Biannual Report

Department of Mathematics

2005 and 2006

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Preface

Ladies and Gentlemen,
dear Friends of the Mathematics Department:

In recent years buzzwords such as "Bologna process", "elite universities", "initiative for excellence", or "international visibility" have resounded throughout the country, not only in the scientific community. They all aim to bring about new developments, structures and ideas in academia with the goal to strengthen science and teaching in Germany in the long run. 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 scientist must meet the challenge and try to see themselves in a new perspective. This is also true of departments such as the Mathematics Department 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 project a picture which satisfies 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, 2005 and 2006.
The department is still facing a change of generations. Within the last five years offers from other universities were extended to twelve colleagues and seven neew colleagues accepted an offer from our university. The department has exploited this opportunity and has undertaken 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. In teaching the Master programme was introduced with the start of the academic year 2006/07. The new bachelor programme is due to be accredited in 2007. 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 find 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. Alexander Martin
(Dean of the Mathematics Department)

1 The Department of Mathematics

With over 900 students, above 20 professorships and approximately 75 scientific members of staff the mathematics department at TUD is one of the bigger maths 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 mathematics department caters for the core mathematical education in all other subjects at TUD. Through lively scientific exchange with other subjects - in the engineering sciences, in the natural sciences and in the 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 one side by a number of offers colleagues received from other universities and on the other side 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 in eight groups. This new structure allows to be better visible within and outside the university and to simplify the organization of our teaching responsibilities.

The department currently educates more than 750 students in the mathematics program, in addition to those we have around 200 students in the international program "Mathematics with Computer Science" and 200 in the teacher training program. A survey of all students in the last years can be seen from the Table on page 106 as well as the alumni in Table on page 107.
Other than the forty research assistants supported by the university we have more than thirty further PhD students in mathematics supported by the German Academic Exchange Service (DAAD), the German Science Foundation (DFG) and others. All PhD thesis are listed in Section 4.7.
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 the engineering departments , over those from natural sciences up to the students in humanity. In total these are more than 3.500 students per year.
In research the department is participating in 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 a member of two Collaborative Research Centres and three Research Training Groups that are located at the university.
On an international level the department is visible in many 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 have been slightly more than a million Euros in the years 2005 and 2006. More than 60 % of the money came from 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 Siemens, SAP, Linde, Texas Instruments, Wincor Nixdorf and others.

2 Research

2.1 Overview

Over the last decade the research profile of the department has undergone substantial changes. Several colleagues retired, new colleagues joined the department, and some moved on in response to offers from other universities. The department could also attract a number of new and young people who brought in new ideas and contributed new facets to our research profile. To reflect these changes, the research units within the department were restructured too. We decided to organise the department into eight research areas, each represented by between two and four professors. An overview of the topics and professors is given in Table 1.

Analysis	Algebra, Geometry, and Functional Analysis	Didactics	Logic
Alber	Bruinier	Bruder	Kohlenbach
Farwig	Kümmerer	Kümmerer	Otto
Hieber	Neeb		Streicher
JP Farkas	NN		JP NN

Geometry and Applications	Optimization	Scientific Computing	Stochastics
Große-Brauckmann	Joswig	Kiehl	Lehn
Reif	Martin	Lang	Ritter
	Ulbrich	Spellucci	Stannat
	JP Dür	NN	JP Creutzig

Table 1: Research Structure of the Department

This new structure is meant to kill two birds with one stone. On one hand, each group now has the critical mass to apply for research grants from the DFG, BMBF, and others. On the other hand, this structure also helps with the organisation of teaching, in particular in giving each research group the responsibility and the opportunity to contribute thematic tracks of advanced modules in the Master program. In the following sections the research groups introduce themselves and report on their current projects.

2.2 Research Groups

2.2.1 Algebra, Geometry and Functional Analysis

The foundations of many mathematical theories are based on structures that can be described by coupled algebraic and geometric properties. Typical examples of such structures are Lie groups which are groups endowed with a compatible smooth manifold structure. The structure and representation theory of Lie groups is a core research topic of this group. This theory provides means to desribe and classify symmetries that arise in all kinds of mathematical models and symmetries described by an infinite number of parameters are presently of particular interest. A great deal of the fascination of this field is due to its manifold connections to serveral other core disciplines of mathematics, such as differential geometry, number theory, and in particular mathematical physics.

Project: Totally disconnected groups and their automorphisms

While specific classes of totally disconnected, locally compact topological groups (like pro-finite groups, automorphism groups of graphs and algebraic groups over local fields) have been studied successfully for a long time with individual tools, a structure theory for general totally disconnected groups only developed in the 1990s after a seminal paper by George A. Willis. The goals of this project are to develop further the general structure theory, and to explore relations to the theory of Lie groups over local fields. Of particular interest are automorphisms α of a totally disconnected group G and the associated contraction group $U_\alpha = \{x \in G\colon \alpha^n(x) \to 1 \text{ as } n \to \infty\}$. If U_α is closed, then it admits a composition series of α-stable closed subgroups. One of the highlights of the results obtained so far (jointly with Willis) is a classification of all possible composition factors (i.e., a classification of the simple totally disconnected contraction groups). A current goal is the extension of results previously known only for p-adic Lie groups and their automorphisms to the case of Lie groups over local fields of positive characteristic, using ideas from the general structure theory.

Partner: George A. Willis (Newcastle, Australia)

Support: German Research Foundation (DFG).

Contact: Helge Glöckner

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Project: Direct limits of infinite-dimensional Lie groups

Many infinite-dimensional Lie groups of interest can be expressed as a union $G = \bigcup_{n\in\mathbb{N}} G_n$ of subgroups $G_1 \subseteq G_2 \subseteq \cdots$ which are easier to understand. For instance, each G_n might simply be a finite-dimensional Lie group (this situation is by now well understood). The current project is devoted to the more complicated case where already the pieces G_n are infinite-dimensional Lie groups. Its goals are to construct new classes of such groups; to explore their properties; and to obtain novel results concerning general direct limit groups $\bigcup_n G_n$, beyond the specific examples. For instance, one is interested in the direct limit properties of $G = \bigcup_n G_n$ in various categories. In many cases, G fails to be the direct limit $G = \varinjlim G_n$ in the categories of topological spaces and smooth manifolds, i.e., there exists a map $f : G \to X$ to a suitable topological space (resp., smooth manifold) X which is discontinuous (resp., not smooth) although $f|_{G_n}$ is continuous (resp., smooth) for each $n \in \mathbb{N}$. Surprisingly, in all examples inspected so far, such pathologies do not occur if f is a *homomorphism* to a topological group (or Lie group) X, and thus $G = \varinjlim G_n$ holds in the category of topological groups and in the category of Lie groups.

Support: DFG (Heisenberg grant, starting 2007); further DFG-support for Ph.D.-student pending

Contact: Helge Glöckner

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Project: Diffeomorphism groups of non-compact manifolds

Diffeomorphism groups of smooth manifolds play an important role in various areas of mathematics and mathematical physics, notably in hydrodynamics and quantum field theory. While the diffeomorphism group of a compact manifold can be made a Lie group in a fully satisfactory way, the diffeomorphism group of a non-compact manifold cannot be modelled on the space of all smooth vector fields, but only on the space of compactly supported smooth vector fields. It then carries an extremely fine topology, which is not adequate for all purposes. The goal of this project is the construction of new types of diffeomorphism groups of non-compact manifolds and the investigation of their Lie-theoretic properties. In particular, one wants to use larger spaces of vector fields as the modelling space (than merely compactly supported vector fields). It is also of interest whether subgroups of geometric relevance (like symplectomorphism groups) are Lie groups. For the most part, the methods used are complementary to related work of Eichhorn (who studied diffeomorphism groups in the context of bounded geometry). They can be used just as well to produce Lie groups of diffeomorphisms of infinite-dimensional Banach (or even Fréchet) spaces, or manifolds modelled on such spaces.

Partner: Boris Walter (Ph.D. student at Darmstadt)

Support: German Research Association (DFG).

Contact: Helge Glöckner

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Project: Differential calculus over topological fields

While integral calculus depends on specific properties of the real numbers, differential calculus can be performed over an arbitrary (non-discrete) topological field (e.g. over the field of p-adic numbers). This project is based on a setting of C^k-maps between open subsets of topological vector spaces over topological fields developed in [8]. Its goal is to transfer ideas from infinite-dimensional real differential calculus into non-archimedian analysis. The aspects of non-linear non-archimedian functional analysis considered so far include the following: Implicit functions from arbitrary topological vector spaces to Banach spaces over valued fields have been constructed [2], [7]. All major constructions of infinite-dimensional Lie groups (linear Lie groups, mapping groups, diffeomorphism groups, direct limit groups) could be performed over more general topological fields [1]. Invariant manifolds around hyperbolic fixed points could be constructed for dynamical systems modelled on Banach spaces over ultrametric fields [3]. Differentiability properties of typical non-linear mappings between spaces of functions (or sequences) have been discussed (like composition and evaluation), as well as exponential laws for function spaces [1]. Finally, the existence of fixed points and their C^k-dependence on parameters has been studied [2]. A survey of these studies and their applications can be found in [4].

Support: Partially supported by DFG

Contact: Helge Glöckner

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Project: Phan Theory

In Phan theory one studies the chamber sub-system, called flipflop systems, of a twin building consisting of those chambers that are mapped to an opposite by a flip of that twin building, i.e., an involutory automorphism flipping the two parts of the twin building and preserving codistances.
Current research includes:

- Phan theory of finite Chevalley groups (to be applied in the classification of the finite simple groups),
- Phan theory of compact Lie groups,

- Phan theory of algebraic groups and Kac-Moody groups,
- homotopy theory of flipflop systems,
- classification of flips,
- presentations of groups with a flip,
- finiteness properties of groups with a flip.

Partner: C. Bennett, A. Devillers, C. Hoffman, B. Mühlherr, S. Shpectorov

Support: German Research Association (DFG).

Contact: R. Gramlich, M. Horn, W. Nickel

Project: Centralisers of Fundamental Subgroups of Chevalley Groups

In order to apply Phan theory in the classification of the finite simple groups, one has to find a way to use Phan theory in the centralisers-of-involutions approach used in the second generation of the classification proof.
The current state of the art can be found in K. Altmann's PhD thesis (Darmstadt 2006).

Partner: R. Lyons, R. Solomon

Support: German Research Association (DFG).

Contact: K. Altmann, R. Gramlich

Project: Covering Theory for Intransitive Geometries

A powerful tool in geometric group theory is a lemma by Tits:
Let A be a poset, let G be a group acting on A, let F be a fundamental domain for the action of G on A,
i.e.,
(i) $a \in F$ and $b \leq a$ implies $b \in F$,
(ii) $A = G.F$,
(iii) $G.a \cap F = \{a\}$ for all $a \in F$, and let $\mathbb{I}$ be a small category with objects F and morphisms $b \leftarrow a$ for all $b \leq a \in F$.
Then the poset A is simply connected if and only if G is the colimit of the diagram $\delta\colon \mathbb{I} \to \mathbb{G}$, where $\delta(a) = G_a$ and $\delta(b \leftarrow a) = (G_b \hookleftarrow G_a)$.
This project extends the above result to posets with a group action without a fundamental domain satisfying weaker assumptions. Since there are several variants how to do this, our research program is inspired by examples that need to be handled.

Partner: A. Pasini, H. Van Maldeghem

Support: German Research Association (DFG).

Contact: R. Gramlich, M. Horn

Project: 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 groups 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.

Partner: Professor Sidney A. Morris, School of Information Technology and Mathematical Sciences, University of Ballarat, Victoria, Australia.
E-mail: s.morris@ballarat.edu.au
URL: `http://uob-community.ballarat.edu.au/~smorris`

Support: University of Ballarat

Contact: Professor Dr. Karl Heinrich Hofmann

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Project: Textbook on Infinite-Dimensional 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. 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 modeled 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: Helge Glöckner, TU Darmstadt

Contact: Karl-H. Neeb

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Project: Structure and Classification of Toroidal Lie Groups

The goal of this project is to understand the natural generalizations of affine Kac–Moody–Lie algebras and the Virasoro–Lie algebra arising in geometric situations. The classical case is the correspondence between the loop algebra $C^\infty(S^1, L)$ of a complex simple Lie algebra L and the corresponding Kac–Moody–Lie algebra $\hat{L}$, which is obtained by a central extension plus an additional exterior derivation.
In the present project we replace the circle S^1 by a more general finite-dimensonal smooth manifold M and study the Lie algebras arising from the universal central extension of $C^\infty(M, L)$ by the space $Z := \Omega^1(M)/dC^\infty(M)$ and further enlarging it by the Lie algebra $V(M)$ of smooth vector fields of M, acting by exterior derivations. These procedures admit certain twists, leading in the one-dimensional case from the Witt algebra to the Virasoro algebra. In the general case these twists are parametrized by the cohomology group $H^2(V(M), Z)$, and the goal of our project is to understand this group. Presently, this goal has been achieved for parallelizable manifolds, hence in particular for tori and Lie groups.

Partner: Prof. Yuly Billig (Carleton University, Ottawa)

Contact: Karl-H. Neeb

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Project: Geometric Aspects of Non-Commutative Geometry and Unitary Representations

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.

A major direction for the future is based on holomorphic extensions of continuous multiplier actions to holomorphic actions of certain complex semigroups which in turn provides new means to find analytic vectors for representations of infinite-dimensional groups and hence exhibiting the corresponding infinitesimal generators as essentially selfadjoint.

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. Hendrik Grundling (University of Sydney)

Contact: Karl-H. Neeb

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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 powerfull 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.
One part of the project, worked on by Christoph Müller, 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. He gives necessary conditions for this space to be non-trivial and shows that the corresponding representation is actually a Banach representation. The second part of the project deals with the group $Diff(S^1)$ acting as a symmetry group on many root graded Lie groups, such as loop groups. For this group Matthias Hofmann-Kliemt has shown that a certain homogeneous space of this real group carries a natural complex structure, so that Borel-Weil theory also applies in this context.

Partner: DFG-Collaborator: M. Hofmann-Kliemt, Chr. Müller

Support: German Research Association (DFG).

Contact: Karl-H. Neeb

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2.2.2 Analysis

The research group Analysis consists of six professors, H.-D. Alber, R. Farwig, M. Hieber, S. Roch (apl.), B. Farkas (J.-Prof.) and P. Neff (Prov.-Doz.), and about 10 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 Darmstadt University of Technology is open to new mathematical problems and scientific challenges.
One focal point of research activities is the investigation of the nonlinear equations of fluid mechanics including an enhanced analysis of linear model problems which are solved by methods of evolution equations, maximal regularity and harmonic analysis. A famous open problem concerning the existence of smooth solutions of the so-called Navier-Stokes equations is one of the seven Millennium Problems of Clay Mathematics Institute.
A second focus is put on the modeling and analysis of problems in solid mechanics with a special emphasis on viscosity and plasticity; these questions are of crucial importance in material sciences and fracture mechanics. Furthermore, models of phase transitions and microstructures in crystal lattices are under investigation. The mathematical tools in this field are based on nonlinear analysis and homogenization.
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.

Project: Models for Diffusionless Phase Transitions in Solid

The project is concerned with the investigation of phase field models for the evolution of interfaces in solids and surfaces of solids. In many cases the evolution of these interfaces and surfaces is not connected to diffusion or only partly connected to diffusion. For example, there is no diffusion process associated to the evolution of phase interfaces in solids showing martensitic phase transformations, or to the propagation of cracks in solids, which can also be described as evolution of a surface. Even surface motion by surface diffusion is from the point of view of a mathematical model only partly

governed by diffusion, and has hyperbolic aspects. The standard phase field models for interface motion (the Cahn-Hilliard and Allen-Cahn equations, in particular), describe the evolution as a diffusion process, and cannot be used for such situations. It is the aim of the project to develop "hyperbolic" phase field models applicable in such situations, and to investigate the mathematical properties of such models.
The new models developed in the project use evolution equations for the order parameter of the form

$$\begin{aligned} S_t &= -c\,(\psi_S(S) - \nu\Delta_x S)\,|\nabla_x S|, && (1)\\ S_t &= c\,\mathrm{div}_x\Big(\nabla_x\big(\psi_S(\varepsilon(\nabla_x u), S) - \nu\Delta_x S\big)|\nabla_x S|\Big), && (2) \end{aligned}$$

where S, ψ, ε, u, respectively, are the order parameter, the free energy density, the symmetric part of the deformation gradient and the displacement. c, ν are positive constants. These equations differ from the Allen-Cahn and Cahn-Hilliard equations

$$\begin{aligned} S_t &= -c\,(\psi_S(S) - \nu\Delta_x S)\,, && (3)\\ S_t &= c\,\mathrm{div}_x\Big(\nabla_x\big(\psi_S(\varepsilon(\nabla_x u), S) - \nu\Delta_x S\big)\Big), && (4) \end{aligned}$$

by the term $|\nabla_x S|$, which gives the new evolution equations the character of a transport equation with small regularizing terms.
Some mathematical investigations have been carried out: global existence of weak solutions has been proved for both equations in one space dimension, and traveling wave solutions have been derived. Many problems related to the new models are still open, for instance the existence of weak solutions for multi-dimensional problems and the convergence to corresponding sharp interface models as the regularizing parameter ν tends to zero. An important task is also the generalization of the models to less special situations. For example, the models should be generalized to free energies with many local minima, which appear in solids with martensitic transformations.

Support: German Research Association (DFG).

Contact: H.-D. Alber, Peicheng Zhu

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Project: Existence theory for equations modelling ferroelectric material behavior.

Ferroelastic materials change their shape when they are subjected to an externally applied electric field, and vise versa they generate electric charges in response to applied mechanical stresses. This property suggests promising applications of ferroelastic materials as active elements in actuators and sensors. Potential industrial developments require reliable mathematical models, which allow to simulate the behavior of ferroelectrica precisely and reliable. A number of such phenomenological models have been developed during the last years, among others the model presented in [3,4], which was developed recently. The goal of this project is to investigate the mathematical properties of this model. In particular, we want to show that solutions exist and study the regularity of these solutions.
Ferroelastic materials demonstrate hysteresis effects (butterfly hysteresis). The mathematical model for this behavior consists of a set of equations for the mechanical variables and of a set of equations for the electric variables. Both sets are coupled and contain partial differential equations and nonlinear ordinary differential equations resembling the equations used to model viscoelastic material behavior of solids. Such viscoelastic models have been studied extensively in the last ten years in our research group. Of numerous publications of our research group about these equations we mention here only [1,2]. In our investigation of ferroelectric model we aim to use this structure and to develop a mathematical theory based on the experience obtained in the investigation of viscoelastic models. An important mathematical tool used in our studies is the theory of monotone operators, though the complete ferroelectric model itself is not monotone.

Contact: Hans-Dieter Alber, Nataliya Kraynyukova

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Project: Existence Theory for Models of Monotone Type

A standard mathematical model for crack propagation in solids is based on Griffith theory. In this theory the crack is modelled by an evolving (growing) surface, which is part of the boundary of the domain representing the solid body. The crack tip is driven by constitutive forces. The model resembles a sharp interface model for the evolution of phase boundaries in solids, with the interface replaced by the crack surface. However, whereas in models for phase evolution the interface does not have a boundary, the crack surface has a boundary. This introduces singularities in the solutions of the model equations, and makes the analytical and numerical treatment of the model more difficult. It is therefore desirable to replace the standard model by a phase field model for crack propagation, which avoids such singularities. Such a model has been formulated on the basis of general ideas concerning phase field models, which where developed in the working group in the last years, cf. [1, 2]. In the project we study existence of solutions and properties of the new model equations.

Contact: Alber, Dwivedi

Support: German Research Association (DFG).

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Project: Existence Theory for Models of Monotone Type

A large number of constitutive equations for viscoplastic material behavior at small strains have been formulated in the engineering sciences, which differ widely in the special form of the differential equations and the number of interior variables. The complicated structure of these constitutive equations hides their mostly similar mathematical properties. Progress in the advanced theory of viscoplasticity is therefore strongly linked to a model formulation, which is special enough to contain all the relevant mathematical properties of a large class of constitutive models, but is general enough to show them in a clear-cut way. In the project we study the existence and homogenization theory for constitutive equations, for which such a formulation exists, the class of constitutive equations of monotone type introduced in [2]. This class generalizes the class of generalized standard materials introduced by B. Halphen and Nguyen Quoc Son in [6]. The generalization is necessary, since a careful investigation of many viscoplastic models in [2] showed that the class of generalized standard materials is too small to include most of these models used in engineering.

The initial-boundary value problem to constitutive equations of monotone type is

$$\begin{aligned} -\operatorname{div}_x T(x,t) &= b(x,t), & (5)\\ T(x,t) &= \mathcal{D}[x](\varepsilon(\nabla_x u(x,t)) - Bz(x,t)), & (6)\\ \frac{\partial}{\partial t} z(x,t) &\in g(x, -\nabla_z \psi(\varepsilon(\nabla_x u(x,t)), z(x,t)) & (7)\\ &= g(x, B^T T(x,t) - Lz(x,t)), & (8) \end{aligned}$$

with suitable initial and boundary conditions. Here $u(x,t) \in \mathbb{R}^3$ is the displacement, $T(x,t)$ is the Cauchy stress tensor, $z(x,t) \in \mathbb{R}^N$ denotes the vector of internal variables and $\varepsilon(\nabla_x u(x,t))$ is the strain tensor. B is a linear mapping, and $\mathcal{D}$ is a linear, symmetric, positive definite mapping, the elasticity tensor. b is the volume force. The positive semi-definite quadratic form

$$\psi(x,\varepsilon,z) = \frac{1}{2}\mathcal{D}[x](\varepsilon - Bz)\cdot(\varepsilon - Bz) + \frac{1}{2}(Lz)\cdot z$$

is the free energy. Finally, the constitutive function $z \to g(y,z) : \mathbb{R}^N \to 2^{\mathbb{R}^N}$ is monotone for every x. The name of the class of constitutive equations stems from this assumption. In the working group a satisfactory existence theory has been developed in the last decade for initial-boundary value problems modeling materials with linear hardening. For such materials the free energy ψ is positive definite. Also homogenization could be justified recently for this type of materials in [7, 8].
However, most materials show nonlinear hardening. For such materials the free energy is only positive semi-definite. In this case the existence theory is much less understood, and the homogenization theory does not exist at all. The project is focused on the development of these theories.

Contact: H.-D. Alber, S. Nesenenko.

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Project: Kolmogorov equations in infinite dimensions

Kolmogorov equations in infinite dimensions are second order parabolic equations with an infinite number of variables. They are closely related to stochastic differential equations in infinite dimensional spaces. Such equations occur in many fields from Physics, Chemistry and Mathematical Finance. There are two ways of studying these equations, by using probabilistic and analytic methods. The mathematical form of these equations can be stated as follows

$$\begin{cases} \frac{\partial}{\partial t}u(t,x) = \frac{1}{2}\mathrm{Tr}(QD^2u(t,x)) + \langle Ax + F(x), Du(t,x)\rangle, \quad t>0,\, x\in H, \\ u(0,x) = \varphi(x), \quad x \in H. \end{cases} \tag{9}$$

Here H is a separable Hilbert space, Q is a selfadjoint positive operator, and A is the generator of a strongly continuous semigroup $(e^{tA})_{t\geq 0}$ on H and F is a function mapping H into itself.
One approach to solve this equation in infinite dimension is to describe the semigroup $(P(t))_{t\geq 0}$ generated (in some sense) by the realization of the Kolmogorov operator

$$L_0\varphi(x) = \frac{1}{2}\mathrm{Tr}QD^2\varphi(x) + \langle Ax + F(x), D\varphi(x)\rangle, \quad x \in D(A) \tag{10}$$

in the space $BUC(H)$ and to show that, under suitable hypotheses, the unique solution of problem (9) is given by the formula

$$u(t,x) = P(t)\varphi(x).$$

When one starts from the stochastic differential equation in H.

$$\begin{cases} dX(t) &= (AX(t) + F(X(t)))dt + Q^{1/2}dW(t), \quad t \geq 0, \\ X(0) &= x \in H. \end{cases} \tag{11}$$

where W is a cylindrical Wiener Process in H. Equation (11) can be seen as the stochastic characteristic equation of (9) in the following sense. If $X(t,x)$ is the solution of (11), then by using the Ito formula for the stochastic differential equation, the solution of (9) can be represented by the formula

$$u(t,x) = \mathbb{E}[\varphi(X(t,x))].$$

Moreover, the semigroup $(P(t))_{t\geq 0}$ is the so called Markov transition semigroup associated with equation (9) and can be defined by

$$P(t)\varphi(x) = \mathbb{E}[\varphi(X(t,x))], \quad \varphi \in BUC(H).$$

In [2] such equations are studied in L^2-spaces with respect to a Gaussian measure μ. Various properties of the perturbed semigroup such as compactness and positivity. Strong Feller property, existence and uniqueness of an invariant measure are discussed as well. In [1] a regularity result for an invariant measure μ associated to a equations of type (11) is proved. Regularity here means that μ is absolutely continuous with respect to a properly chosen Gaussian reference measure μ_0 on the separable Hilbert space H, and the square root of its Radon-Nikodym derivative ρ should belong to some directional Sobolev space $W^{1,2}_C(H, \mu_0)$.

Partner: B. Farkas (TU Darmstadt)

Contact: A. Es-Sarhir

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Project: Degenerate elliptic and parabolic 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 consists of a diffusion term and a linear drift. In general, replacing the assumption of uniform ellipticity we assume that our operators are *hypoelliptic* in the sense of Hörmander. A typical feature of such operators are the different regularity properties in different space directions of the solutions to the corresponding elliptic problem. This means we have to work in anisotropic Hölder or Sobolev spaces [4]. As a first step in this project optimal regularity result has been proved for the elliptic equation for the Ornstein-Uhlenbeck operator [2]. Then, continuing the work of Lorenzi [3], we have investigated [1] the more general situation, proving the existence of an associated semigroup and optimal Schauder estimates both for the parabolic and the elliptic problems belonging to the second-order operator

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

Partner: Luca Lorenzi (University of Parma), Alessandra Lunardi (University of Parma)

Contact: B. Farkas

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Project: Weak stability of C_0-semigroups

Strongly continuous semigroups on Banach spaces (C_0-semigroups for short) provide a very efficient and elegant tool for the treatment of concrete and abstract Cauchy problems (say PDEs). They not only yield well-posedness results (through the classical Hille-Yosida theorem and its variants), but also allow a detailed description of important qualitative properties of the solutions of the Cauchy problem. In this context, it is important to describe the asymptotic behaviour of the solutions. In terms of the semigroup, this means the following. Let $(T(t))_{t\geq 0}$ be a C_0-semigroup with generator A on a Banach space X. For each $x \in X$ describe the behaviour of $T(t)x$ as $t \to \infty$. We are particularly interested in convergence to zero, $T(t)x \to 0$, for the weak operator topology (i.e., weak stability). This notion is not just of pure mathematical interest, but is very naturally motivated: In the setting of quantum theory, one thinks of X as the state space, while the dual space X' is the space of observables of some system. Therefore, for $\varphi \in X'$ the scalar valued function

$$t \mapsto \langle T(t)x, \varphi \rangle$$

gives the time evolution of a measuring process. Consequently, weak stability is the property of a system which can indeed be *observed.* It turns out, similarly to the notion of *strongly mixing* in ergodic theory, that understanding weak stability is very difficult.

A less natural but essentially easier notion is *almost weak stability* which means weak convergence to zero along a *large* set of time values. This phenomenon can be fully characterised by spectral properties of the infinitesimal generator. In [2] such questions are addressed, and several other connections to harmonic analysis, ergodic theory or Banach space geometry are observed.

Partner: T. Eisner (University of Tübingen), R. Nagel (University of Tübingen), A. Serény (Central European University)

Contact: B. Farkas

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Project: Fluid Flow Around Rotating and Moving Obstacles

In the project *Fluid Flow Around Rotating and Moving Obstacles* the participants are working on problems of fluid-structure interaction of either fluid flow around a rotating obstacle with fixed axis of rotation or of a falling, rotating body immersed in a fluid. The main mathematical questions concern the existence of stationary (time-periodic) or instationary solutions and the stability or attainability of terminal states in Newtonian or non-Newtonian fluids. In this context even the linearized equations yield new problems since after a coordinate transform there appears – in addition to the classical Coriolis force term – a first order differential operator which is not subordinate to the Laplacian. Similar mathematical problems occur for the Navier-Stokes equations in exterior domains with unbounded initial values.

Partner: Š. Nečasová, M. Krbec, M. Pokorný (Prague), A. Świerczewska, K. Krohne, M. Hieber, H. Heck, E. Dintelmann (TU Darmstadt)

Support: German Academic Exchange Service (DAAD), Project-Based Personnel Exchange Programme between the Mathematical Institute of the Academy of Sciences, Czech Republic and the Department of Mathematics of TU Darmstadt

Contact: R. Farwig

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[1] R. Farwig. Estimates of lower order derivatives of viscous fluid flow past a rotating obstacle. *Banach Center Publ., Warszawa*, 70:73–84, 2005.

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Project: Stability Analysis of ODE Systems with Time-Dependent Delay

This PhD project deals with the stability analysis of systems of ordinary differential equations with time and even state-dependent delays. Such delay systems occur in the modelling of metal cutting where material is continuously chipped from a rotating workpiece. One model derived in this project is a system of two coupled ordinary differential equations of second order in time where the delay is either a given time-dependent function or even state-dependent. Based on recent results on Hopf bifurcation for systems with state-dependent delays the evolving of chatter marks which occur at the onset of instability and will destroy the workpiece is explained for a certain range of parameters.

Partner: R. Pfleiderer

Support: Robert Bosch GmbH Stuttgart-Schwieberdingen

Contact: R. Farwig

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[1] R. Pfleiderer. Analysis eines Drehprozesses: Stabilität und Hopfverzweigung einer Funktionalgleichung mit zustandsabhängigem Delay. Phd thesis, TU Darmstadt, 2005.

Project: Regularity of Navier-Stokes Equations

One of the seven Millennium Prize Problems of Clay Mathematics Institute from 2000 concerns the global regularity of weak solutions of Navier-Stokes equations in three dimensions. Only under additional assumptions such as Serrin's condition a weak solution $u(x,t)$ can be shown to be regular globally in time. To be more precise, if u lies in $L^s\big(0,T;L^q(\Omega)\big)$ where $\frac{2}{s}+\frac{3}{q}=1$, then u is unique and regular. Similar results in this theory of conditional regularity are using conditions on only special components of u, of ∇u or of the vorticity rot u, which are based on Serrin's condition. In this project we are looking for conditions beyond Serrin's criterion such as $u\in L^r\big(0,T;L^q(\Omega)\big)$ where $\frac{2}{r}+\frac{3}{q}>1$, but assuming smallness of the norm of u in $L^r\big(0,T;L^q(\Omega)\big)$, to prove regularity. The methods will be based on the theory of very weak solutions to the Navier-Stokes system.

Partner: H. Sohr (University of Paderborn), H. Kozono (Tôhoku University, Sendai)

Contact: R. Farwig

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Project: Theory of Very Weak Solutions of the Navier-Stokes Equations

The theory of very weak solutions was recently introduced by H. Amann (University of Zürich) to define a new, large class of solutions of the instationary Navier-Stokes equations in which Serrin's condition $u \in L^s\big(0,T;L^q(\Omega)\big)$ with $\frac{2}{s}+\frac{3}{q}=1$ and consequently uniqueness hold, but where u has no differentiability properties. In general these solutions do not have finite kinetic and dissipation energy and hence are not necessarily weak solutions in the classical sense. In this project we generalize the concept of very weak solutions from the Besov space setting to L^q-spaces and even allow for a non-zero divergence and nonzero boundary data of regularity as low as possible in bounded as well as in exterior domains $\Omega \subset \mathbb{R}^n$, $n \geq 2$.

Partner: G.P. Galdi (University of Pittsburgh); H. Kozono (Tôhoku University, Sendai); H. Sohr (University of Paderborn)

Contact: R. Farwig

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[1] R. Farwig, G.P. Galdi, and H. Sohr. Large classes of existence, uniqueness and regularity of stationary Navier-Stokes equations in bounded domains of $\mathbb{R}^n$. Preprint, TU Darmstadt, 2005.

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Project: Viscous Fluid Flow around Rotating Obstacles

For an incompressible fluid flowing around a rotating obstacle the Navier-Stokes equations have to be considered in a time-dependent domain. By a suitable coordinate transform we get modified equations in a fixed domain, but with two additional linear terms which are not subordinate to the Stokes operator. Since the fundamental solution does not yield a classical Calderón-Zygmund kernel, even the linearized equations pose new difficulties. The problem to get *a priori* estimates in L^q rather than in L^2 is solved by Littlewood-Paley theory and with the help of several modified maximal operators which are related to the underlying physics of particle transport. To deal with the stability of steady (time-periodic) solutions an approach in Lorentz spaces rather than in usual L^q-spaces is needed since the integral kernels decaying as $|x|^{-1}$ and the nonlinear term $u \cdot \nabla u$ do not admit an analysis in L^q, $1 < q < \infty$.

Partner: T. Hishida (Niigata University, Niigata)

Contact: R. Farwig

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[2] R. Farwig. An L^q–analysis of viscous fluid flow past a rotating obstacle. *Tôhoku Math. J.*, 58:129–147, 2005.

[3] R. Farwig and T. Hishida. Stationary Navier-Stokes Flow Around a Rotating Obstacle. *Funkcialaj Ekvacioj*, To appear.

Project: Maximal Regularity of Stokes Operators

Considering instationary Stokes and Navier-Stokes system as an abstract evolution equation using analytic semigroup theory, maximal regularity of the Stokes operator is the crucial property to get $L^s(0,T;L^q(\Omega))$-estimates. Since in some sense the Stokes equation is a nonlocal elliptic equation of fourth order, it is much harder to prove maximal regularity than for second order scalar elliptic equations. For applications to free surface flow and to regularity theory of weak solutions also boundary conditions different from the usual Dirichlet (no-slip) condition are needed. In this project the Stokes operator with several kinds of boundary conditions will be analyzed to prove maximal regularity and to establish a theory of very weak solutions.

Partner: Y. Shibata (Waseda University, Tokyo); H. Sohr (University of Paderborn)

Contact: R. Farwig

Project: Vorticity and Rotation in the Navier-Stokes Equations

Most approaches to the stationary and instationary Navier-Stokes equations deal with the nonlinear transport term $u \cdot \nabla u$ by using Hölder's inequality and Sobolev embedding estimates. By this method the mathematical structure and the physical meaning of $u \cdot \nabla u$ are not respected. Indeed, the vorticity $\omega = \text{rot } u$ plays a crucial rôle in the analysis of the nonlinear term since $u \cdot \nabla u = \omega \wedge u + \nabla(\frac{1}{2}|u|^2)$ and since a large vorticity indicates the existence of local strong eddies in the flow. Moreover, the vorticity transport equation in 3D shows that so-called *vorticity stretching* may occur, but that only rapid changes in the orientation of the vorticity vector give rise to possible singular solutions. In this project we will analyze these interrelations more carefully to prove results of conditional regularity. Moreover, we are organizing a conference entitled *Vorticity, Rotation and*

Symmetry – Stabilizing and Destabilizing Fluid Motion at CIRM (Luminy, Marseille) to be held in May 2008.

Partner: P. Penel (Université du Sud, Toulon–Var); J. Neustupa (Academy of Sciences of the Czech Republic, Prague)

Contact: R. Farwig

Project: Spectral Theory of Stokes and Oseen Operators

In the analysis of the Navier-Stokes equations of flow past or around a rotating obstacle there appear modified Stokes or Oseen operators with two additional linear terms which cannot be considered as perturbations of the classical Stokes or Oseen operators, respectively. For stability analysis it is important to have good knowledge about the structure and location of the spectrum of these operators. Based on perturbations techniques for essential spectra it is proved that the essential spectrum of these operators consists of an infinite set of half lines (Stokes case) or parabola (Oseen case) in the left half of the complex plane; these sets are shifted from each other by an integer multiple of $i\omega$ where ω is the angular speed of the rotating obstacle. In additon to the essential spectrum there could exist sequences of discrete eigenvalues which can cluster only in the essential spectrum or at infinity. When the obstacle is rotationally symmetric with respect to the axis of rotation, the usual spectrum coincides with the above-mentioned essential one; hence there are no eigenvalues.

Partner: J. Neustupa (Academy of Sciences of the Czech Republic, Prague)

Contact: R. Farwig

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[1] R. Farwig and J. Neustupa. On the spectrum of a Stokes-type operator arising from flow around a rotating body. Preprint, TU Darmstadt, 2005.

[2] R. Farwig and J. Neustupa. On the spectrum of an Oseen-type operator arising from flow past a rotating body. Preprint, TU Darmstadt, 2006.

Project: Compressible Fluid Flow Around Rotating Obstacles

Recently the analysis of viscous fluid flow around or past a rotating obstacle was in the focus of many mathematicians. The interesting new feature is the complicated behaviour of the linearized system which appears after a suitable coordinate transform in order to work on a time-independent domain. In contrast with most papers which consider the incompressible case for a Newtonian incompressible fluid the project is dealing with compressible fluids. In this case one major problem is to find a decomposition of the coupled parabolic-hyperbolic system into two parts which can be analyzed separately and in a much easier way. One approach leads to a linear system the fundamental solution of which is defined by a non-smooth multiplier function. Hence the theory of Bochner-Riesz operators which is widely used in L^q-theory of the wave equation will play a crucial rôle.

Partner: M. Pokorný (Charles University Prague)

Contact: R. Farwig

Project: Harmonic Analysis, Weighted Estimates and Fluid Flow Around Rotating and Moving Obstacles

Weighted L^q-estimates for solutions of partial differential equations help to control the behaviour of solutions at infinity in unbounded domains or near the boundary of the underlying domain. Usually radially symmetric power weights such as $|x - x_0|^\alpha$ or $(1+|x|)^\alpha$ are used. However, in the case of fluid flow past an obstacle anistropic weights with different behaviour in different space directions are needed to control the wake behaviour. A typical weight has the form $(1 + |x|)^\alpha(1 + |x| - x_3)^\beta$ when the velocity at infinity is parallel to the third unit vector. A new difficulty occurs in the case of a rotating obstacle when also weighted estimates of a univariate maximal operator are needed in the proof. Unfortunately the restriction of the anisotropic weight $(1+|x|)^\alpha(1+|x|-x_3)^\beta$ to the variable x_3 when x_1, x_2 are fixed is no longer a Muckenhoupt weight for $\beta \neq 0$. In this case the theory of one-sided Muckenhoupt weights and one-sided maximal operators is needed.

Partner: M. Krbec, Š. Nečasová (Academy of Sciences of the Czech Republic, Prague)

Contact: R. Farwig

References

[1] R. Farwig, M. Krbec, and Š. Nečasová. A weighted L^q–approach to Stokes flow around a rotating body. Preprint, TU Darmstadt, 2005.

[2] R. Farwig, M. Krbec, and Š. Nečasová. A weighted L^q–approach to Oseen flow past a rotating body. Preprint, TU Darmstadt, 2006.

Project: Decay Properties of Solutions of Oseen Equations

The decay of solutions to the Navier-Stokes equations in an exterior domain is mainly determined by the behaviour of the fundamental solution of the Stokes or Oseen equations depending on whether the velocity at infinity equals either zero or a constant nonzero vector. For the nonlinear system the decay of solutions is much harder to analyze, but it helps to understand whether the solution is *physically reasobable*, i.e., the solutions have the same decay as in the linear case and satisfy those physical properties which *a priori* can be proved only formally. Moreover, decay results show how and where in numerical approximation schemes the unbounded domain shoud be truncated and which kind of artificial boundary condition is reasonable to get optimal approximation properties. Whereas the Stokes case has been investigated in many papers there are almost no results for the Oseen case, especially for the case of fluid flow past a rotating obstacle. The aim of the project is to analyze the decay behaviour of instationary solutions in the Oseen case by weighted estimates.

Partner: P. Deuring (University of Littoral, Calais)

Support: Guest professorship for one month at the University of Littoral, Calais

Contact: R. Farwig

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

In the analysis of solutions to the Navier-Stokes equations of fluid flow past a rotating obstacle there appears a singular integral operator which does not have the classical Calderón-Zygmund form. Its L^q-estimates are based on Littlewood-Paley theory and a composition of several non-classical maximal operators. In order to get weighted estimates the different maximal operators require restrictions on the weight function which seem to be too strong and unnatural. In this project we will use the theory of singular integral operators on homogeneous spaces with a metric adapted to the underlying physical problem of particle transport around the obstacle to get weighted estimates for a much larger class of Muckenhoupt weights.

Partner: D. Müller, H. Bloch (University of Kiel)

Contact: R. Farwig

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[1] H. Bloch. Ein Integraloperator auf homogenen Gruppen. Preprint, University of Kiel, 2004.

[2] R. Farwig. An L^q–analysis of viscous fluid flow past a rotating obstacle. *Tôhoku Math. J.*, 58:129–147, 2005.

[3] R. Farwig, T. Hishida, and D. Müller. L^q–theory of a singular "winding" integral operator arising from fluid dynamics. *Pacific J. Math.*, 215:297–312, 2004.

Project: Stability of Fluid Flow in Infinite Cylindrical Domains

The theory of Navier-Stokes equations in unbounded cylinders combines the advantage of the validity of the Poincaré inequality with the disadvantage of the usual difficulties in unbounded domains. For the analysis of the resolvent of the corresponding Stokes operator in a straight cylinder with constant cross section it is natural to use a partial Fourier transform, to solve the parametrized problem in the cross section for each Fourier variable and finally applying the inverse Fourier transform. This procedure leads to operator-valued multiplier functions on Banach spaces. In order to prove maximal regularity this approach must even be extended to weighted estimates in the cross section for every Muckenhoupt weight in order to apply the extrapolation theorem of harmonic analysis. The final aim of this project is the stability analysis of steady flows with nonzero fluxes through the exits to infinity of a system of finitely many connected cylinders.

Partner: Ri Myong Hwan (Academy of Sciences, DPR Korea)

Support: Gottlieb Daimler- and Benz-Stiftung

Contact: R. Farwig

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[4] R. Farwig and Myong-Hwan Ri. The resolvent problem and H^∞–calculus of the Stokes operator in unbounded cylinders with several exits to infinity. *J. Evol. Eq.*, To appear.

[5] R. Farwig and Myong-Hwan Ri. Stokes resolvent systems in an infinite cylinder. *Math. Nachr.*, To appear.

Project: Time-depending Ornstein-Uhlenbeck operators

Time-depending Ornstein-Uhlenbeck operators arise from nonautonomous stochastic Cauchy problems. It is known that they generate an evolution system $(P_{s,t})_{s\leq t}$ in L^2-spaces with respect to invariant measures. We investigate the generator of the evolution semigroup associated to $(P_{s,t})_{s\leq t}$. In particular, we are interested in spectral properties and the domain of the generator. The spectral properties of the generator allow us to obtain optimal convergence estimates for the evolution system $P_{s,t}$ as $t - s \to +\infty$. The domain of the generator leads to maximal regularity estimates for the parabolic problem. In the future this problem will also be investigated in the L^p-setting. Maximal regularity estimates are of general interest since they can be used to show (local) existence and uniqueness of associated nonlinear problems.

Partner: A. Lunardi (University of Parma, Italy).

Contact: M. Geißert.

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[1] G. Da Prato and A. Lunardi. Ornstein-Uhlenbeck operators with time periodic coefficients. *Preprint*, 2006.

Project: A Quasilinear equation arising from the description of non-isothermal phase transitions

In [1] P. Krejčí, E. Rocca and J. Sprekels propose a model to describe non-isothermal phase transitions with non-conserved order pararmeter driven by a spatially nonlocal

free energy with respect to the temperature and the order parameter.
The analytical treatment of this model leads to a quasilinear equation of the form

$$\begin{cases} \partial_t u(t,x) - m(t,x,u(t,x)) \cdot \Delta u(t,x) & = f(t,x), \qquad x \in \Omega,\ t \in [T_0,T], \\ u(T_0,x) & = u_0(x), \qquad x \in \Omega, \\ \partial_\nu u(t,x) & = 0, \qquad x \in \partial\Omega,\ t \in [T_0,T]. \end{cases}$$

Here Ω is a bounded, regular domain in $\mathbb{R}^3$, ∂_ν denotes the normal derivative and m is a bounded mesaurable function.
The aim of this project is to find suitable conditions on m to prove existence and uniqueness of strong solutions for this equation. In particular we want to reduce the requirements on the smoothness with respect to the time variable, since the classical criteria demand Hölder continuity in time uniformly in the space variable, which is too restrictive for applications. Furthermore, we hope to give criteria for global existence in time of the solution.
Further plans include the application of the results to problems of optimal control for such processes.

