Books & Reports

Spin-Stabilized Microsatellites With Solar Concentrators

A document proposes the development of spin-stabilized microsatellites powered by solar photovoltaic cells aided by solar concentrators. Each such satellite would have a cylindrical or other axisymmetric main body with solar cells mounted in a circumferential beltlike array on its exterior surface. The solar concentrator would be a halo-like outrigger cylindrical Fresnel lens array that would be deployed from and would surround the main body, connected to the main body via spokes or similar structural members.

The spacecraft would be oriented with its axis of symmetry perpendicular to the line of sight to the Sun and would be set into rotation about this axis. In effect, the solar cells and concentrator would be oriented and rotated in a "rotisserie" mode, making it possible to take advantage of the concentration of solar light while preventing localized overheating of the solar cells. In addition, the mechanical stabilization inherently afforded by the rotation could be exploited as a means of passive attitude control or, at least, of reducing the requirement for active attitude control.

This work was done by Paul Timmerman and Virgil Shields of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-43055

Phase Calibration of Antenna Arrays Aimed at Spacecraft

A document describes a method of calibrating phase differences among ground antennas in an array so that the maximum-intensity direction of the far-field interference pattern of the array coincides with the direction for aiming the antennas to enable radio communication with a distant spacecraft. The method pertains to an array typically comprising between two and four 34-m (or similar size) antennas. The antennas are first calibrated pair-wise to maximize the uplink power received at a different spacecraft that is close enough for communication via a single ground antenna.

In the calibration procedure, the phase of the signal transmitted by one of the antennas is ramped through a complete cycle, thereby causing the interference pattern to sweep over this closer spacecraft and guaranteeing that, at some point during the sweep, this spacecraft is illuminated at maximum intensity. The varying received uplink power is measured by a receiver in the closer spacecraft and the measurement data are transmitted to a ground station to enable determination of the optimum phase adjustment for the direction to the closer spacecraft. This adjustment is then translated to the look direction of the distant spacecraft, which could not be reached effectively using only one antenna.

This work was done by Victor Vilnrotter, Dennis Lee, Leslie Paal, Ryan Mukai, and Timothy Cornish of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-43647

Ring Bus Architecture for a Solid-State Recorder

A document concisely describes a ring bus architecture for a proposed solid-state recorder (SSR) that would serve as buffer of data to be transmitted from a spacecraft to Earth. This architecture would afford fault tolerance needed for reliable operation in an anticipated high-radiation environment in which traditional SSRs cannot operate reliably. Features of the architecture include one or more controller boards and multiple memory boards interconnected in a ringlike topology. The interconnections would be high-speed serial links complying with the Institute of Electrical and Electronics Engineers (IEEE) standard 1393 (which pertains to a spaceborne fiber-optic data bus).

Accordingly, each controller and memory board would be equipped with an IEEE-1393-compliant ring-bus-interface unit. The ringlike topology and the multiplicity of memory boards (and, optionally, of controller boards) would afford the redundancy needed for fault tolerance. Each board would be a fault-containment region. The IEEE 1393 links could be routed so that the SSR would continue to function even in the event of multiple failures. This architecture would also support scalability over a wide range. In a fully redundant configuration, it could accommodate between 1 and 125 memory boards.

This work was done by W. John Walker, Edward Kopf, and Brian Cox of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-45132

Image Compression Algorithm Altered To Improve Stereo Ranging

A report discusses a modification of the ICER image-data-compression algorithm to increase the accuracy of ranging computations performed on compressed stereoscopic image pairs captured by cameras aboard the Mars Exploration Rovers. (ICER and variants thereof were discussed in several prior *NASA Tech Briefs* articles.) Like many image compressors, ICER was designed to minimize a mean-square-error measure of distortion in reconstructed images as a function of the compressed data volume. The present modification of ICER was preceded by formulation of an alternative error measure, an image-quality metric that focuses on stereoscopic-ranging quality and takes account of image-processing steps in the stereoscopic-ranging process. This metric was used in empirical evaluation of bit planes of wavelet-transform subbands that are generated in ICER.

The present modification, which is a change in a bit-plane prioritization rule in ICER, was adopted on the basis of this evaluation. This modification changes the order in which image data are encoded, such that when ICER is used for lossy compression, better stereoscopic-ranging results are obtained as a function of the compressed data volume.

This work was done by Aaron Kiely of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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