סמינריון

הנך מוזמן/ת להרצאה סמינריונית של הפקולטה להנדסת מכונות שתתקיים ביום ד׳ 07.07.21

(כז׳ בתמוז, תשפ״א), בשעה 13:00 באמצעות הזום : https://technion.zoom.us/j/92604591060

מרצה : נינה ליאורה ברייטמן

מנחה : פרופ׳ פנחס בר-יוסף

על הנושא:

Nonlinear Finite Element Analysis of Liquid Sloshing in Upright Circular and Square-base Cylindrical Containers

The seminar will be given in Hebrew

תקציר ההרצאה :

The study of liquid sloshing in partially filled liquid storage containers has gained significant attention as the seismic vulnerability of these containers represents a potential source of severe environmental accidents: large amplitude sloshing exerts excessive hydrodynamic loads on the container walls and can create a high risk of both catastrophic mechanical failure and overspill of hazardous liquids. Particular concern is the pressure distribution on the container walls and its local spatio-temporal peaks that can reach during sloshing flow patterns.

The aim of this study is to develop a 3D novel finite element method for simulating fully nonlinear liquid sloshing waves in upright circular and square-base cylindrical containers subjected to horizontal harmonic oscillations.

We use the potential flow assumptions to obtain a reduced order modeling, which significantly simplifies the calculation process and makes the algorithm more efficient. A computational problem encountered by all the nonlinear simulations of inviscid free-surface flows is the appearance of numerical instabilities on the free surface as the waves become steep. The present research study introduces a computational approach, based on our novel finite element formulation. It compares between damping and filtering techniques, both common and innovative for sloshing problems. We analyze the influence of these techniques on the free surface and velocity profiles, and choose the most robust and accurate stabilized finite element formulation, which comprises the Savitzky-Golay filtering technique, never used for sloshing problems.

The assumption of potential flow and the use of Savitzky-Golay filter are validated and verified by the comparison with a full Navier-Stokes equations solution, obtained with OpenFOAM commercial code and with experiments provided in our group laboratory. Our FE solution is in perfect match with the reference solution that has been frequently used as a reliable reference solution in comparative computational studies. Present study provides free surface elevation,

velocity profiles and pressure distribution on a container walls, as well as the maps of different sloshing regimes (planar, swirling, etc.).
Finally, we present simulation results of different sloshing regimes induced in 3D containers. It was observed experimentally that flow regime depends on a frequency and amplitude of external excitation. Sloshing motion can be planar, rotational (swirling), swirling with changing direction or chaotic. We performed a parametric study to build a sloshing regime maps for cylindrical containers.

בברכה,

שירותי אתי סאס
מרכז הסמינרים