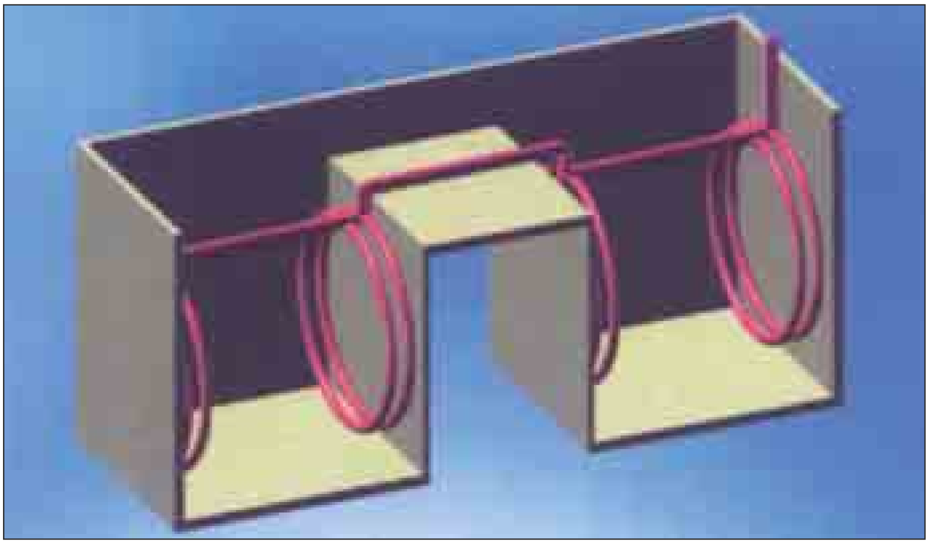

The **Middle-Loop Sensing Gradiometer** concept shows a schematic illustration of cryostat wall geometry (cut-off view). The imaging volume is in between two middle loops, outside the cryostat at room temperature.

comes the imaging volume with the enclosing cryostat built accordingly.

Because of the sensing middle loops at both ends of the imaging volume, the sensitivity at the center of the imaging volume is twice that of conventional geometry with the same SQUID noise. Only about half of the induced energy is lost in the non-sensing loops in the new scheme. The symmetric placement of the sensing loops gives more uniform sensitivity. There is no inductance matching penalty associated with the new configuration, because the geometry and the inductance remain to be that of a single second-order gradiometer.

This work was done by Konstantin Penanen, Inseob Hahn, and Byeong Ho Eom of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

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:

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Refer to NPO-45720, volume and number of this NASA Tech Briefs *issue, and the page number.*

Volcano Monitor: Autonomous Triggering of *In-Situ* Sensors

NASA's Jet Propulsion Laboratory, Pasadena, California

In-situ sensors near volcanoes would be alerted by the Earth Observing-1 (EO-1) craft to take more frequent data readings. This project involves developing a sulfur-dioxide-sensing volcano monitor that will be able to transmit its readings through an Iridium modem. The monitor, when integrated into the Sensor Web network, will demonstrate the autonomous capabilities of the Sensor Web, as well as the speed and accuracy of the network. A potential scenario might involve an Earth-based sensor near the volcano, such as a tilt meter or a seismometer, encountering a critical reading. This particular sensor could alert EO-1, which could then look for other sensors in the area. It would then send an alert message down to the Volcano Monitoring Box, which would increase the frequency of its readings from once an hour to once a minute. All these data would then be collected on a Web site that is accessible by volcanologists and other scientists. A typical data reading will include a date, time, temperature reading, humidity reading, and sulfur dioxide reading.

By using the speed and ease with which EO-1 transmits data, information about volcanic activity can be collected quickly and autonomously. In better understanding the volcanoes of Earth, this technology will enable better study and understanding of volcanoes on other moons and planets as NASA sends unmanned vehicles to farther regions of space.

This work was done by Kate Boudreau of University of Idaho, Johanna Cecava of New Mexico State University, and Alberto Behar, Ashley Davies, and Daniel Q. Tran of Caltech for NASA's Jet Propulsion Laboratory. For more information, contact iaoffice@jpl.nasa.gov. NPO-45445

Wireless Fluid-Level Sensors for Harsh Environments

Sensors can be encased for protection, and are interrogated without wire connections.

Langley Research Center, Hampton, Virginia

Magnetic-field-response sensors have been developed for use in measuring levels of fluids under extreme conditions. The sensors work without wire connections or direct physical contact with power sources, microprocessors, data-acquisition equipment, or electrical circuitry. For fuel-level sensors, the absence of wire connections offers an important safety advantage in elimination of potential ignition sources.

