

10:00–12:00 @ Room SR2

### Recent developments in the Finite Cell method (FCM)

*Chairman: Stefan Kollmannsberger (TUM)*

Since its advent in 2007, the FCM has been widely used for the numerical solution of PDEs on complex geometries. We will discuss recent developments and current issues in particular related to a posteriori error estimation for the FCM.

12:00–13:00 **Lunch break**

13:00–15:00 @ Room D

### Variational solutions versus weak solutions

*Chairman: Paolo Marcellini (University of Florence)*

We will discuss the notion of variational solution and its connection to weak solutions. In order to prove that a variational solution is a weak solution one often has to prove some regularity. We will concentrate on global regularity issues as well as on the parabolic  $p_i$ -Laplace.

13:00–15:00 @ Room SR2

### Spline-based discretizations for the FCM

*Chairmen: Davide D'Angella, Philipp Kopp (TUM)*

The constants in the error estimates of the Galerkin projection, in some instances, can be sharpened by projecting into subsets  $S^{p,k}$  of  $H^{k+1}$ ,  $k \geq 1$  instead of  $H^1$ . B-splines allow for a flexible construction of the spaces  $S^{p,k}$  on fairly general meshes. We will discuss B-splines as well as alternative spline constructions in the context of the FCM.

15:00–17:00 @ Room D

### Free discussion

## MARS – Models, Algorithms, Computers and Systems

Modern high tech research in science and technology requires an interdisciplinary approach. This applies particularly to wide areas of the methodological sciences mathematics and computer science, where typically several aspects of closely related fields of research are considered. These start with a mathematical model, continue with algorithmic problems, and finally cover aspects of the implementation on computers or high performance computing environments and therefore also issues related to the efficiency of computer systems.

MARS is a doctoral program at the Doctorate School PLUS (DSP Programme), which is organized by the departments of mathematics and computer science of the University of Salzburg. Its objective is to educate doctoral students in the research fields models, algorithms, computers, and systems and also to achieve new insights and research findings especially with regard to the inter-dependency of these fields of research. The focus will be on important topics relevant for the Salzburg research site. MARS fields of research form a cohesive and closely linked line of research and cover a wide spectrum of scientific interests.



# MARS

Models, Algorithms, Computers and Systems

## Researcher Training

December 11 – 13, 2019

Department of Mathematics  
Department of Computer Sciences  
University of Salzburg

## Objectives

The aim of this researcher training is to bring together PhD students and experts of different international research groups. We discuss topics of the PhD thesis as well as other interesting open research problems. PhD students will receive feedback and new ideas related to their PhD thesis from the experts. Moreover future research projects and international cooperations are initiated.

This meeting is a continuation of regular meetings of the involved research groups. The longterm goal is to establish a huge network from which PhD students can benefit, and to attack the open questions in the fields of polynomial recurrence relations, degenerate evolution equations and finite-element discretizations.

## Programme and Abstracts

Room D: Dekanats Sitzungssaal, Naturwiss. Fakultät

Room SR2: Seminarraum 2, Naturwiss. Fakultät

### Wednesday, December 11 2019

11:00–12:00 @ Room SR2

#### Presentation of PhD projects

*Patrick Bammer, Sebastian Heintze, Rudolf Rainer, Thomas Stanin, Nicole Vorderbermeier*

In this opening session the PhD projects are presented. The team of supervisors and experts will get an overview on the status of the PhD projects and the problems that currently have to be faced. These presentations will be the starting point for the discussions on Wednesday, Thursday, and Friday.

12:00–13:00 Lunch break

13:00–15:00 @ Room D

#### Polynomial recurrence relations and transcendence theory

*Chairman: Stephan Wagner (Stellenbosch University)*

Polynomial recurrence relations play an important role in the counting of combinatorial structures such as trees and also appear in number theoretic considerations such as Sylvester's sequence. Similar to linear recurrence relations also polynomial recurrence relations can be computed by explicit, (double) exponential Binet-like formulas. Within this meeting we want to discuss arithmetic properties of such sequences and related problems in transcendence theory.

### Thursday, December 12 2019

10:00–12:00 @ Room D

#### Recent developments in higher integrability for doubly nonlinear systems

*Chairman: Juha Kinnunen (Aalto University)*

We will discuss recent developments related to the higher integrability of the spatial gradient of solutions to doubly nonlinear equations and systems. Moreover, we are interested in applications like stability of solutions and global gradient estimates.

12:00–13:00 Lunch break

13:00–15:00 @ Room D

#### Analysis and Numerics of Curvature Energies

*Chairmen: Philipp Reiter (University of Halle)*

We will discuss open problems regarding evolution equations and the existence and regularity of critical points of repulsive potentials.

13:00–15:00 @ Room D

#### Existence issues for evolution problems

*Chairmen: Christoph Scheven (University of Duisburg-Essen), Matias Vestberg (Aalto University)*

The longterm goal is to develop an extensive and unified approach to the existence of solutions of evolution problems. In this session we will concentrate on doubly nonlinear equations and in particular on the shallow water equation.

16:00–18:00 @ Room D

#### Free discussion

We will work in smaller groups on some current projects. In particular, some of the ongoing projects are supposed to be finalized during this meeting.

19:00

Dinner – Restaurant S'Nockerl im Elefant  
Sigmund-Haffner-Gasse 4, Salzburg

### Friday, December 13 2019

10:00–12:00 @ Room D

#### Hölder continuity and Harnack's inequality for doubly nonlinear equations

*Chairmen: Frank Duzaar, Andreas Heran, Leah Schätzler (University of Erlangen-Nürnberg)*

Since the seminal works of E. DiBenedetto there has been a great progress in the understanding of the regularity of solutions to the Porous Medium Equation and the parabolic  $p$ -Laplace equation. In this session we will concentrate on doubly nonlinear equations. We will discuss the state of the art and ongoing projects.