ÖMG–TAGUNG CSASC 2011

Joint Mathematical Conference of the Austrian Mathematical Society at the Donau-Universität Krems together with the Catalan, Czech, Slovak, and Slovenian Mathematical Societies

September 25–28, 2011

Redaktion:

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Contents

Program

Abstracts

This program folder can also be found at the Conference web-site

http://www.dmg.tuwien.ac.at/OMG/OMG-Tagung/

Welcome

The Austrian Mathematical Society welcomes you to the conference

ÖMG-Tagung – CSASC 2011
Donau-Universität Krems, Sept. 25–28, 2011

that is jointly organized with the Donau-Universität Krems (DUK), which is also the venue of the conference. The scientific program is organized together with the Catalan, Czeck, Slovak, and Slovenien Mathematical Societies.

It is a continuation of the "Nachbarschaftstagungen" of the ÖMG in Bozen, Italy, Sept. 22-26, 2003 (organized jointly with SIMAI and UMI), in Podbankse, Slovakia, Sept. 16-21, 2007 (organized jointly with JSMF), the joint mathematical conference CSASC 2010 in Prague, Czech Republik, Jan. 22-27, 2010, and The Czech-Catalan meetings in 2005 in Prague and 2006 in Barcelona.

Within the conference there will be plenary-talks, minisymposia on special topics, contribued talks, and two special sessions for teachers.

Furthermore, on Monday, Sept. 26, 18:30, the general assembly of the Austrian Mathematical Society will take place at the Audi-Max of the DUK.

The organizers are in particular grateful for the support of the Niederösterreichische Landesregierung, the government of the Austrian State "Lower Austria", the Donau-Universität Krems, the Vienna University of Technology and the National Research Network "Analytic Combinatorics and Probabilistic Number Theory" of the FWF.

Michael Drmota
President of the Austrian Mathematical Society

General Information

Conference Office

The Conference Office is open during the whole conference. It is situated at the ground floor of Trakt N of the DUK.

E-Mail:	michael.drmota@tuwien.ac.at
Phone:	+43 676 580 52 51

Registration

The Registration will be open on Sunday from 12:30–18:00 and on Monday, from 08:30–10:30 at the Audi-Max. During the remaining time of the conference please consult the Conference Office.

In front of the Audi-Max you will also find a "News Board" where news and changes of the program are posted.

For further information please consult the web-site of the conference: *http://www.dmg.tuwien.ac.at/OMG/OMG-Tagung/*

Meals and Coffee Breaks

Next to the Audi-Max of the DUK there is the MENSA, where you can have lunch from Monday–Wednesday for a moderate prize.

There are also several restaurants and coffee houses close to the DUK campus. You will find a list of recommended restaurants in your conference bag.

The Coffee Breaks are held in front of the Audi-Max every morning and every afternoon after the plenary talks. We serve coffee, tea, mineral water, juice and cookies.

Conference Site

All activities of the conference (opening, plenary lectures, prize lectures, minisymposia, contributed talks) take place at the campus of the DUK, in particular at the at the Audi-Max and in several seminar room. At the end of this Abstract Book you will find a list of lecture rooms and corresponding maps. Note that the DUK campus is partitoned in so-called "Trakts" which are labelled by A, B, C, etc.

All lecture rooms are equipped with a beamer and a flipboard. If you need an overhead projector please consult the Conference Office.

Internet

There is WLAN at the DUK.

Username:	**wlan-oemg**
Password:	**guest**

Program

Opening of the Conference

Sunday **September 25, 2011**
Audi-Max of the Donau-Universität Krems

13:30–13:45 Opening of the Conference

Opening words by the President of the ÖMG,
Prof. Dr. *Michael Drmota*

Opening words by the President of the DUK,
Rektor Prof. Dr. *Jürgen Willer*

Opening words by the 2. Präsident des Niederösterr. Landtags
Mag. *Johann Heuras*
representing Landeshauptmann Dr. *Erwin Pröll*

Scientific Program – Sunday

Sunday September 25, 2011
Audi-Max of the DUK

13:30–13:45 Opening of the Conference

Plenary Lecture

13:45–14:45 Franc Forstnerič (Ljubljana)
What is an Oka manifold?

14:45–15:15 Coffee Break

Minisymposium "Algebraic and Topological Graph Theory" 1

Sunday Seminar room SE 2.4

15:15 Ján Karabáš (Banská Bystrica)
Dicrete group actions on orientable surfaces

15:45 Roman Nedela (Banská Bystrica)
A recent progress in map enumeration

16:30 Kan Hu (Banská Bystrica)
Regular embeddings of multiple graphs

17:00 Naer Wang (Banská Bystrica)
Regular maps whose automorphisms are 2-groups of maximal nilpotent class

17:25 Edita Rollová (Bratislava)
Cycle covers of signed graphs

17:50 Michal Kotrbčík (Bratislava)
Genus of Cartesian products containing triangles

Minisymposium "Complex Analysis" 1

Sunday Audi-Max of the DUK

15:15 Jasna Prezelj (Ljubljana)
Conic neighbourhoods in 1-convex spaces

16:00 Frank Kutzschebauch (Bern)
A solution to the Gromov-Vaserstein Problem

16:45 Laurent Stolovitch (Nice)
Holomorphic transformations to normal forms in sectorial domains

17:30 Dimitri Zaitsev (Dublin)
Dynamics of one- and multi-resonant biholomorphisms

Minisymposium "Geometry, Analysis and Mathematical Physics" 1

Sunday Seminar room SE 0.2

16:15 Radka Malikova (Ostrava)
Helmholtz morphisms in the variational sequence and the corresponding covariant inverse variational problem

16:45 Monika Havelková (Ostrava)
A geometric analysis of dynamical systems with singular Lagrangians

17:15 Olga Krupkova (Ostrava)
Affine duality, and Lagrangian and Hamiltonian systems

17:45 David Saunders (Ostrava)
Homogeneity for higher-order ordinary differential equations

Minisymposium "Nonlinear PDEs – Modelling, Computations, Applications" 1

Sunday Seminar room SE 0.1

15:15 Michal Beneš (Prague)
Numerical simulation of anomalous transport in porous media

15:45 Angel Calsina (Barcelona)
A Selecetion Mutation Model for the Maturation Age

16:15 Karol Mikula (Bratislava)
3D curve evolution algorithm with tangential redistribution for a fully automatic finding of an ideal camera path in virtual colonoscopy

16:45 Thomas Fidler (Wien)
Shape Encoding and Shape Reconstruction with the Circular Integral Invariant

Minisymposium "Oscillation and Spectral Theory of Differential and Difference equations" 1

Sunday Seminar room SE 1.2

15:15 Zuzana Došlá (Brno)
Oscillation of fourth order differential equations

15:45 Ondrej Došlý (Brno)
Two-paramentric conditional oscillation of half-linear differential equations

16:15 Werner Kratz (Ulm)
Spectral Theory of Continuous Hamiltonian and Discrete Symplectic Systems

16:45 Roman Šimon Hilscher (Brno)
Oscillation and spectral theory for Sturm-Liouville equations with nonlinearity in the spectral parameter

17:15 Kerstin Ammann (Wien)
Relative Oscillation Theory for Jacobi Matrices

Minisymposium "Uncertainty modelling" 1

Sunday Seminar room SE 1.1

15:15 Milan Bašta (Prague)
Time series analysis with wavelets

15:45 Jozef Komorník (Bratislava)
Rotations of copulas and their applications in modelling of financial data

16:15 Olga Nánásiová (Bratislava)
Modeling of non-compatible random events via multidimensional states

17:00 Jana Kalická (Bratislava)
Optimal bandwith in nonparametric regression

17:10 Jana Lenčuchová (Bratislava)
Comparing the power properties of the proposed test and some other nonlinearity tests for Markov-switching time series models

17:20 Anna Petričková (Bratislava)
Modelling of the ARMA models residuals using autocopulas

17:30 Danuša Szköeová (Bratislava)
SETAR models in the streamflow modeling

17:40 Petra Zacharovská (Bratislava)
Comparison of descriptive and predictive properties of MSW models with different probability distribution of residuals

17:50 Miroslav Sabo (Bratislava)
Clustering by two methods simultaneously

18:00 Mária Bohdalová (Bratislava)
Monte Carlo simulation Value at Risk and PCA

Contribued Talks, Session 1

Sunday Seminar room SE 0.3

15:15 Alois Panholzer (Wien)
Some new results for deriving hook-length formulas for trees

15:45 Marie-Louise Bruner (Wien)
Enumerative formulae for multiset-permutations avoiding the pattern 122 and another pattern of length three

16:15 Bernhard Gittenberger (Wien)
Boolean functions in the implicational fragment: On the number of Boolean expressions and its relation to the function complexity

17:15 Martin Zeiner (Wien)
Limit laws of the Rogers-Szegö-distribution

17:15 Michael Drmota (Wien)
Universal exponents and tail estimates in the enumeration of planar maps

17:45 Elmar Teufl (Tübingen)
An Asymptotic Independence Theorem for the Number of Matchings in Graphs

Contribued Talks, Session 2

Sunday Seminar room SE 1.4

15:15 Friedrich Pillichshammer (Linz)
Discrepancy of Polynomial Lattice Point Sets

15:45 Peter Kritzer (Linz)
On Some Examples of Mixed Quasi-Monte Carlo Point Sets

16:15 Gunther Leobacher (Linz)
Fast orthogonal transforms and generation of Brownian paths

16:45 Matthias Weber (Innsbruck)
Uniqueness Results for Extremal Quadrics

Contribued Talks, Session 3

Sunday Seminar room SE 2.3

15:15 Wolfgang Herfort (Wien)
Pro-p groups acting with finite stabilizers on pro-p trees

15:45 Miroslav Kureš (Brno)
Finite dimensional factors of polynomial algebras and their fixed point subalgebras

16:15 Daniel Mayer (Graz)
Principalization algorithm via class group structure

16:45 Günter Pilz (Linz)
Algebra for Agriculture

Scientific Program – Monday

Monday **September 26, 2011**
Audi-Max of the DUK

Plenary Lecture

09:00–10:00 Vicent Caselles (Barcelona)
Exemplar-Based Image Inpainting and Applications

10:00–10:30 Coffee Break

Minisymposium "Complex Analysis" 2

Monday Seminar room SE C 2.08

10:30 Jean Ruppenthal (Bonn)
L^2-cohomology of complex spaces with isolated singularities

11:15 Friedrich Haslinger (Wien)
Compactness of the $\bar{\partial}$- Neumann operator and applications to Schrödinger and Dirac operators

12:00 Elisabeth Wulcan (Göteborg)
Effective membership problems on varieties

Minisymposium "Combinatorics and Graph Theory" 1

Monday Seminar room SE 1.6

10:30 Marc Noy (Barcelona)
Maximum degree in minor-closed classes of graphs

11:00 Guillem Perarnau (Barcelona)
Rainbow matchings of complete bipartite graphs

11:30 Tomáš Kaiser (Plzeň)
Discharging and the hamiltonicity of line graphs

12:00 Jiri Fiala (Prague)
The k-in-a-path problem for claw-free graphs

Minisymposium "Nonlinear PDEs – Modelling, Computations, Applications" 2

Monday Audi-Max of the DUK

10:30 Angela Handlovičová (Bratislava)
Numerical schemes for level set equations – analysis and applications

11:00 Tomas Oberhuber (Prague)
New constrained level-set method for image segmentation with implementation on GPU

11:30 Bartomeu Coll (Prague)
Local and non local models in image denoising

12:00 Mariana Remešíková (Bratislava)
Cell tracking in 3D+time image sequences

Minisymposium "Operator Theory" 1

Monday Seminar room SE 0.2

10:30 Vladimir Müller (Prague)
Mappings preserving Browder, semi-Browder and similar classes of operators

11:15 Peter Šemrl (Ljubljana)
Adjacency preserving maps

12:00 Michal Zajac (Bratislava)
Hyperreflexivity of linear spaces of operators

Minisymposium "Oscillation and Spectral Theory of Differential and Difference equations" 2

Monday Seminar room SE 1.2

10:30 Pavel Řehák (Brno)
A critical oscillation constant depends on time scales

11:00 Harald Woracek (Wien)
An addendum to M.G.Kreĭn's Inverse Spectral Theorem for strings

11:30 Jonathan Eckhardt (Wien)
Measure Sturm–Liouville operators

12:00 Gerald Teschl (Wien)
On Sturm–Liouville operators on time scales

Fachhochschultag, Session 1

Monday Seminar room SE C 2.01

10:00 Registration and Opening

10:30 Gerd Krizek (FH Technikum Wien)
Blended Learning für Mathematik in der Studieneingangsphase

11:00 Thomas Schrefl (FH St. Pölten)
Mathematik in der Studieneingangsphase an der FH St. Pölten

11:30 Kurt Steiner (FH JOANNEUM Graz)
Mathematik Warm Up an der FH JOANNEUM

Contribued Talks: Session 4

Monday Seminar room SE 0.1

10:30 Michael Oberguggenberger (Innsbruck)
Linear hyperbolic partial differential equations with non-smooth coefficients

11:00 Mechthild Thalhammer (Innsbruck)
Space and time adaptive integration methods for nonlinear Schrödinger equations

11:30 Josef Hofbauer (Wien)
Minimax via differential equations

Monday September 26, 2011
Audi-Max of the DUK

Plenary Lecture

13:30–14:30 Christoph Helmberg (Chemnitz)
A View on Graph Laplacians from the Perspective of Semidefinite Optimization

14:30–15:00 Coffee Break

EuroGiga Session

Monday Audi-Max of the DUK

15:00 Opening

15:15 Bojan Mohar (Burnaby and Ljubljana)
Immersions in graphs and digraphs

16:00 Pavel Valtr (Prague)
On empty pentagons and hexagons in planar point sets

16:30 Jan Kratochvil (Prague)
Kuratowski-type theorem for Partially Embedded Planarity

17:00 Martin Škoviera (Bratislava)
Edge-colourings of cubic graphs and point-line configurations

Minisymposium "Categorical Algebra, Homotopy Theory, and Applications" 1

Monday Seminar room SE 1.2

15:00 Michael Makkai (Montreal)
Kan complexes and face structures

15:30 Fernando Muro (Sevilla)
Moduli spaces of differential graded algebra structures

16:00 Jan Šťovíček (Prague)
Generating the bounded derived category and perfect ghosts

16:30 Oriol Raventós (Brno)
Adams representability in triangulated categories

17:00 Javier J. Gutiérrez (Barcelona)
Generalized Ohkawa's theorem

17:30 David Pospíšil (Prague)
(Co)tilting classes over commutative noetherian rings

Minisymposium "Geometry, Analysis and Mathematical Physics" 2

Monday Seminar room SE 1.6

15:00 Jaroslav Dittrich (Rez)
Integer topological charges for finite energy fields in the $O(3)$ sigma-model

15:30 Thomas Hoffmann-Ostenhof (Vienna)
Spectral Minimal Partitions

16:30 Josef Janyska (Brno)
Higher order Utiyama's reduction method

17:00 Marina Delgado-Téllez (Madrid)
Lagrangian submanifolds as geometric tools to describe discrete Hamilton-Jacobi theory

17:30 Miguel-C. Munoz-Lecanda (Barcelona)
Kinematic reduction and the Hamilton–Jacobi theory

Minisymposium "Operator Theory" 2

Monday Seminar room SE 0.2

15:00 Nadia Boudi (Meknes)
On locally linearly dependent operators

15:30 Calin-Grigore Ambrozie (Prague)
On certain multidimensional integrals

16:00 Bojan Kuzma (Ljubljana)
On maximal distances in commuting graph

16:30 Janko Barčič (Ljubljana)
Reflexive and hyperreflexive sets of operators

Fachhochschultag, Session 2

Monday Seminar room SE C 2.01

13:30 Martin Lehner (FH Technikum Wien)
Workshop zur Mathematik in der Studieneingangsphase

15:45 Diskussion und Definition aktueller Anliegen und Ziele der FH-Vertretung innerhalb der ÖMG, Organisation der nächsten FH-Tage

Contribued Talks: Session 5

Monday Seminar room SE 0.1

15:00 Zuzana Kriva (Bratislava)
Adaptive algorithms for finite volume schemes in image processing

15:30 Robert Cunderlik (Bratislava)
Surface finite volume method for nonlinear filtering of data on the Earths surface

16:00 Vladimir Klement (Přibyslav)
Implementation of the multigrid method on the GPU

16:30 Vítězslav Žabka (Prague)
Numerical Simulation of Air Flow over Urban Canopy

17:00 Pavol Kutik (Bratislava)
Numerical Solution to Nonlinear Partial Differential Equations in Financial Mathematics

17:30 Martin Balazovjech (Bratislava)
Numerical modeling of forest fire propagation

Scientific Program – Tuesday

Tuesday **September 27, 2011**
Audi-Max of the DUK

Plenary Lecture

09:00–10:00 Pavol Quittner (Bratislava)
Singularity and decay estimates of solutions of nonlinear partial differential equations via scaling and Liouville-type theorems

10:00–10:30 Coffee Break

Minisymposium "Categorical Algebra, Homotopy Theory, and Applications" 2

Tuesday Seminar room SE 1.2

10:30 Imma Gálvez Carrillo (Terrassa)
Generalized Syzygies for Commutative Koszul Algebras

11:00 Pavel Příhoda (Prague)
Projective modules over universal enveloping algebras

11:30 Lukáš Vokřínek (Brno)
When is the colimit functor homotopy invariant?

