NASA SBIR/STTR Technologies

High Performance Monopropellants for Future Planetary Ascent Vehicles

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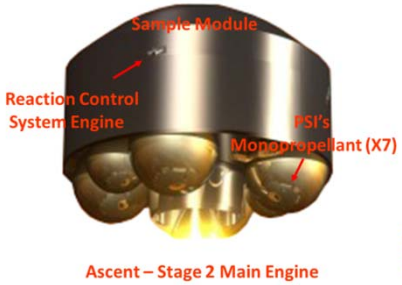
Proposal No.: S3.08-8886

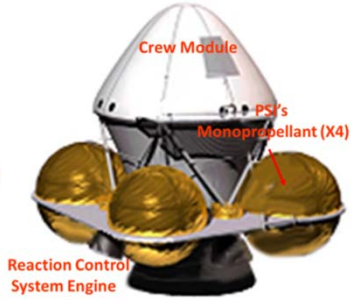
Identification and Significance of Innovation

- Developed and demonstrated three unique, high performance, high density, energetic, non-carcinogenic and green relative to hydrazine, non-cryogenic, less corrosive, storable monopropellants
- Superior specific impulse performance exceeding 240 sec solicitation requirements by 56% and ρI_{sp} between 71% - 112% to hydrazine
- Fine droplet dispersion with ignition delays less than 10ms at 1030psi
- Competitive with bipropellant combinations and superior to alternative monopropellant formulations for notional sample and manned missions to and from Mars for vehicles modeled using pressure or pump fed propulsion systems

Expected TRL Range at the end of Contract (1-9): ~3



Mars Sample Return Vehicle



Mars Crew Return Vehicle

- Significantly smaller vehicle with reduced launch mass enabling increased payload
- ~56% reduction in lift-off compared to hydrazine
- ~9% reduction in lift-off mass compared to LOX/LCH_4
- ~11% reduction in de-orbit mass compared to LOX/LCH_4
- A simpler, more compact system than bi-propellant systems

Technical Objectives and Work Plan

- Evaluated the physical and chemical properties of proposed monopropellants to ensure maximum I_{sp} and ρI_{sp}. Identified monopropellants thermal stability, storability, freezing point temperature, viscosity as a function of temperature, material compatibility
- Demonstrate fine droplet dispersion, ignition and sustained combustion of the monopropellants up to chamber pressures of 1000psi
- Identified a Mars Ascent Vehicle design (using the Design Reference Architecture 5.0 as baseline) for sample return and manned mission that uses the proposed monopropellant, and demonstrated by analysis enhanced vehicle performance and its implementation for space borne mission

NASA and Non-NASA Applications

Multiple application within the NASA Exploration System and Planetary Science directorate:

- Advanced Capabilities Program
- Exploration Technology Development Program
- Mars Exploration program

Non NASA applications include:

- NetCentric Airborne Defense Element Proto-program
- Falcon force HTV-2 program
- Divert attitude control and upper-stage propulsion system for MDA missile programs

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NON-PROPRIETARY DATA