Books & Reports

Graphite Composite Booms With Integral Hinges

A document discusses lightweight instrument booms under development for use aboard spacecraft. A boom of this type comprises a thin-walled graphite-fiber/matrix composite tube with an integral hinge that can be bent for stowage and later allowed to spring back to straighten the boom for deployment in outer space. The boom design takes advantage of both the stiffness of the composite in tubular geometry and the flexibility of thin sections of the composite. The hinge is formed by machining windows in the tube at diametrically opposite locations so that there remain two opposing cylindrical strips resembling measuring tapes. Essential to the design is a proprietary composite layup that renders the hinge tough yet flexible enough to be bendable as much as 90° in either of two opposite directions. When the boom is released for deployment, the torque exerted by the bent hinge suffices to overcome parasitic resistance from harnesses and other equipment, so that the two sections of the hinge snap to a straight, rigid condition in the same manner as that of measuring tapes. Issues addressed in development thus far include selection of materials, out-of-plane bending, edge cracking, and separation of plies.

This work was done by Wes Alexander, Rene Carlos, Peter Rossoni, and James Sturm of **Goddard Space Flight Center**. *Further information is contained in a TSP (see page 1).* GSC-14896-1

Tool for Sampling Permafrost on a Remote Planet

A report discusses the robotic arm tool for rapidly acquiring permafrost (RATRAP), which is being developed for acquiring samples of permafrost on Mars or another remote planet and immediately delivering the samples to adjacent instruments for analysis. The prototype RATRAP includes a rasp that protrudes through a hole in the bottom of a container that is placed in contact with the permafrost surface. Moving at high speed, the rasp cuts into the surface and loads many of the resulting small particles of permafrost through the hole into the container. The prototype RATRAP has been shown to be capable of acquiring many grams of permafrost simulants in times of the order of seconds. In contrast, a current permafrost-sampling system that the RATRAP is intended to supplant works by scraping with tines followed by picking up the scrapings in a scoop, sometimes taking hours to acquire a few grams. Also, because the RATRAP inherently pulverizes the sampled material, it is an attractive alternative to other sampling apparatuses that generate core or chunk samples that must be further processed by a crushing apparatus to make the sample particles small enough for analysis by some instruments.

This work was done by Gregory Peters of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).* NPO-43128

Special Semaphore Scheme for UHF Spacecraft Communications

A semaphore scheme has been devised to satisfy a requirement to enable ultra-high-frequency (UHF) radio communication between a spacecraft descending from orbit to a landing on Mars and a spacecraft, in orbit about Mars, that relays communications between Earth and the lander spacecraft. There are also two subsidiary requirements: (1) to use UHF transceivers, built and qualified for operation aboard the spacecraft that operate with residual-carrier binary phase-shift-keying (BPSK) modulation at a selectable data rate of 8, 32, 128, or 256 kb/s; and (2) to enable low-rate signaling even when received signals become so weak as to prevent communication at the minimum BPSK rate of 8 kHz. The scheme involves exploitation of Manchester encoding, which is used in conjunction with residual-carrier modulation to aid the carrier-tracking loop. By choosing various sequences of 1s, 0s, or 1s alternating with 0s to be fed to the residual-carrier modulator, one would cause the modulator to generate sidebands at a fundamental frequency of 4 or 8 kHz and harmonics thereof. These sidebands would constitute the desired semaphores. In reception, the semaphores would be detected by a software demodulator.

This work was done by Stanley Butman, Edgar Satorius, and Peter Ilott of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).* NPO-42910