8th. World Congress on Computational Mechanics (WCCM8)
5th. European Congress on Computational Methods in Applied Sciences and Engineering (ECCOMAS 2008)
June 30 – July 5, 2008
Venice, Italy

VIBRATIONS OF STRUCTURES CONTAINING LIQUIDS HYDROELASTIC/SLOSHING INTERACTIONS AND COMPRESSIBILITY EFFECTS

***R. Ohayon[1], J.-S. Schotté[2]**

[1]Conservatoire National des Arts et Métiers
Structural Mechanics and Coupled Syst. Lab.
2 rue Conté -75003 Paris, France
ohayon@cnam.fr - www.cnam.fr/lmssc

[2]ONERA/DADS
29 av. de la division Leclerc
92320 Chatillon Cedex, France
schotte@onera.fr

Key Words: *Fluid-Structure Interaction, Sloshing, Elasto-Gravity Operator, Compressibility.*

ABSTRACT

In a first step, we present the low frequency vibratory analysis of fluid–structure interactions in an elastic tank partially filled with an incompressible inviscid liquid. The originality of this work is to give an exact expression of the gravity interface operator whereas other standard hydroelastic formulations treat this effect through approximations. The properties of this so-called elastogravity operator is studied from theoretical and numerical point of view. The computational model quantifies the effect of coupling between the liquid sloshing and the hydroelastic deformations of the structure.

In a second step, various variational formulations for the linear vibrations of bounded fluid–structure systems, taking into account possible gravity/acoustic interactions are investigated and discussed. The system consists of a tank partially filled with an inviscid liquid. Two situations corresponding to the cases of a *homogeneous* and a *non-homogeneous* liquid are considered. In this respect, the basic equations describing the interactions between acoustic and gravity waves are derived and appropriate variational formulations are constructed.

In a third step, we investigate and discuss, from *theoretical point of view*, various reduced order variational formulations for modal analysis of linear vibrations of bounded fluid–structure systems with free surface, taking into account possible gravity/compressibility interactions, in a *non-homogeneous* fluid situation. Those formulations are based on component mode synthesis techniques and various modal reduction schemes are then obtained.

REFERENCES

[1] H. Morand and R. Ohayon, *Fluid Structure Interaction*, Willey, 1995.

[2] J.-S. Schotté and R. Ohayon, “Incompressible hydroelastic vibrations: finite element modelling of the elastogravity operator” *Computers & Structures*, Vol. **83**, pp. 209-219, (2005).

[3] O. Andrianarison and R. Ohayon, “Compressibility and gravity effects in internal fluid–structure vibrations: Basic equations and appropriate variational formulations”, *Computer Methods in Applied Mechanics and Engineering*, Vol. **195**, pp. 1958-1972, (2006).

[4] O. Andrianarison and R. Ohayon, “Reduced models for modal analysis of fluid–structure systems taking into account compressibility and gravity effects”, *Computer Methods in Applied Mechanics and Engineering*, Vol. **195**, pp. 5656-5672, (2006).