Additively Manufactured Liquid Injection Thrust Vector Control System, Phase I

Completed Technology Project (2018 - 2019)

Project Introduction

Parabilis Space Technologies is pleased to propose the development of a Liquid Injection Thrust Vector Control (LITVC) system integrated into a regeneratively cooled, additively manufactured nozzle in response to solicitation S4.03, Spacecraft Technology for Sample Return Missions. The use of additive manufacturing and regenerative cooling prevents nozzle erosion near the injection ports, enables optimization of the nozzle surface for global system efficiency, and allows incorporation of high efficiency side force throttling techniques.

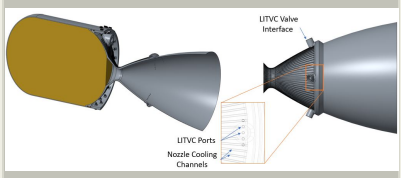
The proposed innovation addresses the steering needs of sample return missions through the use of a high-performance LITVC system integrated into a regeneratively cooled, additively manufactured nozzle. The proposed system integrates extremely efficiently with Parabilis' aft-injection center exhaust (ACE) architecture. The system is particularly synergistic with JPL's hybrid rocket motor architecture proposed for Mars sample return, but it is beneficial for other missions as well.

Anticipated Benefits

The proposed propulsion system is applicable to a number of current and future NASA programs. This technology is directly targeted for a potential Mars sample return mission under development by JPL that would launch in the 2020-time frame, however, it would be applicable to other missions as well.

The proposed technology has significant benefits for terrestrial propulsion systems as well and is synergistic with hybrid Nanolaunch stages Parabilis is currently developing for NASA.

Commercial terrestrial launch vehicles will also benefit greatly from this technology. There is developing market for low cost launch vehicle providers, several of which have been proposed that use, or potentially use, hybrid rocket motor technology. Hybrid rocket motors using LITVC fit easily within the economical strategic visions for these low-cost launch vehicles.



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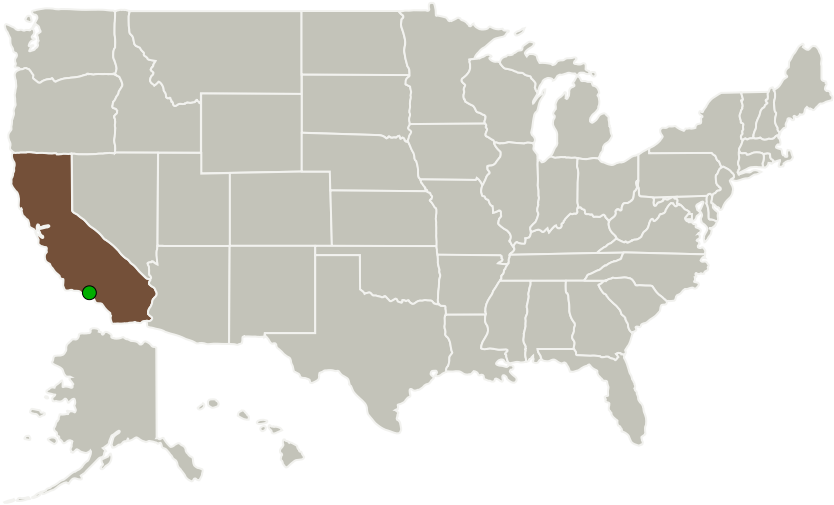
Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Parabilis Space Technologies, Inc.	Lead Organization	Industry Historically Underutilized Business Zones (HUBZones)	SAN MARCOS, California
● Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations
California

Project Transitions

July 2018: Project Start

February 2019: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/141233)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Parabilis Space Technologies, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

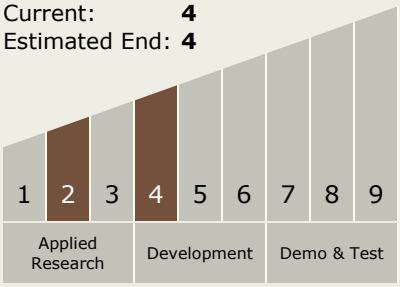
Carlos Torrez

Principal Investigator:

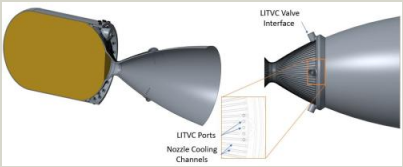
Christopher S Grainger

Technology Maturity (TRL)

Start: **2**
Current: **4**
Estimated End: **4**



Images



Briefing Chart Image
Additively Manufactured Liquid Injection Thrust Vector Control System, Phase I
(https://techport.nasa.gov/image/136069)

Final Summary Chart Image
Additively Manufactured Liquid Injection Thrust Vector Control System, Phase I
(https://techport.nasa.gov/image/126601)

Technology Areas

Primary:

- TX01 Propulsion Systems
  └ TX01.1 Chemical Space Propulsion
    └ TX01.1.5 Hybrids

Target Destinations

The Moon, Mars, Others Inside the Solar System