**Geometrical nonlinear prestressed effects on the linear vibrations of partially filled tanks with liquid. Numerical analysis and results**

C. Hoareau, J.-F. Deü and R. Ohayon

Laboratoire de Mécanique des Structures et des Systèmes Couplées (LMSSC), Conservatoire national des arts et métiers (Cnam), 292 Rue Saint-Martin, Paris 75003, France

e-mail: {christophe.hoareau,jean-francois.deu}@lecnam.net,
web page: http://www.lmssc.cnam.fr/en

**ABSTRACT**

The classical approaches in vibration analysis of partially filled elastic tanks [1] suggests that the reference configuration remains the same regardless possible evolution of quasi-static external loads (e.g. gas or liquid hydrostatic pressure). In the case of very thin structures or soft material, the static equilibrium state of the tank could be out of the small-displacement assumption. Therefore, the global stiffness of the structure may change in function of the fluid volume amount [2,3,4]. In this paper, we propose a general framework, based on the Finite Element Method, to predict the influence of the prestressing effect (i.e. geometrical nonlinearities) on the linearized hydroelastic vibrations. The originalities lies on the computation of the nonlinear equilibrium states and there use for hydroelastic vibration analyses. A particular attention is given to the definition of the tangent stiffness operators which depends on the amount of fluid. The approach is split in two main steps. A quasi-static solution is first computed from an empty to a fully filled state of the tank, by considering geometrical nonlinearities and hydrostatic follower forces [5] (no volumetric mesh of the fluid is needed for this nonlinear static step). Then, the linearized incompressible hydroelastic vibration is analysed through a reduced order model using dry eigenmodes, in order to minimize the computational cost of the added mass matrix. Some numerical examples are finally given to illustrate the efficiency of the approach.

**REFERENCES**