12:00 Georgios Raptis (Osnabrück)
The stable model categories of modules over the Frobenius rings $\mathbb{F}_p[\varepsilon]/(\varepsilon^2)$ *and* $\mathbb{Z}/p^2$

Minisymposium "Combinatorics and Graph Theory" 2

Tuesday Seminar room SE 0.2

10:30 Martin Klazar (Prague)
Counting paths in the honeycomb graph

11:00 Christian Krattenthaler (Wien)
A method for determining the mod-2^k *behaviour o f (certain) recursive sequences*

11:30 Christoph Koutschan (Linz)
Lattice Green's Functions of the Higher-Dimensional Face-Centered Cubic Lattices

Minisymposium "Geometry, Analysis and Mathematical Physics" 3

Tuesday Seminar room SE 1.6

10:30 Július Korbaš (Bratislava)
On the characteristic rank of smooth manifolds

11:00 Xavier Gràcia (Barcelona)
The time-evolution operator for non-autonomous lagrangians in the homogeneous formalism

11:30 Eva Miranda (Barcelona)
From action-angle coordinates to geometric quantization and back

12:00 José A. Vallejo (San Luis Potosí)
Lie algebroids of Poisson type

Minisymposium "Innovative Time Integrators" 1

Tuesday Seminar room SE C 2.01

10:30 Bojan Orel (Ljubljana)
Approximate solution of initial-boundary value problems with nonperiodic Fourier series

11:10 Antti Koskela (Innsbruck)
An analysis of exponential Taylor integrators

11:50 Alexander Ostermann (Innsbruck)
Exponential integrators

Minisymposium "Nonlinear PDEs – Modelling, Computations, Applications" 3

Tuesday Seminar room SE 0.1

10:30 Pep Mulet (Valencia)
High resolution numerical methods for some models of sedimentation of polydisperse suspensions

11:00 Joachim Schöberl (Wien)
Hybrid discontinuous Galerkin methods for the Navier-Stokes equations

11:30 Hans Peter Stimming (Wien)
Nonlinear Schroedinger Equations: Modeling and Simulation of Bose-Einstein condensates (BECs)

12:00 Daniel Ševčovič (Bratislava)
On a gradient flow for the anisotropic ratio and other nonlocal geometric flows

Minisymposium "Uncertainty modelling" 2

Tuesday Audi-Max of the DUK

10:30 Pal Rakonczai (Budapest)
Bivariate generalized Pareto distribution in practice: models and estimation

11:10 Piotr Jaworski (Warsaw)
Invariant multivariate dependence structure under univariate truncation

11:50 Radko Mesiar (Bratislava)
Copulas and integrals

Contribued Talks: Session 6

Tuesday Seminar room SE C 2.07

10:30 Gilbert Helmberg (Innsbruck)
The Eisenstein Packing of the Complex Plane

11:00 Johannes Morgenbesser (Wien)
Combinatorial properties of the Thue-Morse sequence

11:30 Klaus Scheicher (Leoben)
Beta expansions of complex numbers

Contribued Talks: Session 7

Tuesday Seminar room SE C 2.08

10:30 Helmut Länger (Wien)
Symmetric differences on posets with an antitone involution

11:00 Cyrus Nourani (San Francisco)
Filters, Fragment Models, and Stratified Toposes

11:30 Anna Antonyová (Prešov)
Difference Equations as a Means for Solution of Decision Making Problems

Tuesday September 27, 2011
Audi-Max of the DUK

Plenary Lecture

13:15–14:15 Daniel Král (Prague)
Algebraic versions of the graph Removal Lemma

14:14–14:45 Coffee Break

Prize Lectures

14:45–15:30 Christof Sparber (Chicago)
High frequency interactions in nonlinear Schroedinger equations and applications

15:45–16:30 Arne Winterhof (Linz)
Some Applications of Character Sums

Minisymposium "Algebraic and Topological Graph Theory" 2

Tuesday Seminar room SE 1.6

14:45 Monika Cerinšek (Ljubljana)
Exploring the structure of mathematical publications

15:15 Iztok Kavkler (Koper)
Drawing graphs with partial rotational symmetry

15:45 Tomaž Pisanski (Ljubljana)
Configurations of points and polygonal quasi-lines

Minisymposium "Categorical Algebra, Homotopy Theory, and Applications" 3

Tuesday Seminar room SE 1.2

14:45 Beatriz Rodríguez Gonzalez (Sevilla)
A characterization of homotopically cocomplete categories

15:15 Ilias Amrani (Brno)
Infinity categories

15:45 Pavel Ružička (Prague)
Computing $V(R)$ of regular rings

16:15 Andrew Tonks (London)
Crossed complex resolutions of group extensions

Minisymposium "Complex Analysis" 3

Tuesday Seminar room SE C 2.08

14:45 Marko Slapar (Ljubljana)
On CR singular points of real manifolds in complex manifolds

15:30 Francine Meylan (Fribourg)
Local models for strictly pseudoconvex CR structures of hypersurface type

16:15 Erlend Wold (Oslo)
The Hartog's extension phenomenon for line bundles across totally real manifolds

Minisymposium "Innovative Time Integrators" 2

Tuesday Seminar room SE C 2.01

14:45 Winfried Auzinger (Wien)
Krylov subspace techniques for rational integrators

15:25 Othmar Koch (Wien)
Error estimators for adaptive splitting methods

16:05 Dragana Miljkovic (Ljubljana)
Constraint-driven optimization approach to build a Petri Net defence response model in plants

Minisymposium "Uncertainty modelling" 3

Tuesday Seminar room SE 0.2

14:50 Anna Kolesarova (Bratislava)
On the structure of associative n-dimensional copulas

15:00 Vladimir Jágr (Bratislava)
Generalization and construction of Archimax copulas for higher dimensions

15:10 Tomáš Bacigál (Bratislava)
Recent tools for modelling dependence with copulas and R

15:20 Monika Pekárova (Bratislava)
On some insurance risk applications of copulas

15:30 Darina Kyselová (Bratislava)
Aggregation functions-based building of transitive preference structures

15:40 Lucia Vavríkova (Bratislava)
Application of aggregation operators on the assessment of public universities and their faculties

15:50 Tatiana Rückschlossová (Bratislava)
Generalized Bonferroni mean operators in multi-criteria aggregation

16:00 Anna Kolesárová (Bratislava)
Aggregation-based extensions of utility functions

16:10 Martin Kalina (Bratislava)
Implicators and I-partitions

Contribued Talks: Session 8

Tuesday Seminar room SE 0.1

14:45 Petr Bauer (Prague)
FEM for flow and pollution transport in 2D urban canopy

15:15 Pavel Strachota (Prague)
Computational study of operation of a mixed-fuel fired industrial steam generator with air and fuel staging control

15:45 Jan Mach (Prague)
Multiscale Methods for Reaction Diffusion Equations

16:15 Mária Minárová (Bratislava)
Biomechanical investigation on human spine, mathematical modeling and computations

Scientific Program – Wednesday

Wednesday September 28, 2011
Audi-Max of the DUK

Plenary Lecture

09:00–10:00 Barbara Kaltenbacher (Klagenfurt)
Inverse problems: Some technical applications and some regularization techniques

10:00–10:30 Coffee Break

Lehrer- und Lehrerinnentag

10:45–11:30 Alexia Fürnkranz-Prskawetz (Wien)
Mathematik in der Ökonomie

11:45–12:30 Hans Humenberger (Wien)
Das PageRank-System von Gooogle – eine aktuelle Anwendung im Mathematikunterricht

Minisymposium "Complex Analysis" 4

Wednesday Seminar room SE C 2.08

10:30 Barbara Drinovec Drnovšek (Ljubljana)
The Poletsky-Rosay theorem on singular complex spaces

11:15 Anne-Katrin Herbig (Vienna)
Smoothing properties of the Bergman projection

11:40 Joe J. Perez (Vienna)
Unitary representations of unimodular Lie groups in Bergman spaces

12:00 Giuseppe della Sala (Wien)
TBA

Minisymposium "Oscillation and Spectral Theory of Differential and Difference equations" 3

Wednesday Seminar room SE C 2.07

10:30 Katrin Grunert (Trondheim)
Transformation operators for Schrödinger operators on infinite-gap backgrounds

11:00 Jussi Behrndt (Graz)
Elliptic differential operators with δ*-potentials*

11:30 Gabriella Bognar (Miskolc)
Spectral problems of some nonlinear partial differential equations

12:00 Stefan Hilger (Eichstätt)
Deformation of the Weyl algebra

Contribued Talks: Session 9

Wednesday Seminar room SE C 2.01

10:30 Dietmar Dorninger (Wien)
Characterizing generalized fields of events by structural properties

11:00 David Bartl (Ostrava)
A Duality Theorem for Infinite Linear Programming: A Purely Linear-Algebraic Approach

11:30 Thomas Fetz (Innsbruck)
Modelling Uncertainties in Limit State Functions

12:00 Sergiy Pereverzyev Jr. (Linz)
Multi-parameter regularization for construction of extrapolating estimators in statistical learning theory

Contribued Talks: Session 10

Wednesday Seminar room SE 3.6

10:30 Wilfried Imrich (Leoben)
Free and Weak Cartesian Products of Graphs

11:00 Bernhard Krön (Wien)
Tutte's decomposition of graphs for arbitrary connectivity

11:30 Jan Volec (Prague)
Properties of cubic graphs with large girth and random cubic graphs

General Assembly of the ÖMG

Generalversammlung der ÖMG

Die Generalversammlung der ÖMG findet am Montag, dem 26.9.2011 um 18.35 Uhr im Audi-Max der DUK (Dr.-Karl-Dorrek-Str. 30, 3500 Krems) statt.

Tagesordnung

1. Feststellung der Beschlussfähigkeit
2. Berichte des Vorsitzenden und weiterer Vorstandsmitglieder, insbesondere des Kassiers
3. Berichte aus den Landessektionen
4. Bericht der Rechnungsprfer und gegebenenfalls Entlastung des Vorstands
5. Neuwahl des Vorstandes
6. Verleihung des Förderungspreises und der Studienpreise
7. Allfälliges

Univ.-Prof. Dr. Michael Drmota

Special Sessions for Teachers

Fachhochschultag

Montag	Seminarraum SE C 2.01
10:00	Registrierung und Eröffnung
10:30	Gerd Krizek (FH Technikum Wien) *Blended Learning für Mathematik in der Studieneingangsphase*
11:00	Thomas Schrefl (FH St. Pölten) *Mathematik in der Studieneingangsphase an der FH St. Pölten*
11:30	Kurt Steiner (FH JOANNEUM Graz) *Mathematik Warm Up an der FH JOANNEUM*
13:30	Martin Lehner (FH Technikum Wien) *Workshop zur Mathematik in der Studieneingangsphase*
15:45	Diskussion und Definition aktueller Anliegen und Ziele der FH-Vertretung innerhalb der ÖMG, Organisation der nächsten FH-Tage

Lehrer- und Lehrerinnentag

Mittwoch	Audi-Max der DUK
10:45–11:30	Alexia Fürnkranz-Prskawetz (Wien) *Mathematik in der Ökonomie*
11:45–12:30	Hans Humenberger (Wien) *Das PageRank-System von Gooogle – eine aktuelle Anwendung im Mathematikunterricht*

Social Events

Sunday, Sept. 25, 2011

18:30–20:00 **Reception at the "arte Hotel Krems"**
Dr. Karl Dorrek-Str. 23, 3500 Krems (next to the DUK campus)
We serve wine, minear water, and snacks.

Tuesday, Sept. 27, 2011

17:00–22:00 **Excursion to "Dürnstein" (Wachau)**
You will find an information sheet in your conference bag, see also *http://www.duernstein.at/sites/homeen.php*
Buses are taking you from the DUK campus to Dürnstein. They go back to Krems starting at 21:30 after the conference dinner.

18:30-21:30 **Conference Dinner at "Romantik Hotel Richard Löwenherz"**
Dürnstein 8. Buses are going back to Krems starting at 21:30
The prize for accompanying persons is EUR 30.–. Tickets can be paid at the Conference Office.

Abstracts

Plenary Lectures

Exemplar-Based Image Inpainting and Applications

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Image inpainting consists in recovering the missing or corrupted parts of an image so that the reconstructed image looks natural. The purpose of this talk will be to give an overview of recent techniques in non-local exemplar-based image inpainting and its applications in video and cinema post-production.

Non-local methods for image denoising and inpainting have gained considerable attention in recent years. This is due to their superior performance in textured images, a known weakness of purely local methods. Local methods on the other hand have shown to be very appropriate for the recovering of geometric structure such as image edges. The synthesis of both types of methods is a trend in current research. Variational analysis in particular is an appropriate tool for a unified treatment of local and non-local methods. We present a general variational framework for the problem of non-local image inpainting, from which some previous inpainting schemes can be derived, in addition to leading to novel ones. We give an statistical mechanics interpretation of the proposed framework.

We also study the properties of the variational formulation of the Efros-Leung copying scheme.

We show applications of image inpainting to different problems: interpolation of sparsely sampled images, the replacement of objects in video sequences, and to

the post-production of depth-enhanced imagery.

[1] P. Arias, V. Caselles, G. Facciolo, and G. Sapiro. Variational Framework for Exemplar-Based Image Inpainting. Preprint, 2010.

[2] P. Arias, V. Caselles, and G. Sapiro. A variational framework for non-local image inpainting. Proc. of the 7th Int. Conf. on Energy Minimization Methods in Computer Vision and Pattern Recognition EMMCVPR, Springer LNCS, Bonn, August 2009.

[3] G. Facciolo, P. Arias, V. Caselles, and G. Sapiro. Exemplar-Based Interpolation of Sparsely Sampled Images, Proce. of the 7th Int. Conf. on Energy Minimization Methods in Computer Vision and Pattern Recognition, EMMCVPR, Springer LNCS Bonn, August 2009.

[4] P. Arias, V. Caselles, and G. Facciolo. Algorithms for a variational framework for non-local image inpainting. Preprint, July 2011.

What is an Oka manifold?

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Two of the classical theorems in the theory of holomorphic functions are the Runge approximation theorem and the Weierstrass interpolation theorem. A complex manifold Y is said to be an Oka manifold if these results, and some of their natural extensions, are valid for holomorphic maps from any Stein manifold (in particular, from complex Euclidean spaces) to Y. After a brief review of the development of this subject, beginning with the classical Oka-Grauert theory and continuing with the seminal work of Gromov, I will describe some of the recent developments and future challenges in this field of complex geometry.

A View on Graph Laplacians from the Perspective of Semidefinite Optimization

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The Laplace matrix of a graph as well as its eigenvalues and eigenvectors appear in several rather diverse areas such as graph partitioning, Euclidean embedding problems, rigidity and the analysis of mixing rates of Markov chains. Duality in semidefinite optimization allows to develop some intuition on the relation between

these applications. Our main focus will be on an appealing geometric interpretation that arises when studying connections between the separator structure of the graph and eigenvectors to optimized extremal eigenvalues of the Laplacian.

Inverse problems: Some technical applications and some regularization techniques

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In this talk we will introduce the main features of inverse problems especially in the context of partial differential equations and give some examples of industrial applications.

Moreover, we will dwell on regularization strategies for linear and especially also for nonlinear ill-posed problems. Starting from the key step in the convergence proof of the well-known Tikhonov regularization in a Hilbert space setting, we will illustrate its extension in various directions such as:
– adaptive discretization,
– regularization in Banach spaces,
– iterative regularization by Newton type methods.

Algebraic versions of the graph Removal Lemma

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An important tool in graph theory is the Szemeredi Regularity Lemma which allows to partition any graph into pieces that mutually behave in a pseudorandom way. One of its most important corollaries is the Removal Lemma. Vaguely speaking, the lemma says that every graph contains many copies of a subgraph H or it is almost H-free. In 2005, Green proved an analogue of the Szemeredi Regularity Lemma for Abelian groups and derived a statement for Abelian groups analogous to the graph Removal Lemma. In this talk, I would like to survey a continuation of this line of research with my joint work with Serra and Venna which extends the result of Green to non-Abelian groups and systems of equations (the latter result was also proved by Shapira). Szemeredi's theorem on the existence of arithmetic progressions in dense subsets of integers can be obtained as a direct corollary of these results.

Singularity and Decay Estimates of Solutions of Nonlinear Partial Differential Equations via Scaling and Liouville-type Theorems

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Many important mathematical models in physics are described by nonlinear partial differential equations which are scaling invariant. Solutions of such problems can either be regular or may develop singularities. In both cases, rescaling and Liouvilletype theorems (guaranteeing nonexistence or explicit description of all solutions of a limit of rescaled problems) can often be used in order to describe the precise asymptotic behavior of solutions.

