilárd Révész

Reinhard Farwig and Mariarosaria Padula

- Mathematical Fluid Mechanics, Joint Conference of DMV and UMI, Perugia, June 18 to 22, 2007

Reinhard Farwig, Jiři Neustupa and Patrick Penel

- Vorticity, Rotation and Symmetry - Stabilizing and Destabilizing Fluid Motion, Centre International de Rencontres Mathématiques (CIRM) in Luminy, May 19 to 23, 2008

Jaime Gaspar

- Algebra and Probability in Many-Valued Logics (jointly with Ioana Leustean et al)

Karsten Große-Brauckmann

- Section on "Geometric Analysis" at the DMV-Tagung Erlangen Sept. 2008 (jointly with Ulrich Dierkes and Steffen Fröhlich

Matthias Hieber

- Darmstadt Analysis Day (jointly with Reinhard Farwig), Darmstadt, January 30, 2007

- Wolfskehl Colloquium (jointly with Jan Brunier), Darmstadt, June 30, 2008

- Conference on Mathematical Fluid Dynamics (jointly with Matthias Geissert and Horst Heck), Darmstadt, September 8-11, 2008

- Darmstadt Analysis Day (jointly with Reinhard Farwig), Darmstadt, November 27, 2008

Michael Joswig

- "Discrete Mathematics on a Saturday", Frankfurt (jointly with Thorsten Theobald)

Klaus Keimel

- Conference on Foundations of Informatics, Computing, and Software (FICS'08), June 3–6, 2008. Member of the Programme Committee

- Joint Workshop Domains VIII and Computability over Continuous Data Types, Novosibirsk, Russia, September 11 to 15, 2007 (Ershov, Goncharov, Jung, Keimel, Kohlenbach, Morozov, Selivanov, Spreen)

- Workshop Domains IX, University of Sussex, UK, September 22 to 24, 2008 (Achim Jung, Klaus Keimel, Bernhard Reus, Thomas Streicher)

Ulrich Kohlenbach

- Member of PC of the "2007 European Summer Meeting of the Association for Symbolic Logic (ASL)", July 14-19, 2007, Wroclaw, Poland

- Member of PC of "Joint Workshop DOMAINS VIII and Computability over Continuous Data Types", September 11-15, 2007, Novosibirsk, Russia

- Organizer (with S. Buss and H. Schwichtenberg) of "Oberwolfach Workshop: Mathematical Logic: Proof Theory, Constructive Mathematics", April 6-12, 2008

- Organizer (together with G. Mints, Stanford, and B. Moroz, MPIM) of "Trimester on methods of proof theory in mathematics". Max Planck Institute for Mathematics, March-June 2007, Bonn

- Organizer (with G. Mints) of "Conference on Methods of Proof Theory in Mathematics", June 3-10, 2007, Max Planck Institute for Mathematics, Bonn

- Member of Program Committee for "WoLLIC 2008", Edinburgh, July 1-4, 2008, UK

- Organizer and PC Chair of "Colloquium Logicum", TU Darmstadt, Sept. 10-12, 2008

- Member of PC of "Colloquium Logicum", September 2010, Universität Münster

- Organizer (with S. Buss and M. Rathjen) of "Oberwolfach Workshop: Mathematical Logic: Proof Theory, Constructive Mathematics", 2011

Burkhard Kümmerer

- Program "Mathematical Horizons for Quantum Physics", Session 2: "Operator Algebras in Quantum Information", 11.-31.08.08, Institute for Mathematical Sciences and National University of Singapore, Singapore (jointly with Hans Maassen).

Jens Lang

- Minisymposium on Optimal control with PDEs on gas networks at ICIAM2007 (jointly with Alexander Martin)

Ulf Lorenz

- Workshop on Chess and Mathematics (jointly with T. Linss and J. Nievergelt and H.-G. Roos)

Alexander Martin

- Section on *Discrete and Combinatorial Optimization* at the International Symposium on Operations Research 2007, Saarbrücken, September 2007

- Member of the Organizing Committee of the SIAM Conference on Optimization, Boston, USA, May 2008.

Karl-Hermann Neeb

- Wilhelm Killing–Lie Theory and Geometry (Westfälische Wilhelms-Universität Münster), December 7 to 8, 2007; jointly with L. Kramer

Martin Otto

- Colloquium Logicum 2008 (jointly with Ulrich Kohlenbach and Thomas Streicher)

- Workshop on Logic and Computational Complexity, Wroclaw 2007 (jointly with Pawel Urzyczyn (PC co-chairs))

Ulrich Reif

- Industrial Challenges in Geometric Modeling and CAD, March 2007, Darmstadt (jointly with E. Quak)

- Industrial Challenges in Geometric Modeling and CAD, March 2008, Darmstadt (jointly with E. Quak)

Klaus Ritter

- 'Foundations of Computational Mathematics', Hong Kong, June 16–26, 2008, Session on ' Information-based Complexity' (jointly with I. Sloan)

- 'Monte Carlo and Quasi Monte Carlo Methods', Montreal, July 06–11, 2008, Scientific Committee

Lars Schewe

- Workshop MIP-PDE (jointly with Armin Fügenschuh, Martin Frank und Michael Herty)

Wilhelm Stannat

- Sektion "Stochastic Analysis", Stochastik Tage 2008, March 4-7, 2008, RWTH Aachen (jointly with Theo Sturm)

Thomas Streicher

- Colloquium Logicum 2008 (jointly with U. Kohlenbach, M. Otto)

Stefan Ulbrich

- Invited Minisymposium "Large Scale Optimization and PDE-based Problems I-IV´´, SIAM Conference on Optimization, Boston, May 10–13, 2008, Boston, USA (jointly with Ph.L. Toint, M. Ulbrich)

- Minisymposium "Optimization with PDEs", 13th Czech-French-German Conference on Optimization Heidelberg, September 17–21, 2007

6 Workshops and Visitors at the Department

6.1 Mathematisches Kolloquium

Winter term 2006/2007

18.10.06. Prof. Dr. Wilhelm Stannat (TU Darmstadt), *Neue Herausforderungen für die Stochastik aus dem Bereich der Signalverarbeitung*

25.10.06. Prof. Dr. Nina N. Uralceva (St. Petersburg University), *Two-phase obstacle problem*

01.11.06. Prof. Dr. Erich Grädel (RWTH Aachen), *Wie gewinnt man unendliche Spiele?*

08.11.06. Prof. Dr. Karsten Urban (Universität Ulm), *Reduzierte Basis-Methoden für Partielle Differentialgleichungen*

15.11.06. Prof. Dr. Rudolf Seiler (TU Berlin), *e-Learning im universitären Mathematikunterricht: Didaktische Konzepte, Technologie, Erfahrungen und Ziele*

22.11.06. Prof. Dr.-Ing. Rupert Klein (Freie Universität Berlin und Potsdam-Institut für Klimafolgenforschung), *Mathematische Modellierung von Atmosphärenströmungen*

29.11.06. Prof. Dr. Martin Henk (Universität Magdeburg), *Nullstellen von Ehrhartpolynomen*

06.12.06. Prof. Dr. Joachim Naumann (Humboldt-Universität Berlin), *Gilt Energieerhaltung in wärmeleitenden, viskosen, inkompressiblen Flüssigkeiten?*

13.12.06. Prof. Dr. Michael Röckner (Universität Bielefeld), *Ein analytischer Zugang zu stochastischen partiellen Differentialgleichungen*

20.12.06. Prof. Dr. Matthias Baaz (TU Vienna), *Skolemfunktionen - verborgene Beweiselemente*

10.01.07. Celebration colloquium on the occasion of the advent of the retirement of Prof. Dr. Walter Trebels: Prof. Dr. Andreas Seeger (University of Wisconsin-Madison, Wisconsin), *Fragestellungen der modernen harmonischen Analysis*

17.01.07. Prof. Dr. Bärbel Barzel (Pädagogische Hochschule Freiburg), *Offener Unterricht? Computeralgebra? - Dafür bleibt keine Zeit...*

24.01.07. Prof. Dr. Peter Littelmann (Universität Köln), *Über hermitesche Matrizen, Kombinatorik, Schubert–Kalkül und Darstellungstheorie*

31.01.07. Prof. Dr. Ursula Gather (Universität Dortmund), *Bruchpunkt und Gruppen*

07.02.07. Prof. Dr. Karl Kunisch (TU Graz), *Kontrolle reduzierter Ordnung und approximative invariante Mannigfaltigkeiten*

Summer term 2007

18.04.07. Prof. Dr. Manfred Lehn (Universität Mainz), *Holomorph symplektische Mannigfaltigkeiten*

25.04.07. Prof. Dr. Henryk Woźniakowski (Warsaw University and Columbia University, New York), *Tractability of Multivariate Numerical Problems*

