Comparison of time-domain methods for evaluating forces and motions of floating bodies, including mooring arrangements

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ABSTRACT**:** This study presents a comparative assessment of time-domain methodologies for evaluating the hydrodynamic forces and motions of floating bodies, with particular emphasis on the influence of mooring arrangements. The investigation focuses on two axisymmetric floating geometries subjected to two commonly used mooring configurations: a single-line mooring system and a three-leg mooring system. In the first stage, the time histories of body motions and hydrodynamic forces are obtained in the frequency domain and subsequently compared with their counterparts in the time domain. This comparison is performed under a quasi-static representation of the mooring system, allowing the assessment of discrepancies arising from domain transformation and modelling assumptions. In the second stage, a fully time-domain framework is adopted to compare two identification approaches: the Frequency-Domain Identification (FDI) method and the Time-Domain Identification (TDI) method. Under a dynamic mooring formulation, the resulting time histories of body responses and associated forces are computed and analysed. The comparison highlights the capability of each method to capture nonlinear and dynamic effects induced by wave excitation and mooring interactions. The results provide insight into the accuracy and limitations of frequency- and time-domain approaches for predicting the coupled hydrodynamic and mooring responses of floating structures under regular and irregular waves. The findings contribute to the selection of appropriate modelling strategies for the dynamic analysis and design of floating offshore systems.