### Abstract

The AIT group is developing a new hardware platform consisting of mechanical and electrical subcomponents for capturing imaging data in a multi-static radar environment.

With the proposed architecture approach along with innovative algorithms the result will have highly improved resolution compared to leading edge systems available on the market today.

### Background

- Using 60 GHz technology for high-performance, wide bandwidth, short range unlicensed operation
- Wide bandwidth allows for high resolution

### Concept

- 60 GHz integrated chips are available for WirelessHD, Wireless Gigabit standards
- Use transmitter/receiver system as core building block

### Architecture and Current Status

- Lab hardware in process of being debugged for system validation
- Software integration to decrease mechanical and electrical scanning time
- Algorithm debugging

### FMCW SAR

- Received access to 2D (planar) FMCW radar at Reve Imaging Technologies as part of a DHS sponsored summer internship.
- Replaced non-functioning hardware and wrote code to control hardware and collect data in monostatic and multistatic configurations
- Wrote matched filter SAR imaging algorithms that convolve the theoretical response from a point source with the received signal to generate a target image at the specified depth.

The data to the right shows the image from a 1D horizontal scan in a multi-static configuration using the matched filter imaging algorithm.

### Electrical

- Ties the gap between electrical and mechanical components
- Provides controls from multiple software modules into a single interface

### Design Advantages

- Provides the ability to create and run tests that would otherwise have to be run manually, therefore reducing debug time
- Written from the lowest level register settings allowing rapid revisions to accommodate the changing needs as the project progresses
- Written primarily using LabVIEW to leverage its rapid development time and advanced data acquisition capabilities

### Software

- Program used to create automated tests
- Program capable of executing automated tests

### Mechanical

- Aluminum structures provide predictable responses that can be easily accounted for in the imaging algorithms.
- Electrical equipment located on top of the gantry simplifies hardware integration and allows shorter signal cables.

### Transmitter Geometry

Novel transmitting antenna is a doubly curved offset reflector with vertical parabolic variation and elliptical horizontal variation, with common focal point

- “Blade Beam” gives 1cm horizontal illumination stripe on body
- Switched planar receiver array arc for fast multistatic 2D inversion
- Translation in height for stacked 3D reconstruction

### Relevance

- Bridging the gap between high-performance, commercially available technology components and security requirements
- Improved technology platform and algorithms will reduce detection errors and decrease false positive results
- Developed infrastructure is modular, expandable, and scalable. It can be used for a variety of applications relevant to Homeland Security

### Impact

- Resulting platform will be available to validate a multitude of software and mathematical algorithms
- Future advancements in industrial and commercial electronics will be leveraged directly into new revisions of the hardware platform
- The mechanical and electrical platform will advance state-of-the-art; expand field of knowledge through graduate student research, conferences, journals

### Other References