European Women in Mathematics

September 2018

Institute for Mathematics Heinrichstrasse 36, Graz, Austria

It is our great pleasure to welcome you to the EWM general meeting 2018 (celebrating 30 years of EWM!). This event will take place from September 3rd to September 7th, at the Institute of Mathematics and Scientific Computing, University of Graz.

In this booklet you will find useful information.

Contents

Website: `https://sites.google.com/site/ewmgm18/`

1 Organizers - Scientific Committee - Sponsors

1.1 Organizers

- Karin Baur (Karl-Franzens-Universität Graz)
- Kathryn Hess (EPFL)
- Elena Resmerita (Alpen-Adria Universitẗ, Klagenfurt)
- Carola-Bibiane Schönlieb (University of Cambridge)
- Local organizer: Ana Garcia Elsener

1.2 Scientific Committee

- Christine Bessenrodt (Hannover, Germany)
- Alessandra Celletti (Rome, Italy)
- Sylvie Corteel, (Paris, France)
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- Antonella Grassi (U Penn, USA)
- Ursula Hamenstaedt (Bonn, Germany)
- Svetlana Jitomirskaya (U. Cal at Irvine, USA)
- Dusa McDuff (Barnard College, New York, USA)
- Ragni Piene (Oslo, Norway)
- Sylvia Serfaty (Paris, France)
- Ulrike Tillmann (Oxford, UK)
- Tamar Ziegler (Jerusalem, Israel)

1.3 Sponsors

London Mathematical Society - Deutsche Mathematiker Vereinigung - Committee for Women in Mathematics (IMU) - Schweizerische Mathematische Gesellschaft - Ecole Polytechnique Fédérale de Lausanne - Österreichische Mathematische Gesellschaft - NAWI Graz Natural Sciences - UniGraz - TU Graz - AVL.

x	Monday	Tuesday	Wednesday	Thursday	Friday
8:15 -9:00	Breakfast/Opening 11.02	Breakfast	Breakfast	Breakfast	Breakfast
9:00-10:00	S. Artstein 11.02	A. Guionnet 11.02	MS (1) 11.02 (3) 11.01 (10) 11.32	N.Ellemers 11.02	MS (5) 11.32 (8) 11.01 (9) 11.02
10:00-11:00	F. Kirwan 11.02	G. Staffilani 11.02	MS (1) 11.02 (3) 11.01 (7) 11:33 (10) 11.32	I. Fischer	MS (5) 11.32 (8) 11.01 (9) 11.02
11:00-11:30	Coffee	Coffee	Coffee	Coffee	Coffee
11:30-12:30	G. Staffilani 11.02	M. Viazovska 11.02	MS (1) 11.02 (3) 11.01 (7) 11:33 (10) 11.32	G.Staffilani 11.02 11.02	MS (5) 11.32 (8) 11.01 (9) 11.02
12:30-13:30	Lunch	Lunch	Lunch	Lunch	Lunch
13:30-14:00	Poster Session: Foyer, 11.05	ECM 2020 Info	Excursion 13:30-18:30 (South Styria)	Poster Session: Foyer, 11.05	-
14:00-17:00	MS (2) 11.01 (4) 11.02 (6) 11.32	EWM H and RI	-	General Assembly	-
17:00 - 18:00	Exhibition opening	EWM: RI	-	E. Strickland 17:30 11.02	-
18:00 -	Reception 19:00 (Town Hall)	EWM: GD	-	Dinner 18:30 (Mia & Mason Rooftop)	-

Classrooms: 11.01, 11.02, 11.05 (Ground floor), and 11.32, 11.33, 11.34 (3rd floor).

MS:

(1) Discrete and Combinatorial Optimization (2) PDEs around the world (3) Frame Theory and Asymptotic Analysis
(4) Mathematics and Music (5) Real Algebraic Geometry in Action (6) Mathematical Logic
(7) Linear operator theory and applications (8) Mathematics in Industry
(9) Nonsmooth PDE-constrained optimization: problems and methods (10) Applied Analysis

RI: Round of Introductions - participants are paired up and then introduce the other to the whole group.

GD: Group Discussions - we will setup round tables for discussing different topics around women in mathematics.

H: On Tuesday afternoon we will have a festive ceremony about the history of the EWM and its people.

Excursion: A bus will take us to southern Styria where we have a guided tour at the vineyard Silberberg (https://www.silberberg.at)

2 Speakers - Mini Symposia - Posters

2.1 Speakers - Abstracts

- *EMS lecturer:* **Gigliola Staffilani** - MIT (harmonic analysis and partial differential equations)

  Nonlinear dispersive equations and the beautiful mathematics that comes with them.

  Abstract: In these lectures I will give an overview of the rich mathematical structures that characterize the wave solutions of some of the most important nonlinear partial differential equations, such as the Schrodinger equation. In doing so I will illustrate how beautiful pieces of mathematics, developed using different tools, and not just coming from analysis, have been generated over the years in order to answer some of the most fundamental questions for these equations, such as existence and uniqueness of solutions for example. Along the way I will formulate open questions and possible new directions of investigation.

- **Main Speaker: Shiri Artstein** - Tel Aviv University (asymptotic convex geometry)

  Polarity in asymptotic convexity

  Abstract: We shall explore the many ways in which polarity and duality enter into the story of convexity in high dimensions. We shall get acquainted with functional versions of geometric notions and inequalities, meet the hidden cousin of Legendre's transform, and if time permits also dive into some of the mysteries of Mahler's conjecture.

- **Main Speaker: Ilse Fischer** - University of Vienna (combinatorics and discrete mathematics)

  Where are the bijections? Plane Partitions and Alternating Sign Matrices

  Abstract: For about 35 years now, combinatorialists fail to find explicit bijections between three classes of objects that are all counted by the product formula $\prod_{i=0}^{n-1} \frac{(3i+1)!}{(n+i)!}$. These objects are $n \times n$ alternating sign matrices, totally symmetric self-complementary plane partitions in a $2n \times 2n \times 2n$ box, and cyclically symmetric rhombus tilings of a hexagon of side lengths $n+2, n, n+2, n, n+2, n$ with a central hole of size 2. Recently, we have added a fourth class of objects to this list, namely alternating sign triangles, and, even more recently, we have extended this class to alternating sign trapezoids, and have shown that they are equinumerous with cyclically symmetric rhombus tilings of a hexagon with a central hole of size k.

  In my talk, I shall tell the fascinating story of this (so far) unsuccessful search for explicit bijections.

- **Main Speaker: Alice Guionnet** - ENS Lyon (systems in high dimensions, large deviations and coercive inequalities)

  Large deviations in Random Matrix Theory

Abstract: In the fifties, Wigner showed that if one considers a symmetric matrix with independent equidistributed centered entries above the diagonal, then its spectrum is distributed in average according to the semi-circle distribution as the dimension goes to infinity. Soon after, Komlos and Furedy showed that the extreme eigenvalues converge towards the boundary of the semi-circle distribution. However, estimating the probability that the spectrum has a different behavior is much more challenging and could only be done in very specific models. In this talk, I will describe known results, recent progresses and open challenges about these large deviations questions.

- **Main Speaker: Frances Kirwan** - University of Oxford (algebraic geometry, geometric invariant theory, symplectic geometry)

Moduli spaces of unstable curves

Abstract: Moduli spaces arise naturally in classification problems in geometry. The study of the moduli spaces of nonsingular complex projective curves (or equivalently of compact Riemann surfaces) goes back to Riemann himself in the nineteenth century.

The construction of the moduli spaces of stable curves of fixed genus is one of the classical applications of Mumford's geometric invariant theory (GIT), developed in the 1960s. Here a projective curve is stable if it has only nodes as singularities and its automorphism group is finite. The aim of this talk is to describe these moduli spaces and outline their GIT construction, and then explain how recent methods from non-reductive GIT can help us to classify the singularities of unstable curves in such a way that we can construct moduli spaces of unstable curves (of fixed singularity type).

- **Main Speaker: Maryna Viazovska** - Ecole Polytechnique Fédérale de Lausanne (discrete geometry, number theory, approximation theory and applications in physics)

The sphere packing and modular forms

Abstract: The sphere packing problem asks for the densest configuration of non-intersecting open unit balls at the Euclidean space. This classical geometric problem is solved only in dimensions 1, 2, 3, 8, and 24. In this talk, we will present a solution of the sphere packing problem in dimensions 8 and 24. It seems that each dimension has its own features and requires a different approach. One method of estimating the density of a sphere packing from above was suggested by H. Cohn and N. Elkies in 2003. Their approach is based on Fourier optimization. Namely, they showed that the existence of a function satisfying certain inequalities for the function itself and for its Fourier transform leads to an upper bound of the density of a sphere packing. Using this method Cohn and Elkies were able to prove almost sharp bounds in dimensions 8 and 24. We will show that functions providing exact bounds can be constructed explicitly. The key ingredient of our construction is the theory of modular forms.

