DURIP

Distributed SDR testbed for Collaborative Research

Distributed Software Defined Radar Testbed

- Collaborative research resource based on software defined radar (SDR) platforms that can adaptively modify both transmit waveforms and signal processing tasks in real time.

- This collaborative research resource will be utilized by Ohio State University, University of Michigan, Massachusetts Institute of Technology and Arizona State University.

- The testbed will enable validation and refinement of active sensing strategies for wide area surveillance that are being developed under the MURI program.

- Common hardware platform/software development environment across institutions enable repeatable experimentation and experimental comparison of multiple techniques.

Distributed Software Defined Radar Testbed

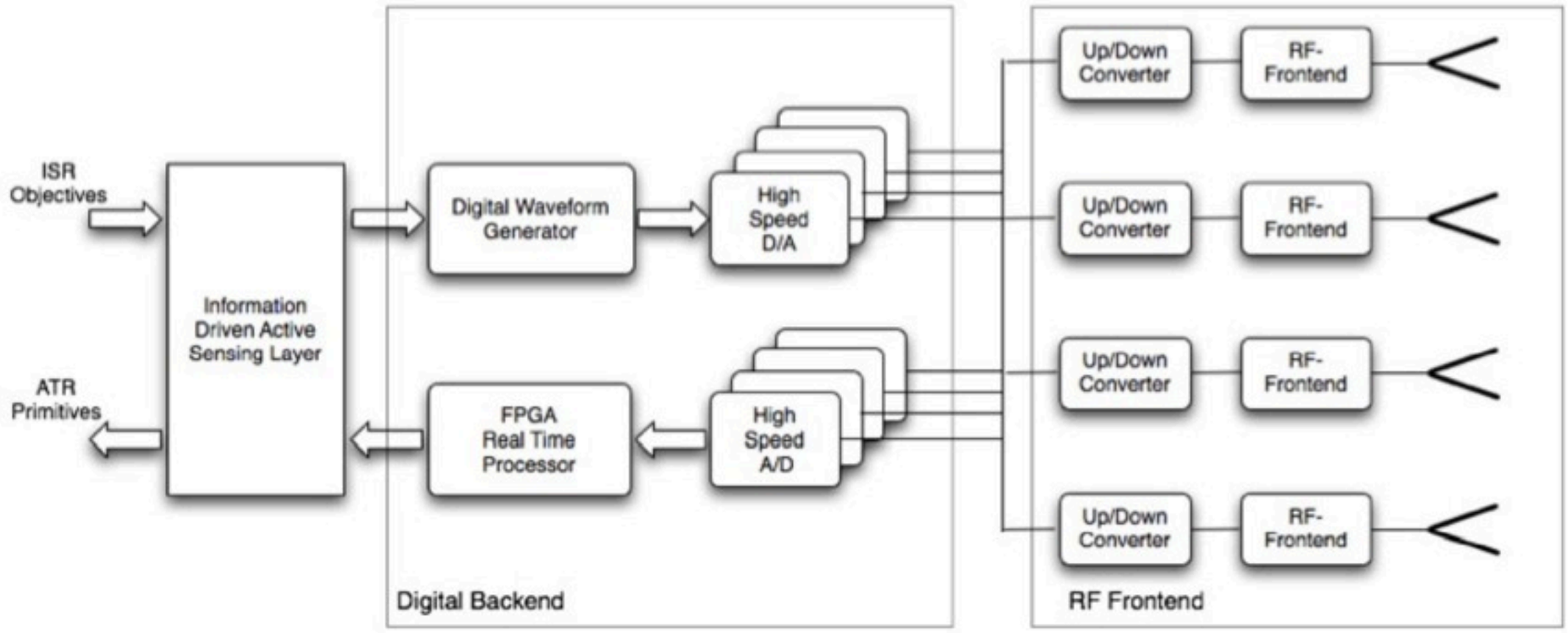
1. Distributed radar testbed consisting of 15 Micro SDRs.
   Mobile form-factor, lightweight, fully digital programmable SDR

2. Colocated MIMO Radar system with 8 TX And 8 RX with airborne collection emulation
   Stand-alone, high-performance stationary infrastructure

