Defect-Correction Finite Element Methods for Parabolic and Hyperbolic Problems

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Finite element methods are commonly used numerical methods for partial differential equations and may be confronted to slow convergence or convergence failures due to the geometry of the domain (existence of re-entrant corners, edges) or the data of the problem, the problem is said to have singularities. This talk considers as model problems the Dirichlet boundary value problem for the Heat Equation, the Wave Equation and the time-dependent Maxwell Equations on polygonal domains and derive, on the one hand, explicit formulas for the singular solutions. On the other hand, the formulas are used to construct an efficient adaptation for Galerkin finite element methods for the spatial discretizations. For time discretization the classical Crank-Nicolson method is employed. A priori error estimates in the L2- and energy-norms for both the semi-discrete as well as for the full discrete problems show that the new adaptation exhibits the same order of accuracy as it is known for problems with regular solutions. Numerical experiments are included to illustrate the practical implementation of the algorithm and to confirm the theoretically expected rates of convergence.

References:

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