MASSEE

International Congress on Mathematics

MICOM 2009

SEE Young Researchers Workshop

TEMPUS JP SEE DOCTORAL STUDIES IN MATHEMATICAL SCIENCES

September 16-20, 2009
Ohrid, Republic of Macedonia

SEE Young Researchers Workshop is a part of the TEMPUS JP SEE Doctoral Studies in Mathematical Sciences, aiming at establishing a harmonized, high quality, internationally oriented and networked doctoral programme in mathematical sciences in South-Eastern Europe. The project is financed by the European Commission.

The project consortium consists of:

- University of Sarajevo (the grant holding institution)
- Karl-Franzens University of Graz
- Sofia University St. Climent Ohridski
- Institute of Mathematics and Informatics of the Bulgarian Academy of Sciences
- Mathematical Society of South-Eastern Europe
- University of Tuzla
- University of Banja Luka
- University of Belgrade
- Ss. Cyril and Methodius University of Skopje
- University of Montenegro
- University Luigj Gurakuqi of Shkodra.

At this workshop, PhD students from participating universities present the research topics they have been working on and the results obtained thus far.

List of participants

PhD students:

- Petar Ruslanov Armyanov
- Vesna Celakoska-Jordanova
- Vesna Dimitrova
- Radoslava Danailova Goranova
- Dženan Gušić
- Sanela Halilović
- Aleksandar Kartelj
- Nacima Memić
- Marija Milanović
- Aleksandra Mileva
- Anastas Mišev
- Nikolai Genchev Noev
- Almasa Odžak
- Vedad Pašić
- Aurelio de los Reyes
- Jelena Rubeša
- Predrag Stanojević
- Vladimir Telebak
- Zlatko Udovičić

Professors:

- Andrey Andreev
- Muharem Avdispahić
- Fehim Dedagić
- Stefan Dodunekov
- Dončo Dimovski
- Franz Kappel
- Petar Kenderov
- Miroslav Marić
- Zorica Stanimirović
- Alexandra Soskova
- Dušan Tošić

Programme

Thursday, 17th September 2009

9:00 - 9:25	Aleksandra Mileva, Skopje
9:25 - 9:50	Sanela Halilović, Tuzla
9:50 - 10:00	Break
10:00 - 10:25	Zlatko Udovičić, Sarajevo
10:25 - 10:50	Jelena Rubeša, Graz
10:50 - 11:10	Break
11:10 - 11:35	Nikolai Genchev Noev, Sofia
11:35 - 12:00	Marija Milanović, Beograd
12:00 - 12:25	Vladimir Telebak, Banja Luka
12:25 - 13:00	Discussions
18:30 - 18:45	Project presentation at MICOM 2009
18:45 - 19:10	Vedad Pašić, Tuzla

Friday, 18th September 2009

9:30 - 9:55 Almasa Odžak, Sarajevo

10:00 - 10:25 Vesna Dimitrova, Skopje

10:25 - 10:50 Aleksandar Kartelj, Beograd

10:50 - 11:10 Break

11:10 - 11:35 Radoslava Danailova Goranova, Sofia

11:35 - 12:00 Anastas Miev, Skopje

12:00 - 12:30 Discussions

14:00 Excursion

Saturday, 19th September 2009

9:00 - 9:25 Dženan Gušić, Sarajevo

9:25 - 9:50 Petar Ruslanov Armyanov, Sofia

9:50 - 10:00 Break

10:00 - 10:25 Aurelio de los Reyes, Graz

10:25 - 10:50 Predrag Stanojević, Beograd

10:50 - 11:10 Break

11:10 - 11:35 Nacima Memić, Sarajevo

11:35 - 12:00 Vesna Celakoska-Jordanova, Skopje

12:00 - 13:00 Concluding discussions

List of abstracts

File Format for Storage of Multimedia Information

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This article studies problems referring to storage, edit and streaming vector graphics and animation. The advantages and disadvantages of existing formats are reviewed and some suggestions to solve the problems are given. An approach for generating vector stream in a format, that allows embedding of additional media such audio and descriptive metadata is introduced. In parallel the problem of conversion multimedia files from one container format to another is described and solution for virtual conversion, based on file system filtering is described. At the end the ways for future development are pointed and some improvements of work already done are suggested.