Micro SDR

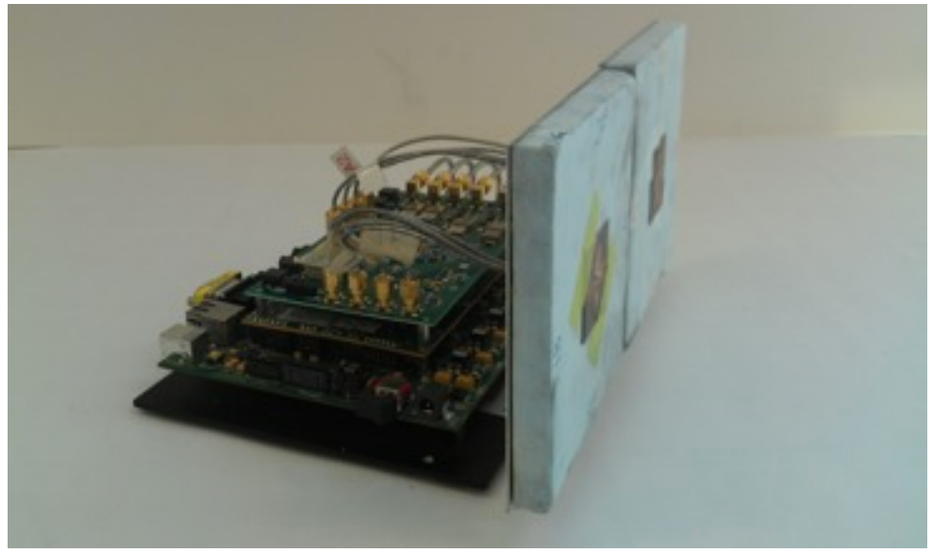
MIMO Radar System

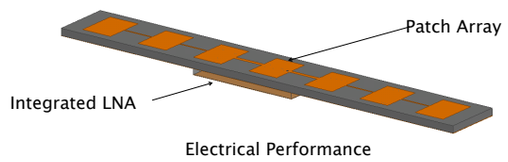
SDR Architecture



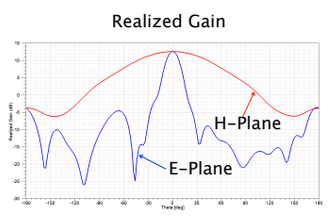
Micro SDR

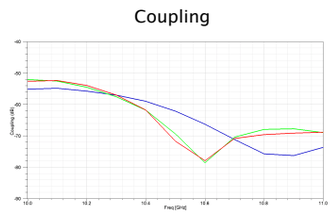
- Based on OSU Micro Radar platform
  - 250 MHz Signal Bandwidth (60 cm resolution)
    - Dual 250 MS/sec 14 bit A/D
    - Dual 1 GS/sec oversampling 16 bit D/A
- Embedded Virtex-6 LX240T FPGA
- 215 mm (W) x 48.05 mm (H) x 290 mm (D)
- Custom X-Band RF-Frontend Switchable Antenna Matrix for directed beams





Electrical Performance





Features of the Micro SDRs

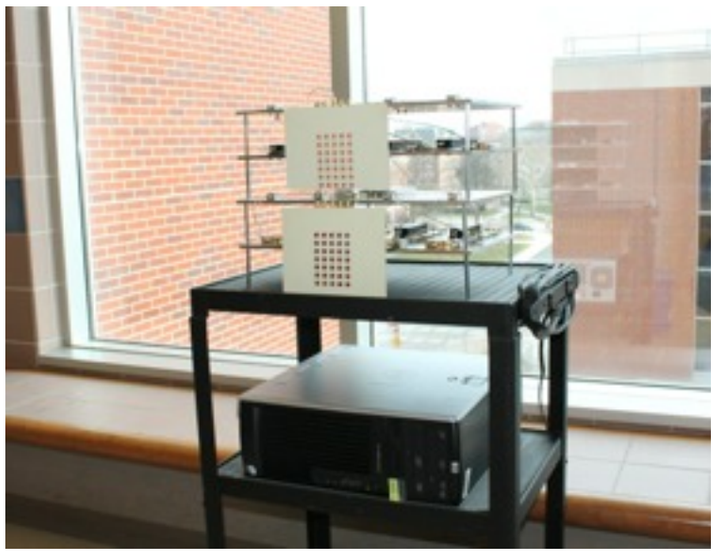
- Micro SDRs can be deployed to perform non-coherent fusion of backscatter returns (also known as statistical MIMO radar) to decrease fluctuations in target returns to selective fading through spatial diversity.

- The Micro SDRs can modify their transmit waveforms and pulse repetition frequencies cooperatively to adapt changes in the background and target returns as well as scene complexity.

- In addition micro SDRs feature switching directed antennas to optimize the collection geometry and derive fusion research with other modalities such as EO, IR cameras and acoustic sensors.

MIMO SDR

- Based on OSU DARPA KeCOM Array
    - 125 MHz Signal Bandwidth (60 cm resolution)
        - 8- 250 Msample/sec 14 bit A/D
        - 8- 1 Gsample/sec oversampling 16 bit D/A
    - Dual Embedded Virtex-6 LX240T
    - 215 mm (W) x 48.05 mm (H) x 290 mm (D)
    - Custom RF-Frontend Switchable Antenna Matrix



Features of the MIMO SDR

- Co-located MIMO array paired with the switchable antenna array matrix can emulate airborne collections for 8x8 coherent MIMO radar. Focus will be on space-time adaptive (STAP) techniques for detection of slow moving targets against stationary clutter.