02.05.07. Dr. Gilbert Greefrath (Bergische Universität Wuppertal), *Modellbildungs- und Problemlöseprozesse bei Schülerinnen und Schülern bei der Bearbeitung offener realitätsbezogener Aufgaben*

09.05.07. Prof. Dr. Patrick Penel (University of the South, Toulon-Var), *Remarkable Properties in Mathematical Fluid Mechanics*

16.05.07. Prof. Dr. Thorsten Theobald (Universität Frankfurt), *Semidefinite Optimierung und reelle algebraische Geometrie*

23.05.07. Prof. Dr. Harald Upmeier (Universität Marburg), *Nicht-konvexe Hardy-Räume und Toeplitz-Operatoren*

30.05.07. Graduation ceremony for winter term 2006/2007 and summer term 2007: Prof. Dr. Jürgen Lehn (TU Darmstadt), *Die Vertreibung jüdischer Mathematiker im Dritten Reich*

06.06.07. Prof. Dr. Konrad Polthier (Freie Universität Berlin), *Anwendungen der diskreten Differentialgeometrie im "Reverse Engineering"*

13.06.07. Prof. Dr. Wolfgang Näther (TU Bergakademie Freiberg), *Einige Resultate zur Statistik mit unscharfen Daten*

20.06.07. Prof. Dr. Uwe Zimmermann (TU Braunschweig), *Folgenpartitionen, Graphfärbungen und Rangieren auf Gleisen*

27.06.07. Prof. Dr. Knut Radbruch (TU Kaiserslautern), *Literatur als Medium einer Kulturgeschichte der Mathematik*

04.07.07. Prof. Dr. Thomas Ehrhard (University of Paris 7, Paris), *A Functional Analytic Model of Linear Logic and Parallel Processes*

11.07.07. Prof. Dr. Robert D. Russell (Simon Fraser University, Vancouver, B.C.), *An overview of adaptive methods for the numerical solution of PDEs*

18.07.07. Prof. Dr. Joachim Stöckler (Universität Dortmund), *Waveletmethoden für Unterteilungsalgorithmen*

Winter term 2007/2008

17.10.07. Prof. Dr. Anne Prescott (University of Technology Sydney), *Student and Teacher Misconceptions about Projectile Motion*

24.10.07. Prof. Dr. Alexander G. Ramm (Kansas State University, Manhattan), *The Pompeiu Problem*

31.10.07. Prof. Dr. Franz Pedit (Universität Tübingen), *Konform immersierte Tori und die Willmore-Vermutung*

07.11.07. Prof. Dr. Gunter Malle (TU Kaiserslautern), *Zählen von Zahlkörpern*

14.11.07. Prof. Dr. Michael Dellnitz (Universität Paderborn), *Zur Approximation von Transportphänomenen*

21.11.07. Dr. habil. Ilka Agricola (Humboldt-Universität Berlin), *100 Jahre G_2 - eine Ausnahme-Gruppe mit Ausnahme-Eigenschaften*

28.11.07. Prof. Dr. Klaus Ambos-Spies (Universität Heidelberg), *Schwache Vollständigkeitsbegriffe in der Komplexitätstheorie*

05.12.07. Prof. Dr. Roland Fried (Universität Dortmund), *Graphische Modelle und die Analyse von Ereignissen in multivariaten Zeitreihen*

12.12.07. Prof. Dr. Andreas Eichler (Universität Münster), *Individuelle, tatsächliche und realisierte Curricula – ein ganzheitlicher Blick*

19.12.07. Prof. Dr. Kai-Uwe Bux (University of Virginia, Charlottesville), *Was heißt und zu welchem Ende studiert man geometrische Gruppentheorie?*

09.01.08. Prof. Dr. Bernd Hofmann (TU Chemnitz), *Das Inkorrektheitsphänomen bei inversen Problemen und wie man es in der Finanzmathematik überwindet*

16.01.08. Prof. Dr. René Schilling (TU Dresden), *Feller-Prozesse: eine Brücke zwischen Analysis und Stochastik*

23.01.08. Prof. Dr. Yoshihiro Shibata (Waseda University, Tokio), *Spectral Analysis of the Stokes Equation and Application to the Navier-Stokes Equation*

30.01.08. Prof. Dr. Jan Hendrik Bruinier (TU Darmstadt), *L-Funktionen und ihre Bedeutung in Geometrie und Arithmetik*

Summer term 2008

02.04.08. Prof. Dr. Michael Kohler (TU Darmstadt), *Wie verkaufe ich eine Amerikanische Option optimal?*

09.04.08. Prof. Dr. techn. Dieter Fellner (Fraunhofer-Institut für Graphische Datenverarbeitung Darmstadt), *Generatives Modellieren*

16.04.08. Prof. Dr. Martin Grohe (Humboldt-Universität Berlin), *Wie berechnet man verbotene Minoren?*

23.04.08. Prof. Dr. Chris Budd (University of Bath), *Parabolic Monge-Ampère Methods for Mesh Generation*

30.04.08. Prof. Dr. Rüdiger Frey (Universität Leipzig), *Kreditrisikomodellierung und Kreditderivate - eine Herausforderung für Mathematiker*

07.05.08. Prof. Dr. Mike Giles (University of Oxford), *Multilevel Monte Carlo path simulation*

14.05.08. Prof. Dr. Pablo Ramacher (Universität Göttingen), *Zur Eigenwertverteilung eines invarianten elliptischen Operators*

21.05.08. Akad. Oberrat i.R. Dr. Gerhard Betsch (Universität Tübingen), *Alexander BRILL und die mathematischen Modelle seiner Zeit - ein Kapitel "anschauliche Geometrie" mit lokalem Bezug*

28.05.08. Graduation Ceremony for winter term 2007/2008 and summer term 2008: Prof. Dr. Albrecht Beutelspacher (Universität Giessen), *Mathematische Experimente*

04.06.08. Prof. Dr. Hideo Kozono (Tohoku University Sendai), *Leray's Problem on the Stationary Navier-Stokes Equations*

11.06.08. Prof. Dr. Reinhard Werner (TU Braunschweig), *Die Welt als Computer: Zur Komplexität physikalischer Dynamik*

18.06.08. Prof. Dr. Reinhard Farwig (TU Darmstadt), *Wenn Flüssigkeiten rotierende Körper umströmen ...*

25.06.08. Prof. Dr. Achim Klenke (Universität Mainz), *Katalytisches Verzweigen - ein populationsdynamisches Modell*

02.07.08. Celebration colloquium on the occasion of the advent of the retirement of Prof. Dr. Christian Herrmann: Prof. Dr. Friedrich Wehrung (University of Caen), *Modular lattices and regular rings*

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"*

6.2 Seminar Lectures

07.02.07. Assoc. Prof. Dr. Anne Kværnø (Norwegian University of Science and Technology), *Exponential integrators*

29.01.08. Assoc. Prof. Dr. Anne Kværnø (Norwegian University of Science and Technology), *Dynamic behavior of moving mesh partial differential equations*

15.01.08. Dr. Petra Csomós (Hungarian Meteorological Service and Eötvös Loránd University, Budapest), *Theoretical and numerical analysis of operator splitting procedures*

02.11.07. Prof. Dr. Rainer Nagel, Dr. Tanja Eisner (Universität Tübingen), *Ein funktionalanalytischer Blick auf arithmetische Progressionen*

16.10.07. Prof. Dr. Luca Lorenzi (University of Parma), *Nonautonomous Kolmogorov parabolic equations with unbounded coefficients*

24.05.07. Dr. Abdelhadi Es-Sarhir (Leiden University), *Existence and uniqueness of the invariant measure for transition semigroups related to Burgers-type equations*

06.03.07. Prof. Dr. Szilárd Révész (Rényi Institute, Budapest), *Concentration of idempotent trigonometric polynomials*

30.01.07. Dr. Hideyuki Miura (Tohoku University Sendai and MPI Leipzig), *Remark on Koch-Taturu's solution to the Navier-Stokes equations*

30.01.07. Prof. Dr. Zdeněk Skalák (Technical University, Prag), *Decays of some strong global solutions of the Navier-Stokes equations in short time intervals*

30.01.07. Dr. Mads Kyed (RWTH Aachen), *On a stationary flow with nonzero velocity at infinity past an elastic body*

30.01.07. Dr. Petr Kaplický (Charles University, Prag), *Fluids with shear and pressure dependent viscosity - regularity of stationary planar flow*

30.01.07. Dr. habil. Lars Diening (Universität Freiburg), *The Lipschitz truncation method*

09.05.07. Prof. Dr. Patrick Penel (University of the South, Toulon-Var), *Remarkable properties in mathematical fluid mechanics*

12.07.07. Dr. L. Zaleskis (Universität Vilnius), *Coercive estimates to the Stokes problem in parabolically growing layer*

