Strategic Study
Workshop Series

Advanced Development for Security Applications

Screening of Personnel and Divested Items at the Checkpoint - Part II

ADSA13
October 2015 Workshop
Final Report

ALERT
AWARENESS AND LOCALIZATION OF EXPLOSIVES-RELATED THREATS

A Department of Homeland Security Center of Excellence

Northeastern University

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1. Executive Summary

A workshop focused on screening of personnel and divested items at the checkpoint was held at Northeastern University (NEU) in Boston on October 28-29, 2015. This workshop was the thirteenth in a series dealing with advanced development for security applications (ADSA13). The workshop was a continuation of the twelfth workshop, ADSA12.

The topic of screening of personnel and divested items at the checkpoint was chosen as the workshop topic in order to support the Department of Homeland Security's (DHS) objective of improving the performance of existing technologies and to improve the passenger experience at checkpoints. Another goal of the workshop was to support DHS's objective to increase the participation of third parties, such as researchers from academia, national labs, and industry other than the incumbent vendors, in algorithm and system development for security applications.

The following topics were addressed at the workshop:

- Emerging hardware, algorithms and processes,
- Concept of operations,
- Testing,
- Improving the passenger experience, and
- Assessing and using risk.

The topics were addressed from the perspectives of the following stakeholders:

- Passengers,
- TSA,
- Airlines, and
- Airports.

The key findings from the workshop on what can be done to improve the experience for the stakeholders at the checkpoint, per the editors of this report, are as follows.

- Addressing the checkpoint from the perspectives listed above resulted in three competing drivers:
    - Strengthen security,
    - Increase operational efficiency, and
    - Improve passenger experience.
- Silver bullets do not exist to solve these goals simultaneously.

- Improvements may be made by developing orthogonal technologies that can be fused with extant technologies. However, improvements are required in the following areas related to fused technologies:
  - Specification,
  - Testing, and
  - Networking.
- Video tracking of passengers and divested objects may be used to improve throughput and to support risk-based screening.
- Vendor neutral airports and standards – there is strong interest when standards and neutrality save time and effort, especially for the vendors.
- Standards, such as the interface to the baggage handling system, are useful when they reduce the development efforts of vendors.
- Game theory and risk-based screening may be useful for allocating resources via a Dynamic Aviation Risk Management Systems (DARMS), but may not find "the needle in a haystack."
- Deterrence may be useful, but test methods are required.
- Advances may be coming in AIT ATR, Terahertz, ETD, CT reconstruction and image enhancement, but it is important to consider how it will be integrated and deployed to the operating environment. Not all capabilities will find a market.
- Working with OEMs has the potential to educate new developers.
- New methods are needed to decrease time from the emergence of a threat to field deployment, including ATRs to detect the threat.

At the meeting, it seemed that ADSA14 (Spring 2016) should address developing and deploying technologies that can be fused.

2. Disclaimers

This document summarizes a workshop at which a number of people participated by discussions and/or presentations. The views in this summary are those of ALERT and do not necessarily reflect the views of all the participants. All errors and omissions are the sole responsibility of ALERT.

This material is based upon work supported by the U.S. Department of Homeland Security under Award Number 2013-ST-061-ED0001. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security.

3. Introduction

The Explosive Division (EXD) of US Department of Homeland Security (DHS) Science & Technology Directorate (S&T), in coordination with the Transportation Security Administration (TSA), has the objectives of improving the performance of existing technologies and to improve the passenger experience at checkpoints. One tactic that DHS is pursuing to achieve these objectives is to create an environment in which the capabilities and capacities of the established vendors can be augmented or complemented by third-party algorithm and hardware development. A third-party developer in this context refers to academia, National Labs, and companies other than the incumbent vendors. DHS is particularly interested in adopting the model that has been used by the medical imaging industry, in which university researchers and small commercial companies develop technologies that are eventually deployed in commercial medical imaging equipment.

A tactic that DHS is using to stimulate third-party algorithm and hardware development is to sponsor a series of workshops addressing the research opportunities that may enable the development of next-generation technologies for homeland security applications. The series of workshops are entitled "Advanced Development for Security Applications (ADSA)". The workshops are convened by Professor Michael B. Silevitch as part of the DHS Center of Excellence (COE) for Awareness and Localization of Explosives-Related Threats (ALERT) at NEU.

ADSA13 was held on October 28-29, 2015 at NEU. The workshop focused on screening of personnel and divested items at the checkpoint. The workshop was a continuation of the twelfth workshop, ADSA12.

This report discusses what transpired at the workshop and details a summary of the findings and recommendations.

4. Discussion

4.1 Objectives

The objective of the workshop was to improve the performance of screening passengers and divested items for explosives. The topics that were addressed centered on the following points.

- Emerging hardware:
  - THz.
  - Photon counting detectors for X-rays.
  - Coded aperture.
  - X-ray backscatter.
  - Explosive trace detection.
- Emerging algorithms and processes:
  - Video tracking of passengers and their divested items.
  - Simulations.
  - Image super resolution.
  - Iterative CT reconstruction.
- Emerging processes:
  - Concepts of operations.
  - Vendor neutral airports.
  - Common interfaces.
  - Fused systems.
- Improving the passenger experience:
  - Improving throughput and reducing divestiture.
  - Integration of detection systems at the checkpoint.
  - Managed inclusion and exclusion of passengers.
- Assessing and using risk:
  - Risk-based screening (RBS).
  - Game theory.
  - Deterrence.
  - Developing and verifying models of adversary behaviors.
- Other:
  - Role of third parties in the development of enhanced explosive detec-

tion equipment.

- Reducing time for ATR deployment.

The purpose of this section is to summarize the discussion and recommendations in response to these objectives and related questions that surfaced during the workshop.

4.2 Stakeholder Perspectives[1]

The discussion at the workshop was centered on the perspectives of the following stakeholders.

- Passengers (non-terrorist) perspective:
  - Assured that flying is safe.
  - Faster, predictable screening with reduced divestiture.
  - Fewer pat-downs and bag opening.
- Airport perspective:
  - Reduced total operating cost due to:
    - Labor,
    - Purchase price and maintenance costs, and
    - Secondary inspection.
  - No events at my airport.
  - Passengers, luggage, and cargo getting on their flights.
- Airline perspective:
  - Passengers, luggage and cargo getting on their flights.
  - Passengers wanting to fly.
  - No events on their specific airline.
- Government, TSA, perspective:
  - No incidents.
  - Equipment with actual and perceived perfect detection and no false alarms.
  - Terrorists deterred to even try to take down planes.
  - No explosives detected because terrorists are not trying.
  - Happy passengers, airlines, and airports.
  - Systems designed with increased detection performance, including more categories of explosives, reduced minimum mass, and reduced

[1] This section was originally published in the ADSA12 Final Report.

minimum sheet thickness and decreased life cycle cost.

4.3 What Did We Hear?

We agreed on the following observations.

1. The perspectives listed in Section 4.2 can be synthesized into three competing goals:
   a. Strengthen security,
   b. Increase operational efficiency, and
   c. Improve passenger experience.
2. Funding is available through DHS EXD's Long Range BAA14-02. Talk to Kumar Babu before submitting a whitepaper.
3. TSA wants 300 passenger and 600 divested items per hour.
4. CT and X-ray diffraction (XRD) at the checkpoint may improve performance.
5. AIT ATR could be improved.
6. New system architecture will enable third party participation in hardware and algorithms.
7. An Open architecture Proof-of-Concept system is being developed at Sandia National Laboratory (OTAP program).
8. DNDO is looking at developing government reference hardware and software.
9. Video analytics can be used to track people and their items.
10. Risk-based security is being used in aviation security.
11. Validating models of adversary behaviors may be useful.
12. Game theory accounts for intelligent terrorists but it does not solve the "needle-in-hay-stack" problem.
13. Advanced material discrimination may be possible with photon counting X-ray detectors and XRD.
14. Development of standards: useful when there is agreement on a need (e.g., interfaces to baggage handling systems). Still need to convince stakeholders that vendor-neutral airports and DICOS are useful. Government should set standards.
15. Advances in trace detection are coming.
16. Vendors are contracting third parties
17. There are obstacles that need to be addressed before X-ray back scatter

(XBS) could be re-deployed.

18. Throughput and financial considerations need to be addressed going forward.
19. Previous ADSAs addressing fusion should be reviewed before moving forward with fused systems.
20. ATRs with analog outputs (versus ATRs having binary outputs) need more work to understand this technology.
21. THz advances may lead to stand-off material discrimination.
22. Image super resolution may be applicable to security. There are concerns that information could be lost or added. Still many questions remain as to its applicability.
23. Iterative CT reconstruction may be possible soon with cost-effective reconstruction computing engines that are enabled by algorithmic changes.
24. Need to evaluate effectiveness of deterrence.
25. What is optimal? High PD *or* low false alarms?
26. CBP prefers lower false alarms so they can focus on other high risk areas. What does TSA want?
27. Reducing the time to deploy new ATRs – methods exist and need to be evaluated.
28. Preventing false discovery (e.g., over-training) in adaptive data analysis should be applied to DHS testing.

4.4 What Did We Not Hear?

1. Proof that Israeli risk based screening (RBS) would apply in the US.
2. RBS metrics and how will they be measured/used.
3. DICOM:
   a. How it benefited medical imaging.
   b. How problems with deploying DICOM can be avoided for DICOS.
4. Third parties:
   a. How the stakeholders (TSA, vendors) will benefit.
5. Differences between perspective on Level 1, 2, 3, etc. and fusion of the levels/technologies.
6. Why have shoe screening technologies failed?
7. Perspectives from airlines and TSOs.
8. Quantifying deterrence and displacement.

9. CONOPS details.
10. Details of spiral development.
11. How does a part of an integrated system get integrated? How is it tested?
12. Harmonized testing, standards, etc.

4.5 What Can Be Done?

1. Risk-based screening (under-screening).
2. Better CONOPS.
3. Orthogonal technologies system and data integration.
4. Standards:
   a. Systems interfacing.
   b. Data integration.
   c. Testing in the lab and field.
5. Better MMW, NMR, NQR, and X-ray hardware and reconstruction software.
6. Grand challenges/task orders:
   a. Reconstruction and ATR for sparse view CT, MMW.
   b. Speeding up CERT/QUAL testing:
      i. More statistical.
      ii. Human in the loop.
   c. Simulated system, bag, and people data sets.
   d. Quantifying deterrence and displacement.

4.6 Resources

a. TSA's long range BAA: https://www.fbo.gov/index?s=opportunity&mode=-form&id=52af31df223ac9ef141f3130ab09c878&tab=core&_cview=1
b. DHS SBIR portal: https://sbir2.st.dhs.gov/portal/public/Menu.action?page=sbir_current_solicitations
c. DHS's long range BAA: https://www.fbo.gov/index?s=opportunity&mode=form&id=5bce-6c00742b4c0c00a478d8063e3e5e&tab=core&_cview=1
d. TSA's request for information (RFI) for checkpoint enhancements:

https://www.fbo.gov/index?s=opportunity&mode=form&id=f4f-794bec81e1949a1d5f72f3542b1ad&tab=core&_cview=1

e. DHS's APEX program for the checkpoint: https://www.fbo.gov/index?s=opportunity&mode=-form&id=724e08edebe2284ad069274c49d4380b&tab=core&_cview=0

f. Other requests for proposals: www.fbo.gov

4.7 ADSA14

The following topics should be considered for ADSA14 and other ADSA workshops in addition to the topics listed in Section 5.5.

1. Specification for checkpoint of the future.
2. Emerging hardware and algorithms.
3. TSA's view of operations.
4. Manual versus automated versus operator-assisted threat detection.
5. Security technology integrated program (STIP); TSA's system integration protocol.
6. Open Threat Assessment Platform project (OTAP) at Sandia National Lab.
7. Testbeds – development and benefits.
8. THz status.
9. Fusion in related fields.
10. Anomaly versus threat detection.
11. Explosive simulants: design and use.
12. Airport case studies of CONOPS and use of video.
13. Civil rights and privacy.
14. Nuisance versus false alarms.
15. DNDO standards.
16. DNDO separation of hardware and software.
17. U.S. Customs and Boarder Protection (CBP) use of under- and over-screening.
18. ECAC perspectives.
19. Phase contrast X-ray imaging.
20. Transitioning technologies.
21. Randomized screening to TSA and to the field.

22. Machine learning applications.
23. Security effectiveness.
24. BDO improvements.
25. Tradeoffs of automated performance as a function of threat mass, other threats, etc.
26. Decision aides.
27. Simulated data and images.
28. Crazy ideas (e.g., no security, limit bag sizes, standard bags, contents and self-security, use smart phones to self-report suspicious activity).
29. Is flying a right or a privilege?
30. Preventing over training.
31. Measuring security effectiveness.
32. Parallel fields (e.g., federal building protection).
33. Sparse-view CT.
34. XRD.

5. Acknowledgements

The planning committee would like to thank the following people and organizations for their involvement in the workshop.