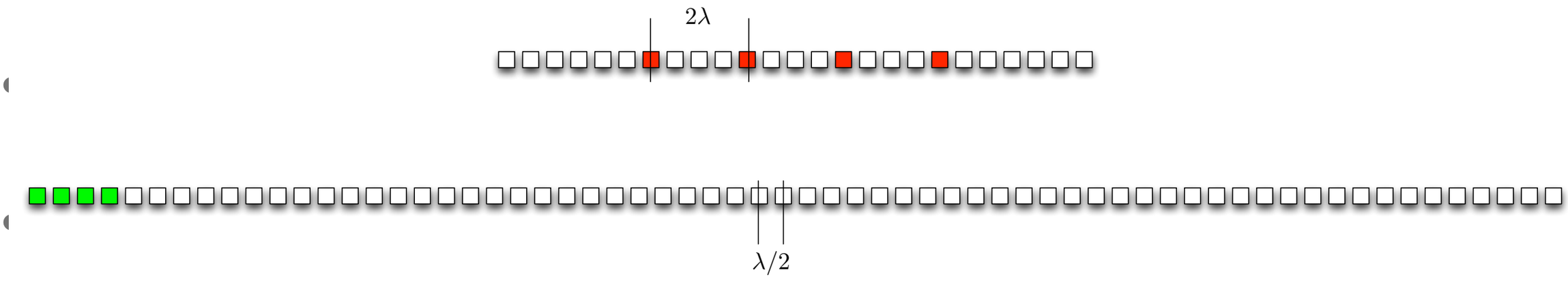
- Alternatively the two components of the testbed can be combined to provide a novel operation scenario, where the coherent MIMO array is used to emulate illumination by an airborne platform with multi-static passive sensing by micro-SDR platforms from diverse set of aspect angles.

Emulation of Airborne Collection

- The design consists of an electronically switchable array of 64 Rx antennas at half wavelength spacing and 4 TX Antennas at 2 wavelength spacing. The Rx antennas are switched in sequences to emulate aircraft platform equipped with a MIMO array of 4 Tx and 4 Rx active elements at each pulse.

- RX antennas are switched in sequences to emulate 8-by-8 array on an aircraft platform

- Emulate air speeds up to 75 m/s (5kHz PRF)



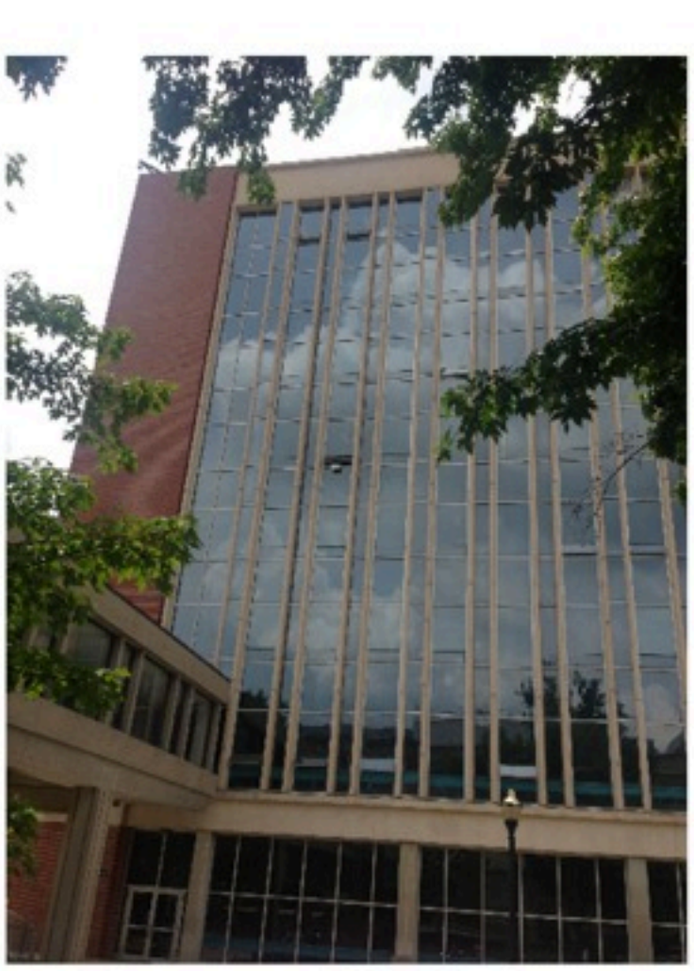
Planned Experiments

- UM-ASU Test and refine methods for adaptive radar processing for target tracking, sensor provisioning and wide area search.These methods require adaptation of the radar pulse repetition rate and/or the spatial waveform in the context of target detection to extract maximum information from the system.

