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Computational Tricks for Efficient Design Sensitivity Analysis

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Efficient design sensitivity analysis is of vital importance when applying gradient based optimization tools on complex coupled nonlinear problems. However, in the analysis of coupled problems the exact Jacobian is often not available and one is faced with the problem of solving a linear system with an unknown coefficient matrix. In the paper we present two iterative methods to accomplish this task efficiently. The key advantages of the two methods compared to an overall finite difference approach are better efficiency because information obtained during analysis can be reused, and a better or at least a known accuracy, because the sensitivity equations are solved to a specified tolerance. These key points are illustrated with a stationary example from nonlinear fluid-structure interaction. Application of the methods to different discretizations shows that the iterative sensitivity analysis scales more favorable than the analysis in terms of number of unknowns in the problem.

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