Canonical objects in classes of (n, V)-groupoids

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If V is a variety of groupoids, then a groupoid G is said to be (n, V)-groupoid iff the subgroupod generated by any n elements of G belongs to the variety V. The class of (n, V)-groupoids is denoted by (n, V). If

$n = 1$, then $(1, V)$-groupoids are called power V-groupoids. In that case, the variety V is a subclass of the class $(1, V)$, and more generaly V is a subclass of the class (n, V). The class $(n + k, V)$ is a subclass of the class (n, V). We give a description of canonical objects in the classes of power-commutative groupoids, power left and right idempotent groupoids, power-slim groupoids and the class of biassociative groupoids. Also, a characterization by means of injective groupoid in that particular class is given.

Quasigroup transformations and applications in cryptography

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Structures of quasigroups, their properties and especially their large number, enable them to be applied in many theories, like cryptography and coding theory. We define quasigroup transformations using quasigroups. Properties of sequences obtained by quasigroup transformations give possibilities of their applications. In this thesis some of the properties of quasigroups, quasigroup transformations and classification of quasigroups are researched. Using graphical presentations some classifications of quasigroups are obtained. We present some applications of quasigroup transformations in cryptography, especially for implementation of pseudo random generators.

Key words: quasigroup, quasigroup transformation, pseudo random sequence generator

Services on Application Level in Grid for Scientific Calculations

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The Grid is a hardware and software infrastructure that coordinates access to distribute computational and data resources, shared by different institutes, computational centres and organisations. The Open Grid Services Architecture (OGSA) describes architecture for a service-oriented grid computing environment, based on Web service technologies, WSDL and SOAP. In this article we investigate possibilities for realization of business process composition in grid environment, based on OGSA standard by analyzing two Grid middlewares (Globus Toolkit 4 and g-Lite).

Integral representations of the logarithmic derivative of the Selberg zeta function

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We point out the importance of the Integral representations of the logarithmic derivative of the Selberg zeta function valid up to the critical line, i.e. in the region that includes the right half of the critical strip, where the Euler product definition of the Selberg zeta function does not hold. Most recent applicatons to the behavior of the Selberg zeta functions associated to a degenerating sequence of finite volume, hyperbolic manifolds of dimensions

2 and 3 are surveyed. The research problem consists in extending this kind of integral representations to the setting of the locally symmetric spaces rank 1.

On Nonlinear Hammerstein Systems

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We study a discrete nonlinear Hammerstein system with non-symetric kernel. We consider various nonlinear spectral theories in order to solve our operator equation, and find the conditions of existence and uniqueness of solution. We also discuss the probability of applying some kind of Fredholm alternative.

Classification of smoking cessation status using various datamining techniques

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This study examines various approaches for binary classification between former and current smokers. Prediction is based on data collected in 2000 National Interview Survey (NHIS). Process is consisted of two essential part. The first one determines which attributes are relevant to smoking status decision using simple genetic algorithm and different evaluation functions. The second part is classification method itself. Comparation of results using logistic regression, neural network etc. is presented. Solving

this type of problem has its real benefits in decision support systems used by some health institution.

Multiplicative systems on ultra-metric spaces

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In this work we give some applications of multiplicative systems on ultrametric spaces. Among ultrametric spaces we cite general Vilenkin groups as the dyadic group, p-series fields and p-adic fields. Some of these applications are used for obtaining forms of derivatives in which elements of the multiplicative system are eigenfunctions of the differential operator with suitable eigenvalues. We also use them for approximation of integrable functions by trigonometric polynomials. Finally, we construct multiplicative systems on a class of compact ultrametric spaces that need not have a group structure.

