COMPUTATIONAL VIBROACOUSTICS

in low and medium frequency bands

Roger Ohayon

Conservatoire National des Arts et Metiers

Structural Mechanics and Coupled Systems Laboratory

Paris France
roger.ohayon@lecnam.fr

.

It is proposed to analyse, from predictive computational point of view – finite element discretization and specially appropriate various reduced order models - the dynamic behaviour of complex coupled systems and their adaptive intelligent treatment of interfaces for vibration and noise reduction of interior fluid-structure interactions problems, such as liquid/gas-structure, in low and medium frequency domains.

The applications may be found for example, in aerospace engineering such as liquid propelled launchers for the attenuation of the vibrations of liquids in tanks, the attenuation of noise in fairings for the satellites as well as attenuation of noise in fuselage cabin of aircrafts or helicopters, attenuation of noise in automotive industries.

The frequency domain of interest is quite important for the computational analysis in order to avoid big number of degrees of freedom which lead to prohibitive computer times. In effect, the coupled situation is quite different from the classical problem of acoustic response to prescribed structural interface displacement/velocity fields because the dynamic of the structure can be very complex (composite structure for instance). The low-frequency regime is characterized by a low modal density for structural-acoustics systems in which a frequency-independent modelling of the structural damping is in most cases satisfactory. The medium frequency range is characterized by a frequency-dependent damping in the structure as well as in the fluid. A distinction should be clearly made between gas and/or liquids taking into account incompressibility/compressibility as well as light fluids/ heavy fluids considerations with gravity sloshing effects.

In parallel of direct symmetric variational formulations/numerical finite elements for modal analysis of fluid-structure interior vibrations, the construction of a family of appropriate reduced order models, is of prime importance for sensitivity analysis, multidisciplinary optimization, updating with experiments as well as hybrid active/passive vibration reduction treatments of those systems for their control (as an example let us cite the modelling of <vibration and noise devices > acting as physical interfaces such as visco/piezo layers).Therefore attenuation of vibrations and noise using smart materials such as piezoelectric and magnetorheological devices will considered.

The purpose of this presentation will be to give a review synthesis of those aspects and perspectives.