



Digital Front End for Wide-Band VLBI Science Receiver

An upgrade to the very-long-baseline-interferometry (VLBI) science receiver (VSR) — a radio receiver used in NASA's Deep Space Network (DSN) — is currently being implemented. The current VSR samples standard DSN intermediate-frequency (IF) signals at 256 MHz and after digital down-conversion records data from up to four 16-MHz baseband channels. Currently, IF signals are limited to the 265-to-375-MHz range, and recording rates are limited to less than 80 Mbps. The new digital front end, denoted the Wideband VSR, provides improvements to enable the receiver to process wider bandwidth signals and accommodate more data channels for recording. The Wideband VSR utilizes state-of-the-art commercial analog-to-digital converter and field-programmable gate array (FPGA) integrated circuits, and fiber-optic connections in a custom architecture. It accepts IF signals from 100 to 600 MHz, sampling the signal at 1.28 GHz. The sample data are sent to a digital processing module, using a fiber-optic link for isolation. The digital processing module includes boards designed around an Advanced Telecom Computing Architecture (ATCA) industry-standard backplane. Digital signal processing implemented in FPGAs down-convert the data signals in up to 16 baseband channels with programmable bandwidths from 1 kHz to 16 MHz. Baseband samples are transmitted to a computer via multiple Ethernet connections allowing recording to disk at rates of up to 1 Gbps.

This work was done by Andre Jongeling, Elliott Sigman, Robert Navarro, Charles Goodhart, Steve Rogstad, Kumar Chandra, Sue Finley, Joseph Trinh, Melissa Soriano, Les White, and Robert Proctor of Caltech and Benno Rayhrer (contractor) for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). . NPO-41191

Multifunctional Tanks for Spacecraft

A document discusses multifunctional tanks as means to integrate additional structural and functional efficiencies

into designs of spacecraft. Whereas spacecraft tanks are traditionally designed primarily to store fluids and only secondarily to provide other benefits, multifunctional tanks are designed to simultaneously provide multiple primary benefits. In addition to one or more chamber(s) for storage of fluids, a multifunctional tank could provide any or all of the following:

- Passageways for transferring the fluids;
- Part or all of the primary structure of a spacecraft;
- All or part of an enclosure;
- Mechanical interfaces to components, subsystems, and/or systems;
- Paths and surfaces for transferring heat;
- Shielding against space radiation;
- Shielding against electromagnetic interference;
- Electrically conductive paths and surfaces; and
- Shades and baffles to protect against sunlight and/or other undesired light.

Many different multifunctional-tank designs are conceivable. The design of a particular tank can be tailored to the requirements for the spacecraft in which the tank is to be installed. For example, the walls of the tank can be flat or curved or have more complicated shapes, and the tank can include an internal structure for strengthening the tank and/or other uses.

This work was done by David H. Collins, Joseph C. Lewis, and Paul D. MacNeal of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-41407

Lightweight, Segmented, Mostly Silicon Telescope Mirror

A document presents the concept of a curved telescope primary reflector structure, made mostly of silicon, that would have an areal mass density $\leq 1 \text{ kg/m}^2$ and would be deployed in outer space, where it would be operated at a temperature in the cryogenic range. The concept provides for adjustment of the shape of the mirror to maintain the required precise optical surface figure despite the flexibility inherent in the ultra-lightweight design. The structure would include a thin mirror layer divided into hexagonal seg-

ments supported by flexure hinges on a lightweight two-layer backing structure. Each segment would also be supported at three points by sets of piezoelectric linear microactuators that could impose small displacements along the optical axis. The excitations applied to the aforementioned microactuators would be chosen to effect fine adjustments of the axial positions and the orientations of the segments relative to the supporting structure. Other piezoelectric linear microactuators embedded in the backing structure would enable control of the displacements of the segments along the hexagonal axes; they would also enable control of the curvature of the backing structure and, thus, additional control of the curvature of the reflector.

This work was done by Eui-Hyeok Yang of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-42106

Assistant for Analyzing Tropical-Rain-Mapping Radar Data

A document is defined that describes an approach for a Tropical Rain Mapping Radar Data System (TDS). TDS is composed of software and hardware elements incorporating a two-frequency spaceborne radar system for measuring tropical precipitation. The TDS would be used primarily in generating data products for scientific investigations. The most novel part of the TDS would be expert-system software to aid in the selection of algorithms for converting raw radar-return data into such primary observables as rain rate, path-integrated rain rate, and surface backscatter. The expert-system approach would address the issue that selection of algorithms for processing the data requires a significant amount of preprocessing, non-intuitive reasoning, and heuristic application, making it infeasible, in many cases, to select the proper algorithm in real time. In the TDS, tentative selections would be made to enable conversions in real time. The expert system would remove straightforwardly convertible data from further consideration, and would examine ambiguous data, performing analysis in depth to determine which algorithms to select. Conversions per-

formed by these algorithms, presumed to be correct, would be compared with the corresponding real-time conversions. Incorrect real-time conversions would be updated using the correct conversions.

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

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-42515.



Anion-Intercalating Cathodes for High-Energy-Density Cells

A report discusses physicochemical issues affecting a fluoride-intercalating cathode that operates in conjunction

with a lithium ion-intercalating anode in a rechargeable electrochemical cell described in a cited prior report. The instant report also discusses corresponding innovations made in solvent and electrolyte compositions since the prior report. The advantages of this cell, relative to other lithium-ion-based cells, are said to be greater potential (5 V vs. 4 V), and greater theoretical cathode specific capacity (0.9 to 2.2 A-h/g vs. about 0.18 A-h/g). The discussion addresses a need for the solvent to be unreactive toward the lithium anode and to resist anodic oxidation at potentials greater than about 4.5 V vs. lithium; the pertinent innovation is the selection of propylene carbonate (PC) as a solvent having significantly more stability, relative to other solvents that have been tried. The discussion also addresses the need for an electrolyte additive, denoted an anion receptor, to complex the fluoride ion;

the pertinent innovation is the selection of tris(hexafluoroisopropyl) borate as a superior alternative to the prior anion receptor, which was tris(pentafluorophenyl) borate.

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

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

*Innovative Technology Assets Management
JPL*

Mail Stop 202-233

4800 Oak Grove Drive

Pasadena, CA 91109-8099

(818) 354-2240

E-mail: iaoffice@jpl.nasa.gov

Refer to NPO-42316, volume and number of this NASA Tech Briefs issue, and the page number.