04.06.08. Prof. Dr. Hideo Kozono (Tohoku University Sendai, Japan), *Leray's problem on the stationary Navier-Stokes equations*

18.06.08. Prof. Dr. Taku Yanagisawa (Nara Women's University, Japan), *Leray's problem on the stationary Navier-Stokes equations and Leray's inequality*

15.10.08. Prof. Dr. Friedemann Schuricht (TU Dresden), *Kontakt elastischer Körper: Schwierigkeiten und deren Behandlung*

11.04.08. Prof. Dr. Robert Kusner (University of Massachusetts), *Holomorphic differentials and surface theory*

11.04.08. Prof. Dr. Jürgen Wolfart (Universität Frankfurt), *Hurwitz surfaces*

01.02.08. Dr. Matthias Schneider (Universität Heidelberg), *Kurven mit vorgeschriebener geodätischer Krümmung*

01.02.08. Prof. Dr. Friedrich Tomi (Universität Heidelberg), *Das Plateau-Problem für nicht-kompakte Kurven*

16.10.07. Prof. Dr. Simundur Gudmundsson (University of Lund), *Harmonic morphisms from Lie groups and symmetric spaces*

16.10.07. Prof. Dr. Christoph Böhm (Universität Münster), *Ricci flow in higher dimensions*

22.06.07. Prof. Dr. Yuxiang Li (Universität Freiburg), *Some Applications of capacity in geometric PDEs concerning Moser-Trudinger inequalities*

22.06.07. Dr. Reto Müller (ETH Zürich), *Differential Harnack inequalities and monotone quantities*

02.06.07. Dr. Tobias Lamm (MPI Golm), *Approximationen von harmonischen Abbildungen*

02.06.07. Prof. Dr. Wolfgang Reichel (Universität Gießen), *Approximationen von harmonischen Abbildungen*

20.04.07. Dr. Philipp Reiter (RWTH Aachen), *Sind Knoten endlicher Energie differentierbar?*

20.04.07. Dr. Simon Blatt (RWTH Aachen), *Eine Bogen-Sehnen-Bedingung für Untermannigfaltigkeiten beliebiger Kodimension*

30.01.07. Prof. Alessandra Lunardi (University of Parma, Italy), *Time dependent Ornstein-Uhlenbeck operators and invariant measures*

30.01.07. Onno van Gaans (Leiden University, Netherlands), *Invariant measures for stochastic delay equations*

30.01.07. Hideyuki Miura (Tohuko University, Sendai, Japan), *Remark on the Koch-Tataru's solution to the Navier-Stokes equations*

10.05.07. Stefano Cardanobile (Universität Ulm), *Parabolische Systeme von partiellen Differentialgleichungen: ein variationeller Zugang*

24.05.07. Abdelhadi Es-Sarhir (Leiden University, Netherlands), *Existence and uniqueness of the invariant measure for transition semigroups related to Burgers-type equations*

20.06.07. Yoshihiro Shibata (Waseda University, Tokyo, Japan), *Navier-Stokes flow past rotating obstacles, Part I*

21.06.07. Yoshihiro Shibata (Waseda University, Tokyo, Japan), *Navier-Stokes flow past rotating obstacles, Part II*

16.10.07. Luca Lorenzi (University of Parma), *Nonautonomous Kolmogorov parabolic equations with unbounded coefficients*

23.10.07. Tomoyuki Suzuki (Osaka University, Japan), *Regularity of weak solutions to the Navier-Stokes equations in unbounded domains, Part I*

24.10.07. Dr. Tomoyuki Suzuki (Osaka, Japan), *Regularity of weak solutions to the Navier-Stokes equations in unbounded domains, Part II*

07.11.07. Rainer Nagel (Universität Tübingen), *Ein funktionalanalytischer Blick auf arithmetische Progessionen I*

07.11.07. Tanja Eisner (Universität Tübingen), *Ein funktionalanalytischer Blick auf arithmetische Progessionen II*

22.11.07. Yutaka Terasawa (Sapporo University, Japan), *On Stokes-like Operators with Variable Viscosity in Bounded and Unbounded Domains*

22.01.08. Yoshihiro Shibata (Waseda University, Tokyo, Japan), *Oseen flow past rotating obstacles*

24.01.08. J"urgen Saal (Universität Konstanz), *The Newton Polygon Approach to Mixed Order Systems*

13.02.08. Herbert Amann (University of Zurich, Switzerland), *Zur mathematischen Modellierung von intelligenten Grenzflächen*

24.06.08. Daniel Daners (University of Sydney, Australia), *Zur Faber-Kahn Ungleichung*

27.11.08. Yoshihiro Shibata (Waseda University, Tokyo, Japan), *Resolvent estimates for Oseen flows*

27.11.08. Peer Kunstmann (KIT Karlsruhe), *The Navier-Stokes equations in general domains*

26.11.08. Yoshihiro Shibata (Waseda University, Tokyo, Japan), *Maximal regularity for certain free boundary value problems related to the Navier-Stokes equations, Part I*

27.11.08. Yoshihiro Shibata (Waseda University, Tokyo, Japan), *Maximal regularity for certain free boundary value problems related to the Navier-Stokes equations, Part II*

09.01.07. Anders Jensen (Aarhus Universitet), *Maximal lattice free bodies, Frobenius numbers and test sets*

22.02.07. Dr. Gunnar Wilken (Westfälische Wilhelms-Universität Münster), *Elementary Patterns of Resemblance Applications of Resource-bounded Measure*

22.02.07. Dr. Philippe Moser (Centro Politécnico Superior, Zaragoza), *Applications of Resource-bonded Measure Theory in Derandomization and Computable Analysis*

27.02.07. Dr. Björn Kjos-Hanssen (Cornell University, Ithaca, USA), *Brownian Motion and Kolmogorov Complexity*

16.04.08. Prof. Dr. Martin Grohe (Humboldt-Universität, Berlin), *Wie berechnet man verbotene Minoren?*

22.06.07. Dr. Jayme Gaspar (Lisbon, Portugal), *A Direct Bounded Functional Interpretation of Peano Arithmetic*

30.10.07. Prof. Dr. Maciej Maczynski (Warsaw University of Technology), *Boolean Algebras in Mathematics, Physics and Cryptography*

01.02.08. Prof. Victor Selivanov (Novosibirsk State Pedagogical University), *Definability in the h-Quasiorder of Labeled Forests (a joint work with Oleg Kudinov and Anton Zhukov)*

13.03.08. Dr. Mark Weyer (Humboldt-Universität, Berlin), *Zum Boundedness-Problem von MSO*

14.03.08. Dr. Michal Stonkowski (Warsaw University of Technology), *Subreducts of Modules*

20.03.08. Prof. Dr. Vasco Brattka (University of Capetown), *Algorithmische Zufälligkeit und Darstellungen reeller Zahlen*

01.04.08. Dr. Martin Ziegler (Universität Paderborn), *Kolmogorov Complexity Theory over the Reals*

01.04.08. Dr. Robert Rettinger (Fernuniversität Hagen), *Schnelle Berechnung von Julia-Mengen*

15.06.08. Dr. Vadim Puzarenko (Sobolev Institute of Mathematics, Novosibirsk), *Omega-logic and Omega-structures*

10.07.08. Prof. Dr. Fred Wehrung (Universite de Caen, CNRS), *Large Lattices of Small Breadth*

10.09.08. Prof. Dr. Nicole Schweikardt (J.-W.-Goethe-Universität Frankfurt), *Gaifman's Locality Theorem Revisited*

10.09.08. Prof. Dr. Michiel van Lambalgen (University of Amsterdam), *Logic in a Neuroscience Lab*

11.09.08. Prof. Dr. Sergey Goncharov (Novosibirsk State University), *On Two Problems of Turing Complexity for Strongly Minimal Theories*

11.09.08. Prof. Dr. Joel David Hamkins (City University of New York), *Set-Theoretic Geology*

11.09.08. Prof. Dr. Georg Kreisel (F.R.S., Salzburg), *Aspects of Herbrand's These: Combinations with Contemporary Ideas and Relations to Foundational Perennials*

12.09.08. Prof. Dr. Robert Lubarsky (Florida Atlantic University), *Topological Semantics with Settling*

29.01.07. Prof. Dr. Roland Speicher (Univ. of Kingston, Kanada), *Freie Wahrscheinlichkeitstheorie und Zufallsmatrizen*

09.01.07. Anders N. Jensen (Aarhus University, Denmark), *Maximal lattice free bodies, Frobenius numbers and test sets*

24.04.07. Prof. Dr. Zbigniew Lonc (Politechnika Warszawska, Poland), *Greedy algorithms for computing minimal transversals in uniform hypergraphs*