We will first mention a few famous problems studied by methods based on scaling arguments and Liouville-type theorems and then we will describe one of such methods in detail. In order to do so, we will consider an elliptic problem whose solutions correspond to the solitary waves of nonlinear Schroedinger equations.abs

Prize Lectures

High frequency interactions in nonlinear Schroedinger equations and applications

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We review recent results on interaction of high frequency waves interacting for equations of nonlinear Schroedinger equation. Applications to ill-posedness results will also be given.

Some Applications of Character Sums

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Character sums are important tools in the theory of finite fields since they govern the hidden relation between the additive and multiplicative structure of the field.

In this talk we mention some applications of character sums including check digit systems (e.g. ISBN and IBAN) and pseudorandom numbers.

For the construction of check digit systems which cannot detect only single errors but also neighbor transpositions ($ab \to ba$) orthomorphisms are pertinent, i.e., permutation polynomials $f(X)$ of a finite field such that $f(X)-X$ is also a permutation polynomial. Orthomorphisms can be constructed using multiplicative characters and their number can be estimated with character sums.

The integration error for the Monte-Carlo integration depends on the distribution of the used pseudorandom numbers. Their quality can be evaluated via additive character sums.

Minisymposium "Algebraic and Topological Graph Theory"

Organizers: Roman Nedela (Banska Bystrica), Tomaž Pisanski (Ljubljana)
Session 1: Sunday, 15:15–18:15, SE 2.4
Session 2: Tuesday, 14:45–16:45, SE 1.6

Exploring the structure of mathematical publications

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Zentralblatt MATH Database (ZBMATH) contains a large collection of papers and books about mathematics and is produced by the Berlin editorial office of FIZ Karlsruhe and edited by the European Mathematical Society, FIZ Karlsruhe and Heidelberger Akademie der Wissenschaften. Within the ESF project GReGAS over 1,300,000 records of mathematical publications covering the period 1990 to 2010 were analyzed. The software for analysis and visualization of large networks Pajek was the main tool for analysis. Significant attributes from ZBMATH were transformed into Pajek 2-mode network files: publication author, publication journal, publication keyword, and publication - MSC. The main part of the analysis was exploration of the collaboration structure among authors. We were also able to cluster MSC codes in order to obtain a visualization of hierarchical structure of mathematical knowledge.
Analysis was performed in collaboration with Vladimir Batagelj, Boris Horvat and Tomaž Pisanski.

Regular embeddings of multigraphs

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Let X be an arc-transitive connected simple graph with valency n and X^m be the corresponding multiple graph with multiplicity m. Let M be a regular embedding of X^m. We show that if $(m,n) = 1$, then M is a split regular covering of some regular embedding of X, or else $(m,n) \neq 1$, then M is a non-split regular covering of some regular embedding of X. As an application, we give rise to the classification of regular embedding of multiple cycles and multiple Platonic graphs.

Discrete group actions on orientable compact closed surfaces

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Discrete groups of self-homeomerphisms of compact connected surfaces attract interest of mathematicians in distinguished fields of mathematics since ancient times. The classification of spherical groups is a classical part of crystallography. By definition, groups acting on compact surfaces of genera ≥ 2 are finite. Their classification is in general a hard problem. Published lists of actions go up to genus five (Broughton; Bogopolskij; Kuribayashi and Kimura). For small genera, the the classification can be done with help of computer algebra systems. We derived the list of actions of discrete groups up to genus 24 (including). Lists of discrete groups have many applications in different fields of mathematics. In combinatorics they can be used to derive lists of highly symmetrical maps of fixed genus: regular maps, vertex-transitive maps, Cayley maps or edge-transitive maps. Such a classification results can be used as an experimental material for further research.

Drawing graphs with partial rotational symmetry

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drawing graphs with the emphasis on the symmetries of the graph. For this purpose, we represent an individual graph automorphism by constraining its orbits to concentric circles in the plane. Respecting this constraint, the graph is drawn using a force-directed embedding. Resulting drawings typically have more symmetry than simple force-directed drawings and are largely determined by the choice of automorphism. Unlike other methods for symmetric drawing, this works even when the automorphism cannot be represented as exact rotation. Any energy function of the embedding can be used in optimization; however, when the energy can be decomposed over pairs of vertices and is rotationally invariant, the symmetry constraint enables us to reduce the amount of computation required in calculating the forces and energy.
This is joint work with T. Pisanski, P. Potočnik and M. Aleksandrov.

Genus of Cartesian products containing triangles

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We investigate the genus of G_n, the cartesian product of n triangles, and related graphs. Using a lifting method we present a general construction of a low-genus embedding of G_n using a low-genus embedding of G_{n-1} satisfying some additional conditions. Our method provides currently the best upper bound on the genus of G_n for all $n \geq 5$. Additionally, we report results obtained by computer search which includes improving the upper bound on the genus of G_4 to 39, complete genus distribution of G_2, and more than 200 nonisomorphic genus embeddings of G_3.
This is joint work with T. Pisanski.

A recent progress in map enumeration

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A map is a 2-cell embedding of a graph into a closed surface. The map enumeration problem reads as follows. For a given family F of maps determine the number of isomorphisms classes maps in F having e edges. Sometimes the maps are enumerated with respect to the given number of edges and vertices (faces). A map is called rooted if one of the darts (edges endowed with orientation) is distinguished. In our talk we consider the map enumeration problem for the families of orientable maps with fixed genus and the family of all maps (regardless of genus). Exact formula for the number of rooted edges of given genus is known for $g = 0$ (Tutte 1963), $g = 1$ (Arques 1987), $g = 2,3$ (Bender and Canfield 1991), $g = 4$ (Giorgetti,Mednykh 2011). Giorgetti, Mednykh and Walsh have recently derived the enumeration formula's up to genus 10. In general, the function enumerating rooted maps of fixed genus is known up to some coefficients which can be determined provided the values are known for the number of edges $2g \leq e \leq \mu(g)$, where $\mu(g)$ is a bound depending on g.

In 1981 independently Liskovets and Wormald derived an enumeration formula for the number of isomorphism classes of spherical maps. In 2006 Mednykh and Nedela developed a general method for the enumeration of isoclasses of maps of fixed genus g. The method requires first to determine the numbers of rooted maps of all genera $\gamma \leq g$ as well as to determine all quotient surfaces of the surface S_g by all actions cyclic groups. Using this machinery the enumeration problem was

solved first for genera $\gamma = 1, 2, 3$. Later Giorgetti, Mednykh and Walsh derived the enumeration formulas for genera g, where $4 \leq g \leq 10$.

A similar method was successfully used by Breda, Mednykh and Nedela to solve the enumeration problem for the family of all maps and for the family of reflexible maps. An asymptotic analysis of these sequences done by Drmota and Nedela shows that the number of reflexible maps takes about square root of the number of all maps. The map enumeration problem remains open for the family of spherical reflexible maps.

Configurations of points and polygonal quasi-lines

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It is well known that not all combinatorial configurations admit geometric realizations. Some of them, such as the Moebius-Kantor configuration or the Fano plane do not admit even realizations with points and pseudolines. In other words, they are not topological configurations. In this presentation we introduce configurations of points in polygonal quasilines that include all topological in geometric configurations. By solving a suitable optimization problem we obtain topological or geometric realization of a combinatorial configuration, whenever such realizations exist. This is a joint work with Marko Boben, Matej Petkovič and Arjana Žitnik.

Cycle covers of signed graphs

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In this talk we focus on cycle covers of signed graphs, graphs where each edge has a sign (either $+1$ or -1). Our interest in coverings of signed graphs comes from a close relationship between coverings of graphs and nowhere-zero flows. Although the problem of finding a nowhere-zero flow in a signed graph has been examined in the past 30 years, there are no known results about cycle covers of signed graphs. We prove that for every signed graph which admits a nowhere-zero flow there is a linear bound on the total length of a cover in terms of number of edges of the graph, which is independent on the chosen graph.

Regular maps whose automorphisms are 2-groups of maximal nilpotent class

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The orientably regular maps with automorphism group isomorphic to 2-groups of maximal class are determined and classified. Our results extend the results in [A.Malnic, R.Nedela, M.Skoviera, Regular maps with nilpotent automorphism groups] where 2-groups of nilpotent class 2 were considered.

Minisymposium "Categorical Algebra, Homotopy Theory, and Applications"

Organizers: Carles Casacuberta (Barcelona), Jiri Rosicky (Brno), Jan Trlifaj (Prague)

Session 1: Monday, 15:00–18:00, SE 1.2

Session 2: Tuesday, 10:30–12:30, SE 1.2

Infinity categories

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We compare and explain from homotopical point of view the different models for the notion of ∞-categories (simplicial sets, simplicial categories) constructed by A. Joyal and J. Bergner. We construct a new model for ∞-categories, namely, the model category of topological categories Cat_{Top}. If time permit we will discuss some potential consequences of such new model.

Generalized Syzygies for Commutative Koszul Algebras

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I will report on work in progress with Vassily Gorbounov(Aberdeen), Zain Shaikh (Cologne) and Andrew Tonks (Londonmet) on the relations between Koszul duality and cohomology. We will consider the generalized syzygies of a commutative finitely generated Koszul algebra and we will prove that they agree with the cohomology of the Lie ideal $L_{\geq 3}$ of the graded Lie superalgebra such that $A^! \cong U(L)$. This generalizes results by Movshev and Schwarz, and by Gorodentsev, Khoroshkin and Rudakov. The proof uses homological algebra techniques, in particular the homotopy perturbation lemma. Also, we conjecture that $L_{\geq 3}$ will be a free algebra and proving it would help to give support to an old conjecture by Avramov.

Generalized Ohkawa's theorem

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The classical Ohkawa theorem states that in the homotopy category of spectra there is only a set of Bousfield classes. This fact has been studied and generalized to other triangulated categories by Neeman, IyengarKrause and DwyerPalmieri. In this talk we will present a generalization of Ohkawa's theorem in the context of combinatorial model categories.
This is a joint work with C. Casacuberta and J. Rosický.

Kan complexes and face structures

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Let Λ denote the subcategory of Δ (familiar from simpliicial sets) whose objects are the same as those of Δ, but whose arrows are the injective maps (face operators) only. A "face structure" is a presheaf on Λ. Every simplicial set has an underlying face structure. The talk is about results around the fact that the full simplicial structure on a Kan complex is merely a property of the underlying face structure of the complex, similarly to being an elementary topos is merely a property of the underlying category. The precise results include a characterization in FOLDS (First Order Logic with Dependent Sorts) of the homotopy invariant first-order language of Kan complexes. There are generalizations to quasi categories and Θ categories (A. Joyal). Some, but all, of the present subject I talked about in Durham, England, in 2009.

Moduli spaces of differential graded algebra structures

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In this talk I will present the comparison between the spaces of unital and non-unital differential graded algebra structures on a given chain complex. This sheds some light from an operadic point of view on various normalization results in the literature.

(Co)tilting classes over commutative noetherian rings

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In the talk, I will discuss a classification of tilting and cotilting classes over commutative noetherian rings, recently obtained jointly with Lidia Angeleri, Jan Stovicek and Jan Trlifaj. The classification is in terms of certain subsets of the Zariski spectrum of the corresponding ring.

Projective modules over universal enveloping algebras

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I will survey results on projective modules over universal enveloping algebras of finite dimensional Lie algebras over a field of characteristic zero. I will focus on the relation between direct sum decompositions of infinitely generated projective modules and the structure of the Lie algebra.

The stable model categories of modules over the Frobenius rings $\mathbb{F}_p[\varepsilon]/(\varepsilon^2)$ and $\mathbb{Z}/p^2$

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In this talk I will survey some results about the homotopy theories of the title as they were studied by Schlichting, Dugger-Shipley and in joint work with Muro. This is a fascinating case study for homotopy theory and K-theory and has led to some interesting conclusions. Time permitting, the following topics will be discussed:

(a) the associated homotopy categories are triangulated-equivalent but the model categories are not Quillen equivalent. This connects to the problem of the rigidity of a stable homotopy theory which is nicely analysed using the methods of derived Morita theory.

(b) The associated triangulated derivators cannot be equivalent, however they agree on the domain of finite ordinals. This connects to the general question of the comparison between model categories and their associated derivators.

(c) They have different Waldhausen K-theory, which can be regarded as a subtle invariant of homotopy theories, but the same derivator K-theory. This leads to some negative conclusions for derivator K-theory.

Adams representability in triangulated categories

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We will discuss recent results about the representability of cohomological functors defined from a subcategory of compact objects (with respect to a fixed cardinal) of a well-generated triangulated category.

Given a triangulated category T and a regular cardinal κ, we say that T satisfies Adams representability with respect to κ if every cohomological functor from the category of κ-compact objects in T to the category of abelian groups that sends coproducts of less than κ objects to products is the restriction of a representable functor $\mathrm{Hom}(--,X)$ with X an object in T.

If κ is countable, Adams representability is a classical result proved by Adams in the stable homotopy category, who inferred the representability of homology theories and it was later generalized by Neeman to a broader family of triangulated categories.

We will impose conditions on a triangulated category ensuring that it satisfies Adams representability with respect to an arbitrary regular cardinal κ. We will focus on concrete examples in the case when κ is $\aleph_1$

A characterization of homotopically cocomplete categories

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In this talk we review different notions of homotopy colimits and homotopy cocomplete categories appearing in the literature, and describe some relations between them. In addition, for categories with exact coproducts we give a characterization of homotopical cocompleteness based on the existence of "homotopy coequalizers", interpreted as good homotopy colimits for diagrams of simplicial shape. This characterization might be understood as a homotopical version of the classical result stating that all colimits can be computed using coproducts and coequalizers.

Computing $V(R)$ of regular rings

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Given a ring R, $V(R)$ stands for the commutative monoid of isomorphism classes of finitely generated projective right R-modules. A monoid realized as $V(R)$ of a regular ring is easily seen to be conical and to satisfy the refinement property. These properties, however, do not characterize all realizable commutative monoids due to Wehrung's counter-example. The size of the counter-example is at least $\aleph_2$; thus it leaves open the question whether all conical refinement monoid of smaller size (in particular all countable ones) are realizable. This is often quoted as the fundamental problem posed by K. R. Goodearl. We will discuss some ways how to attack this problem and present some examples of non-trivial representable monoids.

Generating the bounded derived category and perfect ghosts

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This is an account on joint work with S. Oppermann. We show for a wide class of abelian categories studied in representation theory and algebraic geometry that there are no non-trivial thick subcategories of the bounded derived category containing all perfect complexes and having finite Rouquier's dimension. This holds in particular for the category of finitely generated modules over an artin algebra, or for the category of coherent sheaves over an affine or projective scheme.

Crossed complex resolutions of group extensions

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An old paper of CTC Wall shows, with a simple spectral sequence argument, that given free chain resolutions for groups H and K one may construct a resolution for any group extension G of H by K. More recently Brown, Ellis and others have attempted, with some degree of success, to lift this construction from the category of chain complexes to that of crossed complexes or of spaces. This non-abelian situation is considerably harder; one knows, for example, that there is no homological perturbation theory for crossed complexes. In this talk we will give an

overview of the problem and present some new results obtained in collaboration with O Gill.

When is the colimit functor homotopy invariant?

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It is well known that for a (cofibrantly generated) model category $\mathcal{M}$ the colimit functor $\mathrm{colim}_I : [I, \mathcal{M}] \to \mathcal{M}$ preserves weak equivalences between diagrams that are cofibrant in the projective model structure on the diagram category $[I, \mathcal{M}]$. Some special cases are known where such homotopy invariance holds in greater generality, for example in the case of pushouts. We generalize this to other indexing categories I.

Our main application is a construction of a well-behaved cofibrant replacement functor in the category $\mathcal{V}$-$\mathtt{Cat}_O$ of categories enriched in a monoidal model category $\mathcal{V}$ with a fixed set O of objects. We hope that it will serve to extend the theory of homotopy coherent diagrams (well known for $\mathcal{V}$ being the category of simplicial sets) to arbitrary bases.

Minisymposium "Combinatorics and Graph Theory"

Organizers: Michael Drmota (Vienna), Jan Kratochvil (Prague), Marc Noy (Barcelona), Oriol Serra (Barcelona)

Session 1: Monday, 10:30–12:30, SE 1.6

Session 2: Tuesday, 10:30–12:30, SE 0.2

The k-in-a-path problem for claw-free graphs

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The k-in-a-Path problem is to test whether a graph contains an induced path spanning k given vertices. This problem is NP-complete in general graphs, already when $k = 3$. We show how to solve it in polynomial time on claw-free graphs, when k is an arbitrary fixed integer not part of the input.
This is joint work with Marcin Kaminski, Bernard Lidicky and Daniel Paulusma.

Discharging and the hamiltonicity of line graphs

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In a recent paper [1], we proved that all 5-connected line graphs with minimum degree at least 6 are hamiltonian, a partial result towards the conjecture of Matthews and Sumner (and an equivalent one of Thomassen) that 4-connected line graphs are hamiltonian. The proof involves 3-hypergraphs and a newly introduced structure called a quasigraph.

In this talk, we will show how the method can be combined with a discharging-type argument — usually associated with graphs embedded in surfaces — to prove another line graph hamiltonicity result. Recall that a graph G is *essentially k-connected* if $|V(G)| > k$ and for all vertex cuts X in G such that $|X| < k$, $G - X$ has at most one nontrivial component. Thus, a graph can be essentially k-connected even if it contains vertices of degree less than k. We give the following improvement of a result of Lai et al. [2].