- DHS S&T for funding ALERT and sponsoring the workshop.
- Doug Bauer, DHS (retired), Laura Parker, DHS, and George Zarur, DHS & TSA (retired), for their vision to involve third parties in the development of technologies for security applications.
- Laura Parker, DHS, for coordinating DHS/ALERT activities.
- NEU for hosting the workshop.
- Lior Kamil, Innovation Technologies, Clem Karl, Boston University, Harry Martz, LLNL, Laura Parker, DHS, Luc Perron, Lpvision, Malcolm Slaney, Google, and George Zarur, DHS/TSA (retired), for helping with the speaker selection.
- Suriyun Whitehead, Booz Allen Hamilton, for reviewing the executive summary for this report.
- Harry Martz, LLNL, for taking notes.

The workshop would not have been a success without the participants and the speakers. We extend our heartfelt thanks to them for their contributions.

6. Workshop Planning and Support

The planning committee for the workshop consisted of the following people:

Carl Crawford, Csuptwo

Harry Martz, Lawrence Livermore National Laboratory

Michael Silevitch, Northeastern University

The workshop was moderated by:

Carl Crawford, Csuptwo

The body of the final report was written by:

Carl Crawford, Csuptwo

Harry Martz, Lawrence Livermore National Laboratory

The final report was assembled by:

Teri Incampo, Northeastern University

Minutes were taken by:

Suriyun Whitehead, Booz Allen Hamilton

Logistics for the workshop were led by:

Melanie Smith, Northeastern University

Other logistics were handled by:

Sara Baier, Northeastern University

Deanna Beirne, Northeastern University

Kristin Hicks, Northeastern University

Teri Incampo, Northeastern University

Anne Magrath, Northeastern University

The SSI review was performed by:

Horst Wittmann, Northeastern University

7. Appendix: Notes

This section contains miscellaneous notes about the workshop itself and the final report.

1. The timing in the agenda was only loosely followed because of the amount of discussion that took place during the presentations and to allow for additional times for participants to network.
2. Some of the presenters edited their material (mainly redacted information) after the workshop.
3. The minutes were edited for purposes of clarity. All errors in the minutes are due to the editors of this report and not due to the speakers themselves. Minutes were only recorded during the question and answer period for each presentation.
4. PDF versions of the presentations from this workshop can be found at the following link: https://myfiles.neu.edu/groups/ALERT/strategic_studies/ADSA13_Presentations.

8. Appendix: Agenda

8.1 October 28, 2015 - Day 1

TIME	TOPIC	SPEAKER	AFFILIATION
	Introduction		
8:00	**Registration/Continental Breakfast**		
9:00	Welcoming remarks - ALERT	Michael Silevitch	ALERT / NEU
9:05	Welcoming remarks - DHS	Laura Parker	DHS
9:10	Workshop Objectives	Carl Crawford	Csuptwo
	DHS Apex Program - Aviation Checkpoint of the Future		
9:30	Program Overview	Kumar Babu	DHS
9:50	Open Discussion		
10:35	**Break**		
	Video Analytics		
11:05	Full Scale Airport Security Checkpoint Surveillance using a Camera Network	Srikrishna Karanam	Rensselaer Polytechnic Institute
11:25	Human Pose Estimation from Static Video Images	Henry Medeiros	Marquette University
11:40	Open Discussion		
11:55	**Lunch**		
	Assessing and Using Risk		
12:45	"Risk Based" Strategy in Aviation Security	Rafi Ron	New Age Security Solutions
1:15	Validating Models of Adversary Behaviors	Jun Zhuang	University at Buffalo
1:40	Game Theory - An Outside Party Perspective	Jun Zhang	University of Wisconsin-Milwaukee
1:55	Open Discussion		
	Miscellaneous Topics		
2:30	Airport Passenger Screening Using Backscatter X-Ray Machines	Harry Martz	Lawrence Livermore National Laboratory
2:45	Task-Specific Information for Analysis and Design of Advanced X-Ray Explosive Threat Detection	Amit Ashok Mark Neifeld	University of Arizona
3:10	Checkpoint Security Screening Trade-offs	Amir Neeman	Amir Neeman Consulting

TIME	TOPIC	SPEAKER	AFFILIATION
3:35	Open Discussion		
3:50	**Break**		
	Standards		
4:20	Necessary or Sufficient: Vendor Neutral Airports and DICOS	Suriyun Whitehead	Booz Allen Hamilton
4:35	Development of Standards: "Digital Imaging and Communication in Security (DICOS)"	Harry Massey	National Electrical Manufacturers Association (NEMA)
4:55	Open Discussion		
	Trace Detection		
5:15	Advances in Trace Detection	Laura Parker Richard Lareau	DHS TSL
5:35	Open Discussion		
6:00	**Adjourn**		

8.2 October 29, 2015 - Day 2

TIME	TOPIC	SPEAKER	AFFILIATION
	Introduction		
7:30	**Registration/Continental Breakfast**		
8:00	Call to Order- Day 2	Carl Crawford	Csuptwo
	Fusion		
8:10	Review of Previous ADSAs Addressing Fused Systems (ADSA05 and ADSA06)	Harry Martz	Lawrence Livermore National Laboratory
8:30	ATRs with Analog Ouputs-Developing and Test	Sondre Skatter	Morpho Detection
8:45	Open Discussion		
9:20	**Break**		
	Emerging Algorithms and Hardware		
9:50	Novatrans and Terasafe Intro	Eran Gabbai	Terasafe
10:10	XRD CZT Technology for Checkpoint Screening	Kris Iniewski	Redlen Technologies
10:20	Image Super Resolution	Jun Zhang	University of Wisconsin-Milwaukee

TIME	TOPIC	SPEAKER	AFFILIATION
10:35	High Performance Iterative CT Reconstruction using Super-Voxel Technology	Charles Bouman Sherman Kisner	Purdue University High Performance Imaging
10:45	Open Discussion		
Automated Threat Detection			
11:05	Setting the Stage	Carl Crawford	Csuptwo
11:15	Reducing the Time for Deploying new ATRs	Matthew Merzbacher	Morpho Detection
11:35	Preventing Overfitting in Adaptive Data Analysis	Jonathan Ullman	NEU
12:05	Open Discussion		
12:25	**Lunch**		
Third Party Involvement			
1:15	Working WIth Third Parties	Carl Crawford	Csuptwo
1:25	System Architecture	Frank Cartwright	TSA
1:40	Third Party Perspective on Third Party Involvement	Chad Johnson	Telesecurity Sciences
1:50	Vendor Perspective on Third Party Involvement	Piero Landolfi	Morpho Detection
2:00	Vendor Perspective on Third Party Involvement	David Schafer Sergey Simanovsky	Analogic
2:10	Third Party Involvement with ALERT	John Beaty	NEU/ALERT
2:20	SAFETY Act: The Support Anti-Terrorism by Fostering Effective Technologies Act of 2002	Andrea Schultz	DHS
3:40	Open Discussion		
Next Steps			
3:00	Perspectives on: Screening of personnel and divested items at the checkpoint	Harry Martz Carl Crawford	LLNL Csuptwo
Closing Remarks			
3:50	Closing Remarks	Michael Silevitch	NEU/ALERT
3:55	Closing Remarks	Laura Parker	DHS
4:00	**Adjourn**		

9. Appendix: Previous Workshops

Information about the previous eleven workshops, including their final reports, can be found at: www.northeastern.edu/alert/transitioning-technology/strategic-studies.

10. Appendix: List of Participants

NAME		AFFILIATION
Farzin	Aghdasi	Rapiscan Systems
Timothy	Ashenfelter	Department of Homeland Security
Amit	Ashok	University of Arizona
David	Atkinson	Pacific Northwest National Laboratory
Erick	Audet	Optosecurity
Parisa	Babahedarian	Boston University
Kumar	Babu	Department of Homeland Security
Sara	Baier	Northeastern University
Douglas	Bauer	Department of Homeland Security
John	Beaty	Northeastern University
Simon	Bedford	Astrophysics Inc.
Deanna	Beirne	Northeastern University
Tim	Bortz	Polestar
Charles	Bouman	Purdue University
Toby	Breckon	Durham University
Emel	Bulat	Northeastern University
Frank	Cartwright	Transportation Security Administration
David	Castañón	Boston University
John	Chang	Lawrence Livermore National Laboratory
Gongyin	Chen	Varian Medical Systems
James	Connelly	Integrated Defense and Security Solutions
Aaron	Courture	American Science and Engineering, Inc.
Andrew	Cox	Department of Homeland Security
Carl	Crawford	Csuptwo
Gerry	Delisle	General Dynamics
Jason	Dickinson	University of Massachusetts- Lowell
Dolan	Falconer	ScanTech IBS
Tomi	Falt	Detection Technology, Inc.
Jonathan	Foley	Tufts University
Alfred	Forbes	ScanTech IBS
John	Fortune	HXI, LLC
Raymond	Fu	Northeastern University

NAME		AFFILIATION
Tobias	Funk	Triple Ring Technologies
Eran	Gabbai	Terasafe
Erin	Gallagher	Schafer Corporation
William	Garrett	Transportation Security Administration
Keith	Goll	Transportation Security Administration
Brian	Gonzales	XinRay Systems LLC
Chris	Green	ScanTech IBS
Chris	Gregory	Smiths Detection
Craig	Gruber	Northeastern University
Peter	Harris	Yankee Foxtrot, Inc.
Kristin	Hicks	Northeastern University
Charles	Hone	MITRE Corporation
Paul	Hurd	Passport Systems Inc.
Teri	Incampo	Northeastern University
Kris	Iniewski	Redlen
Edward	Jimenez	Sandia National Laboratories
Eric	Johnson	SureScan
Chad	Johnson	Telesecurity Sciences, Inc.
Srikrishna	Karanam	Rensselaer Polytechnic Institute
Clem	Karl	Boston University
Tracy	Kennedy	General Dynamics AIS
Kathleen	Kiernan	Kiernan Consulting Group
Sherman	Kisner	High Performance Imaging
Robert	Klueg	Department of Homeland Security
Shiva	Kumar	Rapiscan Laboratories, Inc.
Roderick	Kunz	Lincoln Laboratory
Hanh	Lai	Morpho Detection
Pierfrancesco	Landolfi	Morpho Detection
Richard	Lareau	Department of Homeland Security
Tanushree	Luke	Department of Homeland Security
Kaishi	Ma	Nuctech Company Limited
Douglas	MacIvor	Department of Homeland Security
Anne	Magrath	Northeastern University
Julien	Marin	VOTI Inc.

NAME		AFFILIATION
Ignacio	Martinez-Moyano	Argonne National Laboratory
Harry	Martz	Lawrence Livermore National Laboratory
Harry	Massey	National Electrical Manufacturers Association
Barry	Masters	Department of Homeland Security
Matt	McGlynn	MITRE Corporation
Henry	Medeiros	Marquette University
Matthew	Merzbacher	Morpho Detection
Eric	Miller	Tufts University
Ronald	Molway	Quasars
Will	Moulder	MIT Lincoln Laboratory
Amir	Neeman	Amir Neeman Consulting LLC
Mark	Neifeld	University of Arizona
Mohammad	Nemati	Northeastern University
Jim	Olson	Stratovan Corporation
Jimmie	Oxley	University of Rhode Island
Basak	Oztan	American Science and Engineering, Inc.
Laura	Parker	Department of Homeland Security
John	Parmeter	Sandia National Laboratories
Brent	Pernak	Transportation Security Administration
Alicia	Pettibone	Department of Homeland Security
Simon	Pongratz	L-3 Communications
Peter	Prodzenko	Transportation Security Administration
Richard	Radke	Rensselaer Polytechnic Institute
Robert	Rains	MITRE Corporation
Carey	Rappaport	Northeastern University
Tim	Rayner	MultiX Detection
Martin	Rommel	American Science and Engineering, Inc.
Rafi	Ron	New Age Security Solutions
Susan	Rose-Pehrsson	Naval Research Laboratory
Peter	Rothschild	American Science and Engineering, Inc.
Michael	Saunders	General Dynamics AIS
David	Schafer	Analogic Corporation
Andrea	Schultz	Department of Homeland Security
Firas	Shaikh	Transportation Security Administration

NAME		AFFILIATION
Michael	Silevitch	Northeastern University
Sergey	Simanovsky	Analogic Corporation
Sondre	Skatter	Morpho Detection
Melanie	Smith	Northeastern University
Tim	Smith	Transportation Security Administration
Armita	Soroosh	Transportation Security Administration
Emmanuel	St-Aubin	VOTI Inc.
Earle	Stewart	HXI, LLC
Zachary	Sun	Boston University
Ling	Tang	Rapiscan Laboratories, Inc.
Kyle	Thompson	Sandia National Laboratories
David	Throckmorton	Department of Homeland Security
Luis	Tirado	Northeastern University
Brian	Tracey	Tufts University
Jonathan	Ullman	Northeastern University
Alex	Van Adzin	BMG Ventures
Amit	Verma	Capture, LLC
Lou	Wainwright	Triple Ring Technologies, Inc.
Dana	Wheeler	Radio Physics Solutions
Alyssa	White	Northeastern University
Suriyun	Whitehead	Booz Allen Hamilton
David	Wiley	Stratovan Corporation
Mark	Witinski	Eos Photonics
Steve	Wolff	Wolff Consulting Services
Jun	Zhang	University of Wisconsin- Milwaukee
Jun	Zhuang	University of Buffalo

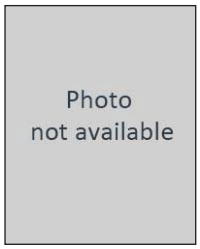
Note: The list of participants reflects those individuals that registered for either Day 1 or Day 2 of ADSA13. Any errors are due to the editors of this report and not to the participants themselves.