A genetic algorithm approach for solving the generalized vertex cover problem

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The topic is related to solving the generalized vertex cover problem (GVCP) by genetic algorithm. Binary representation and standard genetic opera-

tors are used along with the appropriate objective function. The experiments were carried out on randomly generated instances with up to 500 vertices and 10000 edges. Performance of the genetic algorithm is compared with CPLEX solver and 2-approximation algorithm based on LP relaxation. The genetic algorithm outperformed both CPLEX solver and 2-approximation heuristic.

Cryptographic primitives with quasigroup transformations

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Two eminent specialists on quasigroups, J. Denes and A. D. Keedwell, once proclaimed the advent of a new era in cryptology, consisting in the application of non-associative algebraic systems as quasigroups and neofields. Nevertheless, at present, very few researchers use these tools and cryptographic community still hesitate about them. We want to justify the use of quasigroups in cryptography. We obtain new quasigroup transformations and new method for fast computation of large quasigroup operation by Extended Feistel networks as orthomorphisms of an Abelian group and Sade's diagonal method. We incorporate this method in the cryptographic hash function NaSHA, which was one of the 51 first round candidates on the NIST SHA-3 competition. In every quasigroup transformation of every iteration of NaSHA we use different quasigroup of order 2^{64}, and all these quasigroups depend from the processed messsage block.

GRID WORKFLOWS
Grids from the users' point of view

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Grid computing is de facto the next "big thing" in the area of information and communication technologies. This is supported not only by the great number of research projects, practical implementation and allocated resources, but also by the political commitment, especially by the EU. The current level of Grid computing offers relatively mature infrastructure that is available and usable. Still, there are lots of open issues that need to be addressed so this technology will become widespread and wide accepted. Especially important are the issues connected to the users perception of the Gird computing. Enabling the users to have better insight, but also better control of the jobs they submit to the Grid will enable them to feel more comfortable to use it, increasing the area of applications. Using the process mining to analyze GRID middleware is not a new idea, but very little has been done to actually analyze the platform. Analyzing the data from the logging and bookkeeping service, we have obtained a different perspective on what actually happens during the lifetime of the Grid jobs. Introducing user level monitoring tools enables the Grid infrastructure users to get a better understanding of the jobs lifetime and workflow. Defining clear QoS metrics and relations greatly contributes to wider acceptance of the Grid infrastructure, both with the scientific and business users. This will open the possibility to establish firm and clear relations between all the participants, including service and resource providers and users, both scientific and business.

Organization and security of the audio and video archive for unique Bulgarian bells

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The purpose of this investigation is to study and to identify the most valuable unique bells as well as to develop an digital archive with the help of advanced technologies. The main tasks are: development of the audio archive of information gathered from artifacts, analysis, optimization and addition of metadata for indexing of digital data, compression and data protection, prevention of data loss, design, organization and maintenance of archive. We investigate the methods of protection with watermarking which can be used against illegal use of data. And also, we developed the functions for creating, formatting and protection of samples for additional applications and web sites.

The Project is financially supported by the Ministry of Education and Sciences -Bulgarian National Science Fund under Grant KIN - 1009/2006.

On Li's coefficients for some classes of L-functions

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We study the generalized Li coefficients associated with some classes of L functions. The class $\mathcal{S}^{\sharp\flat}$ of functions containing the Selberg class and

(unconditionally) the class of all automorphic L functions attached to irreducible unitary cuspidal representations of $GL_N(\mathbb{Q})$ and the class of L-functions attached to the Rankin-Selberg convolution of two unitary cuspidal automorphic representations π and π' of $GL_m(\mathbb{A}_F)$ and $GL_{m'}(\mathbb{A}_F)$ are treated. We deduce a full asymptotic expansion of the archimedean contribution to these coefficients and investigate the contribution of the non-archimedean term. Obtained results are applied to automorphic L-functions. Also, bound towards a generalized Ramanujan conjecture for the archimedean Langlands parameters $\mu_\pi(v, j)$ of π is derived.