Theorem *All 3-connected, essentially 9-connected line graphs are hamiltonian.* The result extends to Hamilton-connectedness and to claw-free graphs.

This is joint work with Petr Vrána.

[1] T. Kaiser and P. Vrána, Hamilton cycles in 5-connected line graphs, European J. Combin., to appear. Available at `arXiv:1009.3754 [math.CO]`.

[2] H.-J. Lai, Y. Shao, H. Wu and J. Zhou, Every 3-connected, essentially 11-connected line graph is Hamiltonian, J. Combin. Theory Ser. B 96 (2006), 571–576.

Counting paths in the honeycomb graph

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I will present a proof of the theorem of Duminil-Copin and Smirnov (2010) saying that the number of paths with length n in the honeycomb graph is $(2\cos(\pi/8))^{n+o(n)}$.

Lattice Green's Functions of the Higher-Dimensional Face-Centered Cubic Lattices

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We study the lattice Green's functions of the face-centered cubic lattice (fcc) in up to six dimensions. We give computer algebra proofs of results that were conjectured by Guttmann and Broadhurst for the four- and five-dimensional fcc lattices. Additionally we derive a differential equation for the six-dimensional fcc lattice, a result that was not believed to be achievable with current computer hardware.

A method for determining the mod-2^k behaviour of (certain) recursive sequences

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I shall present a method to obtain congruences modulo powers of 2 for sequences given by recurrences of finite depth with polynomial coefficients. I shall illustrate the method by applying it to Catalan numbers, and to subgroup counting functions

associated with Hecke groups and related groups. Thereby numerous new results are obtained, including many extensions of known results to higher powers of 2. This is joint work with Thomas Müller.

Maximum degree in minor-closed classes of graphs

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Given a class of graphs G closed under taking minors, we study the maximum degree Δ_n of random graphs from G with n vertices. We prove lower and upper bounds that hold with high probability, depending on the nature of the forbidden minors. In particular, we find orders of magnitude for Δ_n not observed before, such us $\log n/\log\log\log n$ and $\log n/\log\log\log\log n$.
This is joint work with Omer Giménez and Dieter Mitsche.

Rainbow matchings of complete bipartite graphs

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A perfect matching M in an edge-colored complete bipartite graph $K_{n,n}$ is rainbow if no pair of edges in M have the same color. We obtain asymptotic enumeration results for the number of rainbow matchings in terms of the maximum number of occurrences of a color. We also consider two natural models of random edge–colored $K_{n,n}$ and show that, if the number of colors is at least n, then there is with high probability a rainbow matching. In particular, this shows that almost every matrix in which every entry appears n times has a Latin transversal.

Minisymposium "Complex Analysis"

Organizers: Franc Forstnerič (Ljubljana), Martin Kolář (Brno), Bernhard Lamel (Vienna)

Session 1: Sunday, 15:15–18:15, Audi-Max

Session 2: Monday, 10:30–12:30, SE C 2.08

Session 3: Tuesday, 14:45–16:45, SE C 2.08

Session 4: Wednesday, 10:30–12:30, SE C 2.08

The Poletsky-Rosay theorem on singular complex spaces

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If u is an upper semicontinuous function on a locally irreducible complex space X, then the largest plurisubharmonic function v that is less than or equal to u is obtained as the pointwise infimum of the averages of u over the boundaries of analytic discs in X. This was proved by Poletsky (1993) for $X = C^n$ and by Rosay (2003) for X a complex manifold. Applications include the description of the plurisubharmonic hull of a compact set in a complex space.

Compactness of the $\bar{\partial}$- Neumann operator and applications to Schrödinger and Dirac operators

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We use a description of precompact subsets in L^2-spaces to characterize compactness of the $\bar{\partial}$-Neumann operator

$$N : L^2_{(0,q)}(\Omega) \to L^2_{(0,q)}(\Omega),$$

where $\Omega \subset \mathbb{C}^n$ is a bounded pseudoconvex domain, or

$$N_\varphi : L^2_{(0,q)}(\Omega, e^{-\varphi}) \to L^2_{(0,q)}(\Omega, e^{-\varphi}),$$

where $\Omega \subseteq \mathbb{C}^n$ is a pseudoconvex domain and φ is a plurisubharmonic weight function. It turns out that G årding's inequality in the interior and and the boundary behavior (respectively the behavior at infinity) of suitable plurisubharmonic

functions (respectively of the weight function) play a crucial role. Using the general characterization of compactness it is easy to show that property (P) implies compactness of N, if Ω is a smoothly bounded pseudoconvex domain, and that a certain behavior at infinity of the eigenvalues of the Levi matrix of the weight function φ imply compactness of N_φ.
In the case $L^2(\mathbb{C}^n, e^{-\varphi})$ there is a relationship to Schrödinger operators with magnetic field and Pauli and Dirac operators and to the complex Witten Laplacian. We show that the above results on the $\bar{\partial}$-Neumann operator can be used to settle the question whether these operators have compact resolvent. In this connection it is important to know whether the Fock space

$$\mathcal{A}^2(\mathbb{C}^n, e^{-\varphi}) = \{f : \mathbb{C}^n \to \mathbb{C} \text{ entire} : \int_{\mathbb{C}^n} |f|^2 e^{-\varphi} d\lambda < \infty\}$$

is infinite-dimensional, which again depends on the behavior at infinity of the eigenvalues of the Levi matrix of the weight function φ.

[1] F. Haslinger, Compactness for the $\bar{\partial}$- Neumann problem - a functional analysis approach, ESI-preprint 2208, arXiv:0912.4406 , Collectanea Mathematica 62 (2011), 121-129.

[2] F. Haslinger, Compactness of the $\bar{\partial}$- Neumann operator on weighted $(0,q)$-forms. ESI preprint 2291, arXiv: 1012.433 , Proceedings of the IWOTA Conference 2010, Birkhäuser Verlag, to appear.

Smoothing properties of the Bergman projection

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Let D be a bounded domain in $\mathbb{C}^n$ with smooth boundary. If the Bergman projection, B, on D is sufficiently regular, then it actually exhibits certain smoothing behaviors. E.g., if B is exactly regular, then derivatives of the output of B, measured in $L^2(D)$, only depend on derivatives of the input in a certain tangential direction.
This is joint work with Jeff McNeal and Emil Straube.

A solution to the Gromov-Vaserstein Problem

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Any matrix in $Sl_n(\mathbb{C})$ can (due to the Gauss elimination process) be written as a product of elementary matrices. If instead of the complex numbers (a field) the

entries in the matrix are elements of a ring, this becomes a delicate question. In particular the rings of maps from a space $X \to \mathbb{C}$ are interesting cases. A deep result of Suslin gives an affirmative answer for the polynomial ring in m variables in case the size of the matrix (n) is greater 2. In the topological category the problem was solved by Thurston and Vaserstein. For holomorphic functions on $\mathbb{C}^m$ the problem was posed by Gromov in the 1980's. We report on a complete solution to Gromov's problem. A main tool is the Oka-Grauert-Gromov-h-principle in Complex Analysis.
This is joint work with Bjrn Ivarsson.

Local models for strictly pseudoconvex CR structures of hypersurface type

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In this talk, we will analyse all the strictly pseudoconvex CR structures of hypersurface type on the standard contact structure on $\mathbb{R}^{2n+1}$.

Unitary representations of unimodular Lie groups in Bergman spaces

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For an arbitrary unimodular Lie group G, we construct strongly continuous unitary representations in the Bergman space of a strongly pseudoconvex neighborhood of G in the complexification of its underlying manifold. These representation spaces are infinite-dimensional and have compact kernels. In particular, the Bergman spaces of these natural manifolds are infinite-dimensional.

Conic neighbourhoods in 1-convex spaces

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We present the relative Oka-Grauert principle for holomorphic submersions over 1-convex spaces using conic neighbourhoods of holomorphic sections over 1-convex spaces. As an application we have the generalized Oka-Grauert principle for 1-convex manifolds: Every continuous mapping X to Y from a 1-convex manifold X to a complex manifold Y which is already holomorphic on a neighborhood of the exceptional set is homotopic to a holomorphic one provided that either Y

satisfies the CAP property or we are free to change the complex structure on X.

L^2-cohomology of complex spaces with isolated singularities

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Let X be a compact complex space with isolated singularities. In this talk, we give a complete description of the L^2 Dolbeault cohomology for $(0,q)$-forms on X in terms of a resolution of singularities $\pi : M \to X$. In fact, the L^2 cohomology of X is equivalent to the cohomology of M with values in a certain holomorphic line bundle modulo some torsion which sits on the exceptional set of the desingularization. The idea how this torsion can be described for all kinds of isolated singularities goes back to an observation made by Øvrelid and Vassiliadou earlier this year.

On CR singular points of real manifolds in complex manifolds

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Let M be a real manifold in a complex manifold X. The dimension of a maximal complex subspace T_p point of a generic point p inM equals $m-n$, with $m \geq n$ respectively being real and complex dimension of M and X. The points where this dimension is grater than $m-n$ are called CR singular. We will review the situation $m = n = 2$ and give some new results in the case $m = 4, n = 3$.

Holomorphic transformations to normal forms in sectorial domains

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We will talk about local classification of germs of holomorphic vector fields vanishing at 0. It is always possible to transform a vector field into a simpler model, called a normal form. Such a transformation is usually a divergent formal power series at the origin. Nevertheless, we will show that some germs of holomorphic vector fields can be transformed into a polynomial normal form by mean of an holomorphic map defined in a sectorial domain which contains 0 in the boundary.

The Hartog's extension phenomenon for line bundles across totally real manifolds

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Let X be a complex manifold of dimension greater than or equal to three, and let M be a closed real analytic totally real submanifold of X. Then any holomorphic line bundle over X/M extends to X. The most interesting case is when $\dim X = \dim M = 3$, in which case there are locally near points in M topologically nontrivial line bundles.
This is joint work with Fornæss and Sibony.

TBA

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Effective membership problems on varieties

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This talk is based on a joint work with Mats Andersson, in which we use residue currents to bound the degrees of solutions to polynomial ideal membership problems on algebraic varieties. In particular, I will discuss a generalization to the non-smooth case of a global Briancon-Skoda theorem due to Hickel and Ein-Lazarsfeld.

Dynamics of one- and multi-resonant biholomorphisms

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We construct a simple formal normal form for holomorphic diffeomorphisms in $\mathbb{C}^n$ whose differentials have one-dimensional family of resonances in the first m eigenvalues, $m \leq n$ (but more resonances are allowed for other eigenvalues). Next, we provide invariants and give conditions for the existence of basins of attraction

and extend them to the case of larger sets of resonances. Finally, we give applications and examples demonstrating the sharpness of our conditions.
This is a joint work with Filippo Bracci and Jasmin Raissy.

EuroGiga-Session

Joint Session of the Minisymposia "Algebraic and Topological Graph Theory" and "Combinatorics and Graph Theory"

Session: Monday, 15:00–18:00, Audi-Max

Kuratowski-type theorem for Partially Embedded Planarity

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In 2010, Angelini et al. presented a linear time algorithm for planarity testing of partially embedded graphs. We complement this algorithmic result by a structural theorem which a) describes minor-like operations on partially embedded graphs, and b) identifies minimal obstructions with respect to these operations.
This is a joint work with Vit Jelinek and Ignaz Rutter.

Immersions in graphs and digraphs

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An immersion of a graph H into a graph G is a one-to-one mapping $f : V(H) \to V(G)$ and a collection of edge-disjoint paths, one for each edge of H, such that the path P_{uv} corresponding to edge uv has endpoints $f(u)$ and $f(v)$. As a central result, it will be shown that every simple graph with average degree $\Omega(t)$ immerses the complete graph K_t. Moreover, if G is dense enough, then there is an immersion of K_t in which each path P_{uv} is of length precisely 2. Time permitting, extensions to digraphs will be discussed.

Most of the results presented in the talk are joint work with Matt DeVos, Zdenek Dvorak, Jacob Fox, Jessica McDonald, and Diego Scheide.

Edge-colourings of cubic graphs and point-line configurations

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We study proper edge colourings which may use any number of colours but otherwise resemble the usual 3-edge-colourings. The fundamental property of these colourings is that the colours of any two edges meeting at a vertex always determine the same third colour. We analyse this concept from both geometric and combinatorial viewpoint. In doing this, we regard the colours as geometric points and place a line through a pair of points whenever the two colours meet at some vertex. In the talk we discuss several interesting instances of such colourings, either related to symmetrical point-line configurations, or to well-known conjectures in graph theory such as the Fulkerson conjecture, or to both.

On empty pentagons and hexagons in planar point sets

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We give improved lower bounds on the minimum number of k-holes (empty convex k-gons) in a set of n points in general position in the plane, for $k = 5, 6$.

Minisymposium "Geometry, Analysis and Mathematical Physics"

Organizers: Xavier Gràcia (Barcelona), Thomas Hoffmann-Ostenhof (Wien), Olga Krupkova (Ostrava & Melbourne)

Session 1: Sunday, 15:15–18:15, SE 0.2

Session 2: Monday, 15:00–18:00, SE 1.6

Session 3: Tuesday, 10:30–12:30, SE 1.6

Lagrangian submanifolds as geometric tools to describe discrete Hamilton-Jacobi theory

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As Alan Weinstein stated once "is a Lagrangian submanifold". For instance, in 1976 Lagrangian submanifolds were used to describe Lagrangian mechanics by Tulczyjew. In classical mechanics Hamilton-Jacobi theory is useful to integrate partially or completely Hamilton's equations. Recent developments such as (Carinena et al, 2006) have provided this theory with an intrinsic formulation. In this talk we will show how Lagrangian submanifolds offer a different interpretation of Hamilton-Jacobi theory in a continuous setting. HamiltonJacobi theory has also been studied in the discrete setting (Ohsawa, Bloch and Leok, 2009). Analogously to the above-mentioned description in the continuous setting, we present here a novel intrinsic description of discrete HamiltonJacobi theory in terms of Lagrangian submanifolds.
This is joint work with María BarberoLinán and David Martín.

Integer topological charges for finite energy fields in the $O(3)$ sigma-model

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In the $(2+1)$-dimensional classical $O(3)$ σ-model, all finite energy fields have integer topological charges regardless of their asymptotic behavior at in

nity. Topological charge is conserved for the fields with finite Euclidean action, without further assumptions on the field equations or asymptotics. The fields with continuous first derivatives as well as fields in Sobolev-like spaces analogical to $W^{1,2}$ are considered.

The time-evolution operator for non-autonomous lagrangians in the homogeneous formalism

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The geometric description of time-dependent lagrangians can be done in the framework of jet bundles. In the singular case, it is also especially useful to consider the time-evolution operator that relates the constraints of hamiltonian and lagrangian formalisms. On the other hand, the homogeneous formalism transforms a time-dependent lagrangian into a time-independent homogeneous one. The main goal of this talk is to relate geometrically the dynamics and the constraints of these various settings.

A geometric analysis of dynamical systems with singular Lagrangians

MONIKA HAVELKOVÁ
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The aim is to find the corresponding "dynamical picture", i.e. the complete solution of the equations of motion (which are 2-nd order ODE). In case of regular Lagrangians the problem has a well-known and easy solution: the dynamics is completely described by a one-dimensional foliation of the phase space. For singular Lagrangians the situation is much more difficult. It is necessary to apply the so-called geometric constraint algorithm which provides a system of so-called final constraint submanifolds (where the dynamics proceeds). This method provides a mathematically correct solution to the problem to find and describe the singular Lagrangian dynamics first considered by Dirac in 1950. Contrary to the geometric approach the Dirac's heuristic method often provides incorrect results. Our aim is to analyze completely the dynamics of a concrete singular Lagrangian by the geometric approach.

This is joint work with Olga Krupkova.

Spectral Minimal Partitions

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Consider a domain $\Omega \subset \mathbb{R}^2$ and a partition of Ω into k pairwise disjoint sets, $D_1, D_2, \ldots, D_k$. Associate to each of the D_i the corresponding lowest Dirichlet eigenvalue $\lambda_1(D_i)$). Take the infimum of $\max_{i \leq k} \lambda_1(D_i)$ over all k-partitions and call it $\mathcal{L}_k(\Omega)$. A partition for which the minimum a is achieved is called a spectral minimal partition.

In this talk we will review some properties of the $\mathcal{L}_k(\Omega)$ and their associated $\mathcal{P}_k(\Omega)$. In particular, relations of the $\mathcal{L}_k(\Omega)$ with the spectrum of the Dirichlet Laplacian for Ω and the relation between the $\mathcal{P}_k(\Omega)$ with the eigenfunctions and their nodal domains are discussed. Finally, we present a new approach characterizing those $\mathcal{L}_k(\Omega)$ and $\mathcal{P}_k(\Omega)$ with the help of Aharonov Bohm problems.
This is joint work with Bernard Helffer and Susanna Terracini; some important numerical work has been contributed by Virginie Bonnaillie Noel.

