conditions. More specifically, this system processes RTSS image data, by use of advanced algorithms, to predict trends in visibility. The image data are acquired, stored, and processed at 15-minute intervals. The processing of the data yields 15-minute updates of a visibility-versus-time plot, on which visibility is quantified on a suggested scale of 0 to 1.

This work was done by David A. Maluf, Yuri Gawdiak, Christopher Leidichj, and Richard Papasin of **Ames Research Center** *and Peter B. Tran and Kevin Bass of QSS Group, Inc. Further information is contained in a TSP (see page 1).*

Inquiries concerning rights for the commercial use of this invention should be addressed to the Ames Technology Partnerships Division at (650) 604-2954. Refer to ARC-15029-1.

Implantable Wireless MEMS Sensors for Medical Uses

Integrated Sensing Systems, Inc., Ypsilanti, Michigan

Sensors designed and fabricated according to the principles of microelectromechanical systems (MEMS) are being developed for several medical applications in outer space and on Earth. The designs of these sensors are based on a core design family of pressure sensors, small enough to fit into the eye of a needle, that are fabricated by a "dissolved wafer" process. The sensors are expected to be implantable, batteryless, and wireless. They would be both powered and interrogated by hand-held radio transceivers from distances up to about 6 in. (about 15 cm). One type of sensor would be used to measure blood pressure, particularly for congestive heart failure. Another type would be used to monitor fluids in patients who have hydrocephalus (high brain pressure). Still other types would be used to detect errors in delivery of drugs and to help patients having congestive heart failure.

This work was directed by Alexander Chimbayo of **Integrated Sensing Systems, Inc.** *under a NASA Small Business Innovation Research (SBIR) contract monitored by* **Langley Research Center**. *For further information, contact:*

Dr. Alexander Chimbayo
Integrated Sensing Systems, Inc.
391 Airport Industrial Drive
Ypsilanti, MI 48198
Phone No.: (734) 547-9896 Ext. 116
E-mail: alec@mems-issys.com

Refer to SBIR-0010, volume and number of this NASA Tech Briefs *issue, and the page number.*

Embedded Sensors for Measuring Surface Regression

Electrical-resistance measurements are translated into real-time material thickness and surface regression data for hybrid fuels, solid propellants, and ablative materials.

Stennis Space Center, Mississippi

The development and evaluation of new hybrid and solid rocket motors requires accurate characterization of the propellant surface regression as a function of key operational parameters. These characteristics establish the propellant flow rate and are prime design drivers affecting the propulsion system geometry, size, and overall performance. There is a similar need for the development of advanced ablative materials, and the use of conventional ablatives exposed to new operational environments. The Miniature Surface Regression Sensor (MSRS) was developed to serve these applications. It is designed to be cast or embedded in the material of interest and regresses along with it. During this process, the resistance of the sensor is related to its instantaneous length, allowing the real-time thickness of the host material to be established. The time derivative of this data reveals the instantaneous surface regression rate.

The MSRS could also be adapted to perform similar measurements for a variety of other host materials when it is desired to monitor thicknesses and/or regression rate for purposes of safety, operational control, or research. For example, the sensor could be used to monitor the thicknesses of brake linings or racecar tires and indicate when they need to be replaced. At the time of this reporting, over 200 of these sensors have been installed into a variety of host materials.

An MSRS can be made in either of two configurations, denoted "ladder" and "continuous" (see Figure 1). A ladder MSRS includes two highly electrically conductive legs, across which narrow strips of electrically resistive material are placed at small increments of length. These strips resemble the rungs of a ladder and are electrically equivalent to many tiny resistors connected in parallel. A substrate material provides structural support for the legs and rungs. The instantaneous sensor resistance is read by an external signal conditioner via wires attached to the conductive legs on the non-eroding end of the sensor. The sensor signal can be transmitted from inside a high-pressure chamber to the ambient environment, using commercially available feedthrough connectors. Miniaturized internal recorders or wireless data transmission could also potentially be employed to eliminate the need for producing penetrations in the chamber case.

The rungs are designed so that as each successive rung is eroded away, the resistance changes by an amount that yields a readily measurable signal larger than the background noise. (In addition, signal-conditioning techniques are used in processing the resistance readings to mitigate the effect of noise.) Hence, each discrete change of resistance serves to indicate the arrival of the regressing host material front at the known depth of the affected resistor rung. The average rate of regression between two adjacent resis-