



Diverse Sensing for Synergistic Protection in Urban Threat Environments Demonstration Results



Nikola Subotic, Brian Thelen, William Buller, Brian Wilson, Joseph Garbarino, Ben Hart, Michelle Wienert, Stan Andersen, Rob Gengkinger, John Henderson

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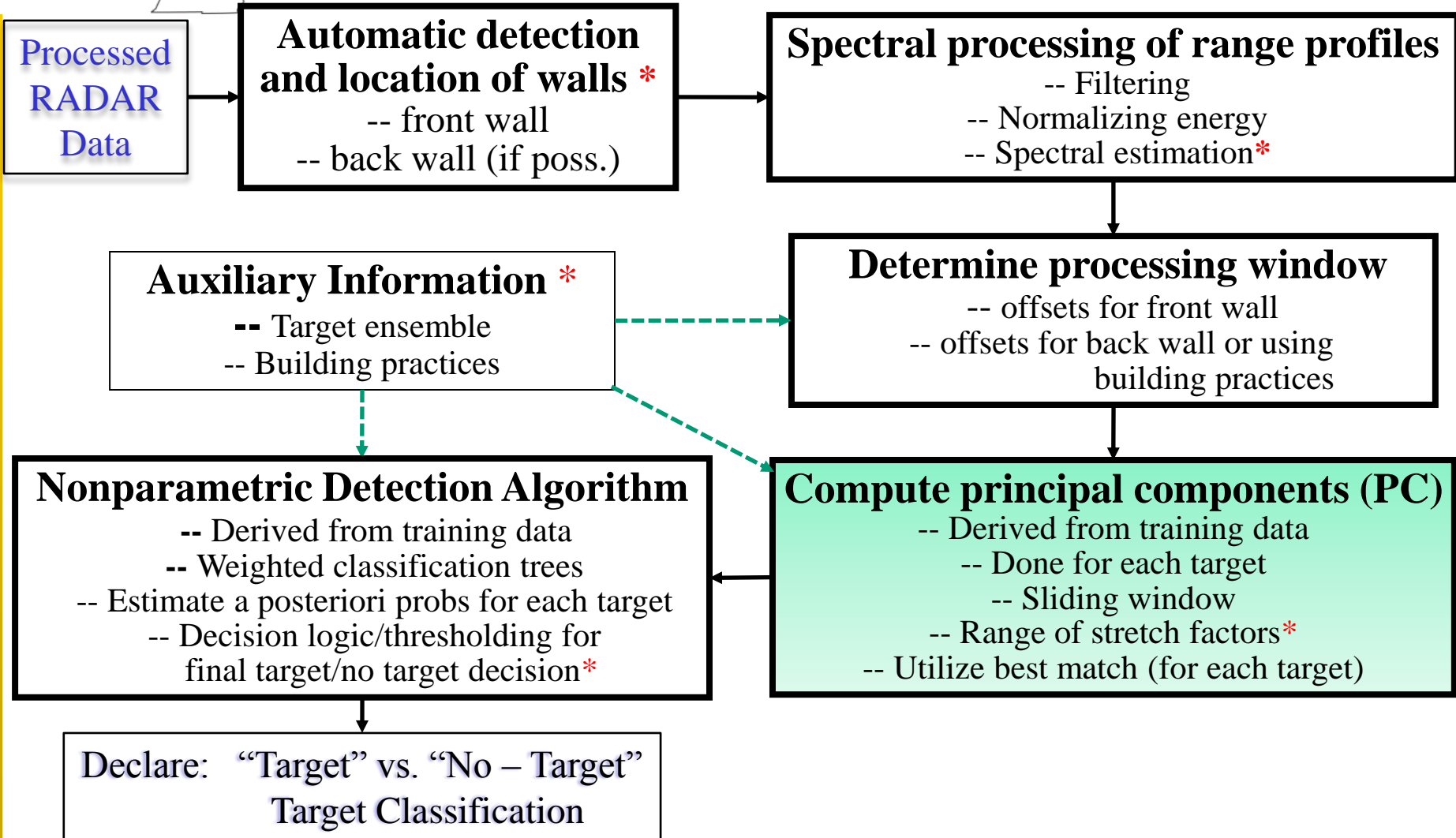


Objective

- Show reasonable time, automated algorithm performance of pre-shot cueing algorithm on live, blind test collected data