Partner: P. Krejčí and J. Sprekels (Weierstraß Institute for Applied Analysis and Stochastics, Berlin).

Contact: R. Haller-Dintelmann.

References

[1] P. Krejčí, E. Rocca, and J. Sprekels. Nonlocal temperature-dependent phase-field models for non-isothermal phase transitions. WIAS Preprint No.1006, 2005.

Project: Evolution Equations on star-shaped networks

The aim of this project is to study the foundations for the understanding of evolution phenomena on star-shaped networks, composed of n semi-infinite branches that are connected at their origins. To this end, we want to construct explicitely a real spectral representation for the weighted Laplacian on this network and arising from this the equivalent of the Fourier transform, that diagonalizes this operator.
This then allows to formulate a functional calculus for the weighted Laplacian, designed to construct explicit solution formulas to various evolution equations such as the heat, wave or Klein-Gordon equation with different leading coefficients on the branches.
The model of the n-star should in the future lead to a comprehension of the phenomena happening locally in time and space near the ramification nodes of more complicated networks.

Partner: F. Ali Mehmeti and V. Régnier (University of Valenciennes, France).

Contact: R. Haller-Dintelmann.

References

[1] F. Ali Mehmeti, R. Haller-Dintelmann, and V. Régnier. Expansions in generalized eigenfunctions of the weighted Laplacian on star-shaped networks. Preprint, 2006.

Project: Obstacle identification for Stokes and Navier-Stokes equations

The Navier-Stokes equations is a model for the flow of a viscous incompressible fluid. Consider an obstacle immersed in an incompressible viscous fluid which fills a bounded region Ω. We study the following inverse problem: Can we get the shape and location of the obstacle from the knowledge of the Dirichlet-to-Neumann map associated to the underlying equation which models the fluid flow? During a former project we studied this question for stationary Stokes flows. Next, we like to attack the case of instationary Stokes flows. Considering the Stokes equations has the advantage that we have to deal with linear equations. It is also an aim of the project to solve the obstacle identification problem for the (nonlinear) Navier-Stokes equations.

Partner: Prof. G. Uhlmann, University of Washington, Seattle, USA; Prof. J.-N. Wang, National Taiwan University, Taipei, Taiwan.

Contact: H. Heck.

References

[1] C. Alvarez, C. Conca, L. Friz, O. Kavian, and J. H. Ortega. Identification of immersed obstacles via boundary measurements. *Inverse Problems*, 21(5):1531–1552, 2005.

[2] H. Heck, G. Uhlmann, and J.-N. Wang. Reconstruction of obstacles immersed in an incompressible fluid. *Inverse Problems and Imaging*, 1:63–76, 2006.

Project: Stability of the plane Couette flow

The so called Couette flow is a special stationary solution to the Navier-Stokes equation in an infinite flat layer. We ask for the stability property of small perturbations of the Couette flow with respect to several classes of perturbations. The case of periodic and non-periodic perturbations in the Hilbert space L^2 has been studied extensively by many scientists during the last decades. We aim to get the stability of the Couette flow for perturbations in L^n where n denotes the space dimension.

Partner: Prof. H. Kozono, Tohoku University, Sendai, Japan; Prof. H. Kim, Sogang University, Seoul, South Korea

Contact: H. Heck.

Project: Navier-Stokes Flow past Rotating Obstacles

This project deals with the flow of an incompressible, viscous fluid past several moving and rotating obstacles. A suitable change of coordinates yields a modified problem, now on a fixed exterior domain but, with the usual Stokes operator being modified by a term of Ornstein-Uhlenbeck type. Existence of local and global mild solutions to the problem under certain assumptions have been shown recently. Strong solutions to the problem are known to exist only locally, so far. It is the aim of the project to develop methods and techniques which allow to prove existence of global strong solutions to the flow after rotating obstacles. Of further interest are the related problems in the Non-Newtonian case and in the situation of compressible fluids.

Partner: Y. Shibata, Waseda University, Tokyo, Japan

Contact: M. Hieber

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[1] M. Geissert, H. Heck, and M. Hieber. L^p-theory of the Navier-Stokes flow past rotating obstacles. *J. Reine Angew. Math.*, 596:45–62, 2006.

[2] M. Hieber and O. Sawada. The Navier-Stokes equations in $\mathbb{R}^n$ with linearly growing initial data. *Arch. Rat. Mech. Anal.*, 175:269–285, 2005.

[3] T. Hishida and Y. Shibata. $L^p - L^q$-estimates of the Stokes operator and Navier-Stokes flow in the exterior of a rotating obstacle. *Preprint*, 2006.

Project: Ekman boundary layers

Ekman boundary layers and so-called Ekman pumping play an important role in the investigation of rotating viscous fluids. A general problem in boundary layer theory is to determine whether the layer remains laminar or becomes turbulent. Classical fluid dynamics tells us that the answer depends essentially on the ratio between inertial and viscous forces. In this project we aim to show in a rigorous way that there exists a critical Reynolds number R_c such that the flow is stable and the boundary layer remains stable for $R < R_c$ and such that the flow is unstable and the boundary layer becomes even turbulent for $R > R_c$. In the case of Ekman layers the critical Reynolds number can be approximated numerically but this value differs significantly from the values one obtains by analytic methods.

Partner: A. Mahalov, B. Nicolaenco, Arizona State University, Tempe, USA

Support: DAAD

Contact: M. Hieber

References

[1] Y. Giga, K. Inui, A. Mahalov, S. Matsui, and J. Saal. Rotating Navier-Stokes equations in $\mathbb{R}^3_+$ with initial data nondecreasing at infinity: the Ekman boundary layer problem. *Archive Rat. Mech. Anal.*, To appear.

[2] M. Hess, M. Hieber, A. Mahalov, and J. Saal. L^2-stability of the Ekman spiral. *Preprint*, 2006.

Project: Quasilinear Parabolic Equations with Mixed Boundary Conditions on Nonsmooth Domains

The theory of quasilinear parabolic problems has many applications to evolutionary problems in the natural and engineering sciences. Indeed, many reaction-diffusion systems and geometric flow problems as well as many free boundary value problems as the Stefan problem fit into this framework. In this project we consider in particular quasilinear systems with mixed Dirichlet-Neumann boundary conditions on Lipschitz domains. This type of domains and boundary conditions appears typically in the modelling of semiconductors. Being interested in strong solutions, we consider the associated linear operators as generators of analytic semigroups in suitable function spaces. The precise description of the domains of these generators as well as their isomorphism properties are of central importance for our approach.

Partner: J. Rehberg, Weierstraß Institute, Berlin

Contact: M. Hieber

References

[1] J. Elschner, J. Rehberg, and G. Schmidt. Optimal regularity for elliptic transmission problems including C^1-interfaces. *WIAS preprint 1094*, 2006.

[2] M. Hieber and J. Rehberg. Quasilinear parabolic systems with mixed boundary conditions on non-smooth domains. *Preprint*, 2006.

Project: The Navier-Stokes Equations with Low-Regularity Data in Weighted Function Spaces

We consider the stationary and instationary Stokes and Navier-Stokes Equations. It is the aim to enlarge the class of solutions and this includes that simultaneously we are choosing the data as general as possible. Since the solutions are a priori only integrable, i.e., we do not demand any differentiability properties of the velocity field, an appropriate formulation of the problem is needed, the so-called very weak solutions to the Navier-Stokes equations. We investigate this problem in the context of spaces of functions and functionals that are weighted in the spaces variable. More precisely, we consider Lebesgue, Sobolev, and Bessel potential spaces with respect to the measure $w\,dx$, where w is a weight function contained in the Muckenhoupt class A_q. This is the class of nonnegative and locally integrable weight functions, such that the Maximal Operator is continuous on the weighted Lebesgue spaces $L^q_w(\mathbb{R}^n)$. However, when turning to the nonlinear case the estimates of the nonlinear term require strong assumptions to the weight function or higher regularity of the involved functions and functionals. Thus we consider very weak solutions to the Stokes and Navier-Stokes equations in weighted Bessel potential spaces. This, in turn, requires a good understanding of weighted Bessel potential spaces on domains including interpolation properties, in particular of spaces of functions vanishing on the boundary.

Contact: K. Krohne.

Project: Strong and Very Weak Solutions to the Navier Stokes Equations with Rotation

We consider the motion of a viscous fluid in the exterior of a rotating object in $\mathbb{R}^n$. In the stationary case this means that the obstacle rotates with a constant angular velocity around a fixed axis. This problem is modeled by the Navier-Stokes equations, however a coordinate transformation to a coordinate system that fixed to the rotating body gives rise to two additional linear terms. The aim is to prove weighted inequalities for strong and very weak solutions to this problem. In the very weak context one obtains a large class of solutions that possess in general no weak derivatives. Following the approach of Farwig, Krbec, Nečasová we choose weight functions contained in a subclass of the class of Muckenhoupt weights including certain power weights and axially symmetric weights.

Partner: Š. Nečasová (Mathematical Institute of the Czech Academy of Sciences, Prague)

Support: DAAD

Contact: K. Krohne.

References

[1] R. Farwig, M. Krbec, and Š. Nečasova. A weighted L^q-approach to Stokes flow around a rotating obstacle. *Preprint No. 2422 Department of Mathematics, TU Darmstadt*, 2005.

Project: An Intrinsic Norm in Trace Spaces of Sobolev Spaces with Particular Weight Functions

We consider the weighted Sobolev space $W_w^{1,q}(\Omega)$ which is defined as in the classical case, however we integrate with respect to the measure $w\,dx$, where w is a weight function contained in the class of Muckenhoupt weights. It turns out that this space is contained in $W_{loc}^{1,1}(\overline{\Omega})$. Hence, the restriction of a function $u \in W_w^{1,q}(\Omega)$ to the boundary $\partial\Omega$ is well-defined. Thus one can consider the space $W_w^{1,q}(\Omega)|_{\partial\Omega}$ equipped with the norm of the factor space. In the unweighted case this factor space is well-understood and exactly characterized by an intrinsic norm. However, for weighted spaces with general Muckenhoupt weights this is a difficult open problem. It is solved only for a relatively small class of weight functions such as powers of the distance to the boundary. Our aim is to find a characterization of these spaces for other weight functions e.g. powers of the distance to a point on the boundary or weights behaving in a different way close to different parts of the boundary.

Partner: Prof. Dr. Miroslav Krbec (Mathematical Institute of the Czech Academy of Sciences, Prague), Dr. Helmut Abels (Max Planck Institute for Mathematics in the Sciences, Leipzig)

Support: DAAD

Contact: K. Krohne.

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 distingiuished 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. The goal of this project is a better understanding of the structure of (concrete or abstract, self-similar or not) algebras of matrix sequences.

Partner: Bernd Silbermann

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[1] V. Rabinovich, S. Roch, and B. Silbermann. Finite sections of band-dominated operators with almost periodic coefficients. Preprint, TU Darmstadt, Department of Mathematics, 2004. To appear in a special volume of Operator Theory: Advances and Appl.

[2] V. Rabinovich, S. Roch, and B. Silbermann. On finite sections of band-dominated operators. Preprint, TU Darmstadt, 2006. Submitted to Proc. WOAT.

[3] S. Roch. Finite sections of band-dominated operators. Preprint, TU Darmstadt, Department of Mathematics, 2004. To appear in Memoirs AMS.

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. Goals 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.

Partner: Vladimir S. Rabinovich

Support: CONACYT, German Research Association (DFG).

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[3] V. Rabinovich and S. Roch. The essential spectrum of Schödinger operators on lattices. *J. Phys. A: Math. Gen.*, 39:8377 – 8394, 2006.

[4] V. Rabinovich and S. Roch. The Fredholm index of locally compact band-dominated operators on $L^p(R)$. *Integral Eq. Oper. Th.*, pages 1 – 19, 2006. Online first publ.

Project: Spline approximation methods and pre-image reconstruction

One-dimensional singular equations of Cauchy type on curves in the complex plane as well as Mellin equations on intervals can be attacked numerically by spline or wavelet projection methods. The stability of several of these methods (Galerkin, collocation, qualocation, also some quadrature methods) is quite well understood. We want to apply these results to equations which arise from problems of image foveation. The basic question is whether a foveated image (with a high resolution at its fovea and a low resolution in some distance from the fovea) contains enough information to reconstruct its pre-image.

Partner: Victor Didenko

References

[1] V. Didenko, S. L. Lee, S. Roch, and B. Silbermann. Approximate foveated images and reconstruction of their uniform pre-images. Preprint, Darmstadt University of Technology, 2004. Submitted to J. Approx. Th.

Project: Non-commutative Gelfand theories

The classical Gelfand theory provides a useful tool to study invertibility problems in commutative Banach algebras. But several questions (Fredholmness of non-normal operators, stability of approximation methods, for instance) involve invertibility problems in non-commutative algebras in a natural way. Tthere are several generalizations of Gelfand theory to a non-commutative context, which are often called local principles. Among them are the local principle of Allan/Douglas working for algebras with non-trivial center, Krupnik's local principle for Banach algebras satisfying a polynomial identity, Simonenko's local principle for operators of local type, and the local principle of Gohberg und Krupnik which can be considered as an abstract version of Simonenko's principle. The goal of this project is to clarify the relations between local principles and to consider several applications, for example to spline approximation methods for equations of convolution type on $L^p(\mathbb{R}^N)$. Of particular interest is the C^*-case where local principles do not only yield invertibility criteria, but also give information about the structure of the algebra (as the classical Gelfand-Naimark theorem does for commutative C^*-algebras). We plan to present these results in a textbook.

Partner: Pedro dos Santos, Bernd Silbermann

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, the appropriate generalization of the strong Szegö theorem is still open.

Partner: Torsten Ehrhardt, Bernd Silbermann

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[1] S. Roch and B. Silbermann. Szegö limit theorems for operators with almost periodic diagonals. Preprint, Darmstadt University of Technology, Department of Mathematics, 2006. To appear in Operators and Matrices.

2.2.3 Applied Geometry

The research group "Geometry and Approximation" is investigating foundations and applications of geometric objects as well as approximations thereof.
Classical Differential Geometry is dealing with curves and surfaces. Surfaces arising in applied sciences are frequently minimizers to certain functionals. In the simplest case, say a biological cell, they are bounding a given volume in such a way that the area of the surface is minimal. Other examples include functionals involving higher order terms like the mean curvature. Such problems typically lead to complicated non-linear partial differential equations.
In Geometric Modeling, mathematical tools for the explicit description of geometric objects are developed and analyzed. Unlike in elementary geometry, the focus is not on simple objects like circles or spheres, but on more complex structures, as they arise in various applications. One may think of a car body, a piece of cloth, or a dinosaur in an animated film.
Both the surfaces considered in Differential Geometry and Geometric Modeling have typically a fairly complicated structure which requires approximation in a function space of reduced complexity, say a spline space, for further processing. For that reason, the development of tools for efficient approximation of geometric objects is an important task, giving rise to interesting mathematical questions in the field of multivariate approximation theory.

Project: Surfaces with Prescribed Curvature in Theory and Application

We are interested in a classical problem of differential geometry, namely surfaces whose curvatures are constant, or which minimize energies involving curvatures. In a theoretically motivated part, we investigate boundaryless surfaces of constant mean curvature in Euclidean space, under a weakened embeddedness assumption, called Alexandrow-embeddedness. We want to study a global problem, namely the structure of the space of examples. Another part is motivated by applications. Triply periodic surfaces arise as interfaces, but often the precise energies which create them are not known. So we focus on a typical example, namely the bending energy under a volume constraint. Here, the ultimate goal is a better understanding of as to why the observed morphologies form.

Partner: R. Kusner (Amherst), J. Sullivan (TU Berlin)

Support: German Research Association(DFG) priority programme 1154: Global Differential Geometry

Contact: K. Grosse-Brauckmann

Project: WEB-Splines

Weighted extended B-splines (WEB-splines) provide a new class of finite elements for solving two- and three-dimensional boundary value problems. They combine the approximation power of tensor product B-splines with optimal stability properties. The resulting WEB-method does not require any grid generation and, as a consequence, can be implemented very efficiently. Further information can be found at `www.web-spline.de`.

Partner: K. Höllig, J. Wipper (University of Stuttgart)

Support: Technologie-Lizenz-Büro, Karlsruhe

Contact: U. Reif.

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[1] K. Höllig, U. Reif, and J. Wipper. Weighted extended b-spline approximation of Dirichlet problems. *SIAM Journal on Numerical Analysis*, 39(2):237–256, 2001.

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Project: Shape Optimization by Free Form Deformation

Typically, the optimization of the shape of a geometrical object (such as a reflector, a ship hull, or a machine part) is an extremely complicated task since the space of shape parametrizations is very high dimensional, and the functional is expensive to evaluate. In this project, we investigate an approach which is based on free form deformations (FFDs) of the embedding space. Thus, the space of optimization parameters is decoupled from the geometry. A model implementation shows that iterated application of optimal low-dimensional FFDs can yield a substantial improvement of shape.

Partner: J. Hechler (TU Darmstadt)

Support: InuTech (Nürnberg)

Contact: U. Reif.

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[1] J. Hechler. *Optimierung von Freiformflächen mittels Raumdeformation.* PhD thesis, TU Darmstadt, 2006.

Project: Analysis of Subdivision Surfaces

Subdivision algorithms are the method of choice for the modeling of surfaces in many Computer Graphics applications. While these algorithms are easy to implement, their mathematical analysis is non-trivial and an ongoing challenge. In this project, asymptotic expansions of geometric invariants on subdivision surfaces are derived in order to understand shape properties in a vicinity of an extraordinary point, and to design improved schemes. A monograph on the topic is close to completion.

Partner: J. Peters (University of Florida, Gainesville)

Contact: U. Reif.

References

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2.2.4 Didactics and Pedagogics of Mathematics

Research in the didactic of mathematics

The working group didactic of mathemathics deals with different questions how to teach and learn mathematics. In 2005-2006 the research activities on the didactic of mathemathics concentrated on

1. the development and evaluation of integrated teaching concepts as well as corresponding training and further training concepts for maths teachers
   - on the learning of mathematical problem-solving in connection with self-regulation (conclusion of a six-xear DFG-project) and
   - the computer-based teaching and learning of maths within the scientific framework of different model tests in four Federal States in Germany and
2. the development and evaluation of e-learning - activities in research and development (e-learning-label by TU Darmstadt, participation in the postgraduate program on e-learning at TU Darmstadt) and in the teacher further training (www.proLehre.de).

The DFG priority program school education quality 2005-2006 not only allowed to gain valuable insight into the possibilities of further development of maths lessons but also

to develop new survey tools for the collection of ideas on the teaching and learning of maths which were presented on national and international conferences. The achieved research results were taken up in most requested teacher further training units which are provided half-yearly since 2005.
Moreover new computer-based learning and teaching arrangements for maths and maths didactic have been developed and tested. A general quality label for computer-based learning surroundings was elaborated and adopted in first examples.

Operator Algebras and Mathematical Physics

Quantum probability is an extension of classical probability theory that also allows to treat probabilistic effects of quantum systems. Such an extension is necessary: events of a quantum system do no longer form a Boolean lattice (this is, what the discussions around Schrödinger's cat seek to indicate); hence they can not be described by the elements of a Σ-algebra. Instead, quantum events are modelled by subspaces of a Hilbert space. Operator algebras allow a unified treatment of both cases: events of both kinds can be described by projections in an operator algebra and a probability measure becomes a state, i.e., a positive normalized linear functional, on an operator algebra. Similarly, all the basic notions of probability like expectations, random variables, stochastic processes, Markov processes, 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. Indeed, it is the interplay between theoretical mathematics and applicable physics which makes this subject so fascinating. 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 stochastic processes (Markov processes, noise, quantum trajectories, filtering, etc.), be it the dynamics generated by completely positive maps (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 fascinating field of quantum information.

Project: Enhancing of Problem-solving and Self-regulation (PROSA)

The PROSA project is focussed on the support of mathematical problem-solving and self-regulative competencies in maths lessons in secondary level I by a training and further training concept for teachers. The development of specific problem-solving competencies is based on the purpose of maths lessons to provide general education and was anchored in the education standards. The results of the relevant international comparative studies of education TIMSS , PISA 2000 and PISA 2003 underline that there are still not enough students with sufficient mathematical problem-solving competencies. In the first phase 2000-2002 it was possible to show, in addition to the trainability of specific problem-solving competencies, the positive influence of self-regulative learning on mathematical performance. With the PROSA project a training and further training program for maths teachers in secondary level I was developed and tested, which contains the successful training aims. The active participation in this program should enable maths teachers to acquire competencies in enhancing the problem-solving and self-regulative skills of their students. On the basis of student training courses evaluated positively in the first phase of the project described by Otto et al.2006, a teaching concept for maths teaching in secondary level I was developed in cooperation with test teachers of Hessian schools and students of the Technical University Darmstadt, which aims at the enhancement of problem-solving and self-regulative competencies of students (project phase 2, 2002-2004). For the three phases of teacher qualification - study (cf. Komorek, Bruder, Schmitz, 2004), traineeship (cf. Komorek, 2006) and further training courses - training programs were developed, tested and evaluated. In Komorek et al, 2006, are presented the theoretical elements of the developed training schemes, followed by a report on a field study on the evaluation of the further training concept for teachers (phase 3, 2004-2006).

Partner: Prof. Bernhard Schmitz TU Darmstadt, Dr. Evelyn Komorek, Christina Collet

Support: German Research Association (DFG).

Contact: R. Bruder.

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[1] R. Bruder, B. Schmitz, and E. Komorek. Integration of training concepts for problem-solving and self-regulation in maths lessons. In J. Doll and M. Prenzel, editors, *Schulische und außerschulische Ansätze zur Verbesserung der Bildungsqualität*, pages 54–76. Waxmann, Münster, 2004.

[2] E. Komorek, R. Bruder, C. Collet, and B. Schmitz. *Inhalte und Ergebnisse einer Intervention im Mathematikunterricht der Sekundarstufe I mit einem Unterrichtskonzept zur Förderung mathematischen Problemlösens und von Selbstregulationskompetenzen*. Waxmann, Münster, 2006.

[3] B. Otto, F. Perels, B. Schmitz, and R. Bruder. *Längsschnittliche und prozessuale Evaluation eines Trainingsprogramms zur Förderung sachspezifischer und fächerübergreifender (selbstregulativer) Kompetenzen*. Waxmann, Münster, S., 2006.

Project: Longitudinal and processual evaluation of a training program to improve mathematical as well as self-regulatory competences

To create flexibility and lifelong willingness to learn the development of capabilities of self dependent and self regulated learning is one of the main tasks beside passing on knowledge to educate young people (PISA, 2004). Self regulated competences can be successfully developed in the frame of training if apart from interdisciplinary self regulative also mathematical contents are passed on. The aim of the project was the development, realisation and evaluation of training methods to improve self regulated

learning in conjunction with problem solving of students. The project contained 3 phases, the third one was executed in the period 2004 - 2006.
In the former both phases it has been proved that self regulation and mathematical problem solving can be successfully improved for students of the 8th and 5th class of a Gymnasium. The aim of the 3rd phase of the project was consequently the realisation of intervention means for students of the 4th class to improve self regulated learning and mathematical problem solving well in advance of the change from the primary school to the Highschool.

Partner: Leader: Prof. Dr. Bernhard Schmitz, TU Darmstadt

Support: German Research Association (DFG).

Contact: R. Bruder.

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[1] B. Otto, F. Perels, B. Schmitz, and R. Bruder. *Längsschnittliche und prozessuale Evaluation eines Trainingsprogramms zur Förderung sachspezifischer und fächerübergreifender (selbstregulativer) Kompetenzen.* Waxmann, Münster, S., 2006.

Project: Evaluation of the SINUS project in Hesse (EVAHESI)

The aim of the evaluation of the project for teacher further training in the Federal State of Hesse (2004-2005) called SINUS-transfer was to find out the effects of this concept. Special attention was drawn on the changes of ideas of the teachers and the results of the students. All in all 16 schools with more than 70 teachers of classes 5 to 8 were involved. Different tools were used for the punctual and longitudinal evaluation. Tests for students (class 5 and 6) were developed as well as questionnaires for teachers and students. Lesson reports were used as tools for monitoring of the teachers. Results are summarised in the project report EVAHESI under www.math-learning.com .

Partner: Dr. Evelyn Komorek, Marina Ströbele

Support: IPN Kiel (BMBF-Project SINUS)

Contact: R. Bruder.

Project: Intelligent use of CAS at school (in Hesse)

A half-year project on the use of CAS primarily in class 11 reveals increased acceptance of both teachers and students to use calculators. First desirable modifications in the teaching and learning of maths by using CAS were stated also by the students, especially in terms of communication support and reflections on how to proceed. During the project many well applicable and didactically valuable task examples for the intelligent use of CAS were developed which were published in a separate report. In the frame of the project evaluation didactic criteria for teaching portfolios on the use of calculators were developed and applied.

Partner: Nicole Roth-Sonnen, Dr. Ralf Pfleiderer

Support: TEXAS Instruments

Contact: R. Bruder.

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[2] R. Bruder. CAS-use from class 11 - project evaluation of teaching portfolios on the use of calculators in hessen. In *Taschencomputer in Klasse 11 - Portfolioevaluation eines Modellprojektes in Hessen.* GDM-Meeting Osnabrück, 2006.

[3] R. Bruder. *Sinnvoller Einsatz von CAS in der Schule - ein Projektbericht.* Franzbecker, 2006.

Project: CALiMERO

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

Partner: Maria Ingelmann

Support: TEXAS Instruments and Ministry of Education Lower Saxony

Contact: M. Ingelmann.

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[2] M. Ingelmann and R. Bruder. Supporting mathematical presentations by CAS - use from class 7. Submitted paper for PME-31 in Seoul 2007.

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. The evaluation of the project will be executed by Prof. Dr. Regina Bruder , Technical University Darmstadt. Details on www.proLehre.de .

Support: TEXAS Instruments and Ministry of Education Rhineland-Palatinate

Contact: R. Bruder.

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, Technical University Darmstadt. The materials developed by the teachers are discussed and improved on meetings every half year. Details on www.proLehre.de .

Support: Ministry of Education Hamburg

Contact: R. Bruder.

Project: Internet based professional training for math teachers (proLehre+x)

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. In both courses 200 teachers have been trained. Two internet platforms developed at the Technical University 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: Marina Ströbele

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

Contact: M. Stroebele.

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

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

Partner: Dr. Michael Deneke, HDA, Dr. Susanne Offenbartl, elc, Julia Sonnberger, elc

Support: TU Darmstadt

Contact: J. Sonnberger.

Project: Research programme e-learning at TU Darmstadt

The main focus of the research programme e-learning at the Technical University Darmstadt is oriented on interdisciplinary applications of e-learning at the university. Particularly it is planned to investigate which e-learning tools have a high potential of learning and how the transferability and reusability of e-learning tools can be ensured. It is scheduled to create a team of scientists funded by DFG (German Research Association) in 2007. Details on `http://www.cre-elearning.tu-darmstadt.de`.

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

Support: TU Darmstadt

Contact: R. Bruder.

Project: Virtual propaedeutic tutorial course "Mathematics" (VEMA)

This project was generated in March 2003 to elaborate supporting multimedia materials for the introducing course "Mathematics" held before starting the regular lectures in the first semester, particularly to refresh the mathematical content learned at school. The materials shall supplement the lessons in the frame of tutorial courses at the universities in Kassel and Darmstadt (MCS study). Supported by the Ministry of Science and Culture of the state Hesse in 2005 the materials were upgraded in cooperation between both universities, e.g. an interactive book was structured in a better way , the usability was significantly improved. A comprehensive, newly developed collection of tasks can be used for self study and to close gaps of knowledge.

The virtual propaedeutic course is focussed on all lessons and lectures for the preparation of first semester students for subjects containing math like engineer and natural sciences. Details on `http://www.mathematik.uni-kassel.de/~vorkurs/`.

Partner: Prof. Rolf Biehler, University of Kassel, Dr. Werner Nickel, TU Darmstadt, Jens Bruder, Vienna

Support: Ministry of Science and Culture in Hesse

Contact: R. Bruder.

Project: Operationalisation of the national educational standards for math

Five regional working groups were set up in 2005 to operationalise the educational standards. The regional working group "East" was scientifically lead by Prof. Dr. Regina Bruder. First results of all regional groups are summarised in the hand book "Bildungsstandards konkret".

Partner: IQB Berlin, Prof. Werner Blum, University of Kassel and the "standards-team"

Support: IQB Berlin

Contact: R. Bruder.

References

[1] R. Bruder. Langfristiger Kompetenzaufbau. In W. Blum, D. Drüke-Noe, R. Hartung, and O. Köller, editors, *Bildungsstandards Mathematik: konkret. Sekundarstufe I: Aufgabenbeispiele, Unterrichtsanregungen, Fortbildungsideen*, pages 135 – 151. Berlin: Cornelsen Scriptor, 2006.

Project: "Ma+" - subject connecting lessons

The Technical University Darmstadt develops exemplary items of a modular complete system for teacher's further and continuing education: "The scientific continuing education under the aspect of subject combining lessons of Mathematics and other science". In curricula and educational planning, subject combining lessons that contribute to anchor the learned are demanded but happen just occasionally. Teachers quote structural problems and a lack of time as reasons. But also not enough trust in their own abilities with application problems. The association of subject contents with naturalistic questions offer new chances for the realisation of subject combining lessons. Also the use of new media in combination with modern forms of teaching and learning support these chances. The aim of this project is to show possible synergy effects, to develop modules for interdisciplinary lessons in cooperation with other universities and to offer suitable further education for teachers. After the first testing and the following improvement these modules are available in the internet. An integral qualification concept should link the named didactic orientations in a way that methodical accompanied and assured experiences will help the members for their own teaching practice. The offer addresses Mathematics and Science teachers for junior high school and sixth form.

Partner: University of Frankfurt, Gerhard Glas, Prof. Martin Kiehl, Prof. Burkhard Kümmerer

Support: Bund-Länder Comission (BLK).

Contact: G. Glas.

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 play a central role.
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 (Reading)

Contact: B. Kümmerer

References

[1] F. Haag. *Asymptotisches Verhalten von Quanten-Markov-Halbgruppen und Quanten-Markov-Prozessen.* PhD thesis, University of 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 $\phi(x) = \mathrm{tr(x}\rho)$, ρ a density matrix, then the probability for the outcome i is given by $\pi_i = \phi(a_i^* a_i)$. Since T is identity preserving, $(\pi_1, \dots, \pi_n)$ induces a probability distribution on the set $\{1, \dots, k\}$ of all 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 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: B. Kümmerer

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[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 probabilites of quantum Markov processes, quantum measurement processes (cf. the description of the project above), 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). 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 $T^k(x) \to \phi(x)\mathbf{1}$ as $k \to \infty$.
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 $(T^k)_{k\in\mathbb{N}}$ in order to obtain approximations for the equilibrium state ϕ. According to ergodic properties 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: B. Kümmerer, Kay Schwieger, N. 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 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 (Department of Physics, TU Darmstadt)

Contact: B. Kümmerer

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 no immediate 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 (Reading), C. Köstler (Ottawa)

Contact: B. Kümmerer

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[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, in the most important situation where the stochastic process is Markovian, 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 mathematicians have 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 one of the most important tools for analyzing stochastic behaviour in time.

Similarly, one would like to describe time evolutions of stochastic quantum systems by stochastic differential equations. A fist 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 one theory 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: B. 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 elementes in $A^{\mathbb{Z}}$. A code maps sequences in $A^{\mathbb{Z}}$ to sequences in $B^{\mathbb{Z}}$. 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 probabilites 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 particular form of the time evolution allows to look at it from the point of view of scattering theory, in particular, 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: B. Kümmerer

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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 analogues of two-sided infinite sequences of symbols and time translation invariance.

Contact: B. Kümmerer, L. Steiner

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.

Contact: B. 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 measuremts 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: B. Kümmerer

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2.2.5 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: Model Theory for 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 finite structures, prefix-recognisable structures, and the Caucal hierarchy. 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 (Irisa, Rennes)

Contact: A. Blumensath

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Project: Effective Fixed Point Theory

We investigate computational aspects of metric fixed point theory, with particular emphasis on finding explicit rates of convergence and so-called rates of proximity for certain iteration sequences for some classes of selfmaps of metric spaces. The project is a case study in the application of methods from proof theory to ordinary mathematics - using techniques and insights from the program of proof mining, as developed in recent years by U. Kohlenbach. We also aim to extend the use of the relevant logical techniques to cover previously unexplained findings, and to give sufficiency criteria for when one can find computable rates of convergence for the iteration sequences in question.

Contact: E. Briseid.

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Project: Equational logic and structural theory uf modular lattices

Modular lattices occur as congruence lattices of various kinds of algebraic structures. The equational theory is known to be decidable for lattices associated with abelian groups [2] and undecdidable for all modular lattices (even in four variables, only [1]). The intermediate classes to be considered, next, are congruence lattices of metabelian groups on one end, Arguesian lattices on the other. This requires further development of structure theory as considered in [4, 3] for finite height lattices, The latter has been used to show that a variety generated by finite modular lattice has only finitely many covers generated by finite height lattices. Structural theory is also a key tool in studying finite axiomatizability of finitely generated quasi-varieties.

Partner: A. Nurakunov (Kirghiz Academy of Science)

Support: INTAS, Humboldt-Stiftung

Contact: C. Herrmann.

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Project: Regular rings and complemented modular lattices

Von Neumann regular rings can be viewed, up to subdirect decomposition, as rings of endomorphimsm of vector spaces which admit quasi-inverses. Via Coordinatization Theory they are closely related to complementd modular lattices and so to lattices of subspaces of projective spaces, The objective of the project is to further the understanding of this relationship (cf. [6]), to provide more structural proofs of coordinatization theorems, and to study classes of such structures from a universal algebraic point of view. For the latter see [3] where it is shown that any existence variety of regular rings (with or without unit) resp. sectionally complemented modular lattices is generated by its artinian members. Here, existence varieties are classes closed under homomorphic images, direct products, and regular resp. sectionally complemented substructures. In particular, this implies that the equational theories of all regular rings resp. sectionally complemented modular lattices are decidable. Possible applications are in the representation theory of algebras cf [1, 4] and in congruence and dimension theory [5, 2].

Partner: M. Semenova (Russian Academy of Science, Novosibirsk), M. Roddy (Brandon University), F. Wehrung (University of Caen)

Support: INTAS, NSERC

Contact: C. Herrmann.

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Project: Regular rings with involution and orthocomplemented modular lattices

Orthocomplemented modular lattices and regular rings with positive involution have been associated by von Neumann [6] with algebras of operators. More precisely, any finite von Neumann algebra has an orthocomplemented modular lattice of projections and this in turn is coordinatized by a *-regular ring which can be understood as a ring of partial operators [6] or as a ring of quotients [1]. The purpose of the project is to investigate these structures under logico-algebraic points of view. The principal result [2, 7] is that in both cases each equational class is generated by its finite dimensional members. This implies representations as homomorphic images of substructures of direct products of finite dimensionals as well as representations in terms of vector spaces equippped with scalar products [3, 5]. Further research is directed towards an analysis of the representations associated with von Neumann algebras and to the question of unit-regularity [4, Problem G48].

Partner: N. Niemann (TU Darmstadt), M. Roddy (Brandon University)

Support: NSERC, Studienstiftung

Contact: C. Herrmann.

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Project: Applications of Proof Interpretations

This project concerns the development of general logical metatheorems 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 ([5]). This vastly generalizes previous results due to U. Kohlenbach where the boundedness of the whole spaces in questions was needed ([7]). 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 numerous applications in metric fixed point theory (see e.g. [2]) and cover the recently found strongly uniform version of theorems due to Ishikawa and Borwein-Reich-Shafrir ([9, 6]). Whereas in the presence if classical logic severe restrictions on the logical form of the theorems considered are necessary, this can largely be avoided in a semi-intuitionistic context ([4]). Other recent applications of proof interpretations are concerned with efficient extractions of Herbrand disjunctions from proofs in open theories ([3]). Very recently, a strong nonstandard uniform boundedness principle has been formulated which (although not valid under the intended interpretation) has the property to yield valid conclusions if the latter have a certain rather general logical form. This can be used to simplify proofs enormously ([8]).

Partner: Dr. Philipp Gerhardy (BRICS, Aarhus University (Denmark), TU Darmstadt and Carnegie Mellon University Pittsburgh, USA)

Support: Danish National Research Foundation

Contact: U.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 [4] we present a comprehensive survey of the new results that were obtained in these areas in the course of this investigation. In [3] the underlying logical aspects of these developments are analyzed and pushed further. A full book-length treatment of this material is under preparation. Together with M.-D. Hernest we investigate the computational complexity of the program and bound extraction algorithms provided by functional and monotone functional interpretation ([2]). Building on this, M.-D. Hernest developed a full implemention of these algorithms together with a novel (so-called 'light') version which optimizes the performance of the algorithm ([1]).

Partner: Dr. M.-D. Hernest (LIX, School Polytechnique, Palaiseau, France).

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

Contact: U.Kohlenbach.

References

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Project: The approximate fixed point property in product spaces

We generalize to unbounded convex subsets C of hyperbolic spaces results obtained by W.A. Kirk and R. Espínola on approximate fixed points of nonexpansive mappings in product spaces $(C \times M)_\infty$, where M is a metric space and C is a nonempty, convex, closed and bounded subset of a normed or a CAT(0)-space. We extend the results further, to families $(C_u)_{u\in M}$ of unbounded convex subsets of a hyperbolic space. The key ingredient in obtaining these generalizations is a uniform quantitative version of a theorem due to Borwein, Reich and Shafrir, obtained by the authors in a previous paper ([1]) using techniques from mathematical logic. Inspired by that, we introduce in the last section the notion of uniform approximate fixed point property for sets C and classes of self-mappings of C.

Support: German Research Associatin (DFG).

Contact: U.Kohlenbach and L. Leuştean.

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[2] U. Kohlenbach and L. Leuştean. Approximate fixed points of nonexpansive functions in product spaces. *Nonlinear Analysis*, 66:806–818, 2007.

Project: Topics in the Theory and Practice of Computable Analysis

This project deals with applications of logic to computable analysis. In particular, proof theoretic techniques are used to extract the first effective bounds on the asymptotic regularity of Krasnoselski-Mann iterations of asymptotically quasi-nonexpansive functions with error terms ([1]). In this context a novel form of quasi-monotone sequences of real numbers plays an important role. Generalising a result of Y. Matiyasevich it is shown that for suitable recursive definitions of such sequences it is possible to extract effective moduli of convergence ([2]). Another part of this project (B. Lambov [2]) deals with a new type-1 approach to exact real number computations and its implemention (RealLib,[2]).

Partner: Dr. Branimir Lambov (BRICS, Aarhus University (Denmark), TU Darmstadt)

Support: Danish National Research Foundation

Contact: U.Kohlenbach.

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Project: Proof mining in functional analysis and hyperbolic geometry

This project is part of the general program of *proof mining*, developed by Kohlenbach beginning with the 90's. General logical metatheorems were proved by Gerhardy/Kohlenbach [1] for classes of spaces such as metric, hyperbolic spaces in the sense of Takahashi/Reich/Kirk/ Kohlenbach, CAT(0) spaces, (uniformly convex) normed, and inner product spaces. These metatheorems guarantee a priorly, under very general logical conditions, the extractability of effective bounds from large classes of proofs in functional analysis, and moreover they provide algorithms for actually extracting the bounds. The bounds are uniform for all parameters meeting very weak local boundedness conditions. In [3], we adapted existing metatheorems of Gerhardy/Kohlenbach [1] to other important classes of spaces from functional analysis and hyperbolic geometry: Gromov hyperbolic spaces, $\mathbb{R}$-trees, and uniformly convex hyperbolic spaces (a very general class of spaces which includes CAT(0)-spaces, $\mathbb{R}$-trees, and the Hilbert ball). As an application of proof mining in metric fixed point theory, we obtained [4] a quadratic bound on the rate of asymptotic regularity for Krasnoselski-Mann iterations of nonexpansive functions in CAT(0)-spaces; this turned out to be a consequence of a more general result for uniformly convex hyperbolic spaces, which is an instance of the logical metatheorem for these structures. Future directions of research:

- to develop new metatheorems for other structures, e.g.: Λ-trees, bolic spaces or hyperconvex spaces;
- to apply our results in metric fixed point theory to hyperbolic geometry, and to explore further, using proof mining, the connection between these two different areas. A first connection between the theory of nonexpansive mappings and the theory of holomorphic mappings on the Hilbert ball was made by Goebel and Reich in their book [2].

Support: Kurt Gödel Society (Vienna), The John Templeton Foundation, German Research Association (DFG).

Contact: L. Leuştean

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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. It is often natural to consider classes of structures based on very restricted classes of underlying frames. The model theory of modal logics over non-elementary classes of frames (as, e.g., the classes of all finite or of all rooted frames) requires entirely novel techniques compared with the well-developed classical techniques [2]. Model constructions – often of a combinatorial character – that preserve bisimulation equivalence (equivalences based on model theoretic games) have to be adapted to the restricted classes. Characterisations of modal logic as a fragment of first-order logic have been obtained over several interesting classes [3, 1], but many open problems remain in particular with stronger extensions of basic modal logic.

Partner: A co-operation with A. Dawar (Cambridge University) was partly supported by a joint DAAD and Royal Society grant.

Contact: M. Otto

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Project: Boundedness Issues in Fixed-Point Recursion

Relational monotone fixed-point recursion provides an important extension of first-order logic. A key decision issue in connection with fixed-point recursions is the question whether they are bounded, in the sense of 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 [2] and in co-operation with N. Schweikardt and S. Kreutzer (HU Berlin) in [1].

Contact: M. Otto

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Project: Relating First Order Set Theories and Elementary Toposes

A natural notion of model for Higher Order Intuitionistic Arithmetic (HAH) is given by elementary toposes with a natural numbers object (nno). We are developing a Basic Intuitionistic Set Theory (BIST) admitting a categorical semantics (à la Joyal and Moerdijk's *Algebraic Set Theory*) such that the small part of such models is always a topos with nno. Using a kind of forcing semantics we show that every model of HAH can be augmented to a model of BIST whose small part is equivalent to the original model of HAH. We are aim to show that BIST is complete w.r.t. this forcing semantics. Besides its foundational impact our work has also the more pragmatic benefit that it allows one to speak within (models of) HAH about classes of structures like all groups or all topological spaces.

Partner: S. Awodey (CMU Pittsburgh), C. Butz (ITU Copenhaguen), A. Simpson (University of Edinburgh).

Contact: T. Streicher.

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Project: Dialectica Topos

Realizability and Functional Interpretations have been developed in the 40ies and 50ies of last century for the sake of extracting computational content from proofs. End of 70ies M. Hyland (following a suggestion of D. Scott) has constructed models for constructive logic based on (number and function) realizability. These have been used with great success not only in the metatheory of constructive systems but also in semantics and logic of (functional) programming languages. Also Kreisel's modified realizability has been given a semantical account of in form of the modified realizability topos (Hyland, Grayson, vanOosten). Since a couple of years we investigate now a semantic version of Gödel's functional ("Dialectica") interpretation which is more complicated and also more interesting than the aforementioned proof interpretations. Streicher has developed a semantic version of the Diller-Nahm variant. But there is also a version closer to Gödel's original. It has been shown that one can interpret implication in a way different from Gödel's one overcoming the restriction to decidable relations. One interesting aspect of the Dialectica tripos is that it contains realizability and modified realizability toposes as quotients and thus may be seen as a kind of unifying account. However, it is more complex in the respect that its truth value object contains the lattice of Turing degrees whereas (modified) realizability toposes are 2-valued. Checking whether certain logical principles hold in the Dialectica topos leads to challenging combinatorial problems on which we are currently working. Typical such questions are: validity of Markov's principle, characterization of $\neg\neg$-sheaves and $\neg\neg$-separated objects, wellpointedness of the finite type hierarchy over the natural numbers etc.

Partner: B. Biering, L. Birkedal, C. Butz (ITU Copenhaguen), M. Hyland (Univ. Cambridge), J. vanOosten (University of Utrecht), G. Rosolini (University of Genova).

Contact: T. Streicher.

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2.2.6 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: Numerical solution of stochastic ordinary differential equations

In many applications, e.g. in epidemiology or mathematical finance, including stochastic effects in the modeling of continuous time dynamical systems leads to stochastic differential equations. Often one is not interested in approximating the solution pathwise (strong convergence), but in the expectation of functionals of the solution, which leads to weak convergence. We construct explicit and implicit stochastic Runge-Kutta schemes of weak stochastic order 2 including continuous schemes.

Partner: Anne Kværnø, Norwegian University of Science and Technology

Contact: K. Debrabant, D. Küpper, J. Lehn, A. Rößler.

