University Center for Mathematical Modeling, Applied Analysis and Computational Mathematics

Semester Seminar, 7th December 2015, 8:30–11:30, Room K3

Schedule

Time	Speaker	Title
8:10		Opening
8:10	Marek Cúth	Lipschitz-free spaces
8:30	Martin Lanzendörfer	On numerical simulations in plane slider lubrication
8:50	Ondřej Souček	Surface-free energy formulation of static contact-angle condition for Allen–Cahn and Cahn–Hilliard type models
9:10		Coffee break
9:20	Vít Průša	Towards mathematical description of creep and stress relaxation tests in the mechanics of nonlinear viscoelastic materials
9:40	Iveta Hnětynková	Fully automatic imaging-based classification of synthetic gemstones
10:00	Miloslav Vlasák	Stability of ALE formulations
10:20		Coffee break
10:40	Václav Vlasák	Haar meager and Haar null sets 1
11:00	Benjamin Vejnar	Haar meager and Haar null sets 2
11:20		Conclusion

Dušan Pokorný and Václav Kučera are on long term stays abroad, and they will not give lectures this time. Ondřej Kurka is attending a conference on 7th December 2016, and he will give lecture on 30th November at 10:10-10:30 in room K3. His lecture is a part of the seminar of project MORE.

Abstracts

Ondřej Kurka: Zippin's embedding theorem and amalgamations of classes of Banach spaces. A classical result of Zippin states that every separable reflexive Banach space embeds isomorphically into a reflexive Banach space which admits a Schauder basis. We show that it is possible to provide an isometric version of this result. This enables us to find an isometrically universal reflexive space for many classes of reflexive spaces. For example, there exists a separable reflexive Banach space that contains an isometric copy of every super-reflexive separable Banach space.

Marek Cúth: Lipschitz-free spaces. Given a metric space M, it is possible to construct a Banach space $F(M)$ in such a way that the Lipschitz structure of M corresponds to the linear structure of $F(M)$. This space $F(M)$ is often called "Lipschitz-free space". The study of those spaces has recently became an actvie fiels of study (mostly in France). In my talk I will try to explain why it is interesting to study those spaces and briefly say few words about results contained in recent works of myself, M. Doucha and P. Wojtaszczyk.

Martin Lanzendörfer: On numerical simulations in plane slider lubrication. We will comment on the numerical results and approaches available in literature for selected problems arising in hydrodynamic lubrication, compare some with our results obtained by full FEM simulations and advert to some open problems.

Ondřej Souček: Surface-free energy formulation of static contact-angle condition for Allen–Cahn and Cahn–Hilliard type models. We present a formulation of static angle boundary conditions for Allen–Cahn and Cahn–Hilliard type models. It is based on an extension of the standard bulk energy functional by certain surface energy contribution derived from the three-phase free-energy functional proposed Boyer and Lapuerta (2009).

We derive a formula for static contact angle which does not distort the inter-phase transition zone in the vicinity of the contact line, and which is easy-to implement numerically. This is confirmed in numerical simulations.

Our energy formulation allows to extend the numerical analysis of Minjeaud (2012) and to propose a time discretization that ensures validity of dicrete energy equality and consequently unconditional stability of the numerical scheme.

Vít Průša: Towards mathematical description of creep and stress relaxation tests in the mechanics of nonlinear viscoelastic materials. The response of physical systems governed by linear ordinary differential equations to step input is traditionally investigated using the classical theory of distributions. The response of nonlinear systems is however beyond the reach of the classical theory. The reason is that the simplest nonlinear operation—multiplication—is not defined for the distributions. Yet the response of nonlinear systems is of interest in many applications, most notable example is the analysis of the creep and stress relaxation tests in mechanics of viscoelastic materials. Consequently, a mathematical framework capable of handling such problems is needed.

We argue that a suitable framework is provided by the so-called Colombeau algebra that gives one the possibility to overcome the limits of the classical theory of distributions, namely the possibility to simultaneously handle discontinuity, differentiation and nonlinearity. Our thesis is documented by means of studying the response of two systems governed by nonlinear ordinary differential equations to step input. In particular, we show that using the rules of calculus in Colombeau algebra it is possible to obtain an explicit and practically relevant characterisation of the behaviour of the considered systems at the point of the jump discontinuity.

Iveta Hnětynková: Fully automatic imaging-based classification of synthetic gemstones. This talk concentates on the problem of defect detection in synthetic gemstones appearing in the jewellery industry. We decribe how this task can be handled by image processing methods, based in particular on image fussion and object detection. We present results of a fully automatic highly accurate classification method we have developed in collaboration with our industrial partner. Challenges in the new project of collective classification are mentioned.

Miloslav Vlasák: Stability of ALE formulations. In this talk we will focus on PDEs with time dependent domains, where the "movement" of the domain is described by smooth known ALE mapping. This problem will be discretized in space and time by the discontinuous Galerkin finite element method. Finally, we will show stability of the discrete solution in $L^\infty(L^2)$ norm by discrete characteristic function technique. (Joint work with Monika Balázsová and Miloslav Feistauer.)

Václav Vlasák: Haar meager and Haar null sets 1. There are two basic concepts of smallness in R^n. One of them is measure theoretic concept, represented by Lebesque null sets and another one is topological concept represented by meager sets. Christensen 1972 generalized the notion of Lebesque null sets by the notion of Haar null sets. In the similar way, Darji developed the notion of Haar meager sets. I would like to present some basic facts about these two notions.

Benjamin Vejnar: Haar meager and Haar null sets 2. The notion of Haar meager sets was introduced by Darji in 2013 as a topological counterpart to the notion of Haar null sets. Haar meager sets are kind of small sets in a Polish (=completely metrizable and separable) group. They are reflecting both the topological and algebraic structure of the Polish group. We present several results answering a question of Darji. Namely we proved that in any uncountable Polish abelian group there is a non-Haar meager set satisfying a weakened form of Haar meagerness. We will be also dealing with the incomparability of Haar meager and Haar null sets. Some intriguing questions in the field of study are still remaining.