Floating body simulations of an off-shore marine energy platfom using FEniCS-HPC

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ABSTRACT

We simulate turbulent incompressible two-phase flow targeting marine energy applications. To achieve this the Finite Element Method/General Galerkin methodology for turbulent incompressible flow [1] is extended. The methodology is to directly solve the variable density incompressible Navier-Stokes equations, prescribe an initial condition on the density modeling the two phases. To improve immiscibility we introduce a phase separation technique on the weak form of the equations. This method is validated against experimental results for the MARIN benchmark [3]. We are also involved in the study of an off-shore marine energy device: the Nautilus platform, a floating platform supporting a wind turbine. The goal is to evaluate the stability and the required robustness of the platform. This involves a floating body motion simulation with a moving mesh following the displacement of the body. The complete methodology is implemented in the open source FEniCS-HPC framework [1, 2].

REFERENCES

[1] Hoffman J, Jansson J, de Abreu RV, Degirmenci NC, Jansson N, Mller K, Nazarov M, Sphler JH. *Unicorn: Parallel adaptive finite element simulation of turbulent flow and fluid-structure interaction for deforming domains and complex geometry*, Computers & Fluids, 2013.

[2] Hoffman J, Jansson J, Jansson N, *FEniCS-HPC: Automated predictive high-performance finite element computing with applications in aerodynamics*, PPAM 2015. Lecture Notes in Computer Science, 2015.

[3] Kleefsman KMT, Fekken G, Veldman AEP, *A volume-of-fluid based simulation method for wave impact problems*, Journal of computational Physics, 2005