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DISPLACEMENT-BASED MODELLING OF ACOUSTIC FLUID-STRUCTURE INTERACTION PROBLEM: INVESTIGATION OF FREE VIBRATION

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In this abstract we present displacement-based finite element formulation for analysis of a quadratic eigenvalue problem arising in dissipative acoustic.

A number of finite element formulations have been proposed for acoustic fluids in the analysis of fluid-structure interaction problems, for example Hamdi et al. [2], Olson and Bathe [4], Morand and Ohayon [3]. Today, as a result of increasing availability of high performance and large capacity computers, the primitive variable formulations show great promise in utilization of a broad range of problem. The displacement formulation has received considerable attention, because it does not require any special interface conditions or new solution strategies and because of the potential applicability to the solution of a broad range of problems.

Previous computations using a displacement field and Lagrangian approximation to model the motion of liquid were confronted with some difficulties [4; 5]. To avoid them, we proposed to take into account natural viscosity of the medium.

When the problem of vibration of an elastic solid coupled with viscous compressible acoustical fluid is modelled by means of finite element method, the natural frequencies and mode shapes are the solution of the following quadratic eigenvalue problem:

$$(K + \lambda D + \lambda^2 M)u = 0$$

where K, D and M are the $n \times n$ stiffness, viscous damping and mass matrices of the n degree of freedom model.

We solve this problem using a subspace iteration algorithm for quadratic eigenproblem, proposed by T. Gmur and A. Schorderet [1].

Implementation issues are discussed and numerical experiments are presented in case of three-dimensional coupled systems.

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