Books & Reports

Dust Mitigation Vehicle

A document describes the development and demonstration of an apparatus, called a "dust mitigation vehicle," for reducing the amount of free dust on the surface of the Moon. The dust mitigation vehicle would be used to pave surfaces on the Moon to prevent the dust from levitating or adhering to surfaces.

The basic principle of operation of these apparatuses is to use a lens or a dish mirror to concentrate solar thermal radiation onto a small spot to heat lunar regolith. In the case of the prototype dust mitigation vehicle, a Fresnel lens was used to heat a surface layer of regolith sufficiently to sinter or melt dust grains into a solid mass. The prototype vehicle has demonstrated paving rates up to 1.8 m^2 per day. The proposed flight design of the dust mitigation vehicle is also described.

This work was done by Eric H. Cardiff of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15488-1

Optical Coating Performance for Heat Reflectors of the JWST-ISIM Electronic Component

A document discusses a thermal radiator design consisting of lightweight composite materials and low-emittance metal coatings for use on the James Webb Space Telescope (JWST) structure. The structure will have a Thermal Subsystem unit to provide passive cooling to the Integrated Science Instrument Module (ISIM) control electronics. The ISIM, in the JWST observatory, is the platform that provides the mounting surfaces for the instrument control electronics. Dissipating the control electronic generated-heat away from JWST is of paramount importance so that the spacecraft's own heat does not interfere with the infrared-light gathering of distant cosmic sources.

The need to have lateral control in the emission direction of the IEC (ISIM Electronics Compartment) radiators led to the development of a directional baffle design that uses multiple curved mirrorlike surfaces. This concept started out from the so-called Winston non-imaging optical concentrators that use opposing parabolic reflector surfaces, where each parabola has its focus at the opposite edge of the exit aperture. For this reason they are often known as compound parabolic concentrators or CPCs.

This radiator system with the circular section was chosen for the IEC reflectors because it offers two advantages over other designs. The first is that the area of the reflector strips for a given radiator area is less, which results in a lower mass baffle assembly. Secondly, the fraction of energy emitted by the radiator strips and subsequently reflected by the baffle is less. These fewer reflections reduced the amount of energy that is absorbed and eventually re-emitted, typically in a direction outside the design emission range angle.

A baffle frame holds the mirrors in position above a radiator panel on the IEC. Together, these will direct the majority of the heat from the IEC above the sunshield away towards empty space.

This work was done by Robert A. Rashford, Charles M. Perrygo, Matthew B. Garrison, Bryant K. White, Felix T. Threat, Manuel A. Quijada, James W. Jeans, Frank K. Huber, Robert R. Bousquet, and Dave Shaw of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15823-1

SpaceCube Demonstration Platform

A document discusses how the HST SM4 SpaceCube flight spare was modified to create an experiment called the SpaceCube Demonstration Platform (SC DP) for use on the MISSE7 Space Station payload (in collaboration with NRL). It is designed to serve as an on-orbit platform for demonstrating advanced fault tolerance technologies. A simple C&DH (command and data handling) system was developed for the Virtex4 FPGAs (field programmable gate arrays). Both Virtex4s on each SpaceCube run the same program, and both receive incoming telemetry. The rad-hard service FPGA performs simple error checking to verify that the incoming telemetry is valid. The SpaceCube framework was modified to allow for new program files to be sent from the ground, to be stored on the SpaceCube, and to be executed through ground commands. Each SpaceCube Virtex4 FPGA has resources set aside for experiments that are functionally isolated from the C&DH system. The experiments communicate to the C&DH system through a set of dual port memories, and this area is where the fault-tolerance experiments are executed.

With the use of Xilinx commercial Virtex4 FX60 FPGAs, the fault tolerant framework allows the system to recover from radiation upsets that occur in the rad-soft parts (Virtex4 FPGA logic, embedded PPCs in Virtex4 FPGAs, SDRAM and Flash), the C&DH system that runs simultaneously on both Virtex4 FPGAs that uses a robust telemetry packet structure, checksums, and the rad-hard service FPGA to validate incoming telemetry. The ability to be reconfigured from the ground while in orbit is a novel benefit, as well as is the onboard compression capabilities that allow compressed files from the ground to be uploaded to the SpaceCube.

This work was done by Daniel Espinosa, Jeffrey Hosler, Alessandro Geist, David Petrick, Manuel Buenfil, Gary Crum, and Tom Flatley for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15953-1

Aperture Mask for Unambiguous Parity Determination in Long Wavelength Imagers

A document discusses a new parity pupil mask design that allows users to unambiguously determine the image space coordinate system of all the James Webb Space Telescope (JWST) science instruments by using two out-of-focus images. This is an improvement over existing mask designs that could not completely eliminate the coordinate system parity ambiguity at a wavelength of 5.6 microns. To mitigate the problem of how the presence of diffraction artifacts can obscure the pupil mask detail, this innovation has been created with specifically designed edge features so that the image space coordinate system parity can be determined in the presence of diffraction, even at long wavelengths.

This work was done by Brent Bos for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-15956-1