Higher order Utiyama's reduction method

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Generalizations of Utiyama's reduction method will be presented for various types of connections (general linear connections on vector bundles, principal connections on principal bundles, general connections on fibered manifolds). In all cases the Utiyama's theorem and the invariant interaction can be generalized for any finite order.

On the characteristic rank of smooth manifolds

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The subject of this talk is the characteristic rank of smooth manifolds – a homotopy invariant introduced in J. Korbaš, The cup-length of the oriented Grassmannians vs a new bound for zero-cobordant manifolds, Bull. Belgian Math. Soc. 17 (2010), 69–81. More precisely, the characteristic rank, charrank(M), of a smooth closed connected d-dimensional manifold M is defined to be the largest integer k $(0 \leq k \leq d)$ such that each element of the cohomology group $H^j(M; Z_2)$ with $j \leq k$

can be expressed as a polynomial in the Stiefel-Whitney characteristic classes of M.

Affine duality, and Lagrangian and Hamiltonian systems

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We use affine duals of jet-bundles to describe how Legendre maps may be used to provide Hamiltonian representations of variational problems in a single independent variable. Such a problem may given as a Lagrangian (of first-order or of higher-order), or alternatively as a locally variational form on a jet bundle of arbitrary order with no preferred Lagrangian.
This is joint work with David Saunders.

Helmholtz morphisms in the variational sequence and the corresponding covariant inverse variational problem

RADKA MALIKOVA
University of Ostrava

We investigate the properties of the Helmholtz morphisms in the variational sequence in the context of the calculus of variations. It is known that the kernel of the Helmholtz mapping consists of locally variational dynamical forms. We study the image of Helmholtz morphism and the kernel of next morphism. We solve the corresponding local and global inverse problem.

The talk refers on joint work with Olga Krupková.

From action-angle coordinates to geometric quantization and back

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A choice of polarization is a key ingredient in the geometric quantization scheme. A Lagrangian foliation gives a real polarization. It is a well-known result due to Snyaticki that in the case this regular Lagrangian is a fibration (with Hausdorff leaf space), the geometric quantization (à la Kostant) is given by its Bohr-Sommerfeld leaves. Under compactness assumptions, the set of Bohr-Sommerfeld leaves is discrete and can be determined via action-angle coordinates (Guillemin-Sternberg).

In this talk, we will extend these results to the singular setting and explain some of our current projects. One of the main ingredients is the study of normal forms and action-angle coordinates with singularities for integrable systems in the symplectic and Poisson context.

Kinematic reduction and the Hamilton–Jacobi theory

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The relationship between the classical Hamilton–Jacobi theory and the kinematic reduction of control systems by decoupling vector fields is studied in this talk. The geometric interpretation of this relationship relies on new mathematical techniques for mechanical systems defined on a skew-symmetric algebroid. This geometric structure allows us to describe nonholonomic systems, with both control and external forces, in a simplified way.

Homogeneity for higher-order ordinary differential equations

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Homogeneity for higher-order ordinary differential equations Abstract: A system of homogeneous second order ordinary differential equations may be represented by a spray; the geodesics of the spray are curves in the base manifold with an orientation but without any particular parametrization. In this talk I shall describe a geometric homogeneity property for systems of higher-order ODEs, and show how the third order case differs from the case of fourth (and higher) order systems.

Lie algebroids of Poisson type

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I will show how to characterize those Lie algebroids on algebraic oneforms that come from Poisson algebras in a general setting (actually, that of Lie-Rinehart algebras). Moreover, I will give a description of the parametrization of a certain subclass of transitive algebroids by means of a connection and a way to construct new Poisson algebras from these transitive algebroids

Minisymposium "Innovative time integrators"

Organizers: Bojan Orel (Ljubljana), Alexander Ostermann (Innsbruck)
Session 1: Tuesday, 10:30–12:30, SE C 2.01
Session 2: Tuesday, 14:45–16:45, SE C 2.01

Krylov subspace techniques for rational integrators

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Implementation of exponential integrators is usually based on Krylov subspace methods, with control of generalized residuals.

We consider the case where rational analogues are used for the matrix exponential and the phi- or related functions, e.g. in Adams-Padé methods. In this case, each step involves solution of linear systems involving certain matrix polynomials, and the corresponding residuals can be readily evaluated by Krylov techniques. We study the question how this can be used to estimate and correct the error of the Krylov approximation.

Error estimators for adaptive splitting methods

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We put forward different estimators of the local error of split-step time integrators for evolution equations, to act as a basis for adaptive time-stepping. The first estimator is constructed from related pairs of splitting formulae of different orders, similarly to embedded Runge-Kutta methods, where several of the compositions coincide to save computational work. The second class of estimators is based on the defect correction principle and yields asymptotically correct estimates. The underlying idea is to form the defect of the splitting approximation and backsolve for the estimator using a related Sylvester equation. This results in an integral representation which can be approximated numerically with little computational effort. We demonstrate that both error indicators can successfully act as the basis for adaptive time-stepping which is commensurate with the solution behavior for a number of linear and nonlinear test problems comprising nonlinear Schroedinger equations and dissipative parabolic problems.

This is joinw work with Winfried Auzinger, Christof Neuhauser, and Mechthild Thalhammer.

An analysis of exponential Taylor integrators

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We consider a Taylor series based exponential integrator for the time integration of large stiff systems of ordinary differential equations, which result from semidiscretiza- tion of partial differential equations and which are of the form $u'(t) = Au(t) + g(u(t))$. The integrator can be obtained by Taylor series expansion of the nonlinear part $g(u(t))$ at each numerical approximation u_n, and is given by a sum of the form $\sum_{k=0}^{p} h^k \varphi_k(hA) w_k$. The matrix functions φ_k are related to the exponential function, and the coefficients w_k represent time derivatives of $g(u(t))$ at u_n. The computational attractiveness of this method comes from a result of Al-Mohy and Higham [1], which states that this sum can be expressed in terms of a single exponential of a matrix $\tilde{A}$ built by augmenting A with p additional rows and columns. The integrator works well for small values of p. For $p \geq 4$, however, the method suffers from instabilities which are caused by the loss of smoothness in the numerical solution along the time integration. The accumulation of round-off errors is demonstrated. Moreover, we perform numerical comparisons for the case of a state-independent inhomogeneity $u'(t) = Au(t) + g(t)$, where these instabilities do not occur. For the case of a state- dependent inhomogeneity we shortly discuss the effcient computation of the Taylor coefficients using the principles of automatic differentiation. Numerical experiments supporting the theoretical analysis are given using MATLAB.
This is joint work with A. Ostermann.

[1] Awad H. Al-Mohy and Nicholas J. Higham: Computing the action of the matrix exponential, with an application to exponential integrators, SIAM J. Sci. Comput. 33 (2011) pp. 488–511.

[2] Antti Koskela and Alexander Ostermann: Exponential Taylor methods – analysis and implementation, University of Innsbruck, preprint, 2011.

Constraint-driven optimization approach to build a Petri Net defence response model in plants

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Even though there is a huge interest in the biological community, the global de-

fence response model in plants for simulation purposes has not been developed so far. One of the reasons is the mechanism complexity. Moreover, in this particular case, there is only one publicly available experimental dataset with time series longer than two time points per gene expression, which makes the model construction difficult.

For these reasons, having in mind that there is huge domain knowledge available, the only feasible approach to construct the model turned out to be manual development by biology experts. After thorough search for appropriate modelling formalism, we have selected Hybrid Functional Petri Net (HFPN) [1] since it combines the intuitive graphical representation and the Ordinary Differential Equations calculations.

Basically, the manually developed HFPN model contains 46 biological reactions, where each differential equation describes one reaction that contains one speed rate parameter. Moreover, there are 10 inhibition threshold parameters to estimate. The output of the model is 61 time series data with 1000 time points that represent dynamical behaviour of biological molecules when the virus attacks the plant. Having such a complex model with 61 differential equations that represent each biological molecule and 56 unknown parameters in total, the manual parameter estimation to satisfy the biological expectations was unattainable. Moreover, the set of solutions is infinite.

To overcome this problem, we have to compute the evolution of this system with different values of parameters. This enables us to locate the values of parameters that violate the minimal number of constraints. The constraints are provided by the experts and represent unary and binary biological molecules relations. More specifically, the constraints are limited only to the output, i.e. time series of 61 biological molecules. If the simulation results do not match expert expectations, the model and the constraint definitions are revised and the optimization parameter search is repeated. Finally, the system yields both simulation results and optimized model parameters, which provide an insight into the biological system.

Our constraint-driven optimization approach allows for an efficient exploration of the dynamic behaviour of the biological models and also increases their reliability.

This is joint work with Matjaž Depolli, Marko Petek, Tjaša Stare, Marina Dermastia, Kristina Gruden, Igor Mozetič, and Nada Lavrač.

This work has been also supported by the European Commission under the 7th Framework Programme FP7-ICT-2007-C FET-Open, contract no. BISON-211898, AD Futura scholarship and the Slovenian Research Agency grants P2-0103 and J4-2228.

[1] Matsuno H, Doi A, Drath R, Miyano S. Genomic Object Net: Hybrid Petri net for describing biological systems. Currents in Computational Molecular Biology. 2001; 233-4.

Approximate solution of initial-boundary value problems with nonperiodic Fourier series

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For solving parabolic (i.e. heat) equations or hyperbolic (i.e. vibrating string) equations, the method of lines is an alternative to finite difference methods or finite elements method. This method consists of discretizing the equation in space variables and integrating the remaining initial value ODEs. We choose truncated nonperiodic trigonometric series for the spatial dis- cretization and a Magnus method for the integration in time. The trigono- metric series approximation with its spectral convergence allows us to use a smaller ODE system, which enables us to apply the Magnus method for time integration. The approximation with nonperiodic trigonometric series is based on Huybrechts' technique for approximating nonperiodic functions by trigonometric series.

In the first part of the talk we'll describe the efficient construction of the half-range Chebyshev polynomials of the first and second kind and their role in approximating functions with trigonometric series, as well as efficient manipulations with these series (computing derivatives and products of two such series). In the second part applications of these techniques to BVPs will be considered. Finally, in the third part we will apply the Magnus method to the resulting IVP in ODEs.

Exponential integrators

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In recent years there has been a considerable progress in the construction, analysis and implementation of new types of time discretizations for evolution equations. In this talk we will concentrate on exponential methods, a class of integrators which dates back to the late 1950ies.

We start with a historical account on these methods and emphasize their relation to linearly implicit time integration which was developed in parallel. The larger part of the talk, however, is devoted to recent developments. In particular, we will touch upon the relation to multiple time stepping methods.

Finally, we outline the construction of a meshfree integrator and illustrate its properties with the help of two numerical examples: the Molenkamp–Crowley test and a nonlinear Schrödinger equation exhibiting an interesting soliton dynamics.

[1] M. Caliari, A. Ostermann, S. Rainer, Meshfree exponential integrators. Preprint (2011)

[2] M. Hochbruck, A. Ostermann, Exponential integrators. *Acta Numerica* 19, 209–286 (2010)

[3] M. Hochbruck, A. Ostermann, Exponential multistep methods of Adams-type. To appear in *BIT* (2011).

Minisymposium "Nonlinear PDEs - Modelling, Computations, Applications"

Organizers: Karol Mikula (Bratislava), Michal Beneš (Prague), Vicent Caselles (Barcelona), Otmar Scherzer (Vienna)

Session 1: Sunday, 15:15–18:15, SE 0.1

Session 2: Monday, 10:30–12:30, Audi-Max

Session 3: Tuesday, 10:30–12:30, SE 0.1

Numerical simulation of anomalous transport in porous media

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In the contribution, we present computational studies of the fractional-advection dispersion equation containing the fractional-derivative multidirectional diffusion term which can be responsible for anomalous transport effects. Known justification of this model relies on the relation with the Levy stochastic processes. The solution of the model exhibits anisotropic features and variety of interesting phenomena not observed in the Brownian diffusion. Numerical solution of the transport equation leads to the linear systems of equations with full matrices which slows down the solution process. We couple the transport equation to the single-phase saturated flow in a heterogeneous medium and study the anomalous contaminant transport in it.

A Selcetion Mutation Model for the Maturation Age

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Selection-mutation equations are nonlocal partial differential equations for population densities of individuals with respect to some evolutionary trait. So they serve as mathematical models of biological evolution.

A selection-mutation equation will be presented where the evolutionary trait is the age at maturity. From the mathematical point of view, the model belongs to the so called Physiologically Structured Population Dynamics and the structuring variables are the physiological age and the maturation age. Existence and uniqueness

of solution of the initial value problem as well as existence of steady states will be briefly discussed.

Local and non local models in image denoising

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n this talk, we will give an introduction to the problem of noise removal in digital images and study the relationship between the neighborhood filters and partial differential equations. In a paper of Buades-Morel-Coll, 2005, the authors introduced the NL-means algorithm, a new concept based on non-local similarity between pixels. We will show the advantages of this new non local approach by comparing with the classical local neighborhoods. Finally, we will give some examples of application for the NL-means in some problems of image processing (video, demosaicking ...).

Shape Encoding and Shape Reconstruction with the Circular Integral Invariant

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In this talk I briefly introduce and discuss the properties of the circular integral invariant and present numerical results in the context of an ill-posed problem confirming the applicability of this invariant as a geometrical shape descriptor.

Numerical schemes for level set equations – analysis and applications

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New non-diffusive numerical schemes for level set equations are presented. They are based on finite volume numerical method and differ from the approximation of a gradient which arises in the denominator in the level set equation. Numerical analysis for the approximation solution together with numerical experiments are presented.

3D curve evolution algorithm with tangential redistribution for a fully automatic finding of an ideal camera path in virtual colonoscopy

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We describe new method for nding the optimal trajectory of the camera in the virtual colonoscopy - the medical technology dealing with colon diagnoses by computer. The proposed method consists of three steps: 3D segmentation of the colon from CT images, nding an initial trajectory guess inside the segmented 3D subvolumes, and driving the initial 3D curve to its optimal position. To that goal, the new fast and stable 3D curve evolution algorithm is developed in which the initial curve is driven by the velocity eld in the plane normal to the evolving curve, the evolution is regularized by curvature and accompanied by the suitable choice of tangential velocity.

High resolution numerical methods for some models of sedimentation of polydisperse suspensions

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Polydisperse suspensions consist of small particles which are dispersed in a viscous fluid, and which belong to a finite number N of species that differ in size or density. Spatially one-dimensional kinematic models for the sedimentation of such mixtures are given by systems of N non-linear first-order conservation laws for the vector ϕ of the N local solids volume fractions of each species. The problem of hyperbolicity of this system is considered here for the models due to Masliyah, Lockett and Bassoon, Batchelor and Wen and Höfler and Schwarzer. In each of these models, the flux vector depends only on a small number $m < N$ of independent scalar functions of ϕ, so its Jacobian is a rank-m perturbation of a diagonal matrix. This allows to identify its eigenvalues as the zeros of a particular rational function $R(\lambda)$, which in turn is the determinant of a certain $m \times m$ matrix. The coefficients of $R(\lambda)$ follow from a representation formula due to Anderson [Lin. Alg. Appl., 1996]. It is demonstrated that the secular equation $R(\lambda) = 0$ can be employed to efficiently localize the eigenvalues of the flux Jacobian, and thereby to identify parameter regions of guaranteed hyperbolicity for each model.

We show that efficient local characteristics based upwind numerical methods can be designed if an adequate prescription of numerical viscosity at sonic points takes place. This prescription relies upon an interleaving of flux Jacobian eigenvalues

and phase velocities that is guaranteed by the secular equation.
This is joint work with Raimund Bürger, Rosa Donat, and Carlos Vega.

New constrained level-set method for image segmentation with implementation on GPU

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We propose a new constrained level-set method for semi-automatic image segmentation. The method allows to specify which parts of the image lie inside respectively outside the segmented objects. Such an a-priori information can be expressed in terms of upper and lower constraints prescribed for the level-set function. Constraints have the same meaning as the initial seeds of the graph-cuts based methods for image segmentation. A numerical approximation scheme is based on the complementary-finite volumes method combined with the Projected successive over-relaxation method adopted for solving range bounds constrained linear complementarity problems. The solver is implemented in CUDA to run on GPU. The advantage of the constrained level-set method is demonstrated on several artificial images as well as on cardiac MRI data.

Cell tracking in 3D+time image sequences

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We introduce new techniques for 4D (space-time) segmentation and tracking in time sequences of 3D images of zebrafish embryogenesis. Instead of treating each 3D image individually, we consider the whole time sequence as a single 4D image and perform the extraction of objects and cell tracking in four dimensions. The segmentation of the spatiotemporal objects corresponding to the time evolution of the individual cells is realized by using the generalized subjective surface model that is discretized by a 4D finite volume scheme. Afterwards, we use the distance functions to the borders of the segmented spatiotemporal objects and to the initial cell center positions in order to backtrack the cell trajectories. The distance functions are obtained by numerical solution of the time relaxed eikonal equation.

Hybrid discontinuous Galerkin methods for the Navier-Stokes equations

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Discontinuous Galerkin finite element methods provide a lot of freedom to obtain desired stability properties of numerical schemes. In particular, the upwind choice of numerical fluxes allow large convective terms, e.g. large Reynolds numbers. Furthermore, by relaxing the continuity constraints of the finite element basis functions it becomes simple to construct exactly divergence free discrete approximations leading to stability in kinetic energy.

