Radio Ranging System for Guidance of Approaching Spacecraft
Lyndon B. Johnson Space Center, Houston, Texas

A radio communication and ranging system has been proposed for determining the relative position and orientations of two approaching spacecraft to provide guidance for docking maneuvers. On Earth, the system could be used similarly for guiding approaching aircraft and for automated positioning of large, heavy objects. In principle, the basic idea is to (1) measure distances between radio transceivers on the two spacecraft and (2) compute the relative position and orientations from the measured distances. Half-duplex communication links would be established between transceivers on the two spacecraft, and pulses having durations of the order of a nanosecond would be exchanged. The distances would be determined by the pulse-time-of-flight method. Data signals could be transmitted in addition to ranging pulses.

This work was done by Vikram Manikonda and Eric van Doorn of Intelligent Automation, Inc. for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-23474-1.

Electromagnetically Clean Solar Arrays
Cells are laminated with shielding, narrow-current-loop wiring, and structural supports.
John H. Glenn Research Center, Cleveland, Ohio

The term “electromagnetically clean solar array” (“EMCSA”) refers to a panel that contains a planar array of solar photovoltaic cells and that, in comparison with a functionally equivalent solar-array panel of a type heretofore used on spacecraft, (1) exhibits less electromagnetic interference to and from other nearby electrical and electronic equipment and (2) can be manufactured at lower cost. The reduction of electromagnetic interference is effected through a combination of (1) electrically conductive, electrically grounded shielding and (2) reduction of areas of current loops (in order to reduce magnetic moments). The reduction of cost is effected by designing the array to be fabricated as a more nearly unitary structure, using fewer components and fewer process steps. Although EMSCAs were conceived primarily for use on spacecraft, they are also potentially advantageous for terrestrial applications in which there are requirements to limit electromagnetic interference.

In a conventional solar panel of the type meant to be supplanted by an EMCSA panel, the wiring is normally located on the back side, separated from the cells, thereby giving rise to current loops having significant areas and, consequently, significant magnetic moments. Current-loop geometries are chosen in an effort to balance opposing magnetic moments to limit far-field magnetic interactions, but the relatively large distances separating current loops makes full cancellation of magnetic fields problematic. The panel is assembled from bare photovoltaic cells by means of multiple sensitive process steps that contribute significantly to cost, especially if electromagnetic cleanliness is desired. The steps include applying a cover glass and electrical-interconnection tabs to each cell to create a cell-interconnect-cell (CIC) subassembly, connecting the CIC subassemblies into strings of series-connected cells, laying down and adhesively bonding the strings onto a panel structure that has been made in a separate multi-step process, and mounting the wiring on the back of the panel. Each step increases the potential for occurrence of latent defects, loss of process control, and attrition of components.

An EMCSA panel includes an integral cover made from a transparent silicone material. The silicone cover supplants the individual cover glasses on the cells and serves as an additional unitary structural support that offers the advantage, relative