Parametric Study of the Vertical Launcher by Coupled CFD/CSD with Hybrid Particle Level-set Method – Coupled Problems 2017

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ABSTRACT

Vertical launch system (VLS) is commonly used for operating and sheltering of high-speed launch vehicle. In order for a preliminary design of VLS, rear-side aft closure does significant role in protecting interiors from high-temperature pressurized loads induced by ignition of the adjacent canister. Although the configuration of VLS is fully three-dimensional, computational cost should be considered to relieve for the relevant fluid-structural interaction (FSI) analysis. This paper presents a two-dimensional FSI approach based on the elasto-plastic and reflected behaviours from the internal structures. The rocket plume loading is modelled by fully Eulerian method. Non-linear structural model, i.e., rear-side aft closure, is obtained by total Lagrangian formulation based on a 9-node planar element. For the material nonlinearity, Newton-Raphson return-mapping algorithm based on the bi-linear hardening rule is used. In order to define the materially plastic state, von Mises yield criterion is adopted. Lagrange multipliers and penalty term are used for the contact analysis. The interface motion and boundary conditions between the fluid and solid phase are described by the hybrid particle level-set method, specifically using the Ghost Fluid framework. The method is validated by experimental results and the present results show qualitatively similar regarding the pressure and its arriving time on arbitrary points in VLS. Further, parametric study considering variation in the material property and geometry will be conducted.

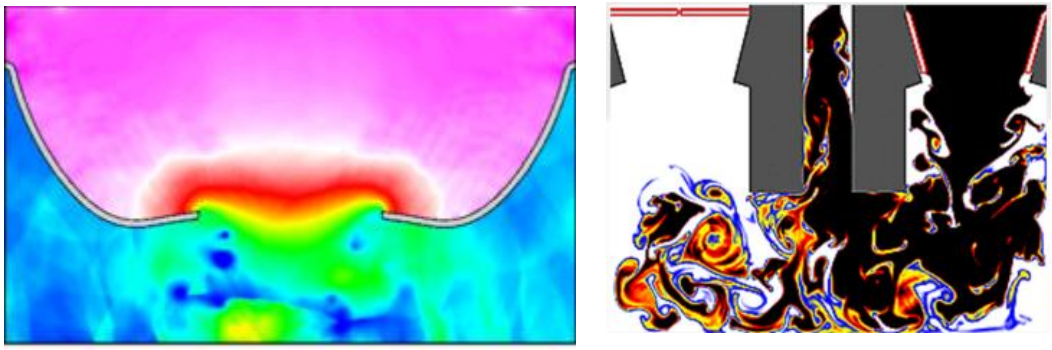

Fig. 1. Results of the present FSI analysis for VLS

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