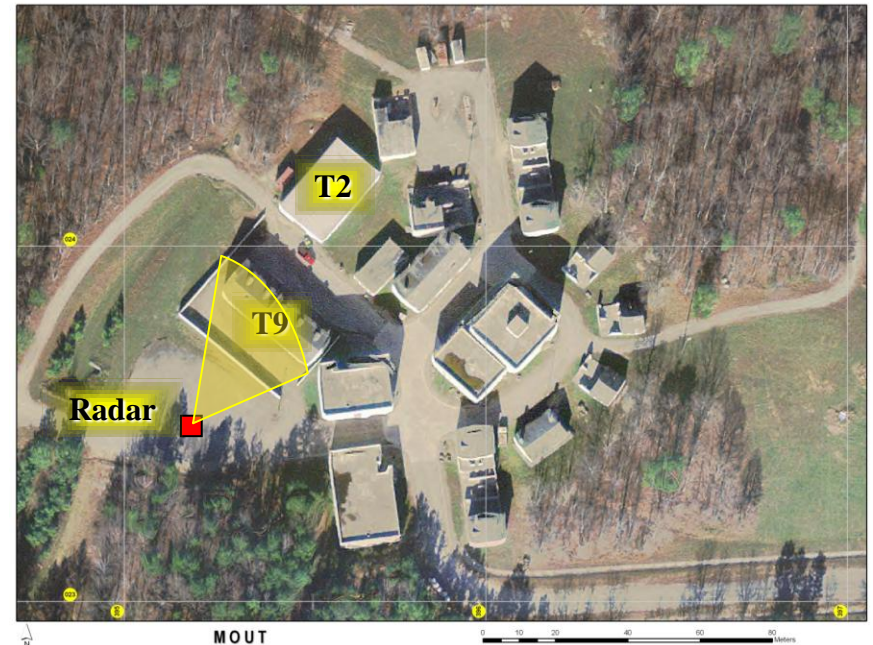
Automated Detection Algorithm Flow Diagram



* Corresponds to a significantly new component for this program

Demonstration Location

- Ft. Pickett MOUT site
- Deployment at 'Warehouse building' (T9)
- Processing/display at 'Schoolhouse' building (T2)



MTRIs Rotating Antenna Stage

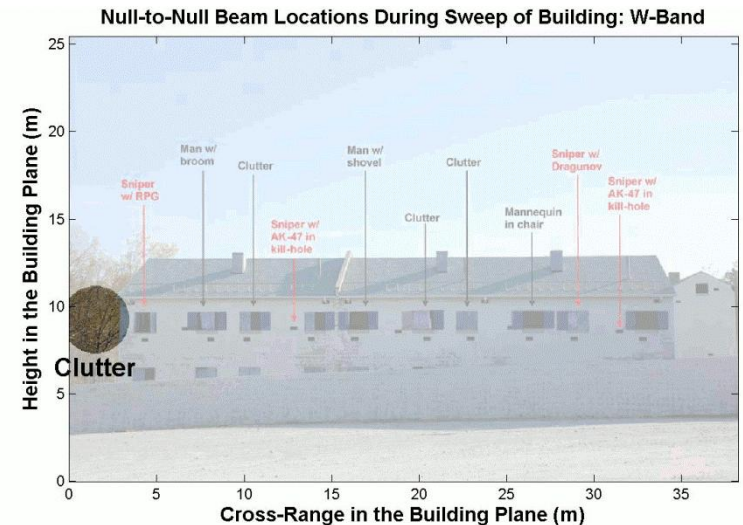
- Antenna head mounted on adapter for servo-controlled rotation stage
 - provides estimates of antenna azimuth



- Collection used continuous rotation rate of $0.2 \text{ }^\circ/\text{s}$ with frequency sweep rate of 2 Hz
 - emulates a rotating antenna at $200 \text{ }^\circ/\text{s}$ with 2 kHz frequency sweep rate

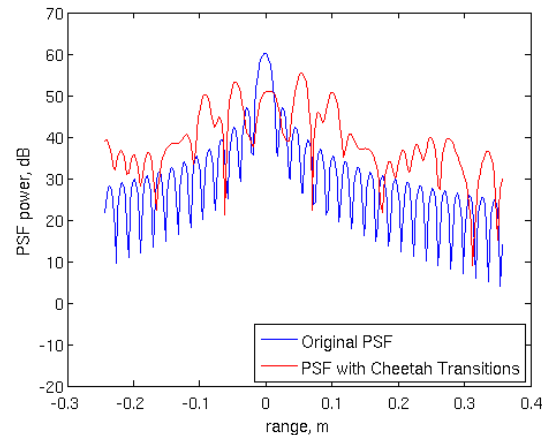
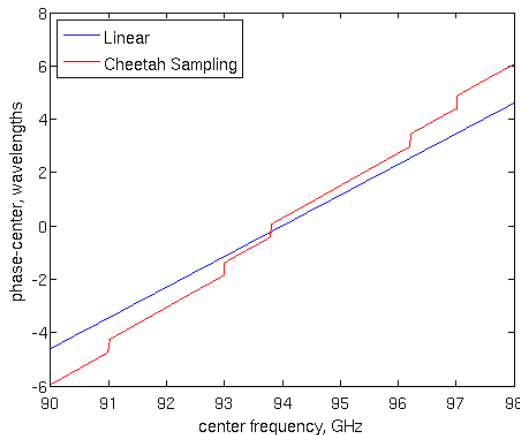
Demonstration Structure

