Test Waveform Applications for JPL STRS Operating Environment

NASA's Jet Propulsion Laboratory, Pasadena, California

This software demonstrates use of the JPL Space Telecommunications Radio System (STRS) Operating Environment (OE), tests APIs (application programming interfaces) presented by JPL STRS OE, and allows for basic testing of the underlying hardware platform. This software uses the JPL STRS Operating Environment ["JPL Space Telecommunications Radio System Operating Environment," (NPO-4776) *NASA Tech Briefs*, commercial edition, Vol. 37, No. 1 (January 2013), p. 47] to interact with the JPL-SDR Software Defined Radio developed for the CoNNeCT (COmmunications, Navigation, and Networking rEconfigurable Testbed) Project as part of the SCaN Testbed installed on the International Space Station (ISS). These are the first applications that are compliant with the new NASA STRS Architecture Standard.

Several example waveform applications are provided to demonstrate use of the JPL STRS OE for the JPL-SDR platform used for the CoNNeCT Project. The waveforms provide a simple digitizer and playback capability for the S-Band RF slice, and a simple digitizer for the GPS slice ["CoNNeCT Global Positioning System RF Module," (NPO-47764) *NASA Tech Briefs*, commercial edition, Vol. 36, No. 3 (March 2012), p. 36]. These waveforms may be used for hardware test, as well as for on-orbit or laboratory checkout.

Additional example waveforms implement SpaceWire and timer modules, which can be used for time transfer and demonstration of communication between the two Xilinx FPGAs in the JPL-SDR. The waveforms are also compatible with ground-based use of the JPL STRS OE on radio breadboards and Linux.

This work was done by James P. Lux, Kenneth J. Peters, Gregory H. Taylor, Minh Lang, Ryan A. Stern, and Courtney B. Duncan of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

This software is available for commercial licensing. Please contact Dan Broderick at Daniel.F.Broderick@jpl.nasa.gov. Refer to NPO-48028.

Pneumatic Proboscis Heat-Flow Probe

Applications include measuring heat flow in areas on Earth where optimal thermal isolation of heaters/temperature sensors is of paramount importance.

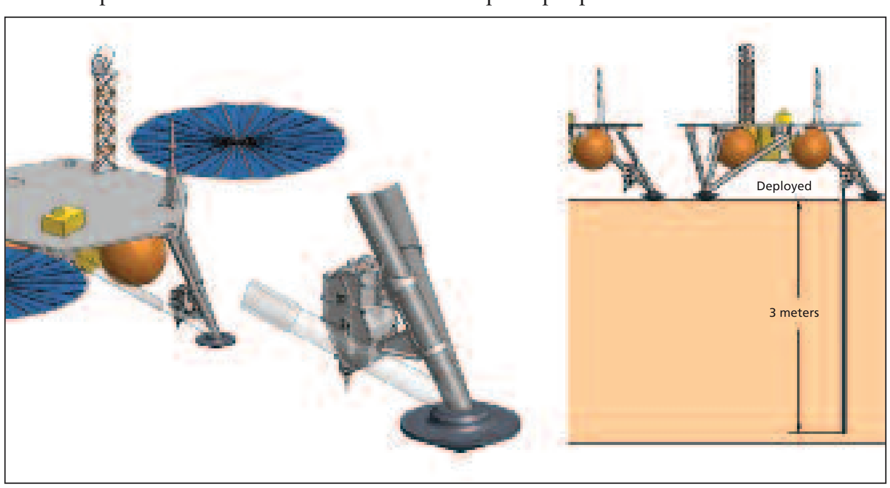
Marshall Space Flight Center, Alabama

Heat flow is a fundamental property of a planet, and provides significant constraints on the abundance of radiogenic isotopes, the thermal evolution and differentiation history, and the mechanical properties of the lithosphere. Heat-flow measurements are also essential in achieving at least four of the goals set out by the National Research Council for future lunar exploration. The heat-flow probe therefore directly addresses the goal of the Lunar Geophysical Network, which is to understand the interior structure and composition of the Moon.

A key challenge for heat flow measurement is to install thermal sensors to the depths ≈3 m that are not influenced by the diurnal, annual, and longer-term fluctuations of the surface thermal environment. In addition, once deployed, the heat flow probe should cause little disturbance to the thermal regime of the surrounding regolith.

A heat-flow probe system was developed that has two novel features: (1) it utilizes a pneumatic (gas) approach, excavates a hole by lofting the lunar soil out of the hole, and (2) deploys the heat flow probe, which utilizes a coiled up tape as a thermal probe to reach >3-meter depth.