The sensors can be designed for

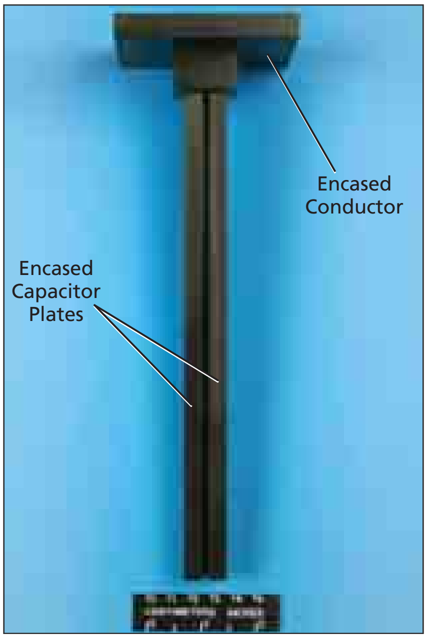

Figure 1. This **Liquid-Level Sensor** comprises two parallel capacitor plates and an inductor, all completely encased in poly(ethylene terephthalate) that has been formulated to afford protection against acids and similar harsh liquids.

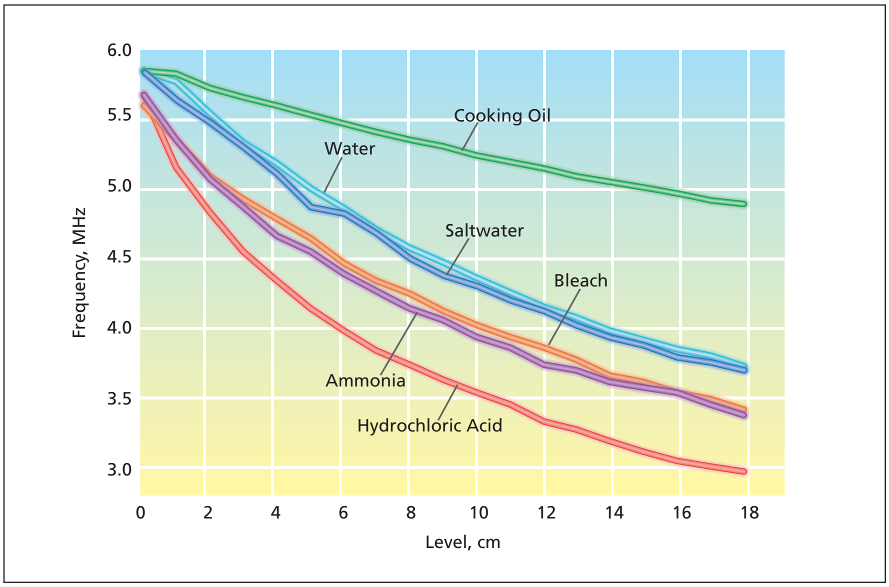

Figure 2. **Resonance Frequency vs. Liquid Level** was measured in experiments in which the sensor of Figure 1 was immersed in several different liquids.

measuring the levels of any fluids that can be stored in electrically nonconductive reservoirs. The sensors can readily be designed and built to withstand cryogenic, acidic, or caustic fluids: The sensor design and the method of powering and interrogating them makes it possible to completely encase the sensors in materials that can be chosen for their ability to endure, and to protect the sensor circuitry against, the harsh fluid environments.

A fluid-level sensor of this type contains a passive resonant circuit comprising an inductor and a pair of parallel capacitor plates, all encased in a material that protects them from the fluid environment (see Figure 1). When the sensor is mounted so that the parallel capacitor plates extend downward into a dielectric fluid, the capacitance increases, and thus resonance frequency of the circuit decreases, as the level of the liquid rises.

The sensor is interrogated by use of the system described in "Magnetic-Field-Response Measurement-Acquisition System" (LAR-16908), *NASA Tech Briefs*, Vol. 30, No. 6 (June 2006) page 28. To recapitulate: The system includes a transmitting/receiving antenna that is placed in proximity to the inductor. The system generates a series of increasing oscillating magnetic field harmonics that powers the sensors. Once powered, the sensors respond with their own oscillating magnetic fields. The system measures the response of the sensor circuitry to excitations at different frequencies to identify the resonance frequency. Hence, once calibration data of liquid level versus resonance frequency have been acquired (see Figure 2), the sensor can be used as a fluid-level sensor.

This work was done by Stanley E. Woodard of Langley Research Center and Bryant D. Taylor of Swales Aerospace. Further information is contained in a TSP (see page 1). LAR-17155