NASA SBIR/STTR Technologies

Advanced Vortex Hybrid Rocket Engine (AVHRE)
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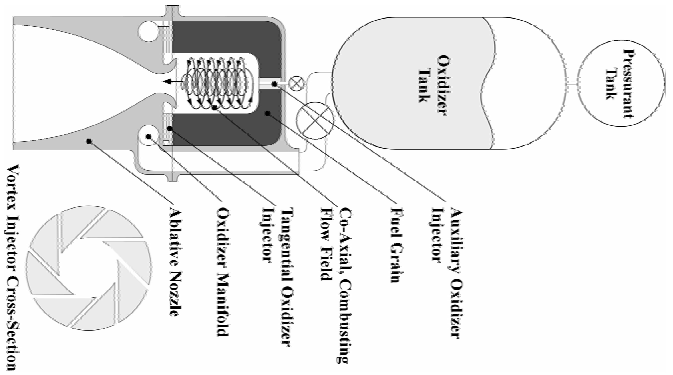
Proposal No.:X6.01-7813

Identification and Significance of Innovation

ORBITEC propose to develop a unique Advanced Vortex Hybrid Rocket Engine (AVHRE) to achieve a highly-reliable, low-cost and extremely versatile propulsion technology. The benefits of AVHRE result from the combination of ORBITEC's patented vortex injection technique; high-regression rate, paraffin solid fuels; and a new fuel formulation innovation to control the solid fuel regression characteristics and provide improved structural integrity of the grain. A vortex injector generates a coaxial vortex pair, driving high solid-fuel regression rates and improved combustion efficiency. In addition, paraffin also regresses very rapidly, further enhancing the systems flexibility. The rapid regression rates and many design degrees of freedom offered by AVHRE offers the potential for: (1) increased propellant mass fractions; (2) the ability to tailor and optimize a hybrid propulsion system for a specific application; (3) increased I_{SP} efficiency; (4) a reduction or elimination of residual fuel; (5) improved grain structural integrity and increased melting temperature; (6) reduced need for thermal insulation.



Technical Objectives

1) Conduct AVHRE mission and systems benefit analysis
2) Develop processes for casting Paraffin-HTPB grains over a wide range of mixture formulations
3) Conduct lab-scale hot-firings of several Paraffin-HTPB formulations
4) Design of a 1,000 lb_f thrust AVHRE engine
5) Prepare and activate the BAAP rocket test facility
6) Conduct a progressive series of AVHRE hot firings up to a thrust of 1000 lb_f.

Work Plan

Task 1. Mission and Systems Analysis
Task 2. Paraffin-HTPB Grain Production
Task 3. Lab-Scale Paraffin-HTPB Evaluation
Task 4. 1,000 lb_f AVHRE Engine Design
Task 5. Facility Preparation
Task 6. 1,000 lb_f AVHRE Testing
Task 7. Preliminary Phase II AVHRE Design
Task 8. Reporting

NASA Applications

The AVHRE is designed to address key operational challenges of traditional hybrid rocket engine systems. If successful, this could catapult hybrid rocket systems into a highly competitive position for many earth-to-orbit propulsion applications, where their inherent safety, simplicity, and low-cost could be competitively harnessed. AVHRE is expected to have application to reusable and expendable launch vehicles, sounding rockets, and upper stage propulsion systems. This technology is closely related to ORBITEC's vortex combustion cold-wall (VCCW) chamber technology for liquid bi-propellant applications. The next generation launch vehicles can benefit from these technologies.

Non-NASA Applications

AVHRE is expected to have application to reusable and expendable launch vehicles, sounding rockets, and upper stage propulsion systems. This technology is closely related to ORBITEC's vortex combustion cold-wall (VCCW) chamber technology for liquid bi-propellant applications, and has the potential to significantly improve liquid rocket lifetime, reusability, and thrust-to-weight ratio. Potential military applications include: kinetic energy boost-phase interceptors, high-speed and/or high altitude target drones, and cruise missile propulsion. A new market is also emerging to provide suborbital launch vehicles for space tourists as well as the entertainment market for amusement rides and rocket car demonstrations at air shows.

Firm Contacts

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