Books & Reports

Plasmoid Thruster for High Specific-Impulse Propulsion

A report discusses a new multi-turn, multi-lead design for the first generation PT-1 (Plasmoid Thruster) that produces thrust by expelling plasmas with embedded magnetic fields (plasmoids) at high velocities. This thruster is completely electrodeless, capable of using *in-situ* resources, and offers efficiencies as high as 70 percent at a specific impulse, I_{sp}, of up to 8,000 s. This unit consists of drive and bias coils wound around a ceramic form, and the capacitor bank and switches are an integral part of the assembly. Multiple thrusters may be ganged to inductively recapture unused energy to boost efficiency and to increase the repetition rate, which, in turn increases the average thrust of the system.

The thruster assembly can use storable propellants such as H_2O, ammonia, and NO, among others. Any available propellant gases can be used to produce an I_{sp} in the range of 2,000 to 8,000 s with a single-stage thruster. These capabilities will allow the transport of greater payloads to outer planets, especially in the case of an I_{sp} greater than 6,000 s.

This work was done by Peter Fimognari of the University of Alabama in Huntsville and Richard Eskridge, Adam Martin, and Michael Lee of Marshall Space Flight Center. Further information is contained in a TSP (see page 1). MFS-32364-1

Analysis Method for Quantifying Vehicle Design Goals

A document discusses a method for using Design Structure Matrices (DSM), coupled with high-level tools representing important life-cycle parameters, to comprehensively conceptualize a flight/ground space transportation system design by dealing with such variables as performance, up-front costs, downstream operations costs, and reliability. This approach also weighs operational approaches based on their effect on upstream design variables so that it is possible to readily, yet defensibly, establish linkages between operations and these upstream variables.

To avoid the large range of problems that have defeated previous methods of dealing with the complex problems of transportation design, and to cut down the inefficient use of resources, the method described in the document identifies those areas that are of sufficient promise and that provide a higher grade of analysis for those issues, as well as the linkages at issue between operations and other factors. Ultimately, the system is designed to save resources and time, and allows for the evolution of operable space transportation system technology, and design and conceptual system approach targets.

This work was done by Edgar Zapata of Kennedy Space Center and A.C. Charania and John Olds of Spaceworks Engineering. Further information is contained in a TSP (see page 1). KSC-12797

Improved Tracking of Targets by Cameras on a Mars Rover

A paper describes a method devised to increase the robustness and accuracy of tracking of targets by means of three stereoscopic pairs of video cameras on a Mars-rover-type exploratory robotic vehicle. Two of the camera pairs are mounted on a mast that can be adjusted in pan and tilt; the third camera pair is mounted on the main vehicle body. Elements of the method include a mast calibration, a camera-pointing algorithm, and a purely geometric technique for handing off tracking between different camera pairs at critical distances as the rover approaches a target of interest.

The mast calibration is an extension of camera calibration in which the camera images of calibration targets at known positions are collected at various pan and tilt angles. In the camera-pointing algorithm, pan and tilt angles are computed by a closed-form, non-iterative solution of inverse kinematics of the mast combined with mathematical models of the cameras. The purely geometric camera-handoff technique involves the use of stereoscopic views of a target of interest in conjunction with the mast calibration.

This work was done by Won Kim, Adnan Ansar, and Robert Steele of Caltech for NASA's Jet Propulsion Laboratory.

The software used in this innovation is available for commercial licensing. Please contact Karina Edmonds of the California Institute of Technology at (626) 395-2322. Refer to NPO-42756.

Sample Caching Subsystem

A paper describes the Sample Caching Subsystem (SCS), a method for storing planetary core and soil samples in a container that seals the samples away from the environment to protect the integrity of the samples and any organics they might contain. This process places samples in individual sleeves that are sealed within a container for use by either the current mission or by following missions.

A sample container is stored with its sleeves partially inserted. When a sample is ready to be contained, a transfer arm rotates over and grasps a sleeve, pulls it out of the container from below, rotates over and inserts the sleeve into a funnel where it is passively locked into place and then released from the arm. An external sampling tool deposits the sample into the sleeve, which is aligned with the tool via passive compliance of the funnel. After the sampling tool leaves the funnel, the arm retrieves the sleeve and inserts it all the way into the sample container. This action engages the seal. Full containers can be left behind for pick-up by subsequent science missions, and container dimensions are compatible for placement in a Mars Ascent Vehicle for later return to Earth.

This work was done by Paul G. Backes and Curtis L. Collins of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-44154

Multistage Passive Cooler for Spaceborne Instruments

A document describes a three-stage passive radiative cooler for a cryogenic spectrometer to be launched into a low orbit around the Moon. This cooler is relatively lightweight and compact, and its basic design is scalable and otherwise adaptable to other applications in which there are requirements for cooling instrumentation in orbit about planets.

The cooler includes multiple lightweight flat radiator blades alternating with cylindrical parabolic infrared re-