Validation of the SPH method applied to aircraft ditching

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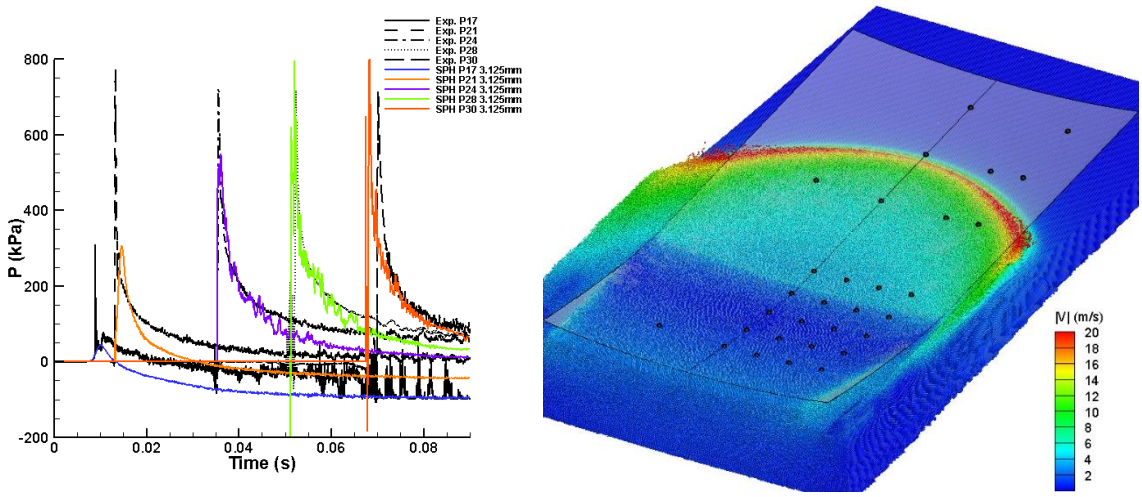
ABSTRACT

In this paper, the high-speed water entry of an aircraft shape is investigated with the Smoothed Particle Hydrodynamics (SPH) numerical method. Within the SMAES-FP7 project, the high-speed water entry of flat and single-curvature shapes have been experimented (cf. Iafrati et al. [2]). Within the SARAH-H2020 project, shapes with double curvature are experimented (cf. Iafrati et al. [3]). This valuable experimental database is essential to validate numerical methods for aircraft ditching applications.

The study carried out in this paper assesses the ability of an advanced SPH model (cf. Oger et al. [1]) to accurately simulate such flow. Comparison between SPH numerical results and experimental measurements are provided. Further analysis shed light on the numerous phenomena involved during the ditching impact: generation of high-speed water jets, wetting / de-wetting of the specimen, suction effect, occurrence of cavitation and / or ventilation.

Experimental runs with deformable specimens have also been conducted during the test campaign (cf. Iafrati et al. [3]). The Fluid-Structure Interaction (FSI) capabilities of the SPH method, when coupled with an FEM solver, is also demonstrated by comparison with experimental measurements. Such numerical capability allows a detailed investigation into the risk of structural damage due to the water impact.



Local pressure comparison between SPH-based simulation and experimental measurement on the high-speed water entry of a double curvature shape

REFERENCES

[1] G. Oger, S. Marrone, D. Le Touzé, M. de Leffe, "SPH accuracy improvement through the combination of a quasi-Lagrangian shifting transport velocity and consistent ALE formalisms", *Journal of Computational Physics*, vol. 313, pp.76-98, 2016.

[2] A. Iafrati, S. Grizzi, M.H. Siemann, L. Benítez Montañés, "High-speed ditching of a flat plate: Experimental data and uncertainty assessment", *Journal of Fluids and Structures* 55 (2015) 501–525

[3] A. Iafrati, S. Grizzi, and F. Olivieri. "Experimental investigation of fluid-structure interaction phenomena during aircraft ditching", AIAA Scitech 2019 Forum, AIAA SciTech Forum, (AIAA 2019-2030)