11. Appendix: Presenter Biographies

Amit Ashok

Amit Ashok is an Assistant Professor in the College of Optical Sciences and the Department of Electrical and Computer Engineering at the University of Arizona. He received his Ph.D. and M.S. degrees in ECE from University of Arizona and University of Cape Town in 2008 and 2001 respectively. He directs the Intelligent Imaging and Sensing Lab (I^2SL) and has over 15 years of research experience in both industry and academia spanning the areas of computational/compressive imaging and sensing, Bayesian inference, statistical learning theory and information theory. He has made key contributions in task--based joint--design framework for computational imaging and information--theoretic system performance measures such as the task--specific information across various DARPA, Army and DHS programs ranging from EO/IR to X--ray modalities. He has over 30 peer--reviewed publications and several patents, and has been invited to speak at various OSA, IEEE, SIAM, SPIE and Gordon research conferences. Currently he serves as a general chair of SPIE conferences on Anomaly Detection and Imaging with X--rays (ADIX) and Computational Imaging (CI).

Kumar Babu



Kumar Babu is Branch Chief of Aviation Security in the Explosives Division of DHS's Science & Technology Directorate. He directs S&T support of innovative technologies that extend the capability of systems covering Air Cargo, Checkpoint Passenger and Baggage screening, Checked baggage and Trace. He was also the Program Manager, during the initiation phase, of the Apex Screening at Speed program and successfully obtained funding approval for the program. Most of the individual programs constituting Apex fall under the Aviation Security Group.

Kumar has over 30 years' experience in engineering, with about 20 of them being in the explosive detection and biometrics industries. He has held very senior positions, many of them involving management of multimillion dollar programs, at L-1 Identity Solutions (now part of Morpho Trust), Rapiscan, Analogic, L-3 Communications, and Texas Instruments Defense Systems (now Raytheon). Kumar has been intimately involved both directly, and as a consultant, in almost all facets of explosive detection technologies, biometric technologies and credential authentication technologies. Kumar has a successful

record of getting many EDS and biometric systems designed, certified, installed and operational at over 20 airports.

John Beaty

John Beaty serves as the Director of Technology Programs for ALERT and the Bernard M. Gordon Center for Subsurface Sensing and Imaging Systems (Gordon-CenSSIS). He also co-teaches the Engineering Leadership course for the Gordon Engineering Leadership Program. Mr. Beaty has extensive experience managing research and development for the scientific instrument, semiconductor, and government contract industries. John spent 30 years with three companies, Thermo Electron Corporation, Schlumberger Test and Transactions, and FEI Company developing a wide variety of instruments and tools, using diverse technologies. In most instances, John procured development resources from a variety of sources: government, industry, industry consortia, and venture capital.

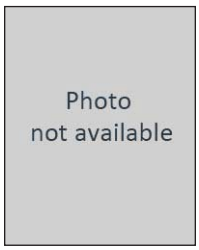
Charles A. Bouman

Charles A. Bouman received a B.S.E.E. degree from the University of Pennsylvania in 1981 and a MS degree from the University of California at Berkeley in 1982. From 1982 to 1985, he was a full staff member at MIT Lincoln Laboratory and in 1989 he received a Ph.D. in electrical engineering from Princeton University. He joined the faculty of Purdue University in 1989 where he is currently the Showalter Professor of Electrical and Computer Engineering and Biomedical Engineering. He also is a founding co-director of Purdue's Magnetic Resonance Imaging Facility located in Purdue's Research Park.

Professor Bouman's research focuses on the use of statistical image models, multiscale techniques, and fast algorithms in applications including tomographic reconstruction, medical imaging, and document rendering and acquisition. Professor Bouman is a Fellow of the IEEE, a Fellow of the American Institute for Medical and Biological Engineering (AIMBE), a Fellow of the society for Imaging Science and Technology (IS&T), a Fellow of the SPIE professional society. He is also a recipient of IS&T's Raymond C. Bowman Award for outstanding contributions to digital imaging education and research, has been a Purdue University Faculty Scholar, received the College of Engineering Engagement/Service Award, and Team Award, and in 2014 he received the Electronic Imaging Scientist of the Year award. He was previously the Editor-in-Chief for the IEEE Transactions on Image Processing and a Distin-

guished Lecturer for the IEEE Signal Processing Society, and he is currently the Vice President of Technical Activities for IEEE Signal Processing Society. He has been an associate editor for the *IEEE Transactions on Image Processing* and the *IEEE Transactions on Pattern Analysis and Machine Intelligence*. He has also been Co-Chair of the 2006 SPIE/IS&T Symposium on Electronic Imaging, Co-Chair of the SPIE/IS&T conferences on *Visual Communications and Image Processing 2000* (VCIP), a Vice President of Publications and a member of the Board of Directors for the IS&T Society, and he is the founder and Co-Chair of the SPIE/IS&T conference on Computational Imaging.

Frank Cartwright



Frank Cartwright is a Technology Portfolio Manager for the Transportation Security Administration. He has approximately 15 years of government service as a systems engineer supporting the requirements and strategic system development of Checked Baggage systems, Cargo (i.e. Intermodal) systems, and Passenger Screening Systems, and is currently supporting the Mission Analysis Division as the Technology Portfolio Manager within the Requirements Branch.

Carl Crawford

Carl R. Crawford, Ph.D., is president of Csuptwo, a technology development and consulting company in the fields of medical imaging and Homeland Security. He has been a technical innovator in the fields of computerized imaging for more than thirty years. Dr. Crawford was the Technical Vice President of Corporate Imaging Systems at Analogic Corporation, Peabody, Massachusetts, where he led the application of signal and image processing techniques for medical and security scanners. He developed the reconstruction and explosive detection algorithms for a computerized tomographic (CT) scanner deployed in airports worldwide. He was also employed at General Electric Medical Systems, Milwaukee, Wisconsin, where he invented the enabling technology for helical scanning for medical CT scanners, and at Elscint, Haifa, Israel, where he developed technology for cardiac CT scanners. He also has developed technology for magnetic resonance imaging (MRI), single photon emission tomography (SPECT), positron emission tomography (PET), ultrasound imaging (U/S), dual energy imaging and automated threat detection algorithms based on computer aided detection (CAD). Dr. Crawford has a doctorate in electrical engineering from Purdue University. He is a Fellow of the Institute of Electrical and Electronics Engi-

neers (IEEE), a Fellow of the American Association of Physicists in Medicine (AAPM), and is an associate editor of *IEEE Transactions on Medical Imaging*.

Gabbai Eran

Gabbai Eran is a serial entrepreneur that spent the past 20 years in studying water-based applications. He is an autodidact in the fields of Physics, Chemistry, Biology and Mathematics .In the past decade, Mr. Eran has focused on collaborating with professors Eshel Ben-Jacob and Prof. Yakir Aharonov from the Tel-Aviv University on studies in Biological Physics and Quantum Mechanics and with Prof. Arie Zaban from the Bar-Ilan University on Nanotechnology research. He has also conducted research on biofilms with Dr. Yoram Siegel, head of the Urology Department at Asaf-Ha-Rofe hospital and with Prof. Shlomo Magdassi from the Casali Institute of Applied Chemistry of the Hebrew University. Working with water and trying to better understand how to use and control this medium hit a break wall, lack of technology that can better visualizes structures and networking in time frame of Ps (Terahertz domain) this break wall prevent finding better solutions for today's problems.

Kris Iniewski

Krzysztof (Kris) Iniewski is managing R&D development activities at Redlen Technologies Inc., a detector company based in British Columbia, Canada. During his 10 years at Redlen he managed development of highly integrated CZT detector products in medical imaging and security applications. Prior to Redlen Kris hold various management and academic positions at PMC-Sierra, University of Alberta, SFU, UBC and University of Toronto.

Dr. Iniewski has published over 100 research papers in international journals and conferences. He holds 18 international patents granted in USA, Canada, France, Germany, and Japan. We wrote and edited several books for Wiley, Cambridge University Press, Mc-Graw Hill, CRC Press and Springer. He is frequent invited speaker and has consulted for multiple organizations internationally. He received his Ph.D. degree in electronics (honors) from the Warsaw University of Technology (Warsaw, Poland) in 1988. He can be reached at kris.iniewski@gmail.com.

Chad Johnson

Chad Johnson has been employed by Telesecurity Sciences since 2014. His work experience includes CT reconstruction and ATD algorithms.

Srikrishna Karanam

Srikrishna Karanam is a Ph.D. student in the Department of Electrical, Computer, and Systems Engineering at Rensselaer Polytechnic Institute, Troy NY. He received the Bachelor of Technology degree in Electronics and Communication Engineering from the National Institute of Technology Warangal in 2013 and the Master of Science degree in Electrical Engineering from Rensselaer Polytechnic Institute in 2014. His research interests include computer vision, video processing, machine learning, and optimization.

Piero Landolfi

Mr. Landolfi has over 18 years of experience in the field of aviation security. In his current role, he is responsible for leading all the engineering activities for Morpho Detection's CT products including new product development, customizations, algorithm development, sustaining activities and so on. Mr. Landolfi joined InVision Technologies (now Morpho Detection) in 1997, as part of the team that designed the CTX9000, the first Explosive Detection System (EDS) explicitly designed for in-line applications. Prior to his current position Mr. Landolfi held a variety of roles, including managing the image processing team, leading the research effort into combining CT with other technologies and managing the development of the CTX 9800 DSi, with more than 200 units deployed in the US and abroad.

Mr. Landolfi holds a Laurea in Physics from the University of Rome, with a thesis in Experimental Cosmology focused on detecting cosmic strings in the Universe. He holds 7 US Patents in the field of aviation security and was awarded the 2006 GE Innovation Edison Award for his work on CT development.

Richard Lareau

Richard Lareau is the Acting Technical Director and Chief Scientist for the Transportation Security Laboratory, Science & Technology Directorate, Department of Homeland Security. Dr. Lareau holds a Ph.D. in analytical chemistry from Arizona State University. At DHS, he is involved in external and internal explosives detection RT&E programs that span several technology areas, including trace and bulk detection. Additionally, Dr. Lareau is Subgroup Chair for DoD's CTTSO/TSWG CBRNE programs. Previously, Dr. Lareau worked as a senior researcher at the Army Research Laboratory, Electronic Technology & Devices Laboratory, Sensors Division, at Ft. Monmouth, N.J. and Adelphi, M.D., laboratories.

As an analytical chemist, Dr. Lareau established and operated DOD's state-of-the-art Advanced Microanalysis Laboratory and materials processing groups. Dr. Lareau is co-Organizer and Scientific Advisor of two scientific workshop series; The Annual Workshop on Secondary Ion Mass Spectrometry and the Annual Workshop on Trace Explosives Detection.

Harry E. Martz

Photo
not available

Harry Martz is the Director for Non-destructive Characterization Institute and a distinguished member of the technical staff at Lawrence Livermore National Laboratory. He is also Principal Investigator (PI) on Department of Homeland Security, Science and Technology, Explosive Division Projects and PI for Domestic Nuclear Detection Office, Nuclear and Radiological Imaging Platform and Passive And X-ray Imaging Scanning projects. Harry joined the Laboratory in 1986 as a Physicist to develop the area of X-ray imaging and proton energy loss computed tomography for the non-destructive inspection of materials, components, and assemblies. He received his M.S. and Ph.D. in Nuclear Physics/Inorganic Chemistry from Florida State University, and his B.S. in Chemistry from Siena Collage.

Harry's interests include the research, development and application of non-intrusive characterization techniques to better understand material properties and inspection of components and assemblies, and generation of finite element models from characterization data. He has applied CT to inspect one-millimeter sized laser targets, automobile and aircraft components, reactor-fuel tubes, new production reactor target particles, high explosives, explosive shape charges, dinosaur eggs, concrete and for non-destructive radioactive assay of waste drum contents. Recent R&D efforts include CT imaging

for conventional and homemade explosives detection in luggage and radiographic imaging of cargo to detect special nuclear materials and radiological dispersal devices. Dr. Martz has authored or co-authored over 300 papers and is co-author of a chapter on Radiology in Non-destructive Evaluation: Theory, Techniques and Applications, Image Data Analysis in Non-destructive Testing Handbook, third edition: Volume 4, Radiographic Testing, and contributed a chapter entitled Industrial Computed Tomographic Imaging to the Advanced Signal Processing Handbook: Theory and Implementation for Radar, Sonar and Medical Imaging Real-Time Systems. He has also served on several National Academy of Sciences Committees on Aviation Security and was the Chair of the Committee on Airport Passenger Screening: Backscatter X-Ray Machines. Harry has been co-chair of the Awareness and Localization of Explosives-Related Threats, Advanced Development for Security Applications Workshops. Dr. Martz has presented a short course on CT imaging at The Center for Non-destructive Evaluation, Johns Hopkins University and a course on X-ray Imaging for UCLA's Extension Program. Awards include 2000 R&D 100 WIT-NDA (Waste Inspection Tomography for Nondestructive Assay), 1998 Director's Performance Award Active and Passive Computed Tomography and Federal Laboratory Consortium for Technology Transfer 1990 Award of Merit. He is a member of the Physics Honor Society Sigma Pi Sigma.

