

Passing vessel interaction: an assessment of MARIN's FlowInteraction module

In order to accurately predict passing vessel interaction forces, different simulation tools have been developed over the years. Many of these are based on a double body flow approach. MARIN (a hydrodynamic research institute located in the Netherlands) developed a simulation tool called the FlowInteraction (FI) module, which is part of the modular hydrodynamic simulation tool aNySIM. This module is based on double body flow theory – new is that it takes body motions into account in the force interaction. This is done by solving the equations of motion at every time step. The FI module has been verified and validated during this research.

An assessment was made of whether the physics in the FI module has been implemented correctly. To do this, verification and validation case studies have been done. The verification case studies have been evaluated based on expectations from the implemented physics and mathematics. Unexplainable results suggesting an incorrect implementation have been analyzed and used to draw conclusions. As validation material, a set of results from model tests done during the ROPES joint industry project has been used.

When the added mass force is neglected (as it is in the FI module) during a single body heave oscillation, cushion forces are dominant. This leads to a positive net mean force, which does not correspond with reality. Therefore, in order to simulate realistic behaviour, the added mass force should be included. Some numerical and discretization errors, due to the additional functionality of taking the body motions into account, are recognized. Based on these findings, recommendations on how to solve these problems are made.

It has been concluded that a double body flow model, as implemented in the FI module, only provides good force estimations when the added mass force is implemented. The usability is currently restricted to the simulation of captive ships; radiation forces can then be neglected without consequence. The FI module enables a fast hydrodynamic time domain simulation taking the influence of body motions on the interaction forces into account.

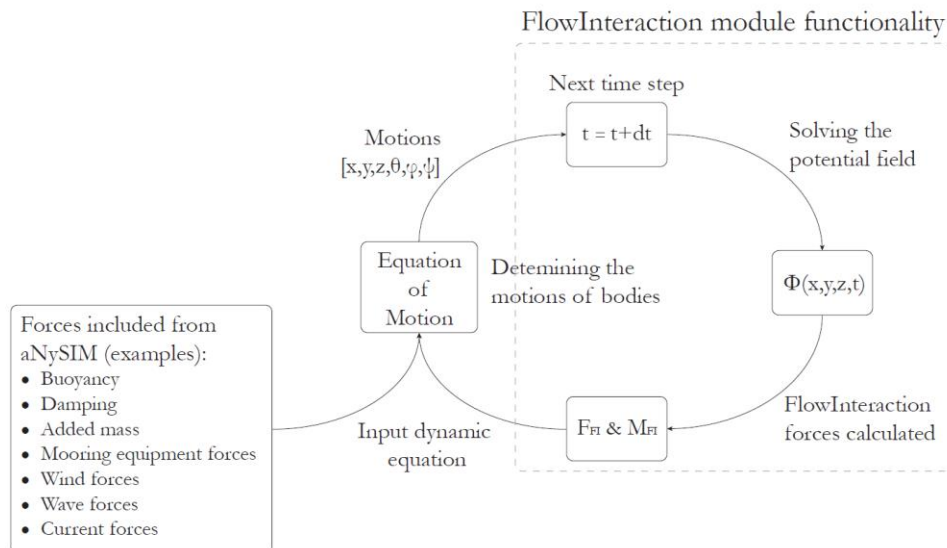


Figure: An overview of how the FlowInteraction module is integrated in the modular aNySIM program. On the right the functionality of the FI module is circled: it provides forces to the equation of motion which is an already operational aNySIM functionality.