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Hydroelastic response of tubular structures to water impact: Theory and Experiments

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ABSTRACT

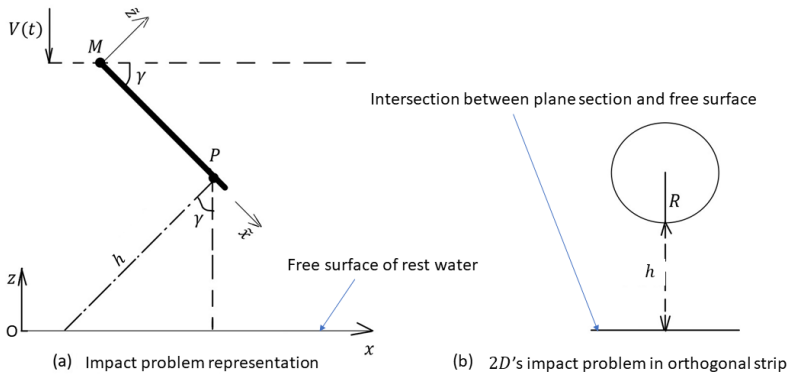

Figure 1: Illustration of the considered impact problem

The design of offshore structures requires a good characterization of their response to water impact. To do this, it is necessary to understand the hydroelastic coupling phenomenon. As Khabakhpasheva et al. (2024) explained, one way to approach the impact problem is to use a simple model in a controlled configuration (Figure 1). In the present work, a semi-analytical and experimental study of the hydroelastic response of a tubular structures due to an hydrodynamic impact is described. The semi-analytical model is based on the Euler-Bernoulli's beam theory to model the tubular structures, coupled to a Wagner-type water impact model to determine the hydrodynamic loading as a function of the prescribed motion and deformation.The water impact model relies on the Modified Logvinovich model proposed by Korobkin (2004) and the fictitious body continuation approach (FBC) proposed by Tassin et al. (2014) to deal with flow separation. The modal decomposition technique is used to formulate the impact problem as a system of partial differential equations, which is solved numerically. The experimental validation of the semi-analytical model is done by comparing the results obtained from an experimental campaign currently underway. Experiments are conducted on aluminum and steel tubes using the shock machine at ENSTA Bretagne. The transient responses of the beam is monitored using accelerometers and strain gauges mounted at different locations along the tube. The reaction force at the attachment point is also measured. Preliminary comparisons show a good qualitative agreement between theory and experiments. The effect of hydroelastic coupling on the damping of the vibrational response will be characterized, in particular.

References

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