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Project: Global Optimization with Parallel Evaluation of the Cost Function

Most optimization algorithms take into account not also the cost for evaluating the cost function and its derivatives, but also the overhead to determine the next arguments of the evaluation. In order to keep this overhead small, many algorimths only use the most significant information.
In many applications however this overhead can be neglected and in some special cases the cost function can be evaluated in parallel in nearly the same time at many points. In this case it is worthwile to use all information that is available to find the most interesting argument for the next parallel evaluation. This gives rise to new algorithms.

Partner: Michael Godzierz

Contact: M. Kiehl

Project: Evolution Models in Population Dynamics

Many models for population dynamics show can reproduce some aspectsof nature. The accuracy however is usually rather poor. The main outcome is rather understanding of principals than prediction of the behaviour of a special real system.
In this project we like to explain, how some complex looking systems can develope by simple random mutation and species interaction.
Examples are the coevolution of predator and pray, destinction of dinosaurs, the prime number cycles of some insects, and the developement of social behaviour such as living in swarms.

Contact: M. Kiehl

Project: Cheap Search Parameteroptimization in Dynamical Systems

Optimization algorithms take into account the cost for evaluating the cost function and its derivatives. Thereby it is usually assumed, that the evaluation cost does not depend on the argument. This is not true in many applications.
In this project we study stiff differential equations, where the stiffness depends on the parameters that are to be identified during the optimization process. The idea is to avoid the simulation of very stiff systems as long as the cost function shows good progress with other choice of the parameters. Thus the search direction is choosen so that the improvement of the cost function related to the cost to evaluate the cost function is optimal.

Partner: Marco Schuchmann

Contact: M. Kiehl

Project: Adaptive Error Control in Large Eddy Simulations

This project is part of the SFB 568 "Flow and Combustion in Future Gas Turbine Combustion Chambers" at TU Darmstadt. Large-eddy simulation (LES) technique focuses on capturing the large, energetic structures in a turbulent flow. The use of different LES models and numerical schemes give rise to subgrid-modelling and numerical errors. Mathematically it is essential to develop a rigorous error analysis for LES. In this project we quantify these errors according to a chosen quantity of interest. By using the concept of dual-weighted residuals we are able to split the error into space-time integrals of numerical residuals and modelling residuals multiplied by dual weights. These dual weights can be obtained by solving an associate dual problem. The LES and the corresponding dual models are numerically solved by a stabilized finite element method in space and an one-step method of Rosenbrock-type in time. Equipped with reliable and efficient a posteriori error estimators, our method is able to determine local spatial refinement and efficient step sizes to keep local discretizations errors under a prescribed tolerance.

Partner: Projects in CRC568

Support: German Research Association (DFG)

Contact: I. Teleaga, J. Lang

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Project: Optimal Control of Network Flows

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 tens of thousands pipes which makes global optimization with high resolution impossible. We employ different models in different regions of the network according to actual measurements of the gas flow. Efficient numerical solvers and reduced models for adjoint-based optimization techniques are developed.

Partner: A. Klar, M. Herty (TU Kaiserslautern), G. Leugering (University of Erlangen), A. Martin (TU Darmstadt)

Support: Scholarship (TU Darmstadt)

Contact: P. Bales, J. Lang

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Project: Space-time Adaptive Magnetic Field Computation

The discretization of transient magnetic field problems using a finite element method results in nonlinear differential-algebraic systems of equations of index one. The efficient transient computation of magnetic fields in induced eddy current layers as well as in regions of ferromagnetic saturation that may appear or vanish depending on the external current excitation may require 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 University of the Federal Armed Forces Hamburg).

Support: German Research Association (DFG)

Contact: D. Teleaga, J. Lang

References

[1] J. Lang D. Teleaga. Towards a fully adaptive space-time fem for magnetoquasistatics. COMPUMAG2007 Conference, Aachen, accepted, 2006.

Project: Adaptive Moving Finite Elements

The purpose of this project is to study a combination of an r–adaptive and an h–adaptive finite element method. r–adaptivity, i.e., moving grid points through the computational domain without destroying the mesh connectivity, is accomplished by a moving mesh method which has been developed by Cao, Huang, and Russell for a few years. This method is based on a moving mesh PDE where the gradient or an a posteriori error estimate of the numerical solution is used to indicate the regions requiring higher mesh density. Although moving methods have a good potential to solve non–trivial problems including free boundaries or time–dependent domains, a fixed number of grid points may become a major disadvantage. Here, h–adaptivity can be useful to insert new grid points in regions where large solution variations have to be resolved and to delete grid points where they are no longer needed. Thus, the main idea is to run the r–method until an h–method is required to keep the estimated discretization error in space below a certain tolerance.

Partner: W. Cao (University of San Antonio, Texas), W. Huang (Kansas State University), R.D. Russell (SFU Vancouver)

Support: German Research Association (DFG)

Contact: D. Kirchner, J. Lang

References

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Project: Modelling, Analysis, Simulation and Optimization of Gas Transport through Networked Pipelines

This project is concerned with the solution of optimization and control problems for flow processes in gas networks. Gas flow problems on networks are described by a hierarchy of local dynamics (PDEs or ODEs) on the edges and transmission conditions at the nodes of the network. The overall dynamics is optimized by discrete decision variables and by continuous control variables according to a certain target functional. Global solutions of corresponding optimization and control problems are obtained by a hierarchy of combinatorical and continuous methods. The successful solution of such complex problems requests the combination of mathematical modelling, mixed-integer optimization, discrete and continuous control theory and numerical mathematics. Combining all these areas we develop new efficient solution strategies.

Partner: A. Klar, M. Herty (TU Kaiserslautern), G. Leugering (University of Erlangen), A. Martin (TU Darmstadt)

Support: German Research Association (DFG)

Contact: O. Kolb, J. Lang

Project: Global Error Estimation and Control for Partial Differential Equations

When partial differential equations are solved numerically, the focus often lies on the efficiency of the methods used, whereas the reliability finds much less attention. Existing popular codes use local error control to optimize time and space grids adaptively, hoping that also the global error remains small. Depending on the condition and stability of the problem under consideration, this can lead to wrong results. In this project we develop methods to efficiently estimate the global time and space error. As these are approximately proportional to the tolerances used in the grid control, we can also provide an error control strategy. This allows the computation of an accurate numerical solution with respect to a user-prescribed tolerance. Recently, we have started to apply our method to mesh moving partial differential equations.

Partner: J. Ma, R.D. Russell (Simon Fraser University, Vancouver), J. Verwer (CWI, Amsterdam)

Contact: K. Debrabant, J. Lang.

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Project: Error based anisotropic monitor functions for r-adaptive finite element methods

Many problems arising from science and engineering have solutions with domains of large solution variations. Dense meshes are required to resolve them accurately. Uniform dense meshes are not always suitable in such cases, because the number of required elements can become very large. Using fine resolutions only in regions of large solution variations can significantly reduce the computational effort and makes the solving process more efficient.

However, controlling only the size of mesh elements combined with the use of almost equilateral elements results in isotropic meshes which tend to have too many elements in regions with large solution error. This is especially the case when the solution changes more significantly in one direction then in others. Such a solution is called anisotropic. Typical problems with anisotropic solutions are diffusion-convection-radiation equations or problems coming from fluid dynamics or weather simulation. Better numerical results for such problems can be achieved by adjusting not only the size but also the shape and the orientation of mesh elements according to the behaviour of the solution.

One of the mesh adaptation strategies commonly used is the r-adaptation method - a method that generates adaptive meshes by reallocating node positions. The node reallocation and thus the size, orientation and shape of mesh elements are described by a matrix function, usually referred to as the monitor function.

The objective of this project is now to find a way to assemble an appropriate anisotropic monitor function using information from the finite element solution and from a-posteriori error estimations.

Partner: R.D. Russell (Simon Fraser University, Vancouver), W. Huang (Kansas State University, USA)

Contact: L. Kamenski, J. Lang.

Project: Reaction-Diffusion Systems in Electrocardiology

Computational medicine has been a major research area for quite a number of years. Multiscale issues arise in nearly every of the corresponding problems. In this project we study fully adaptive numerical methods to solve challenging three-dimensional cardiac reaction-diffusion models. This includes the simulation of a complete heartbeat, from the excitation to the recovery phase. Anisotropic monodomain and more realistic bidomain models coupled with either a variant of the simple FitzHugh-Nagumo model or the complex pase-I Luo-Rudy ionic model are used. Our simulations are performed with the KARDOS code library that realizes an adaptive multilevel finite element in space and linearly implicit Runge-Kutta-Rosenbrock methods in time. The numerical results show a rather satisfactory performance of our adaptive method for cardiac problems up to moderate size. Ongoing research is focused on splitting methods to speed up the computing time.

Partner: P. Deuflhard, B. Erdmann (ZIB), P.C. Franzone (University of Pavia, Italy), L.F. Pavarino (University of Milano, Italy)

Contact: J. Lang.

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Project: Linearly Implicit Two-Step Peer Methods for Time-Dependent PDEs

Linearly implicit two-step peer methods are succesfully applied in the numerical solution of ordinary differential and differential-algebraic equations. One of their strenghts is that even high-order methods do not show order reduction in computations for stiff problems. We have included this type of methods in our finite element software KARDOS and have found that they are more efficient, at least competitive, in comparison with linearly implicit one-step methods already provided in KARDOS.

Partner: A. Gerisch, H. Podhaisky, R. Weiner (Martin-Luther-University Halle-Wittenberg)

Contact: J. Lang.

References

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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 nonlinear 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), optimisation and moving finite elements.

Although this software is mainly used for scientific and educational purposes, we are interested in cooperations with external organisations (industry, goverment research laboratories, etc) or other university departments (particularly engineering departments).

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

Contact: J. Lang.

Project: Large Scale SQP Solver

The method of Sequential Quadratic Programming is known as one of the efficient and robust solution methods for general nonlinear (smooth) optimization problems. In the last decade a special version of this method using only equality constrained QP problems has been developed and implemented, which works quite successfully, [4]. Only in the case of violation of the LICQ constraint qualification it must escape to a full inequality constrained QP problem with artificial variables, sometimes named the "elastic mode" approach [3]. Presently all these solves use "exact" (finitely terminating) linear dense solvers which becomes prohibitively costly when the dimension increases. For this reason the use of iterative (approximate) linear solvers is considered presently. In principle everything boils down to the solution (or regularized solution) of so called linear saddle point equations of the form

$$\begin{pmatrix} H & N \\ N^T & O \end{pmatrix} \begin{pmatrix} d \\ \lambda \end{pmatrix} = \begin{pmatrix} g \\ c \end{pmatrix} .$$

The main difficulty lies in the fact that neither positive definiteness of H (even not on the null space of N^T) nor full rank of N can be assumed for arbitrary initial guesses to the solution. Ealier attempts to design a successful iterative solver in this situation had their main trouble exactly there [1]. Therefore a new approach for computing approximate solutions to these systems is presently under consideration which is based on a smoothed version of an exact penalty function [2]. This in turn requires the cheap but reliable computation of the smallest eigenvalue resp. singular value of a matrix without using the technique of inverse iteration. Two methods for this task are under test presently. .

Contact: P. Spellucci.

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2.2.7 Optimization

The research group **Optimization** consists of the groups **Discrete Optimization** and **Nonlinear Optimization**, which cooperate closely. Mathematical Optimization considers the development, analysis and application of efficient numerical methods for minimizing (or maximizing) a function under constraints. While Discrete Optimization studies mainly linear or convex problems involving integer variables, Nonlinear Optimization focuses on nonlinear problems with continuous variables. The research group covers both research topics in a comprehensive way and cooperates in particular in the challenging field of Mixed Integer Nonlinear Programming, which considers nonlinear optimization with mixed discrete-continuous variables.
Discrete Optimization has 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, VLSI-design, network design problems in telecommunication, production planning and supply chain management, optimal charging of automatic teller machines, public mass transportation, or energy optimization, 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 reserach 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 Collaborative Research Center SFB 666 "Integral sheet metal design with higher order bifurcations - Development, Production, Evaluation", the Research Traning Group GK 853 "Modeling, simulation amd optimization of engineering applications", the BMBF network on "Decentralized regenerative energy supply" and the DFG Priority Programme SPP 1253 "Optimization with Partial Differential Equations".

Project: Integer Programming Methods for Protein Structure Prediction in the HP Model

Predicting the three-dimensional structure of a protein is a highly active field of research. Up to now, only experimental methods (NMR spectroscopy and X-ray diffraction) are applicable for retrieving suitable information about protein structure. However, these methods are expensive both concerning cost and time. For this reason, there are intensive efforts for finding a mathematical solution. There are several approaches, but due to the complexity of the problem an efficient solution to the problem has not yet been found.
A mathematical approach for finding the three-dimensional structure of a protein (also denoted as its native state) requires several of abstractions. We investigate the HP lattice model introduced by Ken A. Dill which is a highly simplified representation of the protein structure prediction problem. The sequence of amino acids whose native state has to be determined is reduced to a string of beads distinguished by the hydrophobicity of the corresponding amino acids. There are H (hydrophobic) and P (polar) elements. The principle underlying the HP model is the so-called hydrophobic collapse, meaning that in an energetically advantageous folding the H elements tend to be situated close together in the center of the protein, whereas the P elements are on the surface sheltering the hydrophobic core from the aqueous environment. Respecting this principle of the hydrophobic collapse, the HP string has to be folded on a given lattice (in the majority of cases a two-dimensional rectangular lattice is used), so that the number of H-H contacts (i.e. lattice edges with an H element on each of its lattice points) is as big as possible.
The formulation of the HP lattice model can be canonically realized in an Integer Programming model: As objective function (which has to be maximized), we have the number of H-H contacts of a folding of the HP string.
The constraints are given by the requirements that each HP string element has to be placed somewhere on the lattice, on each lattice point, at most one HP string element can be placed, consecutive HP string elements have to be placed on adjacent lattice points, and an edge of the lattice produces an H-H contact if and only if on both of its end points an H element is placed. For the solution of this model, we use a Branch-and-Bound procedure and investigate the application of several primal and dual methods, such as cutting planes for a set of relaxed constraints (including LP relaxation), symmetry reduction by preprocessing, primal and dual heuristics for obtaining lower resp. upper bounds, alternative IP models.

Contact: A. Dittel

Project: Electrical Energy Efficiency in Public Buildings

Efficient use of electrical energy is of big interest, not only since the cost of energy is increasing rapidly. Especially in public buildings, there is great potential of saving electrical energy. In this project, we deal with an approach for recognizing the actual energy consumption in order to find saving possibilities.
In cooperation with the engineering office Steinigeweg Beratende Ingenieure (S+P), a method for the simulation of energy consumption is developed.
Based on characteristic data of the building (such as building type, floor space, number of workplaces etc.), S+P provides profiles for the minimum utilization of electrical energy which are calculated in accordance with engineering guidelines. These profiles describe the percentage of utilized power for each class of consumers of electricity installed in the building on a set of days with characteristic run of utilization percentage (such as working days, holidays etc).
Additionally, for each consumer of electricity, the maximum utilization according to the amount of power installed in the building is provided.
Given the monthly energy consumptions documented in the electricity bills of the power supply company, we calculate utilization profiles for the consumers of electricity that are bounded by the minimum and maximum profiles and yield an electricity consumption as close as possible to the documented consumption values.

Support: Steinigeweg Beratende Ingenieure, Darmstadt

Contact: A. Dittel

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 or the quadratic assignment problem can be stated in this form, and, more generally, every integer linear problem can be reformulated as a copositive program. Moreover, some mixed integer nonlinear problems like QPs with integrality 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. The aim of this research project is therefore to formulate necessary and sufficient conditions for copositivity, to find polyhedral approximations of the copositive cone and, based on this theory, to develop efficient algorithms to solve these problems.

Contact: S. Bundfuss, M. Dür.

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Project: Neutral Data Fitting

Suppose you are interested in estimating the slope of a line fitted to data points. How should you fit the line if you want to treat each variable on the same basis? Least squares regression is inappropriate here since it's purpose is the prediction of one of the variables. If the variables are switched it provides a different slope estimate. Multiple Neutral Data Fitting is a method to analyse the relationship between a number of variables alternative to the well known least squares estimation. Least squares is so popular because it is so easily computed. It does, however, suffer from several shortcomings: For example, in order to apply least squares, the user needs to specify which variables are the independent variables, and which one is the dependent variable. A change in this setting will lead to a completely different least squares estimate. In practice, however, a distinction between explanatory and response variables is not always so easy. Another deficiency of least squares fitting is an assumption in the underlying model that may be unrealistic in many situations: the model is based on the assumption that only the dependent variable is subject to measurement errors. The independent variables are assumed to be known exactly, a premise that is often not fulfilled. Multiple Neutral Data Fitting is an approach that avoids these shortcomings. The basic idea is that a different criterion is chosen as objective of the optimisation problem: Instead of minimizing the sum of the squares of the residuals, we consider the deviations for each variable and multiply them. As a result, we get a slope estimate different from the least squares solution. The new estimate possesses nice theoretical properties, but comes with a higher computational cost when fitting a model to multiple variables. In contrast to least squares regression, our method requires the solution of a global optimisation problem.

Partner: C. Tofallis (University of Hertfordshire Business School), K. Will.

Contact: M. Dür

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Project: Mathematical Optimization in Sheet Metal Design

The new sheet metal forming process "linear flow splitting" provides the opportunity to form branched profiles in an integral style out of a single sheet of metal. However, each additional branch leads to new possibilities for the topology and the geometry of the product. Manufacturing constraints also have to be taken into account. Handling the amount of producible profile variants thus requires a methodical procedure. Because of the high complexity, the entire procedure is split into three sub-problems: 1) the generation of an optimal topology, 2) the refinement of the geometry, and 3) an incorporation of the production constraints. The output of one step is thereby taken as input for the next one. In each of the three steps, different mathematical modeling and solution techniques are used. For the topology generation, we use linear mixed-integer programming. The geometry refinement is based on non-linear, particularly PDE-constrained, optimization. Finally, the production constraints can be formulated as certain graph-theoretical problems which can be approached using approximation algorithms as well as linear mixed-integer programming.

Support: Collaborative Research Center (CRC) 666 of the German Research Association (DFG).

Contact: A. Fügenschuh, U. Günther, W. Hess, A. Martin, S. Ulbrich.

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Project: Integrated Coordination of School Starting Times and Public Transport

Traffic peaks are peaks in cost. This is in particular true for rural counties in Germany, where public mass transportation is focused on the demand of pupils. About half to two third of pupils in rural areas take a bus to get to school. The respective county in which the pupils live is responsible for the transfer. This in particular means that the county administration pays the fees. Since tax money is a scarce resource in our days, the administration has great interest in reducing their payments as much as possible. By the state's school law, schools are allowed to change their starting times within some interval (between 7:30 and 8:30 a.m.). If the school starting times are changed, then the bus starting times also have to be adjusted accordingly. The question is, how to simultanenously change the starting times for all schools and bus trips in a certain county so that the number of scheduled buses is minimal. In this project, we developed an integer programming model. This model turns out to be an extension of the classical VRPTW (vehicle routing problem with time windows). The new aspect are coupling constraints on the time windows, hence it is called the VRPCTW (vehicle routing problem with coupled time windows). For its solution we use a greedy-type construction heuristic. Moreover, we analyze exact methods, such as branch-and-cut and branch-and-price. Compared to the currently used number of buses our methods are able to detect savings of 10-30%, or absolute 5-50 buses. The reduction by a single bus is worth around 30,000 Euro of tax allowance per year, so this adds up to several hundred thousand Euros per county. Extrapolated to all 323 German counties, this would mean savings of several hundred million Euros, year by year.

Partner: M. Prick, P. Stöveken (Center for Integrated Traffic Systems, ZIV, Darmstadt).

Contact: A. Fügenschuh.

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Project: Solving Partial Differential Equation Systems with Mixed-Integer Programming Techniques

Since the early days of Newton and Leibnitz, phenomena involving physical laws such as growth and decay, transport of mass, or conservation of energy are described by differential equations. In our days, continuous models based on partial differential equations (PDEs) are used in various areas of applications, for example, in the simulation of production processes, the understanding of traffic flow in street networks, or the simulation and control of the energy transport from power plants to customers. PDEs provide the finest level of description for many physical and economical processes. In particular, for simulations of large quantities, only the continuous formulations of the PDE models can provide an accurate description of the underlying physical process. Usually, these models rely on quantities such as density (parts per length) and flux (parts per time unit), where the involved parts are not considered individually, but as a continuum. The new aspect of our work is to introduce a relationship between continuous models and mixed integer programming (MIP) models. The advantage of this MIP approach to PDE models is twofold. First, in many cases MIPs can be solved even for large scale instances in reasonable time by state-of-the-art numerical solvers. Second, the solutions come with a quality warranty, that is, either optimality is proven or an estimation of the optimality gap for the best-known solution is returned. Linear mixed-integer programming can be applied in many ways to continuous PDE models. Examples in this respect are: The transient flow of traffic in street networks [3], the contamination detection in water supply networks [2], or the layout of production networks [1].

Partner: S. Göttlich, M. Herty (Kaiserslautern University of Technology).

Contact: A. Fügenschuh.

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Project: Optimization for Railway Systems

Passenger and freight railway systems in general have a high level of intrinsic complexity. At all stages of the business process optimization problems are involved. Our project partner Deutsche Bahn AG (DB) is the largest German railway company with 216,000 employees and a turnover of 25 billion Euros in 2005. Per year, 1.8 billion passengers (72 billion passenger kilometers) and 253 million tons of goods (77 billion ton kilometers) are transported. For the long-term simulations and future predictions of the network load, DB use in-house developed simulation tools. The entire simulation tool has evolved over the last 5 years, and is still under continuous improvement. The scope of our research is to use methods from discrete and mixed-integer optimization to enhance the capabilities of these simulation tools. For example, in [4] we analyze the problem of empty car scheduling in freight transport, and in [1,2,3] we present a new model for a strategic locomotive scheduling problem. The latter model is based on a multi-commodity min-cost flow formulation that is also used for public bus scheduling problems. However, several new aspects have to be additionally taken into account, such as cyclic departures of the trains, time windows on starting and arrival times, network-load dependend travel times, and a transfer of wagons between trains. The model is formulated as an integer linear programming problem (ILP). The formulation is improved by preprocessing and additional cutting planes. Solutions are obtained using a randomized greedy heuristic as well as commercial ILP solvers, and combinations of both.

Partner: A. Huck, G. Pfau, A. Schoch (Deutsche Bahn AG, Frankfurt).

Contact: A. Fügenschuh.

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Project: Forecasting of Cash Point Transactions and Optimal Replenishment Schedules

An efficient management of cash points is an important task for banks and financial institutions, influenced by apparent factors like customers behaviour, cash point location, opening hours, and non obvious ones like loss of interest, cost for handling and availability of resources for transport. Handling such complex situations requires accurate prediction of future turnovers and best possible replenishment plans. Here, the prediction is performed using time series methods based on the past data. In order to find the best possible replenishment schedule, methods from linear mixed-integer programming are used.

Partner: Wincor-Nixdorf GmbH

Contact: U. Günther, A. Martin, K. Ritter, T. Wagner.

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Project: `polymake`

The mathematical software system `polymake` provides a wide range of functions for convex polytopes, simplicial complexes, and other objects. `polymake` tries to combine the features of a variety of established software systems by providing a framework, which, for instance, allows to use one program to compute the convex hull of a given set of points and to use a second program to visualize the output. There are two key points to mention. Firstly, the `polymake` user does not have to specify which programs are to be used in which order (but he or she can if need be). Secondly, neither of the two programs involved has to be aware of the other. It is not even necessary that the two programs are developed in the same programming language. In fact, currently `polymake` interfaces to programs written in C, C++, Java, and Perl. In 2005 `polymake` was awarded the Heinz-Billing-Preis (2. Preis). `polymake` is an open sourec software project. The current version 2.3 can be downloaded freely from `www.polymake.de`. Further technical details to be found at `wwwopt.mathematik.tu-darmstadt.de/polymake`.

Partner: Ewgenij Gawrilow (TU Berlin)

Contact: M. 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: M. Joswig

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Project: Branched Coverings and a Combinatorial Holonomy Theory

The theory of simplicial and polyhedral surfaces has combinatorial notions of paths and geodesics, quite distinct from the case of smooth surfaces. Thus it requires a separate theory of "how to move information along paths on the surface," which also has useful and interesting extensions beyond the two-dimensional case of surfaces. In this project we also study higher-dimensional generalizations including, in particular, the case of complex surfaces. The transport of information "along the surface" and thus "in tangent direction" is in some sense transversal/orthogonal to the moduli that any (unparametrized, but embedded/immersed) surface would admit, that is, to motions "in normal directions." In particular, inconsistencies in motions along closed paths along a manifold may be captured in holonomy groups and may partially be resolved by a construction of covering surfaces/manifolds. Moreover, in the combinatorial (triangulated/polyhedral) case branched coverings arise for which the branching locus is suggested/determined by combinatorial data. Surprisingly rich classes of manifolds may be obtained that way, and connections to rather deep combinatorial (coloring) problems arise naturally. Already the surface case is rich in this respect: The theory of branched coverings of the 2-sphere has an inherently combinatorial flavor. Related topics include graph embeddings into surfaces and group actions on graphs.

Partner: Günter M. Ziegler (TU Berlin)

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

Contact: M. Joswig

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Project: Optimal Grid Partitioning for Parallel Flow Computations on Block Structured Grids.

Multiprocessors and parallel computation allow the simulation of turbulent flows in rather complex geometries. To achieve small or even minimal simulation times it is important to distribute the computational load equally over the available processors and to keep the overhead for interprocessor communication small. This is usually done by solving a graph-partitioning problem in which the grid that underlies the simulation is represented as graph. The objective of this problem is to distribute the nodes equally over the processors and to keep the number of edges between processors small, as this number is assumed to be proportional to the communication overhead. In other words, in an optimal solution to this problem the computational load is perfectly balanced between the processors and the number of inter-processor edges is minimal.

Apart from other deficiencies this traditional model has the drawback that it does not account for constraints on the communication schedule imposed by the hardware and does not take into account the tradeoff between imbalance of the load and reduction of communication overhead.

In this project we propose a new integer programming model that accounts for the tradeoff between communication overhead and load-balancing as accurately as possible. Moreover, we do not make the over-simplifying assumption that communication overhead is proprotional to the number of inter-processor edges. Instead we determine an

optimal communication schedule that respects constraints imposed by the communication hardware.
In order to solve instances of the newly defined optimization problem we employ local search techniques like Tabu search as well as Branch-and-Bound algorithms. Computational experiments show that using these two classes of algorithms we are able to solve real-world problem instances that are based on block-structured grids (the kind of grids usually employed in computational fluid dynamics). The mappings that are implied by the computed solutions save up to 25 percent of the simulation time when compared to mappings that correspond to optimal solutions of the standard model.

Partner: M. Schäfer, Department of Numerical Methods in Mechanical Engineering, TU Darmstadt

Support: German Research Association (DFG), Research Training Group 853, "Modelling, Simulation and Optimization of Engineering Applications".

Contact: A. Martin.

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Project: New Algorithms in Invariant Theory

The Invariant Theory of finite groups is a classical topic of commutative algebra. Here, a finite group G acts linearly on a polynomial ring R with n variables. We assume that we are in the modular case, i.e., the order of G is not divisible by the characteristic of R. The *invariant ring* $R^G = \{r \in R\colon\ g.r = r\ \forall g \in G\}$ is a subalgebra of R, and the problem is to find generators for R^G. It is well known that there are n algebraically independent homogeneous polynomials $p_1, ..., p_n \in R^G$ such that R^G is a finitely generated module over the subalgebra $P \subset R$ generated by $p_1, ..., p_n$. These polynomials are called *primary invariants*, and a minimal set of homogeneous module generators for R^G is called *secondary invariants*. Those secondary invariants that can not be expressed as a polynomial in the primary and the other secondary invariants is called *irreducible*. The primary and irreducible secondary invariants generate R^G as a subalgebra of R. Both primary and secondary invariants are not uniquely determined. There are algorithms for the computation of primary and (irreducible) secondary invariants, implemented, e.g., in Singular or Magma. However, in our topological applications [2], we found examples of invariant rings too complex for these algorithms. The computation of primary invariants was not particularly difficult, but the problem was the computation of secondary invariants. Based on a result on Groebner bases, we developed a new algorithm for the computation of secondary invariants that marks a dramatic improvement in the manageable problem size [1]. It is implemented in Singular 3-0-2 (released in Juli 2006). We still work on improvements of our algorithm, that will be part of release

3-0-3. Meanwhile we also found examples in which the computation of primary invariants of minimal degree is very complex. We now try to improve the methods also in this context.

Partner: G. M. Greuel

Contact: S. King.

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Project: "Ideal" Invariants in Low-Dimensional Topology

In [5](see [3] for a summary), I generalized certain homeomorphism invariants of compact 3–dimensional manifolds, called *Turaev–Viro invariants*. The generalised invariant takes values in a quotient of some polynomial ring by some ideal, which is the reason why I call them *ideal* Turaev–Viro invariants. The "classical" Turaev–Viro invariants are obtained by evaluation of ideal Turaev–Viro invariants. First of all, ideal Turaev–Viro invariants are much stronger than the classical invariants. Moreover, there are some further potential applications. E.g., the degrees of the polynomials occuring in the ideal Turaev–Viro invariant provide lower bounds for the minimal number of triangulations of a manifold. In experiments, this bound turned always out to be trivial, and it is not yet understood why. Also, starting with ideal Turaev–Viro invariants it is possible to obtain so-called *Andrews–Curtis invariants*. With such invariants, in principle one could detect counterexamples to the famous Andrews–Curtis conjecture in Group Theory. By work of Bobtcheva and Quinn [2], a detection of counterexample is impossible for those Andrews–Curtis invariants that come from classical Turaev–Viro invariants. However, our ideal invariants do not satisfy the hypothesis of the Bobtcheva–Quinn obstruction. So, there is hope to detect counterexamples to the Andrews–Curtis conjecture using ideal Turaev–Viro invariants. In a very similar spirit, one can also try to generalise well known invariants for knots and links, such as the *Jones polynomial*. There had been several approaches, of myself and of Louis Kauffman. So far, in contrast to the results on 3–manifolds, the ideal knot invariants did not turn out to be stronger than the classical knot invariants. Now, Kauffman and I try to overcome these limitations. The computation of ideal Turaev–Viro invariants involve applications of Computer Algebra. In fact, our work is a source of test examples for the computation of Gröbner bases and of invariant rings. In our examples, the algorithm `slimgb` for the computation of Gröbner bases [1] turned out to perform particularly well. Our examples motivated us to develop a new algorithm for the computation of secondary invariants (here, we do not mean "homeomorphism invariants of manifolds" but "polynomials that are invariant under the linear action of some finite group"). This algorithm was implemented in SINGULAR and marks a breakthrough in the manageable problem size [4].

Partner: L. Kauffman

Contact: S. King

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Project: Facility Location Problems

Facility Location Problems deal in its basic form with the problem of deciding where to open certain facilities in order to serve a given set of customers best possible. The terms "facility" and "customer" may have different names and vary from application to application. To give two examples, the "facilities" might be processors of a parallel computer and the "customers" are jobs to be distributed on the processors. Or the "facilities" might be service technicians and the "customers" are clients that need a certain service in time. Mathematically these problems lead to so-called multiple knapsack problems with additional side constraints. Our research group has extensive experiences in solving such multiple knapsack problems to proven optimality. The applications are manifold and range from telecommunication, via energy supply to parallel computing.

Partner: Linde AG, Devision Linde Gas; Telecommunication Company (wants to stay unnamed)

Contact: A. Martin.

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Project: Solving the Minimum Graph Bisection Problem

The minimum graph bisection problem concerns partitioning the nodes of a graph into two subsets such that the total weight of each set is within some lower and upper limits. The objective is to minimize the total cost of edges between both subsets of the partition. Due to the knapsack condition on the weight of each partition the problem is NP-hard. The problem has a variety of applications, for instance in the design of electronic circuits and devices. In our project we investigate current efficient optimization methods for solving the minimum graph bisection problem. On one side integer programming methods like branch-and-cut algorithm based on the linear relaxation are applied. On the other side the semidefinite programming with spectral bundle method deliver good quality approximations. Both linear and semidefinite approaches benefit from the results on the widely investigated max-cut problem and the corresponding cut-polytope. Ferreira et al. (1996, 1998) deliver an overview about the polyhedral structure of graph partitioning problems with a knapsack condition. An introduction to the semidefinite relaxation of the graph bisection problem can be found in Helmberg (2000, 2001). Based on these results we implement a semidefinite relaxator, primal heuristics and separation methods for both semidefinite and linear relaxations within a branch-and-cut framework SCIP.

Partner: M. Armbruster, C. Helmberg (Chemnitz University of Technology); T. Achterberg (Konrad-Zuse-Institute Berlin).

Support: German Research Association (DFG).

Contact: M. Fügenschuh, A. Martin.

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Project: Gas Network Optimization

A gas network consists of a set of pipes to transport the gas from the suppliers to the consumers. Due to friction with the pipe walls gas pressure gets lost. This pressure loss is compensated by so called compressors. The goal of so called Transient Technical Optimization (TTO) is to operate the gas transmission in such a way that the consumer

demands are satisfied and the compressors are set in cost-efficiently. This 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. We study sub-polyhedra linking these SOS conditions yielding exact separation algorithms. Suitable branching strategies complement the separation algorithms and guarantee the SOS conditions. In a next step we consider the time-dependent case which is also called transient case. At first we need an appropriate modelling of the gas dynamics in pipes. Again we approximate nonlinearities by piece-wise linear functions via SOS constraints. We improve the branching strategies by adequate preprocessing techniques. In the transient case we also get further conditions, for example min-up and min-down times and switching costs for compressors. We develop a simulated annealing algorithm to get an upper bound in our branch-and-cut algorithm.

Partner: S. Dymkou, G. Leugering (University of Erlangen-Nuremberg); O. Kolb, J. Lang (TU Darmstadt).

Support: German Research Association (DFG).

Contact: B. Geißler, A. Martin, S. Moritz, N. Nowak.

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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 as well as control of the wave generation at the water surface. This involves optimization problems including very complex and highly coupled systems of PDE constraints.
In that framework, the following optimization problems are considered for the optimization of the hull-keel-winglet configuration:

- shape optimization within constraints of weight, structural strength and lift
- tracking type problems for the control of the wave generation at the water surface.

The main research topics of the project are:

- Multilevel optimization methods based on inexact trust-region SQP techniques using a hierarchy of adaptive discretizations or models.
- Semismooth Newton and interior point methods to handle inequality constraints for design and state variables.
- Adaptivity in time and space based on the goal oriented approach and including the issue of inequality constraints.
- Parallel processing for the optimization schemes via space and time domain decomposition.

The developed techniques can be applied directly for the Shosholoza boat competing in the America's Cup for the next two trophys and for which V. Heuveline is leading the Scientific Advisory Team.

Partner: V. Heuveline (University of Karlsruhe); M. Ulbrich (TU Munich).

Support: German Research Association (DFG).

Contact: C. Brandenburg, S. Ulbrich.

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

The aim of this project is to develop, analyze and apply highly efficient optimization methods for optimal control problems with control- and state-constraints governed by time-dependent PDAEs. To this end we want to combine in a modular way modern space-time adaptive multilevel finite 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. We will focus on two exemplary applications: The optimal boundary control of the cooling down process of glass in glass manufacturing and the optimal redistribution of dopants in silicon. For both the examples, first simulation results are available.
In this project we have the opportunity to enrich the state-of-the-art solver KARDOS for PDAEs with specific features to perfectly match the needs of an outer optimization algorithm. We are therefore in the position to evaluate the potential of combining multilevel optimization methods and adaptive PDAE solver techniques. This offers the possibility to obtain optimal complexity for the optimization process also for complex real-life problems.

Support: German Research Association (DFG)

Contact: D. Clever, C. Ziems, J. Lang, S. Ulbrich

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[1] D. Clever. Optimalsteuerung für die Abkühlung von Glas. Master's thesis, TU Darmstadt, Department of Mathematics.

[2] J. Lang. Adaptive computation for boundary control of radiative heat transfer in glass. *J. Comput. Appl. Math.*, 183:312–326, 2005.

[3] S. Ulbrich. Generalized SQP-methods with "Parareal" time-domain decomposition for time-dependent PDE-constrained optimization. In *Real-time PDE-Constrained Optimization*, pages 145–168. SIAM, 2007.

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. The purpose of this project is to develop algorithms for solving the dynamic balancing problem. To this end, we make use of linear programming and second order cone programming techniques.

Partner: Schenck RoTec GmbH

Contact: M. Dür, A. Fügenschuh, A. Martin, S. Ulbrich

References

[1] M. Dür, A. Fügenschuh, A. Martin, and S. Ulbrich. Verfahren und Vorrichtung zum Auswuchten von wellenelastischen Rotoren. Deutsche Patentanmeldung DE 10 2006 060 583.7 vom 19.12.2006.

[2] W. Hess. Verfahren für gemischt ganzzahlige Second-Order-Cone-Programme. Diploma Thesis, 2006.

Project: Optimal Design of Dispersed Generation Systems

The increasing utilization of dispersed generation systems requires the planning of adapted supply networks. 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 problem of the optimal network planning consists of topological design on the one hand and 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.

Partner: Institute of Energy Systems and Energy Economics (University of Dortmund); Fraunhofer Institute UMSICHT (Oberhausen).

Support: Federal Ministry of Education and Research (BMBF).

Contact: D. Mahlke, A. Zelmer.

Project: Use of Energy Storages to Decouple Regenerative Energy Supply and Consumer Demand

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.
Mathematically, this problem leads to a nonlinear mixed integer program. The combinatorial aspects arise because of switching processes of the storages and plants, whereas the nonlinearities result from the consideration of start up costs and efficiency factors of the plants and storages.

Partner: Institute of Energy Systems and Energy Economics (Ruhr-University Bochum).

Support: Federal Ministry of Education and Research (BMBF).

Contact: D. Mahlke, A. Zelmer.

2.2.8 Stochastics

Research in the stochastics group is focused on stochastic processes, i.e., on mathematical models for random phenomena that evolve in time (and space). We are interested in both, 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 stochastic evolution equations, stochastic (partial) differential equations, and Lévy processes with contributions to stochastic analysis and filtering theory as well as to numerical analysis and complexity theory. Furthermore, we study Monte Carlo methods for high-dimensional integration and stochastic optimization algorithms.
Applied mathematical statistics is another area of research in the stochastics group and here we have carried out a number of research projects with well-known industrial partners. Research in mathematical statistics will be further strengthend by a new appointment of a professor in 2007.
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 partial differential equations, numerical analysis, and information-based complexity.

Project: Stability Analysis with Corrupted and Censored Data

The project aims at creating a mathematically solid and easily usable implementation of drug stability testing, which is conformant to standard international regulatory guidelines. Stability Analysis is concerned with the evaluation and estimation of degradation of drug substances over time in different environments. The situation is becoming more complicated since there is also a difference in substance concentration and degradation between various batches. The regulatorial guidelines emitted by the ICH (Specifiactions Q6A, Q1E Q1AR2) as of yet propose separated estimation shelf–life for several batches with a second test for significant differences. In a number of papers, it was demonstrated both in thoery and practice that mixed–effect models are superior to this approach. However, this approach is not per se robust against outliers and does not incorporate censored data. Since both abound in real–world data on stability and substance concentration, several modifications on the original mixed–effect–model have to be invented, described analytically, implemented and tested.

Partner: Merck AG

Contact: J. Creutzig

Project: Quantization of Levy Processes

Quantization of stochastic processes can be viewed as an infinite–dimensional equivalent to the problem of building quadrature rules. Basically, one is trying to construct a discrete measure on the path space, which, in the Wasserstein metric, is close to the distribution of the original process. This naturally has applications within the numerical evaluation of path integrals. Our interest is within the rates (and, if possible, strong asymptotics) of optimal quantizations as the size of the support of the approximating discrete measure tends to infinity. For Gaussian processes, there are remarkable close links to the small deviation probabilities of the process, which allows to derive quantization rates and even strong asymptotics in a number of cases. For Levy processes and diffusions, only partial results are known. is the L_p norm with a large p. We establish general connections to certain kinds of nonlinear approximations, which enables to treat such cases. We also try to generalize known lower estimates for the symmetric stable case.

Partner: Dr. Steffen Dereich, TU Berlin

Contact: J. Creutzig

Project: Free–Knot Spline Approximation of Stochastic Processes

Our interest lies within the approximation of a stochastic process using piecewise polynomial splines with a (random or fixed) number of (freely and path–dependently chosen) knots. To be more precise, we ask for the minimal error possible using at most n knots and study the asymptotics as $n \to \infty$. Rough (and sometimes sharp) asymptotics were found for diffusion processes, stable Lévy processes and fractional Brownian motion. For the case of a Brownian motion or a diffusion process, it was shown that there is essentially no improvement in the error rate compared to naïve linear equidistant interpolation; however, for more symmetric stable Lévy processes, it is shown that nonlinear approximation yields better rates than linear approximation. In both cases, it is possible to construct simulations of such nonlinear approximations with a *guaranteed* error which is close to the optimal average error. Our aim is to generalize these results, e.g. to fractional versions of the above processes. We already found the error rates in the case of fractional Brownian motion; however, up to now we do not have simple and efficient constructive algorithms similar to those described above. Further, we will try to generalize those findings to fractional stable motion.

Partner: Prof. Dr. M.Lifshits, St. Petersburg University

Contact: J. Creutzig

Project: Transient Noise Analysis in Circuit Simulation

This project is motivated by the need to deal effectively with arbitrary perturbations of electrical circuits in the design process of microchips. These perturbations, so-called inner electronic noise, are caused by an increasing number of electrical circuits integrated on a microchip along with a steadily reducing chip size. Shorter life cycles and therefore decreasing time slots for the development make numerical circuit simulation essential to ensure the correct functioning of the design before the first costly prototype of a new chip is produced. Mathematical modelling of microelectronical circuits leads to stochastic differential-algebraic equations (SDAEs), which often do not have any analytical solutions. Algorithms which approximate these solutions have to deal with the implicit structur of the equations. Since the domain of SDAEs is still young, there do not exist many standard algorithms for their numerical treatment. Within the scope of this project a new efficient Runge-Kutta type algorithm for the approximation of the solutions of SDAEs is developed. So far, no algorithm of this type was known for the use with SDAEs. Runge-Kutta type algorithms are derivative free and possess good stability properties.

Partner: A. Rößler (TU Darmstadt)

Support: Research Training Group 853 (DFG)

Contact: J. Lehn, D. Küpper

References

[1] G. Denk and O. Schein. Numerical solution of stochastic differential-algebraic equations with applications to transient noise simulation of microelectronic circuits. *Journal of Computational and Applied Mathematics*, 100:77 – 92, 2006.

[2] D. Küpper, J. Lehn, and A. Rößler. A step size control algorithm for the weak approximation of stochastic differential equations. *Preprint 2411, TU Darmstadt (submitted)*, 2005.

[3] O. Schein. *Stochastic Differential-Algebraic Equations in Circuit Simulation.* Ph.D. Thesis, TU Darmstadt, Shaker, Aachen, Germany, 1999.

[4] R. Winkler. Stochastic differential algebraic equations of index 1 and applications in circuit simulation. *Journal of Computational and Applied Mathematics*, 157:477–505, 2003.

Project: Generalized Mixed Poisson Processes

In insurance mathematics, mixed Poisson processes play a central role in order to model claim number processes. A fundamental property of these point processes is the conditional uniformity of its points, that is, given the total number of points of the process in a certain time interval, these points are independently, uniformly distributed. A generalization of this property via generalized models of ordered random variables is possible and leads to a richer class of point processes which could be of interest for users looking for appropriate models beyond mixed Poisson processes. Such generalized processes are studied within the project, especially considering distributional aspects.

Partner: external tutors from Friedrich-Schiller-University Jena and TU Dresden

Contact: Prof. Lehn, B. Niese.

References

[1] Birgit Niese. A generalized order statistic property. Technical report, TU Darmstadt, April 2006. Nr. 2453.

Project: Monte Carlo Algorithms (Textbook)

Based on numerous courses held at the Universities of Erlangen, Jena, Madgeburg, and Darmstadt we develop an introductory textbook on Monte Carlo Algorithms (in German). We aim at readers with a basic knowledge in probability and numerical analysis, which is typically provided in second year university courses on these topics. First we study direct simulation, i.e., the classical Monte Carlo algorithm, as well as simulation of distributions and variance reduction techniques together with applications in, e.g., particle physics, computational finance, and insurance risk modeling. In a second part, we investigate Markov chain Monte Carlo methods and high-dimensional numerical integration. For the latter problem we also address the issue of optimal randomized or deterministic algorithms within the framework of information-based complexity. A third part is devoted to random numbers, covering the practical issue of random number generation as well as the question of how to define randomness of sequences of bits or real numbers. Several optional parts of the text provide outlooks to related but mathematically more advanced topics like quasi Monte Carlo methods, Monte Carlo methods for integral equations, approximation of stochastic differential equations, and quantum computing.