24.04.07. Dr. Konstanty Szaniawski (Politechnika Warszawska, Poland), *Generalizations of Sperner Lemma*

02.05.07. Prof. Dr. Dorit S. Hochbaum (University of California, Berkeley, USA), *Ranking sports teams, web pages, academic papers, NSF proposals and more with optimization techniques*

29.05.07. Lena Rodriguez-Ojea (University of Havanna, Cuba), *Introduction into estimation distribution algorithms*

12.06.07. Prof. Dr. Volker Kaibel (Universität Magdeburg), *Polyedrische Aspekte der Symmetriebrechung in der Ganzzahligen Linearen Optimierung*

26.06.07. Prof. Dr. Christian Haase (Freie Universität Berlin), *Permutation polytopes*

08.10.07. Dr. Jan Christoph Wehrstedt (TU München), *Formoptimierung mit Variationsungleichungen als Nebenbedingung und eine Anwendung in der Kieferchirurgie*

29.10.07. Prof. Dr. Volker Schulz (Universität Trier), *Herausforderungen und Lösungsansätze bei der aerodynamischen Formoptimierung*

26.11.07. Evandro Bracht (University of Campinas, Brazil), *Approximation Algorithms*

05.12.07. Dr. Thorsten Koch (Konrad-Zuse-Zentrum für Informationstechnik Berlin), *Optimizing the landside operation of a container terminal*

05.12.07. Xin Liu (Chinese Academy of Sciences, Beijing, China), *New Efficient Sampling Methods for Distance Geometry Problems*

05.12.07. Peipei Yao (Chinese Academy of Sciences, Beijing, China), *Discussion on Mathematical Modelling of Financial Market*

11.12.07. Dr. Konstanty Junosza-Szaniawski (Politechnika Warszawska, Poland), *Finding Covering and Partition in Time* $O(2^n)$

17.12.07. Dr. Alexander Zock (ECAD Darmstadt), *System Dynamics in der Praxis: Beispiele aus der Luftverkehrsindustrie*

07.04.08. Prof. Dr. Kay Hamacher (TU Darmstadt, Department of Biology), *Global Optimization: a challenge in theoretical physics*

26.05.08. Fernando Mã¡rio de Oliveira Filho (Centrum voor Wiskunde en Informatica, Amsterdam, The Netherlands), *The Lovász theta number for infinite graphs on the sphere*

19.06.08. Prof. Dr. Robert E. Bixby (Rice University, Houston, USA), *Recent Advances in Computational Linear and Mixed-Integer Programming*

01.07.08. Dr. Dennis Michaels (Universität Magdeburg), *Novel Convex Underestimators and their Application to the Synthesis of Combined Reaction Distillation Processes*

02.07.08. Kerstin Dächert (Bergische Universität Wuppertal), *Einführung in die multikriterielle Optimierung*

21.07.08. Irma Hernandez Magallanes (University of California Berkeley, USA), *Seasonality & Volatility: Applications to Time Series and Point Processes*

21.07.08. Erick Moreno Centeno (University of California Berkeley, USA), *Country credit-risk rating aggregation via the separation-deviation model*

01.09.08. Aditya Amah (TU Darmstadt, Graduate School of Computational Engineering), *Multi-antenna multi-user two way relaying*

09.09.08. Dr. Carlos E. Ferreira (Universidade de São Paulo, Brazil), *A polyhedral investigation of the LCS problem and a repetition-free variant*

19.09.08. Sebastian Stiller (TU Berlin), *A Constant-Approximate Feasibility Test for Multiprocessor Real-Time Scheduling*

28.10.08. Milan Studený (Academy of Sciences of the Czech Republic, Prague), *Geometric View on Learning Bayesian Network Structures*

02.12.08. Katrin Becker (TU Darmstadt, Department of Chemistry), *Modellierung mikrostruktureller Polymereigenschaften*

02.12.08. Thomas Herrmann (TU Darmstadt, Department of Chemistry), *Modellierung technischer LDPE - Hochdruck - Reaktoren*

12.12.08. Dr. Sebastian Pokutta (KDB Krall Demmel Baumgarten, Frankfurt am Main), *The Gomory-Chvátal Procedure for Polytopes in the 0/1-Cube*

16.01.07. Jinpeng An (Universität Zürich), *Twisted conjugacy of Lie groups and nonabelian cohomology*

24.04.07. Daniel Beltita (Rumanian Academy of Sciences, Bucharest), *Lie theoretic applications of averaging over amenable groups*

31.05.07. Georg Hofmann (Univ. of Dalhousie, Halifax/Canada), *Wurzelmengen und Symmetriegruppen*

19.06.07. Melika Ait Ben Haddou (Univ. Meknes/Marokko), *Roots in hyperbolic Lie algebras*

05.07.07. Hendrik Grundling (University of NSW, Sydney), *The resolvent algebra of the canonical commutation relations*

30.10.07. Rezso Lovas (Univ. Debrecen/Ungarn), *Finslergeometrie*

08.01.08. Ivan Dimitrov (Queens Univ./Kanada; MPI Bonn), *Borel-Weil-Bott theorem and cup product on homogeneous varieties*

22.01.08. Arlo Caine (Univ. of Arizona; MPI Bonn), *Symmetric spaces, triangular factorization, and Poisson geometry*

08.04.08. Matthias Peters (Univ. Luxembourg), *Geometric quantisation and the orbit method for compact Lie groups*

15.04.08. Bogdan Popescu (Rumanian Academy of Sciences, Bucharest), *Lie group structures on infinite dimensional transformation groups*

16.06.08. Kishore Marathe (City Univ. New York), *Geometric Topology and Physics*

01.07.08. Christoph Zellner (LMU München), *Base Change for Weak Bialgebras from Subfactors*

Nov. 08. Daniel Beltita (Rumanian Academy of Sciences, Bucharest), *Genuinely Geometric Features of Operator Algebras; 6 Lectures*

03.05.07. Prof. Dr. Sigurd Assing (University of Warwick), *New ideas on the Markov field property of the solution of the stochastic heat equation*

10.05.07. Prof. Dr. Dirk Blömker (Universität Augsburg), *Eine SPDE zur Modellierung von Oberflächenwachstum*

24.05.07. PD Dr. Norbert Hofmann (Aareal Bank Wiesbaden), *Modellierung von Kreditrisiken mit CreditRisk+*

28.06.07. Frank Aurzada (TU Berlin), *Das Quantizierungsproblem für Lévyprozesse*

08.05.08. Prof. Dr. Andreas Eberle (Universität Bonn), *Quantitative approximations of evolving probability measures*

30.10.08. Dipl.-Math. Daniel Rudolf (Universität Jena), *Markov Chain Monte Carlo - Explizite Fehlerschranken*

04.11.08. Dr. Hiroshi Kawabi (Okayama University, Japan), *Riesz transforms associated with diffusion operators on a path space with Gibbs measures*

13.11.08. Dipl.-Math. Christoph Eisinger (Universität des Saarlandes), *Nichtparametrische Regressionsschätzung mit zusätzlichen Messfehlern in beiden Variablen*

16.01.07. Prof. Dr. Vladimir Rabinovich (IPN Mexico-City), *Pseudodifference operators and signal processing*

08.01.08. Prof. Dr. Evgeny Korotyaev (Humboldt-Universität Berlin), *A trace formula and high energy spectral asymptotics for the perturbed Landau Hamiltonian*

07.11.08. Prof. Dr. Dennis A. Hejhal (University of Uppsala and University of Minnesota Minneapolis), *Some remarks on primes, zeros, and Weyl's law.*

29.10.07. Prof. Dr. Volker Schulz (Universität Trier), *Herausforderungen und Lösungsansätze bei der aerodynamischen Formoptimierung*

08.10.07. Dr. Jan Ch. Wehrstedt (TU München), *Formoptimierung mit Variationsungleichungen als Nebenbedingung und eine Anwendung in der Kieferchirurgie*

26.06.08. Prof. Dr. Wilhelm Weber (METU Ankara), *Environmental and Life Sciences: Gene-Environment Networks and their Dynamics*

6.3 Guests

Prof. Dr. Anne Prescott, University of Technology Sydney, October 2007.

Assoc. Professor Dr. Anne Kværnø, Norwegian University of Science and Technology, Trondheim, Norway, February 2007.

Assoc. Professor Dr. Anne Kværnø, Norwegian University of Science and Technology, Trondheim, Norway, January to February 2008.

Dr. Hideyuki Miura, Tohoku University Sendai and MPI Leipzig, January 2007.

Prof. Dr. Zdeněk Skalák, Technical University, Prague, January 2007.

Dr. Mads Kyed, RWTH Aachen, January 2007.

Dr. Petr Kaplický, Charles University, Prague, January 2007.

Dr. habil. Lars Diening, Universität Freiburg, January 2007.

Prof. Dr. Christian Simader, Universität Bayreuth, February 2007.

