Books & Reports

Ka-band Digitally Beam-formed Airborne Radar Using SweepSAR Technique

A paper describes a frequency-scaled SweepSAR demonstration that operates at Ka-Band (35.6 GHz), and closely approximates the DESDynl mission antenna geometry, scaled by 28. The concept relies on the SweepSAR measurement technique. An array of digital receivers captures waveforms from a multiplicity of elements. These are combined using digital beamforming in elevation and SAR processing to produce imagery.

Ka-band (35.6 GHz) airborne SweepSAR using array-fed reflector and digital beamforming features eight simultaneous receive beams generated by a 40-cm offset-fed reflector and eight-element active array feed, and eight digital receiver channels with all raw data recorded and later used for beamforming. Illumination of the swath is accomplished using a slotted-waveguide antenna radiating 250 W peak power. This experiment has been used to demonstrate digital beamforming SweepSAR systems.

This work was done by Gregory A. Sadowy, Chung-Lun Chuang, Hirad Ghaemi, Brandon A. Heavey, Lung-Sheng S. Lin, and Momin Quddus of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). **NPO-48376**

Composite With *In Situ* Plenums

A document describes a high-performance thermal distribution panel (TDP) concept using high-conductivity (>800 W/mK) macro composite skin with *in situ* heat pipes. The processing technologies proposed to build such a panel result in a one-piece, inseparable assembly with high conductance in both the X and Y planes. The TDP configuration can also be used to produce panels with high structural stiffness. The one-piece construction of the TDP eliminates the thermal interface between the cooling plenums and the heat spreader base, and obviates the need for bulky mounting flanges and thick heat spreaders used on baseline designs. The conductivity of the TDP can be configured to exceed 800 W/mK with a mass density below 2.5 g/cm^3. This material can provide efficient conductive heat transfer between the *in situ* heat plenums, permitting the use of thinner panel thicknesses. The plenums may be used as heat pipes, loop heat pipes, or liquid cooling channels.

The panel technology used in the TDP is a macro-composite comprised of aluminum-encapsulated annealed pyrolytic graphite (APG). APG is highly aligned crystalline graphite with an in-plane thermal conductivity of 1,700 W/mK. APG has low shear strength and does not constrain the encapsulating material.

The proposed concept has no thermal interfaces between the heat pipes and the spreader plate, further improving the overall conductance of the system. The *in situ* plenums can also be used for liquid cooling applications. The process can be used to fabricate structural panels by adding a second thin sheet.

This work was done by Mark Montesano of k-Technology, a Division of Thermacore, for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). **GSC-16043-1**

Multi-Beam Approach for Accelerating Alignment and Calibration of HyspIRI-Like Imaging Spectrometers

A paper describes an optical stimulus that produces more consistent results, and can be automated for unattended, routine generation of data analysis products needed by the integration and testing team assembling a high-fidelity imaging spectrometer system. One key attribute of the system is an arrangement of pick-off mirrors that provides multiple input beams (five in this implementation) to simultaneously provide stimulus light to several field angles along the field of view of the sensor under test, allowing one data set to contain all the information that previously required five data sets to be separately collected. This stimulus can also be fed by quickly reconfigured sources that ultimately provide three data set types that would previously be collected separately using three different setups: Spectral Response Function (SRF), Cross-track Response Function (CRF), and Along-track Response Function (ARF), respectively.

This method also lends itself to expansion of the number of field points if less interpolation across the field of view is desirable. An absolute minimum of three is required at the beginning stages of imaging spectrometer alignment.

This work was done by Michael L. Eastwood, Robert O. Green, Pantazis Mouroulis, Eric B. Hochberg, Randall C. Hein, Linley A. Kroll, Sven Geier, and James B. Coles of Caltech, and Riley Meehan of Tufts University for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). **NPO-47809**

JWST Lifting System

A document describes designing, building, testing, and certifying a customized crane (Lifting Device — LD) with a strong back (cradle) to facilitate the installation of long wall panels and short door panels for the GHe phase of the James Webb Space Telescope (JWST).

The LD controls are variable-frequency drive controls designed to be adjustable for very slow and very-short-distance movements throughout the installation. The LD has a lift beam with an electric actuator attached at the end. The actuator attaches to a rectangular strong back (cradle) for lifting the long wall panels and short door panels from a lower angle into the vertical position inside the chamber, and then rotating around the chamber for installation onto the existing ceiling and floor.

The LD rotates 360° (in very small increments) in both clockwise and counterclockwise directions. Eight lifting pads are on the top ring with 2-in. (≈5-cm) eye holes spaced evenly around the ring to allow for the device to be suspended by three crane hoists from the top of the chamber.

The LD is operated by remote controls that allow for a single, slow mode for booming the load in and out, with slow and very slow modes for rotating the load.

This work was done by William Tolleson of CSC Applied Technologies LLC for Johnson Space Center. Further information is contained in a TSP (see page 1). **MSC-25176-1**

Next-Generation Tumbleweed Rover

A document describes a next-generation tumbleweed rover that involves a split balloon system that is made up of two half-spherical air bladders with a disc between them. This disc contains all the electronics and instruments. By deflating only the bottom balloon, the rover can sit, bringing the surface probe into contact with the ground. The bottom balloon has a channel passing through it, allowing the surface probe to reach the surface through the balloon.

Once the sample has been gathered and analyzed, the rover can re-inflate the lower air bladder and continue rolling.

The rover will use a small set of instruments and electronics situated at the center of its inflatable spherical hull. The current version is a large beach-ball-like construction, about 1.8 m in diameter and weighing roughly 15 kg. The rover comprises two major parts, an outer spherical hull (split in half at the central disc) and an inner, disc-shaped cylindrical section. The balloons are attached to the bottom and top of the disc. Inside the disc, there are temperature and pressure sensors to keep track of the inner and outer conditions of the rover. A system of pumps and valves is responsible for independently inflating and deflating the balloons as necessary. There are also accelerometers to record the movement, together with a GPS receiver. The data are then sent through a modem to a control station. This work builds upon the project "Tumbleweed rover for planetary exploration," described in the Technical Support Package, as noted below.

This work was done by Jeffrey P. Nosanov of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47648

Pneumatic System for Concentration of Micrometer-Size Lunar Soil

A report describes a size-sorting method to separate and concentrate micrometer-size dust from a broad size range of particles without using sieves, fluids, or other processes that may modify the composition or the surface properties of the dust.

The system consists of four processing units connected in series by tubing. Samples of dry particulates such as lunar soil are introduced into the first unit, a fluidized bed. The flow of introduced nitrogen fluidizes the particulates and preferentially moves the finer grain sizes on to the next unit, a flat plate impactor, followed by a cyclone separator, followed by a Nuclepore polycarbonate filter to collect the dust.

By varying the gas flow rate and the sizes of various orifices in the system, the size of the final and intermediate particles can be varied to provide the desired products. The dust can be collected from the filter. In addition, electron microscope grids can be placed on the Nuclepore filter for direct sampling followed by electron microscope characterization of the dust without further handling.

This work was done by David McKay and Bonnie Cooper of Johnson Space Center. Further information is contained in a TSP (see page 1). MSC-25264-1