WWTF - Vienna Research Groups for Young Investigators Call 2017

PRESENTATIONS BY THE CANDIDATES

29.5.2017, 14:00, MR09, Franz Baumdicker

Mathematics and Biosciences

"MATHEMATICAL MODELS FOR MICROBIAL EVOLUTION -- FROM DISTRIBUTED GENOMES TO CRISPR SPACER ARRAY EVOLUTION"

29.5.2017, 15:30, MR09, Gregory Roth

Mathematics and Population Ecology

"PERSISTENCE OF POPULATIONS IN FLUCTUATING ENVIRONMENTS"

1.6.2017, 11:00, MR09, Helen Alexander

Mathematics and Biology

"STOCHASTIC MODELS OF PATHOGEN EVOLUTION"

7.6.2017, 09:00, SR01, Michael Feischl

Mathematics and Functional Materials

"ADAPTIVE ALGORITHMS, MAGNETISM, AND UNCERTAINTY"

I will introduce the three main areas of my current research and discuss recent results and connections between them. I will start with the Landau-Lifshitz-Gilbert equation and talk about time-stepping algorithms and regularity results. This will lead us to adaptive mesh refinement strategies and the question of optimality of adaptive algorithms.

Finally, I will discuss stochastic noise in partial differential equations. This includes random coefficients but also Wiener processes and leads to interesting questions about algorithms and theory.

7.6.2017, 10:00, SR01, Giuliano Lazzaroni

Mathematics and Materials

"DYNAMIC FRACTURE: A ONE-DIMENSIONAL ANALYSIS"

We present a simplified model of dynamic crack propagation where the equation of elastodynamics is coupled with Griffith's principle, which prescribes the evolution of the domain. In recent years there has been an increasing interest in studying systems where second-order equations for displacements are coupled with first-order flow rules for internal variables. Despite a number of papers devoted to regularised models, only preliminary results are available for dynamic fracture; in this context heavy mathematical difficulties have to be overcome. In our work we deal with a problem of debonding propagation for a one-dimensional thin film, partially glued on a substrate and subject to oscillations in the debonded part. We provide existence and uniqueness results for dynamic evolutions and study the limit as the speed of external loading tends to zero. We establish the properties of the limit solution and see that in general it does not coincide with the expected quasistatic limit.

7.6.2017, 11:00, SR01, Martin Huesmann

Mathematics and Finance

"OPTIMAL TRANSPORT AND SKOROKHOD EMBEDDING"

The Skorokhod embedding problem is to represent a given probability as the distribution of Brownian motion at a chosen stopping time. Over the last 50 years this has become one of the important classical problems in probability theory and a number of authors have constructed solutions with particular optimality properties. These constructions employ a variety of techniques ranging from excursion theory to potential and PDE theory and have been used in many different branches of pure and applied probability. We develop a new approach to Skorokhod embedding based on ideas and concepts from optimal mass transport. In analogy to the celebrated article of Gangbo and McCann on the geometry of optimal transport, we establish a geometric characterization of Skorokhod embeddings with desired optimality properties. This leads to a systematic method to construct optimal embeddings. It allows us, for the first time, to derive all known optimal Skorokhod embeddings as special cases of one unified construction and leads to a variety of new embeddings. While previous constructions typically used particular properties of Brownian motion, our approach applies to all sufficiently regular Markov processes. (j.w. with M. Beiglböck and A. Cox)

7.6.2017, 12:00, SR01, Seyedehsomayeh Hosseini

"A Riemannian gradient sampling algorithm for nonsmooth optimization on manifolds"

In this talk, an optimization method for nonsmooth locally Lipschitz functions on Riemannian manifolds will be presented. The method is based on approximating the subdifferential of the cost function at every iteration by the convex hull of transported gradients from tangent spaces at randomly generated nearby points to the tangent space of the current iterate, and can hence be seen a generalization of the well-known gradient sampling algorithm to a Riemannian setting. A convergence result will be obtained under the assumption that the cost function is continuously differentiable on an open set of full measure, and that the employed vector transport and retraction satisfy certain conditions, which hold for instance for the exponential map and parallel transport. Then with probability one the algorithm is feasible, and either the sequence of function values associated with the constructed iterates is unbounded from below, or each cluster point of the iterates is a Clarke stationary point.

