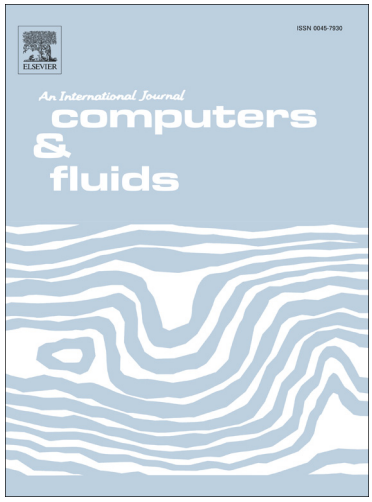

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A SMOOTHED PARTICLE HYDRODYNAMICS MODEL FOR 3D SOLID BODY TRANSPORT IN FREE SURFACE FLOWS

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Abstract.
This study has developed a 3D Smoothed Particle Hydrodynamics (SPH) numerical scheme to reproduce the transport of rigid bodies in free surface flows (e.g. floods, surface waves). It is based on the Euler-Newton equations for body dynamics, implemented through the SPH formalism. This scheme has been coupled to a Weakly Compressible (WC)-SPH model for the main flow, based on the semi-analytic approach (Di Monaco et al. 2011). The SPH boundary treatment of Adami et al. (2012) has been implemented and adapted to free-slip conditions to model the "fluid–solid body" coupling terms. On the other hand, the "solid-solid" ("body-body" and "body-frontier") interactions are represented by the "boundary force particles" of Monaghan (2005). This technique has been implemented by introducing some modifications to represent the impingements of entire bodies (not only isolated particles), even at low velocities.

The new model has been validated on a sequence of 2D and 3D test cases. They involve preliminary tests both with single and multiple bodies and frontiers, four water entries of falling solid wedges, and the propagation of a 3D dam break front. This is driven by the regular lift of a mobile gate, transports a floating body (6 degrees of freedom) and impacts two fixed obstacles and several solid frontiers. This last phenomenon has also been experimentally realized during this study. Validation refers to comparisons vs. measurements, Unsteady Reynolds-Averaged Navier-Stokes (URANS) results, other SPH models, analytical and theoretical solutions.

Keywords.
SPH; Mesh-less; Particle Methods; dam break; floating bodies; floods.