Numerical simulation of the high-speed water entry of a projectile with 3D SPH method

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Abstract

The high-speed water entry problem is related to the shape and trajectory design of naval architectures. During the water entry process, the structure is always subjected to the strong impact load and meanwhile the water-entry cavity is formed. For the high-speed case, the water entry cavity is also accompanied by natural cavity, therefore the forecast of the water-entry behaviors and cavity loads become more difficult. In this paper, the smoothed particle hydrodynamics (SPH) method is introduced to simulate the high-speed water entry process of a projectile. Firstly, the cavity model is incorporated into the 3D SPH model and validated by a benchmark case. What's more, the efficiency of the 3D program is improved in terms of the combined CPU and GPU parallelization. Furthermore, the model of a slender projectile water entry is established and several typical cases of different incipient speeds and angles are studied. Then, the water-entry impact load, the evolution of cavity shape and the mutual effects between them are analyzed and finally the mechanism of the projectile responding to the water entry loads is concluded. The study aims to provide some references for the hydrodynamics design of naval architectures.

Reference：

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