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Experimental and numerical study of water impact investigations for aircraft crashworthiness application analysis

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Abstract

It is important for crashworthiness of an aircraft fuselage and its structural components to evaluate the aircraft airworthiness in crash-landing scenarios on different terrains (i.e. rigid, soil, and water). In this study, a new experimental method by Doppler shift is performed to measure the velocity and thus the water impact loads of a rigid sphere bottom structure dropping onto a water surface. Doppler Effect measurements are conducted to precisely obtain the water impact responses acting on the structure. And experimental results are validated and evaluated with the classical experimental data, as well as numerical simulation performed on the explicit FEM code LS-DYNA. A penalty coupling algorithm within the frame of multi-material Arbitrary Lagrangian Eulerian (ALE) model is utilized to numerically simulate the experimental cases. It concludes that the Doppler measurement is a reliable and effective method to not just obtain the water-impact responses and its great potential to be applied to aircraft crashworthiness analysis.

Keywords: Crashworthiness, Water impact; Drop tests; Doppler measurement; Finite element analysis.