- *Invited main speaker on gender balance:* **Naomi Ellemers** - Faculty of Social Sciences, Utrecht University (diversity and inclusion, integrity and ethics at work)

Implicit bias and the development of academic careers

Abstract: Academic success (or lack of it) is generally seen as a reflection of individual merit. Evaluation procedures and competitions for relevant resources are structured on the assumption that we are able to recognize talent when we see it. We think we derive such judgments from objective markers of academic quality. In this presentation I will review psychological theory and research findings that challenge this assumption. I will explain when, why, and how evaluations of academic merit are likely to suffer from implicit bias. There is abundant empirical evidence indicating that it is an illusion to think that differential career success in academia is the result of differences in individual merit. Acknowledging this uncomfortable reality constitutes the first step towards building a truly meritocratic system.

- *Presentation:* **Elisabetta Strickland** - Department of Mathematics, University of Rome "Tor Vergata", GIO, Gender Interuniversity Observatory, Italy

  From Algebra to the secrets of the Universe: the fascinating life of Mary Somerville

  It is an astonishing experience to go back in time and explore the world where study and research for women were forbidden by law. The fascinating life of the Scottish scientist and popular writer Mary Fairfax Somerville (1780-1872) brings us back in this past and, in the same time, describes the fight of one great dame for equal rights and opportunities for women. Her fight was not political, in a sense that she did not try to influence the public opinion with her words or her actions, but by winning the respect of the scientific world. Her extraordinary mathematical talent only came to light through fortuitous circumstances. Barely taught to read and write as a child, all the science she learned and mastered was self taught. By giving this example of scientific competence, she backed the struggle towards education opportunities for women that lead to their access to schools. The Somerville College in Oxford was named in her honor in 1879 and produced famous graduates like Dorothy Hodgkin, Indira Gandhi and Margaret Thatcher.

2.2 Mini Symposia - Abstracts

2.2.1 MS1 Discrete and Combinatorial Optimization

Organized by E. Dragoti-Cela, B. Klinz, TU Graz

09:00 - 09:05	Bettina Klinz *
09:05 - 09:45	Nicole Megow
09:50 - 10:20	Renata Sotirov
10:25 - 10:55	Eranda Cela
11:30 - 12:00	Elisabeth Gaar
12:05 - 12:35	Angelika Wiegele

* (introduction to mini symposium)

Upper Bounds on Combintorial Optimization Problems through an Augmented Lagrangian Algorithm
Angelika Wiegele

Abstract. Semidefinite programming proved to be a succesful way to obtain high quality bounds to certain combinatorial optimization problems. Semidefinite problems can be solved by interior point methods. However, large-scale problems (i.e., problems with a large number of variables and/or constraints) are intractable for solvers based on interior point methods.

In this talk we will present an augmented Lagrangian approach to solve semidefinte programs. These methods apply an augmented Lagrangian approach to the dual semidefinite problem where in each iteration a projection onto the cone of positive semidefinite matrices is performed. Furthermore, with the aim of improving the convergence rate of these methods, we propose to update the dual variables before the projection step. Numerical results demonstrate that this significantly decreases the overall number of iterations within the augmented Lagrangian algorithm.

Joint work with Marianna De Santis and Franz Rendl

On the (Monotonic) Bend Number of Certain Graph Classes

Elisabeth Gaar

Abstract. A graph G is called an edge intersection graph of paths on a grid if there is a grid and there are paths on this grid, such that the vertices of G correspond to the paths, and two vertices are adjacent in G iff the corresponding paths share a grid edge. Such a representation is called an EPG representation of G. The bend number of a graph G is the smallest non-negative integer k, such that there is an EPG representation of G in which every path bends at most k times. Analogously, the monotonic bend number of a graph G is the smallest non-negative integer k, such that there is an EPG representation of G in which every path bends at most k times and where additionally the paths can only bend up or to the right.

Edge intersection graphs of paths on a grid are an interesting combinatorial object with applications in circuit layout setting and chip manufacturing. The decision problem whether the (monotonic) bend number of a given graph equals a given non-negative integer k is known to be NP-complete for $k = 1$. We show that the monotonic bend number of outerplanar graphs is at most 2 and determine the exact bend number and the monotonic bend number of maximal outerplanar graphs and cacti by stating forbidden subgraphs. Moreover we consider the relationship between the bend number and the monotonic bend number of a graph. Clearly the bend number of a graph is smaller than or equal to its monotonic bend number. It is known, that there are graphs with bend number 1 with a monotonic bend number larger than 1. We extend this result to graphs with bend number k for all non-negative integers k except for $k = 4$ and $k = 6$.

This is joint work with Eranda Dragoti-Cela.

Combinatorial Optimization with Explorable Uncertainty

Nicole Megow

Abstract. Explorable uncertainty refers to settings where parts of the input data are initially unknown, but can be obtained at a certain cost using queries. An algorithm can make queries one by one until it has obtained sufficient information to solve a given problem. The challenge lies in balancing the cost for querying and the impact on the solution quality. In this talk, we give a short overview on recent work on explorable uncertainty for combinatorial optimization problems and then focus on a new scheduling problem.

The Path-TSP: new solvable cases
Eranda Dragoti Cela

Abstract. In the Path-TSP, the travelling salesman is looking for the shortest route through all cities from a given set. The route has to start at a given city s and end at another given city t after visiting every other city exactly once. It is well known that the Path-TSP is NP-hard in its general formulation. However polynomially solvable cases of the problem arise if the distance matrix of the set of the cities has specific combinatorial or algebraic properties. For example it is known that if the distance matrix of the cities is a Kalmanson matrix, then the Path-TSP is solvable in polynomial time for any arbitrary pair of origin and destination cities s and t, respectively. In this talk we identify new polynomially solvable cases of the Path-TSP which arise when the distance matrix of the cities belongs to one of the well known classes of Demidenko matrices or Van der Veen matrices. We characterize the combinatorial structure of the optimal solutions of the problem and show that each of these special cases can be solved by dynamic programming with a time complexity which is quadratic on the number of cities.

Joint work with Vladimir Deineko and Gerhard Woeginger

Linearization based bounds for the quadratic shortest path problem
Renata Sotirov

Abstract. The quadratic shortest path problem (QSPP) is the problem of finding a path in a directed graph such that the sum of interaction costs over all pairs of arcs on the path is minimized. This problem is known to be NP-hard.

We classify QSPP instances into linearizable and non-linearizable instances. The linearizable QSPP instances are instances whose optimal solution can be obtained by solving the corresponding (easy) instance of the shortest path problem. We present a polynomial-time algorithm that solves the linearization problem for the QSPP, i.e., verifies whether a given QSPP instance is linearizable. For a non-linearizable instance, our algorithm generates a system of equations that is further exploited to compute lower bounds of the original problem.

To the best of our knowledge, this is the first study in which the linearization problem is exploited to compute bounds for the corresponding combinatorial optimization problem. Numerical results show that our approach provides the best known linear programming bounds for the QSPP.

2.2.2 MS2 PDE's around the world

Organized by S. Cingolani (Bari), B. Pellaci (Napoli), A. Pistoia (Roma 1)

14.00-14.10	Introductory talk
14.10-14.40	Liliane Maia
14.45-15.15	Nicola Fusco
15.20-15.50	Gamze Duzgun
15.55-16.25	Yannick Sire
16.30-17.00	Florica Cirstea

On the fundamental solutions for the anisotropic Laplacian
Florica Cirstea
University of Sydney, NSW 2006, Australia.

Abstract. Let $\Omega \subseteq \mathbb{R}^N$ be a domain containing the origin and $n \geq 2$. For $i = 1, ..., n$, let $p_i \in (1, \infty)$ be such that their harmonic mean p satisfies either Case 1: $p < n$ and $\max\limits_{1 \leq i \leq n} \{p_i\} < p(n-1)/(n-p)$ or Case 2: $p = n$ and Ω is bounded. For anisotropic elliptic equations

$$-\sum_{i=1}^{n} \partial_{x_i}(|\partial_{x_i} u|^{p_i - 2} \partial_{x_i} u) = \delta_0$$

being δ_0 (the Dirac mass at 0) in Ω and $u|_{\partial\Omega} = 0$, we introduce a suitable notion of fundamental solution and establish its existence, together with sharp pointwise upper bound estimates near the origin for the solution and its derivatives. The latter is based on a Moser-type iteration scheme specific to each case, which is intricate due to our anisotropic analogue of the reverse Hölder inequality. Critical tools in our proof include generalized anisotropic Sobolev inequalities and estimates in weak Lebesgue spaces. This is joint work with Jérome Vétois (McGill University).

Space Expansion for a Solution of an Anisotropic p-Laplacian Equation by Using a Parabolic Approach

Fatma Gamze Duzgun
Hacettepe University, Ankara, Turkey

Abstract. We prove a space expansion of positivity for solutions of an elliptic equation with anisotropic growth. By this work, we show that a technique introduced in the parabolic setting works also in the elliptic context.

