Nonlinear sloshing of two superposed immiscible liquids in a two-dimensional rectangular tank

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ABSTRACT

Sloshing is a physical phenomenon of great importance in technology. In particular, the double-layered sloshing which one meets in much process industrial: Engines developed with tanks with two fuels, the condensers of the thermodynamic systems with two fluids and the installations of the water-oil separators which increase annually because of the interest growing for the water pollution. Although the problem is generally non-linear, the linearization of this problem gives satisfactory results in much case. It however is recognized that it does not account for the real form of the profile of this surface. Moreover, the experiment shows that when the steepness of the wave becomes sufficiently large, the peaks break down.

Recently, Hara and Takahara [1] studied the linear sloshing of two incompressible irrotational immiscible fluids of different densities with a dynamic free surface and interface by using a Hamiltonian formulation. They analysis the linearized time history response and the linear properties and revealed the Influence of the surface tension on the Eigen frequencies and the vibration modes .The same authors [2], applied analytical method for nonlinear sloshing in this problem by using Hamiltonian formulation. They drive the Hamiltonian equation which involve the effect of nonlinearity. Transitions of surface and interfacial elevations and time histories of surface elevations are calculated by solving these quations.

We propose in this paper second order perturbation method to analysis the nonlinear effects involving in the interface and free surface of two superimposed fluids of different densities in a fixed rectangular tank. The asymptotic development of the modes interaction supposes the existence of only one dominating mode where the second order solution is given analytically. The dispersion relation for each order and a time histories of interface and free surface elevation are given.

REFERENCES

[1]   Kensuke Hara, Hiroki Takahara *Hamiltonian Formulation of Surface and Interface sloshing in a Tank Containing Two immiscible Fluids*, Journal of System Design and Dynamics **2(1)**, 299-310, 2008.

[2]   Kensuke Hara, Hiroki Takahara *Hamiltonian Formulation for Nonlinear sloshing of Two immiscible Fluids*, Journal of System Design and Dynamics **2(5)**, 1183-1193, 2008.