- Azimuth scan on single building
 - Set up time too long to move, re-align instrumentation system
- Confusers/targets need to remain 'still' during illumination
 - Long sweep time of instrumentation radar (100 msec) and short wavelength (3mm, W band) make data susceptible to scintillation and smear
 - Field operational Radars have much faster sweep times (<100usec) which will effectively 'freeze' signatures
- Targets will be > 1 foot behind plane of walls
 - EO system will see threat if exposed at opening
- Radar and target will have direct line of site and have weapon pointed at Radar
 - Threat is defined as weapon pointed at vicinity of Radar



Measures to Mitigate Scene Motion

- Long chirp time (100ms) and non-uniform filter transition time coupled with small wavelength (W band) creates phase anomalies in moving targets



- Used monopods in Demo to mitigate PRF spoilage due to range-relative target motion



Demonstration Structure

- Scan set #1
 - False alarm testing
 - Scan #1: building with confuser targets
 - Empty rooms, people, people with implements
 - » Positioning of people determined on site with government
 - Scan #2: completely empty building, shutters open
 - Scan #3: empty building with shutters closed

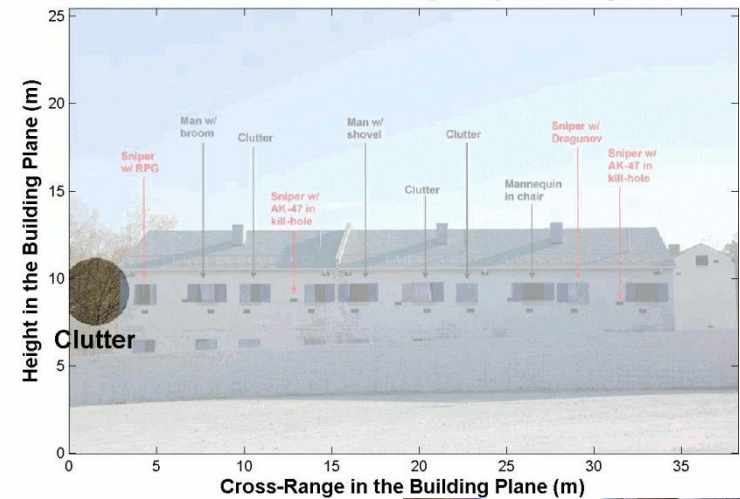
- Inspection of processing results

- Scan set #2

- Detection testing

- 3 Scans
- 4 Weapons
 - RPG-7, Dragunov, AK-47, AR-10
- Positioning of target determined on site with government
- Confusers added as resources permit

Null-to-Null Beam Locations During Sweep of Building: W-Band





Demo April 2010 Detection Results

- Demo performed under TARDEC supervision
 - TARDEC chose deployment scenarios in real time
- Deployment of weapons and confusers under control of TARDEC
 - Weapons: RPG, Dragunov, AK-47, AR-10
 - Confusers: Person, person with tripod, person with broom
 - 6 building scans: 2 empty building, 4 with weapons/confusers
- Automated detection system
 - Data moved from collection system to detection system via data stick
 - All parts of detection system were automated
- Demo handled as a blind test
 - Truth was not used during testing, only for display purposes