Partner: Prof. Dr. E. Novak (Friedrich-Schiller University of Jena), PD Dr. T. Müller-Gronbach (Fern University of Hagen)

Contact: K. Ritter

Project: Optimal Approximation of Stochastic Evolution Equations

We study algorithms for approximation of stochastic evolution equations. The latter are used, e.g., for modeling 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 relate error and cost. In order to establish optimality, the following kind of result is needed: the error of any algorithm with computational cost at most N is at least $e(N)$. Here the lower bound $e(N)$ does not depend on the specific algorithm but only on the evolution equation under consideration. The use of non-uniform time discretizations, or more generally adaptive 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: PD Dr. T. Müller Gronbach (Fern University of Hagen)

Support: German Research Association (DFG).

Contact: K. Ritter, T. Wagner

References

[1] T. Müller-Gronbach and K. Ritter. Lower bounds and non-uniform time discretization for approximation of stochastic heat equations. Online first, 2006. To appear in Found. Comput. Math.

[2] T. Müller-Gronbach and K. Ritter. An implicit Euler scheme with non-uniform time discretization for heat equations with multiplicative noise. 2007. To appear in BIT.

[3] T. Müller-Gronbach, K. Ritter, and T. Wagner. Optimal pointwise approximation of a linear stochastic heat equation with additive space-time white noise. 2007. To appear in Monte Carlo and Quasi Monte Carlo Methods, Springer, Berlin.

Project: Constructive Quantization and Infinite-Dimensional Quadrature

Quantization of probability measures provides a tool for approximate computation of integrals by means of deterministic quadrature formulas, and very promising results for applications in mathematical finance are reported in the literature. In this project we are interested in constructive quantization, as we wish to determine order optimal quantizers at a computational cost close to the 'size' of the quantizers. We focus on diffusion processes and constructive quantization of the corresponding measures on path spaces, where infinite-dimensional quadrature may be used, e.g., for valuation of path-dependent options.

Partner: Dr. S. Dereich (TU Berlin), PD Dr. T. Müller-Gronbach (Fern University of Hagen)

Contact: J. Creutzig, K. Ritter

References

[1] S. Dereich, T. Müller-Gronbach, and K. Ritter. Quantization and infinite-dimensional quadrature. Preprint, 2006.

Project: Nonlinear Approximation of Stochastic Processes

Our interest lies within the approximation of a stochastic process using functions from a nonlinear manifold, which may consist, e.g., of piecewise polynomial splines with a (random or fixed) number of (freely and path-dependently chosen) knots. To be more precise, we ask for the minimal error possible using at most n knots (on the average) and study the asymptotics as $n \to \infty$. Rough (and sometimes sharp) asymptotics were found for diffusion processes, stable Lévy processes and fractional Brownian motion. For the case of a Brownian motion or a diffusion process, it was shown that there is at most an improvement in terms of logarithmic factors in the error rate compared to naïve piecwiese linear equidistant interpolation; however, for more general (e.g., symmetric stable Lévy) processes, it turned out that nonlinear approximation yields significantly better rates than linear approximation. In both cases, we aim at constructing simulation methods of such nonlinear approximations with a guaranteed error, and future work will include wavelet-based methods as well.

Partner: Prof. Dr. S. Dahlke (University of Marburg), Prof. Dr. M. Lifshits (St. Petersburg University), PD Dr. T. Müller-Gronbach (Fern University of Hagen), Prof. Dr. L. Plaskota (University of Warsaw)

Contact: J. Creutzig, K. Ritter

References

[1] J. Creutzig. Approximation of sαs lévy processes in l_p norm. *J. Approx. Theory*, 140:71–85, 2006.

[2] J. Creutzig and M. Lifshits. Free-knot spline approximation of fractional brownian bridge. Preprint, 2007.

[3] J. Creutzig, T. Müller-Gronbach, and K. Ritter. Free-knot spline approximation of stochastic processes. Preprint, 2006.

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[5] M. Kon and L. Plaskota. Information-based nonlinear approximation: an average case setting. *J. Complexity*, 21:211–229, 2005.

Project: Numerical Methods for Affinely Controlled Systems

Traditional numerical methods for ordinary differential equations fail to achieve their asserted order of convergence when applied to affinely controlled nonlinear systems where the control functions are assumed to be only measurable functions and where the differential equation is interpreted in the sense of Carathéodory. Therefore, the aim of this project is the systematically derivation of Runge-Kutta methods for such affinely controlled nonlinear systems. This is based on rooted tree analysis with several colours. Order conditions for such Runge-Kutta methods are determined and the performance of these new numerical methods compared with Taylor schemes is analysed by simulation studies.

Partner: P. E. Kloeden (Johann Wolfgang Goethe–University of Frankfurt)

Contact: A. Rößler.

References

[1] R. Ferretti. Higher–order approximations of linear control systems via Runge–Kutta schemes. *Computing*, 58:351–364, 1997.

[2] L. Grüne and P. E. Kloeden. Higher order numerical schemes for affinely controlled nonlinear systems. *Numer. Math.*, 89:669–690, 2001.

[3] P. E. Kloeden and A. Rößler. Runge-Kutta Methods for affinely controlled nonlinear systems. *To appear in: J. Comput. Appl. Math.*

Project: Numerical Methods for Affinely Controlled Systems

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Partner: P. E. Kloeden (Johann Wolfgang Goethe–University of Frankfurt)

Contact: A. Rößler.

References

[1] R. Ferretti. Higher–order approximations of linear control systems via Runge–Kutta schemes. *Computing*, 58:351–364, 1997.

[2] L. Grüne and P. E. Kloeden. Higher order numerical schemes for affinely controlled nonlinear systems. *Numer. Math.*, 89:669–690, 2001.

[3] P. E. Kloeden and A. Rößler. Runge-Kutta Methods for affinely controlled nonlinear systems. *To appear in: J. Comput. Appl. Math.*

Project: Stochastic Filtering Theory and Particle Filters A stochastic filter is a statistical device to estimate a signal X given by a noisy observation $Y = G(X, e)$. If the joint distribution of X and the measurement error e is known, the mean $\hat{X} = \int x\,\mu^Y(dx)$ of the a posteriori distribution $\mu^Y(A) = P[\,X \in A|Y\,]$ provides the optimal estimate for X in the least square sense and is therefore called the optimal filter. In recent years Sequential Markov Chain Monte Carlo methods (SMCMC) (in particular particle filters) have become a major tool to obtain reasonable approximations of the a posteriori distribution (see [ref1]). These algorithms are reminiscent of genetic algorithms with mutation/selection mechanisms and their mathematical analysis is at the very beginning. One question of interest is a simplified description of the fluctuations within the approximation of the optimal filter for a large number of particles. Techniques from Stochastic Analysis have been applied recently to understand the dependence of the a posteriori distribution on the a priori distribution of the signal X and to provide explicit quantitative estimates. It is a major goal for the near future to understand this dependence for the approximating particle filters as well.

Partner: D. Crisan (Imperial College, London).

Contact: W. Stannat.

References

[1] A. Doucet, N. de Freitas, and N. Gordon (Eds). *Sequential Monte Carlo methods in practice.* Statistics for Engineering and Information Science. Springer, 2001.

[2] W. Stannat. On the stability of feynman-kac propagators. In *Stochastic Analysis, Ascona 2005, to appear*, Progress in Probability. Birkhäuser.

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

[4] W. Stannat. Stability of the optimal filter via pointwise gradient estimates. In *Stochastic Partial Differential Equations and Applications VII*, volume 245 of *Lecture Notes in Pure and Applied Mathematics*, pages 281–293. CRC Press, Taylor & Francis Group, 2005.

[5] W. Stannat. Stability of the pathwise filter equation for a time-dependent signal on r^d. *Appl. Math. Optim.*, 52:39–71, 2005.

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

Stochastic partial differential equations (SPDE) are used in material sciences to describe macroscopic properties of materials subject to complex interactions on the microscopic level. However, most of the existing theory on SPDE cannot be applied to the equations of interest. Within this project we will follow a new approach via the Kolmogorov operator associated with a given SPDE to study the following fourth order nonlinear SPDE

$$dX_t = \left(-\partial_x^{(4)} X_t + \gamma \partial_x^{(2)} X_t - \partial_x^{(2)} \left((\partial_x X_t)^2\right)\right) dt + dW_t \quad \in L^2([0,L]) \tag{12}$$

describing thin-film surface growth. Existence of mild solutions in one dimension has been shown by D. Blömker and M. Hairer 2004, but uniqueness is an open problem, as well as generalizations to higher dimensions. In the stable case, the invariant measure for the SPDE (12) will be studied, in particular a priori estimates, using a new technique developed in joint work with A. Es-Sarhir ([ref1]). Existence and uniqueness of strongly continuous Markovian semigroups generated by the Kolmogorov operator

$$LF(X) = \frac{1}{2}\mathrm{tr}_{L^2([0,L])}\left(F''(X)\right) + \langle -\partial_x^{(4)} X + \gamma \partial_x^{(2)} X - \partial_x^{(2)} \left((\partial_x X)^2\right), F'(X)\rangle \tag{13}$$

associated with the SPDE (12) will be studied in L^p-spaces induced by invariant measures. Markov processes whose transition semigroups are generated by (13) will be identified as weak solutions of the SPDE (12).

Partner: M. Hino (Kyoto University), H. Kawabi (Kyushu University).

Contact: W. Stannat.

References

[1] A. Es-Sarhir and W. Stannat. l^1-uniqueness for kolmogorov operators with local lipschitz drift coefficients. *Manuscript, publication in preparation*, 2007.

2.3 Memberships in Scientific Boards and Committees

Jürgen Bokowski

- Honory member of the International Society for the Interdisciplinary Study of Symmetry (ISIS-Symmetry)

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

Mirjam Dür

- Member of the Managing Board of EUROPT (the EURO Working Group on Continuous Optimization), 2006 –

Reinhard Farwig

- Selection Committee of Gottlieb Daimler- und Karl Benz-Stiftung

Michael Joswig

- Programme Committee of the 2nd International Congress on Mathematical Software 2006, Castro Urdiales, Spain
- Scientific Advisory Board of Oberwolfach References on Mathematical Software

Klaus Keimel

- External Examinator for Mathematics, University of Brunei - Darussalam, 2006 - 2008

Martin Kiehl

- Member of the executive board "Center of Mathematics, Bensheim"

Ulrich Kohlenbach

- Vice President of "Deutsche Vereinigung für Mathematische Logik und für Grundlagen der Exakten Wissenschaften(DVMLG)", since 2006
- Member of the Danish Censorcorps for Computer Science, 2002-2005
- Member of the LICS Organizing Committee, 2002-2005

Jens Lang

- Member of board of directors of the research centre "Computational Engineering", TU Darmstadt, 2004 -
- Member of scientific board of "International Centre of Computational Heat and Mass Transfer", 1996 - 2006

Jürgen Lehn

- Elected Member of ISI, 1991 -
- Member of DMV
- Executive Member of Verein zur Föderung des Mathematischen Forschungsinstituts Oberwohlfach, 1995 -
- Member of the Board of Trustees of Oberwohlfach Foundation, 1998 -
- Member of the Selection Commitee Bundeswettbewerb Mathematik
- Consulting Professor of Tongji University Shanghai, 1987 -

Katja Lengnink

- Member of the Executive Committee of the Gesellschaft für Didaktik der Mathematik (GDM), 2006 -

Alexander Martin

- Member of the Board of the INFORMS Computing Society (ICS), 2004 - 2006
- Member of the advisory board of the "Gesellschaft für Operations Research (GOR)", 2004 -
- Honory appointment to the BMBF advisory board "Mathematics", 2007 - 2010

Karl-Hermann Neeb

- Member of the Scientific Board of conference "Harmonic Analysis on Lie groups and symmetric spaces, in honor of Jacques Faraut", Nancy, June 2005

Stefan Ulbrich

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

R. Wille

- Managing director of the "ERNST SCHRÖDER ZENTRUM für Begriffliche Wissensversarbeitung e.V."

2.4 Awards and Offers

Awards

Kristina Altmann, Award of the program "Forschungsaufenthalt junger Mathematiker aus Deutschland in USA" supported by DMV and DFG

Armin Fügenschuh, Förderpreis of Stiftung Heureka, 2005

Armin Fügenschuh, Best Paper Award of 2. Workshops on Hybrid Metaheuristics, 2005

Armin Fügenschuh, Reception in the Marquis' Who is Who in Science and Engineering, 9. edition, 2006

Armin Fügenschuh, Dissertation award of Gesellschaft für Operations Research, 2006

Armin Fügenschuh, Klaus Tschira Preis für verständliche Wissenschaften – Mathematik, 2006

Helge Glöckner, Heisenberg Grant by The German Research Foundation (DFG), April 2006

Ralf Gramlich, 12.06.2005 - 25.06.2005 RiP research stay at Oberwolfach (jointly with Corneliu Hoffman, Bernhard Mühlherr, Sergey Shpectorov)

Ralf Gramlich, 27.08.2006 - 09.09.2006 RiP research stay at Oberwolfach (jointly with Alice Devillers, Bernhard Mühlherr)

Ralf Gramlich, 08.06.2006 acceptance as Heisenberg fellow

Ewgenij Gawrilow (TU Berlin) und Michael Joswig, Heinz-Billing-Preis zur Förderung des wissenschaftlichen Rechnens 2006, 2. Preis

Debora Mahlke, Best Master Thesis in the Area of HPSC (sponsored by IBM, in connection with opening ceremony of the new high-performance computer in Darmstadt), May 2006

Rudolf Wille, Invitation to a research visit at the Department of Economics and Information Systems of the University of Wollongong/Australia in March/April 2006

Offers of Appointments

Jens Lang, Professorship (W3) for "Numerik Partieller Differentialgleichungen", University of Chemnitz

Alexander Martin, Professorship (W3) for "Operations Research und Anwendungen", University of Karlsruhe (TH)

Karl-Hermann Neeb, Professorship (W3) for "Komplexe Geometrie", Ruhr-University Bochum

Klaus Ritter, Professorship (W3) for "Numerische Mathematik", University of Kiel

Klaus Ritter, Professorship (W3) for "Angewandte Stochastik", TU Berg Academy Freiberg

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 Bachelor program "Mathematics with Computer Science" (since 2002) and the masters program in mathematics (since 2005). The following tables show the number of students enrolled in the last 6 years:

Students in Mathematics programs

Program	2001	2002	2003	2004	2005	2006
Diplom incl. MCS	926	1031	1180	791	750	755
Bachelor MCS		100	182	221	230	207
Master Mathematics					1	7

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.

New students - enrolled

Program	2001	2002	2003	2004	2005	2006
Diplom	366	357	441	230	183	194
Diplom MCS	110					
MCS Bachelor		100	117	95	54	31

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 that legislation discourages people from enrolling without intention to study.

New students - attended

Program	2001	2002	2003	2004	2005	2006
Diplom	108	121	140	133	124	156
Diplom MCS	88					
MCS Bachelor		94	101	80	40	33

The years 2005 and 2006 were marked by the department's efforts to implement the Bologna Accord and introduce an integrated Bachelors and Masters program in mathematics. After a year of planning and consultation, approval by the university's committees for a new Masters program in mathematics was obtained in 2005. After the

program had been accredited, it started in the winter semester of the same year. Since then efforts have been concentrated on designing a Bachelors program. The program was approved by the university committees in 2006 and is expected to be accredited during the summer of 2007 for a start in the winter semester 2007. The new program structure is planned to replace the Diplom program and incorporate the 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 programs 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 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
Diplom	29	28	30	42	34	47
Diplom MCS			2	3	11	13
Bachelor MCS	2	8	4	11	28	11

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
Diplom	11,59	11,29	12,3	11,52	12,07	10,15
Diplom MCS			7,95	7,46	9	10,38

3.2 Teacher Education

The department offers courses for educating secondary school teachers and teachers at vocational schools. The following tables show how many students were enrolled in those programs.

	2001	2002	2003	2004	2005	2006
Students	155	184	229	187	213	232
New students - enrolled	33	71	81	50	66	60
New students - attended	35	45	78	46	48	49
Graduates	2	9	7	7	15	

In the winter semester 2005 the teacher study programs started with a new course structure. The main aspects of the new program for secondary school teachers are that it has a modular structure and puts a stronger emphasis on didactics and the combination of didactics and mathematics. A new master of education program offers education for teachers for vocational schools.

3.3 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 stochastic. 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 2006	
Architecture	133
Biology	107
Chemistry	78
Civil Engineering	371
Computer Science	424
Electrical Engineering	379
Industrial Engineering	762
Matrial Sciences	151
Mechanical Engineering	665
Physics	388
Psychology	70

3.4 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.

3.5 E-Learning/E-Teaching in Academic Training

E-Learning in the departement of mathematics is present in research and teachings. We got 50000€ external funds for E-Learning projects (Bruder, Hieber, student group, Nickel). Reference person for E-Learning in our department is Regina Bruder. 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) and speaker of the working group "E-Learning quality".

Research and research-based development

In the last two years Regina Bruder and Julia Sonnberger (elc) developed a concept of labelling to answer the questions: What is an E-Learning-lecture and which criteria of quality are needed? This project is 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.
In connection with the project VEMA (cooperation between TU Darmstadt (Bruder, Nickel) and Kassel-University (Biehler, Kroepf) some E-Learning-elements for the bridge-course for beginners in the MCS-study path and a special database for additional tasks were developed (`http://www.vemada.de`).
In cooperation with the department of Informatics (Prof. Dr. Henhapl) some special tools were put into practise, supporting E-Learning lectures in our department. One of these results is a repository for flexibel documentation of digital content. Other results from four scientific complementary works are special learning environments with modern mathematical issues for the application in our "Aufgabenpraktikum online" for teacher-students. We presented all these results 2005 and 2006 on the LEARNTEC exhibition.
The use of blended-learning concepts is a new trend in further training for teachers. Based on the results of a research project, founded by the DFG, an online programme for further education was developed for the learning platform "MOODLE" (`http://www.prolehre.de`). The first half-year-course (Problem solving and self regulation) started in 2005, the second (learning basics in mathematics) in 2006. The blended learning course was carried out in three semesters with 121 participants in total.

It was evaluated throughout questionnaire and the analysis of the working results. For additonal support, a data base for exercises http://www.madaba.de and a platform for materials http://www.problemloesenlernen.de were provided.

3.5.1 E-Learning/E-Teaching in the academical training

The status quo of the use of elements of E-Learning in our lectures was carried out by the elc.
The majority of all professors are already using digital content in different formats and communication via E-Mail or Newsletter. 65% of all professors use their own websites for presenting digital content. four lecture courses (in didactics of mathematics, Bruder, Ingelmann) got the "Label E-Learning" (http://www.elc.tu-darmstadt.de/) Thirty other lecture courses have the potential to get an E-Learning label.
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:8081/ (Spellucci).

3.6 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

Regina Bruder

- *mathematik lehren* (Associate Editor)

Mirjam Dür

- *European Journal of Operational Research* (Guest Editor)
- *Mathematical Methods of Operations Research* (Guest 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)

Martin Kiehl

- *Mathematische Modellierung mit Schülern* (Chief Editor)

Ulrich Kohlenbach

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

Jens Lang

- *Applied Numerical Mathematics* (Editor)

Jürgen Lehn

- *Metrika* (Book Review Editor)
- *Statistical Papers* (Associate Editor)
- *Statstics and Decisions* (Associate Editor)
- *Teubner Skripten zur Stochastik* (Co-Editor)

Alexander Martin

- *Operations Research Letters* (Area Editor)
- *Optimization Methods and Software* (Associate Editor)
- *Mathematical Methods of Operations Research* (Associate Editor)

Karl-Hermann Neeb

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

Rudolf Wille

- *Discrete Mathematics* (Associate Editor)
- *Acta Mathematica Universitatis Comenianae* (Associate Editor)
- *Mathematiques, Informatique et Sciences Humaines* (Associate Editor)

4.1.2 Editors of Proceedings

Karl-Hermann Neeb

- *Proceedings of the XXIVth workshop on Geometric Methods in Physics (Bialowiecza)* (jointly with S.T. Ali, J.-P. Gazeau, G.A. Goldin, A. Odziewicz, M. Schlichenmaier)

Ulrich Reif

- *Geometric Modelling and Differential Geometry, Special Issue of CAGD, 2005* (jointly with K. Große-Brauckmann)

4.1.3 Editors of a Festschrift

Simon King

- *Festschrift zum 60-jährigen Jubiläum — Mathematisches Forschungsinstitut Oberwolfach* (jointly with Gert-Martin Greuel and Stephan Klaus)

4.1.4 Editors of Collected Works

Karl Heinrich Hofmann

- *Hellmuth Kneser, Gesammelte Abhandlungen/ Collected Papers, Publishing house Walter De Gruyter, Berlin, 2005, xvi +923 pages* (jointly with Gerhard Betsch)

Rudolf Wille

- *Formal Concept Analysis: Foundations and Applications. State-of-the-Art Sirvey. LNAI3626, Springer, Heidelberg 2005* (jointly with B. Ganter and G. Stumme)

4.2 Preprints

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4.3 Publications in Journals and Proceedings

4.3.1 Journals

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4.4 Monographs and Books

[1] O. Barndorff-Nielsen, U. Franz, R. Gohm, B. Kümmerer, and S. Thorbjornsen. *Quantum Independent Increment Processes II.* Lecture Notes in Mathematics 1866. Springer, 2006.

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[3] A. Fügenschuh. *The Integrated Optimization of School Starting Times and Public Transport.* Logos, Berlin, 2005.

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4.5 Reviewing and Refereeing

4.5.1 Reviewing Articles and Books

Mirjam Dür Review of the book: *Mathematics of Optimization: Smooth and Nonsmooth Case* by G. Giorgi, A. Guerraggio, and J. Thierfelder (Elsevier 2004). In: Mathematical Methods of Operations Research 61 (2005) 171–172. Review of the book: *Convex Optimization* by Stephen Boyd and Lieven Vandenberghe (Cambridge University Press 2004). In: Mathematical Methods of Operations Research (2005) 521–522.

Helge Glöckner Mathematical Reviews, Zentralblatt

Ralf Gramlich Math Reviews, Zentralblatt MATH

Horst Heck Math. Reviews of the AMS: J.I. Diaz, *Special finite time extinction in nonlinear evolution systems: dynamic boundary conditions and Coulomb friction type problems*, Nonlinear elliptic and parabolic problems, 71–97, Progr. Nonlinear Differential Equations Appl., 64, Birkhäuser, Basel, 2005.

Herrmann Zentralblatt der Mathematik

Michael Joswig Mathematical Reviews, Zentralblatt

Martin Kiehl Journal of "Mathematische Modellierung mit Schülern"

Simon King Mathematical Reviews

Ulrich Kohlenbach Mathematical Reviews

Jens Lang Large Eddy Simulation turbulenter Strömungen, Jochen Fröhlich, Teubner 2006

Karl-Hermann Neeb Math. Reviews, Zentralblatt MATH, Jahresbericht der DMV, Semesterberichte Math.

Steffen Roch Mathematical Reviews (AMS)

Wilhelm Stannat MathSciNet

Stefan Ulbrich Mathematical Reviews, DMV Jahresbericht

4.5.2 Refereeing for Journals, Proceedings, and Publishers

Achim Blumensath Logical Methods in Computer Science, Transactions on Database Systems

Jakob Creutzig Journal of Complexity, Journal of Approximation Theory, Forum Mathematicum

Kristian Debrabant SIAM Journal on Scientific Computing (SISC), Applied Numerical Mathematics (Apnum), Journal of Computational and Applied Mathematics (Journal CAM)

Mirjam Dür Annals of Operations Research, Central European Journal of Operations Research, Computing, Decision Support Systems, European Journal of Operational Research, International Journal of Applied Earth Observation and Geoinformation, Journal of Computational and Applied Mathematics, Journal of Discrete Algorithms, Journal of Global Optimization, Journal of Optimization Theory and Applications, Mathematical Programming, Mathematical and Computer Modelling, Operations Research Letters, Optimization Letters, Optimization Methods and Software, SIAM Journal on Optimization

Bálint Farkas J. Math. Anal. Appl., Semigroup Forum, Per. Math. Hungar., Acta Math. Hungar., Studia Math. Hungar., J. Evol. Eq.

Reinhard Farwig Mathematische Annalen, Nonlinear Analysis, Journal of Continuum Mechanics and Thermodynamics, Archiv der Mathematik, Mathematische Nachrichten, Journal of Mathematical Fluid Mechanics, Zeitschrift für Angewandte Mathematik und Mechanik, International Journal on Discrete and Continuous Dynamical Systems, Zeitschrift für Analysis und ihre Anwendungen, Journal of Evolution Equations, Journal of Differential Equations, Journal of Mathematical Analysis and Applications, Pacific Journal of Mathematics, Annales da la Faculté des Sciences Toulouse Mathématiques, Funkcialaj Ekvacioj, Differential and Integral Equations, Mathematical Methods in the Applied Sciences, Communications in Mathematical Physics, Lecture Notes in Applied and Computational Mechanics, Proceedings of STAMM '04 (International Symposium onTrends in Applications of Mathematics to Mechanics), Proceedings of International Kyoto Conference on Navier-Stokes Equations 2006

Armin Fügenschuh GRACO 2005 Proceedings; LATIN 2006 Proceedings; WI 2007 Proceedings; Operations Research Letters; Operations Research; Optimization Methods and Software; Mathematical Programming; Journal of Numerical Analysis, Industrial and Applied Mathematics

Marzena Fügenschuh GRACO 2005 Proceedings; Operations Research Letters

Helge Glöckner Glasgow Mathematical Journal, Journal of Algebra, Journal of Functional Analysis, Journal of Lie Theory

Ralf Gramlich Geometriae Dedicata, Bulletin of the Belgian Mathematical Society (Simon Stevin), European Journal of Combinatorics, Forum der Mathematik, Combinatorica, Journal of the London Mathematical Society, Journal of Algebraic Combinatorics, Innivations in Incidence Geometry, Advances in Geometry

Karsten Große-Brauckmann Annals of Global Analysis and Geometry, Mathematische Zeitschrift, Inventiones, Indiana University Mathematics Journal, Manuscripta Mathematica

Christian Herrmann Algebra Universalis, Archive for Mathematical Logic, Information and Computation, Journal of Pure and Applied Algebra, Order

Matthias Hieber Mathematische Annalen, Mathematische Zeitschrift, Archive Rational Mechanics and Analysis, Communications PDEs, J. Reine Angewandte Mathematik, Archiv Mathematik, Transactions Amer. Math. Soc., Annali Scuola Norm. Pisa, Ann. Inst. Fourier, Differential and Integral Equations, Studia Math., J. Diff. Equations, Birkhäuser, Springer Lecture Notes

Karl Heinrich Hofmann Journal of Lie Theory, Mathematische Nachrichten, Mathematische Zeitschrift, Semigroup Forum

Max Horn European Journal of Combinatorics

Michael Joswig Advances in Geometry, Annals of Combinatorics, Beiträge zur Algebra und Geometrie, Discrete Mathematics, Discrete and Computational Geometry, Experimental Mathematics, Israel Journal of Mathematics, International Journal of Computational Geometry and Applications, Journal of Algebraic Combinatorics, Journal of Combinatorial Theory A, Journal of Symbolic Computation, Linear Algebra and Its Applications, SIAM Journal Discrete Mathematics, Statistica Sinica, Conference MEGA 2006, Conference Symposium on Computational Geometry 2005, Conference SODA 2006, Conference on "Algebraic and Geometric Combinatorics" in Anogia (Greece)

Klaus Keimel Journal of Algebra, Algebra Universalis, Order, Theoretical Computer Science, International Journal of Pure and Applied Mathematics, Proceedings of the Workshop Applied Semantics II, Topology and its Applications, Acta Mathematica Sinica, Mathematical Structures in Computer Science, Logical Methods in Computer Science, Beiträge zur Algebra und Geometrie, Semigroup Forum, Oriental Journal of Mathematical Sciences

Simon King Geometry & Topology, Fund. Math., Discr. Math, Discrete Appl. Math.

Ulrich Kohlenbach Annals of Pure and Applied Logic, Fixed Point Theory and Applications, 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

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

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

Jürgen Lehn Metrika, Insurance: Mathematics & Economics

Katja Lengnink Journal for Didaktik der Mathematik

Laurenţiu Leuştean Computer Science Logic'05, '06, Fixed Point Theory and Applications, International Joournal of Mathematics and Mathematical Sciences, Journal of Multiple-Valued Logic and Soft Computing

Alexander Martin Discrete Optimization, European Journal of Operational Research, INFORMS Journal on Computing, Management Science, Mathematical Programming, Operations Research, Operations Research Letters, Optimization Methods & Software, Springer, Springer Lecture Notes

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, Journal of Logic and Computation, Mathematical Logic Quarterly, Siam Journal of Computation, Theoretical Computer Science, Information and Computation, Archive for Mathematical Logic, Information Processing Letters, Logical Methods in Computer Science, Studia Logica, Springer Lecture Notes in Computer Science, IEEE LICS, CSL, STACS, FOIKS, AIML

Ulrich Reif Journal of Approximation Theory, Computer Aided Geometric Design, ACM Transactions on Graphics, SINUM, SIGGRAPH, ERA-AMS, Computers & Graphics, BIT

Steffen Roch J. Integral Eq. Appl., J. Math. Anal. Appl., J. Numerical Anal. Ind. Appl. Anal., J. Operator Theory, Math. Nachr.

Andreas Rößler Journal of Computational and Applied Mathematics, Journal of Mathematics and Computers in Simulation, Journal of Stochastic Analysis and Applications, Journal of Mathematical Methods in the Applied Sciences, Central European Journal of Operations Research

Peter Spellucci Applied Numerical Mathematics, Computational Optimization and Applications, Mathematical and Computer Modelling, Mathematische Nachrichten

Wilhelm Stannat Electronic Journal of Probability, Potential Analysis, Probability Theory and Related Fields, Stochastic Processes and their Applications

Thomas Streicher Annals of Pure and Applied Logic, Notre Dames Journal of Formal Logic, Springer Lecture Notes, LICS Conference

Walter Trebels Journal of Approximation Theory, Mathematische Nachrichten, Mathematische Zeitschrift, Revista Matematica Complutense, London Mathematical Society

Stefan Ulbrich Computational Optimization and Applications, Journal of Mathematical Analysis and Applications, Journal of Optimization Theory and Applications, Mathematical Programming, Optimization Methods & Software, SIAM Journal on Optimization, SIAM Journal on Scientific Computing

Rudolf Wille Algebra Universalis, Acta Mathematica Universitatis Comenianae, Springer Lecture Notes of the International Conferences on Conceptual Structures (ICCS

2005, ICCS 2006), Springer Lecture Notes of the International Conferences on Formal Concept Analysis (ICFCA 2005, ICFCA 2006), Springer Lecture Notes of the International Conference on Concept Lattices and Their Applications (CLA '06)

4.6 Software

Haskell Code for Oriented Matroids

When dealing with oriented matroids, computational aspects often lie in the foreground. A functional programming language is very close to mathematical thinking. The Haskell code for a collection of implemented mathematical functions in the context of oriented matroids is available from `juergen@bokowski.de`

IKOSANA Integrierte Koordinierung von Schulanfangszeiten und des Nahverkehrs-Angebots

IKOSANA is a software for the coordination of school starting times and schedules of public buses. The software was developed by Armin Fügenschuh as a dissertation project. For more information see `www.ikosana.de`

polymake

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.polymake.de`

Singular Library "finvar.lib"

Singular is a free Computer Algebra System for polynomial computations with special emphasis on the needs of commutative algebra, algebraic geometry, and singularity theory. Singular was developed by G.–M. Greuel, G. Pfister and H. Schönemann; further authors contributed to program libraries. The library "finvar.lib" is concerned with actions of finite groups on polynomial rings. For the distribution 3-0-2, Simon King implemented a new algorithm for the computation of Secondary Invariants in the case of characteristic zero (procedures "secondary_char0" and "irreducible_secondary_char0"). There are some examples that have been intractable with the old version of "finvar.lib" and can be solved with the new algorithm in few seconds and with little memory consumption. For more information, see `www.singular.uni-kl.de/Manual/3-0-2/`

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 Tobias Achterberg, Thorsten Koch (both ZIB) and Alexander Martin. For more information, see `www.zib.de`

polycyclic Computation with polycyclic groups
Polycyclic is a refereed package of the computer algebra system GAP. It povides algorithms to work with and investigate polycyclic groups. This is a continuing project with Prof. Dr. Eick, Braunschweig

donlp2 Solving general smooth nonlinear optimization problems, version May 2005
donlp2 is a software for the solution of general nonlinear programming problems provided with different user interfaces. New versions allow elimination of redundant linear equality constraints and an interfacing known as "reverse communication". It is free for research, whereas commercial use requires licensing by TUD. For more information contact the author spellucci(_at_)mathematik.tu-darmstadt.de

numawww Interaktives Lernprogramm zur Numerischen Mathematik
numawww is a cgi/html-based interactiv learning program for numerics, which allows every student, even with minimal programming knowledge, based on standard Fortran 77, to test numerical methods with individually applicable cases. The program contains 60 methods of all spheres of numerics and numerical optimization. Its structure is conductive to further extension. For more information see the version in english.
http://numawww.mathematik.tu-darmstadt.de:8081

4.7 Dissertations

2005

Werner Sanns, *Genetisches Lehren von Mathematik an Fachhochschulen am Beispiel von Lehrveranstaltungen zur Katastrophentheorie* (R.Bruder)

Ralf Pfleiderer, *Stabilität und Hopfverzweigung einer Funktionaldifferentialgleichung mit zustandsabhängigem Delay* (R. Farwig)

Ian Wood, *Elliptic and Parabolic Problems in Non-smooth Domains* (M. Hieber)

Nils Gebhardt, *Quantenstochastische Differentialgleichungen auf von Neumann Algebren vom Typ III* (B. Kümmerer)

Brigitte Walther , *Modellierung von fondsgebundenen Lebensversicherungen mit stochastischem Zins* (J. Lehn)

Armin Fügenschuh, *The Integrated Optimization of School Starting Times and Public Transport* (A. Martin)

Lobna Abdelmoula (Sfax, Tunesien), *Séparations des Représentations Unitaires des Groupes de Lie Connexes et Application Moment Généralisée* (A. Baklouti, K.-H. Neeb)

Bernhard Mößner, *B-Splines als Finite Elemente* (U. Reif)

Julia Klinger, *The Logic System of Protoconcept Graphs* (R. Wille)

Björn Vormbrock, *The Structure of Double Boolean Algebras* (R. Wille)

2006

Evelyn Komorek, *Mit Hausaufgaben Problemlösen und eigenverantwortliches Lernen in der Sekundarstufe I fördern* (R. Bruder)

Ri Myong Hwan, *Stokes Operator and Stability of Stationary Navier-Stokes Flow in Infinite Cylindrical Domains* (R. Farwig)

Matthias Bergner, *Das Dirichlet-Problem für Graphen von vorgeschriebener mittlerer Krümmung* (K. Große-Brauckmann)

Annika Wille, *Residuated Structures with Involution* (C. Herrmann)

Branimir Lambov, *Topics in the Theory and Practice of Computable Analsis* (PhD Aarhus. Supervisor: U. Kohlenbach. After Kohlenbach's move from Aarhus to Darmstadt jointly supervised with M. Nielsen, Aarhus)

Philipp Gerhardy, *Applications of Proof Interpretations* (PhD Aarhus. Supervisor: U. Kohlenbach. After Kohlenbach's move from Aarhus to Darmstadt jointly supervised with M. Nielsen, Aarhus)

Florian Haag, *Asymptotisches Verhalten von Quanten-Markov-Halbgruppen und Quanten-Markov-Prozessen* (B. Kümmerer)

Daniel Junglas, *Optimal Distribution of Block-Structured Grids in Parallel Computing* (A. Martin)

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

Christoph Wockel, *Infinite-Dimensional Lie Theory for Gauge Groups* (K.-H. Neeb, P. Michor (Vienna))

Manon Didry (Nancy), *Structures Algebriques sur les Espaces Symetriques* (W. Bertram, K.-H. Neeb)

Jochen Hechler, *Formoptimierung unter Nebenbedingungen durch Freiform-Deformation* (U. Reif)

Andreas Neuenkirch, *Optimal Approximation of Stochastic Differential Equations with Additive Fractional Noise* (K. Ritter)

Tobias Löw, *Locally Boolean Domains and Universal Models for Infinitary Sequential Languages* (T. Streicher)

Erik Kropat, *Über die Homogenisierung von Netzwerk-Differentialgleichungen* (G. Leugering, S. Ulbrich)

4.8 Master Theses and Theses for the State Board Examinations

2005

Julia Berlin, *Kryptographie im Mathematikunterricht - Bausteine für die Lehrerbildung* (R. Bruder)

Claudia Wehning, *Vergleichsuntersuchung zu Unterrichtsvorstellungen von Mathematiklehrkräften* (R. Bruder)

Jennifer Brandt, *Videobasierte Lehrerfortbildungen als Beitrag zur Qualitätsentwicklung im Mathematikunterricht* (R. Bruder)

Melanie Nagel, *Zahlenverhältnisse in der Natur - Materialien für den Mathemaikunterricht* (R. Bruder)

Andrea Neupärtl, *Aufgabenmaterialien für einen fächerübergreifenden Unterricht Mathematik - Chemie* (R. Bruder)

Andrea Vögler, *Aufgabenvariationen zum Thema Kreis für mathematisch interessierte Schüler* (R. Bruder)

Jörg Becker, *Analyse von Lehrervorstellungen bzgl. Mathematikunterricht im Projekt SINUS-Transfer* (R. Bruder)

Tobias Krebser, *Differentialrechnung im virtuellen Klassenzimmer an der beruflichen Schule* (R. Bruder)

Helmut Trützschler, *Universen, Konglomerate,Kollektionen – Aspekte von Erweiterung der Mengenlehre* (Peter Burmeister)

Alexander Drewitz, *Mild Solutions to Stochastic Evolution Equations with Fractional Brownian Motion* (J. Creutzig)

Jianting Bao, *Singular Stochastic Differential Equations* (J. Creutzig)

Abdelhamid Ayat, *Numerical Comparison of Pure Random Search, Improving Hit&Run and Simulated Annealing Algorithms (Bachelor thesis)* (M. Dür)

Marius Braut, *LP-Ansätze zur Klassifikation von Daten aus zwei Gruppen (Bachelor thesis)* (M. Dür)

Kai Junghans, *A File Recognition System based on Support Vector Machines* (M. Dür)

Stefan König, *Branch-and-Bound Algorithmen im Sum-of-Ratios Optimierungsproblem* (M. Dür)

Eric Nges, *A Numerical Comparison of the Performance of Pure Random Search, Tabu Search, and Genetic Algorithms (Bachelor thesis)* (M. Dür)

Andrea Raith, *Bicriteria Optimization for a Synchronous Generator for Wind Turbines* (M. Dür, Michael Henschel (Institut für elektrische Energiesysteme, Fachgebiet Regenerative Energien, TU Darmstadt))

Andrea Zelmer, *Konvexifizierte und Lagrange-duale Schranken für quadratische Probleme* (M. Dür)

Henning Sudbrock, *Überlagerungstheorie topologischer Gruppen und uniformer Räume* (Helge Glöckner)

Max Horn, *Amalgams of unitary groups in* $Sp(2n, q)$ (R. Gramlich, W. Nickel)

Anita Sellent, *Gauß-Krümmung auf Polyederflächen* (K. Große-Brauckmann, M. Joswig)

J. Plehnert, *Alexandrov's horned sphere (Bachelor thesis)* (K. Große-Brauckmann)

B. Michel, *Ein Kurvenmittelungsproblem (Bachelor thesis)* (K. Große-Brauckmann)

L Dimitrov, *Rotationsflächen vorgeschriebener mittlerer Krümmung (Bachelor thesis)* (K. Große-Brauckmann)

E. Bozhikova, *Surfaces of revolution with constant mean curvature (Bachelor thesis)* (K. Große-Brauckmann)

L. Boiadjieva, *Minimale Regelflächen sind Ebenen oder Katenoide (Bachelor thesis)* (K. Große-Brauckmann)

Bérénice Grec, *Lokale Lösbarkeit von freien Randwertproblemen* (M. Hieber)

Oliver Ratmann, *Diffusions-Halbgruppen in der Populationsgenetik* (M. Hieber)

Matthias Hess, *Anwendung des Bogovskii-Operators auf das Stokes-Resolventen Problem* (M. Hieber)

Céline Schwarz, *Das Stokes-Resolventenproblem auf beschränkten Gebieten* (M. Hieber)

Kyriakos Stavrakidis, *Die Stokes-Halbgruppe auf beschränkten Gebieten* (M. Hieber)

Constanze Lehmann, *Tropische konvexe Hüllen (TU Berlin)* (M. Joswig)

Sven Herrmann, *f-Vektoren von Tight Spans* (M. Joswig)

Katharina Bormann, *Möglichkeiten fächerübergreifender Unterrichtseinheiten in Biologie und Mathematik unter Berücksichtigung der Lehrpläne, wissenschaftliche Hausarbeit* (M. Kiehl)

Keil Michael, *Eingliederung von Differentialgleichungen in den Mathematikunterricht unter Berücksichtigung von fächerübergreifendem Unterricht mit Biologie und Chemie, wissenschaftliche Hausarbeit* (M. Kiehl)

Müller Steffen, *Reaktioeonskinetik – Ein Themenfeld für realitätsnahe fächerübergreifende Unterrichtseinheiten, wissenschaftliche Hausarbeit* (M. Kiehl)

Pia Bales, *Modellierung und Simulation des Gasflusses in Netzwerken* (J. Lang)

Thomas Forell, *Interpolative algebraische Mehrgitterverfahren* (J. Lang)

Frank Mosler, *Simulation von mechatronischen Systemen* (J. Lang, Dr. Piechnick (Bosch-Rexroth))

Hermann Hartfiel, *Streamline Upwind/Petrov-Galerkin Methode für mehrdimensionale Konvektions-Diffusions-Gleichungen mit dominanter Konvektion* (J. Lang)

Axel Richter, *Adaptive Finite Volumen Verfahren* (J.Lang)

Beate Beutel, *Reflektierendes Mathematiklernen am Beispiel der Elementaren Algebra* (K. Lengnink, R. Bruder)

Shinsuke Arai, *Stundenplan-Optimierung: Modelle und Software* (A. Martin, A. Fügenschuh)

Christof Bürger, *Vehicle Routing: Modelle und Software* (A. Martin, A. Fügenschuh)

Benjamin Höfler, *Parametrized GRASP Heuristics for Combinatorial Optimization Problems* (A. Martin, A. Fügenschuh)

Ute Günther, *Optimal Unrolling of Integral Branched Sheet Metal Components* (A. Martin, D. Junglas)

Anja Kaprykowsky, *Leerwagenoptimierung im Schienengüterverkehr* (A. Martin, A. Fügenschuh, Dr. G. Pfau (DB AG))

Carmen Allhoff, *Mathematische Modelle und Methoden in der Entscheidungsfindung im Supply Chain Management* (A. Martin, S. Göttlich)

Sergio Grimbs, *Modifikation des Approximationsalgorithmus von Hart und Istrail für das Proteinfaltungsproblem im HP-Modell* (A. Martin, A. Dittel)

Michael Putowski, *Ein Verbesserungsalgorithmus der Proteinfaltung mit dem HP-Modell von Ken Dill* (A. Martin, A. Dittel)

Michaela Isabel Höhn, *Entwurf und Evaluation von MILP-Modellierungen zur Optimierung einer synchronisierten Abfüll- und Verpackungsstufe in der Produktionsfeinplanung* (A. Martin, H. Braun (SAP AG), T. Kasper (SAP AG))

Ingrid Siegrist, *Integration von Strafkosten für zu niedrige Sicherheitsbestände bei Losgrößenmodellen* (A. Martin, H. Stadtler, H. Seipl (both Institut für Betriebswirtschaftslehre)),

Nadja Günther, *Vergleich von Algorithmen zur Lösung ganzzahliger linearer Ungleichungssysteme mit höchstens zwei Variablen pro Ungleichung* (A. Martin, A. Fügenschuh)

Peter Marcinkowski, *Schaltbedingungen bei der Optimierung von Gasnetzen: Polyedrische Untersuchungen und Schnittebenen* (A. Martin, S. Moritz)

Debora Mahlke, *Der Simulated Annealing Algorithmus zur transienten Optimierung von Gasnetzen* (A. Martin, S. Moritz)