Prof. Dr. Patrick Penel, University of the South, Toulon-Var, May 2007.

Dr. L. Zaleskis, Universität Vilnius, July 2007.

Prof. Dr. Jiři Neustupa, Charles University, Prague, November 2007.

Prof. Šarka Nečasová, Czech Academy of Sciences, Prague, December 2007.

Prof. Dr. Toshiaki Hishida, Nagoya University, Japan, May 2008.

Prof. Dr. Hideo Kozono, Tohoku University Sendai, Japan, May to July 2008.

Prof. Dr. Taku Yanagisawa, Nara Women's University, Japan, June 2008.

Prof. Dr. Friedemann Schuricht, TU Dresden, October 2008.

Prof. Dr. Jiři Neustupa, Charles University, Prague, November 2008.

Evandro C. Bracht, Universidade Estadual de Campinas, October to December 2007.

Prof. Sidney A. Morris, University of Ballarat, Victoria, Australia, December 2008.

Anders Jensen, Aarhus University, Januar 2007.

Prof. Dimitry Palchunov and Prof. Gulnara Yakhyeva, State University of Novosibirsk, January 2007.

Prof. Yuri Ershov, Russian Academy of Sciences, Siberian Branch, December 2007.

Dr. Marina Semenova, Russian Academy of Sciences, Siberian Branch, November and December 2007.

Dr. Denis Ponomaryov, State University of Novosibirsk, May 2008.

Dr. Alexsey Stukachev, Russian Academy of Scienes, Siberian Branch, June and July 2008.

Dr. Vadim Puzarenko, Russian Academy of Sciences, Siberian Branch, July and August 2008.

Prof. Selivanov, Russian Academy of Sciences, Siberian Branch, May 2008.

Dr. Marina Semenova, Russian Academy of Sciences, Siberian Branch, June and July 2008.

Prof. Dr. Fred Wehrung, Universite de Caen, July 2008.

Prof. Alex Simpson, University of Edinburgh, June 2008.

Prof. Steve Awodey, Carnegie Mellon University, June 2008.

Prof. Sergey Goncharov, Russian Academy of Sciences, Siberian Branch, September 2008.

Prof. Anvar Nurakunov, Kirgisian Academy of Sciences, Dezember 2006 to April 2008.

Dr. Ioana Leustean, University of Bucharest, September 2007 to September 2009.

Prof. Dr. Adam Krzyżak, Concordia University, Montreal, June 2008.

Prof. Dr. Hans Maassen, University of Nijmegen, ca. 6 visits in 2007/2008.

Prof. Dr. Bob Russell, Simon Fraser University Vancouver, July 2007.

Bodo Erdmann, ZIB, April to May 2008.

Prof. Dr. Bernd Hofmann, TU Chemnitz, January 2008.

Prof. Dr. Chris Budd, University of Bath, June 2008.

Prof. Dr. Stefan Vandewalle, Katholieke Universiteit Leuven, December 2008.

Dr. Evandro Bracht, University of Campinas, Sao Paulo, Brasilia, October 2007 - January 2008.

Prof. Dr. Konstanty Junosza-Szaniawski, University of Warsaw, Poland, December 2007.

Lena Rodriguez, University of Havanna, Cuba, February - March 2008.

Prof. Dr. Robert Bixby, Rice University, Houston, TX, June 2008.

Prof. Dr. Dorit Hochbaum, University of California, Berkeley, CA, May, 2008.

Irma Hernandesz Magallanes, University of California, Berkeley, CA, July 2008.

Erik Monreno Centeno, University of California, Berkeley, CA, July 2008.

Prof. Daniel Beltita, Rumanian Academy of Sciences, Bucharest, April 2007.

Prof. Melika Ait Ben Haddou, Univ. Meknes/Marokko, June-August 2007.

Prof. Hendrik Grundling, University of NSW, Sydney, July 2007.

Dr. Rezso Lovas, Univ. Debrecen/Ungarn, September-October 2007.

Prof. Daniel Beltita, Rumanian Academy of Sciences, Bucharest, November 2008.

Dr. Henrik Seppänen, Göteborg Univ. (Schweden), October 2007-September 2009.

Dr. Stepahne Merigon, Univ. de Nancy, October 2008-September 2009.

Dr. Oleg Davydov, University of Strathclyde, October to December 2007.

Prof. Dr. Stefan Geiß, University of Jyväskylä, March 2007.

Prof. Dr. Vladimir Rabinovich, IPN Mexico-City, January to February 2007.

Prof. Dr. Vladimir Rabinovich, IPN Mexico-City, October 2007.

Prof. Dr. Evgeny Korotyaev, Humboldt-Universität Berlin, January 2008.

Prof. Dr. Vladimir Rabinovich, IPN Mexico-City, August to September 2008.

Prof. Kevin Burrage, Oxford University, July 2007.

Prof. Michael B. Giles, University of Oxford, May 2008.

Prof. Dr. Bülent Karasözen, METU, Ankara, June to July 2008.

Prof. Dr. Wilhelm Weber, METU, Ankara, June 2008.

Prof. Dr. Michael Ulbrich, TU München, April 2008.

6.4 Workshops and Conferences at the Department

- Four Teachertrainings: problemsolving, basics, computerbased learning mathematics (half day-training), (organized by R. Bruder and colleagues)

- Wolfskehl-Kolloquium, 30.06.08 (organized by Department of mathematics, TU Darmstadt)

- Darmstädter Analysis-Tag, 30.01.07 (organized by Reinhard Farwig and Matthias Hieber)

- Mathematical Fluid Dynamics, 27.11.08 (organized by Reinhard Farwig and Matthias Hieber)

- TUD/ZIB Workshop on Mixed Integer Nonlinear Programming, 29.07.2008 (organized by Thorsten Gellermann, Alexander Martin)

- Analysis Day, January 2007 (organized by Reinhard Farwig and Matthias Hieber)

- Analysis Day, November 2008 (organized by Reinhard Farwig and Matthias Hieber)

- Wolfskehl Colloqium, May 2008 (organized by Jan Bruinier and Matthias Hieber)

- Mathematical Fluid Dynamics, October 15 to 20, 2008 (organized by Matthias Geissert, Horst Heck and Matthias Hieber)

- "Conference: Colloquium Logicum 2008", September 10 to 12, 2008 (organized by U. Kohlenbach (with B. van den Berg, M. Otto and T. Streicher))

- German Research Foundation-Workshop "Geometry and Complexity in Information Theory", May 16 to 17, 2008 (organized by Burkhard Kümmerer)

- BMBF Workshop ODYSSEUS – Discrete-continuous optimization of complex dynamic water supply and urban drainage systems, January 14, 2008 (organized by Antonio Morsi)

- Seminar Sophus Lie, October 5 to 6, 2007 (organized by Karl-H. Neeb)

- Workshop on Nonlinear Approximation, June 29 and 30, 2007 (organized by Klaus Ritter)

6.5 Scientific and Industrial Cooperations

Hans-Dieter Alber

German Research Foundation (DFG) : Modelle für Evolution von Phasengrenzen bei diffusionslosen Übergängen und Phasengrenzdiffusion: Existenz von Lösungen und numerische Simulation, GZ: AL 333/4.

German Research Foundation (DFG): Inverse problems for the Stokes system, Mercator-fellowship for Prof. Dr. A. Ramm, Kansas-University.

German Academic Exchange Service (DAAD), Leonhard-Euler-award-program: Homogenization of Microstructures.

Pia Bales

Prof. Dr. Jens Lang (TU Darmstadt), Prof. Dr. Günter Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. Alexander Martin (TU Darmstadt): Modelling, Analysis, Simulation and Optimal Control of Gas Transport in Networked Pipelines. Supported by the German Research Foundation (DFG), 2006-2007.

Christian Brandenburg

Prof. Dr. Vincent Heuveline (Universität Karslruhe), Prof. Dr. Michael Ulbrich (TU München): Advanced numerical methods for PDE constrained optimization with application to optimal design and control of a racing yacht in the America s Cup. Supported by the German Research Foundation (DFG) within SPP 1253.

Regina Bruder

Texas Instruments, Mr. Stephan Griebel: 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.

IGD Darmstadt, Dr. Göbel: Quality of game-based learning.

PH Freiburg, Prof. Timo Leuders, Prof. Markus Wirtz: Research project for diagnostic of competencies (modelling, problem-solving).

ion2s, Agency for Interaction Darmstadt, Mr. Sauer: Third party certification of quality of E-Learning- Environments.

University of Kassel, Prof. Biehler: (Department of Mathematics) Development of bridge courses in Mathematics.

University of Melbourn, Prof. Kaye Stacey: Development of instruments for evaluation of learning-results in math-lessons.

University of Graz, Dr. Alexandra Sindler: Development of quality of E-Learning on both Universities (book-project).