Demo April 2010

Detection Results – tp9037

Scenario

Empty building,
shutters open

Munitions

- None

Confusers

- None

Results

- No false alarms



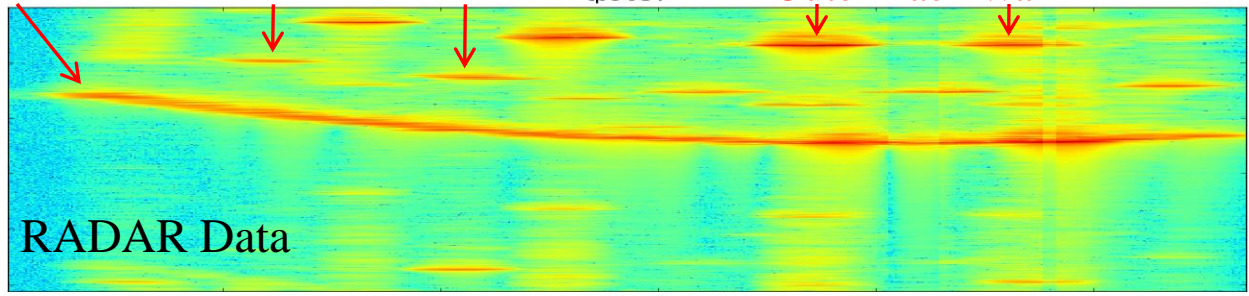
Building
Front Wall

Inner Back Wall

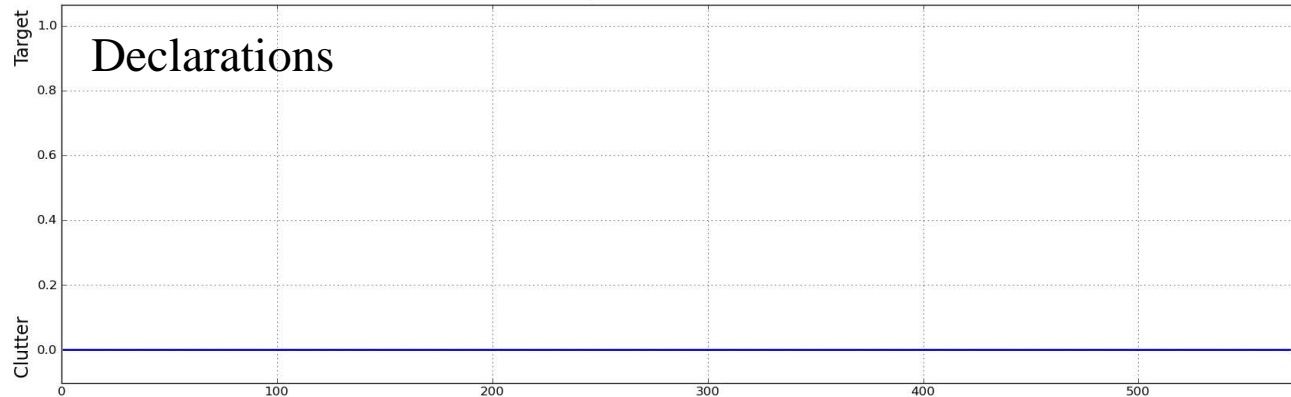
tp9037

Outer Back Wall

Range ↑



Sweep Number →



Sweep Number →

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Demo April 2010

Detection Results – tp9038

Scenario

Empty building,
people as
confusers

Munitions

- None

Confusers

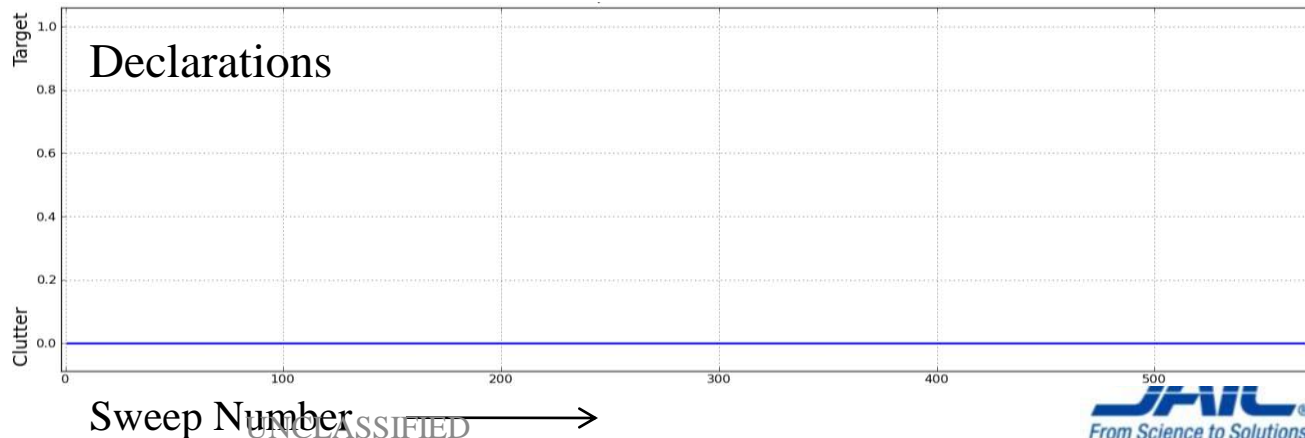
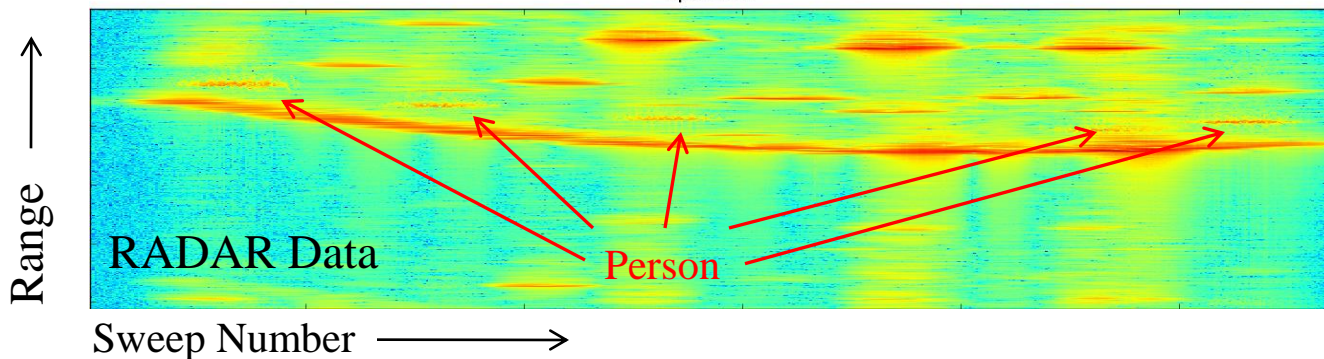
- Person