Annette Göttmann, *Kantenfärbung in Multigraphen* (A. Martin, D. Junglas)

René Hartmann, *Formeigenschaften von Subdivisionsalgorithmen* (U. Reif)

Bengt Autzen, *Extinktionszeiten von Markovschen Populationsprozessen und deren Diffusionsapproximation* (K. Ritter)

Alexander Zarkh, *Quantisierung von stochastischen Prozessen* (K. Ritter)

Marco Keller, *Adaptive Verfahren zur Approximation der stochastischen Wärmeleitungsgleichung mit additivem Rauschen* (K. Ritter, T. Wagner)

Matthias Daiminger, *Value-at-Risk based optimization methods for Portfolio Insurance strategies (TU Munich)* (S. Ulbrich)

Sibylle Kratzer, *Optimierung von Verkehrsflüssen auf Netzwerken (TU Munich)* (S. Ulbrich)

2006

Heiko Fey, *Zur Analyse und Entwicklung von Mathematikleistungen in der FOS* (R. Bruder)

Marco Knecht, *Untersuchung zum rechnergestützten Mathematikunterricht in den Klassen 7 und 8* (R. Bruder)

Hannah Mohr, *Fallstudie zu Effekten eines Lehrerfortbildungsprojektes für Problemlösenlernen und Selbstregulation in der Sekundarstufe I* (R. Bruder , C. Collet)

Christine Reeg, *Vektorrechnung in der Lehramtsausbildung - eine Lernumgebung zu Bezierkurven und Vektorgraphik* (R. Bruder)

Thomas Winter, *Eine digitale Lernumgebung zu geometrischen Konstruktionen* (R. Bruder)

Verena Lenhardt, *Computergestützter Mathematikunterricht in Klasse 9 - Ergebnisanalysen im Projekt TIM* (R. Bruder)

Susanne Fuchs, *Analyse von Lernmodulen im computergestützten Mathematikunterricht im Projekt CIMS* (R. Bruder)

Birgit Berner, *"Rund um die Parabel" - rechnergestützt unterrichten* (R. Bruder)

Ulrich Müller, *Wirtschaftsmathematische Anwendungen zur linearen Algebra als Lernmodult im Lehramtsstudium* (R. Bruder)

Steffen Conrad, *Trigonometrie rechnergestützt unterrichten* (R. Bruder)

Marina Lenhardt, *Computergestützter Mathematikunterricht in Klasse 7 - Ergebnisanalysen im Projekt TIM* (R. Bruder)

Christine Klinger, *Computergestützter Mathematikunterricht in Klasse 7 - Testauswertungen im Projekt CALIMERO* (R. Bruder , M. Ingelmann)

Timo Scheuermann, *Eine Lernumgebung zum Benfort-Gesetz* (R. Bruder)

Karola Gose, *Kryptographie als E-Learning Modul für die Lehramtsausbildung* (R. Bruder)

Silke Abel, *Schülervorstellungen zum Mathematikunterricht - Analysen im Projekt SINUS-Transfer* (R. Bruder)

Denis Jany, *Implizite Volatilität in Buyout-Transaktionen* (Dr. Groh, FB 1, J. Creutzig)

Tobias He"sler, *Ein Genetischer Algorithmus für das Proteinfaltungsproblem im HP-Modell* (A. Martin, A. Dittel)

Wolfgang Hess, *Verfahren für gemischt-ganzzahlige Second-Order-Cone-Programme* (S.Ulbrich, S. Drewes)

Haolin Niu, *A Performance Study of Differential Evolution Algorithms (Bachelor thesis)* (M. Dür)

Klaudia Will, *Neutral Data Fitting – Höherdimensionale lineare Regression mit fehlerbehafteten Daten* (M. Dür)

Henning Homfeld, *Lok- und Wagenumläufe im Güterverkehr der Deutschen Bahn* (A. Fügenschuh, Dr. A. Huck (DB AG), Dr. G. Pfau (DB AG))

Liu Fang, *A Greedy Randomized Adaptive Search Procedure for the Minimum Graph Bisection Problem (Bachelor)* (A. Martin, M. Fügenschuh)

Boris Walter, *Liegruppen von Diffeomorphismen von Banachräumen* (Helge Glöckner)

Frauke Harrach, *Linearity of braid groups* (R. Gramlich, S. King)

Sascha Sieverding , *Historische und mathematische Aspekte zur Lokalisation von Nullstellen komplexer Polynome* (R. Gramlich, M. Dehmer)

Yong He, *Stabilität von Hyperflächen konstanter mittlerer Krümmung* (K. Große-Brauckmann, U. Reif)

N. Bechtloff, *Nicht-Einbettbarkeit der hyperbolischen Ebene (Bachelor thesis)* (K. Große-Brauckmann)

Karoline Götze, *Die Lojasewiecz-Ungleichung und deren Anwendung auf Evolutionsgleichungen* (M. Hieber)

Rafael Dahmen, *Multilineare Algebra schwach vollständiger Vektorräume* (K. H. Hofmann)

Hans-Jürgen Graf Grote, *Disjunkte Pfade in den Graphen von Polytopen* (M. Joswig)

Ben S. Cohen, *Mathematical fouondations for combining probability and nondeterminism over stably compact spaces* (Keimel, Duval (Grenoble))

Olga Gusyeva, *Modellierung der Entstehung der Primzahlzyklen von Auchenorrhyncha, Bachelor* (M. Kiehl)

Kay Schwieger, *Strukturgattungen und ihre verallgemeinerten Brownschen Bewegungen* (B. Kümmerer)

Robin Hillier, *Deterministic and Stochastic Decoupling* (B. Kümmerer)

Ulrich Voss, *Rosenbrock-Methoden höherer Ordnung für CFD* (J. Lang)

Deborah Clever, *Optimalsteuerung für die Abkühlung von Glas* (J. Lang)

Elena Szolgayova, *Comparison of linear and inversive pseudorandom numbers considering the minimal distances in high dimensional clusters (Bachelor thesis)* (J. Lehn, B. Walther)

Nicole Tschauder, *Rekonstruktion von hochdimensionalen atomaren Verteilungsfunktionen aus Randverteilungsdaten mit dem Copula-Konzept* (J. Lehn, S. M. Kast (Department of Chemistry))

Frank Sauer, *A Simulated Annealing Algorithm for the Design of Electrical Energy Supply Networks (Bachelor thesis)* (A. Martin, D. Mahlke, A. Zelmer)

Ivan Stoynov, *An Approximation Algorithm for Edge-Coloring of Multigraphs* (A. Martin, D. Junglas)

Susanne Böhme, *Modelling nonlinear stock holding costs in a facility location problem airsing in supply network optimisation* (A. Martin, B. Samuelsson (Linde Gas))

Walter Heil, *Selected General Purpose Heuristics for Solving Mixed Integer Programs* (A. Martin, M. Fügenschuh)

Heiko Remling, *Bott-Periodizität für Algebren mit stetiger Inversion* (K.–H. Neeb, L. Kramer)

Dennis Frisch, *Zur Spur-Theorie fast kommutativer Algebren* (K.–H. Neeb, B. Kümmerer)

Deike Priemuth-Schmid (Univ. Mannheim), *Nicht-abelsche Kohomologie von Lie-Algebren* (Neeb,Böcherer)

Katharina Rach, *Untersuchungen zu Boundednessproblem und Baumweite* (M. Otto, C. Herrmann)

Martin Beldermann, *Kürzeste Wege auf triangulierten Flächen* (U. Reif)

Carsten Neumann, *Gewichtsfunktionen für web-Splines auf Gebieten mit glattem Rand* (U. Reif)

Lukas Kraus, *Approximation der Stokes-Gleichung mit B-Splines* (U. Reif)

Kevin Hamon, *Histrogram-based perceptual hashing for slowly varying videos* (U. Reif, X. Zhou)

Steffen Reidt, *Topographischs Routing in mobilen Ad hoc-Netzen* (U. Reif, P. Ebinger)

Janka Schuld, *A Lower Bound for Approximation of Stochastic Heat Equations* (K. Ritter)

Astrid Marbs, *Replication of Interest Rate Derivatives by Liquidly Traded Options* (A. Neuenkirch, K. Ritter)

Arnaud de Guibert, *Funktionale Quantisierung und ihre Anwendung in der Finanzmathematik* (K. Ritter)

Oliver Kolb, *Influence of the Yarkovsky Effect on Celestial Bodies* (P. Spellucci, R. Jehn (ESOC))

M. Garcia, *Some embeddings on fractional Sobolev spaces and estimates of Fourier transforms* (W. Trebels)

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

Christian Brandenburg, *Preconditioners for PDE-constrained Optimization with Applications to the Shape Optimization of Sheet Metal Products* (S. Ulbrich)

Marie Cabioc'h, *Rekursive Multilevel Trust-Region-Verfahren für hierarchische Approximationen unendlichdimensionaler Optimierungsprobleme* (S. Ulbrich)

Wolfgang Hess, *Verfahren für gemischt-ganzzahlige Second-Order-Cone-Programme* (S. Ulbrich, S. Drewes)

Jutta Kämper, *Numerical Computation of Lower Bounds for Optimal Control by Semi-infinite Programming* (S. Ulbrich)

Ulrich Kandt, *Dualität von Modellen zur Portfoliooptimierung unter Capital-at-Risk-Nebenbedingungen* (S. Ulbrich)

Björn Köster, *Mining Web Search Results Using Fortmal Concept Analysis* (R. Wille, J. Fürnkranz)

5 Presentations

5.1 Talks and Visits

5.1.1 Invited Talks and Addresses

Kristina Altmann

29.11.06 *A combinatorial local characterization of the compact Lie groups of type* $^2A_7(\mathbb{C})$ *and* $^2E_6(\mathbb{C})$
EIDMA Seminar Combinatorial Theory, Eindhoven

Achim Blumensath

22.02.05 *A Pumping Lemma for Higher-Order Pushdown Automata*
Algorithmic Model Theory, Darmstadt, Germany

14.10.05 *Relations of bounded degree and the Muchnik construction*
PROCOPE Meeting, Rennes, France

24.09.06 *Graph Operations and Decidable Monadic-Theories*
Workshop "Logic and Combinatorics", Szeged, Hungary

13.10.06 *Graph Operations and Decidable Monadic-Theories*
13. Annual Meeting "Logik in der Informatik", Dortmund, Germany

Jürgen Bokowski

2005 *DMV und ÖMG Klagenfurt, Austria*

2005 *Luminy, Marseille, OM5*

2006 *Minisymposium Victoria, Canada*

Regina Bruder

15.02.05 *Talk on the Day of Mathematics in Marburg: Selbstreguliertes Lernen im Mathematikunterricht*

10.03.05 *Talk/Workshops on the Day of Mathematics and Natural Sciences in Erfurt*

12.03.05 *Workshop on the Day of Mathematics 2005 in Heppenheim*

14./15.03.05 *Sinus-advances teacher training in Berlin: Problemlösenlernen in Verbindung mit Selbstregulation*

17.03.05 *Advanced teacher training in Lebach (Saarland): Neue Aufgabenkultur*

05.10.05 *Talk on elc-Info-Day for presentation of the AG Quality in elc*

10.10.05 *Forum e-Learning Hessen von Biehler/Bruder in Gießen: VEMA: Virtuelles Eingangstutorium Mathematik*

11.10.05 *Talk and Workshop at SINUS-advances training in University of Würzburg: Problemlösen lernen im Mathematikunterricht - mit binnendifferenzierenden Lernangeboten und "Strategietraining"*

12.11.05 *MUED-Meeting: Mathematik verstehen, behalten und anwenden lernen - ein Unterrichtskonzept für nachhaltiges Lernen*

22.11.05 *t3-Meeting in Kassel: "Mathematik verstehen und anwenden lernen - Folgerungen für einen computergestützten Mathematikunterricht"*

28.11.05 *Talk in Otto-Hahn-School: "Der Mehrwert neuer Medien im Mathematikunterricht"*

30.01.06 *Talk in the Academy of New Media and Science Transfer in University of Graz: "Qualitätssicherung im E-Learning mit Label und Gütesiegel an der TU Darmstadt"*

07.02.06 *Talk in TU Kaiserslautern: "Konzepte für nachhaltiges Lernen von Mathematik"*

23.02.06 *Advances teacher training for Problemsolving in Bebra*

01.03.06 *An internet-based advanced teacher training for competence oriented lesson in mathematics on the international meeting abou school mathematics in Vienna*

14.03.06 *Workshop of AG "Qualitätssicherung und eLearning" of GMW in Frankfurt: "Qualitätssicherung mit einem E-Learning-Label für universitäre Lehre und einem Gütesiegel"*

15.03.06 *Advanced teacher training in Frankfurt/Main: Individualisierung beim Lernen von Mathematik im Kontext der Bildungsstandards*

02.05.06 *Advanced teacer training in the City-school in Frankfurt: Innere Differenzierung*

16.05.06 *Talk in the Museum of Mathematics in Gießen with Prof. Beutelspacher*

19.05.06 *Referat on advanced teacher training in Soest about Problemsolving*

12.06.06 *Talk in Vienna: Umsetzung der Bildungsstandards für die Expertengruppe Bildungsstandards Mathematik in Österreich*

13.06.06 *Cycle of lectures: Qualität im E-Learning im Graduiertenkolleg der TU Darmstadt*

21.06.06 *Talk in the Department of Education in Mainz: Ergebnisse des Modellversuchs für computergestütztes Lernen (TIM)*

23.06.06 *Meeting at the University of Kassel: E-Learning-Label*

28.06.06 *Talk for SINUS-coordinators in Wiesbaden: Nachhaltigen Lernen von Mathematik*

30.06.06 *Presentation of the project CIMS-SH in Kiel: Computergestützer Mathematikunterricht in Schleswig-Holstein*

04.07.06 *Talk for SINUS-Coordinators in Seeheim-Jugenheim: Nachhaltiges Lernen von Mathematik*

07.07.06 *General Survey on the research-meeting about computerbased teaching mathematics*

20.07.06 *Talk with C. Collet about the PME in Prague: Evaluation of a teaching concept for the development of problemsolving competencies in connection with self - regulation*

25./26.08.06 *Talk and workshop on the Hamburger CAS-Project CIMS: Einführung in das Projekt; Integralrechnung rechnergestützt unterrichten*

12.09.06 *Talk with J. Sonnberger on DELFI-Meeting in TU Darmstadt: Ein E-Learning-Label für universitäre Lehre*

13.09.06 *Panel "Qualität im E-Learning" on DELFI-Meeting in TU Darmstadt*

19.10.06 *Talk on advanced training of Multiples in central Franconia: Problemlösen lernen im Mathematikunterricht mit binnendifferenzierenden, offeneren Lernangeboten und "Strategietraining" in Schwarzenberg*

26.10.06 *Talk on advanced teacher training in Helmholzschool, Frankfurt: Nachhaltiges Lernen von Mathematik*

11.11.06 *Talk on* T^3*-Meeting in Wetzlar: Wie beeinflussen neue Werkzeuge das Lernen von Mathematik? Einblicke in aktuelle Modellprojekte*

18.11.06 *Presentation with C. Collet, E. Komorek and M. Ströbele: Abschlussveranstaltung zum DFG-Schwerpunktprogramm "BIQUA".*

23.11.06 *Talk on meeting for persons in charge of the case "media" in schools in Hesse*

24.11.06 *Talk with C. Collet in front of the research group "Vergleichsuntersuchungen" of GDM in Osnabrück: Wirkungsanalysen in Lehrerfortbildungsprojekten zu SINUS und BIQUA-Untersuchungsergebnisse und -methoden*

27.11.06 *SINUS-Meeting: Mathematischen Problemlösenlernen in Waldfischbach*

29.11.06 *Talk and workshop: Multiplikatorenausbildung für die Implementation der Bildungsstandards Mathematik bzw. des niedersächsischen Kerncurriculums, "Problemlösen lernen im Mathematikunterricht" in Bad Neuendorf*

2.12.06 *Talk and workshop on the Ernst-Schröder-Colloquium in TU Darmstadt: "Problemlösen"*

20.12.06 *Presentation: Einführung einer Lehr-Lernplattform in der Seminarausbildung in Stuttgart*

Stefan Bundfuss

04.07.06 *Linear Approximations of Copositive Programs*
EURO 2006, Reykjavik, Iceland

Jakob Creutzig

2005 *A note on linear and nonlinear algorithms for linear problems*
FOCM conference, Santander, workshop on Information–based Complexity

2005 *Linear and Nonlinear approximation of Gaussian and Stable processes*
FOCM conference, Santander, workshop on Stochastic Computation

2005 *Approximation vs. small deviation of symmetric stable Lévy process*
conference 'Small deviations and related topics II', Petersburg

2006 *Nonlinear Approximation of diffusion processes*
Seminar Stochastik, TU Magdeburg

2006 *Nonlinear Approximation of stochastic processes*
Dagstuhl Seminar 'Algorithms and Complexity for continuous problems'

Mirjam Dür

15.12.05 *Kontinuierliche Lösungsstrategien für diskrete Probleme am Beispiel des Maximum Clique Problems*
Colloquium of Department of Mathematics and Informatics in Phillips University of Marburg

16.12.05 *Branch-and-Bound Approaches to Mixed Integer Nonlinear Programming*
International Workshop on Discrete-Continuous Optimization and Optimal Control, Darmstadt

21.06.06 *Optimierung über konvexen Kegeln: Kontinuierliche Reformulierungen und Relaxierungen für diskrete Probleme*
Colloquium of Department of Mathematics and Natural Sciences in University of Wuppertal, Belgium

14.11.06 *Solving Copositive Programs through Linear Approximations*
Optimization and Engineering Applications Workshop, Banff International Research Station for Mathematical Innovation and Discovery

29.11.06 *Kontinuierliche Ansätze zur diskreten Optimierung mittels konvexer Kegel*
Optimization colloquium in the Department of Mathematics in University of Dortmund

30.11.06 *Continuous Approaches to Discrete Problems by means of Optimization over Convex Cones*
Department of Mathematics, FUNDP Namur, Belgium

11.12.06 *Towards Solving Copositive Programs*
Vienna Continuous Optimization Colloquium 06

18.12.06 *Continuous Approaches to Discrete Problems by means of Optimization over Convex Cones*
Optimization seminar in University of Erlangen

Abdelhadi Es-Sarhir

23.06.05 *Existence of invariant measures for perturbed Ornstein-Uhlenbeck semigroups.*
University of Lecce, Italy.

09.03.06 *A functional analytic approach to transition semigroups in infinite dimensions.*
University of Leiden, The Netherlands.

Bálint Farkas

09.10.06 *Rendezvous numbers, Chebyshev constants and potential theory*
Institut Henri Poincaré, Paris

18.09.06 *Maximal regularity for Kolmogorov operators in* L^2 *spaces with respect to invariant measures*
DMV Annual meeting, Minisymposium Operator theory

05.09.06 *Semigroups, interpolation theory and PDEs: Hypoelliptic Kolmogorov operators*
Approximation Theory Workshop, Kiten, Bulgaria

29.08.06 *Invariant measures and regularity properties of perturbed Ornstein–Uhlenbeck semigroups*
EVEQ06 Conference in memory of Günter Lumer

30.06.06 *Average distance numbers and capacitary measures in Banach spaces*
5th Summer School in Potential Theory

05.04.06 *Maximal regularity of hypoelliptic Kolmogorov operators*
Technical University Budapest, Department of Differential Equations

03.04.06 *Perturbations for Ornstein–Uhlenbeck semigroups: regularity, ergodicity and invariant measures*
Loránd Eötvös University, Budapest

26.08.05 *Maximal regularity for degenerate Ornstein–Uhlenbeck semigroups*
University of Tübingen, Department of Functional Analysis

20.01.05 *Abstract Chebyshev constants, energy and applications*
University of Tübingen, Department of Functional Analysis

Reinhard Farwig

20.02.05 *L^q-Analysis of Viscous Fluid Flow past a Rotating Obstacle*
North-East Seminar, Tohoku University Sendai, Japan

15.06.05 *From Weak to Strong Solutions of the Navier-Stokes Equations*
Partial Differential Equations in Mechanics and Stochastics, Mongolian University of Science and Technology, Ulaanbaatar, Mongolia

26.10.05 *Fluid Flow in Arbitrary Unbounded Domains*
Equations d'évolution: Applications à la Physique, aux sciences de l'ingénieur, de la vie et de l'environnement, Luminy

09.01.06 *An L^q-Appproach to the Stokes Equations in General Unbounded Domains*
Kyoto Conference on the Navier-Stokes Equations and their Applications, RIMS, Kyoto University

14.09.06 *Local and Global in Time Regularity Properties of the Navier-Stokes Equations Beyond Serrin's Condition*
Parabolic and Navier-Stokes Equations, Bedlewo (Banach Center, Poland)

Armin Fügenschuh

17.03.05 *Integrierte Optimierung von Schulanfangszeiten, Fahr- und Umlaufplänen*
IIR Seminar "Kosteneinsparung durch optimierten Schülerverkehr", Hannover, Germany

11.05.05 *IKOSANA – Integrierte Koordinierung von Schulanfangszeiten und des Nahverkehrs-Angebots*
HSB, Hanau, Germany

12.05.05 *IKOSANA – Integrierte Koordinierung von Schulanfangszeiten und des Nahverkehrs-Angebots*
RMV Fachbeirat, Hofheim am Taunus, Germany

13.05.05 *"Warum spart der Staat Steuern, wenn die Schule eine halbe Stunde früher beginnt?"*
University of Paderborn, Germany

02.06.05 *IKOSANA – Integrierte Koordinierung von Schulanfangszeiten und des Nahverkehrs-Angebots*
PTV, Karlsruhe, Germany

20.06.05 *Karriere eines Mathematikers in der Uni*
Seminar “Mathematiker in der Berufspraxis”, University of Oldenburg, Germany

21.06.05 *IKOSANA – Integrierte Koordinierung von Schulanfangszeiten und des Nahverkehrs-Angebots*
Colloqium Angewandte Mathematik, University of Oldenburg, Germany

14.12.05 *Optimization of Sheet Metal Products with Branches of a Higher Order*
Seminar Algebra und Graphentheorie, Politechnika Warszawska, Poland

18.01.06 *Optimale Schulanfangszeiten*
Institute for Mathematics, University of Magdeburg, Germany

14.02.06 *Optimization of Sheet Metal Products with Branches of a Higher Order*
Department of Mathematics, University of Kaiserslautern

23.04.06 *Gerald Schmieder*
Nekrolog anlässlich des Gedächtniskolloquiums für Prof. Dr. Gerald Schmieder, Oldenburg, Germany

28.07.06 *Integrated Optimization of School Starting Times and Public Bus Transport*
University of Sao Paulo, Brasil

08.09.06 *The Integrated Optimization of School Starting Times and Public Bus Services*
Semiplanary Talk, Conf. on Oper. Res. OR2006, Karlsruhe, Germany

14.10.06 *Die Formel für die Verständlichkeit*
Oration on ”Klaus Tschira Preises für verständliche Wissenschaft”, Heidelberg, Germany

23.10.06 *Recent Progress in Topology Optimization for Sheet Metal Products*
Seminar Algebra und Graphentheorie, Politechnika Warszawska, Poland

Marzena Fügenschuh

06.05 *Discrete Optimization methods in Portfolio Selection*
Frankfurt Math-Finance Colloquium, Business School of Finance and Management, Frankfurt am Main, Germany

07.06 *Semidefinite and Polyhedral Relaxations for Graph Partitioning Problems*
Seminar in Optimization, University of São Paulo

10.06 *Linear and Semidefinite Relaxations for the Graph Bisection Problem*
Seminar in Algebra and Graph Theory, Warsaw University of Technology, Poland

Matthias Geißert

28.09.05 *The Navier-Stokes flow in rotating domains*
University of Lecce, Italy

10.05.06 *The Navier-Stokes flow in rotating domains*
University of Parma, Italy

13.10.06 *The Navier-Stokes flow in the exterior of a rotating obstacle*
University of Tokio, Japan

Helge Glöckner

24.01.05 *Colloquium: Differentialrechnung und Liegruppen über topologischen Körpern*
University of Stuttgart

01.09.05 *Differential calculus and Lie groups over topological fields*
University of Newcastle, Australia

19.11.05 *Neue Techniken der Differentialrechnung und ihr Einsatz im Bereich unendlich-dimensionaler Liegruppen*
TU Clausthal

01.12.05 *Colloquium: Unendlich-dimensionale Differentialrechnung im Reellen und über allgemeineren Körpern*
University of Göttingen

24.05.06 *Colloquium: Neue Techniken der Differentialrechnung und ihr Einsatz im Bereich unendlich-dimensionaler Liegruppen*
Catholical University of Eichstätt

24.11.06 *Differentialrechnung in unendlich-dimensionalen Räumen und einige ihrer Anwendungen*
University of Paderborn

Ralf Gramlich

10.03.05 *A combinatorial characterization of certain exceptional Chevalley groups*
Groups and Geometries, Oberwolfach

08.08.05 *Phan theory*
University of Birmingham, UK

16.01.06 *Filtrations of subsets of buildings*
University of Birmingham, UK

04.07.06 *Flipflop geometries*
University of Gent, Belgium

03.11.06 *Flipflop-Geometrien und ihre Anwendungen*
Norddeutsches Gruppentheorie-Kolloquium, Kaiserslautern

24.11.06 *Flipflop-Geometrien und ihre Anwendungen*
University of Paderborn

Karsten Große-Brauckmann

27.01.05 *Constant mean curvature surfaces in terms of spherical metrics*
Advances in Surface Theory, Kloster Benediktbeuern

11.5.05 *Constant mean curvature surfaces: From real world applications to recent results*
Differential Geometry Day, Lund, Schweden

13.10.05 *Known and unknown constant mean curvature surfaces*
Journada de Geometria, Granada, Spain

16.01.06 *Konstante mittlere Krümmung in Theorie und Praxis*
Colloquium, Mannheim, Germany

17.08.06 *Symmetries of constant mean curvature surfaces*
International Conference on Global Differential Geometry, Münster

02.11.06 *Symmetric constant mean curvature surfaces*
Seminar on Differential Geometry and Analysis, Hannover

11.12.06 *Flächen konstanter mittlerer Krümmung*
Colloquium University of Stuttgart

Ute Günther

29.09.06 *How to use discrete mathematics for solving sheet forming problems*
University of São Paulo, Brasil

27.10.06 *How to use discrete mathematics for solving sheet forming problems*
State University of Campinas, Brasil

Robert Haller-Dintelmann

07.12.05 *Opérateurs d'Ornstein-Uhlenbeck sur $L^p(\Omega)$ (Ornstein-Uhlenbeck operators in $L^p(\Omega)$)*
University of Valenciennes, France

13.02.06 *Kolmogorov-Abschätzungen für Ornstein-Uhlenbeck-Operatoren (Kolmogorov estimates for Ornstein-Uhlenbeck operators)*
University of Ulm

01.12.06 *Missing Gaussian bounds – elliptic operators of second order with unbounded first order coefficients*
Conference "Heat kernels in mathematics and physics", Blaubeuren

06.12.06 *Time-dependent multiplicative perturbations in parabolic equations*
University of Valenciennes, France

Horst Heck

10.10.06 *Reconstruction of obstacles immersed in an incompressible fluid*
Math. Institute of the Academy of Science, Prague, Czech Republic

17.07.05 L^p*-Theory of the Navier-Stokes flow in the exterior of a rotating obstacle*
Math. Institute of the Academy of Science, Prague, Czech Republic

31.03.05 L^p*-Theory of the Navier-Stokes flow in the exterior of a rotating obstacle*
Workshop Navier-Stokes Equations, Niigata, Japan

10.01.05 L^p*-Theory of the Navier-Stokes flow in the exterior of a rotating obstacle*
PDE Seminar at Hokkaido University, Sapporo, Japan

Matthias Hieber

12.01.05 *The Navier-Stokes flow past rotating obstacles*
Waseda University, Tokyo, Japan

14.01.05 H^∞*-calculus for elliptic operators subject to general boundary conditions*
University of Tokyo, Tokyo, Japan

22.05.05 *Maximal Regularity for Parabolic Problems with Inhomogeneous Data*
Int. Conference on “Direct and Inverse Problems in PDEs”, Cortona, Italy

28.07.05 *Navier-Stokes and Rotating Obstacles*
EQUADIFF-Conference, Bratislava, Slovakia

05.10.05 *Heat Kernels and Mixed Boundary Conditions*
Int. Confernce on ”Spectral Theory and Mathematical Physics”, CIRM Luminy, France

18.10.05 *The Equations of Navier-Stokes in the rotational framework*
Int. Conference on “Nonlinear Parabolic Problems”, Helsinki, Finnland

07.01.06 *Analysis of the Spin-Coating Problem*
Int. Conference on “Fluid Dynamics”, RIMS Kyoto, Japan

11.01.06 *Quasilinear Problems with Mixed Boundary Conditions*
University of Tokyo, Tokyo, Japan

22.02.06 *Spin-Coating and Moving Contact Lines*
Workshop “Analysis and Numerics of Free Boundary Value Problems”, Halle

30.03.06 *Heat-Kernels and Quasilinear Systems*
European-Magreb-Workshop ”Evolution Equations”, Tunis, Tunisia

01.06.06 *The Sum-Method and Second Order Parabolic Problems*
Colloquium, Univ. Le Havre, France

20.06.06 *Fluids and Rotation*
Workshop "Analysis and Numerics of Geophysical flows", Lighthill Institute, London, England

18.07.06 *Quasilinear Systems with Mixed Boundary Conditions on Lipschitz Domains*
Int. Conf. "Nonlinear Analysis", Armidale, Australia

30.08.06 *Regularity for Parabolic Systems on Lipschitz Domains*
Int. Conference "Evolution Equations", Mons, Belgium

11.09.06 *Stability of the Ekman Spiral*
Int. Conference "Nonlinear Parabolic Problems", Bedlewo, Poland

16.11.06 *Parabolic Problems related to Fluid Dynamcis*
Colloquium Arizona State University, Tempe, USA

24.11.06-3.12.06 *Maximal L^p-Regularity for Parabolic Evolution Equations*
Lecture Series, I-VI, Waseda University, Tokyo, Japan

Karl Heinrich Hofmann

24.05.05 *Angewandte Mathematik in der Renaissance–Crivelli's Verkündigungsbild von Ascoli Piceno in der London National Gallery*
University of Bielefeld

16.06.05 *Eine Klasse topologischer Gruppen, deren häufig unendlichdimensionale Lietheorie wir kennen*
University of Tübingen

16.06.05 *title see 24.05.05*
University of Tübingen

13.03.06 *Pro-Lie Groups and their Lie Theory*
Dalhousie University, Halifax N.S., Canada

15.03.06 *Applied Mathematics in the Renaissance–Crivelli's London Annunciation*
Dalhousie University, Halifax N.S., Canada

17.03.06 *The Katrina Disaster and the Universities of New Orleans*
Dalhousie University, Halifax N.S., Canada

Max Horn

04.05.05 *Amalgame*
Seminar on "Algebra und Gruppentheorie", TU Braunschweig

Michael Joswig

06.01.05 *The Sign of the Tropical Determinant*
Joint Meeting of the AMS-MAA, Special Session: Tropical Geometry, Atlanta, GA, U.S.A.

28.04.05 *Colorings of Convex Polytopes and Combinatorial Manifolds*
TU Berlin

09.05.05 *Polytope Propagation*
ETH Zürich, Switzerland

16.06.05 *Colorings of Convex Polytopes and Combinatorial Manifolds*
Joint Meeting of the AMS-DMV-ÖMG, Special Session: Algebraic Combinatorics, Mainz

27.06.05 *Computing Invariants of SImplicial Manifolds*
University of Stuttgart

26.10.05 *Von Polytopen bis zu DNA-Sequenzen: Anwendungen des Softwaresystems polymake*
TU Darmstadt

10.03.06 *An Approach to Combinatorial Holonomy*
Oberwolfach

26.05.06 *Polytope Constructions, I*
University of Libre, Brusselles, Belgium

27.05.06 *Polytope Constructions, II*
University of Libre, Brusselles, Belgium

02.06.06 *Invariants of Simplicial Manifolds: Algorithms and Software*
Institute Mittag-Leffler, Djursholm, Sweden

07.07.06 *Computing Optimal Discrete Morse Functions*
TU Berlin

29.09.06 *Computing Optimal Discrete Morse Functions*
UC Davis, CA, U.S.A.

03.10.06 *Explicit Computations of Invariants of Simplicial Manifolds*
Workshop on Topological Methods in Combinatorics, Computational Geometry, and the Study of Algorithms, MSRI, Berkeley, CA, U.S.A.

05.10.06 *Bounds on the f-Vectors of Tight Spans*
Workshop on Topological Methods in Combinatorics, Computational Geometry, and the Study of Algorithms, MSRI, Berkeley, CA, U.S.A.

13.10.06 *Products of Foldable Triangulation*
San Francisco State University, CA, U.S.A.

16.10.06 *Computing Optimal Discrete Morse Functions*
UC Berkeley, CA, U.S.A.

08.12.06 *Algorithms in Tropical Convexity*
Erwin-Schrödinger International Institute for Mathematical Physics, Vienna, Austria

Klaus Keimel

20.05.05 *Domains combining probability and nondeterminism*
21st Annual conference on Mathematical Foundations of Programming Semantics, Birmingham, UK, May 18–21, 2005

12.07.05 *Functional analytic and topological tools for semantic domains modelling probability and nondeterminism*
20th Summer Conference on Topology and its Applications, Denison, Ohio, July 10–14, 2005

03.06.06 *Foundations of a domain theoretical semantics combining probability and nondeterminism*
International Symposium on Domain Theory, Changsha, China, June 2–6, 2006

Martin Kiehl

11.03.05 *Mathematisches Modellieren und Simulation mit Excel*
Day of Mathematics, Darmstadt

11.03.05 *Differentialalgebraische Gleichungen und ihre Anwendungen*
Day of Mathematics, Darmstadt

24.05.05 *Die Mathematische Modellierungswoche an der TU-Darmstadt*
Colloquium in the Department of Mathematics, University of Hanburg

18.03.06 *Dynamisches Modellieren und Modellierung dynamischer Systeme mit Excel*
Day of Mathematics, Fulda

Simon King

23.02.05 *Invariants of Turaev–Viro Type and the Andrews–Curtis Conjecture*
Workshop on 3-Manifolds and Complexity, Cortona/Italy

18.06..05 *Ideal Turaev–Viro Invariants*
Joint Meeting of AMS, DMV and ÖMG, Mainz/Germany

26.08.05 *On new* 3*-manifold invariants*
Workshop on Geometry and Topology of 3-Manifolds, Novosibirsk/Russia

16.02.06 *Ideal Turaev–Viro Invariants*
Workshop “Gröbner Bases Theory and Applications in Algebraic Geometry”, Special Semester on Gröbner Bases and Related Methods, Linz/Austria

28.02.06 *Computing Turaev–Viro Invariants*
Workshop “Efficient Computation of Gröbner Bases, Special Semester on Gröbner Bases and Related Methods, Linz/Austria

Ulrich Kohlenbach

3.-6.02.05 *Proof Theory and Uniformity Results in Functional Analysis*
Plenary lecture at UCLA Logic Conference, Los Angeles, USA

20.-26.03.05 *Proof Mining: Applications of Proof Theory in Analysis I-III*
Series of lectures (3 times 60 min) at Conference “Mathematical Logic: Proof Theory, Type Theory and Constructive Mathematics”, Oberwolfach

8.-12.06.05 *Proof Mining in Functional Analysis*
Plenary lecture at Conference “CiE 2005: New Computational Paradigms”, Amsterdam, The Netherlands

17.-23.07.05 *Applications of Logic to Metric Fixed Point Theory*
Plenary lecture at “7th International Conference on Fixed Point Theory and Applications”, Guanajuato, Mexico

11.10.05 *Applications of Logic in Functional Analysis*
Talk at Department of Mathematics, University of Valencia, Spain

14.10.05 *Applications of Logic in Functional Analysis*
Talk at Department of Mathematics, University of Sevilla, Spain

8.12.05 *Proof Theory: from Foundations to Applications*
Talk at Max Planck Institute for Mathematics, Bonn

9.-13.01.06 *Proof Mining: Applications of Proof Theory to Analysis I-IV*
Series of lectures (4 times 60 min) at Conference “MAP 2006”, Castro Urdiales, Spain

27.-29.04.06 *Gödel’s Functional (‘Dialectica’) Interpretation and its Use in Current Mathematics*
Plenary lecture at “Horizons of Truth. Logics, Foundations of Mathematics, and the Quest for Understanding the Nature of Knowledge. Gödel Centenary 2006. International Symposium Celebrating the 100th Birthday of Kurt Gödel”, Vienna, Austria

18.-21.07.06 *Proof Mining: Applications of Proof Theory to Analysis I-II*
Tutorial (2 times 60 min) at “WoLLIC 2006, 13th Workshop on Logic, Language, Information and Computation”, Stanford, California, USA

18.-21.07.06 *A Logical Uniform Boundedness Principle for Abstract Metric and Hyperbolic Spaces*
Plenary talk (75min) at "WoLLIC 2006, 13th Workshop on Logic, Language, Information and Computation", Stanford, California, USA

17.-23.09.06 *Logical Metatheorems and their Use in Functional Analysis and Geodesic Geometry*
Talk at "Minisymposium: The Use of Proof Theory in Mathematics" as part of DMV Meeting, Bonn

19.10.06 *Effective Bounds from Ineffective Proofs in Nonlinear Analysis and Geodesic Geometry*
Colloquium Talk at "Research Institute for Symbolic Computation (RISC)", University of Linz, Austria

8.-9.01.07 *Recent Uses of Proof Theory in Nonlinear Analysis and Geodesic Geometry*
Plenary talk at the Winter Meeting of the Association for Symbolic Logic ASL (held in conjunction with the Joint Mathematics Meeting), New Orleans, USA

5.-8.01.07 *New effective uniformity results in fixed point theory*
Invited talk in AMS-ASL Special Session on Logical Methods in Computational Mathematics, Joint Mathematics Meeting, New Orleans, USA

Burkhard Kümmerer

26.04.05 *Auf Irrwegen sicher zum Ziel: Vom Markovprozess zur Quantenkodierung*
University of Erlangen, Germany

23.05.05 *Ergodic Theory for Repeated Quantum Measurement*
University of Pavia, Italy

29.03.06 *Asymptotic Behaviour of Quantum Markov Processes*
International Conference on Quantum Probability and its Applications, Greifswald, Germany

19.07.06 *Asymptotic Behaviour of Quantum Markov Processes*
Conference "Quantum Probability and Applicastions", Nottingham, UK

21.09.06 *Asymptotic Behaviour of Quantum Markov Processes*
DMV-Annual Meeting, Minisymposium "Mathematische Physik", Bonn

Jens Lang

10.05.05 *Local Versus Global Error Control*
CWI, Amsterdam, The Netherlands

04.08.05 *RH-Adaptive Finite Elements*
60th Birthday of Bub Russell at SFU, Vancouver, Canada

21.01.05 *Adaptive Multilevel Rosenbrock Verfahren*
Rhein–Main Arbeitskreis Mathematics of Computation, Mainz

25.11.05 *On Global Error Control for Initial Value Problems*
FU Berlin

20.01.05 *Hierarchische Modellierung und Adaptive Simulationsverfahren für den optimalen Wärmetransport mit Strahlung in Glas*
TU Darmstadt, FZ Computational Engineering

Jürgen Lehn

17.03.05 *Mathematiker im Dritten Reich*
Odenwald Academy, Synagoge Michelstadt

13.05.05 *Vertreibung jüdischer Mathematiker im Dritten Reich*
Highschool Michelstadt

22.05.06 *Vertreibung jüdischer Mathematiker im Dritten Reich*
"Was steckt dahinter?" TU Darmstadt

08.12.06 *Vertreibung jüdischer Mathematiker im Dritten Reich*
Colloquium in Mathematics, University of Gießen

Katja Lengnink

08.11.05 *Die Lernenden dort abholen, wo sie stehen – Mathematische Bildung im Spannungsfeld von Mathematik und Lebenswelt*
University of Bremen

18.01.06 *Reflektierendes Mathematiklernen*
University of Siegen

13.02.06 *Geometrie unterrichten in offenen Lernumgebungen*
University of Pedagogic Karlsruhe

18.02.06 *Mathematische Bildung im Spannungsfeld von Mathematik und Lebenswelt*
University of Hildesheim

15.09.06 *Didactical perspectives on mathematics and its philosophical implications*
Workshop auf der Jahrestagung der Gesellschaft für analytische Philosophie, Berlin

12.10.06 *Zahldarstellungen und Zahlbereichserweiterungen: Eine Lernumgebung zum reflektierenden Handeln*
University of Siegen

06.11.06 *Reflektierendes Mathematiklernen im Spannungsfeld von Mathematik und Lebenswelt*
Lehrerfortbildung, Frankfurt am Main

28.11.06 *Nach fundamentalen Ideen unterrichten - Stabilisieren und Vernetzen beim Lernen einer schnelllebigen Disziplin*
University of Applied Sciences Darmstadt

Laurențiu Leuștean

13.01.05 *Approximate fixed points of nonexpansive functions in product spaces*
Dagstuhl Seminar 05021: MAP (Mathematics, Algorithms, Proofs), Internationales Begegnungs- und Forschungszentrum (IBFI), Schloss Dagstuhl, Germany

22.03.05 *The approximate fixed point property in product spaces*
Oberwolfach Workshop 0512: Mathematical Logic: Proof Theory, Type Theory and Constructive Mathematics, Mathematisches Forschungsinstitut Oberwolfach, Germany

12.01.06 *Proof mining in CAT(0)-spaces*
MAP (Mathematics, Algorithms, Proofs) 2006, Castro Urdiales, Spain

27.04.06 *Proof mining in functional analysis, hyperbolic geometry and group theory*
Young Scholar Competition, Horizons of Truth: Logics, Foundations of Mathematics, and the Quest for Understanding the Nature of Knowledge. Gödel Centenary 2006. An International Symposium Celebrating the 100th Birthday of Kurt Gödel, Vienna, Austria

21.09.2006 *Proof Mining in functional analysis*
University of Bucharest, Romania

Peter Lietz

14.10.05 *Examination of the rearrangeable blocking behaviour of Clos-Networks with respect to multicast traffic*
University of São Paulo, Brasil

Alexander Martin

10.10.05 *Hard Mixed Integer Programs in Practice*
University of São Paulo, Brasil

09.11.05 *Rearrangably Nonblocking Switching Networks*
Oberwolfach Workshop “Combinatorial Optimization”

27.01.06 *Hard Mixed Integer Programs in Practice*
Eindhoven University of Technology, The Netherlands

11.06.06 *Branching Rules Revisited*
Workshop “MIP 2006”, Miami, USA

19.09.06 *Minimizing Switching Networks*
DMV-Jahrestagung, Minisymposium “Optimierung”, Bonn

10.01.06 *Minimizing Clos Networks*
Workshop "Combinatorial Optimization", Aussois, France

07.11.06 *Hard Mixed Integer Programs in Practice*
German-Myanmar Workshop "Computational Science", Yangon, Myanmar

Karl-Hermann Neeb

03.02.05 *Tripel im Shilovrand beschränkter Gebiete*
University of Paderborn

03.05.05 *Extreme points and convexity in representation theory*
Math. Coll. Univ. of Ottawa and Carleton Univ. (Canada)

05.03.05 *Triples in the Shilov boundaries of bounded symmetric domains*
Lie Theory Workshop, Univ. of Ottawa

18.04.05 *Extreme points and convexity in representation theory*
Math. Coll. International Univ. Bremen

29.06.05 *Extensions of infinite-dimensional Lie groups*
$XXIV^{th}$ Workshop on Geometric Methods in Physics, Bialowieza, Poland

25.07.05 *Triples in the Shilov boundaries of bounded symmetric domains*
Miniworkshop on algebraic groups, Lie groups and transformation groups, Bielefeld

15.12.05 *Locally exponential Lie groups*
Conf. "Infinite Dimensional Lie Algebras and their Applications," Harish-Chandra Res. Institute (Allahabad, Indien)

21.03.06 *Locally exponential Lie groups*
Sem. Math. Physics, Univ. Lille

22.03.06 *Locally exponential Lie groups*
Math. Coll. Univ.of Bourgogne, Dijon

10.06.06 *Locally exponential Lie groups*
I Latin Amer. Conf. on Lie groups and geometry, Campinas (Bras.)

