Popular science summary of the PhD thesis

PhD student	Yunfeng Ding
Title of the PhD thesis	CFD Modelling of Fluid Responses Between Side-by-side Structures in Waves and Currents
PhD school/Department	Department of Civil & Mechanical Engineering

Science summary

* Please give a short popular summary in Danish or English (approximately half a page) suited for the publication of the title, main content, results and innovations of the PhD thesis also including prospective utilizations hereof. The summary should be written for the general public interested in science and technology. Before the thesis defence, the summary is sent to DTU's Office for Communication and Media and to the media *Ingeniøren*:

Fluid resonances, characterized by amplified water oscillations in the gap and violent hydrodynamic forces on the adjacent vessels, present a critical challenge in designing and operating those offshore structures in side-by-side (SBS) offloading.

Nonlinear piston-mode fluid resonance in the gap formed by two identical fixed barges is investigated using a two-dimensional (2D) fully nonlinear numerical wave tank based on a state-of-the-art computational fluid dynamic (CFD) solver. Consistent models are employed to describe the incident waves and wave-structure interactions for finite and shallow water depths. Besides, coupled piston-mode fluid response and the heave motion of the barges are studied between two identical SBS barges under finite-depth and shallow-water waves. Moreover, 2D fluid resonance within the narrow gap formed by two identical SBS fixed barges is investigated under various wave-current conditions, covering both uniform and shear currents. A study of three-dimensional (3D) gap resonance between two SBS fixed barges under 'wave+uniform-current' conditions is further carried out in the numerical wave tank for head- and beam-sea excitation.

This thesis emphasizes the importance of consistently considering the effects of water depth and ship motion in the design and analysis of SBS marine operations involving piston-mode gap resonances. Furthermore, neglecting the influence of currents in SBS marine operations is deemed non-conservative, as it can significantly impact resonant gap responses and the spatial structure of free-surface elevation along the gap. Through high-fidelity CFD modeling, this thesis aims to advance the understanding of the intricate hydrodynamic interactions between SBS structures in waves and currents, offering valuable insights for enhancing the safety of relevant marine operations in real sea environments.

Please email the summary to the PhD secretary at the department