A PARALLEL FREE-SURFACE-MODELLING TECHNOLOGY FOR APPLICATION TO AIRCRAFT FUEL-SLOSHING

Arnaud Malan* **and** **Oliver Oxtoby**†

CSIR Computational Aerodynamics
Building 12, P.O. Box 395, Pretoria 0001, South Africa
*e-mail: amalan@csir.co.za
†e-mail: ooxtoby@csir.co.za

ABSTRACT

We develop a volume-of-fluid free-surface-modelling methodology for immiscible fluids with vastly differing densities in order to model sloshing in aircraft fuel tanks. The interface is captured by using the Compressive Interface Capturing Scheme for Arbitrary Meshes (CICSAM) [1]. Spatial discretisation is effected for computational efficiency via an edge-based, vertex-centred finite volume method for hybrid-unstructured meshes [2]. This yields a method which is second-order accurate in both space and time and applicable to arbitrary meshes. The incompressible characteristic-based split solver [3,4] is enhanced and extended for volume-of-fluid calculations. Particular attention is paid to the consistent treatment of interface physics, avoiding the need for the artificial extrapolation of variables across the interface.

We demonstrate efficient parallel scaling to hundreds of CPUs, as well as assessing the scheme for robustness and accuracy against benchmark test cases in two and three dimensions.

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