Stand Off Detection of Buried Anti-Personnel Landmines

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American Electronic, Inc. (Amelex) has introduced a new Synthetic Aperture Radar (SAR) waveform and system that is very small, lightweight, and low power. This system has the potential to be mounted on small UAV's and to be used for the airborne detection of buried landmines. Recent experiments have demonstrated excellent resolution (~6 inches) while simultaneously reducing the energy required for SAR imagery by –30 dB.

The system utilizes an ultrawideband (UWB) radar operating between 1-3 GHz and has demonstrated the ability to produce synthetic aperture radar (SAR) images of surface laid landmines using an experimental rail SAR setup at a stand off range of 30 feet.

The new picoswitching ultra wideband technology, implemented in the new system, has recently emerged from the commercial industry. Amelex has licensed a type of this new technology from the Time Domain Corporation of Huntsville, Alabama for the use in a new type of bistatic CW radar waveform. The prototype radar system is very small, 3" x 8" x 12" and is shown in Figure 1 below.

Figure 1

The prototype system uses a bistatic pair of small, 3" x 4", planar PCB mounted magnetic antennas. The antenna pair is shown in Figure 2.

The waveform consists of 10 MHz microwatt monocycle pulses that are dithered with a PRN code to flatten the frequency spectrum. The system operates between 1-3 GHz. The receiver utilizes a picosecond switching range gate that subdivides the received 500 picosecond pulse into 15 picosecond time intervals.

The radar prototype system is currently in operation and being used on a Rail SAR setup with a 24 foot rail mounted 22 feet above the ground. The look down angle is 45 degrees. The carriage used for the rail SAR carries both the radar system and the antennas. The carriage is shown in Figure 3.

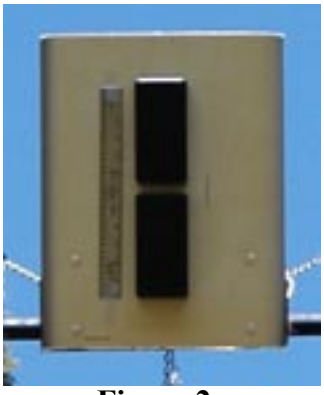

Figure 2

The unique function of this new system is the ability to accurately switch in picoseconds. This rapid switching capability has been implemented in the current prototype. The prototype has recently demonstrated range accuracy of 0.01 foot and range

resolution of 6 inches with milliwatts of power.

An example of the results of a recent experiment is shown in Figure 4. The target is a small calibrated 1 ft^2 sphere placed on the ground. The horizontal axis gives the positions in feet along the 24 foot rail at which data was taken. The vertical axis is the down range distance in feet.

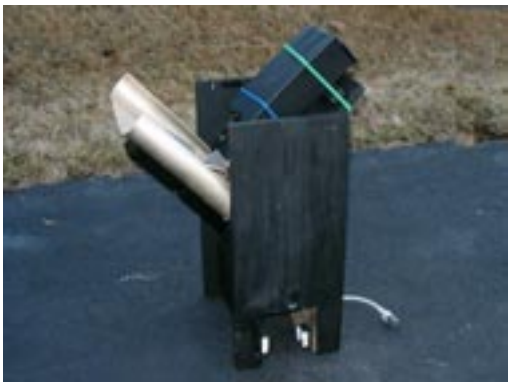

Figure 3

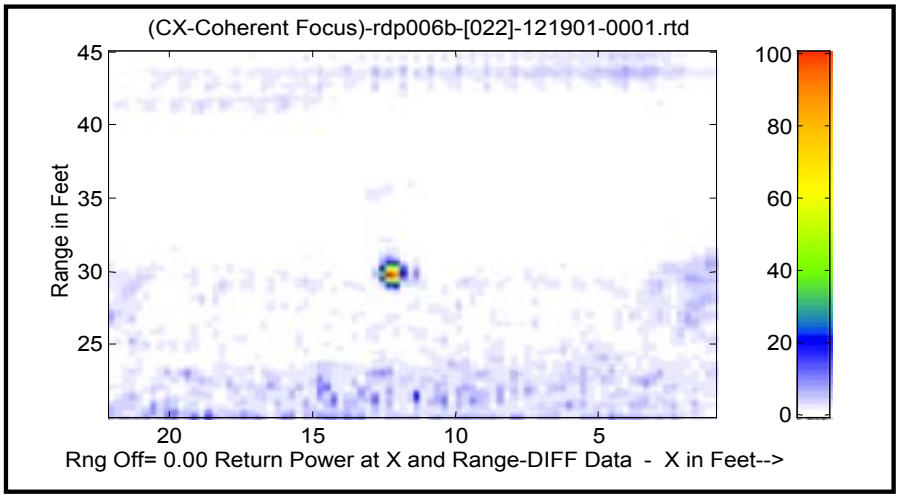

Figure 4

The target set being used consists of 9 elements. The 4 sizes of DOD approved mine simulants are used. These targets range in size from the largest anti-tank mine sin which is 11.5 inches in diameter and 4 inches high to the smallest anti-personnel mine sim which is 4.4 inches in diameter and 1.5 inches high. Also included are two 14" pieces of empty 2 _ plastic piping capped at both ends, two rocks about 5 inches in diameter, and a calibrated metal 1 ft^2 sphere. The target set is shown at Figure 5. Recent results of the imaging experiments of the target set are shown in Figure 6.

The previous experiments produced the radar images of the target set shown here with 6 inch resolution at a stand off range of 30 feet. Current experiments are investigating buried targets. Further refinements are planned for the current algorithms that are expected to increase the resolution and processing gain. Future experiments will investigate longer ranges and higher power.

Figure 5

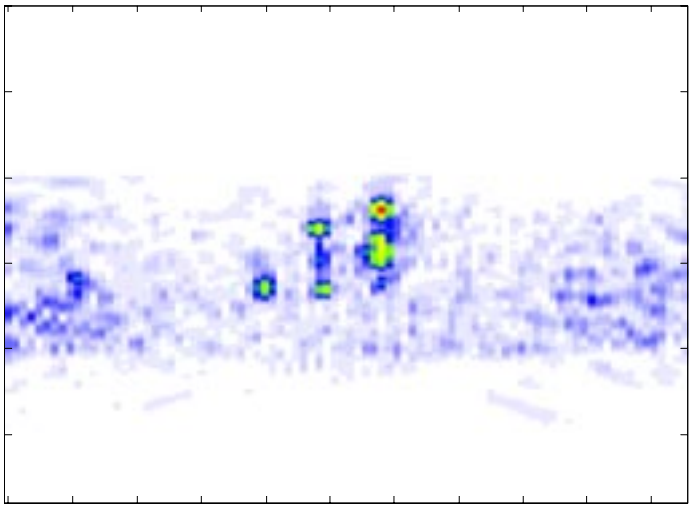

Figure 6