A Multi-Model Reduction Technique for Optimization of Coupled Structural-Acoustic Problems

Finite Element models of structural-acoustic coupled systems can become very large for complex structures with multiple connected parts. Optimization of the performance of the structure based on harmonic analysis of the system requires solving the coupled problem iteratively and for several frequencies, which can become highly time consuming. Several modal-based model reduction techniques for structure-acoustic interaction problems have been developed in the literature. The unsymmetric nature of the pressure-displacement formulation of the problem poses the question of how the reduction modal base should be formed, given that the modal vectors are not orthogonal due to the asymmetry of the system matrices. In this paper, a multi-model reduction (MMR) technique for structure-acoustic interaction problems is developed. In MMR, the reduction base is formed with the modal vectors of a family of models that sample the design domain of the optimization parameters. The orthogonalization of the resulting reduction base is therefore a key point in the method. The use of the different reduction approaches found in the literature for developing an efficient and robust MMR technique is investigated. Several methods are compared in terms of accuracy and size of the reduced systems for optimization of simple models.

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