Multistatic Imaging Radar for Standoff Concealed Threat Detection

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Securing public spaces such as mass transit systems and large arenas represents a major challenge due to high foot traffic, numerous points of entry, and easy concealment of threat items. Standoff detection of concealed items can play a critical role in future security architectures for such venues. Microwave sensing is well suited for standoff detection systems, as it can safely (e.g., with non-ionizing emissions) image items concealed under clothing or in bags. While portal-based microwave screening systems have been successfully used in the aviation security environment, they may not be suitable for large, unstructured, and crowded environments. To this end, MIT Lincoln Laboratory has developed a real-time standoff microwave imaging radar testbed for concealed threat detection. The radar, which operates from 24-30 GHz, is based on a multistatic switched antenna array. This allows for hardware efficient realization, even in large-aperture implementations. For example, for a 1m x 1m instance of the design, 480 transmit elements and 480 receive elements are required, in contrast to the nearly 40000 elements needed by an equivalent monostatic aperture. Additionally, the system employs a novel fast imaging technique that allows for reconstruction of 3D microwave images at video rate on cost-effective computing hardware. The system is designed to operate at video rate (10 Hz), in order to rapidly screen subjects in high foot traffic environments.

This talk will review the design and operation of the radar testbed, with an emphasis on the multistatic antenna array. Considerations key to practical implementation such as calibration and array control will be discussed. Additionally, results from a campaign to experimentally evaluate the system will be presented. In addition to assessing fundamental performance parameters such as range and field of view, the campaign will evaluate the effects of clutter in an imaged scene, the effects of various obscuring materials, as well as the role of aperture size. These results will provide new insights on the capabilities and limitations of multistatic imaging radar in complex security environments.

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