Discontinuous Galerkin methods lead to an increased number of unknowns, and even worse, to a much stronger coupling in the stiffness matrix. Here, recent hybridization techniques come into the game. One introduces even more unknowns on element interfaces. But now, the coupling between elements is reduced to the interface variables, and the element unknowns can be eliminated by static condensation.

In our talk we discuss the construction of such hybrid DG methods for the incompressible Navier-Stokes equations. We discuss the connection to time integration (in particular splitting methods), and iterative solvers (in particular domain decomposition methods). Numerical results for benchmark problems are presented.

On a gradient flow for the anisotropic ratio and other nonlocal geometric flows

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We analyze a system of governing PDEs for geometric quantities and propose a numerical method for computing the mean curvature flow with a nonlocal term. The numerical computation is stabilizaed by using the curvature adjusted tangential velocities for which the tangential velocity speed depends on the function of curvature and its curve average.

Nonlinear Schroedinger Equations: Modeling and Simulation of Bose-Einstein condensates (BECs)

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The modeling of a Double-Well experiment for Bose-Einstein-Condensate condensates is described and discussed from a numerical simulation point of view. The experiment is realized by the AtomChip group of the TU Wien and consists of the creation of a BEC in a double-well trapping potential, which splits a single condensate into two parts. The exact shape of the trapping potential is controlled via a so-called AtomChip. Numerical simulations are done in 3 space dimensions and with the help of parallel computing. The interference patterns observed after opening the trap in the experiment can be reproduced by simulations. Exact quantization of decoherence between the two condensate parts in the time evolution of the GPE can be simulated and connected to state-of-the-art theory for coherence decay in BEC. Beyond the BEC modeling, I will also discuss Blow-Up solutions for focusing cubic (or quintic) NLS. A numerical study shows non-monotonicity of Blow-Up time in dependence to coupling strength.

Minisymposium "Operator Theory"

Organizers: Vladimir Müller (Prague), Janko Bračič (Ljubljana)
Session 1: Monday, 10:30–12:30, SE 0.2
Session 2: Monday, 15:00–18:00, SE 0.2

On certain multidimensional integrals

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We discuss various ways of computing certain integrals with application to problems of moments in several variables.

On locally linearly dependent operators

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Locally linearly dependent operators arise in many problems in Operator theory. In this talk, we will say a little about applications of these operators, and study their connection with quantum entanglement.

Reflexive and hyperreflexive sets of operators

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Reflexivity and hyperreflxivity of spaces and algebras of operators have been studied by many mathematicians interested in bounded linear operators on Hilbert and Banach spaces. However, these two notions can be considered also for sets of operators which are not necessary linear spaces or algebras. We will present a few related results and discuss several open questions.

On maximal distances in commuting graph

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A commuting graph of an algebra is a simple undirected, loopless graph whose vertices are noncentral elements of the algebra and where two distinct vertices are connected if the corresponding elements commute. It is known that a commuting graph of a matrix algebra is connected, provided that the underlying field is algebraically closed. Moreover, its diameter (i.e. the maximal distance between two vertices) if four. We will present some recent results which classify matrices that, in a commuting graph, are at maximal distance to some other matrix.

With the help of commuting graph we can also determine which matrices are of rank-one and which are diagonalizable. Since matrices with the same commutant are indistinguishable in commuting graph, our results hold only up to equivalence relation, induced by the commutant.
This is a joint work with G. Dolinar and P. Oblak.

Mappings preserving Browder, semi-Browder and similar classes of operators

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Let H be a separable infiite-dimensional Hilbert space and $H : B(H) \to B(H)$ a continuous surjective additive mapping. We give a characterization of such mappings preserving the class of Browder operators in both directions. Similar characterizations will be given also for mappings preserving upper (lower) semi-Browder operators, operators with inite ascent (descent) and Drazin invertible operators.
This is joint work with M. Mbekhta and M. Oudghiri

Adjacency preserving maps

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We will present some recent results on adjacency preserving maps on hermitian matrices, self-adjoint operators, and Hilbert space effects. These results can be

applied to study symmetries in mathematical foundations of quantum mechanics.

Hyperreflexivity of linear spaces of operators

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A review of results on reflexivity and hyperreflexivity of some spaces of bounded linear operators will be given in the lecture. In particular, we shall consider reflexivity and hyperreflexivity of intertwiners and commutants of Jordan models. A review of known examples of nonhyperreflexive reflexive spaces will be also given.

Minisymposium "Oscillation and Spectral Theory of Differential and Difference Equations"

Organizers: Ondrej Došlý (Brno), Roman Šimon Hilscher (Brno), Gerald Teschl (Vienna)

Session 1: Sunday, 15:15–18:15, SE 1.2

Session 2: Monday, 10:30–12:30, SE 1.2

Session 3: Wednesday, 10:30–12:30, SE C 2.07

Relative Oscillation Theory for Jacobi Matrices

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Classical oscillation theory for Jacobi matrices connects the number of eigenvalues below a given value with the number of sign flips of certain solutions of the underlying difference equation. Considered here will be the difference between the number of eigenvalues of two Jacobi matrices which we will connect with the number of sign flips of the Wronskian of two solutions of the underlying difference equations.

Elliptic differential operators with δ-potentials

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We discuss some spectral properties of a class of uniformly elliptic second order differential operators with δ and δ'-potentials supported on smooth hypersurfaces.

Spectral problems of some nonlinear partial differential equations

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Two eigenvalue problems will be considered:

$$\begin{gathered} \operatorname{div}(|\nabla u|^{q-1}\nabla u)+\lambda|u|^{q-1}u=0 \ \text{ in } \ \Omega, \\ u=0 \quad \text{on} \quad \partial\Omega, \end{gathered} \tag{1}$$

and

$$\begin{gathered} \frac{\partial}{\partial x}\left(\left|\frac{\partial u}{\partial x}\right|^{q-1}\frac{\partial u}{\partial x}\right)+\frac{\partial}{\partial y}\left(\left|\frac{\partial u}{\partial y}\right|^{q-1}\frac{\partial u}{\partial y}\right)+\lambda|u|^{q-1}u=0 \quad \text{in} \quad \Omega, \\ u=0 \quad \text{on} \quad \partial\Omega, \end{gathered} \tag{2}$$

$0<q<\infty$, and Ω is a bounded convex domain in $\mathbb{R}^2$.

The eigenvalues are examined for some special domains (for square and "circle" domains).

Oscillation of fourth order differential equations

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We study fourth order differential equations with the middle term

$$x^{(4)}(t)+q(t)x''(t)+r(t)f(x(t))=0 \tag{3}$$

as a perturbation of the linear equation

$$y^{(4)}(t)+q(t)y''=0. \tag{4}$$

We assume that the differential operator $L(u)=u''+q(t)u$ is oscillatory, i.e. equation (3) cannot be written as a two-term equation.

Using a new iterative method, we show that for every solution y of (4) there exists a solution x of (3) such that $x^{(i)}-y^{(i)}$ $(i=0,\dots,3)$ have bounded variation in a neighborhood of infinity and tend to zero. In particular, we give conditions for the existence of bounded oscillatory solutions of (3). Our results are new also for linear equations.

This is a joint work with M. Bartušek, M. Cecchi and M. Marini.

Two-paramentric conditional oscillation of half-linear differential equations

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We introduce the concept of two-parametric conditional oscillation of the half-

linear second order differential equation

$$\big(r(t)\Phi(x')\big)' + c(t)\Phi(x) = 0, \quad \Phi(x) := |x|^{p-2}x.$$

We show what role plays this concept in the half-linear oscillation theory.

Measure Sturm–Liouville operators

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Consider the measure Sturm–Liouville problem

$$-\frac{d}{dx}\frac{d}{d\varsigma}y(x) + \chi(x)y(x) = z\rho(x)y(x), \quad x \in (a,b),\ z \in \mathbb{C}, \tag{5}$$

where ς, χ and ρ are allowed to be locally finite signed Borel measures on some interval (a,b). We discuss self-adjointness and spectral theory for operators associated with this equation.
This talk is based on joint work with G. Teschl.

Transformation operators for Schrödinger operators on infinite-gap backgrounds

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Transformation operators which preserve the asymptotic behavior at infinity are the main tool for considering different kinds of direct and inverse scattering problems. We present an investigation of the transformation operators for one-dimensional Schrödinger operators with potentials, which are asymptotically close to almost periodic infinite-gap potentials. At the end we will give an outlook on scattering theory in that case.

Deformation of the Weyl algebra

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We will study the Weyl algebra and its so–called h– and q–deformations. These algebras provide an algebraic background for various types of differential and difference operators. The algebras will then appear in certain quiver representations that are connected to basic equations of mathematical physics.

Spectral Theory of Continuous Hamiltonian and Discrete Symplectic Systems

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We consider continuous Hamiltonian differential and discrete symplectic eigenvalue problems with Dirichlet boundary conditions. We present the basic results on these eigenvalue problems in both cases, continuous and discrete, which are the *Oscillation Theorem*, *Rayleigh's Principle*, *Existence* of eigenvalues, the *Expansion Theorem* and *Completeness* of the eigenfunctions. The main tools for the proofs will be discussed, in particular: *Picone's Identity*, *l'Hospital's Rule* for matrices, and an *Index Theorem* for monotone matrix-valued functions.

[1] M. Bohner, O. Došlý and W. Kratz, Sturmian and spectral theory for discrete symplectic systems, TAMS 361(2009), 3109–3123.
[2] W. Kratz, Quadratic Functionals in Variational Analysis and Control Theory, Akademie Verlag 1995.

A critical oscillation constant depends on time scales

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We discuss an extension of Hille-Nehari type criteria and Kneser type criteria to second order dynamic equations on arbitrary time scales. Both, linear and half-linear equations are considered. In particular, we get that the "magic" constant 1/4 known from the linear differential equations case (or the corresponding constant from the half-linear differential equations case) is not invariant with respect to the choice of a time scale. The results turn out to be new even in the well-studied difference equations case. Some applications, related results, and directions for a future research in this field will be indicated as well.

Oscillation and spectral theory for Sturm-Liouville equations with nonlinearity in the spectral parameter

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We consider the second order Sturm–Liouville eigenvalue problem with Dirichlet boundary conditions and nonlinear dependence on the spectral parameter. We allow the potential to be (not necessarily strictly) monotone. We define new notions

of eigenvalues and eigenfunctions and establish the corresponding oscillation theorem.

This work is based on a joint paper "Oscillation and spectral theory for linear Hamiltonian systems with nonlinear dependence on the spectral parameter" (2011) with Martin Bohner (Missouri University of Science and Technology) and Werner Kratz (University of Ulm).

On Sturm–Liouville operators on time scales

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We establish the connection between Sturm–Liouville equations on time scales and Sturm–Liouville equations with measure-valued coefficients. Based on this connection we are able to generalize several results for Sturm–Liouville equations on time scales which have been obtained by various authors in the past.
This talk is based on joint work with J. Eckhardt.

An addendum to M.G.Kreĭn's Inverse Spectral Theorem for strings

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A string is a pair (L,m) where $L \in [0,\infty]$ and m is a positive, possibly unbounded, Borel measure supported on $[0,L]$; we think of L as the length of the string and of m as its mass density. To each string a boundary value problem is associated, namely

$$f'(x) + z\int_0^{\infty} f(y)\,dm(y),\ x \in \mathbb{R}, \qquad f'(0-) = 0\,.$$

A positive Borel measure τ on $\mathbb{R}$ is called a (canonical) spectral measure of the string $\mathrm{S}[L,m]$, if there exists an appropriately normalized Fourier transform of $L^2(m)$ onto $L^2(\tau)$.

In order that a given positive Borel measure τ is a spectral measure of some string, it is necessary that:

- $\int_{\mathbb{R}} \frac{d\tau(\lambda)}{1+|\lambda|} < \infty$.
- Either $\operatorname{supp}\tau \subseteq [0,\infty)$, or τ is discrete and has exactly one point mass in $(-\infty,0)$.

It is a deep result, going back to M.G.Kreĭn in the 1950's, that each measure with $\int_{\mathbb{R}} \frac{d\tau(\lambda)}{1+|\lambda|} < \infty$ and supp $\tau \subseteq [0,\infty)$ is a spectral measure of some string, and that this string is uniquely determined by τ. The question remained open, which conditions characterize whether a measure τ with supp $\tau \not\subseteq [0,\infty)$ is a spectral measure of some string. In the present paper, we answer this question. Interestingly, the solution is much more involved than the first guess might suggest.

Minisymposium "Uncertainty modelling"

Organizers: Josef Arlt (Prague), Magda Komorníková (Bratislava), Radko Mesiar (Bratislava)

Session 1: Sunday, 15:15–18:15, SE 1.1

Session 2: Tuesday, 10:30–12:30, Audi-Max

Session 3: Tuesday, 14:45–16:45, SE 0.2

Time series analysis with wavelets

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Wavelets are a relatively new tool of the data analysis. They have been successfully applied in meteorology, geophysics, hydrology, astronomy, signal processing, statistics, medicine etc. The results are often very interesting and bring new insights into the phenomenon which is being studied. Recently wavelets have also found their way to economics and finance. I give a short introduction to the time series analysis with wavelets and present a few applications of wavelets in the analysis of economic and financial time series.

Invariant multivariate dependence structure under univariate truncation

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The interest in the construction of multivariate stochastic models describing the dependence among several variables has grown in the last years. In particular, the recent financial crisis has underlined the necessity of considering models that can serve to estimate better the evolution of dependency between different factors when one of them is achieving the extreme values. Copulas are the most general measures of dependence. Hence, the first step is to study copulas invariant under univariate conditioning i.e. copulas C, such that if C is the copula of the random vector $X = (X_1, ..., X_{n+1})$, then C is also the copula of X supposing that X_1 is smaller than its alpha-quantile. In my talk I am going to characterize such invariant copulas in terms of the conditional copulas of $X' = (X_2, ..., X_{n+1})$ under the condition $X_1 = x$ and bivariate marginal copulas of pairs (X_1, X_i), $i = 2, \ldots, n+1$.

Rotations of copulas and their applications in modelling of financial data

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We have investigated relations between the returns of some major global stock indexes (New York, Tokyo, London) as well as their influence on the returns of regional indexes in South-East Asia. The existence of the time lag between New York and East Asia enabled us to identify a prevailing global leading influence of the N.Y. stock index (expressed by greatly increased values of the Kendall correlation coefficient of its lagged time series with those of the Asian stocks). However, the intensity of the relations between all studied indexes has manifested a strong time variability (with major changes in the time periods of global recessions, as well as when major local economic disturbances with global consequences occurred). In order to obtain more realistic models for such changes, we applied regimeswitching modeling procedures utilizing Archimedean class copula models and their convex combinations.
This is joint work with Magda Komorníková.

Copulas and integrals

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The stochastic dependence structure of bivariate random variables captured by copulas can be applied in the integration approaches. Indeed, a copula $C : [0,1]^2 \to [0,1]$ can express the connection between function values and measure values through an integral $I_{C,m}$ by $I_{C,m}(a, 1_A) = C(a, m(A))$, where m is the (monotone) measure and $a \in [0,1]$ is a constant. Looking on integrals IC, as functionals, one can introduce an axiomatic approach, too. For example, comonotone additivity is a genuine property of the Choquet integral, while the comonotone maxitivity and the minhomogeneity characterize the Sugeno integral. We give a general axiomatic characterization of discrete copulabased universal integrals.

Modeling of non-compatible random events via multidimensional states

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The theory of quantum logics began in the beginning of the 20th century because the classical theory of probability theory did not explain events that occurred in quantum physics. In these days, many scientific schools are interested in the study of non-compatibility and in the study of uncertainty of random events Algebraic approach is based on the study of more general structures such as Boolean algebra. We will use an orthomodular lattice with at least one state. This structure is called quantum logic. States on quantum logic represent probability measures and observables on quantum logic represent random variables. We will focus on multivariable states that represent measures of intersection, union and symmetric difference in the case of compatibility. Multidimensional states are possible to use for modeling of non-compatible observables, for example, for modeling of joint distribution.

Bivariate generalized Pareto distribution in practice: models and estimation

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Extreme values are of substantial interest in fields of environmental science, engineering or finance, because they are associated with rare but hazardous events (such as flooding, mechanical failure or severe financial loss). There is often interest in understanding how the extremes of two different processes are related to each other. One possible way to tackle this problem is an asymptotic approach which involves fitting multivariate generalised Pareto distribution (MGPD) to data that exceed a suitably high threshold. As exceedances can be defined different ways, there are a few non-equivalent definitions of MGPD in use. A rather classical way is the first type definition which is based on exceedances being over the threshold in all components and a second type definition considers those exceedances, which are over a threshold in at least one of the components regardless of the rest. The first type definition is widely investigated in the recent literature but the second type definition attracted less attention. One aim of this paper is to investigate the applicability of classical parametric dependence models within the second type definition of MGPD. Due to continuity problems the set of available dependence models narrows, especially if asymmetry property is also

required. As an alternative solution, a general transformation is proposed for creating asymmetric models from the well-known symmetric ones. We apply the proposed approach to the exceedances of wind speed data and outline methods for calculating prediction regions as well as evaluating the goodness-of-fit.