Harry Massey

Harry Massey has worked at NEMA since 2003. He manages six product sec-tions including the Industrial Imaging and Communication Section which leads the effort to develop Digital Imaging and Communication in Security (DICOS) standard in partnership with DHS and TSA.

Henry Medeiros

Henry Medeiros has been conducting research and development on systems and algorithms for computer vision, robotics, sensor networks, and embedded systems for over 10 years. As an Assistant Professor of Electrical and Computer Engineering at Marquette University, he directs the Computer Vision and Sensing Systems lab, where his group is devising novel methods and systems to process information collected by cameras and other kinds of sensors to understand

and interact with the world. The work carried out by his group has found applications ranging from agricultural automation, to security and surveillance, to biomedical imaging.

Before joining Marquette, Dr. Medeiros was a Research Scientist at Purdue University, where he carried out research on robotic vision technologies for automated pruning of fruit trees, one of the most labor-intensive activities in the production of fruits and other high value crops. He was also the Chief Technology Officer of Spensa Technologies, a technology startup company at the Purdue Research Park, where he led the team that designed the Z-Trap, an automated insect pest monitoring device for agricultural crops, which is currently being used in four continents.

Previously, as an Assistant Professor of Electrical Engineering at the Federal University of Technology of Parana in Brazil, Dr. Medeiros gave continuation to the work he started during his doctoral studies which resulted in the development of novel protocols for collaborative object tracking in camera networks as well as new image understanding algorithms for advanced embedded architectures, such as the histogram-based particle filter for target tracking in massively parallel smart cameras.

Dr. Medeiros received his PhD from the School of Electrical and Computer Engineering at Purdue University in 2010 as a Fulbright scholar. He also holds a B.S. and an M.S. degree in Electrical Engineering from the Federal University of Technology of Parana in Brazil.

Matthew Merzbacher

Dr. Merzbacher is Director of Product Qualifications at Morpho Detection (part of the SAFRAN group), where he is responsible for detection testing across Morpho's products for explosives and radiation detection. In addition to maintaining an active technical career, Dr. Merzbacher is chair of the ANSI standards group on image quality for CT-based explosives detection systems and chaired the NEMA DICOS Threat Detection Working Group. He joined InVision Technologies in 2003 as a Research Scientist in the Machine Vision group before taking over as manager of that group. Dr. Merzbacher has a Ph.D. in Computer Science from UCLA, specializing in data mining. He has several patents on image processing for explosives detection.

Amir Neeman

Amir Neeman is the Founder and Principal of Amir Neeman Consulting, LLC.

For over 25 years, Mr. Neeman has been involved in aviation security, homeland protection; specifically focusing on Transportation Security Equipment (TSE). His diverse background (as an airport operator, government regulator, equipment manufacturer and strategic advisor to TSA enables him to utilize a holistic approach critically required to develop and implement successful and sustainable security solutions. A globally recognized expert in systems analysis and TSE design, development and implementation, TSE test & evaluation (T&E), business analysis and change management for large and complex project teams and a frequent public speaker and writer on these topics.

From 2005 to 2015, Mr. Neeman headed the Security Practice at LeighFisher where he assisted the TSA and many airports with key nationwide studies related to strategic planning and deployment of TSE. During 2002-2005 Mr. Neeman led the Product Management of CT-based EDS at InVision / GE. During 1994-2001, Mr. Neeman was Head of the Security Technologies Research & Implementation Branch at the Israeli Security Agency (ISA) and during 1991-1994 he managed the technical security screener unit at the Israeli Airports Authority (Ben Gurion Airport). Mr. Neeman holds an MBA (Technology Management Major) from the Technion Institute of Technology, Israel and is a former IDF Explosive Ordinance Disposal Officer.

Laura Parker

Laura Parker is a Program Manager in the Explosives Division of the Science and Technology Directorate at the Department of Homeland Security (DHS) as well as the Program Manager for the ALERT Center of Excellence, a DHS-sponsored consortium of universities performing research that address explosive threats lead by Northeastern University. She works on multiple projects for trace detection of explosives and algorithm development for improved explosives detection. Previous to her present position at DHS, Laura worked as a contractor providing technical and programmatic support of chemical and biological defense and explosives programs for several Department of Defense (DoD) offices. She also worked in several DoD Navy laboratories in the field of energetic materials. She obtained her Ph.D. in chemistry from the Pennsylvania State University.

Rafi Ron

Photo
not available

Rafi Ron is the founder and CEO of New Age Security Solutions (NASS) since its establishment in 2001. Prior to NASS Rafi served as Director of Security at Ben Gurion Tel Aviv Airport for five years. Rafi started his Counter terrorism career serving as a company commander in the Israel Defense Forces (IDF) paratrooper Corp after which he was among the group that founded the Israeli Air Marshall program, serving as an Air Marshall himself. After the terrorist attack at the Munich Olympics, Rafi was called to help in a major revamp of security in Israeli Embassies worldwide. He served as Chief Security Officer at the Israeli Mission to the U.N..

In 1974 Rafi moved to The Israeli Prime Minister office where he served as Special Operations and Intelligence officer for the next 20 years retiring at the rank of Colonel. After 5 years at Ben Gurion Airport and two weeks after 9/11/2001, Rafi was invited by Massport to come to Logan Airport and lead the revamp of security at the airport. The results of the work done at Logan were widely praised by local and Federal Authorities and led to similar projects in numerous Cat-X airports in the U.S. and worldwide. Among NASS outstanding achievements was the creation of the famous Behavior Pattern Recognition program that is aimed at detection of terrorist and other violent criminals prior to their attack by behavior observation and a follow on methodology.

David Schafer

Photo
not available

Dr. Schafer is Director of Physics, Reconstruction, and Detection and a Technical Fellow at Analogic with over 25 years' experience in research and development of security imaging systems including cargo, personnel, checked and cabin bag screening systems. The physics group at Analogic is responsible for all elements of beamline design, image reconstruction, and detection algorithms for medical and security CT system. For 17 of the past 19 years, Dr. Schafer has worked as project physicist, technical vice president, and his current role, and was on the project team responsible for development of several TSA certified EDS systems. The other 2 years involved work on personnel and baggage screening systems at Reveal Imaging. Prior to joining Analogic, Dr. Schafer worked as Director of Engineering at American Science and Engineering, with a focus on cargo and personnel security systems and non-destructive testing R&D. Dr. Schafer has a B.A. in math and physics from Bowdoin College, and a M.A. and Ph.D. in physics from Rice University.

Andrea T. Schultz

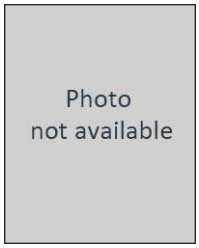
Ms. Andrea T. Schultz, CPP, is the Deputy Director of the Office of SAFETY Act Implementation (OSAI). Prior to her assignment with OSAI, she was at NPPD where she was the Acting Branch Chief for the Critical Industries Branch, and prior to that assignment she was the Section Chief for the Commercial Facilities Sector, in the Sector Outreach and Programs Division of the Office of Infrastructure Protection.

She is a former US Army Explosive Ordnance Disposal (EOD) Technician and a graduate of American Military University; holds a Bachelor's Degree in Homeland Security with a concentration on Threat, and a Master's Degree in Security Management.

Michael B. Silevitch

Michael B. Silevitch is currently the Robert D. Black Professor of Engineering at Northeastern University in Boston, an elected fellow of the IEEE, the Director of the Homeland Security Center of Excellence for Awareness and Localization of Explosives Related Threats (ALERT) and the Director of the Bernard M. Gordon Center for Subsurface Sensing and Imaging Systems (Gordon-CenSSIS), a graduated National Science Foundation Engineering Research Center (ERC). His training has encompassed both physics and electrical engineering disciplines. An author/co-author of over 65 journal papers, his research interests include laboratory and space plasma dynamics, nonlinear statistical mechanics, and K-12 science and mathematics curriculum implementation. Prof. Silevitch is also the creator of the Gordon Engineering Leadership (GEL) Program at Northeastern University, a graduate curriculum offered through the College of Engineering, with the mission of creating an elite cadre of engineering leaders. He and the current GEL Director, Simon Pitts, were recently awarded the 2015 Bernard M. Gordon Prize for Engineering Education by the National Academy of Engineering (NAE).

Sergey Simanovsky



Dr. Simanovsky has been active in the field of computerized imaging for 18 years. A significant portion of his work during this time has been developing methods for the detection of explosives and other contraband using CT scanners.

His other activities are related to the beam line design and image reconstruction methods for security and medical volumetric CT scanners, and also to advanced visualization methods. Dr. Simanovsky has a Ph.D. in Physics from Worcester Polytechnic Institute. He is an author of more than 30 US patents.

Sondre Skatter

Sondre Skatter, Ph.D. is Chief Algorithm Scientist in the Newark office of Morpho Detection, LLC. He received the Diploma degree in physics from the Norwegian University of Science and Technology and a Ph.D. from the Norwegian University of Life Sciences. He is currently managing two DHS programs, the Next Gen XRD program and Risk Based Screening with POMDP, in additional to leading internal research in X-ray diffraction, CT and trace detection.

Sondre Skatter joined Morpho Detection D in 1998 as a Physicist and has been responsible for a number of key developments and inventions, including a distributed risk-based framework for fusing data from explosives detection systems and novel concepts for employing x-ray physics to provide material identification. Since 2011, Skatter has served as Manager of Research and Development. In his role, Skatter directed the current pipeline of externally funded R&D activities around EDS technologies. Skatter holds a PhD degree from the Norwegian University of Life Sciences in Norway.

Jonathan Ullman

Jonathan Ullman joined Northeastern University in the College of Computer and Information Science as an assistant professor in Fall 2015. He completed his PhD and a one-year post-doc at Harvard University under the supervision of Salil Vadhan. He has been a Siebel Scholar and was a member of the inaugural class of the Simons Society of Fellows.

His research interests center on privacy-preserving data analysis and its connections to machine learning, cryptography and mechanism design. His work explores algorithms for privacy-preserving

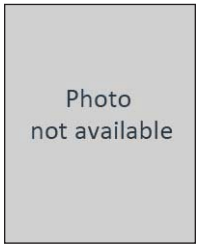
data analysis, the fundamental limits of privacy, and connections between privacy and other areas like the problem of false discovery in empirical science.

Suriyun Whitehead

For over 15 years, Mr. Whitehead has been involved in the force protection and aviation security domains, leading the delivery of solutions addressing a wide variety of technical and programmatic challenges. Mr. Whitehead is developing program initiatives for the Transportation Security Administration Office of Security Capabilities in the areas of: vendor-neutral airports, standardized integration and user interfaces for screening technology, third party development of automated threat detection and recognition algorithms and screening performance validation. He also supported the Department of Homeland Security Science and Technology Directorate, Explosives Division where he enabled the DHS objective to supplement the capabilities and capacities of aviation security vendors, driving the development of the Digital Imaging and Communication for Security (DICOS) standard, expanding the marketplace of screening capabilities, and strengthening the detection of an increased population of homemade explosives. Mr. Whitehead was a staff lead systems engineer with the Boeing Company providing service through PhantomWorks, Homeland Security and Services, and Mission Systems.

He was responsible for the design and deployment of scalable multi-tiered solutions for security command and control, asset visualization and threat assessment services for US Department of Defense, US Department of State, and private sector commercial customers.

Jun Zhang



Jun Zhang received his Ph.D. in electrical engineering from Rensselaer Polytechnic Institute in 1985 and 1988, respectively. He joined the faculty of the Department of Electrical Engineering and Computer Science, University of Wisconsin-Milwaukee, and currently is a professor. His research interests include image processing and signal processing. He has been an associate editor of IEEE Trans. Image Processing and his research has received funding from NSF, ONR, State of Wisconsin, and industry.

Jun Zhuang

Dr. Jun Zhuang is an Associate Professor and Director of Undergraduate Studies, Department of Industrial and Systems Engineering at the University at Buffalo, the State University of New York (UB, or SUNY-Buffalo). Dr. Zhuang's long-term research goal is to integrate operations research, game theory, and decision analysis to improve mitigation, preparedness, response, and recovery for natural and man-made disasters. Other areas of interest include applications to health care, sports, transportation, supply chain management, and sustainability. Dr. Zhuang's research has been supported by the U.S. National Science Foundation (NSF), by the U.S. Department of Homeland Security (DHS) through the National Center for Risk and Economic Analysis of Terrorism Events (CREATE) and the National Consortium for the Study of Terrorism and Responses to Terrorism (START), by the U.S. Department of Energy (DOE) through the Oak Ridge National Laboratory (ORNL), and by the U.S. Air Force Office of Scientific Research (AFOSR) through the Air Force Research Laboratory (AFRL).

