Three-dimensional steady-state resonant sloshing in square-base tank

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A steady-state theory of resonant sloshing in a square base tank performing either longitudinal (along parallel walls) or diagonal harmonic excitations with the forcing frequency close to the lowest natural sloshing frequency is observed [1]. The theory employs the Narimanov-Moiseev nonlinear modal equations, which remain applicable for arbitrary small-magnitude periodic sway/surge/pitch/roll tank excitations of the primary sloshing frequency. In [2], the steady-state three-dimensional resonant waves were classified for the case of arbitrary three-dimensional nonparametric cyclic tank motions.

In the article [2] it is shown how, by proving the asymptotic equivalence of the corresponding periodic solutions of the corresponding periodic solutions of the modal system, it is possible to represent the resonant steady-state waves as a function of the angular position, axis ratio and its elliptic orbits. The dependence between the orbits and the waves will be considered as well as the perturbations and the wave characteristics of fluid motion. For example, the direction of the perturbation orbit does not affect the amplitude-frequency characteristics for symmetric and diagonal types of perturbation. But for the oblique type perturbations, this fact is no longer fulfilled, and it can also be observed that when the ratio of the ellipse axes changes from 0 to 1, a significant change in the characteristics of wave motion occurs too.

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1. Faltinsen O. M., Rognebakke O. F., Timokha A. N. Resonant three-dimensional nonlinear sloshing in a square-base basin. Journal of Fluid Mechanics, 2003, 487, 1–42.
2. Faltinsen O. M., Lagodzinskyi O., Timokha A. N. Resonant three-dimensional nonlinear sloshing in a square base basin. Part 5. Three-dimensional non-parametric forcing. Journal of Fluid Mechanics, 2020, 894, A10, 1–42.