Verification and validation for the cavitating flow around a NACA0015 hydrofoil

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ABSTRACT

When cavitation occurs around hydrofoils it is the cause of noise radiation, vibration and erosion. Consequently numerical cavitation models have been developped and tested over the last decades (Schnerr and Sauer [1]). However, recent works show that numerical predictions for cavitating flow might be very sensitive to the spatial resolution of the mesh and require dicretization errors estimations (Negrato et al. [2], Asnaghi et al. [3]). The experimental and numerical approches joined in this work are the first step of the validation of the ISIS-CFD code for cavitating flows with fluid-structure interaction. Although, only results for a rigid profile in cavitating conditions are presented in this work. The test case is a NACA0015 profile in the cavitation tunnel located at the french Naval Academy Research Institute. On the numerical side, the ISIS-CFD code is used to solve the unsteady Reynolds Averaged Navier Stokes Equations (uRANSE). The two phases mixture dynamics are solved thanks to an interface capturing method and the Sauer cavitation model. The test case is first adressed using a two-dimensional computational domain. A set of unstructured grids is generated using Hexpress to perform a grids and time steps convergence study and obtain uncertainty estimations for both wetted and cavitating flow conditions. Then, the same study is done for an extended three-dimensional geometry taking into account the lateral walls of the tunnel and the convergent section located upstream of the test section. Influences of the turbulence quantities at the inflow and the cavitation model parameters are also assessed. The numerical results are compared with experimental effort measurements, high-speed camera signals and PIV acquisitions provided by Lelong [4]. From the verification and validation analysis a three dimensional grid and a set of computational parameters are chosen for future calculations with fluid-structure interaction and cavitation.

REFERENCES

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