Evolution of material voids by surface diffusion

Nicola Fusco
Università di Napoli "Federico II", Italy.

Abstract. We consider the evolution by surface diffusion of material voids in a linearly elastic solid. We prove short time existence and asymptotic stability when the initial configuration is close to a stable critical point for the energy. Similar results are also obtained for the evolution by surface diffusion of epitaxially thin films.

A positive bound state for the nonlinear Schrödinger equation with a vanishing potential

Liliane Maia
University of Brasília, Brazil.

Abstract. We will present some recent results on the existence of a positive solution to the stationary nonlinear Schrödinger equation

$$-\Delta u + V(x)u = f(u), \qquad u \in \mathcal{D}^{1,2}(\mathbb{R}^N),$$

with $\lim\limits_{|x| \to \infty} V(x) = 0$ in situations where this problem does not have a ground state. We consider general superlinear nonlinearities possibly non-homogeneous, with supercritical growth at the origin and subcritical at infinity. This is a work in collaboration with Mónica Clapp (UNAM, Mexico). This research has been partially supported by CNPq/Brazil.

Rigidity for phase transitions

Yannick Sire
John Hopkins University, Baltimore, MD USA

Abstract. After recalling classical results on phase transitions related to a conjecture bye De Giorgi, I will go to a nonlocal version of it and the latest developments. There has been several results in this direction but many problems remain open and mathematically very challenging. I will give an overview of the state of the art.

2.2.3 MS3 Frame Theory and Asymptotic Analysis

Organized by D.T. Stoeva (Austrian Academy of Sciences, Vienna), K. H.-V. Saneva (Ss. Cyril and Methodius U, Skopje)

09:00 - 09:25	Diana Stoeva
09:30 - 09:55	Jasmina Veta Buralieva
10:00 - 10:25	Roza Aceska
10:30 - 10:55	Marzieh Hasannasab
11:30 - 11:55	Ljiljana Arambasic

Frames and Asymptotic Analysis

Diana Stoeva

Abstract. This will be an introductory talk for the Mini Symposium. First we will give a short introduction to the topics of frames and asymptotic analysis. We will present some basics for frames, starting from the Hilbert space setting and reaching the more general concept of a Frechet frame, introduced in the last decade and relevant for spaces of generalized functions. Then we will briefly introduce the topic of asymptotic analysis of generalized functions. Finally, we will give an overview of the Scientific and Technological cooperation project Austria-Macedonia, which aimed to establish cooperation between the Acoustics Research Institute, Vienna, and the University Ss. Cyril and Methodius, Skopje, on research topics combining frames and generalized asymptotic analysis.

Asymptotic results for generalized integral transforms

Jasmina Veta Buralieva

Abstract. The theory of distributions is a very effective device in both pure and applied mathematics and the extension of integral transforms to generalized function spaces is an important research subject. The aim of our investigations was to analyze some integral transforms on distribution spaces and their asymptotic behaviour. So, first we give a brief summary about the theory of distributions and some generalized asymptotics. Then we make a short review for integral transforms which are already extended on distribution spaces and known results for their asymptotics. And, finally we provide our recent results about the extension of the directional short-time Fourier transform and Stockwell transform on the space of distributions. Moreover, we give a various Abelian and Tauberian type results for these transforms.

The talk is based on a joint work with Katerina Hadzi-Velkova Saneva and Sanja Atanasova.

Frames of iterative actions of operators - the finite dimensional case
Roza Aceska

Abstract. The problem of generating a frame by iterative actions of operators (IAO) has emerged within the research related to the dynamical sampling problem. Dynamical sampling is a novel model for studying signals that evolve in time. In a nutshell, lossless trade-off between spatial and temporal samples is possible in special cases i.e. the initial state of a signal can be recovered using a reduced number of sampling devices activated more frequently.

We review the available results pertaining to frames generated by iterative actions of operators in the finite dimensional setting. The conditions under which a frame generated by IAO exists for a finite-dimensional or a separable Hilbert space are stated in detail; the frame inequality is satisfied for a suitable choice of the sampling locations. It shows that the canonical dual frame is also generated by IAO, and under certain conditions, the frame at question is scalable. We highlight that the stability of a frame generated by IAO is in direct relation to the change of sensors locations and is easily achieved when the operator at hand is a contraction. In addition, we provide a brief survey of the latest results in the infinite dimensional setting.

Frames and operator representations of frames
Marzieh Hasannasab

Abstract. One of the central questions in dynamical sampling is to identify when and how a given frame can be represented via iterated actions of a bounded operator on a single element in the underlying Hilbert space. The talk will provide various characterizations of the frames for which this can be done.

The talk presents joint work with Ole Christensen.

Full spark frames and totally positive matrices
Ljiljana Arambasic

Abstract. Let H be an N-dimensional Hilbert space. A frame $(x_n)_{n=1}^{N+M}$ for H is said to be a *full spark frame* if any N of its members make up a basis for H. In this talk we present a connection between full spark frames and totally nonsingular matrices. We also provide a method for constructing infinite totally positive matrices which are a subclass of the class of totally nonsingular matrices.

This is a joint work with Damir Bakić from the University of Zagreb. This research was supported by the Croatian Science Foundation under the project IP-2016-06-1046.

2.2.4 MS4 Mathematics and Music

Organized by K. Baur (U Graz), L. Tedeschini-Lalli (Roma 3)

14:00 - 14:25	Monika Doerfler
14:30 - 14:55	Sara Munday
15:00 - 15:25	Laura Tedeschini Lalli
15:30 - 16:20	Karin Baur & Tamara Friebel

A mathematical description of musical signals
Monika Doerfler

Abstract. We will explain, how mathematical tools can lead to signal representations of structured audio signals (such as music or speech), which are helpful for various signal processing or machine learning tasks. Furthermore we are going to show how a properly chosen representation system improves results achieved by deep neural networks in music information retrieval tasks and how, vice versa, the representation parameters can be informed by appropriately chosen data.

Well-formed scales and continued fractions
Sara Munday

Abstract. We revisit the concept of a well-formed scale, a construction that was introduced and studied by Carey and Clampitt starting 1989, and show how it is related to the convergents of continued fractions. We will indicate a possible direction for further research, using multidimensional continued fraction algorithms.

Space - how do we hear it?
Laura Tedeschini Lalli

Abstract. Sound happens in time and in space, it is energy crossing spaces. Music is organization of sound in time. Mathematics recognizes this organization to be a hierarchical structure of time-scales. For instance, when we talk about “musical notes”, which are commonly regarded to be a material for music, we talk about a span over a timescale of $10^{-2} - 10^{-4}$ seconds. Mathematics deals with the flow of information over different time-scales, structuring the entire “musical message”. In recent research about “soundscape” the study of events in a very small timescale have become crucial, because all spatial information is encoded in a very small time scale, of the order of $10^{-5} - 10^{-6}$ seconds, and is decoded by human ears as as "location" of the source.

Frieze patterns in the triangle between algebra, dynamics and music
Karin Baur & Tamara Friebel

Abstract. In this talk, we report on joint work with K. Fellner (Graz). In our project we research and explore mathematical structures and dynamical systems. We study periodic frieze patterns arising from triangulations of polygons and surfaces. These patterns consist of integers satisfying an SL_2-rule. The polygon cases lead to doubly-periodic patterns, triangulations of annuli give rise to infinite patterns. We show that these entries grow exponentially in blocks. Composer and architect Tamara Friebel (Graz) uses the triangulations of annuli as intuition: interpretations of the interplay arising from the triangular structure have led to various artistic outputs, including the composition, Attractive Privacies of Breathing Borders (Salt festival, Canada 2015).

2.2.5 MS5 Real Algebraic Geometry in Action

Organized by M. Infusino, S. Kuhlmann, Konstanz.

09:00-09:25	Marie-Françoise Roy
09:30-09:55	Maria Lopez Quijorna
10:00-10:25	Victor Vinnikov
10:30 - 10:55	Sabine Burgdorf
11:30-11:55	Salma Kuhlmann
12:00-12:25	Maria Infusino

Quantifier elimination versus Hilbert 17th problem

Marie-Françoise Roy
IRMAR professor emerita, Université de Rennes, France.

Abstract. These two important problems of real algebraic geometry are intimately linked and present also very different features from an effectivity point of view. Quantifier elimination has always had an algorithmic content, and the current research concentrates on complexity issues, while the solutions to Hilbert 17th problem were not giving explicit constructions of sums of squares for decades, and recent known quantitative degree bounds coming from explicit construction methods are far from being optimal.

Detecting optimality and extracting minimizers in polynomial optimization based on the Lasserre relaxation

Maria Lopez Quijorna
University of Konstanz, Germany.

