

Fast, High-Precision Readout Circuit for Detector Arrays

NASA's Jet Propulsion Laboratory, Pasadena, California

The GEO-CAPE mission described in NASA's Earth Science and Applications Decadal Survey requires high spatial, temporal, and spectral resolution measurements to monitor and characterize the rapidly changing chemistry of the troposphere over North and South Americas. High-frame-rate focal plane arrays (FPAs) with many pixels are needed to enable such measurements.

A high-throughput digital detector readout integrated circuit (ROIC) that meets the GEO-CAPE FPA needs has been developed, fabricated, and tested. The ROIC is based on an innovative charge integrating, fast, high-precision

analog-to-digital circuit that is built into each pixel. The 128×128-pixel ROIC digitizes all 16,384 pixels simultaneously at frame rates up to 16 kHz to provide a completely digital output on a single integrated circuit at an unprecedented rate of 262 million pixels per second. The approach eliminates the need for off focal plane electronics, greatly reducing volume, mass, and power compared to conventional FPA implementations. A focal plane based on this ROIC will require less than 2 W of power on a 1×1-cm integrated circuit.

The ROIC is fabricated of silicon using CMOS technology. It is designed

to be indium bump bonded to a variety of detector materials including silicon PIN diodes, indium antimonide (InSb), indium gallium arsenide (InGaAs), and mercury cadmium telluride (HgCdTe) detector arrays to provide coverage over a broad spectral range in the infrared, visible, and ultraviolet spectral ranges.

This work was done by David M. Rider, Bruce R. Hancock, Richard W. Key, Thomas J. Cunningham, Chris J. Wrigley, Suresh Shadri, Stanley P. Sander, and Jean-Francois L. Blavier of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47320

Victim Simulator for Victim Detection Radar

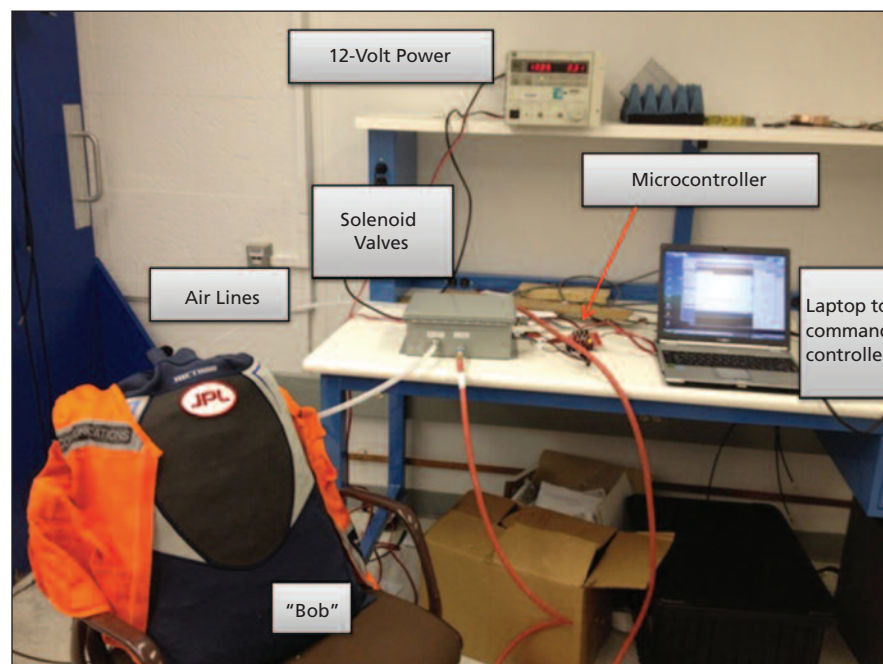
This simulator can be placed for long periods of time in environments that would be unsafe for a human subject.

NASA's Jet Propulsion Laboratory, Pasadena, California

Testing of victim detection radars has traditionally used human subjects who volunteer to be buried in, or climb into a space within, a rubble pile. This is not only uncomfortable, but can be hazardous or impractical when typical disaster scenarios are considered, including fire, mud, or liquid waste. Human subjects are also inconsistent from day to day (i.e., they do not have the same radar properties), so quantitative performance testing is difficult. Finally, testing a multiple-victim scenario is difficult and expensive because of the need for multiple human subjects who must all be coordinated.

The solution is an anthropomorphic dummy with dielectric properties that replicate those of a human, and that has motions comparable to human motions for breathing and heartbeat. Two air-filled bladders filled and drained by solenoid valves provide the underlying motion for vinyl bags filled with a dielectric gel with realistic properties. The entire assembly is contained within a neoprene wetsuit serving as a "skin." The solenoids are controlled by a microcontroller, which can generate a variety of heart and breathing patterns, as well as being reprogrammable for more complex activities.

Previous electromagnetic simulators or RF phantoms have been oriented to-



The Victim Simulation System ("Bob") uses two air-filled bladders sandwiched inside two bags full of a dielectric medium that replicates the properties of humans, within a modified wetsuit to serve as a "skin." An Arduino microcontroller with high-current drivers controls solenoid valves that fill and drain the bladders to simulate human breathing and heartbeat.

wards assessing RF safety, e.g., the measurement of specific absorption rate (SAR) from a cell phone signal, or to provide a calibration target for diagnostic techniques (e.g., MRI). They are optimized for precise dielectric perform-

ance, and are typically rigid and immovable. This device is movable and "positionable," and has motion that replicates the small-scale motion of humans. It is soft (much as human tissue is) and has programmable motions.