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Calibration of mass transfer models for the numerical prediction of cavitating flow around hydrofoils and marine propellers

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ABSTRACT

The presentation will be focused on the numerical predictions of the cavitating flow around a hydrofoil and marine propellers.
The simulations are carried out using ANSYS-CFX, a commercial CFD (Computational Fluid Dynamics) code, and OpenFOAM, a OpenSource CFD toolbox. The cavitating flow is simulated using a so-called homogeneous model, where the working fluid is treated as a homogeneous mixture of two fluids, i.e water and vapour, behaving as a single one, and the mass transfer rate due to cavitation is regulated by the mass transfer model. Here, three widespread mass transfer models are alternatively used. The considered mass transfer models share the common feature of employing empirical coefficients to tune the condensation and evaporation processes, whose values affect the accuracy and the stability of the numerical predictions. Thus, in order to ensure stable and accurate predictions, the empirical coefficients of the three different mass transfer models are properly and congruently tuned using a fair calibration strategy driven by the modeFRONTIER optimization system. The models are calibrated in respect to the two-dimensional and stable sheet cavity flow around a hydrofoil. In the case of ANSYS-CFX the calibrated models are further applied to a three dimensional propeller case.
Regarding ANSYS-CFX, the numerical results obtained with the three different calibrated mass transfer models are very close to each other and in line with the experimental data, even though in the case of the marine propellers the tendency to overestimate the cavity extension is observed. The results obtained using OpenFOAM, although preliminary, are encouraging, but suggest further improvements for the calibration strategy.