The system is a game-changer for small lunar landers as it exhibits extremely low mass, volume, and simple deployment. The pneumatic system takes advantage of the helium gas used for pressurizing liquid propellant of the lander. Nor-



The **Next-Generation Heat Flow Probe Concept**. At left, the conceptual design of the heat flow probe mounted on the spacecraft landing system; at right, deployment of the heat flow probe.

mally, helium is vented once the lander is on the surface, but it can be utilized for powering pneumatic systems. Should sufficient helium not be available, a simple gas delivery system may be taken specifically for the heat flow probe. Either way, the pneumatic heat flow probe system would be much lighter than other systems that entirely rely on the electrical power of the lander.

This work was done by Kris Zacny, Magnus Hedlund, Eric Mumm, Jeffrey Shasho, Philip Chu, and Nishant Kumar of Honeybee Robotics Ltd. for Marshall Space Flight Center. For more information, contact Sammy Nabors, MSFC Commercialization Assistance Lead, at sammy.a.nabors@nasa.gov. Refer to MFS-32935-1.

Method to Measure Total Noise Temperature of a Wireless Receiver During Operation

NASA's Jet Propulsion Laboratory, Pasadena, California

A method has been developed to measure the total effective noise power in a GPS receiver, including contributions from the system temperature, the antenna temperature, interference, lossy components, etc. A known level of noise is periodically injected before the preamplifier during normal tracking, with a switch set to a very low duty cycle, so that there is insignificant signal loss for the GPS signals being tracked. Alternately, a signal of known power may be injected.

The coupling port is fed with a switch that can be controlled from the receiver's digital processing section. The switch can connect the coupling port to a noise or signal source at a known power level. The combined system noise is measured, and nearly continuous noise calibrations are made. The effect from injected noise/signals on the performance of the GPS receiver can be less than 0.01 dB of SNR loss. Minimal additional components are required. The GPS receiver is used to measure the SNRs required to solve for the noise level. Because this measurement is referenced to the preamplifier input, it is insensitive to variations in the receiver gain.

This work was done by Lawrence E. Young, Stephan Esterhuizen, and Dmitry Turbiner 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:

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Refer to NPO-47818, volume and number of this NASA Tech Briefs *issue, and the page number.*

Cursor Control Device Test Battery

A suite of software-based tasks can be used for the study of cursor control devices, gloved operations, and fine motor control.

Lyndon B. Johnson Space Center, Houston, Texas

The test battery was developed to provide a standard procedure for cursor control device evaluation. The software was built in Visual Basic and consists of nine tasks and a main menu that integrates the set-up of the tasks. The tasks can be used individually, or in a series defined in the main menu.

Task 1, the Unidirectional Pointing Task, tests the speed and accuracy of clicking on targets. Two rectangles with an adjustable width and adjustable center-to-center distance are presented. The task is to click back and forth between the two rectangles. Clicks outside of the rectangles are recorded as errors.

Task 2, Multidirectional Pointing Task, measures speed and accuracy of clicking on targets approached from different angles. Twenty-five numbered squares of adjustable width are arranged around an adjustable diameter circle. The task is to point and click on the numbered squares (placed on opposite sides of the circle) in consecutive order. Clicks outside of the squares are recorded as errors.

Task 3, Unidirectional (horizontal) Dragging Task, is similar to dragging a file into a folder on a computer desktop. Task 3 requires dragging a square of adjustable width from one rectangle and dropping it into another. The width of each rectangle is adjustable, as well as the distance between the two rectangles. Dropping the square outside of the rectangles is recorded as an error.

Task 4, Unidirectional Path Following, is similar to Task 3. The task is to drag a square through a tunnel consisting of two lines. The size of the square and the width of the tunnel are adjustable. If the square touches any of the lines, it is counted as an error and the task is restarted.

Task 5, Text Selection, involves clicking on a Start button, and then moving directly to the underlined portion of the displayed text and highlighting it. The pointing distance to the text is adjustable, as well as the to-be-selected font size and the underlined character length. If the selection does not include all of the underlined characters, or includes non-underlined characters, it is recorded as an error.

Task 6, Multi-size and Multi-distance Pointing, presents the participant with 24 consecutively numbered buttons of different sizes (63 to 163 pixels), and at different distances (60 to 80 pixels) from the Start button. The task is to click on the Start button, and then move directly to, and click on, each numbered target button in consecutive order. Clicks outside of the target area are errors.

Task 7, Standard Interface Elements Task, involves interacting with standard interface elements as instructed in written procedures, including: drop-down