Water sloshing experiments in a circular tank with submerged topography

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Sloshing of fluid layers is a well known research topic in fluid dynamics. The phenomenon has applications in engineering, geophysics, biology and microfluidics. Experimental studies are often done in rectangular tanks with fixed boundaries. In the present project, a 4.76 m long circular channel is used. This geometry allows sloshing experiments without boundaries.[1] Sloshing waves are excited due to a submerged symmetrical topography and a sinusoidal (symmetrical) and ratched (asymmetrical) oscillation of the tank. To track the wave propagation, experimental measurements are performed using 18 ultrasonic probes: 17 probes are evenly distributed over a half of the channel the 18th is used to check the symmetry or for synchronization purposes. The submerged oscillating mountain triggers a highly complex non-linear wave field. Different wave types like solitary waves, undular bores and standing waves are observed. The wave amplitudes show resonance peaks around certain eigenfrequencies, which fit with linear sloshing theory. Resonant reflection and transmission of solitary waves by the topography is observed. A ratched oscillation forces transport in the layer. The experiments are of interest for tidal flows over bottom topography. In the future we plan an extension of the experiment using a stratified fluid in view of oceanic application. Also an asymmetrical topography supposed to be investigated, whereby then transport should be possible with symmetrical excitation.

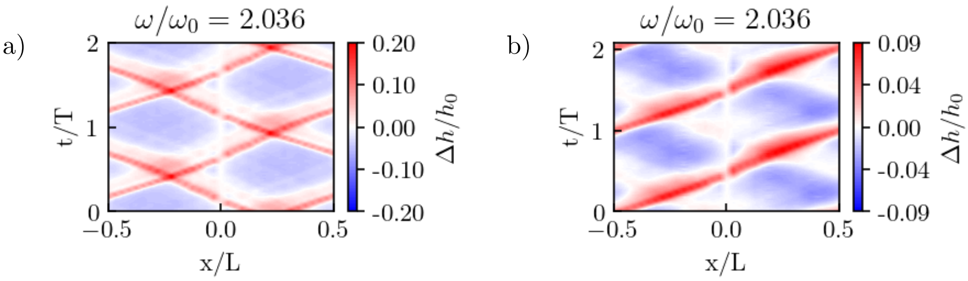

Figure 1: Hovemöller plots of sinosodial a) and ratched b) excitation around second eigenfrequency (transmitting resonance). The topography is located at x=0. In the case of ratched excitation wave propagation is preferred in one direction, while the sinusodial one gives symmetrical wave field. Amplitude in a) is doubled due to wave collision.

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