Results

- No false alarms



tp9038



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Deployed Persons





Demo April 2010

Detection Results – tp9039

Scenario

Empty building, shutters closed

Munitions

- None

Confusers

- None

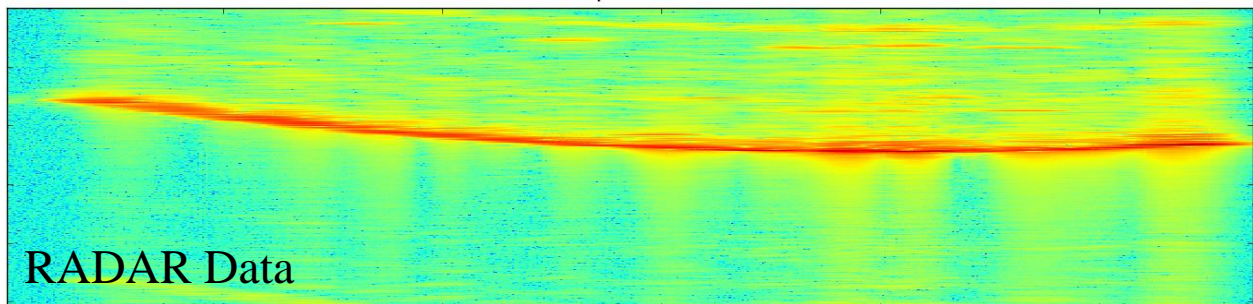
Results

- No false alarms

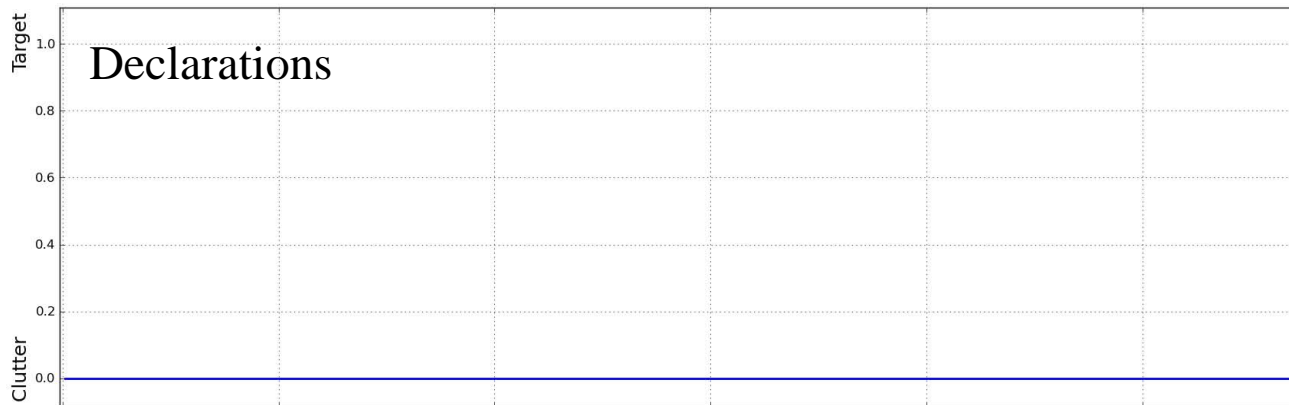