8.6.2017, 10:00, SR02, Miroslav Bacák

Mathematics and Phylogenetics

"Convexity in Hadamard spaces"

The aim of my presentation is to introduce convex analysis and optimization in Hadamard spaces as a rightful subject field, which, despite being relatively young, has found interesting applications both in mathematics and outside. I will focus primarily on discrete and continuous gradient flows and their applications

8.6.2017, 14:30, Sky Lounge , Sara Merino-Aceituno

Mathematics and Biology

"A new flocking model through body attitude coordination"

We present a new model for multi-agent dynamics where each agent is described by its position and body attitude: agents travel at a constant speed in a given direction and their body can rotate around it adopting different configurations. Agents try to coordinate their body attitudes with the ones of their neighbours. This model is inspired by the Vicsek model. The goal of this talk will be to present this new flocking model, its relevance and the derivation of the macroscopic equations from the particle dynamics. In collaboration with Pierre Degond (Imperial College London) and Amic Frouvelle (Université Paris Dauphine).

9.6.2017, 12:45, SR01, Alexander Lorz

Mathematics and Biomedicine

"Mathematical models for population dynamics"

We are interested in the Darwinian evolution of a population structured by a phenotypic trait. In the model, this trait can change via mutations and individuals in the population compete for a common resource, e.g., nutrients. A mathematical model capturing these phenomena can be described by non-local Lotka-Volterra equations. These have the property that solutions concentrate as Dirac masses in the limit of small mutations. We review results on long-term asymptotics, small mutation limits and show connections to free-boundary problems.

Such models can aid in quantitatively understanding the emergence and development of resistance. For example, in cancer therapy, cells in the population are structured by their resistance levels to therapy. We give results on these extensions and discuss optimal control problems arising in this context. Moreover, we expand the model to incorporate heterogeneity.

9.6.2017, 13:45, SR01,Vera Vértesi

Mathematics and Physics

"KNOTS, TANGLES AND HEEGAARD FLOER HOMOLOGY"

Knots are one of the most basic objects in our the physical world. They have been systematically studied since the 18th century, but it took more than 100 years to introduce knot invariants to efficiently distinguish them. One of the first invariants, the Alexander polynomial, was defined in 1928. In 2000, Ozsvath, Szabo and Rasmussen gave a refinement – or categorification – of the Alexander polynomial, which is now called knot Floer homology. Knot Floer homology has proven to be a powerful knot invariant with a lot of geometric content. In this talk we will sketch definitions of the Alexander polynomial and knot Floer homology, and mention some of their most spectacular applications. We will then discuss a recent generalisation of knot Floer homology for tangles. The construction promotes knot Floer homology to a 0+1 dimensional TQFT. This is a joint work with Alexander P. Ellis and Ina Petkova.

20.6.2017, 14:15, WPI Seminar room, Ludwig Gauckler

"SCHRÖDINGER EQUATIONS: NUMERICAL ANALYSIS AND APPLICATIONS"

Time dependent Nonlinear Schrödinger equations (NLS) are a crucial model for dynamics in quantum physics. Efficient numerical methods are the key for the computer simulation of state of the art experiments.
We present some aspects of numerical analysis for NLS and related (highly oscillatory) time dependent wave equations, like time splitting methods, trigonometric integrators and related questions of long time behavior and stability.

22.6.2017, 14:00, WPI Seminar room, Yong Zhang

"NUMERICAL METHODS/ANALYSIS FOR SCHRÖDINGER EQUATIONS AND MICRO-MAGNETISM"

We present some mathematical methods occurring in the modeling and simulation of Nonlinear Schrödinger equations and nonlocal potentials. We focus on Gross-Pitaevskii equations describing Bose Einstein Condensates and stray field calculations in micro-magnetism.