Dr. Zhuang is a recipient of the 2014 MOR Journal Award for the best paper published in 2013 in the journal Military Operations Research. Dr. Zhuang is a recipient of the UB's Exceptional Scholar--Young Investigator Award for 2013. Dr. Zhuang is also a fellow of the 2011 U.S. Air Force Summer Faculty Fellowship Program (AF SFFP), sponsored by the AFOSR, and a fellow of the 2009-2010 Next Generation of Hazards and Disasters Researchers Program, sponsored by the NSF. Dr. Zhuang has published ~40 peer-reviewed journal articles in Operations Research, Risk Analysis, and Decision Analysis, the European Journal of Operational Research, Annals of Operations Research, and Military Operations Research, among others. His research and educational activities have been highlighted in The Wall Street Journal, Industrial Engineer, Stanford GSB News, The Council on Undergraduate Research Quarterly, and The Pre-Engineering Times, among others. He is on the Editorial boards of both Risk Analysis and Decision Analysis, is the co-Editor of Decision Analysis Today, and has reviewed proposals for NSF/ASEE/DOD/NASA, book chapters for Springer, and has reviewed articles for 70+ academic journals and conferences for 200+ times.

Dr. Zhuang is also dedicated to mentoring high school, undergraduate, and graduate students in research. Dr. Zhuang's mentoring efforts have been recognized by the 2008 Graduate Student Mentor Award from the University of Wisconsin-Madison, and the 2012 President Emeritus and Mrs. Martin Meyerson Award for Distinguished Teaching and Mentoring from the University at Buffalo.

12. Appendix: Questionnaire

Attendees were asked to fill out a questionnaire providing feedback on the workshop. The questions are listed below; the answers appear in the next section. Responses are grouped by question and then by person; the first respondent is response A for each question, the second respondent is B, and so on.

1. What is your relationship to ALERT?
2. If you are an industry representative, please indicate if you would be in becoming an industrial member of ALERT and Gordon-CenSSIS.
3. How would you rate the ease of the current registration process for ADSA events?
4. How satisfied are you with the format of the ADSA workshop?
5. How satisfied were you with the topics and focus of the ADSA13 presentations and discussion?
6. Which technologies discussed during this workshop show promise?
7. What promising emerging technologies were not discussed at the workshop?
8. What should be done to expedite the deployment of emerging technologies?
9. How should risk-based screening and game-theory be used at the checkpoint?
10. How can third parties be involved in the development of new explosive detection equipment?
11. What did you like or dislike about this workshop?
12. Please rate your overall satisfaction with the ADSA13 workshop.
13. Do you have recommendations for future workshop topics?
14. What would you like to see changed for future workshops?
15. What other comments do you have?

13. Appendix: Questionnaire Responses

Question 1: What is your relationship to ALERT?

A. Government Representative

B. Academia

C. ALERT Team Member

D. Academia

E. ALERT Team Member

F. Government Representative

G. National Lab Representative

H. Industry Representative

I. Industry Representative

J. Industry Representative

K. Academia

L. Industry Representative

M. National Lab Representative

N. Industry Representative

O. Industry Representative

P. Other

Q. Industry Representative

R. Government Representative

S. Industry Representative

T. Government Representative

U. Academia

V. National Lab Representative

W. Academia

X. Industry Representative

Y. National Lab Representative

Z. Industry Representative

AA. Academia

AB. Industry Representative

AC. Industry Representative

AD. Industry Representative

AE. Industry Representative

AF. Industry Representative

AG. Industry Representative

AH. Industry Representative

AI. Industry Representative

AJ. Industry Representative

AK. Industry Representative

AL. Industry Representative

AM. Industry Representative

AN. National Lab Representative

AO. Industry Representative

AP. ALERT Team Member

AQ. Industry Representative

AR. Government Representative

Question 2: If you are an industry representative, please indicate if you would be in becoming an industrial member of ALERT and Gordon-CenSSIS.

A. No response

B. No response

C. No response

D. No response

E. No response

F. No response

G. No response

H. I am not interested in membership.

I. I would be interested in becoming a member or learning more about the benefits of membership: Multix.

J. I would be interested in becoming a member or learning more about the benefits of membership.

K. No response

L. I am not interested in membership.

M. No response

N. I would be interested in becoming a member or learning more about the benefits of membership: New Age Security Solution, Inc.

O. I am already an industry member.

P. No response

Q. I am not interested in membership.

R. No response

S. I would be interested in becoming a member or learning more about the benefits of membership.

T. No response

U. No response

V. No response

W. No response

X. I am already an industry member.

Y. No response

Z. I am not interested in membership.

AA. No response

AB. I am not interested in membership: NEMA.

AC. I would be interested in becoming a member or learning more about the benefits of membership: ScanTech Identification Beam Systems.

AD. I would be interested in becoming a member or learning more about the benefits of membership: TeraSafe.

AE. I am not interested in membership.

AF. I would be interested in becoming a member or learning more about the benefits of membership: ScanTech IBS.

AG. I am not interested in membership.

AH. I am not interested in membership.

AI. I would be interested in becoming a member or learning more about the benefits of membership.

AJ. I am not interested in membership.

AK. I am not interested in membership.

AL. No response

AM. I would be interested in becoming a member or learning more about the benefits of membership: Wolff Consulting Services.

AN. No response

AO. I would be interested in becoming a member or learning more about the benefits of membership: Voti, Inc.

AP. No response

AQ. I am not interested in membership.

AR. No response

Question 3: How would you rate the ease of the current registration process for ADSA events?

A. No response

B. Extremely Easy

C. Extremely Easy

D. Very Easy

E. Extremely Easy

F. Extremely Easy

G. Very Easy

H. Extremely Easy

I. Very Easy

J. Very Easy

K. Extremely Easy

L. Extremely Easy

M. Extremely Easy

N. I did not use registration

O. Very Easy

P. Very Easy

Q. Very Easy

R. Very Easy

S. Extremely Easy

T. Extremely Easy

U. Extremely Easy

V. Very Easy

W. Extremely Easy

X. Very Easy

Y. Very Easy

Z. Very Easy

AA. Very Easy

AB. Very Easy

AC. Very Easy

AD. Extremely Easy

AE. Very Easy

AF. Very Easy

AG. Very Easy

AH. Very Easy

AI. Very Easy

AJ. Extremely Easy

AK. Extremely Easy

AL. Extremely Easy

AM. Very Easy

AN. Extremely Easy

AO. Extremely Easy

AP. Extremely Easy

AQ. I did not use registration

AR. Moderately Easy

Question 4: How satisfied are you with the format of the ADSA workshop?

A. No response

B. Satisfied

C. No response

D. Satisfied

E. Satisfied

F. Satisfied

G. Neither Satisfied nor Disatisfied: If the concept is to execute a workshop, the current approach suffers the challenge of too large of a forum that is dominated by a handful of strong personalities. Perhaps it would be possible to have a few breakout working sessions that is mixed general sessions as bookends.

H. Satisfied: I thought at times there was too much time left for discussion and the moderator was trying too hard to fill empty time.

I. Very Satisfied

J. Satisfied: Time management can be improved. We ran behind and then ahead of schedule. Limiting discussions and presentation to the time allotted is critical to the success of the workshop. Some speakers were rushed and some were not at all.

K. Very Satisfied

L. Neither Satisfied nor Disatisfied: Format is OK but balance tilted too far towards discussion this time.

M. Satisfied

N. Very Satisfied

O. Satisfied

P. Satisfied

Q. Satisfied

R. Satisfied

S. Satisfied

T. Satisfied

U. Very Satisfied

V. Satisfied

W. Very Satisfied

X. Satisfied

Y. Satisfied: Agenda is just "a guide" and shouldn't hinder debate/discussion.

Z. Satisfied

AA. Satisfied

AB. Satisfied

AC. Very Satisfied

AD. Very Satisfied: It was my first time. I learned allot.

AE. Satisfied

AF. Satisfied

AG. Very Satisfied

AH. Satisfied

AI. Satisfied

AJ. Very Satisfied

AK. Neither Satisfied nor Disatisfied: I would like to see more informal networking time, and less discussion during the talks.

AL. Neither Satisfied nor Disatisfied

AM. Very Satisfied

AN. Very Satisfied

AO. Satisfied

AP. Satisfied

AQ. Very Satisfied

AR. Satisfied

Question 5: How satisfied were you with the topics and focus of the ADSA13 presentations and discussion?

A. No response

B. No response

C. No response

D. No response

E. Satisfied

F. Neither Satisfied nor Disatisfied: I would like to see more of what "innovations" are in the works by industry, or what are government's "goals and objectives"; rather than "research" or "Theoretical" topics that I could not understand how they would help. I think they were there to just ask for funding. As much as Carl tried, a handful of presentations (too many in my opinion) completely lacked "what is the objective" or "what does it do for aviation security". I am not against academic research, they are in fact a must and we need to pursue them, but I did not see the value they were presenting in this conference. Additionally, I think it is NOT a good idea to get others talk about someone else's work or paper as they do not have the depth and cannot answer key questions. DO NOT DO IT. ADSA12 was more valuable to me.

G. Satisfied

H. Satisfied: The game theory talks don't seem to fit in.

I. Satisfied

J. Satisfied: Good focus as a follow-on to ADSA13 in April.

K. Very Satisfied

L. Disatisfied: Satisfied with topics but see previous comment about too-lengthy discussions. Of more concern, especially with the discussion format, is that many of the comments could not be heard. Either the speaker must repeat the comment or question, or a microphone must be given to the audience member who is speaking. I could almost never hear what Carl had to say.

M. Satisfied

N. Very Satisfied

O. Satisfied

P. No response

Q. Satisfied

R. Very Satisfied

S. Very Satisfied

T. Satisfied

U. Very Satisfied

V. Satisfied

W. Very Satisfied

X. Neither Satisfied nor Disatisfied

Y. Satisfied

Z. Neither Satisfied nor Disatisfied

AA. Neither Satisfied nor Disatisfied: It is good to include more technical talks from academic research and the audience can evaluate whether the presented research is practical to be done in real situations; if not what concerns should be added and so...

AB. Satisfied

AC. Very Satisfied

AD. Satisfied: Standardization and methods fusion is an issue.

AE. Very Satisfied

AF. Satisfied

AG. Very Satisfied

AH. Satisfied: It was good to see more involvement from the Government customer at this ADSA, than most of the previous ADSA workshops that I've attended.

AI. Satisfied

AJ. Very Satisfied

AK. Satisfied

AL. Very Satisfied

AM. Satisfied: Good to hear a breadth of talks, even if some are not directly relevant to my own area of interest/ influence.

AN. Very Satisfied

AO. Satisfied

AP. Very Satisfied

AQ. Very Satisfied

AR. Very Satisfied

Question 6: Which technologies discussed during this workshop-show promise?

A. No response

B. No response

C. No response

D. No response

E. No response

F. No response

G. Sensor and information fusion efforts.

H. No response

I. 3rd party ATR.

J. CCTV tracking at SSCPs. TeraHertz.

K. XBS looks promising, with the expectation that the ATRs will follow.

L. There seemed a general acceptance that CT could move to the checkpoint and that data fusion would bring significant benefits.

M. No response

N. No response

O. Direct conversion CZT/CdTE x-ray detectors.

P. No response

Q. Screening Methods.

R. Tracking Passengers and Divested Items.

S. No response

T. Video analytics to show checkpoint throughput, queuing time, etc.

U. Tracking, trace detection.

V. Technologies supporting multivendor solutions.

W. No response

X. No response

Y. No response

Z. Terahertz inspection seems interesting and might offer additional capabilities for security screening.

AA. Computed tomography imaging, DICOM and DICOS, High resolution images using dictionary methods, x-ray diffraction imaging, tracing, Running efficient reconstruction algorithms on GPU.

AB. AIT, Third Party Developments.

AC. No response

AD. For my perspective, THz.

AE. Ceiling camera-based passenger and luggage tracking system.

AF. Few View AT Technology for the checkpoint airline security.

AG. All are good.

AH. The introduction of CT's at the checkpoint is inevitable for enhancing aviation security.

AI. Backscatter seems to have the most opportunity to deliver improved AIT ATR performance...

AJ. Risk Based Screening.

AK. No response

AL. Video analytics for tracking, 3rd party algorithms and analytics to improve Pd confidence, Fusion.

AM. X-ray backscatter, Novel image reconstruction techniques, CT technology for checkpoint.

AN. No response

AO. No response

AP. Integrated Checkpoint screening.

AQ. Data mining and computerized risk assesment.

AR. 3rd party software for detection.

Question 7: What promising emerging technologies were not discussed at the workshop?

A. No response

B. No response

C. No response

D. No response

E. No response

F. No response

G. All technologies have promise but all technologies suffers from the lack of measurable and acceptable spiral development. The technology based solution to try to navigate the valley of death for tech maturation is still lacking and coming up short.

H. Fused technologies.

I. Integrated Checkpoint systems.

J. Dual-Energy CT for SSCPs., XRD for SSCPs., MS and next gen ETD.

K. I enjoyed the freeform "crazy ideas" discussion. New tamer ideas may flow from radical thinking exercises.

L. I believe that DRIFTS could be used for trace detection on surfaces such as the handle of a carry-on bag. DRIFTS is Diffuse Reflectance Infra-red Fourier Transform Spectroscopy.

M. No response

N. C4i, Perimeter intusion detection, Video analytics.

O. X-ray diffraction.

P. No response

Q. Deep Learning and Machine Learning.

R. No response

S. No response

T. No response

U. Object detection in CT imagery, firearm detection based on shape analysis, thermal imaging, hyper-spectral sensing.

V. No response

W. No response

X. No response

Y. No response

Z. Transmission x-rays for personnel screening. There was discussion about redeploying backscatter and possibility to educate people. Maybe should educate also about transmission X-rays, which can be now designed to give maybe even smaller _absorbed_ dose than backscatter.

