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An Automated Fluid-Structural Interaction Analysis of a Large Segmented Solid Rocket Motor

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ABSTRACT

A new analysis procedure has been used to evaluate the propellant grain/flow stability of a new, five segment Space Shuttle solid rocket booster. The fluid-structural interaction (FSI) analysis of the ETM-3 motor used PYTHON, a powerful programming language, and FEM BUILDER, a pre- and post processor developed by ATK Thiokol Propulsion, to automatically couple the ABAQUS structural solver with FLUENT, the CFD solver. This iterative process automatically used the results of one solver as the inputs to the other solver until convergence to a solution was obtained.

The ETM-3 motor was basically an RSRM motor with an additional center segment added. The additional segment and greater nozzle diameter increased mass flow and mach number in the motor. Because of this harsher flow environment, it was necessary to conduct a detailed FSI analysis to ensure propellant grain stability against boot-strapping.

This paper details the FSI analysis work done for ETM-3. The analyses conducted and documented in this report assumed linear elastic material behavior and steady state fluid behavior without time response in either the structural or fluid models.