MONDAY, July 9, 2018, room S2 416-1

9:00 Bernhard Endtmayer *Introduction to Optimal Control and its Relation to the Dual Weighted Residual Method*

10:00 Mehdi Makhul *Probabilities of incidence between lines and a plane curve over finite fields*

11:00 Markus Pöttinger *How to counteract temporal delays in an Adaptive Optics system for astronomical observations*

13:00 Daniel Jodlbauer *Solving Nonexistent Equations - Matrix Free Methods*

14:00 Nicolas Allen Smoot *A New Family of Congruences for Rogers–Ramanujan Subpartitions*

15:00 Andreas Schafelner *Space-time Finite Element Methods for Parabolic Evolution Equations with Variable Coefficients*

Get-Together at Teichwerk

Introduction to Optimal Control and its Relation to the Dual Weighted Residual Method
Bernhard Endtmayer

In the first part of this talk we will give an introduction to optimal control. Afterwards we relate it to adjoint based methods or in particular to the dual weighted residual method, and discuss its application to optimal control problems. Finally some robustness results for dual weighted residual method will be provided.

Solving Nonexistent Equations - Matrix Free Methods
Daniel Jodlbauer

The non-linear and non-convex nature of the energy functional combined with the variational inequality associated to phase-field fracture models puts a great challenge to most optimization algorithms. Dealing with possibly many iterations of the non-linear solver (e.g. active set), a fast method for creating and solving the linearized problems is essential for a good performance. In this talk, we will investigate how to avoid this problem and speed up the computation (eventually). Several advantages and shortcomings of such a method are discussed at the example of the fracture propagation model.

Probabilities of incidence between lines and a plane curve over finite fields
Mehdi Makhul

We study the probability for a random line to intersect a given plane curve, defined over a finite field, in a given number of points defined over the same field. In particular, we focus on the limits of these probabilities under successive finite field extensions. Supposing absolute irreducibility for the curve, we show how a variant of Chebotarev density theorem for function fields can be used to prove the existence of these limits, and to compute them under a mildly stronger condition, known as simple tangency. Partial results have already appeared in the literature, and we propose this work as an introduction to the use of Chebotarev theorem in the context of incidence geometry. Finally, Veronese maps allow us to compute similar probabilities of intersection between a given curve and random curves of given degree.

How to counteract temporal delays in an Adaptive Optics system for astronomical observations
Markus Pöttinger

Adaptive Optics (AO) systems for ground-based telescopes use deformable mirrors to physically correct wavefront distortions induced by atmospheric turbulence. Due to time delays caused by different parts of the AO system, the process of turbulence correction becomes even more difficult since the Earth's atmosphere changes continuously. We propose a new temporal control approach based on a prediction of the future wavefront. Our mathematical formulation of the underlying problem allows the incorporation of computationally efficient reconstruction methods. Based on the frozen flow assumption, the prediction relies on a suitable shift of the reconstructed wavefront. The performance of our temporal control algorithm is demonstrated in the context of a Single Conjugated Adaptive Optics system on a 37 meter telescope, using a Shack-Hartmann wavefront sensor. The numerical results of the control method in ESO's end-to-end simulation tool OCTOPUS show an improvement in the turbulence correction.

Space-time Finite Element Methods for Parabolic Evolution Equations with Variable Coefficients
Andreas Schafelner

We introduce a completely unstructured, conforming space-time finite element method for the numerical solution of parabolic initial-boundary value problems with variable in space and time, possibly discontinuous diffusion coefficients. Discontinuous diffusion coefficients allow the treatment of moving interfaces. We show stability of the method and an a priori error estimate, including the case of local stabilizations which are important for adaptivity. To study the method in practice, we consider several typical model problems in one, two, and three spatial dimensions. The implementation of our space-time finite element method is fully parallelized with MPI. Extensive numerical tests were performed to study the convergence behavior of the stabilized space-time finite element discretization method and the scaling properties of the parallel AMG-preconditioned GMRES solver that we use to solve the huge system of space-time finite element equations.

A New Family of Congruences for Rogers–Ramanujan Subpartitions
Nicolas Smoot

In previous talks we have slowly developed the study of integer partitions. We began by describing elementary methods, and we gradually built up to the theory of modular functions. Finally, we demonstrated the usefulness of a computational approach to the subject. Now we will bring all of our previous topics together, in order to demonstrate a beautiful new result in the theory: the proof of an infinite family of partition congruences, originally conjectured three years ago by Choi, Kim, and Lovejoy. This result is related to many topics previously discussed, including the use of combinatorial arguments, the application of modular equations, Radu's RK algorithm, the classic partition congruences for powers of 5, and the Rogers–Ramanujan identities. It is also an example of contemporary partition theory, making use of recently developed methods within the subject. We will define our partition function and give examples, before we state the C-K-L conjecture and give a brief outline of how it was proven.