Mathematics Subject Classification (2000): 11M41, 11M26, 11S40

Keywords: Li's coefficients, Selberg class, Rankin-Selberg L-functions, Generalized Ramanujan conjecture, Generalized Riemann hypothesis

New Solutions for Quadratic Metric-Affine Gravity

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We deal with quadratic metric-affine gravity, which is an alternative theory of gravity. Spacetime is considered to be a connected real 4–manifold M equipped with a Lorentzian metric g and an affine connection Γ. An *independent* linear connection Γ distinguishes MAG from GR - g and Γ viewed as two totally independent quantities.

We present new vacuum solutions for this theory (*generalised pp-waves*) and attempt to give their physical interpretation on the basis of comparison with existing classical models. We give a comparison with a classical model describing the interaction of gravitational and neutrino fields, namely Einstein-Weyl theory. Future research directions are discussed.

Modeling Pulsatility in the Human Cardiovascular System

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The objective of the talk is to present a mathematical model that predicts the pressures in the systemic and peripheral circulation, and specifically the pulsatile pressures in the the finger arteries where real-time measurements can be obtained. The modeling efforts combined two lumped cardiovascular models the Kappel model and the Ottesen/Olufsen model. The Kappel model is a global nonpulsatile model using average pressures while the Ottesen/Olufsen model is simplified pulsatile model considering the left ventricle as a source of pulsatile flows. The main difficulty is to link the average flow with pulsatile flow. Modifications were made to incorporate the aorta and the finger arteries compartment. Preliminary simulation results will be presented.

Time Optimal Control

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An efficient algorithm, called the Time-Optimal Bang-Bang Control Algorithm (TOBBCA) is proposed for time-optimal switching control of the non-autonomous linear system with multiple control input. The problem of minimal time transition between two stationary points of the system is formulated in a framework of an indirect numerical method. A code, based on a semi-smooth New- ton's iteration, was developed in the C++ language. The NVIDIA CUDA technology made it even faster.

Mathematical optimization for the train timetabling problem

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The rail transportation is very rich in terms of problems that can be modeled and solved using mathematical optimization techniques. Train scheduling problem as the most important part of a rail operating policy has a very significant impact on a rail company profits, considering the fact that from the quality of a train timetable depends the flow of the three most important resources on a rail network: cars, locomotives and crews. The train timetabling problem aims at determining a periodic timetable for a set of trains that does not violate track capacities and satisfies some operational constraints. In this paper, we developed an integer programming approach for determining an optimal train schedule for a single, one-way track linking two major stations, with a number of intermediate stations between. The application has been tested on a realistic example suggested by the PE "Serbian Railways". Obtained results show the potential for a practical application of the proposed approach.

G-maps and nonembeddability

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We will present here notion of G-index, very usefull toll for linking of Combinatorics and Discrete geometry with Topology, and proving combinatorial problems with well developed topological metods. Couple geometric theorems will be showed, together with their topological generalizations. The presentation is mostly based on work of S. Vrecica, R. Zivaljevic and J. Matousek.

Splines in Numerical Integration

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In our investigation we are considering two problems. The first one is approximate computation of the integral

$$\int_0^m \varphi_m(t) f(t) dt,$$

where $\varphi_m(\cdot)$, cardinal B-spline of order m, is considered as a weight function. The most important, but not the only one, result of this investigation is the fact that one point quadrature rule, on the "quasiuniform mesh" has, conditionaly speaking, algebraic degree of exactness equal to $m-1$, for each $m \in \mathbb{N}$.

The second problem is classical problem in mathematical analysis, i.e. approximate computation of the integral

$$\int_a^b f(t) dt.$$

By using different types of splines (interpolating spline and cardinal B-spline), for approximation of the function $f(\cdot)$, we obtain a several quadrature rules for approximate computation of the given integral.

A selection of those results will be included in my PhD thesis.