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STUDY OF THE POSITION INFLUENCE OF THIN IMMERSED STRUCTURES IN AN ACOUSTIC FLUID USING XFEM

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ABSTRACT

Noise reduction for passengers comfort in transport industry is now an important constraint to be taken into account during the design process. This process involves to study several configurations of the structures inside a given acoustic cavity in the context of an optimization, uncertainty or reliability study for instance. The finite element method can be used to model this coupled fluid-structure problem but needs an interface conforming mesh for each studied configuration which may become time comsuming. The aim of this work is to be able to efficiently analyze different configurations of structures immersed in the acoustic domain and their influence on the noise level in the cavity. The embeded structures, such as seats in a plane cabin, are assumed to have no thickness in the acoustic domain: they are seen by the fluid as surfaces. The thin flexible structures, discretized using shell elements, are immersed arbitrarily within the acoustic mesh allowing to always use the same acoustic mesh. This makes the parametric study easier since it does not involved a meshing process anymore.

The XFem is used to take into account the structure influences in the acoustic compressible fluid domain by enriching the pressure by a Heaviside function. The finite element discretization of the whole fluid-structure coupled problem leads to a system in the frequency domain. In this system, the only matrices needed to be recomputed when the structures are placed arbitrarily in the fluid, are those corresponding to the enrichment and the one corresponding to the coupling between the fluid enrichment and the structures.

The proposed approach is thus well suited for a parametric study of the structure positions in the fluid cavity with no remeshing process, which is a significant saving in time.

REFERENCES

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