tp9039

↑
Range



→
Sweep Number





Demo April 2010

Detection Results – tp9040

Scenario

Munitions

- Dragunov
- RPG
- AK47
- AR10

Confusers

- Person with Tripod

Results

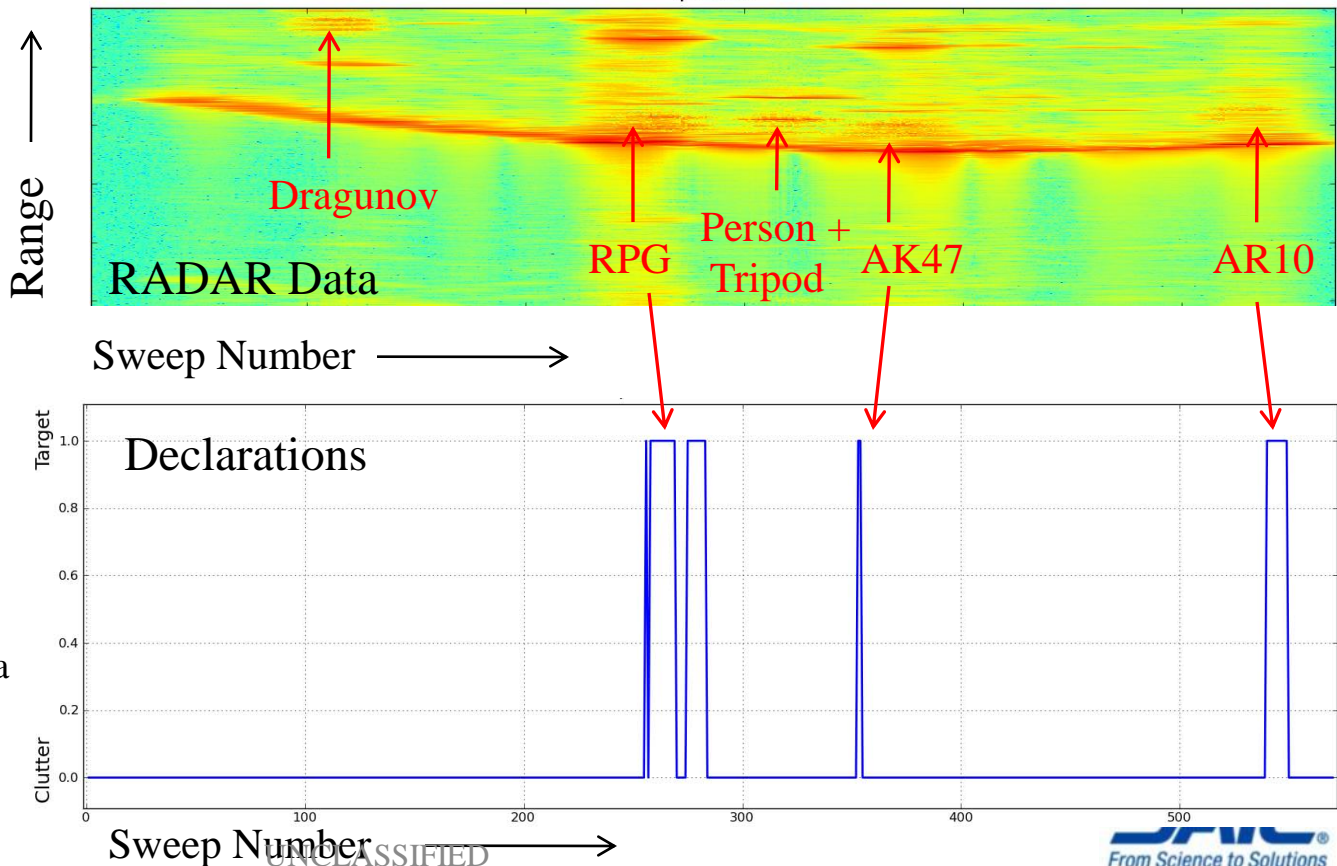
- RPG, AK47, AR10 detected as weapons
- Dragunov was missed
- Person+Tripod was not a false alarm

