# Postprint: Structural Impact Response Characteristics of Internal Flow Fields in Amphibious Aircraft

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## Abstract

Amphibious aircraft possess unique advantages in aerial firefighting applications; however, during high-speed water taxiing for water intake and aerial firefighting water dropping operations, the moving water within the aircraft fuselage generates unsteady hydrodynamic impact effects. Regarding fluid-structure interaction (FSI) problems in aircraft, previous research has primarily focused on interactions between the external flow field and rigid aircraft structures, with minimal attention devoted to the effects of internal flow fields on structural deformation and stress distribution. Therefore, based on the operational profiles of amphibious aircraft, a coupled smoothed particle hydrodynamics (SPH) and structural finite element simulation approach is adopted, structural finite element models and internal flow field models are developed for the primary affected regions of the complete aircraft, and fluid-structure coupling is employed to solve for the dynamic stress distribution in the aircraft's elastic structure under internal flow fields during water intake and dropping operations. The results demonstrate that: During high-speed water intake, the tank structure experiences continuous internal flow impact excitation, stresses throughout the structure undergo continuous variation, certain regions exhibit oscillatory variations with substantial stress amplitudes, and the tank baffle experiences maximum transient stresses of $0.38\sigma$b at certain instants, with a maximum amplitude of $0.42\sigma$max; During gravity-based aerial water dropping, the internal flow impact excitation on the tank structure is comparatively weak, the end frame exhibits maximum transient incremental stresses of $0.15\sigma$b, with a maximum amplitude of $0.22\sigma$max, the structural incremental stress level remains low, and stress oscillation amplitudes are relatively small.

## Full Text

## Preamble

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*Note: Figure translations are in progress. See original paper for figures.*