**Acoustically based Through-the-Wall Target Detection and Classification for Achieving Transparent Urban Structures**
**Principal Investigator: Dr. Moeness Amin**
**Project Duration: 02/01/2007 - 02/01/2010**

**Project Summary:**

The proposed research is conducted by a team from Villanova University and University of Pennsylvania. The technology interest area is "enabling behavior/activity classification by determining intent of personnel detected within structures and standoff detection of weapons and/or explosives caches within structures". The proposed research deals with the development of sense-though-wall technologies for detections and classifications of animate and inanimate objects behind structural walls, and determining intent of detected personnel. Wave propagation, modulation, and polarization properties over different frequency bands are leveraged to overcome different wall penetration losses, and to characterize behaviors, profiles, and activities of stationary and moving indoor targets. The goal is to detect and discriminate among various objects based on their respective acoustic, RF, and ultrasound signatures. The proposed work will provide schemes for motion detection and classification, recovery of individual signal waveforms from their propagated mixtures, and stand-off detection of weapons caches within structures. This is achieved through the applications of blind source separation methods using localized and distributed passive acoustic arrays; vibration, rotation, and translation motion sensing and moving target signature analysis using RF and ultrasound active sensors; and adaptive polarization difference imaging techniques. Solutions from individual approaches are fused for providing an improved performance compared to only applying individual modalities. The proposed research proceeds on both analytical and experimental tracks, and seeks to provide phenomenology and proof of concept. The analytical component integrates advanced theories in signal processing, radar, antennas, and electromagnetics to devise novel techniques for urban sensing. The experimental part of the proposed efforts utilizes Villanova University state-of-theart RF imaging facilities and other laboratories for RF, acoustic and ultrasound testing undercontrolled, semi-controlled, and real-world environments.