Multi-Body Dynamics of a Modular Floating Island in a Coupled Non-Linear Potential Flow Code

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ABSTRACT

In the scope of the H2020 project **Space@Sea**, an advanced concept for a modular floating island is developed. This concepts aims at providing a solution for an efficient exploitation of ocean space by combining several functionalities, such as accommodation, aqua farming, marine logistics and marine renewable energy on a single island. One of the main aspects to consider for this type of island is the operability of the various functionalities in the offshore environment. In addition to safety considerations this variable determines the economic viability of the island and hence its overall success. Since a modular build-up of the island is desirable, a crucial factor for an optimised operability is the implementation of a reliable connection between island modules. The resulting hydrodynamic behaviour of the platform for a given connection approach needs to be assessable by a suitable simulation approach to obtain a precise prediction of the achievable operability.

The hydrodynamic response of a single body in waves can be significantly altered when positioned within the vicinity of and connected to several other bodies. This alteration may be explained by separating the interaction into two components. The first one is a change in motion behaviour due to the hydrodynamic interaction of neighbouring bodies. The second aspect is the direct interaction by transmission of forces through a mechanical connection, e.g. hinges. In order to combine these aspects of interaction and assess the overall motion behaviour, the non-linear potential flow solver *pan*MARE is employed to compute the hydrodynamic forces on each body and their respective influence on bodies in their vicinity. The resulting forces are transferred to the multi-body dynamics solver *Simbody*. Within Simbody, the equations of motion are solved and motions and accelerations, induced by the applied forces, are obtained for each body. These values are then reintroduced into *pan*MARE to obtain forces for a subsequent time step. Specific characteristics of the inter-body connection, such as additional stiffness or damping, are introduced in Simbody as well.

These additional factors become necessary, as the simulated island is based on a novel connection concept developed at TUHH. It consists of an external frame, decoupling the relative rotary motion and transforming them into relative translatory motion. This relative translatory motion is then damped in order to reduce relative motion and enhance operability.

The presented test case shows the simulation of a diamond-shaped four-floater island, connected in the described form for a series of decay and wave-excitation cases. The simulation results are then validated with physical model tests conducted at the TUHH wave basin.

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