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PhD Thesis

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Numerical Modeling of Air Entrainment in Hydraulic Structures

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Background

In turbulent free-surface flow, the deformation of the free-surface leads to entrainment of air bubbles. To ensure safe operation of hydraulic structures, and to optimize its performance, the amount of entrained air and its mixing within the flow must be accurately predicted.

The hydraulics of aerated flows can greatly benefit from insights provided by numerical simulations. An ideal numerical model has to be fast in the definition of a macroscopic interface and at the same time be precise enough to take into account the formation of bubbles through the free surface. Due its complexity, an accurate prediction of the air entrainment process is an ambitious goal for most computational fluids dynamics tools. Some attempts has been done on capturing the physical behavior of the air entrainment process into computational fluid dynamics models (CFD). Nevertheless, more research are needed to get a reliable solver for the generic air entrainment phenomena.

Objective

The objective of this study is to investigate whether a numerical model can reproduce the air-water interaction in hydraulic structures. This will be done using the open-source software, OpenFOAM, which solves the mass- and momentum equations on a three dimensional grid. The capacity of the simulation tool in predicting the air entrainment process will be invested, with the aim of improving the relevant solver.