diffraction and radiation forces on each cylinder. The in-line responses of each cylinder induced by wave excitation are obtained using the motion equations after coupling the diffraction and radiation forces resulting from oscillations of both cylinders. Experiments have also been conducted in a wave flume to measure the in-line responses of the two cylinders. There is good agreement between computed and experimental results.

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14:39–Function Hall A

A theoretical solution of a water- spherical shell-damping layer interaction system for underwater noise reductions

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Based on a fluid-structure interaction analysis (FSIA), the theoretical solution is developed for an integrated spherical shell-damping layer-water interaction system subjected to an internal sinusoidal pressure excitation. The effect of damping layer on reducing underwater noises is investigated. The pressure reduction factor is defined to measure the efficiency of noise reduction. Investigation suggests that the efficiency of noise reduction can be improved by using thick damping layer with materials of high damping factors, large mass density and small speed of sound, which could be the guidelines to design effective damping layers to reduce underwater noises caused by marine structures. The developed theoretical solution provides a useful reference for related researches on underwater noise pollutions. It has been realised that marine structures are quite complex, for which theoretical solutions of FSIA could not be obtained. The developed numerical method with computer code has provided an effective means to deal with underwater noise reduction problems.

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14:42–Function Hall A

SPH simulation of free surface flows with moving objects

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Free surface flows with moving objects are very difficult to simulate for conventional numerical methods as the flows involve rapid movement of solid objects, changing and breakup of free surfaces, strong turbulence and vortex, and violent fluid-solid interaction. Smoothed particle hydrodynamics (SPH) is a popular meshfree, Lagrangian, particle method with some attractive features. It can naturally treat moving features and does not need any interface/surface capture or tracking algorithm. In this paper, we present an SPH model for simulating free surface flows with moving objects. Fluid particles are used to model the fluid flows which are governed by Navier–Stokes equations, and solid particles are used to model the dynamic movement (translation and rotation) of moving rigid objects. The interaction of the neighbouring fluid and solid particles renders the fluid-solid interaction, and the non-slip solid boundary conditions. Two numerical examples, water entry of a cylinder, and the movement of a partially-filled rigid box in a wave tank, have been simulated. It is shown that the SPH method can well capture the inherent fluid-solid interaction physics with smooth pressure field obtained.

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14:45–Function Hall A

The simulation of fluid-structure interaction on two flexible cylinders subjected to an annular flow

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Two cylinders are clamped at its two ends and located in a confined annular flow. The fluid-structure interaction in the system is simulated based on ALE N–S equations with LES turbulence model and the Euler–Bernoulli beam dynamic equation by which the vibrations of the cylinders are calculated numerically. It is found that the weak buckling with weak oscillation around the non-zero equilibrium state may be induced if it the dimensionless velocity is large enough. The non-zero equilibrium state can be regarded as the result of divergence or pitch fork bifurcation.

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14:48–Function Hall A

Dynamic characteristics of rigid cylindrical container with multiple elastic annular baffles and partially filled with liquid

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Coupled dynamic characteristics of multiple elastic annular baffles with liquid partially filled in rigid cylindrical container have been studied. The effect of surface waves of liquid is considered. In the analysis, the liquid domain is divided into several simple sub-domains so that the liquid velocity potential in each liquid sub-domain is of class C1 with continuous boundary conditions. The wet modes of the baffles are expressed in terms of dry-modal functions. The surface wave equation, the sub-domain interface equations and the baffle vibration equations are expressed in terms of Fourier series along the liquid height and Bessel series in the radial direction, respectively. The coupled natural frequencies and corresponding modes have been obtained by solving the generalized eigen-value equation. For the lateral excitation, the total liquid velocity potential is taken as the sum of the container potential function and the liquid perturbed potential function. The dynamic response equations are established by substituting the to-