University Center for Mathematical Modeling, Applied Analysis and Computational Mathematics

Semester Seminar, 19th May 2015, 8:30–13:15, Room K4

Schedule

Time	Speaker	Title
8:30		Opening
8:35	Václav Kučera	Segmentation of Microscopic Images Using Level Set Methods
9:00	Václav Vlasák	Haar meager sets
9:25	Miloslav Vlasák	A posteriori error estimates for DG again
9:50		Discussion & Coffee break
10:20	Ondřej Souček	Hesperian polythermal glaciation in Isidis Planitia, Mars – Ice sheet dynamics and thermal regime inferred from numerical modeling
10:45	Iveta Hnětynková	Solvability of core problems in the TLS sense
11:10	Dušan Pokorný	Is the distance regularizing?
11:35		Discussion & Coffee break
12:05	Benjamin Vejnar	Conjugacy to a map of a constant slope
12:30	Martin Lanzendörfer	Boundary conditions for an incompressible fluid flowing through artificial boundary
12:55	Ondřej Kurka	Embeddings into Banach spaces with a basis
13:15		Concluding remarks

Abstracts

Iveta Hnětynková, Solvability of core problems in the TLS sense. Consider a linear (orthogonally invariant) approximation problem with possibly multiple right-hand sides $AX \approx B$. Recently, it has been described how necessary and sufficient information for solving this problem can be revealed through the so-called core problem reduction. In this contribution, we concentrate on solvability of core problems in the Total least squares (TLS) sense. We show that, contrary to the single right-hand side case, the core problem with multiple right-hand sides may not have a TLS solution.

Václav Kučera, Segmentation of Microscopic Images Using Level Set Methods. This work deals with the automatic processing of microscopic images of living cells in experimental biology. The goal is to evaluate the number of living cells over time in a given substrate. The method used is an image segmentation algorithm tailored to this specific application. The level set method is used and a suitable energy functional is devised for the desired level set function. The variational problem is solved via a gradient flow and the corresponding Euler-Lagrange equations. Numerical results are presented.

Ondřej Kurka, Embeddings into Banach spaces with a basis. We will mention some questions concerning embeddings of separable Banach spaces into "not much bigger" spaces which have a monotone Schauder basis. The questions are motived by results presented in the previous annual seminar and we would like to solve some of them in future.

Martin Lanzendörfer, Boundary conditions for an incompressible fluid flowing through artificial boundary. Some comments on a practical, more or less, issue of choosing an appropriate yet simple boundary condition on those parts of the domain boundary, which are not related to any physical interface. In which cases is it justified to abide with the standard setting? In other cases, is there a better way, or rather not? (A gathering-ideas talk.)

Dušan Pokorný, Is the distance regularizing? Regularization using the distance function (e.g. approximation by parallel neighbourhoods, or its analog for functions, the so-called Moreau–Yosida regularization) is used in many contexts in various areas of mathematics including convex geometry, geometric measure theory or Banach spaces. I will discuss its use in the theory of Monge–Ampère functions with particular emphasis on the approximation of the piecewise affine functions. I will try to explain the motivation and the main questions and perhaps even some recent results which are a joint work with Joseph Fu.

Ondřej Souček, Hesperian polythermal glaciation in Isidis Planitia, Mars – Ice sheet dynamics and thermal regime inferred from numerical modeling. We test the hypothesis that the Thumbprint Terrain observed on the floor of Isidis Planitia, a giant impact crater located close to the martian equator, is a landform assemblage inherited from a glaciation during the Hesperian. For this purpose, we perform numerical simulations with a coupled thermo-mechanical model of ice sheet dynamics. We use surface temperatures and ice accumulation/ablation patterns predicted by a climatic Global Circulation Model, and values of the geothermal heat flux provided by a global model of planetary thermal evolution. We find that, with atmospheric physical properties similar to the current ones and under favorable orbital conditions, net ice accumulation in the northwestern part of Isidis Planitia leads within a few Ma to the development of a massive ice sheet, as much as 4.9 km in thickness, over the entire basin. The modeled ice sheet is polythermal: its center and its periphery are permanently frozen to the base, while the pressure melting point is reached episodically in an intermediate ring. Our simulations suggest that the propagation of thermo-mechanical melting waves in this ring is responsible for the formation of the Thumbprint Terrain, a probable martian equivalent of terrestrial ribbed moraines. They support the interpretation that sinuous ridges and linear valleys observed at the periphery of the basin are parts of a subglacial network of eskers and tunnel valleys that drained glacial meltwater outwards, across the cold-based outer part of the ice sheet. This work strengthens the hypothesis that massive glaciers covered large portions of the martian surface before the Amazonian and that basal melting below the wet-based portions of these ice sheets contributed significantly to the production and flow of liquid water in the ancient martian history.

Benjamin Vejnar, Conjugacy to a map of a constant slope. A classical topological dynamical system is a pair consisting of a topological space and a selfmap of this space. In the field of topological dynamics one studies basically the trajectories of points that are obtained by iterations of the selfmap. It may happen that two different functions have the same dynamical properties. In this case we say that they are conjugated. We are usually seeking a conjugation with a nice function.

It was proved by Parry in 1966 that if we have some sort of a piecewise monotone selfmap of the closed interval then there is a conjugated map with a constant slope. A similar result for some type of maps on the closed interval which are monotone on countably many pieces was obtained by Bobok in 2012. We are able to generalize the second result to finite trees and also to some compactifications of infinite trees.

Miloslav Vlasák, A posteriori error estimates for DG again. We will show a posteriori error estimate for space-time DG discretization for linear problem and its generalization to nonlinear one. Moreover, we will discuss, why we are disappointed with the resulting formula.

Václav Vlasák, Haar meager sets. In many fields of mathematics we use some notions of small sets. One of the best known is the notion of Lebesque null set in $\mathbb{R}^n$. The generalization of this notion is the notion of Haar null set. I would like to present the notion of Haar meager set which is the topology version of the notion of Haar null set.