

Facilitation of Third-party Development of Advanced Algorithms for Explosive Detection Using Workshops and Grand Challenges

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Bottom Line

- Airplanes still high-profile target using explosives
- A tactic of DHS is to augment capabilities and capacities of traditional vendors of security equipment with 3rd party involvement
 - Successful model in other fields such as medical imaging
- Describe how use of workshops and grand challenges facilitates the involvement of 3rd parties in the development of advanced algorithms for detecting threats

Problem

- Terrorists still trying to take down airplanes
 - Huge economic impact
- Terrorists are making home-made explosives (HME)
 - Increasing universe of threats
- Need better detection performance
 - More types of explosives
 - Lower masses
 - Greater area under receiver operator characteristic curve (ROC)
 - Increased probability of detection (PD)
 - Decreased probability of false alarm (PFA)

DHS Tactics

- *Augment* capabilities and capacities of system vendors with 3rd party involvement
- 3rd parties
 - Academia
 - Industry other than system vendors
- Create centers of excellence (COE) at universities
- Hold workshops to educate 3rd parties and discuss issues with involvement of 3rd parties
 - Resulting in grand challenges

Workshop Process

- Assemble people from
 - Incumbent vendors and other industry
 - Academia and national labs
 - TSA, DHS
- Focus on specific topic
 - Technical opportunities
 - Procedure for involving third parties
- Provide networking opportunities

Metrics for Workshop Success

- 3rd parties working on advanced reconstruction
 - Contracting or consulting to vendors
 - Funding from government or ALERT
- Students trained for working in industry
- DHS/TSA acts based on workshop feedback
 - Funding researchers
 - Define methods to work with 3rd parties

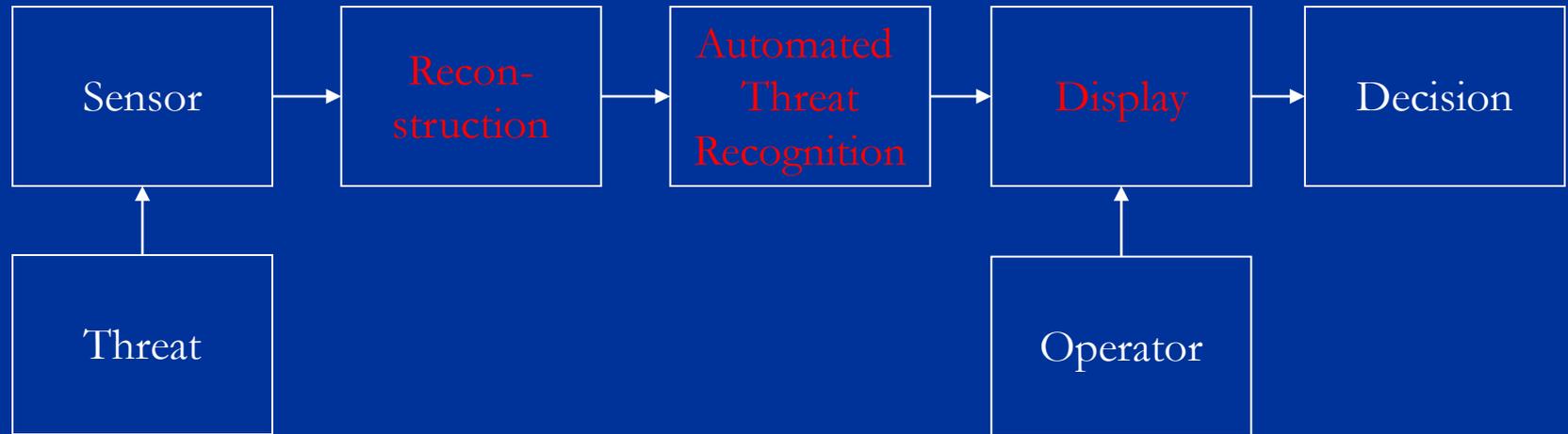
Workshops

1. Check point (April 2009)
2. Implementing grand challenge for segmenting volumetric CT images (October 2009)
3. Advanced imaging technology (whole body imaging) (April 2010)
4. CT reconstruction algorithms (October 2010)
5. Fusion of orthogonal technologies (May 2011)

Final reports available online:

[ftp://ftp.censsis.neu.edu/ADSA0\[1-n\]](ftp://ftp.censsis.neu.edu/ADSA0[1-n])

Generalized Scanner



- Boxes may mean different things to different modalities.
- Some modalities may not have all boxes.
- Multiple systems may be fused.
- Red boxes of interest at workshops

Workshop Recommendations

- Technical opportunities exist for 3rd parties to develop algorithms
- Grand challenges one way to execute
- DHS needs to resolve access to
 - Funding
 - Data
 - Requirements
- APIs and data formats would help

Grand Challenge Process

- Define problem domain capturing areas for algorithm improvement
- Provide representative example data that can be released to third parties
- Define algorithm requirements
- Provide evaluation metrics
- Fund participants

Incentive is to enter security field

Technology Opportunities

- Concept of operations for using sensors
- Modeling of sensors, probe interactions with targets, and clutter sources
- Reconstruction algorithms
- Automated threat recognition (ATR)
 - Segmentation
 - Feature estimation
 - Classification
- Sensor and data fusion of multi-sensor systems, including adaptive processing
- Advanced display

Domains

- Carry-on and checked baggage
 - Segmentation of volumetric CT images
 - Reconstruction algorithms for CT
- Whole body imaging
 - Automated threat recognition (ATR)
 - System modeling
 - Reconstruction for MMW
- System fusion

Evaluation Metrics

- PD/PFA, area under receiver operator curve (ROC)
 - TSA requirements classified
 - Translate into relative improvements
- Image quality
 - MTF, SNR
 - Artifacts
- Segmentation
 - Precision of features (mass, density, volume)

Progress With Tactics

- 3rd party industry working with system vendors and receiving government funding
- Students trained and working for national labs and industry
- Professors consulting to industry
- Students working on AIT projects
 - Sandia dataset made available for these projects
 - Access to SSI data solved
- Grand challenge for CT segmentation in progress
- Funding vehicle in place for ALERT
- DICOS spec released
 - DICOM equivalent for security
- 300 people involved with workshops
- Community being established: government, vendors, 3rd parties

Issues and Mitigations

- TSA concerned that vulnerabilities will be published
 - Restrict publication
 - Encourage consulting
- Accessing sensitive security information and classified material difficult
 - Translate problems: e.g., find cows instead of tanks
- Requirement specs classified
 - Do initial work unclassified and then partner with cleared shop
- Language inaccessible
 - Provide mentors and run training sessions
- Prizes cannot be given
 - “Prize” is IP, commercialization, and entry into security

False Impressions

- TSA would become system integrator
- National labs would compete with industry
- Industry would be forced to procure code (algorithms) from 3rd parties

Conclusions

- Terrorists still trying and getting more sophisticated
- Need to increase number of smart people working on homeland security
- Augmenting capabilities and capacities of system vendors with 3rd parties is one tactic
- 3rd parties can be accessed via workshops and grand challenges
- Successes achieved to date
- Issues need to be resolved to further increase 3rd party involvement