THROUGH-THE-WALL MICROWAVE IMAGING RADAR

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The ability to see through obstacles, such as walls, doors, and other visually opaque materials, using microwave signals has become a major area of interest in a variety of applications in both military and commercial paradigms. Law-enforcement officials, search-and-rescue workers, and counter-terrorism agents encounter situations where they need to detect, locate, and identify occupants of a building. Through-the-wall imaging would clearly offer powerful tools for such applications.

The principal goal of this project is to use hybrid techniques of antenna design, electromagnetic modeling, and signal processing to achieve effective imaging of moving and stationary objects through walls using microwave frequencies. Our proposed research builds on current technologies of wideband through-the-wall microwave imaging. The research cultivates advances in antenna design, computational electromagnetics, and statistical signal processing for enhanced target detection, identification, and classification.

The proposed research proceeds on two fronts, namely the electromagnetics and signal processing aspects of the problem. 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 are performed using state-of-the-art numerical methods. Transmit and receive antennas with dual polarization allows improved target classifications based on polarization properties and is considered key to achieving system performance beyond that obtained through traditional range-Doppler processing.

The offerings of signal processing techniques to through-the-wall microwave imaging system lie in fast implementations, integration of the advances in beamforming and high-resolution 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 estimation of polarization parameters for target identification and clutter removal. Aperture synthesis schemes, Micro-Doppler, and time-frequency algorithms are deployed as vehicles for improved system performance.