SOLVING A RATIONAL EIGENVALUE PROBLEM IN FLUID-STRUCTURE INTERACTION

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Keywords: rational eigenvalue problem, fluid-structure interaction

Abstract

Vibrations of a tube bundle immersed in an inviscid compressible fluid are governed under some simplifying assumptions by an elliptic eigenvalue problem with non-local boundary conditions which can be transformed to a rational eigenvalue problem. In a recent paper we proved that this problem has a countable set of eigenvalues which can be characterized as minmax values of a Rayleigh functional.

To determine eigenvalues and eigenfunctions numerically this approach suggests to apply the Rayleigh-Ritz method yielding a rational matrix eigenvalue problem where the matrices typically are large and sparse. Since for nonlinear eigenvalue problems the eigenvectors do not fulfill an orthogonality condition Krylov space methods do not apply but each eigenpair has to be determined individually by an iterative process where each iteration step requires the solution of a linear system of large dimension.

In this note we propose a projection method where the ansatz vectors are constructed from the solutions of suitable linear eigenvalue problems. The resulting small dimensional nonlinear eigenproblem then is solved by inverse iteration.