Adaptive Finite Elements for Optimal Experimental Design

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Abstract: OED in the context of PDE for practical applications is a difficult optimization task for many reasons. On one side it corresponds in general to a PDE-constrained minimizationn of a nonlinear functional, which depends on the derivatives of the state of the simulated system. On the other side the best performing and robust techniques are needed to solve numerically the huge problem deriving from the discretization of the system of equations. We consider the case of finite dimensional parameter space. In this context we present a numerical approach to the optimization of the design based on an adaptive finite element method (FEM) for the solution of the state equation and the sensitivity equations needed to calculate the covariance matrix of the parameters. The adaptive algorithm is based on a goal oriented a-posteriori error estimation, for which the goal functional is the objective functional of the OED problem. Numerical examples for the cases of different functionals are presented.

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