Institut für Qualitätsentwicklung in Bildungswesen, Berlin, Dr. Claudia Pöhlmann: Begleitforschung zur Implementation der Bildungsstandards..

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.

Jan Hendrik 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. Jens Lang (TU Darmstadt), Prof. Dr. Stefan Ulbrich (TU Darmstadt): Adaptive multilevel SQP-methods for PDAE-constrained optimization with restrictions on control and state. Supported by the German Research Foundation (DFG), SPP 1253.

Kristian Debrabant

Assoc. Prof. Dr. Anne Kværnø (Norwegian University of Science and Technology, Trondheim): B-series analysis of stochastic approximation methods.

Assoc. Prof. Dr. Espen Robstad Jacobsen (Norwegian University of Science and Technology, Trondheim): Consistent and easy to implement monotone schemes for the Bellman equation of optimal control.

Prof. Dr. Mike Giles (Oxford University): Multilevel Monte-Carlo methods.

Jane Elsemüller

Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Bálint Farkas

Rainer Nagel, Tanja Eisner (Universität Tübingen), Markus Haase (Technical University of Delft): Ergodic theory and operator theory; iterated de Leeuw-Glicksberg decompositions.

Szilárd Révész (Rényi Institute): Fourier analysis and densities on groups; Periodic decomposition problems.

Luca Lorenzi (University of Parma): Hypoelliptic operators with unbounded coefficients.

Reinhard Farwig

'Personenbezogener Personenaustausch' (PPP) with the Czech Academy of Sciences and Charles University, Prague, Czech Republic: Mathematical Modeling of Fluid Flow in Unbounded Domains.

Prof. Dr. H. Sohr (Universität Paderborn): Regularity Theory of Instationary Navier-Stokes Equations.

Profs. Dr. E.A. Thomann and R.B. Guenther (Oregon State University, Corvallis, OR): Fundamental Solutions for Linearized Equations of Fluid Fow past Rotating Obstacles.

Prof. Dr. H. Sohr (Universität Paderborn): Navier-Stokes Equations with Nonhomogeneous Data.

Prof. Dr. H. Kozono (Tohoku University, Sendai): Regularity of Solutions to Instationary Navier-Stokes Equations.

Prof. Dr. G.P. Galdi (University of Pittsburgh): Viscous Fluid Flow past Rotating Obstacles.

Prof. Dr. T. Hishida (Nagoya University, Nagoya): Asymptotic Analysis of Viscous Fluid Flow Around Rotating Obstacles.

Center of Smart Interfaces: Understanding and Designing Fluid Boundaries (TU Darmstadt): Drag, Lift and Heat Transfer Control for Fluid Flow in Domains with Rough Boundaries.

Prof. Dr. J. Neustupa (Technical University Prague): Spectral Theory of Stokes and Oseen Operators.

Prof. Dr. M. Pokorný (Charles University Prague): Compressible Fluid Flow Around Rotating Obstacles.

Prof. Dr. M. Krbec (Mathematical Institute, Academy of Sciences Prague): Harmonic Analysis and Weighted Estimates for Fluid Flow Problems.

Prof. Dr. Š. Nečasová (Mathematical Institute, Academy of Sciences Prague): Weighted Estimates for Fluid Flow Around Rotating Obstacles.

Prof. Dr. Ch. Amrouche (University of Pau and Pays de l'Adour): Oseen Equations in Half Spaces.

Prof. Dr. D. Müller (Universität Kiel): Weighted Estimates for Singular Integral Operators Arising from Fluid Flow.

Jaime Gaspar

Dr. P. Oliva (Queen Mary, University of London): On proof interpretations with truth.

Prof. Dr. U. Kohlenbach (TU Darmstadt): On Tao's "finitary" infinite pigeonhole principle.

Matthias Geissert

Prof. Dr. P. Galdi (University of Pittsburgh): Stationary solutions to a Couette flow in unbounded domains.

Björn Geißler

Netzoptimierung: Prof. Dr. Martin Grötschel (Konrad-Zuse-Zentrum für Informationstechnik Berlin), Prof. Dr. Alexander Martin (TU Darmstadt), Prof. Dr. Marc Pfetsch (TU Braunschweig), Prof. Dr. Werner Römisch (Humboldt Universität Berlin), Prof. Dr. Rüdiger Schultz (Universität Duisburg-Essen), Prof. Dr. Marc Steinbach (Leibniz Universität Hannover).

DFG-Projekt 'Approximation nichtlinearer Dynamiken in der gemischt-ganzzahligen Optimierung': Prof. Dr. Jens Lang (TU Darmstadt), Prof. Dr. Günter Leugering (Friedrich-Alexander Universität Erlangen-Nürnberg), Prof. Dr. Alexander Martin (TU Darmstadt).

Thorsten Gellermann

Partner (Zuse Institut Berlin): Techniques for MINLP Solvers.

Bettina Gottermeier

GK 1344: "Instationary System Modelling of Aircraft Turbines", Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by the German Research Foundation (DFG), 2006-2009.

John Coupland, Steve Wellborn (Rolls-Royce plc): Developments of Hydra Acoustic Liner Models.

Karsten Große-Brauckmann

Prof. Dr. John Sullivan (TU Berlin): Constant mean curvature surfaces.

Prof. Dr. Robert Kusner (University of Massachusetts in Amherst): Constant mean curvature surfaces.

Ute Günther

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).

Evandro C. Bracht (Universidade Estadual de Campinas): Approximation Algorithms for Spanning Tree Problems with side constraints.

Kai Habermehl

Collaborative Research Centre (SFB) 805: "Control of uncertainties in load carrying systems of mechanical engineering". Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Robert Haller-Dintelmann

Dr. J. Rehberg (Weierstrass Institute for Applied Analysis and Stochastics): Divergence form operators with mixed boundary conditions in non-smooth domains.

Prof. Dr. F. Ali Mehmeti, Dr. V. Régnier (University of Valenciennes): PDE on star-shaped networks.

Dr. P.-C. Kunstmann, Dr. H. Heck (Universität Karlsruhe): Differential operators with VMO coefficients on domains.

Wolfgang Hess

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).

Karl Heinrich Hofmann

Prof. Sidney A. Morris (University of Ballarat, Victoria, Australia): Pro-Lie Groups and Pro-Lie Algebras.

Department of Mathematics (Tulane University, New Orleans): Student Exchange Program Tulane–TU Darmstadt.

Henning Homfeld

ECAD, Lufthansa Direct Services: Optimizing Aircraft Rotation in Passenger Transport.

DB Regio AG: Mathematische Evaluation von Schichtmodellen.

BMBF Verbundprojekt zwischen TU Braunschweig, TU Dortmund, TU Chemnitz, Universität Heidelberg, Universität Duisburg-Essen, Deutsche Bahn AG: OVERSYS – Optimierung der Transport- und Ressourcenplanung spezifischer Schienen- und Straßenverkehrssysteme.

Max Horn

Prof. Dr. Hendrik Van Maldeghem (Universiteit Gent, Belgium): Involutions of Moufang Polygons.

Lennard Kamenski

Prof. Dr. W. Huang (University of Kansas): Anisotropic mesh adaptation.

Sarah Kessler

Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Ulrich Kohlenbach

Prof. Dr. Grigori Mints (Stanford University): Proof Mining. Supported by personal grant of Prof. Mints.

PD Dr. Boris Moroz (MPIM Bonn): Trimester on methods of proof theory in mathematics. Held at MPIM.

Deutsch-Russisches Kooperationsprojekt (DFG): Berechnungen über nichtdiskreten Strukturen: Modelle, Semantik, Komplexität. Coordinator: Prof. D. Spreen, Siegen, since 2006.

Deutsch-Südafrikanisches Kooperationsprojekt (DFG): From continuity to computability. Coordinator: Prof. D. Spreen, Siegen, since 2007.

Michael Kohler

Dr. Adil Bagirov (University of Ballarat): Estimation of a regression function by maxima of minima of linear functions.

Prof. Dr. Adam Krzyżak (Concordia University, Montreal): Regression based Monte Carlo methods for pricing of American Options.

Prof. Dr. Harro Walk (Universität Stuttgart): Upper bounds for Bermudan options.

Springer, Heidelberg: Textbook on Statistics.

Oliver Kolb

Prof. Dr. Jens Lang (TU Darmstadt), Prof. Dr. Günter Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. Alexander Martin (TU Darmstadt): Modelling, Analysis, Simulation and Optimal Control of Gas Transport in Networked Pipelines. Supported by the German Research Foundation (DFG), 2006-2007.

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 (TU Darmstadt), Hessenwasser GmbH & Co. KG, Siemens AG: Diskret-kontinuierliche Optimierung komplexer dynamischer Wasserver- und -entsorgungssysteme. Supported by BMBF, 2007-2010.