Abstract. A basic closed semialgebraic subset of $\mathbb{R}^n$ is defined by polynomial inequalities. We consider Lasserre's hierarchy of relaxations, based on moments, for minimizing a polynomial over such a set. These relaxations are semidefinite programs whose optimal values give an increasing sequence of lower bounds of the infimum. We provide a new certificate for the optimal value of a Lasserre's relaxation to be the optimal value of the polynomial optimization problem. Namely, we have to check whether a given matrix is of generalized Hankel form. This condition is equivalent to the commutativity of the truncated GNS multiplication operators. In this case we construct a Gaussian quadrature rule for this optimal solution.

Factorizations and Positivstellensätze in Free Noncommutative Analysis

Victor Vinnikov
Ben Gurion University of the Negev, Beer Sheva, Israel

Abstract. Factorization theorems, such as Fejer–Riesz factorization of positive trigonometric polynomials and Kolmogorov–Aronszajn factorization of positive kernels, have longed played a central role in one-variable complex analysis and operator theory. Multivariable analogues came to prominence starting with the work of Agler in the late 1980s and early 1990s. There are close similarities between these results and the Positivstellensätze of real algebraic geometry, including the analytic proofs that use a separation argument followed by a GNS-type construction. There are also some important differences: the setting is that of analytic functions rather than that of polynomials, and one is interested in hermitian squares of analytic functions leading to a possibility of evaluation on tuples of commuting matrices of all sizes (or even tuples of commuting operators on a Hilbert space) rather than just scalar evaluations.

I will present a glimpse of these parallel universes, and discuss some recent joint work with J. Ball and G. Marx in the setting of free noncommutative function theory.

Moments in quantum information theory

Sabine Burgdorf
University of Konstanz, Germany

Abstract. Due to the phenomenon of entanglement quantum correlations are more powerful than classical correlations. One way to investigate those correlations is to compute quantum versions of graph parameters or the so-called values of a quantum game. These numbers are hard to compute but might be approximated using non-commutative optimization and non-commutative moment theory. There are basically two models for quantum correlations: the spatial model and the commuting model, using either spatial tensor products of operators, or respectively products of commuting operators, to generate correlations. Each model leads to a different type of non-commutative moment problems related to trace-optimization or eigenvalue-optimization. After a short introduction into quantum correlations and quantum games we will give an overview of the current status of the different moment problems showing up.

The moment problem for infinite dimensional spaces

Salma Kuhlmann
University of Konstanz, Germany

Abstract. In this talk, we shall present the multivariate moment problem in the general context of the polynomial algebra $\mathbb{R}[x_i \mid i \in \Omega]$ in an arbitrary number of variables $x_i, i \in \Omega$. We shall introduce the class of *constructibly Radon measures* (cf. [1]) on an infinite dimensional real vector space, and explain how they provide solutions to the above moment problem. We shall then recast our results in terms of *cylinder measures*, thus providing a comparison to the results of [2].

References:

[1] M. Ghasemi, S. Kuhlmann, M. Marshall, Moment problem in infinitely many variables, Israel J. Math. 212(2016), 989-1012

[2] K. Schmüdgen, On the infinite dimensional moment problem, arxiv: 1712.06360 (2017)

Projective limit techniques for the infinite dimensional moment problem

Maria Infusino
University of Konstanz, Germany

Abstract. In this talk we deal with the following general version of the classical moment problem: when can a linear functional on a unital commutative real algebra A be represented as an integral w.r.t. a Radon measure on the character space of A equipped with the Borel sigma-algebra generated by the weak topology? In a joint work with Salma Kuhlmann, Tobias Kuna and Patrick Michalski, we approach this problem by constructing the character space X(A) as a projective limit of a certain family of Borel measurable spaces and so by considering on X(A) the associated cylinder sigma-algebra beside the Borel one. This allows us to obtain representations of linear functionals, which are positive on sum of squares in A and fulfill certain quasi-analytic bounds, as integrals w.r.t. measures defined on the cylinder sigma-algebra on X(A).

Combining this result with the well-known Prokhorov theorem, we get extensions of such measures to the Borel sigma-algebra and, hence, generalize to infinitely (even uncountably) generated algebras some of the classical theorems for the moment problem such as the ones by Nussbaum and Putinar. Our results apply in particular to the case when A is the polynomial algebra in an arbitrary number of variables, providing alternative proofs of some recent results for this instance of the moment problem and offering at the same time a unified setting which enables comparisons.

2.2.6 MS6 Mathematical Logic

Organized by C. Antos (Konstanz), V. Fischer (U. Vienna), M. Thomas (Konstanz)

14:00	Salma Kuhlmann
14:30	Diana Carolina Montoya
15:00	Kaisa Kangas
15:30	Sarka Stejskalova
16:00	Charlotte Kestner
16:30	Heike Mildenberger

From Gödel's Incompleteness Theorem to Real Algebra

Salma Kuhlmann
University of Konstanz, Germany

Abstract: Gödel's celebrated Theorem (which established among others the incompleteness of Peano arithmetic) has triggered great interest in the study of fragments of arithmetic in general, and in particular in finding explicit constructions of their models. In this talk, I will explain the interrelation between models of arithmetic on the one hand, and integer parts of real closed fields on the other. I will thereby highlight the interplay between the first order deductive closure of these theories versus the algebraic properties of these commutative domains.

Infinite combinatorics on the generalized Baire spaces.

Diana Carolina Montoya
Kurt Gödel Research Center, Vienna, Austria

Abstract: The study of various classic set theory concepts on the generalized Baire spaces has been a subject of special interest on the last years. One specific example corresponds to the generalization of some classical cardinal invariants to this context. I will present a survey of some of the classical results and their counterparts in the extended case.

Categoricity and Universal Classes.

Kaisa Kangas
University of Helsinki, Finland

Abstract: One example of a universal class is the class of models of a model complete first order theory. More generally, an abstract elementary class $(\mathcal{K}, \preccurlyeq)$ is universal if $\preccurlyeq$ is the submodel relation $\subseteq$ and for all models $\mathcal{A} \subseteq \mathcal{B} \in \mathcal{K}$, we have $\mathcal{B} \in \mathcal{K}$. In our work on universal classes, the aim was to find out whether a version of the the

following statement is true: "Suppose $\mathcal{K}$ is a universal class with $LS(\mathcal{K}) = \lambda$ and $\mathcal{K}$ is categorical in some cardinal $\kappa > \lambda$. Then $\mathcal{K}$ is categorical in every $\xi > \lambda$ and the models of $\mathcal{K}$ are either vector spaces or trivial (in the sense that the geometry is disintegrated)." The interesting part of the statement is that the models would be either vector spaces or trivial, which means that the reason behind the categoricity would be in the realm of classical mathematics. We proved that the statement holds after removing some "noise" from the class. In this talk, I will briefly discuss the background, present our result and discuss its implications.

The tree property.

Sarka Stejskalova
Kurt Gödel Research Center, Vienna, Austria

Abstract: We will discuss the tree property and its effect on the continuum function. For a regular cardinal κ, we say that κ has the tree property if there are no κ-Aronszajn trees. It is known that the tree property has the following non-trivial effect on the continuum function:

(*) If the tree property holds at κ^{++}, then $2^{\kappa} > \kappa^{+}$.

We will present original results regarding the tree property which suggest that (*) is the only restriction which the tree property puts on the continuum function in addition to the usual restrictions provable in ZFC.

Some results in distal theories.

Charlotte Kestner
Imperial College, London, UK

Abstract: One of the aims of model theory is to classify mathematical structures according to properties of their definable sets. I will give an introduction to distal theories, a relatively new area of the classification that has received a lot of attention recently. I will then go on to discuss some results in distal theories. In particular, time allowing, I will discuss the definable (p, q)-theorem for distal theories, and the more recent result that T is distal provided it has a model $\mathcal{M}$ such that the theory of the Shelah expansion of $\mathcal{M}$ is distal. This is joint work with G. Boxall.

Preserving a P-Point and Diagonalising an Ultrafilter.

Heike Mildenberger
Albert-Ludwigs University of Freiburg, Germany

Abstract: We show that under CH there is a forcing that preserves a P-point and diagonalises another ultrafilter. We report on our work towards iterating such a procedure.

2.2.7 MS7 Linear operator theory and applications

Organized by D. Ilišević (Zagreb), M. Kramar Fijavz (Ljubljana)

10-10:25	Cristina Camara
10:30-10:55	Ying-Fen Lin
11:30 - 11:55	Petra Csomos
12:00 - 12:25	Katerina Vassi

Multipliers for model spaces and Toeplitz kernels

Cristina Camara
Instituto Superior Tecnico Lisbon, Portugal

Abstract. In this talk we review some classical and more recent results concerning kernels of Toeplitz operators in Hardy spaces. In particular we focus on the existence of so-called maximal vectors, which determine the kernel in a precise sense, and on multipliers between kernels of Toeplitz operators. It turns out that these multipliers can be characterized in terms of certain test functions, which are precisely the maximal vectors. Applications to model spaces, which are themselves Toeplitz kernels of a special kind, are presented. Based on joint work with Jonathan R. Partington

Zero product preserving maps

Ying-Fen
Queen's University Belfast, United Kingdom

Abstract. In this talk I will first recall some of the results on zero product preserving maps on function spaces and commutative Banach algebras. Then I will introduce the Schur null preserving maps, which are zero product preserving with respect to the so-called Schur product, and present some of our recent work.

