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Booster Interface Loads

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Sponsoring Program(s)

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Project Description

The interaction between shock waves and the wake shed from the forward booster/core attach hardware results in unsteady pressure fluctuations, which can lead to large buffeting loads on the vehicle. This task investigates whether computational tools can adequately predict these flows, and whether alternative booster nose shapes can reduce these loads. Results from wind tunnel tests will be used to validate the computations and provide design information for future Space Launch System (SLS) configurations.

The current work combines numerical simulations with wind tunnel testing to predict buffeting loads caused by the boosters. Variations in nosecone shape, similar to the Ariane 5 design (fig. 1), are being evaluated with regard to lowering the buffet loads. The task will provide design information for the mitigation of buffet loads for SLS, along with validated simulation tools to be used to assess future SLS designs.

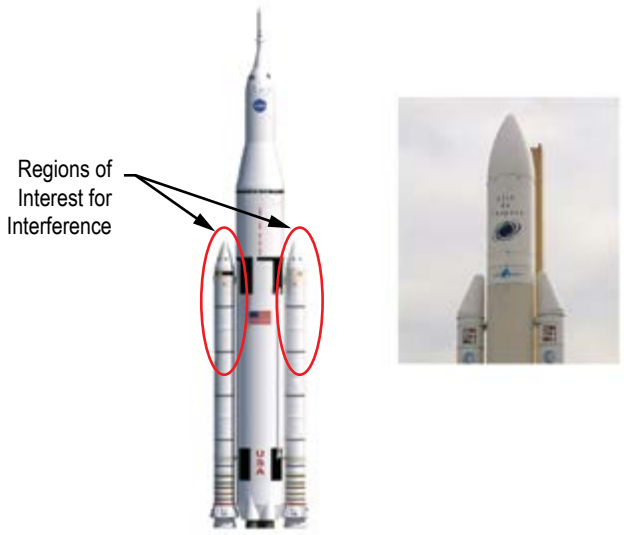

Figure 1: Booster interface loads.

Notable Accomplishments

The project has completed an initial set of computational fluid dynamics cases covering six booster nose configurations for two Mach numbers and two angles of attack. These configurations were tested in the NASA Ames 11-ft Transonic Wind Tunnel, as part of an SLS aero-acoustic test. Both computationally predicted and measured wind tunnel results indicate that substantial improvement in the booster attach region environments can be achieved (fig. 2).

While encouraging, overall root mean square (RMS) pressure levels are a relatively high-level comparison. For combined load analysis, buffet forcing functions, or integrated loads at a given longitudinal station, are needed. Accurate prediction of these buffet-forcing functions requires agreement in both magnitude and frequency.

References

Crumbly, C.M.; Bickley, F.P.; and Hueter, U.: “Space Launch System Spacecraft/Payloads Integration and Evolution Office Advanced Development FY 2014 Annual Report,” NASA/TM—2015–218201, NASA Marshall Space Flight Center, Huntsville, AL, January 2015.

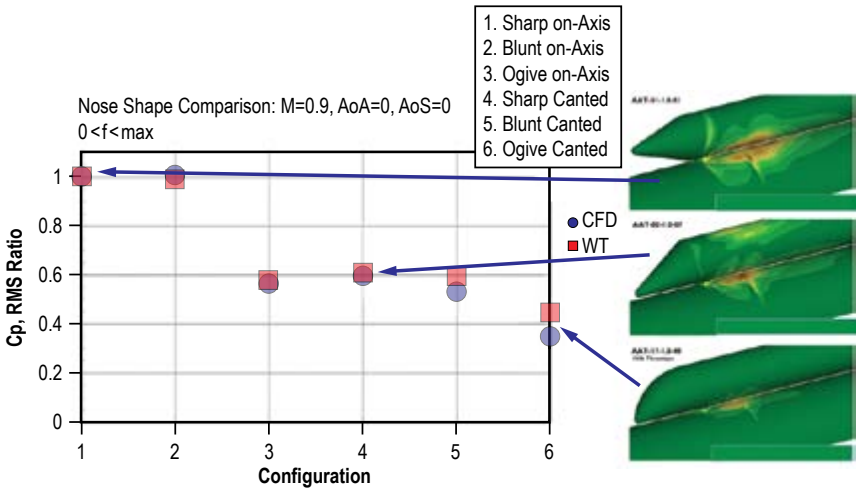

Figure 2: Area-weighted RMS pressure levels in booster attach region.