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Rendezvous Radar for the Orbital Maneuvering Vehicle

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The Rendezvous Radar Set (RRS) was designed at Motorola's Strategic Electronics Division in Chandler, Arizona, to be a key subsystem aboard NASA's Orbital Maneuvering Vehicle (OMV). The unmanned OMV, which was under development at TRW's Federal Systems Division in Redondo Beach, California, was designed to supplement the Shuttle's satellite delivery, retrieval, and maneuvering activities. The RRS was to be used to locate and then provide the OMV with vectoring information to the target satellite (or Shuttle or Space Station) to aid the OMV in making a minimum fuel consumption approach and rendezvous. The OMV development program was halted by NASA in 1990 just as parts were being ordered for the RRS engineering model. The paper presented describes the RRS design and then discusses new technologies, either under development or planned for development at Motorola, that can be applied to radar or alternative sensor solutions for the Automated Rendezvous and Capture problem.

The RRS is an X-Band all solid-state, monopulse tracking, frequency-hopping, pulse-Doppler radar system. One square meter targets are detected at ranges greater than 4.5 nautical miles and larger targets are detected at up to 10 nautical miles. The target is then tracked in angle, range, and range rate to a range of 35 feet from the OMV. Three-sigma measurement performance of <0.1 fps velocity error and <10 ft range error during target track are features of the design. Efficient Gallium Arsenide FET devices for the RF stages and low-power CMOS technology for the digital signal and data processing functions are used extensively to minimize power consumption. To assure mission reliability high-reliability parts are used throughout and the RRS is electrically redundant. Single event upset (SEU) effects have been addressed at both system and circuit levels in the design.

The weight of the electrically redundant system was estimated at 90 pounds, of which 40 pounds was contributed by the antenna, gimbals, motors, etc., leaving 50 pounds for the electronics. Recent progress at Motorola in the infusion of commercial technologies and modern packaging into space systems, promises substantial reductions in size, weight, and cost compared to traditional space hardware designs. Small satellite programs such as Motorola's IRIDIUM space-based personal communications system are developing new packaging approaches for both microwave and digital space-based hardware that could be applied to benefit programs like the RRS. Examples include the use of digital multi-chip modules that would reduce the RRS processor weight by over 70% and MMIC microwave modules that could nearly eliminate critical alignment and tuning procedures (and thus reduce cost and risk) during production.

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A Berthing and Fastening Strategy for Orbital Replacement Units

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A summary of the GSFC applied research effort in robotic berthing is provided. The summary includes several demonstrations and experimental highlights illustrated on video. Two GSFC developments are central to the research, the "Capaciflector" sensor and the "Spline-Locking" Screw fastener.

The Capaciflector is an outstanding close-in complement to vision sensing and is central to collision avoidance, alignment, and precontact and contact control. Its suitability for use in space

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