Operator Semigroups for Innovative Integrators

Petra Csomós
Eotvos Lorand University Budapest, Hungary

Abstract. Innovative integrators (splitting methods, exponential and Magnus-type integrators) are efficient numerical methods for solving nonlinear partial differential equations numerically. In the talk we introduce these schemes, and show how linear operator semigroup theory helps to prove their convergence. We also present several fields of application such as linear quadratic regulator problem for shallow water equations, delay equations, and financial models.

Positivity for a hinged convex plate with stress

Katerina Vassi
Leibniz Universität Hannover, Germany

Abstract. The boundary value problem for the Kirchhoff-Love model of a hinged elastic plate with stress is as follows: $\Delta^2 u - \tau \Delta u = f$ in $\Omega \subset \mathbb{R}^2$, $u = \Delta u - (1 - \sigma)\kappa u_\nu = 0$ on $\partial\Omega$ with weight $f \in L^2(\Omega)$, Poisson ratio $\sigma \in (-1, 1)$, stress coefficient $\tau \geq 0$ and boundary curvature κ. We will prove that this problem is positivity preserving on convex domains, meaning $f \geq 0$ implies $u \geq 0$. The proof relies on optimal estimates for a weighted first Steklov eigenvalue and on an application of the Krein-Rutman Theorem for an auxiliary problem.
We will next consider an application of the positivity preserving property to micro-electromechanical systems (MEMS).

2.2.8 MS8 Mathematics in Industry

Organized by K. Baur, K. Hess, E. Resmerita, C. Schönlieb

09:00 - 09:25	Patricia Egger
09:30 - 09:55	Jasmina Lazic
10:00 - 10:25	Valeriya Naumova
10:30 - 10:55	Barbara Wagner
11:30 - 11:55	Sarah Santner

"You're a mathematician? You can get any job you want!"

Patricia Egger
Deloitte AG, Zurich.

I'm sure many of you have heard people say that, as a mathematician, the professional world is your oyster. Yet these same people are often unable to articulate why that is. Being a mathematician is about more than having a Bachelor?s, Master's or PhD in math or being paid to use mathematics on a daily basis; it?s about being a "mathematical thinker". But what are the main characteristics of a mathematical thinker and how are they useful for a career in industry? I will try to answer this question based on my own experience getting started in a world where mathematicians are believed to be "good with numbers".

The Promises and Limitations of Blockchain: Rethinking Coffee, Travel, Marriage and Kindness

Jasmina Lazic
Chief Data Technologist at Bayes Centre, University of Edinburgh.

Abstract: According to a popular 80s pop song, "we are living in a material world". But we are also living in a social world. What do we value most in our lives? What can we trade? What if we could directly influence how and where our money is being spent once we have made a payment?

Smart contracts and blockchain technology are making it possible to create user-generated contracts between strangers and trade abstract things and concepts that we truly value. As it happens, a coffee machine with a life of its own, dispensing coffee to punters with an ethical preference, already exists. How will these emerging technologies shape the world we live in? And what have hash functions got to do with all of this? These are just some of the questions that will be addressed in this talk.

A machine learning approach to optimal regularization: Tikhonov and elastic-nets

Valeriya Naumova
Simula Research Laboratory, Oslo.

Abstract: Despite a variety of methods and techniques for parameter choice, the issue of parameter or model selection, in general, still remains a challenge for many applications. The main difficulty lies in constructing a rule, allowing to choose the parameter from a given noisy dataset without relying either on any a priori knowledge of the solution or on the noise level.

In this talk, combining advances from statistical learning theory with insights from regularisation theory, we propose a novel approach to approximate the high-dimensional function, mapping noisy data into a good approximation to the optimal parameter in Tikhonov and elastic-net regularisation. Our assumptions are that solutions of the problem are statistically distributed in a concentrated manner on (lower

dimensional) linear subspaces and the noise is sub-gaussian. We provide explicit error bounds on the accuracy of the approximated parameter and the corresponding regularization solution. Furthermore, we present an efficient algorithm for the computation of an approximate optimal parameter from a given training data. We also compare our approach to the state-of-the-art parameter selection criteria and illustrate its superiority in terms of accuracy and computational time on a number of simulated and real data.

Modeling microstructures for light harvesting surfaces

Barbara Wagner
Weierstrass Institute, Berlin.

Abstract: In this talk the topography of nanostructures consisting of arrays of crystalline Si (c-Si) nanodots is discussed. We present formulations for interfacial energy settings that support partial wetting and grain boundaries to predict the equilibrium morphologies of silicon nanodots and compare them to experimental results. We then present an anisotropic phase-field model and corresponding sharp-interface model that describe the dynamics of the dewetting process towards the nanodots.

Fast numerical solvers in applied fluid dynamics

Sarah Santner
AVL List GmbH, Graz.

Abstract: In this talk we will give an overview of how numerical methods are used in industry. We focus on the field of computational fluid dynamics and introduce the multi-purpose CFD software AVL FIRE. We show how methods from different fields of applied mathematics are combined to predict accurate results, which are used in development of engines.

2.2.9 MS9 Nonsmooth PDE-constrained optimization: problems and methods

Organized by D. Ghilli (U Graz), M. Mohammadi (TU Darmstadt), A. Walther (Paderborn)

09:00 - 09:25	Andrea Walther
09:30 - 09:55	Olga Ebel
10:00 - 10:25	Ekaterina Kostina
10:30 - 10:55	Daria Ghilli
11:30 - 11:55	Caroline Löbhard
12:00 - 12:25	Masoumeh Mohammadi

On the Optimization by Successive Abs-Linearization in Function Spaces

Andrea Walther
Universität Paderborn

Abstract. For finite dimensional problems that are unconstrained and piecewise smooth the optimization based on successive piecewise linearisation is well analysed yielding for example linear or even quadratic convergence under reasonable assumptions on the function to be optimised. In this talk we consider related problems in

function spaces, where the nonsmoothness stems from the absolute value function interpreted as Nemytskii operator. We present a quadratic overestimation method called SALOP that is based on successive abs-linearizations to solve the optimization problem and show first convergence results.

Abs-Linearization for Optimization with Non-Smooth PDEs

Olga Ebel
Universität Paderborn

Abstract. Motivated by developments in optimization by successive piecewise linearisation for finite dimensional problems that are unconstrained and piecewise smooth, the goal of this talk is to present the extension and adaptation of these concepts into the infinite dimensional setting for the non-regularized simulation and optimization with non-smooth partial differential equations.

We consider optimal control problems constrained by non-smooth PDEs, where all non-diferentiablilities are assumed to be given by the continuous but non-smooth operators abs(), min() and max().

These problems can not be solved with common methods and thus require new concepts.

A new regularization free method is proposed that solves this kind of non-smooth problem by appropriate decomposition of the original problem into smooth branch problems and exploitation of the information given by the respective dual variables.

Numerical results as well as convergence properties illustrate the proposed approach.

Inverse Optimal Control Problems and Applications to Cerebral Palsy Diagnostics

Ekaterina Kostina
Universität Heidelberg

Abstract. The talk will present numerical methods for solving inverse optimal control problems as complex bi-level dynamic optimization problems: a nonlinear approximation problem on the upper level and a nonlinear optimal control problem (OCP) with discontinuities on the lower level. The OCP solution is considered as a model that describes autonomous optimal processes in nature such as human gait. We develop a direct mathematical all-at-once approach for solving this class of problems and apply this to derive biomechanical optimal control models for the gait of cerebral palsy patients from real-world motion capture data obtained by the Motion Lab of the Orthopedic University Hospital Heidelberg.

Theory and numerical practice for optimization problems involving ℓ^p-functionals, with $p \in [0, 1)$

Daria Ghilli
Universität Graz

Abstract. Nonsmooth nonconvex optimization problems involving the ℓ^p quasi-norm, $p \in [0, 1)$, of a linear map are considered. A monotonically convergent scheme for a regularized version of the original problem is developed and necessary optimality conditions for the original problem in the form of a complementary system amenable for computation are given. Then an algorithm for solving the above mentioned necessary optimality conditions is proposed. It is based on a combination of the monotone

scheme and a primal-dual active set strategy. The performance of the two schemes is studied and compared to other existing algorithms by means of a series of numerical tests in different cases, including optimal control problems, fracture mechanics and microscopy image reconstruction.

