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FULLY NONLINEAR MODEL FOR WATER ENTRY FLOW: A LOW FIDELITY METHOD FOR AIRCRAFT DITCHING

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A fully nonlinear, two-dimensional, potential flow model for water entry is presented. The numerical model is based on a mixed Eulerian-Lagrangian approach, originally proposed in [1]: the velocity potential is assigned on the free surface by integrating the unsteady Bernoulli's equation, whereas the normal derivative is assigned on the body contour. The free surface motion is followed with a Lagrangian approach by integrating in time the kinematic boundary condition. In order to reduce the computational effort, a simplified model is adopted for the thin spray developing long the body. The model has been deeply validated in the case of water entry of a finite wedge [2,3].
In the aircraft design and certification at ditching, beside high-accurate ow solvers, fast and efficient solvers, even if of lower fidelity, are needed. This is particularly true in optimization processes when the solution has to be computed many times. In the past, simplified approaches like Modified Logvinovich Model [4] or generalized Wagner [5] have been proposed, both resulting to be very efficient. However, they are both characterized by a singularity in the pressure distribution and the spray root. The present model, being fully-nonlinear, enables a more accurate prediction of the pressure distribution at the spray root, which can be significant when modelling the fluid-structure interaction.
For the application to the aircraft ditching, the two-dimensional solver is embedded in a 2D+t approach [4,6] which simulates the ow taking place on a transverse plane in an earth-fixed frame of reference. ome validation studies will be presented together with a discussion on future developments of the method.

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