AA. Artifact reduction methods.

AB. No response

AC. No response

AD. THz. I am sure that it will be discuss next time.

AE. No response

AF. Few View AT Technology with the ability to stream data real time providing a SMART Checkpoint.

AG. No response

AH. No response

AI. No response

AJ. No response

AK. No response

AL. No response

AM. RF techniques for passenger inspection (imaging and non-imaging), Standoff detection systems, Non-checkpoint related security.

AN. No response

AO. No response

AP. Sensor Fusion was mentioned but not discussed in detail.

AQ. C4I.

AR. Truth machines for security.

Question 8: What should be done to expedite the deployment of emerging technologies?

A. No response

B. No response

C. No response

D. No response

E. No response

F. No response

G. Building stronger trusted relationships between the broad array of stake holders.

H. Establish vendor-neutral airports like Schiphol in Europe to do testing - TSA should take this on as a priority - nothing better than to test in a real airport.

I. Kick out the incumbents as they stifle change based on their business models.

J. Streamline procurement and T&E process.

K. No response

L. The European model could accelerate new tech deployment since individual airports purchase equipment. We should involve the integrators in ADSA. As a side benefit this might force the issue of vendor interoperability.

M. No response

N. Push info to end users.

O. Early demonstration of technology in realistic environment.

P. No response

Q. Engage people with expertise and background in technology transfer.

R. Unsure. I think that the long pole in the tent is testing and validation. Somehow the testing an validation must become more efficient.

S. Increased level of funding for emerging technologies, and more trans-

parent processes for certifications.

T. Develop an on-going direct relationship with TSA, set up a working group to work through 'Transition' of research into prototypes into products. The topic of transition has been identified as a challenge the last couple of ADSA meetings, but there have been no tangible discussions to address the real issues or ways forward.

U. Putting redundant government owned hardware in the hands of academic research teams - let them test it, bend it, mend it and make it better.

V. No response

W. No response

X. No response

Y. No response

Z. No response

AA. No response

AB. No response

AC. We need members of the TSA executive team to participate in these meetings.

AD. I don't know. It is hard and conservative business.

AE. Overcome governmental inertia and indecision in order to make pro-active decisions BEFORE rather than AFTER a terrorism event.

AF. Government has to establish a standardized spec that all adhere to.

AG. This is challenging. Streamlining funding, product development, certification, integration with airport, and deployment is needed.

AH. More intense vetting at the outset to weed out ideas that don't hold merit, so more time and effort can be spent on those that are more promising. Faster evaluation by the Government customer will also help.

AI. No response

AJ. More flexible standards.

AK. No response

AL. Develop an operational-representative environment for rapid integration and test of emerging technologies. Integrate based on TSA /DHS standards.

AM. Implement a quick look-see test methodology for new technologies. Get new technologies and developers out into the real world as early as possible. Relax the use of SSI and Classified information so that new developers can quickly understand what's needed. Conduct parallel testing for detection and operations rather than todays serial/ linear test methods.

AN. No response

AO. No response

AP. Encourage more teaming between academia, industry & government to jointly arrive at potential solutions. Something like a John Adams Innovation Institute Grant might be a good idea.

AQ. No response

AR. No response

Question 9: How should risk-based screening and game-theory be used at the checkpoint?

A. No response

B. I recommend reading the work of Milind Tambe at USC if you're not already. But this survey is literally the first time I have ever thought about this question.

C. No response

D. No response

E. No response

F. No response

G. Best to use them as tools by SME's and not to try to replace SME's. The human factor cannot be neglected.

H. Risk-based screening must take place as the number of passengers doubles every 10 years - I like random screening over game theory.

I. Randomly in order to adhere to privacy law.

J. Inform operations and technology T&E.

K. No response

L. Consider a 2-stage approach. First use ATR to identify objects of interest. Then divert bags to the 2nd stage such as diffraction. The classification window could be changed according to some risk metric and a larger number of bags diverted for a diffraction test.

M. This is a complex question that needs to be explored in detail. Risk-based screening is at the core of the current approach and would benefit from risk-assessment ideas. At the core of the approach is the idea of treating people in accordance with their risk level. However, how to asses the risk level is unclear. The question related to game theory is even harder to answer as game theory is so vast and could have multiple applications. Additional research in the application of game theoretic concepts to checkpoint understanding and operations is certainly warranted.

N. Look at my presentation page 3.

O. No response

P. No response

Q. To eliminate checkpoints.

R. Unsure. I do not see the to risk-based screening at the check point.

S. It's really a cost-benefit calculation. Knowing that the existing process already has many weak points and security loopholes, a mixture of enhanced risk-based screening and game theory could be used both as an additional deterrent and a improvement on security practices. However, it is highly doubtful that the TSA will want to increase their cost as it relates to the current system in place until another event forces their hand.

T. No response

U. Risk-based screening is important and a clear necessity. Game theory is easy to out-game if we use simple tic-tac-toe type strategies - Does anything actually beat random sampling (weighted or non-weighted based on risk profile) of the travelling public?

V. No response

W. No response

X. With extreme care. A model is only as good as its inputs.

Y. No response

Z. No response

AA. In my opinion, game theory models might not capture the real situation accurately, at least the mouse and cat game discussed in the lecture does not seem to include reasonable assumptions from the real scenario in airport screening; the stackelberg competition is usually used to explain communication scenarios in which there is a competition between users in utilizing the band width.

AB. No response

AC. I am not sure, but technology must be integrated with the sensor vendors at the beginning of the R&D/design process to make it to the field. I believe the technology platforms change too rapidly for this to occur as a third-party effort.

AD. It will never be. For 100% screening with high throughput manner we need and have technology to reach that goal. no need for adding risk.

AE. No response

AF. Secondarily.

AG. In a two-fold manner. First, risk information for a passenger can be transmitted to equipment in order to throttle PD/PFA depending upon the passenger/baggage passing through equipment. This would require changing certification of equipment to consider throttling and also an infrastructure for transmitting risk information. Second, game-theory can be applied In a fused manner. All equipment would need to report relevant information to a centralized analysis engine that applies game-theory techniques to make comprehensive decisions on a passenger, group of passengers, and/or whole plane.

AH. Despite having been around for multiple years now, RBS still remains an ill defined concept. Need to better define it first, and then explore algorithm switching modalities at the checkpoint to implement it effectively. Not convinced yet that game-theory has a place at the checkpoint.

AI. No response

AJ. Individual approach to each person being screened.

AK. No response

AL. Dynamic screening adaptability to optimize security and throughput.

AM. Risk based screening should IMO have 3 categories: Trusted/ PreCheck, Elevated Risk and everyone else. The technologies and staff should be assigned commensurate to the risk posed by each passenger, who would go through the appropriate process. This was part of the original report to IATA that led to PreCheck, but the elevated risk aspect was never developed or implemented.

AN. No response

AO. No response

AP. Not my area of expertise.

AQ. By creating dedicated lanes to different risk levels.

AR. That's a big question.

Question 10: How can third parties be involved in the development of new explosive detection equipment?

A. No response

B. No response

C. No response

D. No response

E. No response

F. No response

G. Third parties need to be a real trusted partner through organizational integration including being brought into be authorized to access the necessary information. The system will not work or be sustainable if that relationship is not solid.

H. They are involved especially with software.

I. Kick out the incumbents.

J. A variety of services that cannot be performed by TSA or OEMs (testing, validation, R&D, etc.).

K. 1. There still seems to be a lack of statistically large amounts of data for 3rd parties to experiment with, which makes sense given the sensitive nature of the data contents. If 3rd parties could follow an application and registration process to be vetted to handle sensitive data with all the typical restrictions of traditional SSI (US entities only of course), data could be made available on a limited basis. This would differ from having to WIN a contract to apply for clearance. 2. Could TSA/DHS open an "innovations center" where vetted and cleared individuals (or groups) could develop algorithms at the TSA facility on approved, TSA provided workstations, thus controlling the data itself in-house to TSA. Alternatively, the TSA could charge for access to the data, to try out algorithms developed off-site, but without sensitive data.

L. Get integrators involved.

M. No response

N. Improve access of small businesses and independant professionals to TSA.

O. If integrated directly to the imaging chain, 3rd parties can deliver algorithms for ATD.

P. No response

Q. No response

R. Third parties can be involved by working with TSA to establish open system interfaces and protocols. They can also provide expertise on the creation of an common GUI.

S. No response

T. No response

U. Hardware into the hands of academics. Open standards. Open data sets - even with benign threats - e.g. release 100,000 baggage images, set a challenge - can we find all the umbreallas or mobile phones in the set ? If we can, then how else can we apply this advance in technology. (e.g. ImageNet challenges, netflix challenge, DARPA grand challenge).

V. No response

W. No response

X. No response

Y. No response

Z. Develop standardisation and libraries, which enable faster start and focus on the actual threats instead of “re-inventing the wheel”.

AA. No response

AB. No response

AC. Become involved with the equipment OEM’s early in the R&D/design phase of new products.

AD. By collaboration with technology integrated companies with emerging technology companies.

AE. Inviting and evaluating competing bids, i.e., the usual competitive processes inherent in an open, market-based system, while always avoiding monopolistic and oligopolistic “capture” of the bidding agencies.

AF. Through supplying access to explosives at more than one facility.

AG. Transparency of deployed environments is necessary. There is currently little to no insight into how a 3rd party can offer a stand-alone product that can be integrated into existing systems. There is also no insight into what types of devices exist, what their roles are in the screening ecosystem, and how these devices connect with one another. Everything is silos right now and it is nearly impossible for new innovative technologies to interface within the airport.

AH. I agree with the notion that third parties can only be effective if they work privately with the OEM supplier under an NDA type arrangement, to perform specific tasks that are well defined.

AI. Third parties should be given opportunities to demonstrate ATR capabilities.

AJ. By interacting directly with vendors.

AK. No response

AL. No response

AM. Make explosive/ threat materials available to new developers. Assist with algorithms and software. Develop/ define capabilities that will allow the outsource of manufacturing, software and routine engineering to keep development costs down for new companies.

AN. No response

AO. No response

AP. What do you mean by third parties?

AQ. No response

AR. Provide a use case from detection equipment so barriers to entry are low and let them work on S/W.

Question 11: What did you like and dislike about this workshop?

A. No response

B. I was very impressed by the clarity and sophistication of the discussions during the talks.

C. No response

D. No response

E. No response

F. Please see earlier comments. Additionally, time allocated to presentations were completely subjective and not controlled. The "Risk based security strategy in aviation security" by Rafi Ron got 75 minutes (yes, I timed it) and "Advanced material discrimination" by Arizona Univ was cut after 35 min even though they had a ton of data and attendees were still asking questions. Cut short in the middle. One more item that needs to be checked in advance, is the speaker speaking abilities. Some of the speakers were very hard to understand or were not suited to present.

G. This was really not a workshop but still more of a presentation driven conference.

H. Many more people are coming from industry and the government - very good for newtworking. I did not like the Ball Room on Thursday - not conducive to a workshop environment.

I. I love the format, I don't like the way discussions have to be cut short.

J. I liked the topics and open discussion. I disliked the time management. It can be improved to keep all speakers and topics on time.

K. I liked the format (this was my first attendance). Would it be possible next time to arrange the seating in less "lecture style" and more in a circular or "U" shaped pattern with concentric rings or "U"s of seating rows?

L. Couldn't hear 3/4 of the people in the audience when they spoke. Some discussions went on well past the point of usefulness.

M. No response

N. Like - quality of presentation and parrticipants.

O. Difficult to hear exchanges and dialog especially on the second day in the ballroom.

P. What is the point of the elaborate registration process if you do not give us contact info on the attendance list?

Q. Overall it was good.

R. The workshop was great. I liked the interaction/discussion between the industry/academia/government. I also, liked the presentation of new technology during the conference. No dislikes.

S. The moderation of the talks could greatly be improved. Too much focus on open discussions pushed back the schedule on all the talks. A better way to approach this would have been to have 2x 15 minute slots in the middle of the talks designated for open discussions but opened with a specific topic that pertained to the earlier talks.

T. The sound system and physical set-up of the 2nd day.

U. A very useful workshop - perhaps a around the room set of introductions or "1 min" pitches ? - "I am Fred, I work for ACME Corp., and we do XYZ".

V. No response

W. No response

X. More discussion time was good. Speaker topics were a little dry.

Y. No response

Z. Liked fluent and productive discussion sessions without too tight schedule pressure. Disliked arrangements especially on 2nd day (high background noise, Setup was for presentations, not good layout for discussions).

AA. Good organization, wide range of audience with different background from academia and industry. It can include more technical talks discussing research from state of the art.

AB. No response

AC. I really enjoyed the session on the treatment/disclosure of testing information in the qualification process. It was very insightful and may be a cause of the problems we are currently experiencing with at the checkpoint.

AD. It gives the notion that you as emerging technology company can't penetrate. it is a close group few companies with the TSA.

AE. Like: Informative presentations.

AF. I would like to see more government-led seminars explaining what they want and where we are.

AG. Thought it was fine.

AH. The ballroom venue for the second day was not ideal for an interactive workshop format. I would continue to encourage more attendance and participation by the Government customer in future upcoming workshops.

AI. No response

AJ. Very good discussions, both formal and on the sidelines.