Analysis, algorithms and applications for the optimal control of variational inequalities

Caroline Löbhard
Weierstrass Institute for Applied Analysis and Stochastics

Abstract. Motivated by applications in physics and engineering, we consider the optimal control of variational inequalities subject to elliptic partial differential euqations. The non-convex and non-differentiable nature of the problem challenges the design of efficient solution algorithms with guaranteed convergence properties in function space. In particular, the optimization scheme determines the significance of limiting stationarity conditions, and thus, the quality of computed solutions.

In this talk, we give an overview on the analysis and applications for variational inequalities and their optimal control. An ℓ_1-penalty algorithm is presented, which, instead of smoothing the variational inequality, directly penalizes the critical complementarity constraint. It can be shown, that in this way, limiting solutions satisfy strong stationarity conditions, if they are feasible. We also report on numerical test cases, and give an outlook on time dependent control problems with variational inequalities.

Discretization error estimates for optimal control of phase-field fracture

Masoumeh Mohammadi
TU Darmstadt

Abstract. An optimal control problem for fracture propagation will be presented. The fracture is modeled by a phase-field approach, and the regularized fracture model is relaxed by a penalization term. The final regularized problem is then linearized and discretized by finite element method. The a priori error estimates will be discussed for the discretization scheme.

2.2.10 MS10 Applied Analysis

Organized by B. Kaltenbacher, E. Resmerita, C. Schönlieb

09:00 - 09:25	Luise Blank
09:30 - 09:55	Ljudmila Bordag
10:00 - 10:25	Victoria Grushkovskaya
10:30 - 10:55	Anna Grybos
11:30 - 11:55	Sanja Konjik
12:00 - 12:25	Neela Nataraj

A diffuse interface approach for topology optimization and a global convergent solver

Luise Blank
University of Regensburg

Abstract. One possibility of modeling interfaces between several phases employs diffuse interfacial layers. Here one assumes that the interfaces have a width of order ε where $\varepsilon > 0$ is small. The governing partial differential equation, given by a sharp interface model are extended appropriately to the diffuse interfaces, where so called phase fields ϕ_i describe at each point the fraction of the $i-$th phase (material). The necessary regularization of the cost function with the perimeter is replaced by the Ginzburg-Landau energy. The phase field approach allows the optimization with respect to multiple phases and without knowing in advance the topology of the minimizer. We introduce the problem formulation in particular for multi-material structural topology optimization.

For the resulting nonlinear optimization problem in function spaces with inequality constraints we deduce a solver -called V(ariable)M(etric)P(rojection) T(ype)-method- to take into account that the cost functional is only differentiable in L^∞. In this solver second order information can be included and we can prove global convergence. This provides a fast, mesh independent solver.

With computational experiments we demonstrate the independence of the mesh size and of the interface thickness in the number of iterations as well as its efficiency in time. We present numerical results for mean compliance problems, compliance mechanism, drag minimization and an inverse problem of discontinuous diffusion coefficients.

Lie group analysis of an optimization problem for a portfolio with an illiquid asset

Ljudmila Bordag
Hochschule Zittau/Görlitz

Abstract. Working in the Merton's optimal consumption framework with continuous time we consider an optimization problem for a portfolio with an illiquid, a risky and a risk-free asset. Our goal in this paper is to carry out a complete Lie group analysis of PDEs describing value function and investment and consumption strategies for a portfolio with an illiquid asset that is sold in an exogenous random moment of time T with a prescribed liquidation time distribution. The problem of such type leads to three dimensional nonlinear Hamilton-Jacobi-Bellman (HJB) equations. Such equations are not only tedious for analytical methods but are also quite challenging form a numeric point of view. To reduce the three-dimensional problem to a two-dimensional one or even to an ODE one usually uses some substitutions, yet the methods used to find such substitutions are rarely discussed by the authors.

We use two types of utility functions: general HARA type utility and logarithmic utility. We carry out the Lie group analysis of the both three dimensional PDEs and are able to obtain the admitted symmetry algebras. Then we prove that the algebraic structure of the PDE with logarithmic utility can be seen as a limit of the algebraic structure of the PDE with HARA-utility as $\gamma \to 0$. Moreover, this relation does not depend on the form of the survival function $\overline{\Phi}(t)$ of the random liquidation time T. We find the admitted Lie algebra for a broad class of liquidation time distributions in cases of HARA and log utility functions and formulate corresponding theorems for all these cases.

We use found Lie algebras to obtain reductions of the studied equations. Several of similar substitutions were used in other papers before whereas others are new to our knowledge. This method gives us the possibility to provide a complete set of non-equivalent substitutions and reduced equations.

We also show in [Bordag2017] that if and only if the liquidation time defined by a survival function $\overline{\Phi}(t)$ is distributed exponentially, then for both types of the utility functions we get an additional symmetry. We prove that both Lie algebras admit this extension, i.e. we obtain the four dimensional L_4^{HARA} and L_4^{LOG} correspondingly for the case of exponentially distributed liquidation time. We list reduced equations and corresponding optimal policies that tend to the classical Merton policies as illiquidity becomes small.

*This research was supported by the European Union in the FP7-PEOPLE-2012-ITN Program under Grant Agreement Number 304617 (FP7 Marie Curie Action, Project Multi-ITN STRIKE - Novel Methods in Computational Finance)

[Bordag2017] L. A. Bordag, I. P. Yamshchikov. *Optimization problem for a portfolio with an illiquid asset: Lie group analysis*. Journal of Mathematical Analysis and Applications, 453(2):668–699,2017.
DOI: 10.1016/j.jmaa.2017.04.014

Gradient-free control algorithms for dynamic optimization problems

Victoria Grushkovskaya
University of Stuttgart

Abstract. In this talk, we present a constructive approach for the solution of the dynamic optimization problems, which gives a broad family of gradient-free control algorithms stabilizing the system at the extremum of a cost function. The proposed controllers depend only on the values of the cost function, and thus are applicable in situations, when the cost function is unknown analytically and can only be measured. We also present a rigorous analysis of the stability properties and asymptotic behavior of solutions to the closed-loop system. The obtained results are illustrated by numerical simulations and experiments with a mobile robot.

Event-Based Signal Processing and Frame

Anna Grybos
University of Science and Technology, AGH Krakow

Abstract. In the analog-to-digital conversion of signals, the sampling is usually assumed to be periodic with a fixed period, i.e. the time between every two consecutive samples is the same. Such a uniform sampling requires a presence of a synchronizing clock, which is a major energy consuming component of the architecture. Additionally, the Shannon sampling theorem imposes the highest expected spectral frequency of sampling. It means that for the slowly varying signals large amount of samples carry no relevant information and unnecessarily increase the activity of the system. It becomes a main problem in wireless sensor devices with limited battery life or when the access to the battery is difficult, like in the implantable biomedical devices.

The event-driven signal processing is self-times and forced by temporal changes of the signal, i.e. a sample is produced only when something significant occurs in the signal. There are many techniques to achieve event-driven sampling of a signal, the most natural sampling scheme is based on the send-on-delta principle. According to this scheme the sampling is triggered if the signal deviates by delta from the value of the most recent sample. Event-based systems are receiving more and more attention as an application as well as theoretical tool and they enjoy widespread use in areas as diverse as signal processing, image compression, wireless communication, finite element methods and many others.

The event-driven approach allows for high energy efficiency but results in irregular sampling of the signal. We stress that the irregular sampling as it occurs in event-driven signal processing is not a perturbed version of some ideal regular sampling anymore. The known tools to manage the perturbed (jittered) sampling like the Kadec's $\frac{1}{4}$-Theorem should not be applied directly to the irregular sampling case.

The condition of Kadec's $\frac{1}{4}$-Theorem imposes the restrictions on the perturbation of the sampling points to keep the properties of a basis and allows for the reconstruction formulas with the use of the nonharmonic Fourier series. However, in the event-driven signal processing any sampling geometry is probable. Duffin and Schaeffer in their very influential article *A class of nonharmonic Fourier series* prooved that the case of irregular sampling exceeding the Kadec's condition always requires oversampling. It results in the redundance of the system.

This is the moment when the frames enter the stage. Frame is a generalization of a basis of a vector space. It is a redundant system of vectors/elements that allows for the span of the whole space, i.e. any element of the space can be represented as a linear combination of the elements of the frame. However, the main disadvantages are that the coefficients of such a linear combination are not unique, the elements of the frame are not linearly independent and usually they are not orthogonal to each other.

We note that the advanced mathematical results concerned the reconstruction of a signal from the irregular samples were applied in the situations where the irregularities in the sampling sets were caused at random (scattered data, perturbations or jitter, error of measurements, data loss due to channel erasures, etc.). Event-driven sampling is the new approach and still there are not many mathematical results and methods of the reconstruction for the event-based sampled signals, i.e. in the situation when the irregularities in the sampling set are not random but they have their reason and meaning, they are caused by the sampling scheme itself.

In the presentation we show the application of the frame algorithm enhanced with adaptive weights method to the reconstruction of the signal from the irregular samples obtained by the send-on-delta sampling scheme, we analyze the examples of signal recovery and set some perspectives for the further development.

