JOHANNES KEPLER UNIVERSITY LINZ

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Talk announcement: HABILITATION COLLOQUIUM

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Robust multigrid solvers and related topics

The main topic of my habilitation thesis is the development and the analysis of fast solvers for partial differential equations (PDEs) which are robust in model parameters (like a regularization parameter or a step size of a time-stepping approach) or in parameters of the discretization (like the grid size or a polynomial degree). Since the linear systems are large-scale and sparse, iterative solvers are a proper choice. We are mainly interested in geometric multigrid solvers because they show robustness in the grid size, which can be seen as a first aspect of robustness. A second aspect of robustness is linked to model parameters, like a regularization parameter of an optimal control problem or a step size of a time-stepping approach. We construct solvers whose convergence rates are independent of such model parameters and, still, of the grid size. Why is this of interest? Because this allows choosing the regularization parameter only according to the parameter choice rule appropriate for the underlying inverse problem. For similar reasons, robustness in the length of time-steps in a time-stepping approach or some cost or material parameters is of interest. A third aspect of robustness is linked to the polynomial (spline) degree, which we consider in the context of Isogeometric Analysis. By using splines for the approximation of the solution to the PDE, this approach yields good results even for a small number of degrees of freedom, particularly for (moderately) large values of the spline degree. This comes for a prize since the condition number grows exponentially with the spline degree. We provide multigrid solvers whose convergence behavior is provable robust in the spline degree. In all cases, we are interested in both numerical experiments and convergence theory. We will see the main results of the thesis and we will discuss a few ideas that have been necessary to develop them.