16.06.06 *Lie groups with a good exponential function*
Journées Metz-Nancy-Strasbourg (Nancy)

Patrizio Neff

15.01.05 *A geometrically exact Cosserat shell-model including size effects, avoiding degeneracy in the thin shell limit. Rigourous justification via* Γ*-convergence for the elastic plate.*
GAMM Seminar on Microstructures, Bedlewo Conference-Center, Polish Academy of Science, Posen, Poland

15.01.05 *Elastic-plastic Cosserat continua. Modelling and mathematical analysis.*
GAMM Seminar on Microstructures, Bedlewo Conference-Center, Polish Academy of Science, Posen, Poland

07.02.05 *A geometrically exact Cosserat shell-model including size effects, avoiding degeneracy in the thin shell limit. Rigourous justification via* Γ*-convergence for the elastic plate.*
Ecole Normale Superior des Mines, Centre des Materiaux, Evry

14.02.06 *A geometrically exact Cosserat shell-model including size effects, avoiding degeneracy in the thin shell limit. Rigourous justification via* Γ*-convergence for the elastic plate.*
Institute of Mathematics and Cryptology, Military University of Technology, Warsaw

17.02.05 *A geometrically exact Cosserat shell-model including size effects, avoiding degeneracy in the thin shell limit. Rigourous justification via* Γ*-convergence for the elastic plate.*
Faculty of Mathematics and Information Sciences, Warsaw University of Technology, Warsaw

16.02.05 *A geometrically exact Cosserat shell-model including size effects, avoiding degeneracy in the thin shell limit. Rigourous justification via* Γ*-convergence for the elastic plate.*
Institute of Fundamental Technological Research, Polish Academy of Sciences, Warsaw

14.04.05 *Eine geometrisch exakte Cosserat Schalenformulierung mit Groesseneffekten: Rigorose Herleitung als* Γ*-Limit eines dreidimensionalen Cosserat Modells.*
Presentation on W2-Professor in Mathematics, Nachfolge Prof. Grueter, University of Saarland

03.07.05 *Eine geometrisch exakte Cosserat Schalenformulierung mit Groesseneffekten: Rigorose Herleitung als* Γ*-Limit eines dreidimensionalen Cosserat Modells.*
Darmstadt Cosserat-Treffen, TU-Darmstadt

03.07.05 *The Cosserat couple modulus* μ_c *for continuous solids is zero! Or: the linearized Cauchy stress tensor is symmetric*
Darmstädter Cosserat-Treffen, TU-Darmstadt

03.07.05 *Linear and nonlinear Cosserat models with vanishing couple modulus - numerical investigations and comparisons*
Darmstadt Cosserat-Treffen, TU-Darmstadt

15.11.05 *Constitutive parameters for a nonlinear Cosserat model. A numerical study.*
Miniworkshop on Analysis and Computation of Microstructure in Finite Plasticity, Mathematisches Forschungsinstitut Oberwolfach

14.01.06 *The extended Korn's first inequality with integrable dislocation density*
Fifth GAMM-Seminar on Microstructures, University of Duisburg-Essen, Campus Essen

05.04.06 *Curl bounds Grad on* SO(3)
, Workshop on Phase Transitions, TU-Darmstadt

23.05.06 *Eine geometrisch exakte Cosserat Schalenformulierung. Rigorose Herleitung als* Γ*-Limit eines dreidimensionalen Cosserat Modells.*
Presentation on W2-Professor in Mathematics, University of Duisburg-Essen

23.05.06 *Ueberlegungen zu einer Vorlesung: Modellieren im Lehramt*
Presentation on W2-Professor in Mathematics, University of Duisburg-Essen

14.07.06 *Eine geometrisch exakte Cosserat Schalenformulierung. Rigorose Herleitung als* Γ*-Limit eines dreidimensionalen Cosserat Modells.*
Presentation on W2-Professor in "Mathematische Modellbildung", University of Hannover

29.07.06 *Loss of ellipticity for fibre reinforced materials*
5th. World Congress of Biomechanics, TU-Munich

09.10.06 *Mathematical Aspects of Continuum Mechanics*
Three invited lectures in: COMMAS Summer School on "Computational Mechanics of Materials and Structures, University of Stuttgart

07.11.06 *A numerical solution method for an infinitesimal elasto-plastic model*
Weierstrass-Institute for Applied Analysis and Stochastic

Werner Nickel

16.06.05 *Polycyclic Groups*
Second joint meeting of AMS, DMV, ÖMG

Birgit Niese

13.12.05 *Gemischte Poissonprozesse und m-verallgemeinerte Ordnungsstatistiken*
RWTH Aachen

Martin Otto

9.-12.01.06 *Model theory with special classes of (finite) relational structures.*
Isaac Newton Institute, Cambridge; Logic and Algorithms Programme, Finite and Algorithmic Model Theory, Durham, series of 4 lectures

Ulrich Reif

21.02.05 *Surface Representations of Higher Order*
Workshop on Analytical and Numerical Methods in Image and Surface Processing, Oberwolfach

03.06.05 *On the Smoothness of the Four-Point Scheme*
Seminar on Geometric Modeling, Schloss Dagstuhl

27.06.05 *Famouns Subdivision Schemes*
EU Summer School on Subdivison, Sienna

30.06.05 *Smoothness Analysis at Extraordinary Points*
EU Summer School on Subdivison, Sienna

08.07.05 *Stability of B-Splines on Bounded Domains*
Foundations of Computational Mathematics, Mini-Symposium on Approximation Theory, Santander

02.11.05 *Shape Analysis of Subdivision Surfaces*
SIAM Conference on Geometric Design and Computing, Mini-Symposium on Subdivision, Phoenix

03.11.05 *Stability of B-Splines on Bounded Domains*
SIAM Conference on Geometric Design and Computing, plenary talk, Phoenix

04.04.06 *On the Regularity of the Four-Point Scheme*
Univeristy of Florida at Gainesville

12.06.06 *Analyse des Vierpunkt-Schemas*
TU Clausthal

03.07.06 *Analysis of the Four-Point Scheme*
Curves and Surfaces, Mini-Symposium on Subdivison, Avignon

17.07.06 *B-Splines as Finite Elements*
World Congress on Computatiopnal Mechanics, Symposium on Computational Geometry and Analysis, Los Angeles

Klaus Ritter

07.05 *An Implicit Euler Scheme with Non-uniform Time Discretization for Stochastic Heat Equations*
Foundations of Computational Mathematics, Santander, Spain

07.05 *On the Complexity of Solving Stochastic Differential Equations*
Foundations of Computational Mathematics, Santander, Spain

09.05 *On the Complexity of Solving Stochastic Differential Equations*
Small Deviation Probablities and Related Topics II, Euler Institute, St. Petersburg, Russia

12.05 *Nicht-uniforme Diskretisierung stochastischer Evolutionsgleichungen*
Seminar in Mathematics, University of Kiel, Germany

12.05 *Simulation stochastischer Evolutionsgleichungen*
Faculty of Mathematics and Informatics, TU Freiberg, Germany

03.06 *Infinite-Dimensional Quadrature and Quantization*
Department of Applied Mathematics, AHG University of Science and Technology, Cracow, Poland

11.06 *Optimal Approximation for a Class of Stochastic Heat Equations*
SFB-Workshop Numerics and Theory for Stochastic Evolution Equations, University of Bielefeld, Germany

Steffen Roch

01.03.05 *Fredholm properties and finite sections of band-dominated operators*
IPN Mexico/City, Mexico

13.09.05 *Finite sections of band-dominated operators*
IST Lisbon, Portugal

31.07.06 *Invertibility and determinants of finite sections of band-dominated operators with almost periodic coefficients*
17th IWOTA Seoul, Corea

05.09.06 *Szegö limit theorems for operators with variable coefficients*
Workshop Operator Algebras and Appl. Lisbon, Portugal

Lars Schewe

07.03.06 *Nonrealizability of Triangulated Surfaces*
Workshop: Discrete Differential Geometry, Oberwolfach

02.09.06 *Generation of Oriented Matroids Using Satisfiability Solvers*
ICMS 2006, Castro Urdiales

Peter Spellucci

06.11.06 *QP-Probleme: Eine bleibende Herausforderung*
University of Kassel, Colloquium FB 17

Wilhelm Stannat

15.07.06 *Functional inequalities for branching processes*
"Stochastic Analysis and Related Topics", Marburg

19.09.06 *On stability of the optimal filter*
DMV-Jahrestagung, Minisymposium "Stochastic Algorithms and Markov Processes", Bonn

07.11.06 *On stability of the optimal filter*
University of Cambridge, UK

17.11.06 *On particle filters*
University of Antwerpen, Belgium

Thomas Streicher

06.06 *Some Independence Problems in* BISH
Workshops on *Trends in Constructive Mathematics*

09.06 *Shoenfield = Gödel after Krivine*
Minisymposium on *The Use of Proof Theory in Mathematics* during the DMV Meeting 2006

Ioan Teleaga

29.09.06 *Radiation effects in the simulation of tunnel fires*
Free University of Berlin, Germany

Walter Trebels

10.05.06 *A Fourier analytic view on Peetre's K-functional as an interface in approximation theory*
"International Conference in Fourier and Complex Analysis: Classical Problems – Current View, Protaras, Cyprus

20.06.06 *K-functionals related to semigroups of operators*
University Complutense of Madrid, Spain

Stefan Ulbrich

13.01.05 *Primal-Dual Interior-Point Multigrid Methods for PDE-Constrained Optimization*
Oberwolfach Workshop "Optimization and Applications"

18.02.05 *Innere-Punkte Mehrgitter-Verfahren für Optimierungsprobleme mit partiellen Differentialgleichungen*
FU Berlin

21.04.05 *Generalized SQP-Methods with Parareal Time-Domain Decomposition for Time-dependent PDE-constrained Optimization*
Oberwolfach Workshop "Optimal Control ofCoupled Systems of PDEs"

18.05.05 *Primal-Dual Interior Point Multigrid Methods for Optimization Problems with PDEs*
SIAM Conference on Optimization, Stockholm

05.06.05 *Recent Developments in PDE-Constrained Optimization*
International Conference on Scientific Computing, Nanjing, China

19.07.05 *Generalized SQP-Methods with Parareal Time-Domain Decomposition for Time-dependent PDE-constrained Optimization*
22nd IFIP TC 7 Conference on System Modeling and Optimization, Turin

11.08.06 *Primal-Dual Interior Point Multigrid Methods for Complementarity Problems in Function Space with Applications to PDE-Constrained Optimization*
ICCP 2005, Stanford University

22.11.05 *Parallel All-at-Once Methods with "Parareal" Time-Domain Decomposition for Time-dependent PDE-constrained Optimization*
RICAM, Linz

17.01.06 *Moderne Multilevel-Verfahren f"ur die Optimierung mit partiellen Differentialgleichungen*
University of Ulm

02.03.06 *Multilevel Preconditioning of Interior Point and Semismooth Newton Methods for Parabolic Optimal Control Problems with Bound Constraints*
Oberwolfach Workshop "Numerical Techniques for Optimization Problems with PDE Constraints"

27.03.06 *Interior Point and Semismooth Newton Multigrid Methods for PDE-Constrained Optimization*
GAMM Annual Meeting, TU Berlin

16.06.06 *Auf der Jagd nach dem Optimum: Wie hilft die numerische Optimierung beim Entwurf von Flugzeugen, Anlagestrategien und medizinischen Eingriffen?*
TU Darmstadt

20.06.06 *Moderne Multilevel-Verfahren f"ur die Optimierung mit partiellen Differentialgleichungen*
University of Regensburg

Rudolf Wille

19.02.05 *Logische und mathematische Denkformen*
TU Darmstadt (Institute of Philosophy), Workshop "Form und Feld"

09.11.05 *Beurteilung von Musikstücken durch Adjektive: Eine begriffsanalytische Exploration*
TU Dresden, together with R. Wille-Henning

10.11.05 *Besteht ein Kontinuum aus Punkten?*
TU Dresden, Institut f. Algebra

15.02.06 *Methods of Conceptual Knowledge Processing*
TU Dresden. Int. Conference on Formal Concept Analysis (ICFCA)

17.03.06 *Methods of Conceptual Knowledge Processing*
University of Wollongong, Australia, Dept. of Economics and Information Systems

21.04.06 *Consists a Continuum of Points?*
University of Wollongong, Australia

08.05.06 *Formal Concept Analysis as Basis for Conceptual Knowledge Processing*
University of Luxembourg, IT-Colloquium

25.05.06 *Allgemeine Wissenschaft und transdisziplinäre Methodologie*
IFF, Karlsruhe

12.06.06 *Beurteilung von Musikstücken durch Adjektive: Eine begriffsanalytische Exploration*
TU Vienna, Algebra Colloquium, together with R. Wille-Henning

01.11.06 *Formal Concept Analysis as Applied Lattice Theory*
International Conference on Concept Lattices and Their Applications (CLA '06), Hammamet, Tunesia

08.12.06 *Probleme mit dem Kontinuum. Mathematische, logische und phänomenologische Betrachtungen*
Wacker Kunst Projekt über diskontinuierlische Probleme, Wacker Fabrik, Nieder-Ramstadt

5.1.2 Contributed Talks

Kristina Altmann

01.06.05 *Hyperbolic lines in unitary polar spaces for* $n \geq 7$
IV Kortrijk Workshop on Discrete groups and Geometric Structure, with Applications (Crystallographic groups and their generalizations), Oostende

18.08.05 *The hyperbolic-line graph of an unitary polar spaces for* $n = 6$
Geometric and Algebraic Combinatorics 3, Oisterwijk

27.09.05 *Hyperbolic lines in unitary polar spaces for* $n = 6$
International Workshop Buildings 2005, Darmstadt

Eyvind Briseid

12.01.06 *Proof mining and fixed points of generalized p-contractive mappings on metric spaces*
MAP 2006 Meeting, Castro Urdiales, Spain

23.09.06 *On Kirk's fixed point theorem for asymptotic contractions*
ICAM 5, North University of Baia Mare, Romania

Stefan Bundfuss

15.09.06 *Lineare Approximationen copositiver Programme*
FRICO 2006, Chemnitz

Jakob Creutzig

10.03.06 *Statistische Verfahren und Software zur Stabilitätsanalyse*
Merck AG, Darmstadt

Kristian Debrabant

04.09.2006 *Continuous Extension of Stochastic Runge-Kutta methods for the Weak Approximation of SDEs*
Numdiff 11, Halle (Saale)

01.11.2006 *The Method of Lines and the Method of Characteristics*
PIMS, Vancouver

08.11.2006 *Global Error Control for PDEs*
PIMS, Vancouver

Mirjam Dür

18.09.05 *Multiple Neutral Data Fitting*
International Workshop on Global Optimization, Almería, Spain

05.07.06 *An Algorithm for Multiple Neutral Data Fitting*
EURO XXI (21st European Conference on Operational Research), Reykjavik, Iceland

07.09.06 *Linear Approximations of Copositive Programs*
Operations Research 2006, Karlsruhe

14.12.06 *Towards Solving Copositive Programs*
Veszprém Optimization Conference: Advanced Algorithms (VOCAL)

Abdelhadi Es-Sarhir

01.06.05 *The first eigenvalue of nonsymmetric elliptic operators with Dirichlet boundary conditions*
Internet Seminar on Analytic Semigroups and Reaction-Diffusion Problems , Casalmaggiore, Italy, June 2005.

28.11.05 *Perturbation of Symmetric Ornstein-Uhlenbeck semigroups*
Analysis meeting , Horb, Germany, November 2005.

10.11.05 *Invariant measures and regularity properties for perturbed Ornstein-Uhlenbeck semigroups*
Seminar at TU Darmstadt, November 2005.

19.01.06 *Sobolev regularity of invariant measure for generalized Ornstein–Uhlenbeck operators*
Seminar at TU Darmstadt, January 2006.

Bálint Farkas

25.08.06 *Maximal regularity for Kolmogorov operators in L^2 spaces with respect to invariant measures*
International Congress of Mathematicians, 2006, Madrid, Spain

05.06.06 *Maximal regularity for Kolmogorov operators in L^2 spaces with respect to invariant measures*
Stochastic and Deterministic systems, Vienna, Austria

22.05.06 *Maximal regularity for Kolmogorov operators in L^2 spaces with respect to invariant measures*
TU Darmstadt, Partial Differential Equations Seminar

05.12.05 *Who Wants to Be a Millionaire – Analytic methods*
TU Darmstadt, Student Orientation Colloqium

14.12.05 *Average distance numbers in Banach spaces via potential theory*
Function Theory in Infinite Dimensional Spaces IX, Madrid, Spain

28.11.05 *Spectral and tiling sets*
Analysis Meeting, Horb

03.11.05 *On a conjecture of Fuglede from harmonic analysis*
TU Darmstadt, Applied Analysis Seminar

06.07.05 *Abstract potential theory and applications*
4th International Summer School in Potential Theory, Debrecen, Hungary

30.06.05 *Weak stability of orbits of C_0-semigroups*
Harmonic Analysis and PDEs Conference, Kiel, Germany

04.06.05 *Abstract Chebyshev constants with new applications*
Constructive Theory of Functions Conference, Varna, Bulgaria

Reinhard Farwig

08.02.05 *Do Solutions of the Navier-Stokes Equations Get Singular in Finite Time?*
Graduate School of Natural Science and Technology, Kanazawa University

12.02.05 *L^q-Analysis of Viscous Fluid Flow past a Rotating Obstacle*
Faculty of Engineering, Niigata University

21.04.05 *Werden Lösungen der Navier-Stokes-Gleichungen singulär?*
Mathematical Colloquium, University of Gießen

03.06.05 *Die Stokes– und Navier–Stokes–Gleichungen in beliebigen unbeschränkten Gebieten*
Mathematical Colloquium, University of Kiel

27.07.05 *Suitable Weak Solutions of the Navier-Stokes Equations in Arbitrary Unbounded Domains*
EQUADIFF 11, Bratislava

30.07.05 *Fluid Flow in Arbitrary Unbounded Domains*
Workshop on Applied Mathematics, Prague

20.10.05 *Very Weak Solutions of the Navier-Sokes Equations in Exterior Domains with Nonhomogeneous Data*
International Conference: Nonlinear Parabolic Problems, Helsinki

23.01.06 *The Stokes Operator with Rotation - Basic Difficulties and Surprising Results*
Waseda University, Tokyo

04.04.06 *Weak L^q-Theory of Stationary Navier-Stokes Flow Around a Rotating Obstacle*
Mathematical Institute, Academy of Sciences Prague

11.04.06 *Strömungen um ein rotierendes Hindernis*
Mathematical Colloquium, RWTH Aachen

12.12.06 *Local and Global in Time Regularity for the Navier-Stokes Equations Beyond Serrin's Criterion*
Mathematical Institute, Academy of Sciences Prague

Armin Fügenschuh

02.03.05 *Integrierte Optimierung von Schulanfangszeiten, Fahr- und Umlaufplänen*
Heureka 2005, Karlsruhe, Germany

22.04.05 *Ein Planungstool zur Schulzeitstaffelung*
DSOR Annual meeting "Entscheidungsunterstützende Systeme in Supply Chain Management und Logistik", Paderborn, Germany

03.08.05 *Modellierung mit Ganzzahligen Variablen*
Workshop on Optimization and Scientific Computing, Hirschegg, Austria

29.08.05 *Parametrized Greedy Heuristics in Theory and Practice*
Hybrid Metaheuristics - HM 2005, 2nd Int. Workshop, Barcelona, Spain

08.09.05 *Integrated Optimization in Public Transport*
Conf. on Oper. Res. OR2005, Bremen, Germany

08.09.05 *Topology- and shape-optimization of branched sheet metal products*
Conf. on Oper. Res. OR2005, Bremen, Germany

14.09.05 *Scheduling Buses in Rural Areas*
10th EWGT-Meeting and 16th Mini-EURO Conference, Poznan, Poland

30.03.06 *Optimization of Sheet Metal Products with Branches of a Higher Order*
GAMM Annual meeting, Berlin, Germany

11.04.06 *Parametrized GRASP Heuristics for Three-Index Assignment*
EvoCOP 2006, Budapest, Hungary

31.05.06 *Mixed-Integer Models for Topology Optimization in Sheet Metal Design*
CORE, Louvain-la-Neufe, Belgium

02.08.06 *Mixed-Integer Programming for Topology Optimization in Sheet Metal Design*
19. Internat. Sympos. on Math. Prog. ISMP, Rio de Janeiro, Brasil

24.08.06 *Mixed-Integer Programming for Topology Optimization in Sheet Metal Design*
ESI European Summer School, Wittenberg, Germany

14.09.06 *Locomotive and Wagon Scheduling in Freight Transport*
6th Workshop on Algorithmic Methods and Models for Optimization of Railways ATMOS, Zürich, Switzerland

13.12.06 *Solving PDEs with MIP Techniques*
Veszprem Optimization Conference: Advanced Algorithms VOCAL, Veszprem, Hungary

Marzena Fügenschuh

08.05 *Ellipsoid Method*
Workshop on Optimization and Scientific Computing, Hirschegg, Austria

09.05 *Strong Valid Inequalities for the Graph Bisection Polytope*
Conference on Operations Research OR2005, Bremen, Germany

04.06 *Hybrid Genetic Algorithm Within Branch-and-Cut for the Minimum Graph Bisection Problem*
6th European Conference on Evolutionary Computation in Combinatorial Optimization EvoCOP06, Budapest, Hungary

08.06 *Polyhedral and Semidefinite Relaxations for Graph Bisection Problems*
19. International Symposium on Mathematical Programming, Rio de Janeiro, Brasil

Matthias Geißert

02.11.06 *The evolution semigroup of Kolmogorov operators with time depending coefficients*
Workshop on Kolmogorov equations in Parma, Italy

27.03.06 *L^p-Theory of the Navier-Stokes flow in the exterior of a rotating obstacle*
Fronts-singularities conference in Nottingham, England

18.10.05 *Strong L^p-Solutions of the Navier-Stokes Equations in the Exterior of a Rotating Obstacle*
Nonlinear parabolic problems in Helsinki, Finland

25.07.05 *Strong L^p-Solutions of the Navier-Stokes Equations in the Exterior of a Rotating Obstacle*
Equadiff 11 Conference in Bratislava, Slovakia

Helge Glöckner

11.06.05 *Ultrametric invariant manifolds and applications in Lie theory*
Seminar Sophus Lie, Nancy

28.06.05 *Open problems in the theory of infinite-dimensional Lie groups*
XXIV Workshop on Geometric Methods in Physics, Bialowieza

18.09.05 *Ultrametric invariant manifolds and applications in Lie theory*
2nd International Conference on p-adic Mathematical Physics, Belgrade

26.09.05 *Classification of the simple totally disconnected contraction groups*
Buildings 2005, Darmstadt

06.07.06 *Classification of the simple totally disconnected contraction groups*
21st Summer Conference on Topology and its Applications, Georgia Southern University, Statesboro

10.07.06 *Aspects of p-adic non-linear functional analysis*
Ninth International Conference on p-adic Functional Analysis, Concepcion, Chile

22.08.06 *Classification of the simple totally disconnected contraction groups*
ICM 2006, Madrid

10.10.06 *Directions of automorphisms of Lie groups over local fields compared to the directions of Lie algebra automorphisms*
Buildings 2006, Münster

14.10.06 *Open problems in the theory of infinite-dimensional Lie groups*
Baltic-Nordic Workshop on Algebra, Geometry and Mathematical Physics, Lund

03.11.06 *Classification of the simple totally disconnected contraction groups*
Seminar Sophus Lie, Vienna

11.12.06 *Direct limits of infinite-dimensional Lie groups*
Infinite-dimensional Lie theory, Oberwolfach

Ralf Gramlich

17.08.05 *Phan theory*
GAC3, Oisterwijk, The Netherlands

27.09.05 *Reflections in Coxeter groups*
Buildings workshop, TU Darmstadt

12.09.06 *Covering theory for intransitive geometries*
Second Irsee conference, Kloster Irsee

10.10.06 *Applications of flipflop geometries*
Buildings workshop, University of Münster

Ute Günther

07.09.05 *Manufacturing constraints for branched sheet metal products*
International Symposium on Operations Research 2005, Bremen

28.09.05 *The optimal loading strategy for cash points*
International Conference on Optimization under Uncertainties 2005, Heidelberg

07.12.05 *An algorithm based approach for integral sheet metal design with higher order bifurcations*
International Conference on Digital Manufacturing, PACE 2005, Darmstadt

28.03.06 *Modelling manufacturing constraints for branched sheet metal products*
Annual Meeting of the Gesellschaft für angewandte Mathematik und Mechanik e.V. GAMM 2006, Berlin

Robert Haller-Dintelmann

28.06.05 *L^p-L^q-estimates for parabolic systems with VMO-coefficients*
Conference "Harmonic Analysis and Partial Differential Equations", Kiel

20.10.05 *H^∞-calculus for products of non-commuting operators*
Conference "Nonlinear Parabolic Equations", Helsinki, Finland

28.03.06 *Elliptic operators with unbounded drift coefficients in $L^p(\Omega)$*
5th European-Maghreb Workshop on Semigroup Theory, Evolution Equations and Applications, Hammamet, Tunisia

Horst Heck

19.09.06 *Stability Estimates for the Inverse Conductivity Problem with Partial Cauchy Data*
DMV Annual meeting, Bonn

12.09.06 *Stability of the Plane Couette Flow with Respect to L^n Perturbations*
Conference Parabolic and Navier-Stokes Equations, Bedlewo, Poland

10.01.06 *The Divergence Problem in Sobolev Spaces of Negative Order*
Conference Navier-Stokes equations and their Applications, Kyoto, Japan

Karl Heinrich Hofmann

10.06.05 *A class of infinite dimensional Lie groups whose Lie theory we know*
Seminar Sophus Lie, University of Nancy, France

06.07.06 *Open Mapping theorems for topological groups*
Summer Conference on Topology at the University of South Georgia, Statesboro, Ga

Max Horn

16.06.05 *Computations with amalgams of unitary groups*
2nd Joint Meeting of AMS, DMV, OeMG, University of Mainz

14.09.06 *Phan amalgams*
Finite Geometries, Second Irsee Conference, Kloster Irsee

10.10.06 *Flips of algebraic groups*
Buildings 2006, University of Münster

Daniel Junglas

24.02.05 *Optimal Distribution of Block Structured Grids in Parallel Computing*
Computational Engineering – Forschung und Lehre, Darmstadt

Klaus Keimel

17.05.06 *The extended probabilistic powerdomain monad over stably compact spaces*
Conference on Theory and Applications of Models of Computation, Bejing

Simon King

01.03.06 *Computing Gröbner Bases of Biedenharn–Elliott ideals*
Problem Session at the Workshop "Efficient Computation of Gröbner Bases, Special Semester on Gröbner Bases and Related Methods, Linz, Austria

27.01.06 *Reductions of modular invariants and the Andrews–Curtis problem*
Frankfurt, Germany

13.06.05 *Anwendungen von Gröbner–Basen in der Topologie*
Darmstadt, Germany

28.01.05 *New solutions of the Biedenharn–Elliott equations*
Frankfurt, Germany

Katrin Krohne

31.01.05 *Sehr schwache Lösungen der Stokes Gleichungen in beschränkten Gebieten*
University of Mainz

21.04.05 *Very Weak Solutions to the Stokes Problem in Bounded Domains*
Tohoku University, Sendai, Japan

29.09.05 *Very Weak Solutions to the Stokes Equations in Weighted Function Spaces*
Mathematical Institute, Academy of Sciences, Prague

09.05.06 *Very Weak Solutions to the Instationary Stokes Equations in Spaces with Muckenhoupt Weights*
Analysis Day, Darmstadt

14.09.06 *Very Weak Solutions to the Instationary Stokes Equations in Weighted Function Spaces*
Conference on Parabolic and Navier-Stokes Equations, Bedlewo

Burkhard Kümmerer

18.02.05 *Unendlichkeit – Aus der Nähe betrachtet*
Ludwig Georgs Highschool, Darmstadt

17.11.05 *Unendlichkeit – Aus der Nähe betrachtet*
Dilthey Highschool, Wiesbaden

Jens Lang

21.02.05 *Adaptive Moving Finite Elements on Time Dependent Domains*
Meeting on Computational Engineering in Forschung und Lehre, Darmstadt

21.02.05 *Advanced Numerical Simulation Schemes for Quasi–Static Electric and Magnetic Fields*
Meeting on Computational Engineering in Forschung und Lehre, Darmstadt

Jürgen Lehn

11.11.05 *Vertreibung jüdischer Mathematiker im Dritten Reich*
Rotary Club Darmstadt-Kranichstein

Laurenţiu Leuştean

21.06.06 *Proof mining in* $\mathbb{R}$*-trees and hyperbolic spaces*
13th Workshop on Logic, Language, Information and Computation (WoLLIC'2006), Stanford, CA, USA

Debora Mahlke

06.09.06 *A Simulated Annealing Algorithm for Transient Optimization in Gas Networks*
International Conference on Operations Research, Karlsruhe

04.10.06 *Zeitliche Entkopplung von Angebot an erneuerbaren Energien und Nachfrage*
BMBF Annual Meeting, Darmstadt

Alexander Martin

01.06.05 *Optimizing Transport Networks*
Linde AG, München

04.10.05 *Gemischt-ganzzahlige Optimierung am Beispiel der Gasoptimierung*
BMBF-Kickoff Meeting, Duisburg

14.11.05 *Optimierung und Stochastik an der TU Darmstadt*
Energieversorgung Offenbach

Susanne Moritz

04.10.05 *Gemischt-Ganzzahlige Optimierung am Beispiel der Gasnetzoptimierung*
BMBF-Kickoff Meeting, Duisburg

15.12.05 *Mixed Integer Models for Gas Network Optimization*
International Workshop on Discrete-Contiuous Optimization and Optimal Control, Darmstadt

Karl-Hermann Neeb

03.11.06 *Pro-Lie groups which are infinite-dimensional Lie groups*
Seminar Sophus Lie, Vienna

Patrizio Neff

31.03.05 *A geometrically exact Cosserat shell-model including size effects, avoiding degeneracy in the thin shell limit. Rigourous justification via* Γ*-convergence for the elastic plate.*
GAMM-Annual Meeting, University of Luxemburg

16.07.06 *A geometrically exact Cosserat shell-model including size effects, avoiding degeneracy in the thin shell limit. Rigourous justification via* Γ*-convergence for the elastic plate.*
AMS/DMV-Joint-Meeting, University of Mainz

12.10.06 *The* Γ*-limit of a finite strain Cosserat model for asymptotically thin domains versus a formal dimensional reduction*
8.th Conference "Shell-Structures: Theory and Applications", Gdansk

27.03.06 *Curl bounds Grad on* SO(3)
GAMM-Annual Meeting, TU-Berlin

06.10.06 *A Numerical Solution Method for an Infinitesimal Elasto-Plastic Cosserat Model*
International Conference on Multifield Problems, University of Stuttgart

Martin Otto

20.02.06 *Boundedness in the Universal Fragment*
AlMoTh Workshop on Algorithmic Model Theory, Aachen

26.06.05 *Modal Characterisation Theorems over Special Classes of Frames*
20th IEEE Symposium on Logic in Computer Science, LICS 2005, Chicago

12.08.06 *The Boundeness Problem for Monadic Universal First-Order Logic*
21st IEEE Symposium on Logic in Computer Science, LICS 2006, Seattle

Ulrich Reif

11.02.06 *Konvergenzanalyse des Vierpunktverfahrens*
Rhein-Ruhr-Workshop, Schwerte

Klaus Ritter

09.05 *An Implicit Euler Scheme with Non-Uniform Time Discretization for Stochastic Heat Equations*
Computational Stochastic Differential Equations, Math. Research and Conf. Center, Bedlewo, Poland

08.06 *Lower Bounds for Approximation of Stochastic Heat Equations*
MCQMC 2006, Ulm, Germany

Andreas Rößler

04.09.06 *Efficient Stochastic Runge–Kutta Methods for the Weak Approximation of the Solution of SDEs*
NUMDIFF-11, Halle (Saale)

17.08.06 *Continuous SRK Methods for the Weak Approximation of SODEs*
7th International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing, Ulm

16.03.05 *Stochastic Runge–Kutta methods for weak approximation*
7th workshop on "Deskriptorsysteme", Liborianum, Paderborn

30.03.05 *Strong Approximation of Scalar Itô Stochastic Differential Equations with Runge–Kutta Schemes*
76th Scientific Annual Conference of the Gesellschaft für Angewandte Mathematik und Mechanik, Luxemburg

23.06.05 *Numerical methods for the approximation of solutions of stochastic differential equations*
Graduiertenkolleg 853 "Modellierung, Simulation und Optimierung von Ingenieuranwendungen", TU Darmstadt

Lars Schewe

07.11.05 *Applications of the theory of oriented matroids to point-line configurations*
Géométries Combinatoires et Applications : Matroides Orientés, Matroides, Luminy

Wilhelm Stannat

18.10.06 *Neue Herausforderungen für die Stochastik aus dem Bereich der Signalverarbeitung*
TU Darmstadt

Thomas Streicher

12.05 QCB *is not closed under sobrification*
University of Marseille

04.06 *Sheaf Models for* CZF_e
Workshop on *Constructive Set Theory* University of Utrecht

09.06 QCB *is not closed under sobrification*
IT University of Kopenhagen

09.06 *The Diller-Nahm Topos*
IT University of Kopenhagen

11.06 *Identity Types and Weak* ω*-Groupoids*
University of Uppsala

Delia Teleaga

22.09.06 *Towards a fully space-time adaptive FEM for magnetoquasistatics*
ICAM 5 - 5th International Conference on Applied Mathematics, Baia-Mare, Romania

25.09.06 *Towards a fully space-time adaptive FEM for magnetoquasistatics*
19th Chemnitz FEM Symposium, Chemnitz

Ioan Teleaga

10.11.05 *Adaptive error control in LES simulations*
CRC 568 Reports, Seeheim

22.09.06 *Higher-order linearly implicit one-step methods for large eddy simulations*
ICAM 5 - 5th International Conference on Applied Mathematics, Baia-Mare, Romania

06.10.06 *Adaptive error control in LES simulations*
SRH Heidelberg

Walter Trebels

22.09.05 *Norm smoothness and a.e. rate of convergence of approximation processes of convolution type*
International Conference Harmonic Analysis and Approximation, III 20-27 September 2005,Tsahkadzor, Armenia

Tim Wagner

28.09.05 *The Optimal Loading strategy for Cash Points*
COUCH 2006, Conference on Optimization under Uncertainties, Heidelberg

30.03.06 *Predicting Turnovers of Cash Recycling Systems*
77th Annual Meeting of the Gesellschaft für Angewandte Mathematik und Mechanik e.V., Berlin

17.08.06 *Non-Equidistant Approximation of Stochastic Heat Equations*
7th International Conference on Monte Carlo and Quasi-Monte Carlo Methods in Scientific Computing, Ulm

28.09.06 *Non-Equidistant Approximation of Stochastic Heat Equations*
Workshop on Algorithms and Complexity for Continuous Problems, Dagstuhl

04.10.06 *Efficient Simulations of Infinite Dimensional Stochastic Equations*
Research-Seminar NEC Europe Computers and Communications Research Laboratories, Sankt Augustin

Stefan Ulbrich

17.10.05 *Optimierungsverfahren für den Unwuchtausgleich an wellenelastischen Rotoren*
Schenck RoTec GmbH, Darmstadt

Julian Wiedl

20.10.05 *Non-analyticity of the Ornstein-Uhlenbeck semigroup*
Nonlinear Parabolic Problems, Helsinki, Finland

30.04.06 *Gradient estimates for systems of parabolic equations with unbounded coefficients*
European-Maghreb Workshop on Semigroup Theory, Evolution Equations and Applications, Hammamet, Tunesia

Rudolf Wille

29.01.05 *Wissen in Begriffen*
46th Ernst Schröder Seminar: "Vom impliziten zum expliziten Wissen", TU Darmstadt

15.02.05 *Coherence Networks of Concept Lattices: The Basic Theorem*
International Conference on Formal Concept Analysis, Lens, France

22.04.05 *Allgemeine Mathematik: Sinn und Bedeutung von Mathematik*
10th Conference Allgemeine Mathematik, TU Darmstadt

27.05.05 *Preconcept Algebras and Generalized Double Boolean Algebras*
Conference Allgemeine Algebra, TU Vienna

24.06.05 *Kontextuelle Logik und Begriffliche Wissensverarbeitung*
Conference Logik und Wissen, TU Darmstadt

09.07.05 *Methoden der Begrifflichen Wissensverarbeitung*
48th Ernst Schröder Seminar:"Begrifliche Wissensverarbeitung: Methoden und Anwendungen", TU Darmstadt

19.07.05 *Conceptual Logic and Aristotle's Syllogistic*
International Conference on Conceptual Structures, University of Kassel

08.12.05 *Drawing Concept Lattices*
COMO-Seminar, TU Darmstadt

19.12.05 *Contextual Logic - A Basis for Conceptual Knowledge Processing*
COMO-Seminar, TU Darmstadt

11.02.06 *The Basic Theorem on Preconcept Lattices*
Conference Allgemeine Algebra, Bedlewo, Poland

06.05.06 *Logisch denken im Mathematikunterricht*
50th Ernst Schröder Seminar: “Bildung durch Mathematik”, TU Darmstadt

17.05.06 *Kommunikative Rationalität, Logik und Mathematik*
Colloquium of Institute of Philosophy, TU Darmstadt

08.06.06 *Formal Concept Analysis as Applied Lattice Theory*
Conference on Lattice Theory (and AAA72), Institute of Mathematics, Hungarian Academy of Sciences, Budapest

24.06.06 *Metaphors for Algebra, Logic and Sets*
51th Ernst Schröder Seminar: “Where Mathematics Comes From”(according to G. Lakoff and R.E. Nunez) TU Darmstadt

18.07.06 *Semantology: Basic Methods for Knowledge Representations*
International Conference on Conceptual Structures (ICCS 2006), University Aalborg, Denmark

17.08.06 *Semantology: Basic Methods for Knowledge Representations*
COMO-Seminar, TU Darmstadt

02.12.06 *Mathematische Kompetenz in der aktuellen bildungspolitischen Diskussion*
53th Ernst Schröder Seminar: “Kompetenzerwerb im Mathematikunterricht”, TU Darmstadt

Andrea Zelmer

07.09.06 *Optimal Design of Dispersed Generation Systems*
International Conference on Operations Research, Karlsruhe

04.10.06 *Gekoppelte optimale Auslegung von Strom-, Gas- und Wärmenetzen*
BMBF Annual Meeting, Darmstadt

5.1.3 Visits

Regina Bruder, learntec Karlsruhe, presentation of different web-sites for teaching and learning mathematics, 13.-15.02.06

Kristian Debrabant, Simon Fraser University, Vancouver, October - December 2006

Abdelhadi Es-Sarhir, University of Lecce, Italy, June 2005

Abdelhadi Es-Sarhir, University of Tübingen, Germany, August-September 2005

Abdelhadi Es-Sarhir, University of Leiden, Teh Netherlands, March 2006

Bálint Farkas, Institute Henri Poincaré, Paris, October 2006

Bálint Farkas, University of Technology Budapest, April 2006

Bálint Farkas, Loránd Eötvös University, Budapest, April 2006

Bálint Farkas, University of Tübingen, June 2005

Reinhard Farwig, Oberwolfach–Tagung: Real Analysis, Harmonic Analysis and Applications to PDE, 03.-09.07.2005

Reinhard Farwig, Mathematical Institute, Academy of Sciences Prague, 12.-16.12.2005

Reinhard Farwig, Tôhoku University Sendai, 13.-22.01.2006

Armin Fügenschuh, Politechnika Warszawska, Poland, December 2005

Armin Fügenschuh, University of São Paulo, Brasil, July – August 2006

Armin Fügenschuh, Politechnika Warszawska, Poland, October 2006

Marzena Fügenschuh, University of São Paulo, Brasil, July – August 2006

Marzena Fügenschuh, Warsaw University of Technology, Poland, October 2006

Matthias Geißert, University of Lecce, Italy, October 2006

Matthias Geißert, University of Parma, Italy, September 2006 - October 2006

Matthias Geißert, University of Parma, Italy, February 2006 - May 2006

Matthias Geißert, University of Tokyo, Japan, August 2005 - September 2005

Helge Glöckner, University of Newcastle, Australia, August 14 – September 15, 2005

Ralf Gramlich, TU Braunschweig, Substitute professorship, April–July 2005

Ralf Gramlich, University of Birmingham, January 2006

Ralf Gramlich, University of Gent, April 2006, 1st half

Ralf Gramlich, University of Birmingham, July 2006

Karsten Große-Brauckmann, University of Massachusetts, Amherst, MA, USA, June/July 2005

Karsten Große-Brauckmann, University of Lund, Sweden, May 2005

Karsten Große-Brauckmann, University of Granada, Spain, October 2005

Karsten Große-Brauckmann, Oberwolfach (Geometry), October 2006

Ute Günther, University of São Paulo, Brasil, September 2006 - November 2006

Robert Haller-Dintelmann, University of Valenciennes, France, December 2005

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, December 2006

Horst Heck, Tohoku University, Sendai, Japan, October 2004 – April 2005

Horst Heck, Hokkaido University, Sapporo, Japan, January, 2005

Horst Heck, Niigata University, Niigata, Japan, March, 2005

Horst Heck, Math. Inst. of the Acad. of Science, Prague, July 2005

Horst Heck, University of Washington, Seattle, USA, August 2005 – January 2006

Horst Heck, Tohoku University, Sendai, Japan, August 2006

Horst Heck, Math. Inst. of the Acad. of Science, Prague, October 2006

Matthias Hieber, University of Tokyo, Japan, January 2005

Matthias Hieber, Helsinki Univeristy of Technology, Finnland, October 2005

Matthias Hieber, Arizona State University, Tempe, USA, October 2006

Matthias Hieber, Waseda University, Tokyo, Japan, November 2006

Karl Heinrich Hofmann, Dalhousie University, Halifax, N.S., Canada, March 2006

Karl Heinrich Hofmann, Tulane University, New Orleans, LA, USA, March 2005, August 2005 until August, 28 (then evacuated by Hurricane Katrina), December, 26, 2005 – January 5, 2006, March 2006 und May 15 – June 30, 2006

Max Horn, University of Libre, Brusselles, Belgium, 2nd week of November 2006

Michael Joswig, Mathematical Sciences Research Institute, Berkeley, CA, U.S.A., September/October 2006

Klaus Keimel, University of Brimingham, UK, May 2005,November 2005

Klaus Keimel, University of Edingburgh, UK, February 2006

Klaus Keimel, Shanghai Normal University, China, May,June 2006

Ulrich Kohlenbach, Universities of Valencia and Sevilla, Spain, October 2005

Katrin Krohne, Tohoku University, Sendai, Japan, April-July 2005

Katrin Krohne, Mathematical Institute of the Czech Academy of Sciences, Prague, 25.09.05 - 08.10.05

Katrin Krohne, Mathematical Institute of the Czech Academy of Sciences, Prague, 29.05.06 - 06.06.06

Burkhard Kümmerer, University of Pavia, Italy, May 2005

Burkhard Kümmerer, University of Nijmegen, Netherlands, At least ten times for four or more days during 2005 and 2006

Burkhard Kümmerer, University of Erlangen, Germany, May 2005

Burkhard Kümmerer, Technical University Berlin, Germany, October 2005

Burkhard Kümmerer, Max Planck Institute of Mathematics in the Sciences, Leipzig, Germany, January 2006

Burkhard Kümmerer, Technical University Berlin, Germany, November 2006

Jens Lang, CWI, Amsterdam, April-May 2005

Jürgen Lehn, Middle East Technical University Ankara, March 2005

Peter Lietz, University of São Paulo, Brasil, October 2005

Alexander Martin, University of São Paulo, Brasil, September 2005

Karl-Hermann Neeb, Carleton University (Ottawa), March 2005

Werner Nickel, University of Braunschweig, 4.–8. April 2005

Martin Otto, Isaac Newton Institute, Cambridge; Logic and Algorithms programme, February – March 2006 and July 2006

Ulrich Reif, University of Florida at Gainesville, March 2006

Klaus Ritter, University of Science and Technology, Cracow, Poland, March 2006

Steffen Roch, IPN Mexico/City, March 2005

Steffen Roch, IST Lisbon, September 2005 and September 2006

Andreas Rößler, Humboldt University of Berlin, September 2005, May 2006

Thomas Streicher, University of Marseille, February – March 2005

Walter Trebels, University Autonoma of Madrid, Spain, June 2006

Rudolf Wille, University of Wollongong, Australia, March – April 2006

5.2 Organization of Conferences and Workshops

Regina Bruder

- Section: Teacher further Training at the GDM2006, Osnabrück

Mirjam Dür

- EURO Summer Institute 2006 on "Optimization Challenges in Engineering: Methods, Software, and Applications", August 18 – September 2, 2006, Wittenberg (jointly with P. Huhn, K. Klamroth and C. Tammer)
- Stream on "Global Optimization – Deterministic and Stochastic Methods" at EURO XXI – 21st European Conference on Operational Research, July 2 – 5, 2006, Reykjavik, Iceland