Burkhard Kümmerer

Dr. Hans Maassen (University of Nijmegen): Quantum Probability.

Prof. Dr. Michael Schürmann (University of Greifswald): Quantum Probability, Supported by the EU.

Prof. Dr. Gernot Alber (TU Darmstadt, Institute of Applied Physices): Deterministic and stochastic decoupling.

Prof. Dr. Ruedi Seiler (TU Berlin): Entropy, Geometry and Coding in Large Quantum Information Systems, supported by the German Research Foundation.

Prof. Dr. Andreas Knauf (Universität Erlangen): Entropy, Geometry and Coding in Large Quantum Information Systems, supported by the German Research Foundation.

Dr. Nihat Ay (Max Planck Institute of Mathematics in the Sciences, Leipzig): Entropy, Geometry and Coding in Large Quantum Information Systems, supported by the the German Research Foundation (DFG).

Dr. Claus Koestler (Department of Mathematics and Statistics, Carleton University, Ottawa, Canada): Stochastic differential equations in operator algebras.

Dr. Rolf Gohm (Department of Mathematics, University of Reading, UK): Quantum Coding in operator algebras.

Jens Lang

Prof. Dr. Jan Verwer (University of Amsterdam and CWI): Global error control for ODEs.

Prof. Dr. Bob Russell (Simon Fraser University Vancouver), Prof. Dr. Weizhang Huang (University of Kansas): Developing mesh moving methods.

Prof. Dr. Peter Deuflhard (Freie Universität Berlin and ZIB): Mathematical models and adaptive methods for electrocardiology.

Prof. Dr. Rüdiger Weiner (Martin-Luther-Universität Halle-Wittenberg): Developing linearly implicit methods.

Prof. Dr. W. Huang (University of Kansas): Anisotropic mesh adaptation.

Bodo Erdmann (ZIB): Kardos programming.

Prof. Dr. Günter Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. A. Martin (TU Darmstadt): Modelling, Analysis, Simulation and Optimal Control of Gas Transport in Networked Pipelines. Supported by the the German Research Foundation (DFG), 2006-2007.

Prof. Dr. Kathrin Klamroth (Bergische Universität Wuppertal), Prof. Dr. Günter Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg), Prof. Dr. Alexander Martin (TU Darmstadt), Hessenwasser GmbH & Co. KG, Siemens AG: Diskret-kontinuierliche Optimierung komplexer dynamischer Wasserver- und -entsorgungssysteme. Supported by BMBF, 2007-2010.

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

GK 1344: "Instationary System Modelling of Aircraft Turbines". Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by the the German Research Foundation (DFG), 2006-2009.

SPP 1253: Optimization with PDEs. Supported by the the German Research Foundation (DFG), 2006-2008, jointly with Prof. Dr. Stefan Ulbrich (TU Darmstadt).

SPP 1276: "MetStröm: Multiple Scales in Fluid Dynamics and Meteorology", Speaker Prof. Dr. Rupert Klein (Mathematics, FU Berlin). Supported by the the German Research Foundation (DFG), 2007-2009, jointly with Prof. Dr. Jochen Fröhlich (Institute of Fluid Mechanics, TU Dresden) and Dr. Andreas Dörnbrack (Institute for Atmospheric Physics, DLR Oberpfaffenhofen.

Laurenţiu Leuştean

Deutsch-Südafrikanisches Kooperations Projekt (DFG): From continuity to computability. Coordinator: Prof. Dr. Dieter Spreen (Universität Siegen), since 2007..

Deutsch-Russisches Kooperations Projekt (DFG): Berechnungen über nicht diskreten Strukturen: Modelle, Semantik, Komplexität. Coordinator: Prof. Dr. Dieter Spreen (Universität Siegen), since 2006..

Stefan Löbig

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), 2007-2009, jointly with Prof. Dr. Jochen Fröhlich (Institute of Fluid Mechanics, TU Dresden) and Dr. Andreas Dörnbrack (Institute for Atmospheric Physics, DLR Oberpfaffenhofen.

Ulf Lorenz

Prof. Dr. M. Platzner (Universität Paderborn): PhD Sponsorship within the Microsoft Research PhD Scholarship programme.

Debora Mahlke

BMBF network: "Decentralized Regenerative Energy Supply: Innovative Modeling and Optimization": Prof. Dr. R. Schultz, Prof. Dr. C. Weber (Universität Duisburg-Essen), Prof. Dr. E. Handschin (Universität Dortmund), Prof. Dr. H.-J. Wagner (Universität Bochum), Prof. Dr. W. Römisch (Humboldt-Universität Berlin), Dr. M. Lucht (Fraunhofer Institute UMSICHT).

Alexander Martin

Siemens AG (Munich): Developing of a software package for the solution of general mixed integer nonlinear programming problems.

Deutsche Börse (Frankfurt): Discrete Optimization for IT-Applications.

DB Regio AG (Frankfurt): Mathematical Evaluation of Shift Scheduling Models.

ZIV (Darmstadt): Scheduling of school buses in rural areas.

J. Lang (TU Darmstadt), G. Leugering (Erlangen): Hybrid dynamical Transport Systems on Networks, supported by the German Research Foundation.

Linde AG, Devision Linde Gas (Stockholm, Sweden): Facility Location Problems.

Ingenieurbüro Steinigeweg (Darmstadt): Modelling the energy consumption in public buildings.

Wincor Nixdorf International GmbH (Paderborn): Stochastic modeling and optimal charging of automatic teller machines.

R. Schultz (Speaker), I. Erlich, Ch. Weber (Uni Duisburg-Essen), E. Handschin (TU Dortmund), W. Römisch (HU Berlin), H.-J. Wagner (Ruhr-Universität Bochum): Decentralized regenerative energy supply, supported by BMBF.

Collaborative Research Centre (SFB) 666: Integral sheet metal design with higher order bifurcations.

J. Lang, M. Ostrowski, M. Oberlack (TU Darmstadt), G. Leugering (Friedrich-Alexander-Universität Erlangen-Nürnberg), Hessenwasser GmbH & Co.KG, Siemens AG, Steinhardt GmbH Wassertechnik: Discrete-continuous optimization of dynamic water systems, supported by BMBF.

U. Zimmermann (Sprecher, Braunschweig), C. Helmberg (Chemnitz), Deutsche Bahn AG: Optimization of integrated wagon and locomotive scheduling in freight transport, supported by BMBF.

Lufthansa AG, ECAD GmbH: Planning flight schedules of "Direct Services".

Lufthansa-Systems AG, Fraunhofer Institut für Graphische Datenverarbeitung (IGD): Free flight optimization.

Excellence graduate school "Computational Engineering": Mixed integer programming on networks with nonlinear constraints.

Antonio Morsi

BMBF joint project: "ODYSSEUS – Discrete-continuous optimization of complex dynamic water supply and urban drainage systems" jointly with Friedrich-Alexander-Universität Erlangen-Nürnberg, University of Wuppertal, Siemens AG, Hessenwasser GmbH & Co. KG, Steinhardt GmbH Wassertechnik. Speaker: Prof. Dr. Alexander Martin (TU Darmstadt).

Karl-Hermann Neeb

Prof. Dr. Daniel Beltita (Rumanian Academy of Sciences, Bucharest): Geometry and Lie theoretic aspects of operator algebras.

Prof. Dr. Hendrik Grundling (University of Sydney): Quantization of gauge theories.

Prof. Dr. Joachim Hilgert (Paderborn), Prof. Dr. Bent Ørsted (Aarhus): Infinite dimensional spherical analysis.

Prof. Dr. Cornelia Vizmann (University of Timisoara; Rumania): The geometry of group extensions and flux cocycles.

Prof. Dr. Friedrich Wagemann (University of Nantes): Current groups and Lie algebras.

Prof. Dr. Helge Glöckner (Paderborn): Infinite-Dimensional Lie Groups (Book project).

Prof. Dr. Joachim Hilgert (Paderborn): Geometry and Structure of Lie Groups (Book project).

Martin Otto

Dr. Anuj Dawar (Cambridge University): Finite model theory of modal logics.

Prof. Dr. Nicole Schweikardt (Goethe-Universität Frankfurt) and Prof. Dr. Stephan Kreutzer (University of Oxford): Boundedness problems.

Dr. Mark Weyer (Humbold Universität zu Berlin): Boundedness problems.

Prof. Dr. Georg Gottlob and Dr. Vince Barany (University of Oxford): Finite controllability and finite model properties of guarded logics.

Andrea Peter

Dipl.-Ing. S. Schlobach (Lufthansa Systems Aeronautics GmbH): Shortest Paths Algorithms – Dijkstra and Beyond.

Dipl.-Ing. S. Schlobach (Lufthansa Systems Aeronautics GmbH): Modeling Alternatives for Free-Flight Optimization.

