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Two-phase flow and floating body finite element simulations using FEniCS-HPC

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We present a methodology and simulation results for two-phase flow problems with the presence of floating bodies. For the simulation of two-phase flow we consider the variable density incompressible Navier-Stokes equations and discretize them by the finite element method with a variational multiscale stabilization. The interphase between the two faces is tracked in time with a level-set type method. A compression technique similar to the one presented in [1] is adopted in order to prevent the smearing of the solution in the interphase. In the presented method, turbulence is implicetly modelled by the numerical stabilization. For the simulation of floating devices we make use of a rigid body motion scheme and a deforming mesh approach [2]. The mesh deforms elastically following the movement of the body. The described methods are implemented in the open source software framework FEniCS-HPC [3] provided with an automated methodology for discretization and error control. Simulation of floating platforms are performed in the framework of a project for marine energy generation in collaboration with Tecnalia R&I. The aim is to study the dynamics of these platforms that are designed for off-shore wind energy generation or device experimentation in the ocean. Our simulation results are compared against the experimental data obtained by Tecnalia R&I in the experimental tank of CEHIPAR in Spain. On the other hand, we participate in the IEA-OES Task 10 project where different simulations of floating bodies are carried out. The results are compared against other groups simulations that use different methodologies.

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