Nitrous Oxide Liquid Injection Thrust Vector Control System Testing

Whittinghill Aerospace, LLC

Technical Abstract

A Nitrous Oxide-fed Liquid Thrust Vector Control system is proposed as an efficient method for vehicle attitude control during powered flight. Pulled from a N2O main propulsion system oxidizer tank, it features system simplicity, no toxicity, room temperature storability, high system mass fraction and superior performance due to its exothermic decomposition characteristics, answering the need for innovative attitude control technologies. A continuing series of 1,000 lb thrust hybrid rocket motor tests are proposed to characterize N2O's Side Specific Impulse as a function of thrust vectoring angle, as well as a series of 4,000 lb thrust motor firings culminating in a closed-loop Guidance Navigation and Control Hardware-In-The-Loop test in a vertical stand. At the conclusion of Phase 2, the technology will be ready for development into an upper stage as an integrated main propulsion Thrust Vector Control (TVC) /Attitude Control System for a small launch vehicle, or as a separate TVC system for any solid, liquid or hybrid powered vehicle.

Company Contact
George Whittinghill
(805) 901-2297
grw@whittinghillaerospace.com

2007 Phase II
Proposal S4.07-8526

Mini-Micro Thrusters, LOX / Hydrocarbon Propulsion, and Attitude Control Systems

Pulsed Electrogasdynamic Thruster for Attitude Control and Orbit Maneuver

Physical Sciences, Inc.

Technical Abstract

In the Phase I program we successfully demonstrated the feasibility of the Pulsed ElectroGasdynamic (PEG) thruster for attitude control and orbital maneuvering. In this thruster, propellant gas is introduced into the thrust nozzle through a fast acting gas valve where a short, high voltage pulse is applied to break down and heat the propellant gas. The heated gas expands in the nozzle generating a high impulse (~mN-s per pulse) at a high specific thrust (120 £gN-s/joule). The specific impulse (Isp) will be in the range of 500~1500 sec. This process can be repeated at a frequency to meet the spacecraft thrust requirements. The thrust generating mechanism of the proposed thruster is gasdynamic expansion, not magnetohydrodynamic interaction. The proposed thruster is different from the conventional pulsed electrothermal thruster in that the joule heating of the propellant takes place as the propellant gas expands through the divergent nozzle, thereby eliminating the heat and momentum losses at the nozzle throat. Our Phase II objectives are: (i) develop an engineering model; and (ii) develop a proto-flight model of the proposed thruster system.

Company Contact
Mary DeLeo
(978) 738-8106
deleo@psicorp.com

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