Franzsika Plehn

LOEWE-Center: "AdRIA: Adaptronik - Research, Innovation, Application". Excellence Initiative of Hesse. Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Ulrich Reif

Prof. Dr. J. Peters (University of Florida at Gainesville): Subdivision Surfaces.

Dr. Bernhard Mößner (Universität Freiburg): Stabilität von B-Splines.

Dr. Oleg Davydov: Scattered Data Approximation.

Klaus Ritter

Prof. F. Hickernell, Ph.D. (IIT, Chicago): Tractability of Infinite-dimensional Integration.

Prof. Dr. T. Müller-Gronbach (Universität Passau): Optimale Approximation der Lösung von stochastischen Evolutionsgleichungen (DFG).

Prof. Dr. T. Müller-Gronbach (Universität Passau), Prof. Dr. E. Novak (Jena): Monte Carlo Algorithmen, Textbook, Springer.

Jun.-Prof. Dr. J. Creutzig (TU Darmstadt), PD Dr. S. Dereich (TU Berlin), Prof. Dr. T. Müller-Gronbach (Universität Passau), Prof. Dr. M. Scheutzow (TU Berlin): Constructive Quantization and Multilevel Algorithms for Quadrature of Stochastic Differential Equations (German Research Foundation (DFG) SPP 1324).

Prof. Dr. S. Dahlke (Otto-von-Guericke-Universität Magdeburg Marburg), Prof. Dr. R. Schilling (Dresden): Adaptive Wavelet Methods for Stochastic Partial Differential Equations (German Research Foundation (DFG) SPP 1324).

German-Russian Cooperation Project: Geometry and Asymptotics of Random Structures (DFG-RFBR, Speaker Dehling (Ruhr-Universität Bochum Bochum)).

REWE-Informationssysteme GmbH, Roßbach v.d.H: Absatzprognose im Lebensmitteleinzelhandel.

Wincor Nixdorf GmbH, Frankfurt: Stochastische Modellierung und optimale Beschickung von Geldautomaten.

Continental Safety Engineering GmbH, Alzenau: Risikomodelle zur Ermittlung des Kollisionsrisikos zwischen Verkehrsteilnehmern im Straßenverkehr.

Merck KGaA, Darmstadt: Statistische Modellierung und Analyse pharmazeutischer Produktionsprozesse.

Steffen Roch

Prof. Dr. Bernd Silbermann (TU Chemnitz): C^*-algebras and numerical analysis.

Prof. Dr. Vladimir Rabinovich (IPN Mexico/City): Band-dominated operators, their Fredholm properties and finite sections. Supported by CONACYT and the German Research Foundation (DFG).

Prof. Dr. Pedro dos Santos (IST Lisbon): Numerical analysis for convolution-type operators with non-continuous coefficients.

Prof. Dr. Torsten Ehrhardt (UC Santa Cruz and POSTECH, Pohang (Rep. of Corea)): Szegö limit theorems.

Andreas Rößler

Rhein-Main-Verkehrsverbund Servicegesellschaft mbH, Frankfurt: Consulting for statistical evaluation methods for the estimation of the number of passengers in public transportation.

A. Neuenkirch (Johann Wolfgang Goethe-Universität Frankfurt), I. Nourdin (Pierre and Marie Curie University, Paris) and S. Tindel (Institut Élie Cartan Nancy (IECN)): Paper on trees and stochastic Taylor expansion of fractional Brownian motion.

Rolf Roth

Collaborative Research Centre (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

Thomas Creutzig (DESY, Hamburg): Natural constructions of some generalized Kac-Moody algebras as bosonic strings.

Alexander Klauer (Universität Mannheim): Natural constructions of some generalized Kac-Moody algebras as bosonic strings.

Lars Schewe

Prof. David Bremner, University New Brunswick: Edge-diameter bounds for convex polytopes.

Prof. Branko Grünbaum, University Seattle: Point-Line configurations.

Prof. Michael Herty (RWTH Aachen) und Dr. Martin Frank, TU Kaiserlautern: The coolest path problem.

LOEWE-Centre AdRIA: Adaptronik-Research, Innovation, Application.

Collaborative Research Centre (SFB) 805: Control of Uncertantity of Load Carrying Systems in Mechanical Engineering.

Christine Schönberger

Prof. Dr. S. Schabel, Dipl.-Ing. K. Villforth (PMV, TU Darmstadt): Process and layout optimization of multi-stage screening systems in recovered paper production.

DB Regio AG: Mathematische Evaluation von Schichtmodellen.

Graduate School GSC 233: "Computational Engineering". German Excellence Initiative. Speaker Prof. Dr. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt)..

Adrian Sichau

Collaborative Research Centre (SFB) 805: "Control of uncertainties in load carrying systems of mechanical engineering". Speaker Prof. Dr.-Ing. Holger Hanselka (Department of Mechanical Engineering, TU Darmstadt).

Fredrik Strömberg

NSF: Computational aspects of L-functions and modular forms. FRG Grant No. DMS-0757627..

PD Dr. Andreas Strömbergsson (University of Uppsala), Dr. Andrew Booker (University of Bristol): Computations of low eigenvalues for Congruence subgroups..

Prof. Dr. Nils Skoruppa (Universität Siegen), Dr. Nathan Ryan (Bucknell University): Computations of Rankin convolution type L-series for Siegel modular forms of genus 2..

Prof. Dr. Dieter Mayer (TU Clausthal), Dr. Tobias Mühlenbruch (Fernuniversität Hagen): Symbolic dynamics and transfer operators for Hecke triangle groups..

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.

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 the German Research Foundation (DFG) within SPP 1253.

Prof. Dr. Vincent Heuveline (Universität Karslruhe), Prof. Dr. Michael Ulbrich (TU München): Advanced numerical methods for PDE constrained optimization with application to optimal design and control of a racing yacht in the America s Cup. Supported by the German Research Foundation (DFG) within SPP 1253.

International Research Training Group IGK 1529: "Mathematical Fluid Dynamics" Speaker Prof. Dr. Matthias Hieber (Department of Mathematics, TU Darmstadt).

Prof. Dr. Bülent Karasözen (METU, Ankara): German Academic Exchange Service (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 the German Research Foundation (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).

Schenck RoTec GmbH (Darmstadt): Balancing of axle-elastic rotors.

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).

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).

Collaborative Research Centre (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 (Universidade de 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 Turbines". Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by the German Research Foundation (DFG), 2008-2011.

Andrea Zelmer

BMBF network: "Decentralized Regenerative Energy Supply: Innovative Modeling and Optimization": Prof. Dr. R. Schultz, Prof. Dr. C. Weber (Universität Duisburg-Essen), Prof. Dr. E. Handschin (Universität Dortmund), Prof. Dr. H.-J. Wagner (Universität Bochum), Prof. Dr. W. Römisch (Humboldt-Universität Berlin), Dr. M. Lucht (Fraunhofer Institute UMSICHT).

6.6 Public Relations

The department celebrated the Year of Mathematics 2008 with a mathematical film festival, organized by Prof. Karsten Große-Brauckmann and Prof. Burkhard Kümmerer in October 2008. The event in cooperation with the cinema Rex (Darmstadt) was supported by the Telekom foundation. It used the framework of a national initiative by Prof. Konrad Polthier (FU Berlin), which was supported by the Federal Ministry of Education and Research (BMBF)
The festival lasted for three days. Each evening a show started with an hour of documentary mathematical videos. A break of half an hour followed which was used to engage the audience in discussion; mathematicians of the department were present for this end. A Hollywood style film followed. The programme featured the following films:

Wednesday, October 22. – *Mathematik spielerisch*
18:45 MathFilm 2008 - math videos
20:30 Twenty-one (USA 2008)
Thursday, October 23. – *Räume, Muster, Labyrinthe*
18:45 Muqarnas – reconstruction of islamic architecture
Flatland – life in two dimensions
20:30 Möbius (Argentina 2007)
Friday, October 24 – *Menschen machen Mathematik*
18:45 Leonhard Euler
Porridge Pulleys and Pi
20:30 A Beautiful Mind (USA 2001)

The evening shows reached a much larger audience than expected: Between 50 (Nash) and 120 people (Möbius) for the main film, and almost 100 for the videos.
Moreover, lunchtime shows were scheduled for schools of the area. About 400 high school students came to see the films Flatland and the Math Video Collection 2008. There had been a more intense response to the invitation letters than we had anticipated, and so the number of shows was increased from two to five. The film Flatland was perceived best, and numerous discussions with high school students took place about the fourth dimension.
Webpage: `http://www.mathematik.tu-darmstadt.de/MathFilm`

7 Contact

7.1 Department

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7.2 Research Groups

Algebra, Geometry and Functional Analysis

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Applied Geometry

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Numeric and Scientific Computing

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Optimization

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Secretary´s Office: Nonlinear Optimization, Global Optimization
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Stochastics

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