Recent tools for modelling dependence with copulas and R

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R is a powerful software for statistical computation and visualization with open-source license and support of wide community of users and developers. We give an overview of built-in tools and extensions for analysis of dependence structure in random vector with copulas, from data preprocessing and visualization, through parameters estimation and goodness-of-fit tests to prediction. Purpose and state of development of several function libraries (including that of ours) are discussed and experience with some graphical user interfaces, editors and integrated development environments are shared.

Aggregation-based extensions of utility functions

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The aim of the paper is to present a method extending fuzzy measures (utility functions) on $N = 1, \ldots, n$ to n-ary aggregation functions (fuzzy utility functions) by means of a suitable n-ary aggregation function and the Möbius transform of the considered fuzzy measure. The method generalizes the well-known Lovász and Owen extensions of fuzzy measures.
This is joint work with Júliana Beganová, Andrea Stupňanová.

Monte Carlo simulation Value at Risk and PCA

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Financial portfolios include many of risk factors, such as asset prices, interest rates, foreign exchange rates, that affect the portfolios profit/loss. Risk factors are often very highly correlated, therefore it is convenient to use principal component analysis to reduce the dimension of the risk factor space. Moreover, the

construction of the principal components guarantees that they are uncorrelated, because they are generated by orthogonal eigenvectors. The ability of PCA to reduce dimensions, combined with the use of orthogonal variables for risk factors, makes this technique an extremely attractive option for Monte Carlo simulation. In highly correlated term structures of risk factors the replacement of the original risk factors by just a few orthogonal risk factors introduces very little error into the simulations, and increases the effciency of the simulations enormously. In this paper the PCA in Monte Carlo simulation with multivariate normal and Student t VaR will be used.
This is joint work with Michal Greguš.

Generalization and construction of Archimax copulas for higher dimensions

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Extreme-value copulas of higher dimensions are discussed and we propose some new construction methods for tail and Pickands dependence functions. In short we recall an overview of some known results for d-dimensional Archimedean copulas. Finally, we focus to the main aim of this paper, which are higher dimensions of Archimax copulas. Some new classes of d-dimensional Archimax copulas are also introduced.

Implicators and I-partitions

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Jayaram and Mesiar (2009) introduced an I-fuzzy equivalence relation. We say that the concept of I-equivalence relation admits a value a from $[0,1]$ iff there exists an I-equivalence relation E and some elements x,y such that $E(x,y) = a$. In this contribution we will investigate properties of the induces I-partitions for some special types of implicators. Particularly, we will be interested I-implicators which do not admit all values form $[0,1]$.
This is joint work with Dana Hliněná and Pavol Krá.

Optimal bandwith in nonparametric regression

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Nonparametric regression can be used when parametric regression insufficiently describes the real data. One of nonparametric methods is kernel smoothing. Very important is the choise of optimal bandwith. We compare some methods for choosing this smoothing parameter.
This is joint work with T. Kulla.

On the structure of associative n-dimensional copulas

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The associativity of n-dimensional copulas in the sense of Post is studied. The structure of associative n-dimensional copulas is clarified. It is shown that associative n-dimensional copulas are n-ary extensions of 2-dimensional copulas with special constraints. The main result solves an open problem formulated by R. Mesiar.
This is joint work with Andrea Stupňanová.

Aggregation functions-based building of transitive preference structures

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Aggregation functions are often needed when building preference relations in multicriteria decision making problems. We bring an overview of methods that enable aggregation-based rankings to be refined. In our contribution we deal with orderings on finite scales and aggregation functions with range in the given finite scale. We discuss the orders based on a system of k-ary aggregation functions and also reversibility and redundancy of order induced by this system. Acknowledgement: The support of the grants VEGA 1/0080/10 and APVV 0073-10 is kindly announced.

Comparing the power properties of the proposed test and some other nonlinearity tests for Markov-switching time series models

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The comparison of the power properties of some already known nonlinearity tests and a new proposed test is provided. We are testing the validity of Markov assumptions by the proposed test as an alternative to the classical test for linearity against the Markov-switching type of nonlinearity, which is very time-consuming. The RESET-type tests, McLeod-Li test and Tsay test are used to investigate their ability to reveal the Markov-switching type of nonlinearity since they test only some departures from linearity in general without a specific nonlinear parametric alternative.

On some insurance risk applications of copulas

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Copulas provide a potential useful modeling tool to represent the dependence structure among variables and to generate joint distributions by combining given marginal distributions. The goal of this paper is to provide simple applications for the practical use of copulas for risk management from an insurance point of view. In this paper we focus on special class of copulas and goodness-of-fit testing.

Modelling of the ARMA models residuals using autocopulas

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The 'k-lag auto-copula' is is a 2-dimensional joint distribution function of the bivariate random vector (Y_t, Y_{t-k}) of time lagged values of random variables that generate time series. In the contribution we extend the idea to the use of auto-copulas (originally used by Rakonczai for tests of the residual independence of time series models) also for investigation of the residuals dependence structures of the linear ARMA (Autoregressive Moving-Average) time series models. We model the residual dependence of ARMA time series models with auto-copulas

(Archimedean, Extreme Value and their convex combinations). The fitting quality (both in-the-sample and out-of-the-sample) of the resulting models was considerable improved for a large class of economic time series.

Generalized Bonferroni mean operators in multi-criteria aggregation

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In this paper we provide a systematic investigation of a family of composed aggregation functions which generalize the Bonferroni mean.Such extenxions of the Bonferroni mean are capable of modeling the concepts of hard and soft partial conjunction and disjunction as well as that of k-tolerance and k-intolerance. There are several interesting special cases with quite an intuitive interpretation for application.
This is joint work with G. Beliakov, S.James, J.Beganová, and R.R. Yager.

Clustering by two methods simultaneously

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Cluster analysis as one of multivariate statistical methods is able to find clusters of similar objects in data. We propose new clustering method and demonstrate it using 2 real-world datasets.
This is joint work with Oľga Nánásiová.

SETAR models in the streamflow modeling

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However linear models dominate empirical time series modeling for simplicity of estimation and forecasting there are many processes out of realy linear structure. The self exciting treshold autoregressive (SETAR) model is linear within a regime but switches between regimes if the ddelay value crosses a treshold. In the presentation we provide briefly the description of SETAR model structure, methods of parameter estimation, the determination of regimes number and the threshold values, the method of testing for treshold nonlinearity and the point forecast evaluation. We illustrate two regimes SETAR(p1,p2,d) models and three regimes

SETAR(p1,p2,p3,d) models in the streamflow research of several Slovak rivers for the time period 1961-2000. For SETAR modeling we consider the residuals time series of observed data after subtraction systematic components (linear trend, seasonal and cyclical components) and the observed time series. In conclusion we focuse on the usefulness of SETAR models for in-of-sample modeling and out-of-sample forecasting relative to linear AR models.
This is joint work with Silvia Kohnová.

Application of aggregation operators on the assessment of public universities and their faculties

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In order to solve decision making problem we have to compare and rank a finite set of alternatives according to finite number of criteria. In this paper we want to show some approaches how to create the preference structure (ranking) of alternatives. These approaches lead us to use chosen multicriteria decision methods and aggregation operators. ARRA (Academic ranking and rating agency) uses one fixed way to create a ranking of public universities and their faculties. Here many more approaches how to create such rankings (or preference structures) of alternatives are discussed.

Comparison of descriptive and predictive properties of MSW models with different probability distribution of residuals

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We modeled the series of annual counts of major earthquakes (i.e. magnitude seven and above) for the years 19002006 by MSW models with different probability distribution of residuals. We considered three probability distributions of residuals two continuous (normal distribution and Student t-distribution) and one discrete (Poisson) probability distribution. We also considered an extension to continuous distributions, including models with different continuous distribution types (mentioned above) in different states. We compared descriptive and predictive properties of these models. The parameters in the MSW model can be estimated using maximum likelihood techniques. The aim of the estimation procedure is not only to obtain estimates of the parameters in the autoregressive models in different regimes and the probabilities of transition from one regime to the other, but also to obtain an estimate of the probabilities of occurrence of each state at each point in time.

Contributed Talks

Difference Equations as a Means for Solution of Decision Making Problems

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The lecture deals with a few examples regarding usage of difference equations for optimization in investment as solution of decision making problems.

Numerical modeling of forest fire propagation

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We introduce new mathematical model for numerical modelling of forest fire front propagation. The model is based on evolution of plane curve. The speed of fire front is given by the properties of a fuel bed scaled (exponentially) by a wind speed projected onto the normal to the front. For numerical modelling we use both Lagrangean and Eulerian level set approaches and compare them in simulations. Moreover, in our Lagrangian approach we solve in a new fast and simple way detection of topological changes.

A Duality Theorem for Infinite Linear Programming: A Purely Linear-Algebraic Approach

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In a vector space over a linearly ordered (possibly skew) field, we consider a linear program with an infinite number of constraints. Only finitely many of them are allowed to be non-zero at a point of the space and a certain constraint qualification must hold. The objective function attains values in another linearly ordered vector space over the field. We present the respective variant of Farkas' Lemma first. We give a generalization of Gale's Theorem of the alternative next. And we formulate the Duality Theorem as well. Finally, we consider possible applications of this theory to other problems of infinite linear programming, whose solution is known, aiming to establish a new approach to solving some of those problems.

FEM for flow and pollution transport in 2D urban canopy

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We develop a mathematical model of air flow and pollution transport in simplified urban canopy. The model is based on incompressible Navier-Stokes and advection-diffusion equations. The solution is obtained by means of Finite Element Method. We use non-conforming Cruzeix-Raviart elements for flow and linear Lagrange elements for concentration. The resulting linear systems are solved by multigrid methods. We present computational studies of the problem.

Enumerative formulae for multiset-permutations avoiding the pattern 122 and another pattern of length three

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Within discrete mathematics, the area of pattern avoidance in permutations deals with so-called restricted permutations. These permutations do not allow for certain patterns to appear, i.e. certain types of subsequences are forbidden. The concept of containing resp. avoiding patterns can be extended from ordinary permutations to permutations on multisets. In this talk I wish to present some results of my diploma thesis in which I was able to close a gap in a recent article of Heubach and Mansour and to complete the study of permutations on regular multisets avoiding a pair of patterns of length three. In all seven studied cases, closed enumeration formulae could be developed using generating trees, generating functions and the Kernel method. Well-known sequences emerge, e.g. (generalized) Catalan and Fibonacci numbers. I shall examplarily present the proof of the case of $(122, 123)$-avoiding permutations and establish a bijection between these permutations and certain lattice paths.

Surface finite volume method for nonlinear filtering of data on the Earths surface

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We present new models for data filtering based on numerical solutions of linear and nonlinear diffusion equations on closed surfaces. To that goal we introduce

a surface finite-volume method (SFVM) that approximate numerically parabolic PDEs on closed surfaces, namely on the Earths surface. The Earth is approximated by a polyhedral surface created by planar triangles and we construct a dual co-volume grid. On co-volumes we define a weak formulation of the problem by applying Greens theorem to the Laplace-Beltrami operator. Then SFVM is applied to discretize the weak formulation considering a piece-wise linear approximation of a solution in space and the backward in time discretization. Later on, we extend a linear diffusion to the regularized surface Perona-Malik model, which represents a nonlinear diffusion equation on a surface. In our numerical experiments we focuse on reducing stripping noise from satellite geopotential models due to the truncation error of spherical harmonics.

Characterizing generalized fields of events by structural properties

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Let S be a set of states of a physical system. The probabilities $p(s)$ of the occurrence of an event when the system is in different states s of S defines a function from S to $[0,1]$ called a numerical event. If the set P of numerical events arising from various observations is structured in an appropriate way in respect to the order of functions and summation of orthogonal elements, spaces arise that are generalizations sigmafields of events and allow to distinguish a quantum mechanical behaviour from a mechanical one. A classical system can be characterized by the fact that P is a Boolean lattice. Starting from a universal notion of a generalized field of events (GFE) properties of GFEs are studied which lead to the identification of lattices and Boolean lattices among GFEs. Thereby the focus is on those properties that can be checked by the summation of functions.

Universal exponents and tail estimates in the enumeration of planar maps

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It has been observed that for most classes of planar maps, the number of maps of size n grows asymptotically like $cn^{-5/2}\gamma^n$, for suitable positive constants c and γ. It has also been observed that, if d_k is the limit probability that the root vertex in a random map has degree k, then again for most classes of maps the tail of

the distribution is asymptotically of the form $d_k \sim ck^{1/2}q^k$ as $k \to \infty$, for positive constants c, q with $q < 1$.

We provide a rationale for this universal behaviour in terms of analytic conditions on the associated generating functions. The fact that generating functions for maps satisfy as a rule a quadratic equation with one catalytic variable, allows us to identify a critical condition implying the shape of the above-mentioned asymptotic estimates. We verify this condition on several well-known families of planar maps.

This is joint work with Marc Noy.

Modelling Uncertainties in Limit State Functions

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Uncertainties in limit state functions g as arising in engineering problems are modelled by adding additional parameters and by introducing parameterized probability density functions which describe the uncertainties of these new additional parameters and of the basic variables of g. This will lead to a function $\mathrm{pf}(a,b)$ for the probability of failure depending on parameters a and b corresponding to the two parameterized density functions. Further the parameters a and b are assumed to be uncertain. Using intervals, sets or random sets to model their uncertainty results in upper probabilities of failure. We also discuss different notions of independence such as strong independence, epistemic irrelevance and random set independence and present a simple engineering example.

Boolean functions in the implicational fragment: On the number of Boolean expressions and its relation to the function complexity

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We consider the logical system of Boolean expressions built on the single connector of implication and on positive literals. Assuming all expressions of a given size to be equally likely, we prove that we can define a natural probability distribution on the set of Boolean functions expressible in this system. Then we show how to approximate the probability of a function f when the number of variables grows to infinity, and that this asymptotic probability has a simple expression in terms of the complexity of f. We also prove that most expressions computing any

given function in this system are simple in a certain sense.
This is joint work with Hervé Fournier, Danièle Gardy, and Antoine Genitrini

The Eisenstein Packing of the Complex Plane

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Let D be the set of the four complex digits $0, 1, \omega = e^{2\pi i/3}, \omega^2 = e^{4\pi i/3}$. For every complex number z there exists at least one series expansion of the form

$$z = \sum_{k=-\infty}^{n} \frac{d_k(z)}{(-2)^k} \qquad n \in \mathbb{N},\ d_k(z) \in D\ (-\infty < k \le n).$$

Let an *Eisenstein set* $\mathcal{E}_{d_n \cdots d_0, d_{-1} \cdots d_{-m}}$ be defined by

$$\mathcal{E}_{d_n \cdots d_0, d_{-1} \cdots d_{-m}} = \{z : d_k(z) = d_k, -m \le k \le n\}.$$

The Eisenstein sets $\mathcal{E}_{d_n \cdots d_0}$ $(n \in \mathbb{N},\ d_k \in D,\ 0 \le k \le n)$ pack the complex plane. They are selfsimilar fractiles since $\mathcal{E}_{d_n \cdots d_0} = \bigcup_{d_{-1} \in D} \mathcal{E}_{d_n \cdots d_0, d_{-1}}$,their boundaries have Hausdorff dimension $\frac{\log 3}{\log 2}$. Still, every Eisenstein set $\mathcal{E}_{d_n \cdots d_0}$ may be decomposed into the union of three crab fractiles, again with boundaries of Hausdorff dimension $\frac{\log 3}{\log 2}$, which therefore furnish a refinement of the Eisenstein packing. Every crab fractile is the union of four similar half-size copies of itself. There is no way, however, to decompose a crab fractile into a union of Eisenstein sets.

Pro-p groups acting with finite stabilizers on pro-p trees

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Long standing joint work with Pavel Zalesskii (UNB) led to achievements in classifying finitely generated pro-p groups that act with finite stabilizers on a pro-p tree. I intend to give some account on our work.

Minimax via differential equations

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I present some ways how to prove the minimax theorem from game theory via differetial equations.

Free and Weak Cartesian Products of Graphs

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Given a set $\{G_\iota \mid \iota \in I\}$ of graphs there are two main constructions that yield a new, vertex transitive graph G that consists of copies of the G_ι. One is the free product and the other the weak Cartesian product.

This note explores the connection between the free product, the weak Cartesian product, and the canonical isometric embedding of Graham and Winkler.
Joint work with Aleksandra Jedrzejaszek, AGH Krakau.

Implementation of the multigrid method on the GPU

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Modern graphics card are fully programmable, which means, that they can be used for general computations. Their main advantage, compared to traditional CPUs, is the fact, that they contain many computations units and thus can solve wide range of problems many times faster. The implementation of the multigrid method on the graphics card and the measured speedup, which was achieved during the solution of 2D air flow simulation, will be presented in this contribution. The mathematical model of this problem is based on the system of Navier-Stokes equations for viscous incompressible flow and its numerical solution is obtained by the finite element method. For the creation of GPU part of program a CUDA technology by NVIDIA company was used.