Notes

- Dragunov was in back room, outside search area



tp9040



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Deployed Persons



Confuser targets
aimed at
RADAR





Demo April 2010

Detection Results – tp9041

Scenario

Munitions

- RPG
- AK47
- AR10
- Dragunov

Confusers

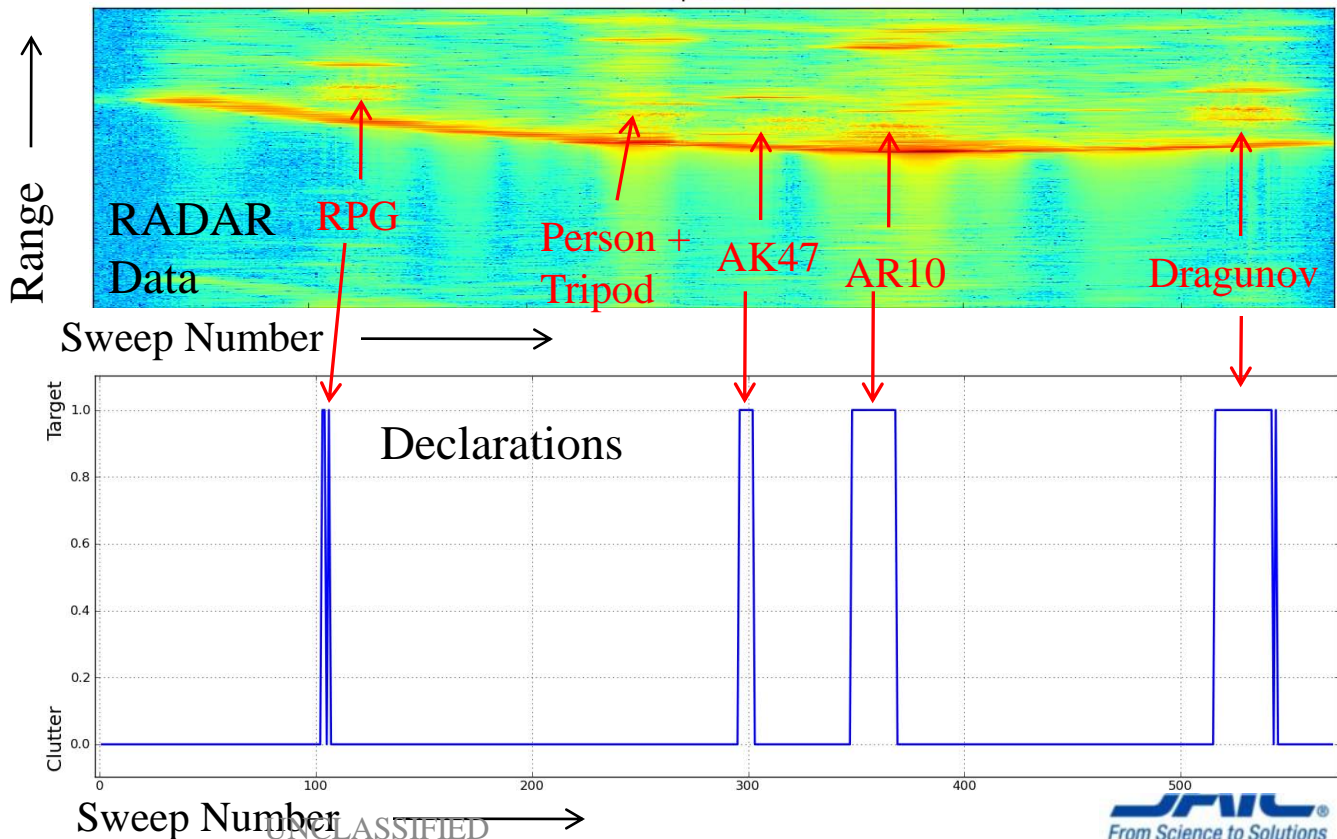
- Person with Tripod

Results

- RPG, AK47, AR10, and Dragunov detected as weapons
- Person+Tripod declared as clutter

