entation of the rocket change between image frames, the algorithm calculates the corresponding new georeferenced position and orientation data and the associated transformation parameters.

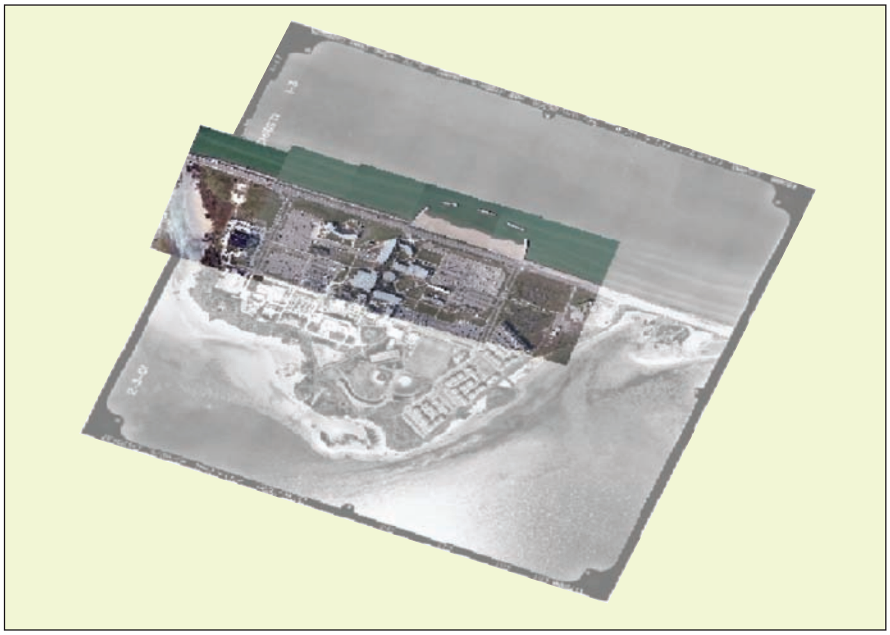
The output imagery can be rendered in any of a variety of formats. The figure presents an example of one such format.

This work was done by Stacey D. Lyle of Conrad Blucher Institute for Surveying and Science at Texas A&M University—Corpus Christi for **Stennis Space Center**.

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:

Texas A&M — Corpus Christi
6300 Ocean Dr.
Corpus Christi, Texas 78412
Phone No.: (361) 825-3712
E-mail: slyle@falcon.tamucc.edu

Refer to SSC-00214-1, volume and number of this NASA Tech Briefs *issue, and the page number.*



A **Digitized, Transformed Image** acquired from a video camera aboard a rocket was superimposed on a scan of an aerial image of a larger area that contains most of the video-image scene.

SiC Multi-Chip Power Modules as Power-System Building Blocks

Fault-tolerant power-supply systems could be constructed and expanded relatively inexpensively.

John H. Glenn Research Center, Cleveland, Ohio

The term “SiC MCPMs” (wherein “MCPM” signifies “multi-chip power module”) denotes electronic power-supply modules containing multiple silicon carbide power devices and silicon-on-insulator (SOI) control integrated-circuit chips. SiC MCPMs are being developed as building blocks of advanced expandable, reconfigurable, fault-tolerant power-supply systems. Exploiting the ability of SiC semiconductor devices to operate at temperatures, breakdown voltages, and current densities significantly greater than those of conventional Si devices, the designs of SiC MCPMs and of systems comprising multiple SiC MCPMs are expected to afford a greater degree of miniaturization through stacking of modules with reduced requirements for heat sinking. Moreover, the higher-temperature capabilities of SiC MCPMs could enable operation in environments hotter than Si-based power systems can withstand.

The stacked SiC MCPMs in a given system can be electrically connected in series, parallel, or a series/parallel combination to increase the overall power-handling capability of the system. In addition to power connections, the modules have communication connections. The SOI controllers in the modules communicate with each other as nodes of a decentralized control network, in which no single controller exerts overall command of the system. Control functions effected via the network include synchronization of switching of power devices and rapid reconfiguration of power connections to enable the power system to continue to supply power to a load in the event of failure of one of the modules.

In addition to serving as building blocks of reliable power-supply systems, SiC MCPMs could be augmented with external control circuitry to make them perform additional power-handling functions as needed for specific applications: typical functions could include regulating voltages, storing energy, and driving motors. Because identical SiC MCPM building blocks could be utilized in a variety of ways, the cost and difficulty of designing new, highly reliable power systems would be reduced considerably.

Several prototype DC-to-DC power-converter modules containing SiC power-switching devices were designed and built to demonstrate the feasibility of the SiC MCPM concept. In anticipation of a future need for operation at high temperature, the circuitry in the modules includes high-temperature inductors and capacitors. These modules were designed to be stacked to construct a system of four modules electrically connected in series and/or parallel.

The packaging of the modules is designed to satisfy requirements for series and parallel interconnection among modules, high power density, high thermal efficiency, small size, and light weight. Each module includes four output power connectors — two for serial and two for parallel output power connections among the modules. Each module also includes two signal connectors, electrically isolated from the power connectors, that afford four zones for signal interconnections among the SOI controllers. Finally, each module includes two input power connectors, through which it receives power from an in-line power bus. This design feature is included in anticipation of a custom-designed power bus incorporating sockets compatible with “snap-on” type connectors to enable rapid replacement of failed modules.

The distributed control hardware and software enable power conversion to continue uninterrupted when as many as two modules fail. Essential to distributed control is an arbitrated, shared communication bus. The arbitration protocol enables asynchronous bidirectional messaging without concern for data collisions and loss of messages. In tests of the four-module system in which failures of as many as two modules were simulated, measurement results showed that the system reconfigured itself rapidly enough in response to the failures to continue delivering power to a load without interruption and with minimum output-voltage sag. The transient time associated with a failure was found to be <5 ms, of which <350 μs was consumed by software and the rest was consumed by operation of bypass relays.

This work was done by Alexander Lostetter and Steven Franks of Arkansas Power Electronics International, Inc. for **Glenn Research Center**.

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18008-1.