Physical Sciences

Oxygen-Methane Thruster

Marshall Space Flight Center, Alabama

An oxygen-methane thruster was conceived with integrated igniter/injector capable of nominal operation on either gaseous or liquid propellants. The thruster was designed to develop 100 lbf (≈445 N) thrust at vacuum conditions and use oxygen and methane as propellants. This continued development included refining the design of the thruster to minimize part count and manufacturing difficulties/cost, refining the modeling tools and capabilities that support system design and analysis, demonstrating the performance of the igniter and full thruster assembly with both gaseous and liquid propellants, and acquiring data from this testing in order to verify the design and operational parameters of the thruster.

Thruster testing was conducted with gaseous propellants used for the igniter and thruster. The thruster was demonstrated to work with all types of propellant conditions, and provided the desired performance. Both the thruster and igniter were tested, as well as gaseous propellants, and found to provide the desired performance using the various propellant conditions. The engine also served as an injector testbed for MSFC-designed refractory combustion chambers made of rhenium.

This work was done by Tim Pickens of Orion Propulsion, Inc. for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32776-1.

Lunar Navigation Determination System — LaNDS

Goddard Space Flight Center, Greenbelt, Maryland

A portable comprehensive navigational system has been developed that both robotic and human explorers can use to determine their location, attitude, and heading anywhere on the lunar surface independent of external infrastructure (needs no Lunar satellite network, line of sight to the Sun or Earth, etc.). The system combines robust processing power with an extensive topographical database to create a real-time atlas (GIS — Geospatial Information System) that is able to autonomously control and monitor both single unmanned rovers and fleets of rovers, as well as science payload stations. The system includes provisions for teleoperation and tele-presence. The system accepts (but does not require) inputs from a wide range of sensors.

A means was needed to establish a location when the search is taken deep in a crater (looking for water ice) and out of view of Earth or any other references. A star camera can be employed to determine the user's attitude in menial space and stellar map in body space. A local nadir reference (e.g., an accelerometer that orients the nadir vector in body space) can be used in conjunction with a digital ephemeris and gravity model of the Moon to isolate the latitude, longitude, and azimuth of the user on the surface. That information can be used in conjunction with a Lunar GIS and advanced navigation planning algorithms to aid astronauts (or other assets) to navigate on the Lunar surface.

This work was done by David Quinn and Stephen Talabac of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15892-1

Launch Method for Kites in Low-Wind or No-Wind Conditions

Goddard Space Flight Center, Greenbelt, Maryland

Airborne observations using lightweight camera systems are desirable for a variety of applications. This system was contemplated as a method to provide a simple remote sensing aerial platform. Kites have been successfully employed for aerial observations, but have historically required natural wind or towing to become airborne. This new method negates this requirement, and widens the applicability of kites for carrying instrumentation. Applicability is primarily limited by the space available on the ground for launching.

The innovation is a method for launching kites in low-wind or no-wind conditions. This method will enable instrumentation to be carried aloft using simple (or complex) kite-based systems, to obtain observations from an aerial perspective. This technique will provide access to altitudes of 100 meters or more over any area normally suited for kite flying. The duration of any observation is dependent on wind strength; however, the initial altitude is relatively independent. The system does not require any electrical or combustion-based elements. This technology was developed to augment local-scale airborne measurement capabilities suitable for Earth science research, agricultural productivity, and environmental observations. The method represents an extension of techniques often used in aeronautical applications for launching fixed-wing