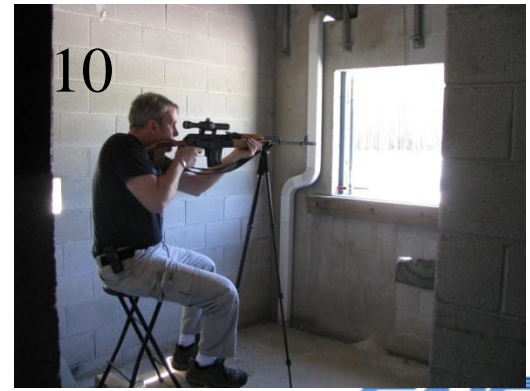


tp9041



Deployed Persons

Confuser targets
aimed at
RADAR





Demo April 2010

Detection Results – tp9042

Scenario

Munitions

- Dragunov
- AK47
- RPG
- AR10

Confusers

- Person with Tripod
- Person with Broom

Results

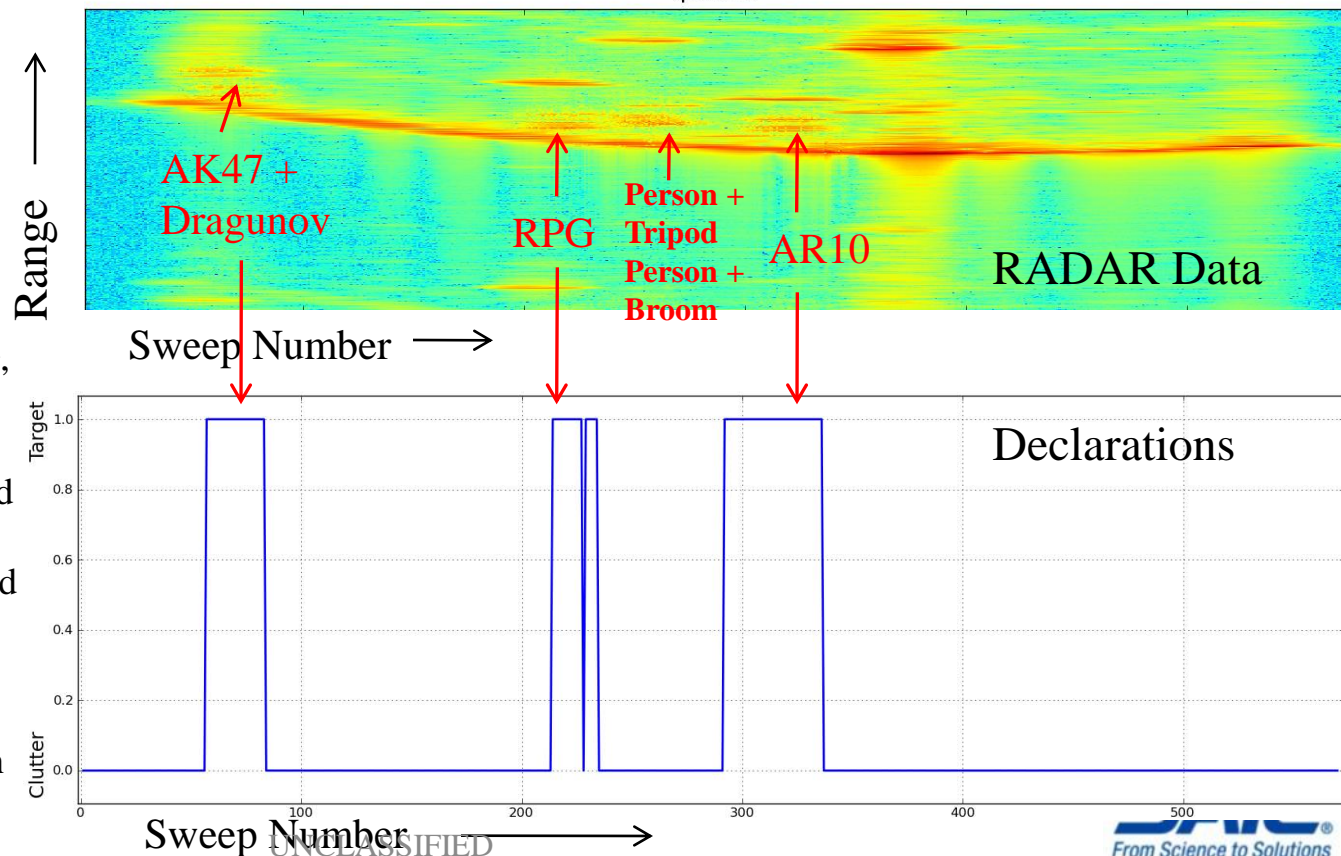
- Dragunov, AK47, RPG, and AR10 detected as weapons
- Person+Tripod declared as clutter
- Person+Broom declared as clutter

Notes

- AK47 and Dragunov in same room



tp9042



Deployed Persons



Window 1 had 2 weapons (AK-47 and Dragunov)

Dragunov in prone position aimed through kill hole





Summary: Algorithm Declarations

	Window 1	Window 2	Window 3	Window 4	Window 5	Window 6	Window 7	Window 8	Window 9	Window 10
Clutter Test, Windows Open										
Clutter Test, Windows Open	Person		Person		Person				Person	Person
Clutter Test, Windows Closed										
Detect Test 1		Dragunov			RPG	Person + Tripod	AK47			AR10
Detect Test 2		RPG			Person + Tripod	AK47	AR10			Dragunov
Detect Test 3	AK47 + Dragunov			RPG	Person+ Tripod Person+ Broom	AR10				

Detection

Missed Detection/
Outside Search Area

False Alarm

Confuser

Correct Declaration

Incorrect Declaration

- ❖ All weapons within search range of system were detected
- ❖ No false alarms
- ❖ Automated algorithm used 4 minutes for declarations (non-real time code)