On Some Examples of Mixed Quasi-Monte Carlo Point Sets

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Quasi-Monte Carlo (QMC) methods are frequently used in (possibly very high dimensional) problems of integration and approximation. The point sets serving as the integration nodes in QMC algorithms usually have the property that they are evenly spread in the integration domain. A recent topic in this field of research is that of mixed QMC point sets, which are finite or infinite sequences of points in the unit cube, the components of which stem from two or more different other QMC point sets. In this talk, we present results on infinite sequences that are obtained by mixing digital sequences in the sense of Niederreiter and Halton with Kronecker sequences, but also on finite sequences that are obtained by mixing

Hammersley point sets with good lattice points. We discuss necessary and sufficient conditions on uniformity of distribution as well as discrepancy estimates. The talk is partly based on joint work with R. Hofer (Linz).

Adaptive algorithms for finite volume schemes in image processing

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We deal with a Perona-Malik equation, a well-known modification of the linear heat equation, solving the problem of blurring across the edges. It can be solved by many well established methods, we concern on semi-implicit time discretization and finite volume space discretization leading to stable numerical schemes. The noisy image does not contain regions of homogenous intensity, but applying the Perona - Malik filter, with increasing time we get larger areas of almost constant intensity. Adaptive methods use this fact, because it enables to merge the grid elements and coarse computational grid leads to linear systems with smaller amount of unknowns. The presented methods employ the quadtree and octtree technique to build the grid, which is constructed in a way enabling fast approach to neighbors. At the end we show the practical application of the algorithm in bioengineering, during filtering images obtained from laser scanning microscopy of living zebra fish embryos.

Tutte's decomposition of graphs for arbitrary connectivity

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As an application of an axiomatic theory of vertex cut systems we obtain a canonic tree decomposition of k-connected graphs. This answers a long-standing question of Tutte who did the same for 2-connected graphs. We also discuss in how far one can extend this to separators whose cardinality is larger than the connectivity of the graph, which is an important question for further applications.
This is joint work with M.J. Dunwoody.

Finite dimensional factors of polynomial algebras and their fixed point subalgebras

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We consider local commutative $\mathbb{R}$-algebra A with identity, the nilpotent ideal $\mathfrak{n}_A$ of which has a finite dimension as a vector space and $A/\mathfrak{n}_A = \mathbb{R}$ and study its subalgebra SA of fixed elements, $SA = \{a \in A;\, \phi(a) = a \text{ for all } \phi \in \mathrm{Aut}_{\mathbb{R}}A\}$, where $\mathrm{Aut}_{\mathbb{R}}A$ is the group of $\mathbb{R}$-automorphisms of the algebra A. This research is motivated by differential geometry, where algebras in question are usually called *Weil algebras* and, in particular, the bijection between all natural operators lifting vector fields from m-dimensional manifolds to bundles of Weil contact elements and the subalgebra of fixed points SA of a Weil algebra A was determined. We also replace $\mathbb{R}$ by $\mathbb{F}_2$ and study quite analogous questions. Results about fixed point subalgebras are totally different from the real case and they can have applications in the coding theory and cryptography.

Numerical Solution to Nonlinear Partial Differential Equations in Financial Mathematics

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In order to estimate a fair value of financial derivatives, various generalizations of the classical linear Black-Scholes parabolic equation have been made by adjusting the constant volatility to be a function of the option price itself. We present a second order numerical scheme, based on the finite volume method discretization, for solving the so-called Gamma equation of the Risk Adjasted Pricing Methodology (RAPM) model. Our new approach is based on combination of the fully-implicit and explicit schemes where we solve the system of nonlinear equations by iterative application of the semi-implicit approach. Presented numerical experiments show its second order accuracy for the RAPM model as well as for the test with exact Barenblatt solution of the porous-medium equation which has a similar character as the Gamma equation.

Symmetric differences on posets with an antitone involution

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The notion of symmetric difference is generalized from Boolean algebras to arbitrary posets with an antitone involution in such a way that one obtains a natural definition in the case that the underlying poset is a lattice. Necessary respectively sufficient conditions for the existence of a symmetric difference are provided. Finally, a different approach is presented that guarantees the existence of symmetric differences in arbitrary directed posets with an antitone involution.

Fast orthogonal transforms and generation of Brownian paths

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We present a couple of fast constructions of discrete Brownian paths that can be used as alternatives to principal component analysis and Brownian bridge for stratified Monte Carlo and quasi-Monte Carlo. By fast we mean that a path of length n can be generated in $O(n\log(n))$ floating point operations. We highlight some of the connections between the different constructions and we provide some numerical examples.

Multiscale Methods for Reaction Diffusion Equations

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omplex long-term dynamics of reaction-diffusion problems requires finer approach leading to quantitatively reliable numerical schemes, for which the error estimate constant does not grow exponentially in time. One of approaches is known as the nonlinear Galerkin method and was introduced in M. Marion and R. Temam, Nonlinear Galerkin Methods, 1989. The motivation for this method was to capture the effect of some of the terms that are neglected in the usual Galerkin method. The idea of the method is further extended to finite element method in M. Marion and R. Temam, Nonlinear Galerkin Methods: The Finite Element Case, 1990. In our talk we present an application of this method to the numerical solution of the selected reaction-diffusion equations in one spatial dimension.

Principalization algorithm via class group structure

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For a number field K with 3-class group of type $(3,3)$ or $(9,3)$, the structure of the 3-class groups of the unramified cyclic cubic extensions $N_1,\ldots,N_4$ of K is calculated using presentations for the metabelian Galois group $G = \mathrm{Gal}(\mathrm{F}_3^2(K)|K)$ of the second Hilbert 3-class field of K. In case of a quadratic field $K = \mathbb{Q}(\sqrt{D})$, the structure of the 3-class groups of $N_1,\ldots,N_4$ determines the type of principalization of K in $N_1,\ldots,N_4$. This provides an alternative to the principalization algorithm by Scholz and Taussky. The new algorithm, easily automatizable and executing very quickly, is implemented in PARI/GP and applied to all 5 742 quadratic fields with discriminant $-10^6 \leq D \leq 10^7$ and 3-class group of type $(3,3)$ or $(9,3)$ to obtain extensive statistics of principalization types and the distribution of second 3-class groups G on coclass graphs.

Biomechanical investigation on human spine, mathematical modeling and computations

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Knowledge of the mechanical response and deformability of the intervertebral discs provides us to predict a degeneration of human spine. From the medical point of view these experiences influence on appropriate selection of medical therapy. The contribution consists of - Biomechanical study of motion segment (vertebra intervertebral disc - vertebra), simplifying of the domain with regard to essential load transmission; physical equations, geometrical equations, Hookes law; material properties, - Mathematical modeling - governing partial differential equations, boundary conditions, - Computation - 2D modeling of axisymmetric structures with nonaxisymmetric loading (axial loads) by using FEM software - results to the stress-strain distribution, deflection and stiffness of human spine.

Combinatorial properties of the Thue-Morse sequence

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Let $(t_n) = (0110100110010110...)$ be the classical Thue-Morse sequence defined by $t_n = s(n) \bmod 2$ where $s(n)$ is the sum of the bits in the binary representation of n. It is well known that for any integer $k > 0$ the frequency of the letter "1" in the subsequence $t_0, t_k, t_{2k}, \ldots$ is asymptotically $1/2$. In this talk I will present a joint work with Jeffrey Shallit and Thomas Stoll which investigates the first occurrence of "1" in this subsequence. It turns out that for any integer k there is an integer $n < k+5$ such that $t_{kn} = 1$ and that this result is best possible. I will also present some results and conjectures of a more general problem.

Filters, Fragment Models, and Stratified Toposes

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Filters, Fragment Consistent Models, and Stratified Toposes Preliminaries Cyrus F Nourani July 2011 Abstract The author had defined infinite language categories the on the Keisler Lw1,w fragments to present a functorial model theory since 1996. A natural basis for forcing on toposes was presented on author;s publications since 1990s. Here a basic Grothendeick topology is defined on the fragments and further new categorical areas are presetend. The authors generic functors and functorial model theory are applied to presheaves providing a glimpse onto the functorial models on the topologies. Further applications to filtering on Joyal Simplicity can be developed on higher stratified functorial models.
Keywords: Functorial Model Theory , Grothendieck topology, Infinitary Language Categories (IFLC).

Linear hyperbolic partial differential equations with non-smooth coefficients

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Linear hyperbolic equations and systems with coefficients whose regularity is below a certain threshold may lack solutions in the sense of distributions. Low regularity coefficients arise in wave propagation in rough media or as paths of

stochastic processes. Regularization of the coefficients by means of convolution with a mollifier produces a net of smooth solutions, which in turn can be viewed as an element of the Colombeau algebra of generalized functions. These nets usually do not converge, but their asymptotics in terms of the regularization parameter may reveal structures of interest. In this talk, propagation of singularities will be studied by means of generalized wave front sets.

Some new results for deriving hook-length formulas for trees

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tarting with a remarkable hook-length formula for binary trees obtained by Postnikov various works in the combinatorial literature are devoted to prove and establish such kind of identities. Here we present several new results in this research direction. In particular we propose an expansion technique for weighted tree families, which unifies and extends recent results obtained by Han and Chen et al. Furthermore we give combinatorial and probabilistic proofs of several new/recent hook-length formulas.
This is joint work with Markus Kuba (TU Wien).

Multi-parameter regularization for construction of extrapolating estimators in statistical learning theory

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In the Statistical Learning Theory, the estimators are used for the approximation of the relationship between the input and the output of a system using the empirical data of the input-output pairs. Construction of an estimator from the empirical data is an ill-posed problem, and traditionally Tikhonov Regularization was used for this purpose. Recently, there has been a lot of interest in the construction of the so called extrapolating estimators, which approximate the input-output relationship beyond the scope of the empirical data. In this talk, we will show that the standard Tikhonov Regularization produces rather poor extrapolating estimators, which indicates that other regularization methods are needed. We will propose several multi-parameter regularization methods. The quality of the constructed extrapolating estimators will be compared. Also, the important question of the parameters choice will be addressed.
Joint work with S. Lu (China) and S. Sampath (Austria).

Discrepancy of Polynomial Lattice Point Sets

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Polynomial lattice point sets (PLPSs) are polynomial versions of classical lattice point sets which are among the most widely used classes of node sets in quasi-Monte Carlo integration rules.

Bounds on the star discrepancy of PLPSs are usually based on the quality measure R_b through the inequality $D_N^*(P) \leq s/b^m + R_b(P)$ which holds for any PLPS P consisting of $N = b^m$ points from the s-dimensional unit cube. Using the component-by-component approach based on R_b one can construct PLPSs P whose star discrepancy satisfies $D_N^*(P) \ll_{s,b} (\log N)^s/N$.

In this talk we show that the method of proof used to show this upper bound does not allow an improvement with respect to the order of magnitude in the total number of points $N = b^m$. Then, using a different approach based on the digital net structure of a PLPS, we show the existence of PLPSs P whose star discrepancy satisfies the improved bound $D_N^*(P) \ll_{s,b} (\log N)^{s-1}(\log\log N)/N$.

Algebra for Agriculture

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Using the structure theory of planar near-rings, one can easily construct excellent balanced incomplete block designs, which in turn are very useful for statistical investigations. From the construction of the near-ring, the parameters of the block design can be told in advance. These disigns are actually used in experiments in agriculture, medicine, and other areas.

Beta expansions of complex numbers

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In this talk we want to give an overview on recent developements on beta expansions.

Computational study of operation of a mixed-fuel fired industrial steam generator with air and fuel staging control

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This contribution deals with the latest improvements of the continuously developed numerical model of pulverized coal combustion in an industrial steam generator with multiple burners allowing both fuel and air distribution control. The underlying mathematical framework encompasses Navier-Stokes equations accompanied by turbulence treatment, simplified chemical reactions simulation by means of Arrhenian kinetics, fuel particle burnout model and heat radiation approximation. For the numerical solution, finite volume method with advection upstream splitting is employed together with adaptive time-stepping higher order Runge-Kutta solver. Recently, we have modified the model to simulate coal-biomass co-firing. After introduction to the device architecture and the mathematical model, we demonstrate the results of simulations with different fuel compositions and fuel and air staging modes. Focus is put on the response of the boiler in terms of heating value and pollutant development.

An Asymptotic Independence Theorem for the Number of Matchings in Graphs

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Let $z(G)$ be the number of matchings of a graph G. For a set M of edges and/or vertices, the ratio $r(M) = z(G \setminus M)/z(G)$ represents the probability that a randomly picked matching of G does not contain an edge or cover a vertex that is an element of M. Let A and B be disjoint sets of edges and/or vertices and let C be their union. We provide estimates for the quotient $r(C)/(r(A)r(B))$, depending on the sizes of A and B, their distance and the maximum degree of the underlying graph G. It turns out that this ratio approaches 1 as the distance of A and B tends to infinity, provided that the size of A and B and the maximum degree are bounded, showing asymptotic independence. We also provide an application of this theorem to an asymptotic enumeration problem related to the dimer-monomer model from statistical physics.

Space and time adaptive integration methods for nonlinear Schrödinger equations

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n this talk, I shall address the issue of efficient numerical methods for the space and time discretisation of nonlinear Schrdinger equations such as systems of coupled time-dependent Gross-Pitaevskii equations arising in quantum physics for the description of multi-component Bose-Einstein condensates. For the considered class of problems, a variety of contributions confirms the favourable behaviour of pseudo-spectral and exponential operator splitting methods regarding efficiency and accuracy. However, due to the fact that in the absence of an adaptive local error control in space and time, the reliability of the numerical solution and the performance of the space and time discretisation strongly depends on the experienced scientist selecting the space and time grid in advance, I will exemplify different approaches for the reliable time integration of Gross-Pitaevskii systems on the basis of a local error control for splitting methods.

Properties of cubic graphs with large girth and random cubic graphs

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We show that for every n-vertex cubic graph G with sufficiently large girth there exists a probability distribution on independent sets of G such that each vertex is in a randomly chosen independent set with probability at least 0.4352. This implies that such a graph G contains an independent set of size $0.4352n$ and has fractional chormatic number at most 2.2978. We also show that there exists a probability distribution on edge-cuts of G such that each edge is in a randomly chosen edge-cut with probability at least 0.88672, which implies that G contains an edge-cut of size $1.33008n$ and has fractional cut covering number at most 1.12776. Our lower bounds on the size of maximum independent set and on the size of maximum edge-cut also apply to random cubic graphs. In particular, a random n-vertex cubic graph asymptotically almost surely contains an independent set of size $0.4352n$ and an edge-cut of size $1.33008n$.

Uniqueness Results for Extremal Quadrics

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There is a well known theorem in convex geometry, stating that every full-dimensional compact subset of d-dimensional Euclidean space can be enclosed by a unique ellipsoid of minimal area respectively volume. The goal of the FWF project Uniquness Results for Extremal Quadrics (grant P21032) was to find similar uniqueness results for extremal ellipsoids with respect to other size functions, extremal conics in non-Euclidean geometries and extremal hyperboloids to sets of subspaces. In our talk we present the results of this research project. In particular the uniquness results for extremal ellipsoids with respect to size functions different from the volume and the partial uniqueness results for extremal conics in the elliptic plane, hyperbolic plane respectively.
This is a joint work with Hans-Peter Schröcker.

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Numerical Simulation of Air Flow over Urban Canopy

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This contribution is concerned with the numerical simulation of the two-dimensional air flow over a simplified urban canopy. The mathematical model used is based on the Navier-Stokes equations for viscous incompressible flow, which are solved numerically by means of the finite element method. Because no explicit turbulence model is employed, the equations have to be resolved on fine enough computational grids to obtain reliable results. Such approach is very expensive in terms of computational cost. In order to be able to compute the solution in a reasonable time, a multigrid method based on smoothers of Vanka type is utilized to deal with the systems of linear equations arising from the finite element discretization. The method has been successfully implemented and tested. In addition, an OpenMP-based parallel implementation has been developed and compared with the serial implementation.

Limit laws of the Rogers-Szegö-distribution

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We investigate a certain q-analogue of the binomial distribution which is connected with basic hypergeometric series (or q-series), namely the Rogers-Szeg distribution. This distribution was introduced by A.W. Kemp in 2002. We establish several convergence results involving the classical binomial, the Euler, the Poisson, and the exponential distribution.

Abstract Index

Lecture Rooms

Donau-Universität Krems
Dr.-Karl-Dorrek-Str. 30

Audi-Max	Ground floor, Trakt A
SE C 2.01	2nd flor, Trakt C
SE C 2.07	2nd flor, Trakt C
SE C 2.08	2nd flor, Trakt C
SE 0.1	Ground floor, Trakt L/M
SE 0.2	Ground floor, Trakt I
SE 0.3	Ground floor, Trakt I
SE 1.1	1st floor, Trakt L/M
SE 1.2	1st floor, Trakt L
SE 1.4	1st floor, Trakt I
SE 1.6	1st floor, Trakt H
SE 2.3	2nd floor, Trakt L/M
SE 2.4	2nd floor, Trakt K
SE 3.6	3rd floor, Trakt I