NASA SBIR/STTR Technologies

Computational Tool for Aerothermal Environment Around Transatmospheric Vehicles

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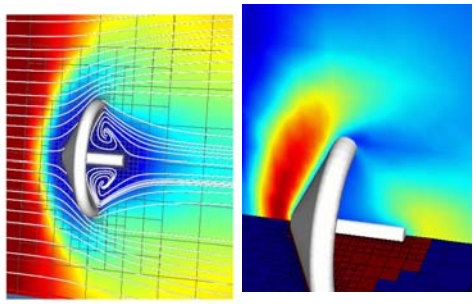
Identification and Significance of Innovation

• Highly accurate computational models to predict aerothermal environment and associated effects on vehicles
• Software tools coupling non-equilibrium chemistry, radiation transport and plasma capabilities for high speed flows
• Innovative flow control methods including plasma actuators for subsonic and supersonic applications

IRVE,
90 km altitude
M=4,
Kn=0.01



UFS simulations of Inflatable Reentry Vehicle Experiment (IRVE) Streamlines, Mach number, and computational mesh (on the left). Gas temperature in the vertical plane, kinetic (red) and continuum (blue) domains in the horizontal plane (on the right).

Technical Objectives and Work Plan

CFDRC has developed a Unified Flow Solver (UFS) for rarefied, transitional and continuum flows. The goal of this Project is to Enhance UFS with advanced non-equilibrium chemistry, Radiation Transport and Plasma capabilities, including
• Boltzmann solver for electrons
• State-to-State vibrational kinetics of molecules
• Advanced non-equilibrium chemistry coupled to radiation transport with real gas effects
• Plasma transport & chemistry

Using developed tool investigate innovative methods of plasma flow control for different applications

NASA and Non-NASA Applications

• Nonequilibrium reentry code with predictive capabilities.
The code will be used as a design tool for development of new generation reentry vehicles (such as Crew Exploration Vehicle).
• Components of future hypersonic vehicles
• Plasma flow control for subsonic and supersonic aerospace vehicles
• Plasma assisted material processing
• Plasma devices under flowing gas conditions for chemical, bio and medical applications

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NON-PROPRIETARY DATA