Fractional distributed order models of the wave equation

Sanja Konjik
University of Novi Sad, Serbia

Abstract. We propose a model of the wave propagation in linear viscoelastic media that involves distributed order fractional derivatives. We present results on existence and uniqueness of a fundamental solution to the generalized Cauchy problem, corresponding to fractional wave equation, as well as on calculation of an explicit form of the fundamental solution. Particular cases of linear fractional and power type distributed order models will be investigated, both analytically and numerically.

This presentation is based on joint work with Ljubica Oparnica and Dušan Zorica.

Finite element methods for nonlinear plate bending problems

Neela Nataraj
IIT Bombay

Abstract. After a brief introduction to plate models, we consider the bending of thin elastic plates modelled by the nonlinear von Karman equations. Conforming, non-conforming and discontinuous Galerkin finite element methods are employed

to approximate the displacement and Airy stress functions. Techniques for deriving optimal order a priori error estimates under minimal regularity assumptions on the exact solution are explained. Results of numerical experiments that justify the theoretical estimates are presented.

2.3 Posters - Titles

The poster sessions will take place on Monday and Thursday at 12:30 hs. There will be awards for the best three posters presented.

- Rola Al-Seidi - *Relaxing the nonsingularity assumption for intervals of totally nonnegative matrices*
- Mirjana Brdar - *Singularly perturbed problems with two small parameters*
- Sonia Cannas - *Mathematical Music Theory: an overview and some pedagogical experiences*
- Marcello Carioni - *Sparsity of solutions for general inverse problems*
- Jasmina Djordjevic - *Z-algorithm for backward stochastic differential equations*
- Marija Đokić Petrović - *The status of women in the Serbian IT sector*
- Tatjana Dosenovic - *Fixed Point Results for Multivalued Mappings in Fuzzy Metric Spaces of Suzuki type*
- Maiko Dzadzamia - *Equivariant absolute retracts and extensors for G-maps*
- Giulia Fabrini - *Greedy Controllability of Reduced-Order Linear & Dynamical Systems*
- Seda Kizilbudak Çaliskan - *On the regularized trace formula of a differential equation given with anti- periodic boundary conditions*
- Eva Kopecka - *Orthogonal projections*
- Dali Makharadze - *On the Weighted Boundedness of Integral Transforms defined on Product Spaces in Generalized Grand Lebesgue*
- Ola Mahmoud - *On the consistency of choice*
- Patrick Michalski Projective - *Limits technique for the infinite dimensional moment problem*
- Budi Nurani Ruchjana - *An Application of Spatio Temporal Models based on Data Mining Approach*
- Rajna Rajič - *Mappings preserving different types of orthogonality on B(H)*
- Sanja Rapajić -*A Nonmonotone Jacobian Smoothing Inexact Newton Method for NCP*
- Michele Serra - *Automorphism groups of Hahn groups and Hahn fields*
- Yonca Sezer - *About second regularized trace of a differential operator*
- Ivana Štajner-Papuga - *On non-additive measures, integration and some applications*

- Nino Svanidze - *Probabilistic Models of the Redundant Repairable System with two Parallel Maintenance Operations*
- Alexandra Tkacenko - *Iterative method for solving the multi-criteria fractional transportation problem of "bottleneck" type with fuzzy cost coefficients*
- Anda Valent *On discrete series representations of groups GSp(2n,F)*
- Markus Youssef *Ringiness - a new network property*

3 WIFI

You can access internet in every building using EDUROAM. If you do not have EDUROAM, the university will provide internet access in the area of the conference premises: "UniGrazTagung".

4 Public transport

There are 6 tram lines and 24 bus lines as well as 8 night bus lines will help you get around quickly.

Tickets are valid for all bus and tram lines in the 101 fare zone. (this extends as far as the Graz/Thalerhof airport), as well as for the Schlossbergbahn funicular.

Where can you buy tickets?
...from the bus driver (1h any combination = 2,40 Euro / 24h-Tickets = 5,30 Euro)
...from the ticket machines in the tram (1h, 24h-Tickets, week passes, month passes)
at the ticket machines at the main train station, Hauptplatz and Jakominiplatz.

There is a free phone-app called **BusBahnBim** that indicates the easiest way to go from one place to another around the city.
This service is also available here:
`https://www.verbundlinie.at/en/`

Taxi (just one of the multiple companies, this one offers English web-page)
`https://www.yellowcab-graz.at/EN/`

5 Places to have lunch/dinner - Stores - ATM

The organization will provide lunch and coffee break through UNI-CAFE (in this building) and MENSA (walking 400 m. along Halbärthgasse).

This is a home-made translation of MENSA's Menu (original version at the end of this file). You will be able to order Salad/Soup + Main dish showing your conference name-tag.

Soup

- Monday - Carrot Ginger
- Tuesday - Consomme with battered pearls
- Wednesday - Consomme with semolina-flour
- Thursday - Celery cream soup
- Friday - Spring onion soup

Classic option I (VEG)

- Monday - Mediterranean pumpkin ragout with cherry tomatoes fried potatoes and salad
- Tuesday - Casserole with potatoes leek carrot, yogurt dip and salad
- Wednesday - Sunflower seeds patty on cabbage turnip with cream
- Thursday - Cous cous, veggie patty on cabbage turnip with cream
- Friday - Vegetarian escalope with yogurt dip and salad

Classic option II

- Monday - Lemon coriander chicken, almond rice and vegetables
- Tuesday - Fried turkey escalope breaded with sesame and potato lettuce salad
- Wednesday - Chopped chicken with cream sauce and almond rice
- Thursday - Beef stroganoff with fusilli
- Friday - MSC Kap hacke (fish) with parsley potatoes and tyrolian sauce

Salad of the week: Summersalad mozzarella rocket cherry tomatoes

G & L option III

- Monday - Noodles alla Norma, eggplant, tomato sauce and Parmesan
- Tuesday - Penne tricolor with cheese cream sauce and Parmesan
- Wednesday - Gnocci with cafe de Paris sauce and Parmesan
- Thursday - Pork ragout vegetables and jasmin rice
- Friday - Fried teriyaki and turkey strips Wok vegetables, garlic ginger sauce and rice

Moreover, this is a list with other places and stores nearby (see map at the end of this file). Notice that this includes **ATM's and pharmacy**. Stores are mentioned as they are placed along the mentioned street, from the university to the park.

Along Zinzendorfgasse

1. SPAR (supermarket + coffee sandwich-salad to go)
2. Pousanne (choose 4 ingredients for your pizza/salad/toast/pasta)
3. AUER Cafe
4. Huber Auer Bakery
5. ATM (crossing Pastaria)
6. Pastaria (pasta)
7. Mangolds
8. Harry's Icecream
9. Geek's
10. Propeller (offers menu of the day - burgers)
11. Babe (asian - to go)
12. Unio Kebap
13. Zio (asian)
14. Parks (**Vegetarian-Vegan**)
15. ATM

Along Heinrichstrasse

1. Barista's cafe
2. Einstein Bar
3. ATM (Mozartgasse corner)
4. Grunzeung Salads & Soup (**Vegetarian-Vegan**)
5. The Churchil bar
6. Skurril Cafe - Bar
7. Rosamunde Kebap
8. Cipollino Pizza
9. Zeppelin (choose 4 ingredients for your pizza/salad/toast/pasta)
10. Grune Karotte (**Vegetarian burgers**)
11. Apotheke = PHARMACY
12. BIPA (cleaning - hygiene)
13. ATM
14. Oscar Markt (evening drinks)
15. Geisdorfstandl Hot dogs - Soup - to go
16. Hubert Auer Sandwiches

