A 6DoF hydrodynamic model for real time implementation in hybrid testing

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Abstract

This work deals with the numerical approach and technical implementation of the 6-DoF hydrodynamic model, which is combined with the Politecnico di Milano HexaFloat robot (Fig.1,2), adopted for wind tunnel Hybrid/HIL tests floating offshore wind turbines.

The wind tunnel hybrid testing methodology, along with its ocean-basin counterpart [1], is currently being considered as a valuable upgrade in the model scale experiments, for its capability to reduce the effect of the typical scaling issues of such systems.

The work reports an overview of the setup and the testing methodology, presenting briefly the main challenges about the deployment on the real-time hardware and summarizing the key solving choices. A set of results related to code-to-code comparison between the optimized HIL numerical model and the reference FAST computations are included, confirming the correctness of the approach.

1 Numerical model

Equations of motions:

\[ \ddot{q} + B \dot{q} + (K + M \epsilon \dot{q}) = F_{\text{corr}} \]

(1)

where \( F_{\text{corr}} \) are the aerodynamic forces, computed through experimental campaigns.

Simplification of the model, without losing physical consistency, is required due to real-time constraints. As an example, the importance of each contribution of Eq.5 is evaluated for combined decay tests.

2 Modelling optimization

Simplification of the model, without losing physical consistency, is required due to real-time constraints. As an example, the importance of each contribution of Eq.5 is evaluated for combined decay tests.

3 Conclusions

In Fig.5 the free decay and irregular sea results results are reported to compare the HIL model to the reference FAST one, for a subset of selected DoF, that are those envisaging the most significant amplitudes. The HIL model shows an almost overlapped behaviour. The same conclusions can be drawn looking at Tab.2, which reports the corresponding natural frequencies, linear and quadratic damping parameters.

References