AK. No response

AL. The DHS and TSA representatives were more engaged and forward leaning with needs and future vision. I like the new approach with minimal slideware designed to spur discussion.

AM. Like: Opportunity to network with colleagues, hear about new ideas in the industry. Ability to participate in the discussions/ presentations rather than just hear a formal presentation on a topic Dislike: background noise was high in one of the halls and there was no PA, making it difficult to hear some of the talks.

AN. No response

AO. No response

AP. I like this one better than previous one because there was more time to network.

AQ. Liked the proffessional level of the speakers.

AR. It seemed a little hustled. Shorter days and perhaps more days would allow for more time to take it in.

Question 12: Please rate your overall satisfaction with the ADSA13 Workshop.

A. No response

B. Satisfied

C. No response

D. No response

E. Satisfied

F. Neither Satisfied nor Disatisfied: Quality and relevance of topics can be improved.

G. Satisfied: The information provided was informative and covered a broad array of topics though recognizing one can only cover so much in a listed time. The whole topic is exasperating and this forum is a strong step in the right direction.

H. Very Satisfied: Carl, the ALERT staff do a great job!

I. Very Satisfied: The best regular meeting in the Industry, like a mini GRC.

J. Satisfied

K. Very Satisfied

L. Satisfied: I couldn't hear. Discussions were too long, some talks were cut off too quickly. Picked up some useful information. Good idea to include talks like the THz inspection and iterative reconstruction algorithmic work.

M. Satisfied

N. Very Satisfied

O. Satisfied

P. Satisfied

Q. Satisfied

R. Very Satisfied

S. Satisfied

T. Satisfied

U. Very Satisfied: A very useful workshop - I like the concept of major and minor ADSA workshops as travel to Boston (in my case from the UK / EU) is difficult twice a year, Would ADSA finacially support non-US academic attendance ? (strength in diversity and all that).

V. No response

W. Very Satisfied

X. Neither Satisfied nor Disatisfied

Y. No response

Z. Satisfied

AA. Satisfied

AB. Satisfied

AC. Very Satisfied

AD. Satisfied: Only fewer contacts are following up after the meeting.

AE. Very Satisfied

AF. Satisfied

AG. Very Satisfied

AH. Satisfied

AI. Satisfied

AJ. Very Satisfied

AK. Neither Satisfied nor Disatisfied

AL. Very Satisfied

AM. Satisfied: Generally good, with exceptions noted earlier. Probably more breadth of new technologies would have bumped the grade to Very Satisfied.

AN. Very Satisfied

AO. Satisfied

AP. Very Satisfied

AQ. Very Satisfied

AR. Very Satisfied

Question 13: Do you have recommendations for future workshop topics?

A. No response

B. No response

C. No response

D. No response

E. No response

F. Not sure.

G. Breakout sessions that is strongly moderated and explicitly tasked by the organizers to expected actions and outcomes.

H. We tend to concentrate on the aviation sector - the non aviation market is in fact a lot bigger - like to see an ADSA address these applications! (buildings, sports venues, prisons, military, loss prevention, etc.).

I. No response

J. I suggest we start with a briefing on latest TSA, ALERT and S&T BAA goals, technology roadmap, capability investment plan, latest acquisition schedule update, etc. and also a package of those with emails and contact info so that instead of questions about "who should I contact about this and that opportunity?" there could be more focused questions (such as "Can I call XX if I have questions about this opportunity"). If possible, I suggest a keynote from TSA OSC AA or head of DHS S&T. No additional future topics beyond what we discussed at last session (ADSA 14).

K. Not yet.

L. Might need some tutorials to raise the level of understanding of the audience. For example, the discussion on compressive sensing degenerated into a debate about detecting a tumor 2 pixels across. Not applicable to explosive detection and also not very useful for medical CT applications.

M. Explore the concept of "security effectiveness," how to measure it, and how to improve it over time.

N. Structure of responsibility authority and accounability for security at the airport level.

O. No response

P. No response

Q. Machine Learning applications.

R. Future workshops may want to invite the TSL and TSIF to discuss testing procedures and policies.

S. No response

T. Transition.

U. Object detection beyond materials discrimination (e.g. Mouton / Breckon et al.).

V. No response

W. No response

X. Discussion of the "top 5" concerns to TSA. Similarly, discuss the "top 5" unsolved/open problems (note that an unsolved problem may not necessarily be related to a top concern).

Y. No response

Z. Focus is now on screening of passengers and their belongings. Should we look the whole picture again, from the beginning into the flights: Where are the most vulnurable points, are there efficient back-ups in place (eg trace detectors in airplain cabin and cargo areas?).

AA. No response

AB. No response

AC. No.

AD. No.

AE. No response

AF. More government Q&A.

AG. We should begin detailed discussions on interoperable platform solutions. The Sandia and GD efforts are leading towards this. Might be

time soon to discuss these in a more public forum.

AH. No response

AI. No response

AJ. Test and evaluation approaches.

AK. Simulations.

AL. No response

AM. Address earlier comments.

AN. No response

AO. Multi-view scanners parametric studies from academia.

AP. No.

AQ. 1. Comprehesive aproach to airport security. 2. Structure of responsibility, authority and accountibility for security at the airport. 3. Human factors in airport security.

AR. Maybe more outsider ideas, from other industries, etc.

Question 14: What would you like to see changed for future workshops?

A. No response

B. No response

C. No response

D. No response

E. No response

F. Get specific Government reps from the right departments to attend and answer all the questions that are sent to government attendees. If a research paper is presented, please spend time at the beginning to CLEARLY state how is it relevant to Aviation Security. DO NOT have others present someone else's paper or work. It does not work. Publish the agenda 2 weeks in advance, so the audience can decide if they want to attend or not.

G. See number 12.

H. I like it the way it is - food has gotten better too!

I. A post meeting networking session with beer.

J. See previous answer.

K. The seating (see previous comment).

L. Better control of discussion by the moderator.

M. No response

N. No response

O. Microphones to pass around for Q/A.

P. No response

Q. No response

R. Nothing.

S. No response

T. No response

U. All good - well done.

V. No response

W. No response

X. More hallway time. Split speakers into “short/long”. The short ones should be discussion leaders, while the long ones are more traditional presenters. The total time per speaker may be the same, but there doesn’t need to be as much discussion when hearing about the latest improvement in trace as there does for a discussion on how to make TSA testing more effective.

Y. No response

Z. Maybe more intime discussion environment.

AA. I already pointed out my suggestions in the answer of previous questions. Thank you.

AB. No response

AC. Nothing.

AD. Don’t have recommendation.

AE. Nothing, really.

AF. More microphones in the larger Hall on the second day.

AG. No response

AH. It would be helpful to post copies of the workshop presentations much sooner, within 2-3 weeks of the event perhaps, while it is still fresh on the minds of the attendees.

AI. No response

AJ. Return to Tuesday-Wednesday schedule.

AK. Less discussion during talks.

AL. No response

AM. Covered earlier. Also consider 3 (2.5) rather than 2 days as a possibility.

AN. No response

AO. Stick to the schedule.

AP. More multi-modality sensor discussions.

AQ. No response

AR. No response

Question 15: What other comments do you have?

A. No response

B. No response

C. No response

D. No response

E. No response

F. Thank you for setting up these conferences, I realize it is a lot of work and coordination. The logistics, facilities, support staff and specially the "informal forum" were excellent.

G. Very valuable forum. There are rooms for improvement in organizational effectiveness and strong need for actionable outcome recommendations.

H. Keep up the great work!

I. No response

J. No response

K. Great job! thanks for the hard work that went into the workshop!

L. No response

M. No response

N. No response

O. No response

P. No response

Q. No response

R. None.

S. No response

T. No response

U. No response

V. No response

W. No response

X. No response

Y. No response

Z. No response

AA. Thanks.

AB. No response

AC. None.

AD. See you next time.

AE. No response

AF. Enjoyed the conference. Very much necessary to the mission.

AG. No response

AH. No response

AI. No response

AJ. No response

AK. No response

AL. No response

AM. No response

AN. No response

AO. No response

AP. No response

AQ. No response

AR. Looking forward to next year.

14. Appendix: Acronyms

TERM	DEFINITION
2D	Two dimensional
3D	Three dimensional
ACI	Airports Council International
AD-102	Acquisition Management Directive 102. Also referred to MD-102 at TSA. http://www.dhs.gov/sites/default/files/publications/102-01_Acquisition_Management_Directive_Rev02.pdf
ADSA	Advanced Development for Security Applications (name of workshops at ALERT
ADSA01	First ADSA workshop held in April 2009 on the check-point application
ADSA02	Second ADSA workshop held in October 2009 on the grand challenge for CT segmentation
ADSA03	Third ADSA workshop held in April 2010 on AIT
ADSA04	Fourth ADSA workshop held in October 2010 on advanced reconstruction algorithms for CT-based scanners.
ADSA05	Fifth ADSA workshop held in May 2011 on fusing orthogonal technologies
ADSA06	Sixth ADSA workshop held in November 2011 on the development of fused explosive detection equipment with specific application to advanced imaging technology
ADSA07	Seventh ADSA workshop held in May 2012 on reconstruction algorithms for CT-based explosive detection equipment
ADSA08	Eighth ADSA workshop held in October 2012 on automated target recognition (ATR) algorithms
ADSA09	Ninth ADSA workshop held in October 2013 on new methods for explosive detection
ADSA10	Tenth ADSA workshop to be held in May 2014 on air cargo inspection
ADSA11	Eleventh ADSA workshop held in November 2014 on air cargo inspection
ADSA12	Twelfth ADSA workshop held in May 2015 on explosive detection at the checkpoint
ADSA13	Thirteenth ADSA workshop held in October 2015 on explosive detection at the checkpoint
ADSA14	Fourteenth ADSA workshop to be held in the spring of 2016 on developing and deploying technologies for fused systems

TERM	DEFINITION
AIT	Advanced imaging technology. Technology for find objects of interest on passengers.
ALARA	As low as reasonably achievable
ALERT	Awareness and Localization of Explosives-Related Threats, A Department of Homeland Security Center of Excellence, at NEU
AMU	Atomic mass unit
APEX	DHS name for projects of primary importance. In this report, it refers to the APEX checkpoint program, which is also known as Screening at Speed (SaS)
API	Application programming interface
AT	Advanced Technology; a TSA term for equipment deployed at the checkpoint
ATR	Automated threat resolution
BAA	Broad Agency Announcement; a DHS and TSA term for a request for proposals
BDO	Behavior detection officer
BHS	Baggage handling system
BLS	Bottled liquid scanner
CAPPS	Computer-Assisted Passenger Prescreening System. https://en.wikipedia.org/wiki/Computer-Assisted_Passenger_Prescreening_System
CAT	Credential Authentication Technology
CBP	Customs and Boarder Protection. http://www.cbp.gov/
CBRA	Checked baggage resolution area. Level 3 screening: open the bag
CERT	Certification test performed by TSL for checked baggage systems (EDS)
CGUI	Common graphical user interface
CPU	Central processing unit
COE	Center of Excellence, a DHS designation
CONOP	Concept of operations
CREATE	A DHS Center of Excellence
CUDA	A parallel computing platform and application programming interface (API) model created by NVIDIA
CT	Computed tomography
CTX	A model of checked baggage scanner produced by Invision

TERM	DEFINITION
CZT	Cadmium zinc telluride. https://en.wikipedia.org/wiki/Cadmium_zinc_telluride
DARMS	Dynamic aviation risk-management system
DHS	Department of Homeland Security
DHS S&T	DHS Science & Technology division
DICOM	Digital Communication in Medicine. A communication standard for medical imaging equipment.
DICOS	Digital image communications for security; a standard for sharing results from screening equipment
DNDO	Domestic Nuclear Detection Office of DHS
DT&E	Developmental test and evaluation
ECAC	European Civil Aviation Conference
EDS	Explosive detection system; a TSA term for systems to detect explosives in checked baggage.
EMD	Enhanced metal detector
ETD	Explosive trace detection
ETP	Explosives trace portal
EXD	Explosive detection directorate of DHS
FA	False alarm
FAR	False alarm rate
FBI	Federal Bureau of Investigations
FOC	Full operational capability
GUI	Graphical user interface
HME	Homemade explosive
HP	Hydrogen Peroxide
HVAC	High voltage and air conditioning
HW	Hardware
IATA	International Air Transport Association
IED	Improvised explosive device
IMS	Ion mobility spectrometry
IOS	Operating system used for mobile devices manufactured by Apple Inc.
IP	Intellectual property
IPT	Integrated product team

TERM	DEFINITION
IR	Infrared
IRD	Interface requirements document
JPEG	Joint photographic experts group
LiDAR	Light Detection And Ranging; see https://en.wikipedia.org/wiki/Lidar
LLNL	Lawrence Livermore National Laboratory
MDI	Morpho Detection
MMW	Millimeter wave imaging
MRI	Magnetic resonance imaging
MS	Mass spectroscopy
NEMA	National Electrical Manufacturers Association. See: http://www.nema.org/
NEU	Northeastern University
NMR	Nuclear magnetic resonance
NQR	Nuclear quadrupole resonance
OCR	Optical character recognition
OEM	Original equipment manufacturer
OMB	Office of Management and Budget
OS	Operating system
OSARP	On screen alarm resolution protocol/process
OSC	Office of Security Capabilities
OSR	On screen resolution
OT&E	Operational test and evaluation
OTAP	Open Threat Assessment Platform. A project conducted performed at Sandia National Laboratory
OUP	Office of University Programs. http://www.dhs.gov/science-and-technology/office-university-programs
PC	Personal computer
PD	Probability of detection
PFA	Probability of false alarm
PI	Principal investigators
PNR	Passenger name record. https://en.wikipedia.org/wiki/Passenger_name_record
PPV	Positive predictive value

