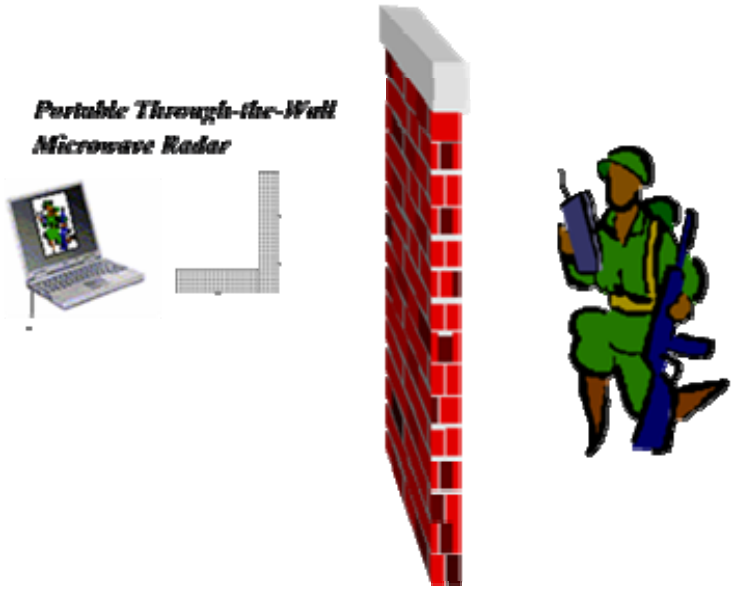
# DARPA / Concurrent Technology Corporation
# CAC Project

## Through-The-Wall Microwave Imaging

Project Director: Dr. Moeness Amin
Project duration: 07/16/2002 - present




### Project Summary

- A microwave radar is under development to achieve imaging of moving and stationary targets through visually opaque obstacles such as walls.
- Low-profile, broadband, and dual polarized antennas are being designed to offer portability, achieve optimal wall penetration, and provide high signal-to-clutter ratio.
- Signal Processing methods are being developed to enhance the signal-to-clutter ratio, improve two-dimensional imaging resolution, distinguish targets of interest from others, and obtain fast and simplified implementations of the designed algorithms.

### Project Description

Hybrid techniques of antenna, design, electromagnetic modeling, and signal processing are used to achieve effective imaging of moving and stationary objects through walls using microwave frequencies. Through-wall microwave sensing can be used in rescue missions, behind-the-wall target detection, surveillance and reconnaissance, and even sensing through smoke and dust, to name a few. Low-profile, broadband, and dual polarized antennas are designed to offer portability, achieve the required bandwidth for proper penetration and resolution, and provide high signal-to-clutter ratios. Electromagnetic modeling of these antennas and the wave interaction with various types of walls and material is performed using

numerical methods such as the Finite-Difference Time Domain technique, the Finite Element Method, and the Method of Moments. Transmit and receive antennas with dual polarization allows improved target classification based on polarization properties and is considered key to achieving system performance beyond that obtained through range-Doppler processing.

The offerings of signal processing techniques to the Through-wall microwave imaging system lie in fast implementations, integration of the advances in beamforming and array signal processing, signal detection using modern and newly developed statistical analysis algorithms. The objectives are to achieve real-time target detection and classification, enlarged array aperture for high-resolution direction finding and clutter removal, and estimation of polarization parameters for target identification. Increased effective aperture is accomplished by using aperture synthesis schemes based on the coarray formalism. Multiplexing the processing apparatus between two small aperture systems can be used to synthesize a larger array. Moving the small aperture system along a rail coinciding with the horizontal axis of the plane in which its elements are deployed is also a vehicle improved system performance.

The proposed research proceeds on two fronts, namely the electromagnetics and the signal processing aspect of the problem. It builds on current technologies of wideband Through-wall microwave imaging. The research cultivates advances in antenna design, computational electromagnetics, and statistical signal processing for enhanced target detection, identification, and classification. Incremental evolutionary changes and full utilization of existing system capacities form the bases of our research efforts. Increased system complexity vs. performance improvement will be furnished and categorized for each proposed effort.

Concurrent Technology Corporation Web Site
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