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Transient total absorption for water waves: a two port setup

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Résumé :

We show, experimentally, the possibility to observe a transient total absorption of a wave exciting scattering zeros at a complex frequency in a two ports setup. Those scattering zeros are accessible sending an incident wave with a temporal shape envelop (divergent exponential) toward a resonant cavity. The transient total absorption leads to the capacity to store wave energy in a cavity and to release it when the incident wave signal is stopped. This idea, first introduced in optics and named coherent virtual absorption CVA[1], is applied here in water waves physics. To obtain CVA, a one port system is used inducing that the scattered wave (reflected wave) is always superimposed to the incident wave. In the present study, we would like to extend this idea and to obtain situation where there is a part without incident wave. To do so, we use a two ports system (geometry shown in figure 1 right) and we implement a virtual barrier: a system where the transmission can be tuned to zero due to temporal shaping of the incident wave. Choosing the right cavity geometry, the scattering zeros corresponding to the transmission and the reflection can occurred at the same complex frequency leading to transient total absorption. The experimental results show that the incident energy is stored with no transmission or reflection and then released through the two ports when the excitation of the cavity by the incident wave is stopped (figure 1).

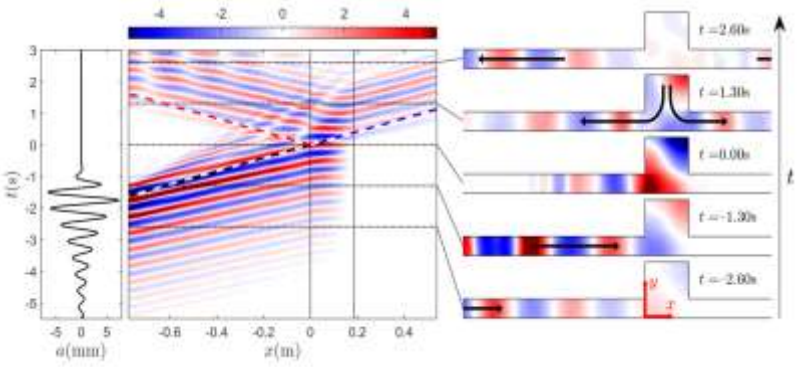


Figure 1: Experimental results. Left: Time signal sent by the wavemaker. Center: Space-time diagram showing the incident wave with no reflection and transmission before the released time t=0s. The two vertical black line indicates the position of the cavity. Amplitude in mm. Right: Snapshots at different times (black dotted lines in the space-time diagram).