DIFFERENTIAL EQUATIONS OF DAMPED RESONANT SLOSHING

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A [machine] learning of the single-dominant nonlinear "inviscid" differential equations [1] on resonant sloshing (the forcing frequency close to the lowest natural sloshing frequency) in a clean rigid rectangular tank is developed [2] to restore *a priori* unknown viscous damping terms. The procedure is realised by using the measured phase-lags [3] between the harmonic horizontal tank excitation and the steady-state resonant wave. A good consistency for liquid-mass centre motions is shown. This confirms that the free-surface nonlinearity (energy flow from the primary-excited to higher natural sloshing modes) and viscous damping of higher natural sloshing modes matter; damping rates depend on the steady-state wave amplitude. The results are generalised in [4] to the steady-state swirling waves in an upright circular tank which moves longitudinally. The steady-state solution of the corresponding differential equations are firstly constructed. Based on these solutions and the cost function expressing the "distance" between measured and theoretical phase-lags for the swirling surface wave amplitude, a satisfactory agreement with experiments [5] is demonstrated.

References

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