Bálint Farkas

- 4th International Summer School in Potential Theory, Debrecen, Hungary, July 4-July 10, 2005 (jointly with D. Benko, N. Levenberg, Sz. Gy. Révész, S. Szabó)

Armin Fügenschuh

- Session "Topology- and shape-optimization of branched sheet metal products", OR 2005, Bremen

Marzena Fügenschuh

- Session "Graph Partitioning Problems", at the 19th International Symposium on Mathematical Programming, July 31 – August 4, 2006, Rio de Janeiro, Brasil

Ralf Gramlich

- Kac-Moody Groups and Geometry, November 17 – 18, 2006, TU Darmstadt (jointly with L. Kramer, E. Heintze, B. Mühlherr, K.-H. Neeb)

Karsten Große-Brauckmann

- Minisymposion Geometrische Analysis, DMV-Tagung, September 18-20, 2006, Bonn (jointly with U. Dierkes)

Matthias Hieber

- Co-Organization Workshop "Int. School of Evolution Equations", June 5 – 9, 2005, Parma, Italy
- Minisymposium on "Navier-Stokes and Rotating Obstacles" at the International EQUADIFF-Conference, July 28 – 29, 2005, Bratislava, Slovakia
- Co-Organization Workshop "Int. School of Evolution Equations", June 11 – 15, 2006, Blaubeuren
- Co-Organization of the Int. Conference on "Functional Analysis and Evolution Equations", August 27 – 31, 2006, Mons, Belgium

Michael Joswig

- Section on “Software for Optimization and Geometric Computation” at the 2nd International Congress on Mathematical Software, September 1 – 3, 2006, Castro Urdiales, Spain (jointly with K. Fukuda)

Martin Kiehl

- Workshop “Lehrerfortbildung fachübergreifender Unterricht: Mathematik und Chemie 2, August 29 – September 1, 2005, Bad Nauheim (jointly with R. Bruder and B. Kümmerer)
- Summerschool: “Mathematische Modellierungswoche, October 16 – 21, 2005, Weilburg
- Workshop “Lehrerfortbildung fachübergreifender Unterricht: Mathematik und Biologie 1, October 17 – 20, 2005, Weilburg 2005 (jointly with R. Bruder and B. Kümmerer)
- Summerschool: “Mathematische Modellierungswoche, October 15 – 20, 2006, Weilburg

Ulrich Kohlenbach

- Member of PC of “14th Annual Conference of the European Association of Computer Science Logic, CSL 2005”, August 22-25, 2005, Oxford, UK
- Member of PC of “15th Annual Conference of the European Association of Computer Science Logic, CSL 2006”, September 25-29, 2006, Szeged, Hungary
- 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
- Ogranizer (jointly with G. Mints, Stanford, and B. Moroz, MPIM) of “Trimester on methods of proof theory in mathematics. Max Planck Institut for Mathematics, March-June 2007, Bonn

Burkhard Kümmerer

- Workshop on “Subject connecting lessons at school: Mathematics and Chemistry”, August 29 – September 1, 2005, Bad Nauheim (jointly with R. Bruder)
- Workshop on “Subject connecting lessons at school: Mathematics and Biology”, October 17 – 21, 2005, Weilburg (jointly with R. Bruder)
- Workshop on “Subject connecting lessons at school: Mathematics and Biology”, October 21 – 24, 2005, Darmstadt (jointly with R. Bruder)

Jens Lang

- Workshop on Computational Engineering in Research and Teaching, Darmstadt, February 2005 (jointly with CE board of directors)

Katja Lengnink

- Workshop on "Mathematik und Bildung", May 5 and 6, 2006, TU Darmstadt (jointly with R. Wille)
- Workshop on "Fundamentale Ideen unterrichten", November 28, 2006, University of Applied Sciences Darmstadt (jointly with U. Andelfinger and I. Schestag)

Alexander Martin

- Section on "Combinatorial Optimization" at the International Symposium on Operations Research, September 7 – 9, 2005, Bremen (jointly with J. Kallrath)
- Section on "Optimization" at the GAMM 2006, March 27 – 31, 2006, Berlin (jointly with M. Hintermüller)
- Cluster on "Mixed Integer Programming" at the International Symposium on Mathematical Programming, July 31 – August 4, 2006, Rio de Janeiro, Brasil

Karl-Hermann Neeb

- Infinite-Dimensional Lie Theory, Oberwolfach, December 10-16, 2006; jointly with A. Pianzola

Martin Otto

- Advances in Modal Logic 2006, 25-28 September 2006, Queensland, Australia (member of programme committee)

Ulrich Reif

- Analytical and Numerical Methods in Image and Surface Processing, Oberwolfach Mini-Workshop, February 2005 (jointly with G. Dziuk, M. Rumpf, and P. Schröder)
- Industrial Challenges in Geometric Modeling and CAD, March 2005, Darmstadt (jointly with E. Quak)
- Industrial Challenges in Geometric Modeling and CAD, March 2006, Darmstadt (jointly with E. Quak)

Klaus Ritter

- Workshop on "Computational Stochastic Differential Equations" at the Math. Research and Conf. Center, Bedlewo, Poland, September 19–24, 2005 (jointly with D. Higham, T. Müller-Gronbach, A. Szepessy)
- Program Committee and Session on "Computational Stochastic (Partial) Differential Equations" at the 7th Intern. Conf. on Monte Carlo and Quasi-Monte Carlo Methods, Ulm, Germany, August 14–18, 2006 (jointly with E. Hausenblas, T. Müller-Gronbach)
- Seminar "Algorithms and Complexity of Continuous Problems" at the Intern. Conf. and Research Center for Comp. Science, Schloß Dagstuhl, September 24–29, 2006 (jointly with S. Dahlke, I. H. Sloan, J. F. Traub)

Stefan Ulbrich

- Section on "Optimization of Complex Systems" at the Eighth SIAM Conference on Optimization, May 15–19, 2005, Stockholm (jointly with M. Hintermüller, M. Ulbrich)
- Section on "PDE-Constrained Optimization" at the International Symposium on Mathematical Programming, July 31 – August 4, 2006, Rio de Janeiro, Brasil

Julian Wiedl

- Project Coordinator for "The Ornstein-Uhlenbeck semigroup" at Tulka Internetseminar 2004/05, Final Workshop June 05 – 11, 2006, Casalmaggiore (Italy) (jointly with M. Hieber and I. Wood)
- Project Coordinator for "Kernel Estimates for Ornstein-Uhlenbeck operators" at the Tulka Internetseminar 2005/06, Final Workshop June 11 – 17, 2006, Blaubeuren (jointly with R. Haller-Dintelmann)

Rudolf Wille

- Interdisciplinary Conference on "Logik und Wissen", TU Darmstadt, June 24 – 26, 2005, together with U. Kohlenbach and A. Nordmann
- Eight Ernst Schröder Kolloquia and Seminars (from 46th to 53rd), together with M. Helmerich

6 Workshops and Visitors at the Department

6.1 Mathematisches Kolloquium

Winter term 2004/2005

20.10.04. Prof. Dr. Bert Jüttler (University of Linz), *Approximative algebraische Geometrie im Computer-Aided Design*

27.10.04. Prof. Dr. Linus Kramer (TU Darmstadt), *Symmetrien und Gebäude*

03.11.04. Prof. Dr. Rainer Picard (TU Dresden), *Probleme der Elektrodynamik mit nicht-linearen Materialgesetzen und Gedächtnistermen*

10.11.04. Prof. Dr. Andreas Weiermann (University of Utrecht), *Überraschende Wechselwirkungen zwischen den Gödelschen Sätzen und analytischer Zahlentheorie*

17.11.04. Prof. Dr. Ulrich Rieder (University of Ulm), *Portfolio-Optimierung mit verschiedenen Informationsstrukturen*

24.11.04. Prof. Dr. Peter Baptist (University of Bayreuth), *Unterricht öffnen – eigene Lernwege gehen. Anregungen durch die BLK-Modellversuche SINUS und SINUS-Transfer*

01.12.04. Prof. Dr. Martin Arnold (University of Halle-Wittenberg), *Wie fährt das virtuelle Fahrzeug?*

08.12.04. Prof. Dr. Christoph Helmberg (TU Chemnitz), *Lineare Optimierung über symmetrischen Kegeln*

15.12.04. Prof. Dr. Richard Weiss (Tufts University Boston, MA), *Buildings, graphs and groups*

05.01.05. Prof. Dr.-Ing. Johann F. Böhme (Ruhr-University of Bochum), *Rekursive und adaptive Raum-Zeit-Signalverarbeitung zur passiven Ortung*

12.01.05. Prof. Dr. Tudor Ratiu (Ecole Polytechnique Fédérale de Lausanne), *Symmetry and reduction in mechanics*

19.01.05. Prof. Dr. Wolfgang Dahmen (RWTH Aachen University), *Adaptive Multiskalenmethoden*

26.01.05. Prof. Dr. Stephan Hußmann (Academy of Pedagogics Karlsruhe), *Konstruktivistisches Lernen von Mathematik*

02.02.05. Prof. Dr. Jürgen Elstrodt (University of Münster), *Von der Partialbruchzerlegung des Kotangens zur Weierstraßschen stetigen nirgends differenzierbaren Funktion*

09.02.05. Prof. Dr. Ulrich Kohlenbach (TU Darmstadt), *Beweistheorie: von den Grundlagen zu Anwendungen*

Summer term 2005

13.04.05. Prof. Dr. Stefan Ulbrich (TU Darmstadt), *Wie optimiert man Flugzeuge, komplexe Bauteile und medizinische Eingriffe? Eine Reise durch die Möglichkeiten und Techniken der modernen Optimierung*

20.04.05. Prof. Dr. Dr.h.c. Luc Devroye (McGill University, Montreal), *New algorithms for exact random variate generation*

27.04.05. Prof. Dr. Marc Goovaerts (Katholieke University of Leuven), *Risk measures and valuation principles*

04.05.05. Prof. Dr. Sven Krumke (University of Kaiserslautern), *Ruck-zuck rauf und runter: Optimierung rund um den Aufzug*

11.05.05. Priv.-Doz. Dr. Eva Jablonka (Free University of Berlin), *Schülerperspektiven auf Mathematikunterricht in Deutschland, Hongkong und den USA*

18.05.05. Dr. Sc. Joachim Rehberg (Weierstraß-Institute for Applied Analysis und Stochastik, Berlin), *Elliptische und parabolische Probleme aus Anwendungen*

25.05.05. Prof. Dr. Fredi Tröltzsch (TU Berlin), *Optimale Steuerung von semilinearen partiellen Differentialgleichungen bei Zustandsbeschränkungen*

01.06.05. Prof. Dr. Josef Dorfmeister (TU Munich), *Gewöhnliche Differentialgleichungen im Komplexen und Flächen konstanter mittlerer Krümmung*

08.06.05. Prof. Dr. Christoph Schweigert (University of Hamburg), *Was sind Untergruppen von Quantengruppen, und wozu studiert man sie?*

15.06.05. Prof. Dr. Gerhard Dziuk (University of Freiburg), *Die Bewegung von Flächen und Kurven bei der Minimierung ihrer elastischen Energie: Numerik für den Willmore-Fluss*

22.06.05. Prof. Dr. Guido Schneider (University of (TH) Karlsruhe), *Wege in die Turbulenz*

29.06.05. Prof. Dr. Michael Fothe (University of Jena), *LOOK! und andere Prinzipien beim Einsatz von Computern im Mathematik- und Informatikunterricht*

06.07.05. Prof. Dr. Ralf Schindler (University of Münster), *Wozu brauchen wir große Kardinalzahlen?*

13.07.05. Graduation ceremony for winter term 2004/2005 and summer term 2005: Prof. Dr. Hermann Karcher (University of Bonn), *Mathematische Objekte dreidimensional erleben*

Winter term 2005/2006

26.10.05. Prof. Dr. Michael Joswig (TU Darmstadt), *Von Polytopen bis zu DNA-Sequenzen: Anwendungen des mathematischen Softwaresystems polymake*

02.11.05. Prof. Dr. Jan Verwer (Centrum voor Wiskunde en Informatica Amsterdam), *Numerical Life and Earth Sciences Research at CWI*

09.11.05. Prof. Dr. Heinz Schumann (Academy of Pedagogics Weingarten), *Dynamische Raumgeometrie - interaktiv*

16.11.05. Prof. Dr. Peter Hertling (University of Bundeswehr München), *Ist die Mandelbrotmenge berechenbar?*

23.11.05. Prof. Dr. Florian Jarre (University of Düsseldorf), *Strenge Polynomialität von linearen Programmen*

30.11.05. Prof. Dr. Herbert Abels (University of Bielefeld), *Affine kristallographische Gruppen*

07.12.05. Prof. Dr. Martin Skutella (University of Dortmund), *Universell maximale Flüsse und Netzevakuierung*

14.12.05. Prof. Dr. Gabriele Steidl (University of Mannheim), *TV Regularisierung, Support Vektor Regression und Splines*

04.01.06. Prof. Dr. Michael Baake (University of Bielefeld), *Mathematische Diffraktionstheorie und verallgemeinerte Kristalle – ein Überblick*

11.01.06. Prof. Dr. Martin Fuchs (University of Saarbrücken), *Eine Regularitätstheorie für anisotrope Variationsprobleme*

18.01.06. Prof. Dr. Nicole Bäuerle (University of Hannover), *Konstruktion von mehrdimensionalen Zählprozessen*

25.01.06. Prof. Dr. Koeno Gravemeijer (University of Utrecht), *Realistic Mathematics Education: An Overview*

01.02.06. Prof. Dr. Michael Scheutzow (TU Berlin), *Wie schnell breitet sich ein Ölteppich in einem zufälligen Medium aus?*

08.02.06. Prof. Dr. Wolfgang A. F. Ruppert (University of Agriculture Vienna), *50 Jahre kompakte Halbgruppen*

15.02.06. Prof. Dr. Angelika May (TU Darmstadt), *Mehrdimensionale stochastische Modellierung mit Copulas*

Summer term 2006

19.04.06. Prof. Dr. Katja Ickstadt (University of Dortmund), *Klassifikation und Variablenselektion für genetische Daten*

26.04.06. Prof. Dr. Sergio Conti (University of Duisburg-Essen), *Nichtkonvexe Variationsprobleme mit singulären Störungen und Musterbildung in Materialien*

03.05.06. Prof. Dr. Herwig Hauser (University of Innsbruck), *Die Geometrie algebraischer Flächen und ihrer Singularitäten*

10.05.06. Prof. Dr. Michael Neubrand (University of Oldenburg), *Impulse aus PISA für die mathematikdidaktische Forschung*

17.05.06. Graduation Ceremony for winter term 2005/2006 and summer term 2006: A.R. Dr.-Ing. Helge Svenshon (TU Darmstadt, Department of Architecture), *"Der Zahl – es gleichet ihr alles". Wieviel Mathematik steckt in antiker Architektur?*

24.05.06. Prof. Dr. Ulrich Dierkes (University of Duisburg-Essen), *Maximumprinzipien für Flächen beliebiger Kodimension*

31.05.06. Prof. Dr. Dr. h.c. Peter Deuflhard (Free University of Berlin and Zuse Institute Berlin (ZIB)), *Das Lächeln der Mathematiker. Mathematik in der Mund-Kiefer-Gesichts-Chirurgie*

07.06.06. Priv.-Doz. Dr. Peter Mathé (Weierstraß-Institute for Applied Analysis and Stochastics Berlin), *Glattheit jenseits von Differenzierbarkeit*

14.06.06. Prof. Dr. Günther Ziegler (TU Berlin), *Extremale Flächen und Polyeder*

21.06.06. Prof. Dr. Peter Paule (University of Linz), *Computeralgebra und die "Digital Library of Mathematical Functions (DLMF)"*

28.06.06. Prof. Dr. Jürgen Hausen (University of Tübingen), *Polyedrische Divisoren und algebraische Toruswirkungen*

05.07.06. Prof. Dr. Kaye Stacey (University of Melbourne), *Computer based teaching and learning mathematics in school*

12.07.06. Prof. Dr. Toshiyuki Kobayashi (RIMS Kyoto University and University of Tokyo), *Is the universe closed? – the existence problem of compact locally symmetric spaces*

19.07.06. Prof. Dr. Hans-Christoph Grunau (University of Magdeburg), *Differentialgleichungen vierter Ordnung aus Mechanik und Differentialgeometrie – Klassische Modelle und aktuelle Herausforderungen*

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 University), *Wie gewinnt man unendliche Spiele?*

08.11.06. Prof. Dr. Karsten Urban (University of 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 (Free University of Berlin and Potsdam-Institute for Climate Impact Research), *Mathematische Modellierung von Atmosphärenströmungen*

29.11.06. Prof. Dr. Martin Henk (University of Magdeburg), *Nullstellen von Ehrhartpolynomen*

06.12.06. Prof. Dr. Joachim Naumann (Humboldt-University of Berlin), *Gilt Energieerhaltung in wärmeleitenden, viskosen, inkompressiblen Flüssigkeiten?*

13.12.06. Prof. Dr. Michael Röckner (University of 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 (Academy of Pedagogics Freiburg), *Offener Unterricht? Computeralgebra? - Dafür bleibt keine Zeit...*

24.01.07. Prof. Dr. Peter Littelmann (University of Köln), *Über hermitesche Matrizen, Kombinatorik, Schubert–Kalkül und Darstellungstheorie*

31.01.07. Prof. Dr. Ursula Gather (University of Dortmund), *Bruchpunkt und Gruppen*

07.02.07. Prof. Dr. Karl Kunisch (TU Graz), *Kontrolle reduzierter Ordnung und approximative invariante Mannigfaltigkeiten*

6.2 Seminar Lectures

10.01.05. Michael Stingl (Friedrich-Alexander-University of Erlangen-Nürnberg), *Ein Augmented-Lagrange-Verfahren zur Lösung nichtlinearer semidefiniter Programme*

09.05.05. Prof. Dr. Petra Huhn (TU Clausthal), *Komplexität von Innere-Punkte-Verfahren: schlimmstenfalls, empirisch und durchschnittlich*

15.05.06. Dr. Ralf Werner (Allianz Group Risk Controlling), *Robuste Optimierung im Asset Management*

31.01.06. Prof. Dr. András Bátkai (Loránd Eötvös University, Budapest), *Differential equations with delay in L^p-phase spaces: A survey*

18.05.06. Tanja Eisner (University of Tübingen), *Almost weak stability of C_0-semigroups*

18.05.06. Vera Keicher (University of Tübingen), *Triviality of the peripheral point spectrum*

03.07.06. Prof. Dr. Luca Lorenzi (University of Parma), *On a class of degenerate elliptic operators in $\mathbb{R}^N$*

20.01.2005. Prof. Dr. J. Neustupa (Technical University Prague), *The Navier-Stokes equations with generalized impermeability boundary conditions*

02.02.2005. Prof. Dr. J. Elstrodt (University of Münster), *Von der Partialbruchzerlegung des Kotangens zur Weierstraßschen stetigen nirgends differenzierbaren Funktion*

19.04.2005. Prof. Dr. G. Seregin (Academy of Sciences, St. Petersburg), *Weak solutions to the Cauchy problem for the Navier-Stokes equations satisfying the local energy inequality*

19.04.2005. Prof. Dr. H. Sohr (University of Paderborn), *Reguläre und singuläre Lösungen der Navier-Stokes-Gleichungen*

24.05.2005. Prof. Dr. M. Krbec (Mathematical Institute, Academy of Sciences Prague), *On Fefferman's inequality and related topics*

31.05.2005. P. Milar (Charles University Prague), *On the Riesz decomposition theorem*

22.06.2005. Prof. Dr. G. Schneider (University of Karlsruhe), *Wege in die Turbulenz*

12.07.2005. Prof. Dr. S. Kračmar (Technical University Prague), *Anisotropic L2 estimates of weak solutions to the stationary Oseen equations around a rotating body*

21.07.2005. Prof. Dr. Y. Shibata (Waseda University Tokyo), *Maximal Lp - Lq Regularity of the Stokes Equations with First Order Boundary Conditions*

22.11.2005. Prof. Dr. M. Pokorný (Technical University Prague), *Stabilization to equilibria of compressible Navier-Stokes equations with infinite mass*

24.04.2006. Dr. C. Kaiser (University of Karlsruhe), *Wavelet-Transformation für Funktionen mit Werten in Banachräumen*

09.05.2006. Prof. Dr. T. Hishida (Faculty of Engineering, Technical University Niigata), *Stability of Navier-Stokes flow around rotating obstacles*

16.05.2006. Prof. Dr. Z. Skalák (Technical University Prague), *Asymptotic Dynamics of Strong Global Solutions to the Homogeneous Navier-Stokes Equations*

13.06.2006. Prof. Dr. S. Nazarov (St. Petersburg State University), *Reynolds equations for thin film lubrication*

20.06.2006. Prof. Dr. M. Yamazaki (Waseda University, Tokyo), *Antisymmetric stationary solutions of the incompressible Navier-Stokes equation in the whole plane*

10.07.2006. Dr. H. Abels (Max-Planck-Institute Leipzig), *On a monotone operator approach to Cahn-Hilliard equation with singular potentials*

17.07.2006. P. Milar (Charles University Prague), *Gross inequality and Sobolev embeddings independent of the dimension*

19.07.2006. Prof. Dr. H.-Chr. Grunau (University of Magdeburg), *Differentialgleichungen vierter Ordnung aus Mechanik und Differentialgeometrie - Klassische Modelle und aktuelle Herausforderungen*

31.10.2006. Prof. Dr. J. Neustupa (Technical University Prague), *Stability of a steady viscous incompressible flow around an obstacle*

09.11.2006. Prof. Dr. S. Nečasová (Mathematical Institute, Academy of Sciences Prague), *On the motion of several bodies in a viscous multipolar fluid*

14.11.2006. Prof. Dr. M. Krbec (Mathematical Institute, Academy of Sciences Prague), *Extrapolation - recent results and problems*

06.12.2006. Prof. Dr. J. Naumann (Humboldt-Universität Berlin), *Gilt Enegieerhaltung in wärmeleitenden viskosen inkompressiblen Flüssigkeiten?*

18.10.05. Prof. Dr. Zbigniew Lonc (Politechnika Warszawska, Poland), *Computing minimal models of CNF theories and answer sets of logic programs*

20.01.06. Dipl. Inf. Matthias Rupp (Frankfurt am Main, Germany), *Optimierungsprobleme in der Industrie*

23.05.06. Dr. Michael Bussieck (GAMS Software, Braunschweig, Germany), *Modellierung und Optimierung - Probleme, Konzepte und Beispiele aus der Praxis*

07.11.06. Dipl.-Ing. Sonja Cypra (University of Karlsruhe, Germany), *Stoff- und Energieflüsse in Gebäuden*

14.11.06. Prof. Dr. Matthias Müller-Hannemann (TU Darmstadt, Germany), *Durchsatzoptimierung bei der Bestückung von PC-Boards durch flexible Platzierungsmaschinen*

21.11.06. Dr. Andreas Huck (Deutsche Bahn AG, Frankfurt am Main, Germany), *Verfahren zur Umlauf- und Wartungsplanung bei Zügen*

28.11.06. MSc. Cara Cocking (University of Heidelberg, Germany), *Improving Facility Access*

02.05.06. Dipl. Ing. Raihan Kibria (TU Darmstadt, ETIT), *Optimizing the Initialization of Dynamic Decision Heuristics in DPLL SAT Solvers Using Genetic Programming*

30.05.06. Prof. Dr. Gerald A. Goldin (Rutgers), *Quantization of vortex motion by means of diffeomorphism group representations*

12.01.06. Prof. Dr. Sergey V. Ludkovsky (Moscow State University of Geodesy and Cartography), *The structure and representations of diffeomorphism groups of non-archimeadian manifolds*

19.04.06. Prof. Dr. Sergey Shpectorov (University of Birmingham), *The locus of curves with prescribed automorphism group*

04.02.2005. Prof. Francisco Martin (Granada University), *Complete proper minimal surfaces in convex bodies in* R^n

13.05.2005. Dr. Frank Müller (TU Cottbus), *Ein Eindeutigkeitssatz für Flächen vorgeschriebener mittlerer Krümmung mit teilweise freiem Rand*

13.05.2005. Dr. Yves Hoffmann (TU Cottbus), *Die Schaudersche Kontinuitätsmethode für ein gemischtes Randwertproblem*

18.11.2005. Dr. Elke Koch (University of Marburg), *Dreifach periodische Minimalflächen aus kristallographischer Sicht*

22.02.2006. Dr. Jens Dittrich (University of Ulm), *A priori-Abschätzungen für Lösungen des Weylschen Einbettungsproblems*

28.04.2006. Dr. Katrin Leschke (University of Augsburg), *Transformation von Willmoreflächen*

28.04.2006. Prof. Bernd Ammann (University of Nancy), *Spinorielle Weierstrass-Darstellung und Flächen konstanter mittlerer Krümmung*

23.6.2006. Prof. Friedrich Sauvigny (TU Cottbus), *Konstruktion der Greenschen Funktion für elliptische Differentialoperatoren*

23.6.2006. Dr. Andreas Krebs (TU Cottbus), *Zur Lösung elliptischer Variationsungleichungen mit der p-Version der Finiten Elemente*

19.05.06. Prof. Dr. J. Rehberg (Weierstrass Institute, Berlin), *Analysis von Halbleitergleichungen*

24.05.05. Prof. Dr. S. Nazarov (Russian Academy of Sciences, St. Petersburg), *The structure of low-dimensional models for boundary value problems in thin domains*

21.07.05. Prof. Dr. F. A. Mehmeti (University of Valenciennes), *Convergence speed of a Banach fixed point iteration for semilinear elliptic problems on conical domains*

28.07.05. Prof. Dr. A. Rhandi (University of Marrakesh), *Kernel estimates for Schrödinger Operators*

4.08.05. Dr. O. Sawada (Waseda University Tokyo), *Applications of uniform boundedness of 2-dimensional vorticity and its asymptotic behaviour*

1.09.05. Prof. Dr. L. Lorenzi (University of Parma), *Elliptic and Parabolic Operators with unbounded coefficients*

24.11.05. Prof. Dr. S. Necasova (Czech Academy of Sciences, Prague), *A weighted L^q approach to Stokes flow around a rotating body*

20.01.06. Dr. A. Batkai (University of Budapest), *A survey on delay equations*

27.04.06-23.05.06. Prof. Dr. A. Mahalov (Arizona State University), *Lecture Series I-VI: 3D Navier-Stokes Equations and Euler Equations with Uniformly Large Initial Vorticity*

9.05.06. Dr. J. Saal (University of Konstanz), *Finite Radon measures, sum-closed frequency sets and global solvability of the 3D Navier-Stokes equations*

13.06.06. Prof. Dr. S. Nazarov (Russian Academy of Sciences, St. Petersburg), *The modified nonlinear Reynolds equation for a thin Navier-Stokes flow*

06.07.06. Dr. B. Gebauer (University of Mainz), *Detecting interfaces in a parabolic-elliptic problem from sureface measurements*

10.07.06. Dr. I. Wood (University of Cardiff), *Non-selfadjoint Spectral Theory*

19.05.05. Prof. Joseph Auslander (University of Maryland, USA), *The Galois theory of minimal flows*

12.07.05. Prof. Sidney A. Morris (University of Ballarat, Australia), *The Topology of Compact Groups*

09.02.06. Prof. Dr. Wolfgang A. F. Ruppert (University for Agriculture, Vienna, Austria), *50 Jahre kompakte Halbgruppen*

26.10.06. Prof. Bill Casselman (University of British Columbia, Vancouver, Canada), *5000 years of mathematics: a photographic tour*

24.01.05. Prof. Dr. Jesus De Loera (UC Davis), *Counting Lattice Points in Convex Polytopes*

07.02.05. Dr. Frank Lutz (TU Berlin), *Flächen, Sphären und Bälle*

21.06.05. Prof. Dr. Bernd Sturmfels (UC Berkeley), *Algebraic Statistics and Computational Biology*

21.06.05. Dr. Frederik Stork (ILOG), *CPLEX und OPL Studio im Einsatz*

17.10.05. Prof. Dr. Jonathan Shewchuk (UC Berkeley), *Star Splaying: An Algorithm for Repairing Nearly-Delaunay Triangulations*

09.05.06. Dipl.-Math. Thilo Schröder (TU Berlin), *Polytopes and polyhedral surfaces via projection*

03.05.06. Prof. Dr. Herwig Hauser (University of Innsbruck), *Die Geometrie algebraischer Flächen und ihrer Singularitäten*

16.05.06. Josephine Yu (UC Berkeley), *Tropical Polytopes and Cellular Resolutions*

29.11.06. Prof. Dr. Martin Henk (University of Magdeburg), *Nullstellen von Ehrhart-Polynomen*

23.05.05. Dr.Gennaro Amendola (Darmstadt/Pisa), *Enumeration of small-complexity closed* 3*-manifolds*

30.01.06. Dr. Josef Berger (LMU München), *The constructive content of the uniform continuity theorem*

24.02.05. Peter Busch and Debbie Richards (Macquarie University Sydney), *Modelling Tacit Knowledge via Questionnaire Data (Busch) Using Concept Lattices for Requirements Reconciliation (Richards)*

25.02.05. George Jiroveanu (Ghent University), *Distributed Diagnosis for Petri Net models with unobservable interactions via common places*

03.03.05. Prof. Maciej Maczynski (Technical University of Warsaw), *Ring-like structures corresponding to generalized orthomodular lattices*

18.03.05. Prof. Chris Impens (Ghent University), *Radically Elementary Analysis*

29.04.05. Branimir Lambov (BRICS/Aarhus und TUD), *REALLIB: An efficient implementation of exact real number arithmetic*

10.05.05. Prof. Grigori Mints (Stanford University), *Unwinding the non-effective proof of a normal form theorem*

13.05.05. Dr. Frithjof Dau (TUD), *Mathematische Logik mit Diagrammen basierend auf Peirces Graphen*

17.06.05. Prof. Alessio Guglielmi (TU Dresden), *Deep Inference : Why and How*

05.07.05. Prof. Ch. Delzell (Louisiana State University), *An extension of the Birkhoff-Pierce conjecture to 'polynomials' with real exponents*

12.07.05. Eyvind Briseid (University of Oslo), *An Effective Version of a Fixed Point Theorem Concerning Contractive Type Mappings*

14.10.05. Prof. Luoshan Xu (Yangzhou University, China), *Representations of Domains*

1.11.05. Prof. Maciej Maczynski (Technical University of Warsaw), *A Mackey-like approach to ring-like structures used in quantum logic*

15.11.05. PD Dr. Boris Moroz (Max-Planck-Institute of Mathematics, Bonn), *Unvollständigkeit der Mengenlehre und diophantische Gleichungen*

25.11.05. Dr. Anvar Nurakunov (National Academy of Science, Kirgistan), *Relatively semidistributive quasivarieties of algebras*

16.12.05. Prof. Friedrich Wehrung (University of Caen), *The complete dimension theory of partially ordered systems with equivalence and orthogonality*

20.10.06. Prof. Dr. S. Badaev (Kazakish Academy of Science, Almaty), *Computable numberings in arithmetical and Ershov hierarchies*

27.10.06. Prof. Dr. J. D. Lawson (Louisiana State University), *Quasicontinuous Functions, Domains, and Extended Calculus*

3.11.06. Prof. Maciej Maczynski (Technical University of Warsaw), *On a cryptographic characterization of classical and non-classical algebras of S-probabilities*

10.11.06. Prof. Andrei Morozov (Novosibirsk State University), *On Sigma-definable countable structures over the fields of real and complex numbers*

04.01.2006. Prof. Dr. Michael Baake (University of Bielefeld), *Mathematische Diffraktionstheorie – ein Überblick*

15.11.2006. Prof. Dr. Ruedi Seiler (Technical University of Berlin), *e-Learning im universitären Mathematikunterricht: Didaktische Konzepte, Technologie, Erfahrungen und Ziele*

06.01.05. Dr. Joseph Maubach (TU Eindhoven), *Space-filling curves for two dimensional grids refined with bisection*

05.07.05. Hang Si (WIAS Berlin), *TetGen - a 3D quality Delaunay mesh generator*

04.05.06. Sergey Grosman (University of München), *Konvergenz der adaptiven FEM mit anisotropen Netzen*

19.12.05. Dr. Matthias Köppe (University of Magdeburg), *A fully polynomial-time approximation scheme for mixed-integer polynomial optimization in fixed dimension*

30.01.06. Dr. Ralf Borndörfer (ZIB), *Optimization Problems in Public Transport*

25.05.06. Dr. Michael Bussieck (GAMS Software), *Modellierung und Optimierung - Probleme, Konzepte und Beispiele aus der Praxis*

13.06.06. Prof. Dr. Carlos E. Ferreira (University of São Paulo), *Polyhedral study for the group Steiner tree problem*

04.07.06. Oliver Weide (University of Auckland), *Robust and Integrated Airline Scheduling*

11.07.06. Prof. Dr. Cristina G. Fernandes (University of São Paulo), *Approximation results on rational objectives*

12.07.06. Dr. Mihaly C. Markot (Hungarian Academy of Sciences), *Applications of Global and Combinatorial Optimization for Discrete Geometry, Space Engineering, and Steel Industry*

13.07.06. Prof. Dr. Robert E. Bixby (Rice University Houston and ILOG), *From Planning to Operations: The Ever-Shrinking Optimization Time Horizon*

18.07.06. Prof. Dr. Sandor Fekete (TU Braunschweig), *Algorithmische und kombinatorische Probleme des geometrischen Faltens*

23.01.05. Prof. Jean-Louis Clerc (University of Nancy), *The Maslov index for bounded symmetric domains*

20.02.05. Dr. Friedrich Wagemann (University of Nantes), *Gerbes, central extensions and principal bundles*

12.04.05. Dr. Bernhard Krötz (MPI Bonn), *Einführung in die komplexen Kronen*

03.05.05. Prof. Hendrik Grundling (University of Sydney), *Generalizing group algebras away from local compactness*

02.06.05. Prof. Norman Wildberger (University of NSW, Sydney), *Rational trigonometry*

21.06.05. Dr. Thomas Püttmann (University of Bochum), *Wiedersehen-Metriken und exotische Involutionen*

13.10.05. Prof. Bob Stanton (Ohio State University), *The image of the heat kernel transform for Riemannian symmetric spaces*

06.12.05. Dr. Elke Markert (University of Bonn), *Ein Modell für konnektive K-Theorie aus euklidischen Feldtheorien*

26.01.06. Dr. Friedrich Wagemann (University of Nantes), *Gerben (Gerbes) und verschränkte Moduln von Lie-Gruppoiden*

31.01.06. Dr. Martin Väth (FU Berlin), *Abbildungsgrad und globale Bifurkation für elliptische Differentialgleichungen mit mehrwertigen einseitigen Randbedingungen*

14.02.06. Dr. Lydia Aussenhofer (Universität Eichstätt), Z^R *ist nicht stark reflexiv*

30.05.06. Prof. Gerald A. Goldin (Rutgers University), *Quantization of vortex motion by means of diffeomorphism group representation*

06.06.06. Dr. Stephane Gaussent (Université de Nancy), *Galleries in representation theory*

13.06.06. Dr. Georg Hofmann (University of Dalhousie, Halifax), *Präsentation von erweitert affinen Weyl Gruppen und Geisterwurzeln*

28.11.06. Prof. Oleg N. Smirnov (College of Charleston / USA), *Z-gradings on simple algebras*

14.12.05. Prof. Dr. Kai Hormann (TU Clausthal), *Barycentric coordinates for arbitrary planar polygons*

14.06.06. Prof. Dr. Jörg Peters (University of Florida at Gainesville), *Polar jet subdivision*

16.06.05. Prof. Dr. Tilmann Gneiting (University Washington, Seattle), *Probabilistische Vorhersage, Kalibration und Schärfe*

16.06.05. Dr. Silke Rolles (University of Bielefeld), *Verstärkte Irrfahrten*

20.06.05. Dr. T. Simon (University of d'Evry-Fal d'Essone), *Über die Absolutstetigkeit von Differentialgleichungen mit Lévy-Rauschen*

23.06.05. Dr. Ralph Neininger (University of Frankfurt), *Stochastische Analyse von Algorithmen*

23.06.05. HD Dr. Wilhelm Stannat (University of Bielefeld), *Der optimale Filter für zeitstetige Signalprozesse*

24.06.05. Prof. Dr. Peter Eichelsbacher (University of Bochum), *Fluktuationen bei Zufallsmatrizen*

21.04.06. Dr. Ivan Nourdin (University of Paris VI), *Exact Rate of Convergence of Some Approximation Schemes Associated to Fractional SDEs*

09.03.06. Prof. Dr. Michael Lifshits (St. Petersburg State University, St. Petersburg), *Dimensionality Curse in Approximation of Random Fields*

04.10.06. Prof. Dr. Michael Kohler (University of Saarland), *Schätzung einer Regressionsfunktion durch das Maximum vom Minimum linearer Funktionen*

04.10.06. PD Dr. Alexander Lindner (TU Munich), *Modellierung und Schätzung eines zeitstetigen GARCH-Porzesses*

09.10.06. Prof. Dr. Markus Reiß (University of Heidelberg), *Statistik für exponentielle Lévy-Modelle in der Finanzmathematik*

09.10.06. Prof. Dr. Wolfgang Polonik (University California at Davis), *Testen in multivariaten Volatilitätmodellen*

10.10.06. JunProf. Dr. Evgueni Spodarev (University of Ulm), *Nichtparametrische räumliche Statistik in der morphologischen Bildanalyse*

26.04.05. Dr. Pedro dos Santos (IST Lisbon), *An approximation theory for operators generated by shifts*

17.05.05. Prof. Dr. Andrew Comech (Texas A & M University), *Global attractors of the singular non-linear Schrödinger equation*

20.12.05. Prof. Dr. Vladimir Rabinovich (IPN Mexico/City), *Essential spectra of perturbed pseudodifferential operators and limit operators. Applications to Schrödinger and Dirac operators*

27.11.06. Prof. Dr. Victor Didenko (University Brunei Darussalam), L_2*-solvability of refinement equations*

11. - 14.01.05. Professor Dr. Nikolai Nikolski (University of Bordeaux I), *Control Theory and Operators (Mini Course)*

17.01.05. A.o. Prof. Dr. Michael Hintermüller (Karl-Franzens-University of Graz), *Theoretische und algorithmische Aspekte zu nichtglatten Minimierungsproblemen in der Bildverarbeitung*

25.05.05. Prof. Dr. Fredi Tröltzsch (TU Berlin), *Optimale Steuerung von semilinearen partiellen Differentialgleichungen bei Zustandsbeschränkungen*

23.11.05. Prof. Dr. Florian Jarre (University of Düsseldorf), *Strenge Polynomialität von linearen Programmen*

14.02.06. Sebastian Sager (University of Heidelberg), *Numerical methods for optimal control with binary valued control functions*

30.05.06. Dr. Roland Griesse (RICAM Linz), *Numerical Methods in PDE-Constrained Optimization*

27.06.06. Dr. Boris Vexler (RICAM Linz), *Adaptive Space-Time Finite Element Methods for Parabolic Optimization Problems*

11.12.06. Prof. Dr. Ole Sigmund (Denmark Technical University), *Current Developments in Topology Optimization and Material Design*

24.02.05. Peter Busch (Macquarie University, Sydney), *Tacit knowledge*

24.02.05. Debbie Richards (Macquarie University, Sydney), *Applications of Formal Concept Analysis on reuqirement analysis*

24.11.05. Dimitry Vlasov (Sobolev Institute of Mathematics, Novosibirsk), *Expanded and definable derived concept lattices*

29.11.05. Andrei Morozov (Sobolev Institute of Mathematics, Novosibirsk), *On computable symmetries*

01.12.05. Dmitry Pal'chunov, Gulnara Yakhyaeva (Sobolev Institute of Mathematics, Novosibirsk and University of Novosibirsk), *Boolean-valued models for fuzzy logics*

03.12.05. Andrei Morozvo (Sobolev Institute of Mathematics, Novosibirsk), *On computable concepts in computble formal contexts*

06.12.05. Dmitry Pal'chunov (Sobolev Institute of Mathematics, Novosibirsk), *Model theoretical formalization of ontology*

08.12.05. Sergej Kuznetsov (VINITE Institute, Moscow), *Comlexity of computing concept lattices and Stem base of implications*

08.12.05. Andrey Maltsev (Sobolev Institute of Mathematics, Novosibirsk), *How "Weltanschauung" can be influenced by general mathematical education*

10.12.05. Sergey Kuznetsov (VINITE Institute, Moscow), *Analysis of data given by labeled graphs: An FCA-based approach in pharmacology*

11.12.05. Denis Ponomaryo (Institute of Information Systems, Novosibirsk), *On decomposability of elementary theories*

12.12.05. Dimitry Vlasov (Sobolev Institute of Mathematics, Novosibirsk), *Trends in combining models and concepts*

12.12.05. Denis Ponomaryo (Institute of Information Systems, Novosibirsk), *Lattice semantics for controlled information extraction in datalog databases*

13.12.05. Andrei Morozov (Sobolev Institute of Mathematics, Novosibirsk), *A new result about the computability of concepts*

20.12.05. Dmitry Pal'chunov (Sobolev Institue of Mathematics,Novosibirsk), *Concepts as classes of models*

06.02.06. Jon Ducrou, PhD-student (University of Wollongong, Australia), *Browsing and search MPEG-7 images by methods of Formal Concept Analysis*

07.02.06. Nicolay Shilov (Sobolev Institute of Mathematics, Novosibirsk), *Pearls of algorithm design*

08.02.06. Nicolay Shilov (Sobolev Institute of Mathematics, Novosibirsk), *Verification techniques in algorithmic designs*

09.02.06. Nicolay Shilov (Sobolev Institute of Mathematics, Novosibirsk), *Update and abstraction in model checking of knowledge*

10.02.06. Nicolay Shilov (Sobolev Institute of Mathematics, Novosibirsk), *Applications of temporal logic and computational tree logic*

28.02.06. Nicolay Shilov (Sobolev Institute of Mathematics, Novosibirsk), *A computer memory interpretation of conceptual semantic systems, labelled transition systems and conceptual semantic systems, Modal Logic for Formal Concept Analysis*

01.03.06. Nicolay Shilov (Sobolev Institute of Mathematics, Novosibirsk), *Propositional dynamic logic*

02.03.06. Nicolay Shilov (Sobolev Institute of Mathematics, Novosibirsk), *Towards a propositional logic for reasoning about formal contexts*

29.06.06. Dmitry Pal'chunov, Gulnara Yakhyaeva (Sobolev Institute of Mathematics, Novosibirsk and University of Novosibirsk), *On the range of fuzzy-valued formulas*

06.07.06. Dmitry Pal'chunov, Gulnara Yakhyaeva (Sobolev Institute of Mathematics, Novosibirsk and University of Novosibirsk), *On the proof of a theorem on fuzzy variables*

24.07.06. Sergej Goncharow (Sobolev Institute of Mathematics, Novosibirsk), *Computable models and semantic programming*

28.08.06. Dmitry Pal'chunov together with K. E. Wolff (Sobolev Institute of Mathematics, Novosibirsk), *Towards a temporal logic for conceptual semantic systems*

20.11.06. Andrei Morozov (Sobolev Institute of Mathematics, Novosibirsk), *Computability in conceptual structures*

27.11.06. Denis Ponomaryo (Institute of Information Systems, Novosibirsk), *Recent advances in the problem of theory decomposability*

30.11.06. Denis Ponomaryo (Institute of Information Systems, Novosibirsk), *On knowledge modularization*

6.3 Guests

Prof. Dr. Kaye Stacey, University of Melbourne, July 2006.

Prof. Dr. M. Lifshits, St. Petersburg University, July 2005, March 2006.

Dr. Frank Aurzada, University of Jena, September 2005.

Prof. Dr. András Bátkai, Loránd Eötvös University, Budapest, January 2006.

Tanja Eisner, University of Tübingen, May 2006.

Vera Keicher, University of Tübingen, May 2006.

Prof. Dr. Luca Lorenzi, University of Parma, July 2006.

Prof. Dr. S. Nečasová, Mathematical Institute, Academy of Sciences Prague, 20.-26.11.2005.

P. Milar, Charles University Prague, 03.-17.05.2006.

Prof. Dr. M. Pokorný, Technical University Prague, 13.-19.08.2006.

Prof. Dr. Zbigniew Lonc, Politechnika Warszawska, October 2005.

Prof. Dr. Cristina Fernandes, University of Sao Paulo, July 2006.

Prof. Dr. Sergey V. Ludkovsky, Moscow State University of Geodesy and Cartography, January and June–August 2006.

