

Phase I Project Summary

Firm: CFD Research Corporation

Contract Number: NNX11CI36P

Project Title: High-Fidelity Prediction of Launch Vehicle Liftoff Acoustic Fields

Identification and Significance of Innovation:

The vibro-acoustic environment induced by acoustic energy resulting from a propulsion system of large launch vehicles during lift-off is of great concern for the integrity of the launch complex, the vehicle itself and the vehicle payloads. Acoustic loads of 160dB to 200dB may reach sections of the launch vehicle, severely threatening the integrity of avionics systems or payloads. Engineering models based on empirical jet acoustic strength and directivity models or scaled Saturn V measurements are current state-of-the-art production tools. These methodologies cannot account for deviations from the original data used in the empirical models. In this project it is proposed to develop a noise propagation analysis software system uniquely tailored towards the complexities and intricacies of launch vehicle lift-off acoustic environments prediction. A combination of advanced computational tools will be integrated to provide a novel lift-off acoustic prediction tool framework.

Technical Objectives and Work Plan:

The overall goal of this project (Phase I and II) is to develop, validate and deliver a unique software system for prediction of launch vehicle liftoff acoustic environments. The tool will couple existing software tools for computational fluid dynamics and computational acoustics and will leverage other existing software systems already in use by NASA analysts. In the Phase I project the objective were to demonstrate the feasibility of the proposed software tool and to identify development requirements and target validation cases for the Phase II project.

Technical Accomplishments:

All technical objectives were accomplished. This work will provide the necessary experience and the foundation for Phase II development, validation and deployment of a coupled CFD/CAA software package for prediction of launch vehicle liftoff acoustics.

NASA Application(s):

The Computational Aero-Acoustics (CAA) tool will be of first order importance in defining lift-off environments for new heavy launch vehicle designs, and for the analysis of noise suppression techniques. The tool will also be invaluable to payload system and instrument developers.

Non-NASA Commercial Application(s):

The proposed innovation offers significant advantages over aeroacoustic prediction tools currently available in industry. The toolset will be invaluable to launch service providers and payload system and sensitive instrument developers, particularly for one-of-a-kind DoD, NRO, and NOAA satellites. At the end of the SBIR, this technology will be readily available for analysis of conventional and vertical landing jet engine noise, and airframe noise in general.

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