Adaptive FE eigenvalue computation with applications to hydrodynamic stability

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Abstract

We present an adaptive finite element method for the solution of eigenvalue problems associated with the linearized stability analysis of non-linear operators in the context of hydrodynamic stability theory. The general framework is the Dual Weighted Residual (DWR) method for local mesh adaptation which is driven by residual-based and sensitivity- controlled a posteriori information. The basic idea is to embed the eigenvalue approximation into the general framework of Galerkin methods for nonlinear variational equations for which the DWR method is already well developed. The evaluation of these error representations results in a posteriori error bounds for approximate eigenvalues reflecting the errors by discretization of the eigenvalue problem as well as those by linearization about an only approximately known base solution. From these error estimates local error indicators are derived by which economical meshes can be constructed.