Prof. Dr. Gerald A. Goldin, Rutgers, May 30–31, 2006.

Prof. Dr. Hendrik Van Maldeghem, Universiteit Gent, January 2005.

Prof. Dr. Hendrik Van Maldeghem, Universiteit Gent, January 2006.

Prof. Dr. Bernhard Mühlherr, Université Libre de Bruxelles, January 2006.

Prof. Dr. Sergey Shpectorov, University of Birmingham, April 2006, second half.

Prof. Dr. Francisco Martin, University of Granada, Spain, February 2005.

Prof. Dr. Rob Kusner, U Massachusetts, Amherst, USA, October 2005.

Prof. Dr. John Sullivan, TU Berlin, October 2006.

Prof. Dr. Luca Lorenzi, University of Parma, Italy, May 2005.

Prof. Dr. Serguei Nazarov, Russian Academy of Sciences, St. Petersburg, April 2005.

Prof. Dr. Abdelaziz Rhandi, Humboldt Fellow , June-September 2005.

Prof. Dr. Alex Mahalov, Arizona State University, USA, Mai 2006.

Prof. Dr. Sidney A. Morris, University of Ballarat, Australia, July-August 2005.

Josephine Yu, UC Berkeley, May 2005.

Dr. Gennaro Amendola, University of Pisa, September 2004 to January 2006.

Prof. Maciej Maczynski, University of Warsaw, Febuary to March and October to November 2005.

Dr. Anuj Dawar, University of Cambridge, Febuary 2005.

Prof. Heneri Dzinotyiweyi, University of Harare, Zimbabwe, March to June 2005.

Prof. Chris Impens, Ghent University, Belgium, March 2005.

Sam Sanders, Ghent University, Belgium, March and June 2005.

Prof. Grigori Mints, Stanford University, z.Zt. Ludwig-Maximillian Universität München, May 2005.

PD. Dr. Boris Moroz, MPIM, Bonn, May and November 2005.

Dr. Anvar Nurakunov, Institute of Mathematics, National Acedemy of Science, Kyrgyzstan, November to December 2005.

Prof. Dmitry Vlasov, Novosibirsk State University, Siberia, November to December 2005.

Prof. Marina Semenova, Novosibirsk State University, Siberia, November to December 2005.

Prof. Andrei Morozov, Novosibirsk State University, Siberia, November to December 2005 and October to November 2006.

Prof. Andrey Malcev, Novosibirsk State University, Siberia, November to December 2005.

Prof. Dmitri Palchunov, Novosibirsk State University, Siberia, November to December 2005, Febuary 2006 and June to September 2006.

Prof. Denis Ponomaryov, Novosibirsk State University, Siberia, November to December 2005 and November to December 2006.

Prof. Gulnara Yakhyaeva, Novosibirsk State University, Siberia, November to December 2005.

Prof. Fred Wehrung, Université de Caen Basse-Normandie, December 2005.

Sam Sanders, Ghent University, Febuary 2006.

Prof. Chris Impens, Ghent University, Febuary 2006.

Prof. Nikolay Shilov, Novosibirsk State University, Siberia, Febuary to March 2005.

Prof. Dimitry Palchunov, Novosibirsk State University, Siberia, Febuary and June to September 2006.

Prof. Sergej Kuznetsov, All-Russia Institute for Scientific and Technical Information (VINITI), Moscow, Russia, Febuary 2006.

Prof. Heneri Dzinotyiweyi, University of Harare, Zimbabwe, May to June 2006.

Prof. Sergei Goncharov, Sobolev Institute of Mathematics, Novosibirsk, July to August 2006.

Prof. Yuri L. Ershov, Sobolev Institute of Mathematics, Novosibirsk, November to December 2006.

Prof. Jimmy Lawson, Lousiana State University, October 2006.

Prof. Andrei Morozov, Novosibirsk State University, Siberia, October to November 2006.

Dr. Anvar Nurakunov, Institute of Mathematics, National Acedemy of Science, Kyrgyzstan, December 2006 to November 2007.

Dr. Hans Maassen, University of Nijmegen, at least ten times for four or more days during 2005 and 2006.

Prof. Dr. Jan Verwer, University of Amsterdam and CWI, November 2005.

Bodo Erdmann, ZIB, April to May 2006.

Prof. Dr. Bülent Karasözent, Middle East Technical University Ankara, April 2005.

Prof. Dr. Bülent Karasözent, Middle East Technical University Ankara, May - July 2006.

Prof. Dr. Ernesto Birgin, University of São Paulo, May 2005.

Prof. Dr. Carlos Ferreira, University of São Paulo, May to July 2006.

Prof. Dr. Robert E. Bixby, Rice University and ILOG, July 2006.

Prof. Jean-Louis Clerc, University of Nancy, January 2005.

Dr. Friedrich Wagemann, University of Nantes, February 2005.

Dr. Bernhard Krötz, MPI Bonn, April 2005.

Prof. Hendrik Grundling, University of Sydney, April/May 2005.

Prof. Norman A. Wildberger, University of NSW, Sydney, June 2005.

PD Dr. Thomas Püttmann, University of Bochum, June 2005.

Prof. Bob Stanton, Ohio State University / USA, October 2005.

Dr. Elke Markert, University of Bonn, December 2005.

Dr. Friedrich Wagemann, University of Nantes, January 2006.

Dr. Martin Väth, FU Berlin, January 2006.

Dr. Lydia Aussenhofer, University of Eichstätt, February 2006.

Prof. Gerald A. Goldin, Rutgers University / USA, May 2006.

Dr. Stephane Gaussent, University of Nancy, June 2006.

Dr. Georg Hofmann, University of Dalhousie / Canada, June 2006.

Prof. Oleg Smirnov, College of Charleston (USA), November 2006.

Prof. Hendrik Grundling, University of Sydney, December 2006.

Prof. Dr. Jorg Peters, University of Florida at Gainesville, June 2006.

Prof. Dr. Mike Floater, University of Oslo, March 2006.

Prof. Dr. Michael Lifshits, St. Petersburg State University, July 2005 and March 2006.

Prof. Dr. Andrew Comech, Texas A & M University, April to May 2005.

Dr. Pedro dos Santos, IST Lisbon, April 2005 and June 2006.

Prof. Dr. Vladimir Rabinovich, IPN Mecico/City, December 2005 to January 2006.

Prof. Dr. Victor Didenko, University Brunei Darussalam, November 2006.

Prof. Dimitry Pal'chunov, Sobolev Institute of Mathematics, Novosibirsk, November-December 2005, June-September 2006.

Dr. Gulnara Yakhyaeva, University of Novosibirsk, November-December 2005, June-September 2006.

Denis Ponomaryov, PhD-Student, Institute of General Informatics, Novosibirsk, November-December 2005, November-December 2006.

Prof. Dr. Andrei Morozov, Sobolev Institute of Mathematics, Novosibirsk, November-December 2005, October-November 2006.

Dr. Dmitry Vlasov, Sobolev Institute of Mathematics, Novosibirsk, October-December 2005.

Prof. Dr. Sergej Gonscharov, Sobolev Institute of Mathematics, Novosibirsk, July-August 2006.

Prof. Dr. Nicolay Shilov, Sobolev Institute of Mathematics, Novosibirsk, February-March 2006.

Prof. Dr. Andrey Maltsev, University of Novosibirsk, November-December 2006.

Prof. Dr. Sergej Kuznetsov, VIVITI Institute, Moscow, December 2005, February 2006.

Dr. Pater Busch, Macquarie University, Sydney, February 2005.

Dr. Debbie Richards, Macquarie University, Sydney, February 2005.

Prof. Dr. Peter Eklund, University of Wollongong, January 2006.

Jon Ducrou, Doctoral Student, Unversity of Wollongong, February 2006.

6.4 Workshops and Conferences at the Department

- Workshop researchgroup computerbased learning mathematics (TI), 07.-08.07.2006 (organized by R. Bruder)
- 2 Teachertrainings: Mathematics and Biology (4days)(2006), R. Bruder, M. Kiehl, B. Kümmerer (organized by G. Glas)
- 2 Teachertrainings: Mathematics and chemistry (4days)(2005), R. Bruder, M. Kiehl, B. Kümmerer (organized by G. Glas)
- 6 Teachertrainings: problemsolving, basics (half day-training, R. Bruder, C. Collet, M. Ströbele, E. Komorek (organized by R. Bruder and colleagues)
- “Darmstadt Analysis Day”, June 21, 2005 (organized by R. Farwig and M. Hieber)
- “Darmstadt Analysis Day”, May 9, 2006 (organized by R. Farwig and M. Hieber)
- Reinhold Baer Kolloquium, January 22, 2005 (organized by L. Kramer)
- Buildings workshop, September 26 – 29, 2005 (organized by L. Kramer)
- Kac-Moody Groups and Geometry, November 17 – 18, 2006 (organized by L. Kramer, R. Gramlich, E. Heintze, B. Mühlherr, K.-H. Neeb)

- 31. Süddeutsches Kolloquium Differentialgeometrie, June 16, 2006 (organized by K. Große-Brauckmann, S. Fröhlich)
- Miniworkshop Lattice Representation Theory, December, 11 -16, 2005 (organized by C. Herrmann)
- “Darmstadt Analysis Day”, June 21, 2005 (organized by R. Farwig and M. Hieber)
- “Darmstadt Analysis Day”, May 9, 2006 (organized by R. Farwig and M. Hieber)
- Discrete Mathematics on a Saturday in Darmstadt, November 26, 2005 (organized by M. Joswig und T. Theobald (TU Berlin))
- “Lehrerfortbildung fachübergreifender Unterricht: Mathematik und Biologie 2, Darmstadt 2006”, August 21 to 24, 2005 (organized by M. Kiehl mit R. Bruder und B. Kümmerer)
- “Meeting: Logik und Wissen”, June 24 to 26, 2005 (organized by U. Kohlenbach (with A. Nordmann and R. Wille))
- DFG-Workshop “Dilatationen”, January 14 to 16, 2005 (organized by B. Kümmerer)
- DFG-Workshop “Dynamiken von Quantensystemen”, June 9 to 10, 2006 (organized by B. Kümmerer)
- “Praktikum Wissenschaftswelt”, Edith-Stein Highschool in Darmstadt, September 26 to September 30, 2005 (organized by J. Lehn, A. Keller, A. Neuenkirch, B. Walther)
- “Praktikum Wissenschaftswelt”, Edith-Stein Highschool Darmstadt, September 19 to September 22, 2006 (organized by J. Lehn, A. Keller)
- BMBF Annual Meeting on “Decentralized Regenerative Energy Supply: Innovative Modeling and Optimization”, October 4 to 5, 2006 (organized by A. Martin)
- BMBF-Jahrestreffen “Regenerative Erneuerbare Energieversorgung: Inovative Modellierung und Optimierung”, October 4 to 5, 2006 (organized by A. Martin)
- Seminar Sophus Lie/Transformation Groups (Darmstadt), January 6-7, 2006 (organized by Karl-H. Neeb)
- Kac-Moody Lie algebras and groups, November 17-18, 2006 (organized by R. Gramlich, E. Heintze, L. Kramer, B. Mühlherr, K.-H. Neeb)
- AlMoTh, Workshop on Algorithmic Model Theory, February 21 – 22, 2005 (organized by M. Otto)
- Rhein-Main-Arbeitskreis “Mathematics of Computation”, February 10, 2006 (organized by K. Ritter)

- International Workshop on Discrete-Continuous Optimization and Optimal Control, December 15–16, 2006 (organized by S. Ulbrich)
- 10. Meeting on "Allgmeine Mathematik": Sinn und Bedeutung von Mathematik, TU Darmstadt, May 5 and 6, 2006 (organized by R. Wille and K. Lengnink)
- COMO-Seminars during 2005 and 2006, (organized by K.E. Wolff and R. Wille)
- BMBF Annual Meeting on "Decentralized Regenerative Energy Supply: Innovative Modeling and Optimization", October 4 to 5, 2006 (organized by A. Martin)

6.5 Scientific and Industrial Cooperations

Hans-Dieter Alber

DFG: Modelle für Evolution von Phasengrenzen bei diffusionslosen Übergängen und Phasengrenzdiffusion: Existenz von Lösungen und numerische Simulation, GZ: AL 333/3.

DAAD: Graduiertenkolleg "Modelling, Simulation and Optimization in Engineering Applications", Speaker: Prof. M. Schäfer, TU Darmstadt.

DAAD, Leonhard-Euler-Stipendienprogramm: Homogenization of Microstructures.

Jürgen Bokowski

Prof. Dr. Branko Grünbaum, (University Seattle, USA): Topological Configurations, Geometrical Configurations.

Prof. Dr. David Bremner, (University Brunswick, Canada): Generation of matroid polytopes.

Prof. Dr. Tomasz Pisanski, (University of Ljublana, Slovenia): Configurations and Arrangements.

Prof. Dr. Gabor Gévay, (University of Szeged, Hungary): Symmetric polytopes.

Prof. Dr. Ernesto Staffetti, (University Rey Juan Carlos, Madrid, Spain): Shape representation and recognition.

Christian Brandenburg

SPP 1253: Project "Advanced numerical methods for PDE-constrained optimization with application to optimal design and control of a racing yacht in the America's Cup". Prof. Dr. Vincent Heuveline (TH Karlsruhe), Prof. Dr. Michael Ulbrich (TU Munich), Prof. Dr. Stefan Ulbrich (TU Darmstadt). Supported by DFG.

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.

elc-TU Darmstadt: Speaker of the working group ”e-learning-quality” with the members: Dr. Offenbartl, Dr. Deneke, Julia Sonnberger.

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 tests.

University of Melbounr, Prof. Kaye Stacey: Development of instruments for evaluation of learning-results in math-lessons.

Ministry of Education in Vienna (Austria), Mr. Stockhammer: Reviews of the standards of mathematic-education in Austria and development of concepts for teacher training.

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, Dr. Michael Katzenbach: Steuerungsgruppe zur Implementation der Bildungsstandards in Mathematik für das Land Hessen.

Jakob Creutzig

Prof. Dr. Mikhail Lifshits (St. Petersburg University): Nonlinear approximation for linear fractional stable processes.

Dr. Steffen Dereich (TU Berlin): Quantization of stable Lévy processes.

PD Dr. Thomas Müller–Gronbach (TU Magdeburg): Free Knot approximation of diffusion processes, jointly with Prof. Dr. Ritter (TU Darmstadt).

Dr. Andreas Neuenkirch (Uni Frankfurt): Simulation of stochastic evolution equations driven by fractional Brownian motion.

Merck AG: Stability analysis and Quality control with censored and distorted data, joint work with Steffen Barembruch.

Kristian Debrabant

Prof. Dr. Anne Kværnø (Norwegian University of Science and Technology, Trondheim): Weak convergence of stochastic Runge-Kutta methods that use an iterative scheme to compute their internal stage values.

Prof. Dr. Robert D. Russel, Dr. Jingtang Ma (Simon-Fraser University Vancouver): Global error control for moving mesh methods.

Prof. Dr. Karl Strehmel (Martin-Luther-University Halle-Wittenberg): Runge-Kutta approximation of linear partial differential-algebraic equations.

Sarah Drewes

Schenk RoTec AG (Darmstadt): Optimierung des Unwuchtausgleichs bei wellenelastischen Rotoren.

Mirjam Dür

Dr. Chris Tofallis (University of Hertfordshire Business School): Neutral Data Fitting.

Abdelhadi Es-Sarhir

Dr. Onno van Gaans (University of Leiden): Stationary Dynamics of Stochastic Evolution Equations..

Bálint Farkas

Prof. Dr. Szilárd Révész (Institute Henri Poincaré, Alfréd Rényi Institute of Mathematics : Periodic decompositions; Positive bases and Lorentz degree of polynomials.

Prof. Dr. Luca Lorenzi (University of Parma): Gradient estimates for certain degenerate elliptic and parabolic PDEs.

Tatjana Eisner (University of Tübingen): Weak stability and weak almost periodicity of operator semigroups .

Prof. Dr. Rainer Nagel (University of Tübingen): Weak stability and weak almost periodicity of operator semigroups .

András Serény (Central European University): Weak stability and weak almost periodicity of operator semigroups .

Béla Nagy (University of Szeged): Transfinite diameter, Chebyshev constants and related notions.

Reinhard Farwig

'Personenbezogener Personenaustausch' (PPP) with Czech Republic: Fluid Flow Around Rotating and Moving Obstacles.

'Promotionsprojekt' with the Robert Bosch GmbH: Stabilitätsanalyse zeitvariabler Delaysysteme.

Prof. Dr. H. Sohr (University of Paderborn): Regularity of Navier-Stokes Equations.

Prof. Dr. H. Kozono (Tohoku University, Sendai): Regularity of Navier-Stokes Equations.

Prof. Dr. G.P. Galdi (University of Pittsburgh): Theory of Very Weak Solutions of the Navier-Stokes Equations.

Prof. Dr. T. Hishida (Faculty of Engineering, Niigata University, Niigata): Viscous Fluid Flow Around Rotating Obstacles.

Prof. Dr. Y. Shibata (Waseda University, Tokyo): Maximal Regularity of Stokes Operators.

Prof. Dr. P. Penel (Université du Sud, Toulon-Var): Vorticity and Rotation in the Navier-Stokes Equations.

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.

Prof. Dr. S. Nečasová (Mathematical Institute, Academy of Sciences Prague): Weighted Estimates for Fluid Flow Around Rotating Obstacles.

Prof. Dr. P. Deuring (University of Littoral, Calais): Decay Properties of Solutions of Oseen Equations.

Prof. Dr. D. Müller (University of Kiel): Weighted Estimates for Singular Integral Operators Arising from Fluid Flow.

Dr. Myong Hwan Ri (Institute of Mathematics, Academy of Sciences Pyongyang): Stokes and Navier-Stokes Equations in Cylindrical Domains.

Gottlieb Daimler- und Karl Benz-Stiftung, May 2004-June 2006: Stability of Fluid Flow in Infinite Cylindrical Domains.

Armin Fügenschuh

Prof. Dr. Cristina Fernandes, Prof. Dr. Carlos Ferreira, Prof. Dr. Yoshiko Wakabayashi (University of Sao Paulo, Brasil): Exact and Approximation Algorithms for Graph Equipartitioning with Connectivity Constraints.

Prof. Dr. Robert Weismantel, Dr. Matthias Köppe (University of Magdeburg, Germany): Primal-dual Methods in Integer Programming.

Prof. Dr. Christoph Helmberg (TU Chemnitz, Germany): Optimization in Railway Freight and Passenger Transport.

Dr. Peter Stöveken, Dipl. Ing. Matthias Prick (ZIV, Darmstadt, Germany): Integrated Optimization of School Starting Times and Public Transport.

CRC 666: "Integral sheet metal design with higher order bifurcations - development, production, evaluation". Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt, Germany).

Dr. Dieter Thelen, Dipl. Phys. Albert Bornheimer (Schenck RoTec, Darmstadt, Germany): Auswuchten von wellenelastischen Rotoren. Joint work with Prof. Stefan Ulbrich.

Prof. Dr. Manfred Boltze (TU Darmstadt, Germany): OptiV - Erschließung von Entscheidungs- und Optimierungsmethoden für die Anwendung im Verkehr.

Prof. Dr. Manfred Boltze, Prof. Dr. Winner, Prof. Dr. Pfohl (TU Darmstadt, Germany): Staufreies Hessen 2030 – Eine Zukunftsvision.

Dr. Andre Stork (Fraunhofer IGD, Darmstadt), Dipl. Ing. Swen Schlobach (Lufthansa Systems, Frankfurt am Main, Germany): Kürzeste Wege Optimierung im Luftverkehr.

Prof. Dr. Zbigniew Lonc, Dr. Konstanty Szaniawski (Politechnika Warszawska, Poland): Exact Enumerative Methods for Combinatorial Optimization Problems.

Prof. Dr. Axel Klar, Dr. Michael Herty, Dipl. Math. Simone Göttlich: Solving Partial Differential Equations with Mixed-Integer Programming Techniques.

Marzena Fügenschuh

Prof. Dr. Christoph Helmberg (Chemnitz University of Technology, Germany): Polyhedral and Semidefinite Relaxation for Graph Partitioning Problems.

Prof. Dr. C. Ferreira, Prof. Dr. Y. Wakabayashi (University of São Paulo, Brasil): Exact and Approximation Algorithms for Graph Equipartitioning with Connectivity Constraints.

Prof. Dr. Zbigniew Lonc, Dr. Konstanty Szaniawski (Warsaw University of Technology, Poland): Exact Enumerative Methods for Combinatorial Optimization Problems.

Matthias Geißert

Prof. Dr. Y. Giga (University of Tokyo): Equations of Navier-Stokes. Supported by DMV/DFG.

Prof. Dr. A. Lunardi (University of Parma): The Navier-Stokes equations in the exterior of a rotating domain, Supported by RTN/European Union.

Prof. Dr. A. Lunardi (University of Parma): The evolution semigroup of Kolmogorov operators with time depending coefficients. Supported by the University of Parma.

Prof. Dr. G. Metafune (University of Lecce): The domain of the generator of the evolution semigroup of Kolmogorov operators with time depending coefficients.

Prof. Dr. S. Nazarov (Russian Academy of Sciences, St. Petersburg): Asymptotic analysis for parabolic problems.

Helge Glöckner

Prof. Dr. Sergey V. Ludkovsky (Moscow State University of Geodesy and Cartography): The p-adic analogue of Boman's Theorem (2006). Supported by DFG.

Prof. Dr. Sergey V. Ludkovsky (Moscow State University of Geodesy and Cartography): Diffeomorphism groups of non-archimedean manifolds (2006–2007). Supported by DAAD.

Prof. Dr. George A. Willis (University of Newcastle, Australia): Totally disconnected groups and p-adic Lie theory (2004–2006). Supported by DFG.

Prof. Dr. George A. Willis (University of Newcastle, Australia): Totally disconnected groups and their automorphisms. Grant support pending.

Dr. Rezso Lovas (University of Debrecen): Infinite-dimensional Poisson vector spaces and coadjoint orbits. Supported by DAAD..

Prof. Dr. L. Lucht (TU Clausthal) and Prof. Dr. Š.Porubský (Academy of Science, Prague): General Dirichlet series and arithmetic convolution equations.

Ralf Gramlich

Prof. Dr. Antonio Pasini, Prof. Dr. Hendrik Van Maldeghem: Covering theory of intransitive geometries.

Dr. Alice Devillers, Prof. Dr. Bernhard Mühlherr: Combinatorial-topological properties of flipflop geometries.

Prof. Dr. Bernhard Mühlherr: Flips and twin root data.

Dr. Corneliu Hoffman, Prof. Dr. Bernhard Mühlherr, Prof. Dr. Sergey Shpectorov: Phan theory of finite groups of Lie type.

Prof. Dr. Bernhard Mühlherr, Prof. Dr. Linus Kramer: Involutions of algebraic groups.

DFG-Sachmittelbeihilfe GR 2077/4-2: Centralizers of fundamental SL_2s.

Karsten Große-Brauckmann

Prof. Dr. Rob Kusner (U Mass, Amherst, USA): Complete constant mean curvature surfaces.

Prof. Dr. John Sullivan (TU Berlin): Complete constant mean curvature surfaces.

Ute Günther

Prof. Dr. Carlos Ferreira, Prof. Dr. Cristina Fernandes, Prof. Dr. Yoshiko Wakabayashi (University of São Paulo): Bounded diameter minimum spanning tree problem. Supported by DAAD.

Wincor-Nixdorf (Paderborn): Stochastic modelling and optimal charging of automatic teller machines, jointly with Prof. Dr. Klaus Ritter.

CRC 666: "Integral sheet metal design with higher order bifurcations - development, production, evaluation". Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).

Robert Haller-Dintelmann

Prof. Dr. Felix Ali Mehmeti and Virginie Régnier (University of Valenciennes): Spectral theory for the Laplacian on a star-shaped network and applications to time decay for the heat and Klein-Gordon equations.

Horst Heck

Prof. Dr. Hyunseok Kim (Sogang University): Stability of the plane Couette flow. Supported by JSPS.

Prof. Dr. Hideo Kozono (Tohoku University): Stability of the plane Couette flow. Supported by JSPS.

Dr. Xiaosheng Li (University of Washington): Parameter identification for the Stokes equations.

Prof. Dr. Sarka Necasova (Acad. of Science Prague): Navier-Stokes flow around rotating obstacles. Supported by DAAD.

Prof. Dr. Jenn-Nan Wang (National Taiwan University): Inverse problems for the conductivity equation and the Stokes equations. Partially supported by DFG.

Prof. Dr. Gunther Uhlmann (University of Washington): Inverse problems for the conductivity equation and the Stokes equations. Supported by DFG.

Christian Herrmann

Dr. Anvar Nurakunov (Kyrghyz Academy of Science, Bishkek): Modular lattices. Supported by INTAS and Humboldt-Stiftung.

Prof. Dr. Michael Roddy (Brandon University): Modular ortholattices and Orthogonal Geometry. Supported by NSERC.

Dr. Marina Semenova (Russsian Academy of Science, Novosibirsk): Complemented modular lattices, Supported by INTAS and DFG.

Prof. Dr. Fred Wehrung (University of Caen): Regular rings and complemented modular lattices.

Matthias Hieber

Prof. Dr. Y. Shibata (Waseda University, Tokyo, Japan): Mathematical Fluid Dynamics.

Prof. Dr. A. Mahalov (Arizona State University): Mathematical Geophysics. Supported by DAAD.

Prof. Dr. Jan Pruess (University of Halle): Nonlinear Parabolic Problems.

Dr. E. Skizora (University of Budapest): Control Theory. Supported by DAAD.

Prof. Dr. S. Necasova (Czech Academy of Sciences): Mathematical Models in Fluid Dynamics, jointly with Prof. Dr. R. Farwig. Supported by DAAD.

Prof. Dr. Y. Giga (University of Tokyo): Equations of Navier-Stokes. Supported by DMV.

Prof. Dr. G. Metafune (University of Lecce): Ornstein-Uhlenbeck processes.

network: International School of Evolution Equations, jointly with universities Karlsruhe, Ulm, Tübingen, Delft, Parma, Lecce. Supported by DAAD.

Karl Heinrich Hofmann

Professor Sidney A. Morris: The structure of almost connected pro-Lie groups. Supported by the Australian Research Council and the University of Ballarat.

Department of Mathematics, Tulane University, New Orleans, Lousisiana, USA: Regular visits for research, teaching, and organizing student exchange between TUD and Tulane as Adjunct Professor of Mathematics, Tulane University.

Max Horn

Prof. Dr. Bernhard Mühlherr (University of Libre, Brusselles, Belgium): Flips and twin root data.

Michael Joswig

Ewgenij Gawrilow (TU Berlin): polymake.

Konrad Polthier (FU Berlin): Electronic Geometry Models.

Günter M. Ziegler (TU Berlin): Branched Coverings and Combinatorial Holonomy.

FOR 565: DFG-Forschergruppe "Polyhedral Surfaces". Speaker Prof. Dr. Alexander Bobenko (TU Berlin).

Marc E. Pfetsch (ZIB Berlin): Optimality in Discrete Morse Theory.

Bernd Sturmfels (UC Berkeley): Tropical Convexity and Affine Buildings.

Daniel Junglas

GK 853: "Modelling, Simulation and Optimisation of Engineering Applications". Speaker Prof. Dr. rer. nat. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt).

Klaus Keimel

Dr. Samy Abbes (LIAFA, University of Paris 7): Projective topologies on bifinite domains.

Prof. Dr. Gordon D. Plotkin, FRS (LFCS, University of Edinburgh): Predicate Transformers, Supported by EU-Network Applied Semantics II.

Dr. Martin Escardo (University of Birmingham, UK): Probabilistic and nondeterministic features in programming.

Prof. Dr. Yuri L. Ershov, Prof. Dr. Andrei Morozov Russian Academy of Sciences, Novosibirsk: Computability over non-discrete structures: Models, Semantics and Complexity.Supported by DFG-RFFI.

Prof. Dr. Jimmie D. Lawson Louisiana State University: Extension of valuations.

Martin Kiehl

BLK-Projekt: Netzwerk Wissenschaftliche Weiterbildung für Lehramtsberufe (NWWL) (Schwerpunkt 3 im Modellversuchsprogramm Wissenschaftliche Weiterbildung) Teilprojekt Ma+ für fächerverbindenden Unterricht, jointly with Prof. Dr. Regina Bruder and Prof. Dr. Burkhard Kümmerer.

Ulrich Kohlenbach

Prof. Dr. Mariko Yasugi (Kyoto Sangyo University): Computable Analysis. Supported by JSPS Sience Grant 2004-2006 of Prof. Yasugi.

Prof. Dr. Susumu Hayashi (Kyoto University): Limit computable mathematics.

Dr. Philipp Gerhardy (Carnegie Mellon University, Pittsburgh: General logical metatheorems for functional analysis.

IST Programme of the EU: APPSEM II Applied Semantics 2003-2006, Coordinator Prof. Dr. M. Hofmann (Munich).

Deutsch-Russisches Kooperations Projekt (DFG): Berechnungen über nichtdiskreten Strukturen: Modelle, Semantik, Komplexität. Cooordinator: Prof. D. Spreen, Siegen, since 2006.

Katrin Krohne

Prof. Dr. Šárka Nečasová (Mathematical Institute of the Czech Academy of Sciences, Prague): Strong and Very Weak Solutions to the Navier Stokes Equations with Rotation.

Prof. Dr. Miroslav Krbec (Mathematical Institute of the Czech Academy of Sciences, Prague), Dr. Helmut Abels (Max Planck Institute for Mathematics in the Sciences, Leipzig): An Intrinsic Norm in Trace Spaces of Sobolev Spaces with Particular Weight Functions.

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 (Technical University of Darmstadt, Institute of Applied Physices): Deterministic and stochastic decoupling.

Prof. Dr. Ruedi Seiler (Technical University of Berlin): Entropy, Geometry, and Coding in Large Quantum Information Systems, supported by the DFG.

Prof. Dr. Andreas Knauf (University of Erlangen): Entropy, Geometry, and Coding in Large Quantum Information Systems, supported by the DFG.

Dr. Nihat Ay (Max Planck Institute of Mathematics in the Sciences, Leipzig): Entropy, Geometry, and Coding in Large Quantum Information Systems, supported by the 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): Developing mesh moving methods.

Prof. Dr. Peter Deuflhard (Free University Berlin and ZIB): Mathematical models and adaptive methods for electrocardiology.

Prof. Dr. Rüdiger Weiner (Martin-Luther-University Halle-Wittenberg): Developing linearly implicit methods.

Bodo Erdmann (ZIB): Kardos programming.

Prof. Dr. Markus Clemens (Hochschule der Bundeswehr, Hamburg): Space-Time Adaptive Magnetic Field Computation. Supported by DFG, 2004-2006.

Prof. Dr. Günter Leugering (University of Erlangen), Prof. Dr. A. Martin (TU Darmstadt): Modelling, Analysis, Simulation and Optimal Control of Gas Transport in Networked Pipelines. Supported by DFG, 2006-2007.

SFB 568: "Flow and Combustion in Future Gas Turbines". Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by DFG, 2003-2006.

GK 853: "Modelling, Simulation and Optimization in Engineering Applications", Speaker Prof. Dr.-Ing. Michael Schäfer (Department of Mechanical Engineering, TU Darmstadt). Supported by DFG, 2004-2006.

GK 1344: "Instationary System Modelling of Aircraft Turbines", Speaker Prof. Dr.-Ing. Johannes Janicka (Department of Mechanical Engineering, TU Darmstadt). Supported by DFG, 2006-2009.

SPP 1253: Optimization with PDEs. Supported by DFG, 2006-2008, jointly with Prof. Dr. Stefan Ulbrich (TU Darmstadt).

Jürgen Lehn

Prof. Michael Schäfer, TU Darmstadt, Research Training Group 853 "Modellierung, Simulation und Optimierung von Ingenieuranwendungen": Project "Approxiamtion von Lösungen stochastischer differential-algebraischer Gleichungssysteme".

Dr. Wolfgang Völkner, RCC Cytotest Cell Research: Project "Erstellung eines statistischen Auswerteverfahrens zur Beurteilung der Testergebnisse aus dem Maus-Lymphoma-Test".

Grace GmbH & Co KG, Lorch: Statistical Analysis of Medical Data.

Textil-Service Klingelmeyer, Darmstadt: Untersuchung von Materialeigenschaften neuartiger Stoffe.

Katja Lengnink

PD Dr.Benedikt Löwe (University of Amsterdam); Dr. Thomas Müller (University of Bonn): Philosophy of Mathematics: Sociological Aspects and Mathematical Practice. Supported by DFG.

Laurențiu Leuștean

German-Russian Cooperationsproject: Berechnungen über nichtdiskreten Strukturen: Modelle, Semantik, Komplexität (DFG, since 2006). Speaker: Prof. Dr. Dieter Spreen (University of Siegen)..

Peter Lietz

DEV Systemtechnik GmbH (Rosbach): Development of mathematical algorithms for the verification and control of 3-stage switching networks.

Debora Mahlke

BMBF network: "Decentralized regenerative energy supply: Innovative Modeling and Optimization", jointly with University of Duisburg-Essen, University of Dortmund, University of Bochum, Humboldt-University of Berlin, Fraunhofer Institute UMSICHT. Speaker: Prof. Dr. Rüdiger Schultz (University of Duisburg-Essen).

Alexander Martin

Prof. Dr. Carlos Ferreira (University of São Paulo): Packing problems with additional side constraints. Supported by DAAD.

Prof. Dr. Robert E. Bixby (Rice University Houston): Developing software for the solution of general mixed integer programs.

Prof. Dr. Robert Weismantel (University of Magdeburg): Primal-dual methods in integer programming.

Dr. Thorsten Koch (ZIB): Mixed integer programming.

Prof. Dr. Eric Fledderus (Eindhoven University of Technology): Mathematical Models and methods for the 4th generation of mobile communication.

Prof. Dr. Christoph Helmberg (Chemnitz University of Technology): Semidefinite and polyhedral relaxations for graph partitioning problems. Supported by DFG.

Linde AG, Devision Linde Gas (Stockholm): Facility location problems.

ZIV (Darmstadt): Integrated optimization of school starting times and public transport..

Ingenieurbüro Steinigeweg (Darmstadt): Modelling the energy consumption in public buildings.

DEV Systemtechnik GmBH (Rosbach): Development of mathematical algorithms for the verification and control of 3-stage switching networks.

Wincor-Nixdorf (Paderborn): Stochastic modelling and optimal charging of automatic teller machines..

Siemens AG (München): Mixed integer models for supply network planning problems.

BMBF network: "Decentralized regenerative energy supply". Jointly with Uni Duisburg-Essen, Uni Dortmund, Uni Bochum, HU Berlin. Speaker: Prof. Dr. Rüdiger Schultz (Uni Duisburg-Essen).

CRC 666: "Integral sheet metal design with higher order bifurcations - development, production, evaluation". Speaker Prof. Dr.-Ing. Peter Groche (Department of Mechanical Engineering, TU Darmstadt).

Karl-Hermann Neeb

Prof. Dr. Yuly Billig (Carleton University, Ottawa): Structure and classification of toroidal Lie groups.

Prof. Dr. Hendrik Grundling (University of Sydney): Geometric aspects of non-commutative geometry.

Prof. Dr. Friedrich Wagemann (Université de Nantes): Current groups and Lie algebras.

Prof. Dr. Cornelia Vizmann (University of Timisoara; Rumania): The geometry of group extensions and flux cocycles.

Prof. Dr. Bent Ørsted (Aarhus University; Denmark): The Maslov index in infinite-dimensional settings.

Prof. Dr. Jean-Louis Clerc (University of Nancy I): The geometry of Shilov boundaries of bounded symmetric domains.

Prof. Dr. Wolfgang Bertram (University of Nancy I): Projective completions of Jordan pairs.

Priv. Doz. Dr. Helge Glöckner (Darmstadt): Infinite-Dimensional Lie Groups (Book project).

Werner Nickel

Dr. Ralf Gramlich (TU Darmstadt): Behandlung kleiner Parameter in Sätzen zur Phan-Theorie.

Prof. Dr. Bettina Eick (University of Braunschweig): Algorithmen für polyzyklische Gruppen.

e-learning center (TU Darmstadt): Aufgabendatenbank Mathematik.

Prof. Biehler, Prof. Köpf (University of Kassel), Prof. Bruder (TU Darmstadt): Virtuelles Eingangstutorium Mathematik.

Martin Otto

Dr. Anuj Dawar (Cambridge University): Finite model theory of modal logics; supported by joint DAAD and Royal Society grant.

Prof. Dr. Nicole Schweikardt and Prof. Dr. Stephan Kreutzer (Humbold University of Berlin): Boundedness over acyclic structures.

Ulrich Reif

Prof. Dr. K. Höllig (University of Stuttgart): web-Splines.

Prof. Dr. J. Peters (University of Florida at Gainesville): Analysis of subdivision surfaces.

Dr. Bernhard Mößner (University of Freiburg): Stabilität von B-Splines.

InuTech (Nürnberg): Formoptimierung von Freiformflächen.

Klaus Ritter

Dr. Steffen Dereich (TU Berlin): Functional Quantization.

PD. Dr. Thomas Müller-Gronbach (University of Magdeburg)): (1) Optimal approximation of stochastic evolution equations, DFG RI599/3. (2) Functional Quantization. (3) Monte Carlo Methods.

Prof. Dr. Erich Novak (University of Jena): Monte Carlo Methods.

Wincor-Nixdorf (Paderborn): Stochastic modelling and optimal charging of automatic teller machines, jointly with Prof. Dr. Alexander Martin.

Steffen Roch

Prof. Dr. Bernd Silbermann (Technical University Chemnitz): C^*-algebras and numerical analysis.

Prof. Dr. Vladimir Rabinovich (IPN Mexico/City): Band-dominated operators and the limit operators method. Supported by DFG.

Prof. Dr. Victor Didenko (University Brunei Darussalam): Spline approximation methods and pre-image reconstruction.

Dr. Pedro dos Sandos (IST Lisbon): Non-commutative Gelfand theories.

Dr. Torsten Ehrhardt (UC Santa Cruz): Szegö limit theorems.

Andreas Rößler

Prof. Dr. Peter E. Kloeden (Johann Wolfgang Goethe-University of Frankfurt am Main): Affinely controlled nonlinear systems.

Prof. Dr. Samy Tindel (Institut Élie Cartan Nancy): Fractional stochastic differential equations.

PD Dr. Evelyn Buckwar (Humboldt University of Berlin): Runge–Kutta methods for SDEs with small noise.

Dr. Kristian Debrabant (TU Darmstadt): Numerical treatment of SODEs with SRK methods.

Dr. Andreas Neuenkirch (Johann Wolfgang Goethe-University of Frankfurt am Main): Fractional stochastic differential equations.

Dr. Ivan Nourdin (University of Pierre et Marie Curie): Fractional stochastic differential equations.

Dr. Mohammed Seaid (TU Kaiserslautern): Numerical treatment of SPDEs.

Dr. Renate Winkler (Humboldt Universität Berlin): Runge–Kutta methods for SDEs with small noise.

Grace GmbH & Co. KG (Lorsch): Statistical analysis of medical Data.

Peter Spellucci

Prof. Dr. Axel Klar, Dr. M. Herty, Dr. Anita Kumari Singh (University of Kaiserslautern): Modeling, Simulation and Optimization of Traffic Flow in Road Networks.

Fijoy Vadakkumpadan, Yinlong Sun (Purdue University): Spectral methods for optimal surface parametrizations.

Walter Trebels

Prof. Dr. George Gasper (Northwestern University, Evanston, IL): Jacobi polynomials, Jacobi multipliers.

Prof. Dr. Kazaros Kazarian (University of Autonoma, Madrid): Complete and minimal systems of functions.

Prof. Dr. Bohumir Opic (Czechs Academy of Sciences, Prague): Interpolation and function spaces.

Prof. Dr. Ursula Schmidt-Westphal (Hannover University: Characterization of K-functionals.

Prof. Dr. Alexander Stokolos (DePaul University, Chicago): Pointwise convergence, maximal functions.

Stefan Ulbrich

Prof. Dr. Martin Brokate, Jan Christoph Wehrstedt (TU München): Shape Optimization with Variational Inequality Constraints with Applications in the Oral Surgery.

Prof. Dr. Matthias Heinkenschloss (Rice University, Houston): PDE-Constrained Optimization.

Prof. Dr. Vincent Heuveline (University of 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 DFG within SPP 1253.

Prof. Dr. Jens Lang (TU Darmstadt): Adaptive multilevel SQP-methods for PDAE-constrained optimization with restrictions on control and state. Theory and Applications. Supported by DFG within SPP 1253.

Schenck RoTec GmbH (Darmstadt): Balancing of axle-elastic rotors.

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).

Prof. Dr. Michael Ulbrich (TU München): Interior Point Multigrid Methods for PDE-constrained Optimization.

Rudolf Wille

GoDa-Project: Cooperation of the Darmstadt "Concept Analysis Group" (coordinator R. Wille) and of the "KVO-Group" in Wollongong (before: Brisbane and Gold Coast), (coordinator P. Eklund) since 1999 financed by Deutsche Forschungsgemeinschaft and the Australian Research Council: .

COMO-Project: Cooperation of the Darmstadt "Concept Analysis Group" (coordinator K.E. Wolff) of the Novosibirsk "Model Theory Group" (coordinator D. Pal'chunov) since 2005 financed by Deutsche Forschungsgemeinschaft and the Russian Foundation of Basic Research: .

Andrea Zelmer

BMBF network: "Decentralized regenerative energy supply: Innovative Modeling and Optimization", jointly with University of Duisburg-Essen, University of Dortmund, University of Bochum, Humboldt-University of Berlin, Fraunhofer Institute UMSICHT. Speaker: Prof. Dr. Rüdiger Schultz (University of Duisburg-Essen).

6.6 Secondary Schools and Public Relations

The Department of Mathematics is involved in several activities for schools and secondary school students and public relations. Beside numerous printed information materials the department of mathematics appears in public on its totally renewed web pages. The relaunch of the Internet presence brought clearly structured web pages to the users. There are quick links for several target groups as well as links leading to specific topics in research and teaching at the department.
To inform our students the department publishes a comprehensive study guide ("Informationsbroschüre"). These guides together with leaflets on special study programs are also distributed in schools, on fairs and in our widespread network with student service centers at universities all over Germany and regional employment centers.
In the following a list of further public relations activities is given:
Activities for high school students and prospective students

- o presentation of the department with a booth and several talks at the job and study information fair "HoBIT - Hochschul- und Berufsinformationstage" each January (about 8.000 participants during the three days fair) (Helmerich, professors, academic staff and students)
- o presentation of the department and mathematics study programs at the university information day ("Hochschulinformationstag HIT") each May with sample lecture and tutorial class, meetings with professors, staff and students of the department (about 50 participants over the course of the day) (Prof. May, Prof. Große-Brauckmann, Prof. Kramer, Helmerich et al.)
- o organization of the Hessian Mathematics Olympiad (third level) in cooperation with the Center for Mathematics Bensheim each February for all grades (about 25

participants per grade each year) (Prof. Bruder, Prof. Kiehl, Prof. Kümmerer, Prof. Roch, academic staff and students)

- o preparation classes for the fourth level of the German Mathematics Olympiad (Prof. Roch, academic staff)

- o hosting of the Internet portal for secondary school students mathe-zirkel.de with information and encouragement for interested secondary school students, including a quarterly contest for secondary school students in grade 7 upwards (Prof. Bruder, Prof. Roch)

- o organization of the Mathematical Modeling Week for secondary school students in grade 12 in cooperation with Center for Mathematics Bensheim each October (40 participants each year) (Prof. Kiehl)

- o involvement in the yearly German Maths Contest (Bundeswettbewerb Mathematik) (about 200 participants) (Prof. Alber, Prof. Lehn, Prof. Roch)

- o Summer School in Stochastics for secondary school students in grade 12 and 13 (37 participants) in August 2006 (Prof. Stannat)

- o Workshop for gifted children on "Unendlichkeit - aus der Nähe betrachtet" (10 participants) (Prof. Kümmerer and staff)

Public Appearances and other activities

- o talks in the interdisciplinary joint lecture "Was steckt dahinter?" (Prof. Lehn, Prof. Ulbrich, Prof. Joswig)

- o several public lectures at schools in Rhein-Main area on "Unendlichkeit - aus der Nähe betrachtet" (100 to 250 participants each) (Prof. Kümmerer)

- o articles in school publications and talk participation in a radio show (Prof. Kümmerer)

- o graduation celebration with friends and family of the graduated students once per year

In addition there have been many activities under the topic "Studium für alle" and at the Ernst-Schröder-Colloquia under the hand of Rudolf Wille.

7 Contact

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