- OSU-MIT: Study robust tracking and sensor management strategies for adversarial targets. Experiments with distributed sensors coordinating their actions to maximize worst-case tracking error. Test and refine methods for quantifying information measures for complex inference in mobile sensor setting

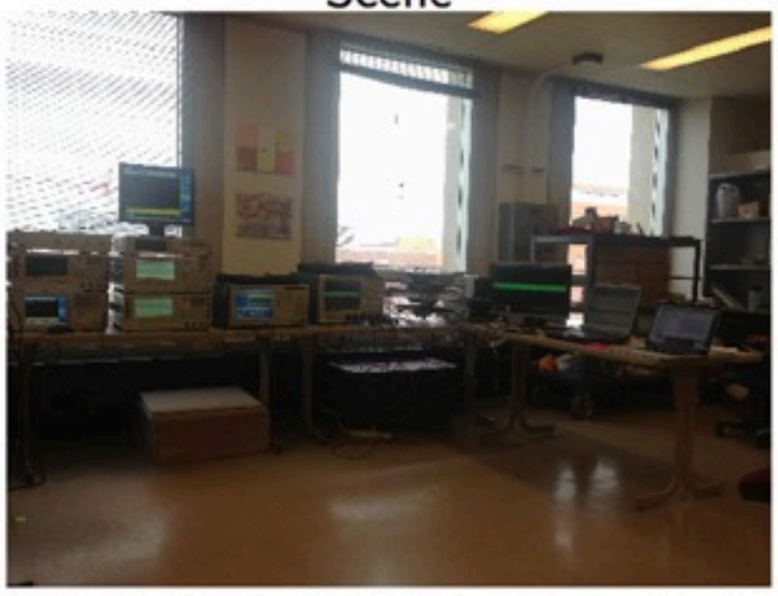
- ASU-OSU: Explore adaptive and feedback strategies in radar waveform design and scheduling. Also support research in information-geometric and information-theoretic foundations of information collection and fusion.

MIMO Array



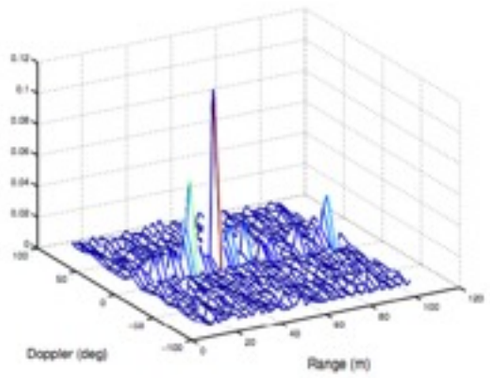
Prototype MIMO Array

Scene

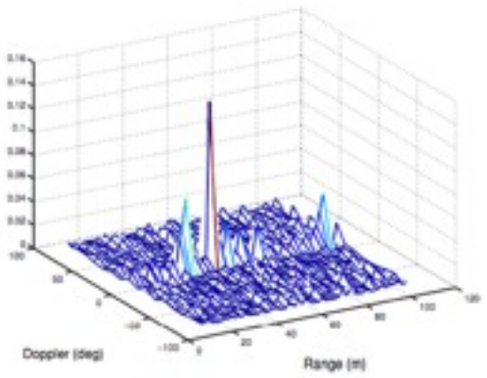


Mission Control

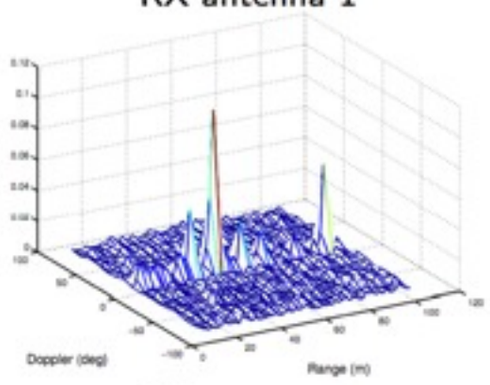
MIMO Array



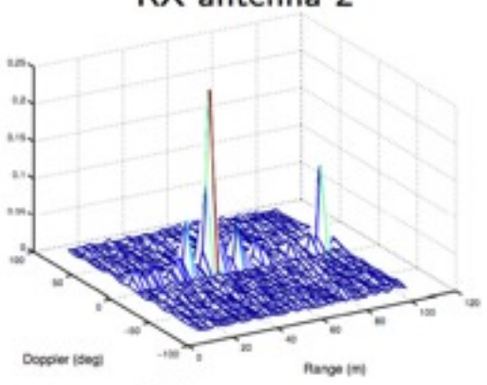
RX antenna 1



RX antenna 2



RX antenna 3



RX antenna 4