Coupled FE-BE eigenvalue problems for fluid-structure interaction

Gerhard Unger[1] A. Kimeswenger[2] O. Steinbach[3]

In this talk we present a coupled finite and boundary element eigenvalue problem formulation for the simulation of the vibro-acoustic behavior of elastic bodies submerged in unbounded fluid domains as submarines in the sea. Usually the fluid is assumed to be incompressible and hence modeled by the Laplace equation. In contrast, we do not neglect the compressibility of the fluid but model it by the Helmholtz equation. The resulting coupled eigenvalue problem for the fluid-structure interaction is then nonlinear since the frequency parameter appears nonlinearly in the boundary integral formulation of the Helmholtz equation. We analyze this eigenvalue problem and its discretization in the framework of eigenvalue problems for holomorphic Fredholm operator–valued functions. For the numerical solution of the discretized eigenvalue problem we use the contour integral method which reduces the algebraic nonlinear eigenvalue problem to a linear one. The method is based on a contour integral representation of the resolvent operator and it is suitable for the extraction of all eigenvalues which are enclosed by a given contour. The dimension of the resulting linear eigenvalue problem corresponds to the number of eigenvalues inside the contour. The main computational effort consists in the evaluation of the resolvent operator for the contour integral which requires the solution of several linear systems involving finite and boundary element matrices.

[1] TU Graz, Institut fuer Numerische Mathematik, Graz, Austria,
gerhard.unger@tugraz.at

[2] TU Graz,
arno.kimeswenger@tugraz.at

[3] TU Graz,
o.steinbach@tugraz.at