University Center for Mathematical Modeling, Applied Analysis and Computational Mathematics

Semester Seminar, 19th May 2016, 8:10–12:10, Room K6

Schedule

Time	Speaker	Title
8:10		Opening
8:10	Marek Cúth	(Generalized) lush Banach spaces and separable reduction
8:30	Martin Lanzendörfer	Artificial boundary conditions for incompressible flow
8:50	Ondřej Souček	Numerical modeling of tidal deformation of Saturn's moon Enceladus: Effect of tiger stripes
9:10		Coffee break
9:20	Vít Průša	On the response of nonlinear viscoelastic materials in creep and stress relaxation experiments in the lubricated squeeze flow setting
9:40	Iveta Hnětynková	On noise in residuals of some Krylov subspace regularization methods
10:00	Miloslav Vlasák	A posteriori error estimates for evolution problems - quadratures
10:20		Coffee break
10:40	Václav Vlasák	Haar meager sets, their hulls, and relationship to compact sets
11:00	Benjamin Vejnar	Compactifiable classes of compacta
11:20	Dušan Pokorný	Packing numbers of Ahlfors regular sets
11:40	Ondřej Kurka	Tsirelson-like spaces and complexity of classes of Banach spaces
12:00		Conclusion

Abstracts

Marek Cúth: (Generalized) lush Banach spaces and separable reduction. By a separable reduction we mean the possibility to extend the validity of a statement from separable spaces to the nonseparable setting without knowing the proof of the statement in the separable case. Using separable reduction we proved that every Banach space which is lush and Asplund is generalized lush. I will say some words about separable reduction in general and mention certain interesting facts concerning (generalized)-lushness.

Martin Lanzendörfer: Artificial boundary conditions for incompressible flow. We will revisit boundary conditions prescribed on artificial boundaries for steady isothermal flows of incompressible fluids in bounded domains. Both Navier-Stokes fluid and some examples of fluids with variable viscosity will be considered. The aim will be to correlate the analysis, numerical simulation and modelling points of view on the issue.

Ondřej Souček: Numerical modeling of tidal deformation of Saturn's moon Enceladus: Effect of tiger stripes. Enceladus is a relatively small planetary body (approximately 250 km in radius) differentiated probably to an outer water-ice layer of somewhat uncertain thickness (varying between few up to several tens of km), probably a global underlying liquid water ocean and a silicate core. This moon gained lot of attention in the past few years both in the geophysical and astrobiological communities since the Cassini mission flybys revealed an ongoing surface activity - active jets of water emanating from the surface fissures ("tiger stripes") around the south pole - that might be connected to a global subsurface water ocean. This makes Enceladus, together with the Jovian moon Europa, one of the promising candidates for the presence of extraterrestrial life and one of the most geologically active bodies in the Solar system.

We have been investigating the effect of the presence of fissures in Enceladus's south polar region and attempting to quantify the impact they might have on the deformation of the outer icy shell when subjected to tidal potential loading in the gravitational field of Saturn. We are particularly interested in the regime of opening and closure of the fissures during the tidal cycle with the aim to explain the observed patterns of activity of the geysers located on these fissures. We also investigate the impact of the fissures on the tidal dissipation inside the ice shell, since this mechanism represents an important internal heating source affecting the overall energy balance of the moon, and is possibly crucial for the long-term sustainability of the liquid ocean.

Vít Průša: Towards mathematical description of creep and stress relaxation tests in the mechanics of nonlinear viscoelastic materials. Standard testing procedures for viscoelastic materials are based on the study of the material response to an oscillatory input (oscillatory tests) and to a step input (creep and stress relaxation tests). While the response of nonlinear materials in the oscillatory setting is nowadays routinely investigated, the response to a step input is discussed less frequently. The reason is that the analysis of the response of nonlinear materials to step inputs requires one to simultaneously handle the discontinuity, differentiation and nonlinearity. This task is however beyond the reach of the standard theories such as the classical theory of distributions and presents a considerable mathematical difficulty.

Recently (Průša & Rajagopal 2016, Int. J. Non-Linear Mech.) have argued that an elegant and relatively easy to use framework capable of accomplishing the task is provided by the Colombeau algebra, which is a generalisation of the classical theory of distributions to the nonlinear setting. We use the Colombeau algebra formalism and derive explicit formulae describing the response of incompressible Maxwell viscoelastic fluid subject to step load/deformation in the lubricated squeeze flow setting. (Joint work with Martin Řehoř and Karel Tůma.)

Iveta Hnětynková: On noise in residuals of some Krylov subspace regularization methods. Golub-Kahan iterative bidiagonalization (GK) represents the core algorithm in several regularization methods for solving large linear noise-contaminated ill-posed problems. Propagation of white noise in bidiagonalization vectors has been studied previously. It this talk we consider more general noise setting and study its influence on the propagation. Residuals of selected GK-based regularization methods are analyzed.

Miloslav Vlasák: A posteriori error estimates for evolution problems - quadratures. It is possible to show that Galerkin discrtizations in time with integration provided by suitable quadratures are equivalent to well known subclass of collocation Runge-Kutta methods. We will use the equilibrated flux reconstruction technique to derive a posteriori error estimates for parabolic problems discretized by these methods.

Václav Vlasák: Haar meager sets, their hulls, and relationship to compact sets. The notion of Haar meager sets is topological counterpart of measure theoretic notion of Haar null sets. I would like to remind some known results related to Haar meager sets. I also mention some new results. Namely, that there exist Haar meager sets without "nice" hulls. I also mention a relation between collection of compact sets and Haar meager sets in non-locally compact Polish spaces.

Benjamin Vejnar: Compactifiable classes of compacta. We say that a class C of compact metrizable spaces is compactifiable, if there is a closed set F in the hyperspace of a compact metrizable space, such that every space from C is homeomorphic to a space in F. Roughly speaking, this means that we can select representatives of C to build a compact space from them. We give several equivalent descriptions of this notion and provide some natural examples of classes which are compactifiable and which are not. Furthermore we will discuss natural relation to the descriptive set theoretical complexity.

Dušan Pokorný: Packing numbers of Ahlfors regular sets. In the talk I will first explain the notion of an Ahlfors regular set and then show how to characterize them using certain tree construction. The main result of the talk will then concern the asymptotic behaviour of the packing numbers of Ahlfors regular sets for which the corresponding tree satisfies some additional assumptions. The results are a joint work with Marc Rauch.

Ondřej Kurka: Tsirelson-like spaces and complexity of classes of Banach spaces. In the talk, I will present an approach to complexity problems in Banach space theory which is based on a fundamental example of Tsirelson.