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**Talk announcement**

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Tuesday, April 19, 2016
13:45, S2 059

# Numerical methods for power-law diffusion problems

In this presentation, we consider numerical methods for solving power-law diffusion prob- lems, e.g. p-Laplace type problems. For the space discretization we use continuous Galerkin finite element methods (FE) with high order polynomial spaces. For the solution of the re- sulting nonlinear system we employ different Newton methods, such as residual-based and error-oriented globalization techniques. In addition, we also transform the original prob- lem into a saddle point problem using an augmented Lagrangian (ALG) decomposition technique. Assuming sufficient regularity for the solution, we derive high order interpolation and error estimates in relevant quasi-norms. We mainly focus on a systematic comparison of first and second order finite element approximations in order to confirm our theoretical find- ings. Our second goal is a very detailed comparison of two different Newton methods: a residual-based procedure and an error-oriented procedure. Lastly, we discuss the solution of the produced ALG saddle point problem. We discretize it using a FE methodology and then we present two iterative methods for solving the resulting nonlinear algebraic system. The first iterative method is the classical ALG1 iterative method, which is usually used in the literature. It can be interpreted as a variant of the Uzawa algorithm, where the Lagrange multiplier is separately updated. The second proposed iterative method can be characterized as a monolithic approach where all the unknown variable are simultaneously computed in one step. All, proposed methods are compared with respect to computational cost and to the con- vergence rates in several examples. This talk is based on a joint work with Thomas Wick, [1]. We gratefully acknowledge the financial support of this research work by the Austrian Science Fund (FWF) under the grant NFN S117-03.