海岸和近海工程国家重点实验室
STATE KEY LABORATORY OF COASTAL AND OFFSHORE ENGINEERING

海岸和近海工程国家重点实验室
学术讲堂

题　目： **Liquid sloshing in an upright circular tank under periodic and transient excitations**

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内容简介：

梁辉，现就职于新加坡海洋与船舶技术中心(Technology Centre for Offshore and Marine, Singapore, TCOMS) 。主要研究方向包括：地效翼升力理论，波浪和结构物相互作用，船行波解析研究等。在Journal of Fluid Mechanics, Journal of Computational Physics, Applied Ocean Research等杂志发表论文20余篇。

摘要：Liquid sloshing problem in an upright circular tank undergoing an oscillation in a single degree of freedom is considered. A fully-nonlinear time-domain Harmonic Polynomial Cell (HPC) method based on overset mesh is developed to delve into the flow physics, and the comparison is made with the weakly-nonlinear multimodal theory. Both periodic and transient-type oscillations are considered. For the time-harmonic oscillation, planar and swirling waves (including time-harmonic and periodically-modulated swirling waves) occur when the excitation frequency is close to the lowest natural frequency. The swirling direction is dependent on initial conditions. The periodically-modulating swirling waves switch back and forth between swirling waves and planar waves. The occurrence of swirling waves results in lateral hydrodynamic force and roll moment on top of in-line force and pitch moment components acting on the tank. The sloshing response in terms of surface elevations contains higher harmonic components, while the hydrodynamic forces and moments on the tank are remarkably linear. A NewWave-type of excitation is imposed which represents on average the most probable maximum excitation to be expected for a given sea-state, and narrow-banded sloshing responses are observed. This allows application of designer wave-type of excitation which would excite the most probable maximum response in sloshing. A focused wave-type excitation is also considered, and impulse-like feature is observed in the in-line force and pitch moment components. The total in-line force and pitch moment are further decomposed into the inertial component, which is induced by the acceleration of the external motion, and residual component, which is closely associated with the liquid sloshing. It is found that under a focused wave-type excitation the inertial component contribution is more dominant, while under a designer-wave type excitation the residual component dominates instead.

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