MARS – Models, Algorithms, Computers, and Systems

Modern high tech research in science and technology requires to a great extent an interdisciplinary approach. This applies particularly to wide areas of the methodological sciences mathematics and computer science, where generally one or more aspects of a chain of consecutive closely interlocked 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 on the efficiency of computer systems.

MARS is a doctoral programme at the Doctorate School PLUS (DSP Programme), which is organized by the departments of mathematics and computer sciences of the Paris Lodron University 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 particularly from a methodological point a cohesive and closely linked line of research and cover a wide spectrum of scientific interests.

Joint activities constitute the structured doctoral program in MARS. These include seminars with external guest speakers, one day workshops with external guests and multi day retreats away from the university, as well as summer schools on the topics of MARS.

Doctorate School PLUS
uni-salzburg.at/doktorat

Program

3.30 - 4.15 pm
Patrick Bammer, MSc
An hp-adaptive strategy based on locally predicted error reductions

4.15 - 5.00 pm
Miriam Schönauer, MSc
Error estimates for perturbed variational inequalities of the first kind

5.00 - 5.45 pm
Annika Osmers, MSc
Goal-oriented error control for the finite cell method

The workshop will be concluded by a dinner:

6.30 pm
Goldene Kugel
Judengasse 3, 5020 Salzburg

Contact

Department of Mathematics
Hellbrunner Str. 34
5020 Salzburg, Austria
e-mail: barbara.babacek@plus.ac.at
https://www.plus.ac.at/mathematik

PARIS LODRON UNIVERSITÄT SALZBURG

MARS

Models, Algorithms, Computers and Systems

Mini-Workshop on Finite Element Methods

WS 2023/24

Tuesday, 12 December, Start: 3.30 pm

Location: Lecture room 421, 2$^{\text{nd}}$ floor
Hellbrunner Straße 34

Department of Mathematics
Department of Computer Science

PARIS LODRON UNIVERSITÄT SALZBURG | Mathematics
PARIS LODRON UNIVERSITÄT SALZBURG | Computer Science

Patrick Bammer, MSc
(Salzburg)
3.30 - 4.15 pm

An hp-adaptive strategy based on locally predicted error reductions

We introduce a new hp-adaptive strategy for self-adjoint elliptic boundary value problems that does not rely on using classical a posteriori error estimators.

Instead, our approach is based on a prediction strategy for the energy norm reduction that can be expressed in terms of local modifications of the degrees of freedom in the underlying discrete approximation space. The computations of the predicted error reductions involve low-dimensional linear problems that are computationally inexpensive.

The mathematical background is first developed on an abstract Hilbert space level, before it is employed to hp-type finite element discretizations. The applicability and effectiveness of the resulting hp-adaptive strategy is illustrated with some numerical examples.

Miriam Schönauer, MSc
(Salzburg)
4.15 - 5.00 pm

Error estimates for perturbed variational inequalities of the first kind

In this talk, we derive a priori error estimates for variational inequalities of the first kind in an abstract setting through the combined application of the first Strang Lemma and the Falk Theorem.

The main application of these estimates is to obtain a priori error estimates for Galerkin methods, where through discretization only a perturbed version of the variational inequality can be solved. Different types of such perturbations caused by discretization are discussed and illustrated by various examples.

Perturbation caused by inexact quadrature, in particular, is examined in the exemplary framework of the Laplacian obstacle problem. For this problem, we focus on the quadrature error and derive guaranteed rates of this error for a higher order h-finite element discretization. In numerical experiments, the influence of the chosen number of quadrature points on the order of convergence of the total approximation error and of the purely quadrature related error is studied for several discretization methods.

Annika Osmers, MSc
(Bremen)
5.00 - 5.45 pm

Goal-oriented error control for the finite cell method

Subject of the presentation is a goal-oriented error control for the finite cell method (FCM). The FCM is characterized by embedding the physical domain of the problem into a fictitious domain to which the finite element method (FEM) is applied.

The error representation derived by the dual weighted residual (DWR) method enables the separation of the different error sources which are introduced by the FCM: fictitious domain approach, discretization and quadrature.

These three error contributions are balanced using an adaptive algorithm in order to obtain adequate solution results.