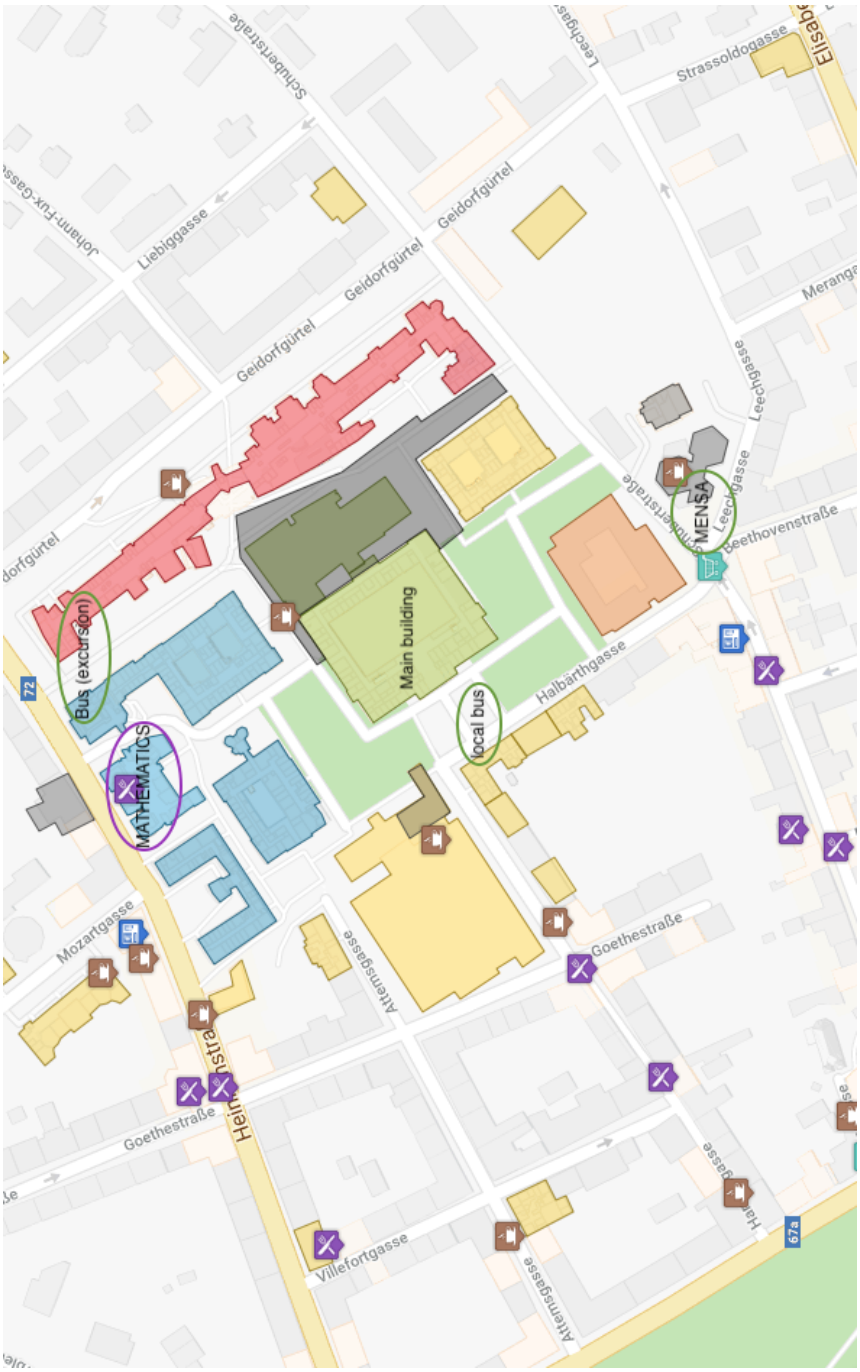
6 Emergency Numbers

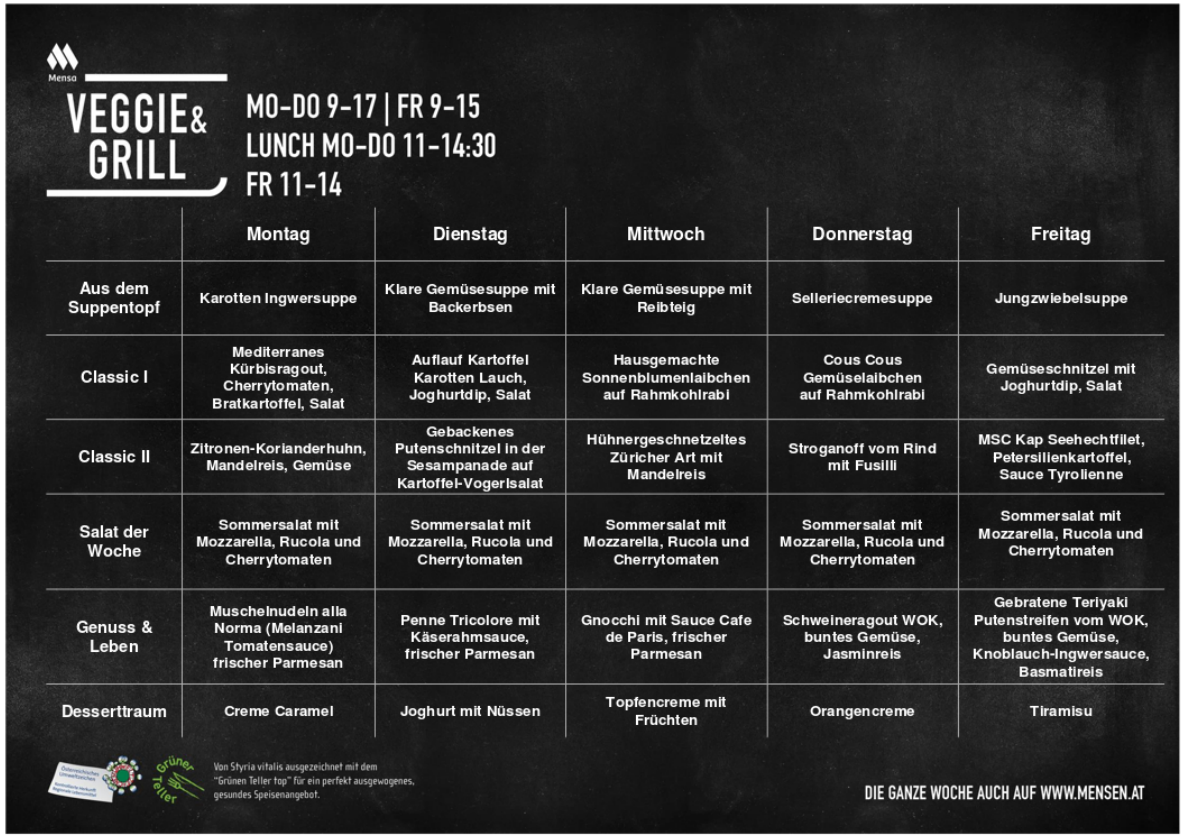
In case of an emergency, you may contact

- Fire brigade 122
- Police 133
- Ambulance 144
- Doctor emergency service (+43 316) 141

For minor emergencies you may also contact one of the local-organizers:

1. Karin Baur +43 664 3060208
2. Ana Garcia-Elsener +43 660 5361932


Schubertstraße
Strassoldogasse
Liebiggasse
Geidorfgürtel
Geidorfgürtel
Geidorfgürtel
Leechgasse
Leechgasse
Schubertstraße
MENSA
Beethovenstraße
Bus (excursion)
Main building
Halbarthgasse
local bus
MATHEMATICS
72
Mozartgasse
Attemsgasse
Goethestraße
Heinrichstraße
Goethestraße
Villefortgasse
Attemsgasse
67a



Mensa

VEGGIE& GRILL

MO-DO 9-17 | FR 9-15
LUNCH MO-DO 11-14:30
FR 11-14

	Montag	Dienstag	Mittwoch	Donnerstag	Freitag
Aus dem Suppentopf	Karotten Ingwersuppe	Klare Gemüsesuppe mit Backerbsen	Klare Gemüsesuppe mit Reibteig	Selleriecremesuppe	Jungzwiebelsuppe
Classic I	Mediterranes Kürbisragout, Cherrytomaten, Bratkartoffel, Salat	Auflauf Kartoffel Karotten Lauch, Joghurtdip, Salat	Hausgemachte Sonnenblumenlaibchen auf Rahmkohlrabi	Cous Cous Gemüselaibchen auf Rahmkohlrabi	Gemüseschnitzel mit Joghurtdip, Salat
Classic II	Zitronen-Korianderhuhn, Mandelreis, Gemüse	Gebackenes Putenschnitzel in der Sesampanade auf Kartoffel-Vogerlsalat	Hühnergeschnetzeltes Züricher Art mit Mandelreis	Stroganoff vom Rind mit Fusilli	MSC Kap Seehechtfilet, Petersilienkartoffel, Sauce Tyrolienne
Salat der Woche	Sommersalat mit Mozzarella, Rucola und Cherrytomaten	Sommersalat mit Mozzarella, Rucola und Cherrytomaten	Sommersalat mit Mozzarella, Rucola und Cherrytomaten	Sommersalat mit Mozzarella, Rucola und Cherrytomaten	Sommersalat mit Mozzarella, Rucola und Cherrytomaten
Genuss & Leben	Muschelnudeln alla Norma (Melanzani Tomatensauce) frischer Parmesan	Penne Tricolore mit Käserahmsauce, frischer Parmesan	Gnocchi mit Sauce Cafe de Paris, frischer Parmesan	Schweineragout WOK, buntes Gemüse, Jasminreis	Gebratene Teriyaki Putenstreifen vom WOK, buntes Gemüse, Knoblauch-Ingwersauce, Basmatireis
Desserttraum	Creme Caramel	Joghurt mit Nüssen	Topfencreme mit Früchten	Orangencreme	Tiramisu

Grünen Teller

Von Styria vitalis ausgezeichnet mit dem "Grünen Teller top" für ein perfekt ausgewogenes, gesundes Speisenangebot.

DIE GANZE WOCHE AUCH AUF WWW.MENSEN.AT