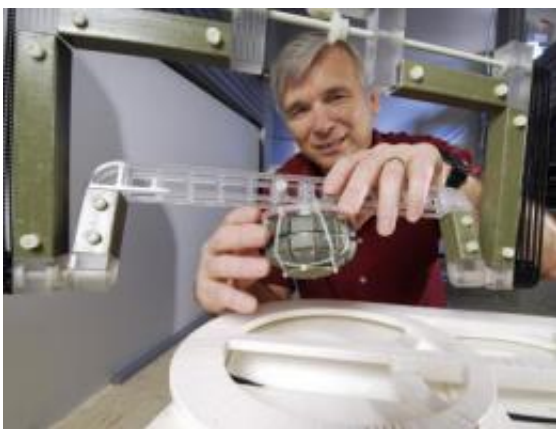


## New testing facility helps researchers improve land mine detection equipment

May 13 2009

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Georgia Tech Electrical and Computer Engineering professor Waymond Scott sets up an experiment in this new facility that will ultimately help researchers better discriminate between land mines and harmless metal objects. Credit: Georgia Tech Photo: Gary Meek

Researchers at the Georgia Institute of Technology have built a test facility to evaluate and enhance sensors designed to detect buried land mines. The unique automated system measures the response of individual electromagnetic induction sensors or arrays of sensors against land mines buried at many possible angles.

Electromagnetic induction sensors work by sending out magnetic fields and detecting the response from the [electric currents](#) generated when the field interacts with a metallic target. While simple versions of these

sensors are capable of detecting most land mines, advanced sensors are required to tell the difference between a land mine and harmless buried metal objects, which can include bottle tops, nails, shrapnel and spent bullets.

"We built this facility to aid in the development of advanced electromagnetic induction sensors and associated detection algorithms, mainly because little was known about how the signals collected by these sensors from land mines changed when the mines were buried underground at odd angles," said Waymond Scott, a professor in Georgia Tech's School of Electrical and Computer Engineering.

Scott and Gregg Larson, a senior research engineer in Georgia Tech's George W. Woodruff School of Mechanical Engineering, constructed the facility with funding from the U.S. Army and described it at the recent SPIE Defense, Security and Sensing Symposium.

The testing structure was built with five computer-controlled axes - three translational stages and two rotational stages - and one manual axis. During testing, an individual sensor or array of sensors is fixed in the middle of the measurement region while the rotational stages orient a target and move it along a prescribed path around the sensor.

For testing, the researchers place the sensor in the center of the area so that it is located as far as possible from any surrounding metal, including the floor that contains structural steel and the aluminum beams of the positioner frame. In the procedure used to measure individual targets, they also controlled for the response from the surrounding metal structures.

The system can collect measurements of typical targets, including shell casings, wire loops, ball bearings and land mines. The data from each target is plotted as response curves, which are a function of the metal

content and structure of the target and help discriminate a land mine from other metal buried in the ground. Previous field tests have shown that the shape of the response curves did not change when targets were buried at different depths, but the researchers wanted to know if the same was true for targets buried at different angles.

"This facility allows us to collect measurements of typical targets and clutter objects with respect to location and orientation, which would be very difficult to measure in the field due to the difficulty of accurately placing and rotating the target," said Scott.

At the symposium, the researchers presented data collected in the facility from three targets - a single wire loop, a composite target with three wire loops and a 9 millimeter shell casing. Their results with the single wire loop and shell casing showed that the shape of the response curve was the same for all of the rotation angles, but the amplitude of the response changed with rotation angle. The more complex three-loop target exhibited changes in the shape and amplitude of the curve when the rotation angle was modified.

The researchers plan to use these results to make improvements to the sensor hardware and processing algorithms. Future efforts in the experimental facility will focus on measuring more targets and investigating methods for summarizing the massive amounts of collected data into simple physical models. The researchers also plan to improve the processing algorithms to help characterize more complicated targets and refine the detection and discrimination methods for electromagnetic induction sensors.

Experiments conducted in the facility will ultimately help researchers better discriminate between land mines and harmless metal objects, which will lead to reduced false alarm rates.

"This facility will help us develop advanced electromagnetic induction sensors that are most effective and able to quickly, accurately and repetitively measure the response of a buried target," noted Scott.

Source: Georgia Institute of Technology

Citation: New testing facility helps researchers improve land mine detection equipment (2009, May 13) retrieved 2 April 2023 from <https://phys.org/news/2009-05-facility-equipment.html>

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