

■ Synopsis

- This project used the HPCMP CREATE™-AV Kestrel solver to explore a method of using limited, hybrid RANS/LES computations to generate models that enable the rapid evaluation of conceptual designs of a hypersonic vehicle with a high degree of confidence.

■ Value to the Organization

- The AFRL High Speed Systems Division generates conceptual designs for hypersonic vehicles that serve as both a starting point for industry concepts and a baseline for evaluation of contractor proposals. This project demonstrated methods to increase the accuracy of the aerodynamic data that supports MS&A tools, improving our ability to predict the performance of notional vehicles.

■ Results

- Demonstrated the ability to realize significant computational savings by generating an aerodynamic database with a single CFD run, rather than the traditional method that takes 10s to 100s of individual simulations, increasing the speed that the AFRL High Speed Systems Division can evaluate hypersonic concepts
- Developed computational models of an air breathing hypersonic vehicle that included non-linear effects, proving the viability of the concept for aerodynamically complex flight regimes
- Combined multiple computational models to accurately capture highly non-linear behavior

■ Intern

- Mr. Matthew Schwartz, Aerospace Engineering, Masters, University of Tennessee Space Institute

■ Contribution to Project

- The intern rapidly developed families of computational meshes for a hypersonic vehicle concept to establish acceptable levels of simulation accuracy. He also designed unique maneuvers to excite various aspects of the vehicle dynamics and then executed Kestrel simulations of the moving vehicles. Finally, he developed custom post-processing scripts to mathematically identify the relationship between the simulation inputs (e.g. angle of attack) and the output aerodynamic coefficients (lift, drag, moments)

■ Importance to Intern

- Familiarity with the typical engineering workflow involving HPC CFD, including mesh generation, executing the code on HPCMP hardware, and post-processing
- Understanding of the Government's role in the acquisition process through the development and evaluation of baseline concepts
- Tours of the world-class hypersonic combustion facilities located at Wright-Patterson AFB, as well as the National Museum of the Air Force containing 60 years worth of supersonic/hypersonic research aircraft
- Discussed future employment opportunities through various USAF programs and the SMART scholarship program