Radar Imaging for Urban Sensing
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Project Summary:

Urban sensing and through the wall radar imaging benefit greatly from fast system implementations, integration of wideband beamforming and array signal processing, signal detection using modern and newly developed statistical analysis and algorithms, and advances in waveform diversity. The key objectives are to provide real-time target detection and classification, enlarged array virtual aperture for high-resolution direction finding and clutter removal, robustness to wall ambiguities, and estimation of polarization parameters for target identification. The proposed research considers RF technologies for urban sensing and employs mono-static and bi-static wideband radar systems to meet the principal urban sensing application goals of high resolution radar imaging, target localization, and motion profiling. Moving target motion signature understanding and classification using time-frequency analysis is of special interest to this project. A simple dual frequency Doppler radar approach for moving target range estimation and localization is proposed and its sensitivity to noise, frequency drift, and in-phase and quadrature mismatch are examined. The research plan aims to employ orthogonal and correlated signals and beams at the multiple antenna transmitter, and apply respective matched filters at the multiple antenna receiver for improved target and image resolution. Array aperture synthesis techniques are used to select desirable point spread functions under different operating waveforms. Verification of concepts and phenomenology proceeds using real-scene measurements provided by Villanova University data collection scanners. The measurements correspond to calibrated and populated scenes as well as stationary and moving targets with linear, simple harmonic motions, and nonlinear motion signatures.