TERM	DEFINITION
Pre-check	A managed inclusion program developed by TSA
QR	Quadrupole resonance
QUAL	Qualification test performed at TSL to enable equipment to be listed on a qualified products list
R&D	Research and development
RBS	Risk-based screening
RFI	Request for information
RFP	Request for proposal
RFST	Random finite sets trackers
ROC	Receiver operating characteristic. https://en.wikipedia.org/wiki/Receiver_operating_characteristic
SaS	Screening at speed
SBIR	Small Business Innovation Research. See https://www.sbir.gov/
SOAP	Simple Object Access Protocol. https://en.wikipedia.org/wiki/SOAP
SOP	Standard operating procedure
SPOT	Screening of passengers by observation techniques
SSI	Sensitive security information
STIP	Security technology integrated program
T&E	Test and evaluation
TBD	To be determined
TCO	Total cost of ownership
TDC	Ticket and document checker
THz	Tera-Hertz inspection
Trace	Synonym of ETD
TRL	Technology readiness level. See: https://en.wikipedia.org/wiki/Technology_readiness_level
TRS	Tray return system
TSA	Transportation Security Administration
TSIF	The Transportation Systems Integration Facility. A TSA testing facility in Washington, DC.
TSL	Transportation Security Lab, Atlantic City, NJ
TSO	Transportation security officer; scanner operator
UI	User interface

TERM	DEFINITION
USB	Universal serial bus
WTMD	Walk-through metal detector
XBS	X-ray back scatter
XRD	X-ray diffraction
Zeff	Effect atomic number

15. Appendix: Minutes

The ADSA13 minutes were edited for purposes of clarity. All errors in the minutes are due to the editors of this report and not due to the speakers themselves.

15.1 Key

The following fields indicate the flow of conversation as it took place during the question and answer portion of each presentation.

- Q: Question
- C: Comments from the audience
- S: S&T statement
- TSA: TSA statement
- ALERT: ALERT statement
- A: Answer
- (???): Inaudible or missing portions

15.2 Day 1 Minutes: October 28, 2015

Speaker: Kumar Babu

DHS has established a joint program to fund developments for deploying the aviation checkpoint of the future.

Q: Where does RBS fit into this?

C: It helps you screen people properly who have already been determined to be higher risk. It does not help screen people properly who are a higher risk, but haven't been identified as such.

Q: Cyber is taking money away from RBS. TSA's budget was slashed 50%. If we can't control [solve] the cyber challenge then how can we adopt RBS?

A: S&T has a cyber division with an independent budget, which works with concerned parties. S&T is not involved with RBS, except to ensure that vendors will be required to interface with it.

Q: Should we in the developer community submit to DHS S&T's Long Range or Targeted Broad Agency Announcements, or instead to TSA's Transportation

Security Innovative Concepts or Targeted Broad Agency Announcements?

A: It is not necessary to submit to both. S&T and TSA work closely together, and participate in reviewing submissions to both. For proposals up to TRL 4, submit to S&T; for proposals from 5 and up, submit to TSA.

C: TSA is looking for solutions that are operationally ready. S&T is relied upon for technology development and maturation.

Q: What is in the new S&T targeted Broad Agency Announcement?

A: We cannot talk about it. It is acquisition sensitive. The primary vehicle is the Long Range Broad Agency Announcement.

Q: Is ATR missing for people screening?

A: It is the toughest problem, but it's not missing.

Q: Can you elaborate on what S&T is doing?

A: See Long Range Broad Agency Announcement Section 10.4. We feel that vendors should be proposing solutions rather than S&T dictating the technology. We aren't telling you what to do, nor dictating the design – I'm not sure we are qualified to do so. Vendors have the expertise. We state the problem, you propose solutions.

Q: Can you talk about checkpoint baggage and divested items screening? What's S&T's vision? Where will it go?

A: TSA defines the requirements: 300 people, 600 items/hour. We won't specify the technology. Give us options. TSA decides what they will deploy.

C: In checked baggage, the goal is to decrease the cost per bag screening, which is assumed to mean fewer false alarms.

A: Defer to TSA for their goals.

TSA: Lower false alarms, less costly installation, maintenance, lifecycle costs.

C: A percentage of bags are going to the checked baggage resolution area for trace screening, which translates into time and labor. We need better algorithms.

TSA: Yes, and not every weapon is the same. There are some explosive chemicals that we care about more, some less. Man hours are a big component of the life cycle cost estimate and total cost of ownership.

A: See S&T Broad Agency Announcement 13-05. S&T has some initiatives in this area. Speak with Sharene Young.

TSA: On the operations side, we don't care what it costs. TSA is being called on security effectiveness. That's where we need to improve. We are concerned about detection as job 1.

Q: S&T is funding this work. How will it get to the field?

A: Part of the IPT is to discuss how to transition. Not everything we support will go to the deployment stage. Tech transition is under discussion.

Q: Part of the Broad Agency Announcement is to ask for solutions. Does the community have enough information to submit viable proposals?

C: One party, who thought they understood the requirements, submitted a proposal that they thought was responsive. They got a rejection, but no opportunity for feedback. Is there a way to obtain feedback so that they can learn to do better next time?

A: Whitepapers are rarely rejected. Reviewers send recommendations to the program office and that office decides if to move on the recommendation.

A: So far, that's not how they want to do outreach. This approach was mandated from above. It's an acquisition process, and they don't give feedback like that.

C: I like the question of transition. Transition is a focus of ALERT. Transition is tricky. Getting to the field is an interesting issue. The customer needs to understand what was developed and to ask and pay for it. There does not appear to be a strong transition capability in S&T. There is lots of talk but I don't see it in fact. We have to recognize that transition is a primary hurdle in getting technology to the marketplace.

A: The new S&T Integrated Product Team has transition as a focus. There is a checkpoint sub-IPT, which is staffed by both S&T and TSA. The discussions are not just about how to meet the goal, but also how to transition from TRL 3 to TRL 5 and beyond. We are working on a transition plan that makes sense to us.

ALERT: You have a resource here – the ALERT COE. We are always looking for ways of transitioning ideas into capabilities for your needs. Can we be more closely involved in the filtering of this information so that the COE can participate even if the government cannot?

A: Laura Parker is the COE focal for S&T. We invite people to present and talk to us. I have a concern about universities. Lots of stuff that we do is classified. You have lots of foreign students so we have restrictions. We need to work under some constraints.

C: You want things to be better than they are now. We need to know what's wrong now. There is good technology deployed today (e.g., if this Raman system alarms every time on a specific enema solution, or an X-ray scanner alarms if a bag has wires in a specific orientation). Unless you provide this information back for feedback, you can't improve.

C: If it's the way stuff is packed in the bag then make a TSA approved bag and charge for it.

A: Vendors do get feedback (e.g., Provision 1 and Provision 2). We do give info back, but the problem is complex. You need to make sure the funding is there to execute the feedback, and there are priorities for executing the feedback. TSL has its own path to communicate with vendors, but that is out of scope for this discussion.

C: A lot of projects at TSA deal with improving the passenger experience. Europe takes things further and works with system architecture and design.

TSA: Yes, we are looking at European models. Please wait for the presentation regarding TSA's Perspective on Third Party Involvement from Mr. Frank Cartwright.

Q: We are taking classified problems and making them unclassified. A traveler has to take out peanut butter at an airport checkpoint. What is going on?

C: That's a gel. You need to see the Sandia National Laboratories' report on liquids and gels.

TSA: It's about variables and constants. You have a $10/hour TSO at a checkpoint. What is the amount of information that the TSO can reliably retain and execute? There are 3100 individual tasks that are part of the screening duties.

A: Training is a critical issue; we must consider those staff resources with an 8th grade education.

C: We have smart people looking at the technology but not the application.

A: Checked baggage is a different problem. You have many more seconds for decision making. The checkpoint is harder, there is less time.

Q: Historically, we have been interested in individual technology – a standalone black box if you will – and assigned a TRL to such a standalone instrument. Should there be a TRL rating for systems solutions?

A: We encourage sensor fusion. Think outside of the box. The S&T Long Range BAA Section 10.4 provides the opportunity to propose such concepts.

C: Jill Vaughn has changed things. TSA becomes a system level integrator of the system, and is starting to look at composite threats and risk. TSA is starting to do that.

C: Gatwick is pushing through 300+ passengers/hour through each checkpoint lane and it works really well. Security is the same level as in the US. The paradigm is shifting from the sensor to the tray return system (TRS). Those are the guys that the airports are going to get solutions from. Which gives more time for alarm resolution? Screening does not revolve around individual tasks. It's about the full solution and which technology to fit into those systems to reduce cost and maintain security (e.g., a TRS system). TSA will see it. It is primarily happening in Europe because of how airports have to buy their own equipment.

C: This is a big picture tradeoff: efficiency vs. efficiency and security. If we have a more efficient system, we have more time to spend on security. We got hit a few months ago. It is very important to us.

A: If you want to integrate systems into bigger and bigger systems then you have to have a way to communicate between them. The problem set is big, but companies have small staffs. Add in classified restrictions, that becomes a big catch-22. If the purpose of classification is to improve national security, it's not doing a good job. If only we could see this information, we could solve the problem. It's going to be very underwhelming. If you are a good technologist then you probably have a pretty good way to go. So go.

C: Technology transition – TSA needs to take responsibility that a screening solution is ready for prime time, but that requires evaluating it in the airport. To do so, we need to put it in an airport. We need to do a better job of prototyping. We need to dip our toes in the water and step up operation assessments.

ALERT: We need to invest in datasets for ATR and gap areas that are ripe for further exploitation. We need to find a way to exploit the data. Datasets are reasonable emulations for corner cases. So, if we can elevate the datasets that we already have, that will spur more general technology development and would be a win-win.

ALERT: We had a discussion on datasets yesterday. It is very hard to get datasets. A good set means you have to pack bags. And you need geometries. But then someone can build the instruments so no one wants to give out the geometry.

ALERT: If we had a better discussion between government, ALERT, and the vendors, we could create a simulation that people would criticize less (e.g., scanning using off-market, older devices or medical devices).

ALERT: We just deployed a video system for detecting passengers who are moving counter to the direction of the other passengers. A courageous Federal Security Director allowed us access to the space. Pairing research with the operational environment- that's a way of transition.

A: You are talking about sensor fusion, multiple modalities and time synchronization, for whatever technologies there are unless you generate simulators. We have a very good thing in place for deploying into checked baggage. People develop algorithms and deploy them. This is being done. Other layers are not done yet. The focus of universities should be how to structure these things at TRL 4-6, not at TRL 7-9.

C: Transition is a sore point with vendors and the government. It is good up to TRL 5, but afterwards, it's about demonstration, and that's hard. So a group that helps with transition is needed.

A: Charter of the IPT is to engage parties for transition. There will be a detailed plan by the end of the year.

C: I would encourage getting vendors involved earlier rather than later.

A: Once we set up the plan, we will figure out when vendors should be there. Right now, it is just planning.

Q: A linear approach to technology development is difficult. There are many times when you get a system to the field that you have to take back to the beginning. Is there a way to do development in parallel – i.e. in the laboratory and in the field, while it is still in the prototype phase – rather than the current model of TSA, which is having to deal with a new box presented for deployment that you've never seen before?

A: Moving from concept to deployment is of concern. There are big procurement cycles, which takes many years. A rapid prototyping model is part of the IPT charter, but you can't cut corners and compromise security.

C: One used to be able to take a system to the San Diego Airport to collect ini-

tial operational data, and then again for confirmation of maturation prior to submitting the system to TSA for format testing.

A: Over time, we learn some of the problems. Some cases are suitable for rapid prototyping.

C: There are 3rd party testing initiatives by TSA that are less formal than AD-102. The TRAP and OTAP programs are being led by General Dynamics and Sandia National Laboratories respectively. Lots of rapid evaluation is part of the transition process; requirements are tested at will, then you can start the formal process. We have been talking about architecture in integrated systems. When we talk about those things, these are integrated environments with complex requirements. Industry would benefit from knowing how to make those important tradeoffs, and then they would be able to come to the government with proposals for the different approaches. The government should develop requirements that would be more compatible with a system architecture approach.

A: S&T will be different than TSA (e.g., S&T won't focus on PFA being X or Y). Technology still in the R&D phase is not at that time 100% compliant with TSA's requirements. S&T is trying to understand what the broader set of viable options is. Perhaps a vendor can get to high speed, but not meet all of the detection requirements. Detection is pushing to smaller and smaller volumes and S&T works to vet with the FBI and to determine if these are credible threats. S&T is focused on an intuitive way, rather than a quantitative way, and is cognizant that there are tradeoffs in terms of R&D.

C: The last 15 years of technology development shows that you need to have the style and usability needs considered early in requirements development. Otherwise you end up with a difficult-to-use device that the end user needs to go through machinations to use. They use it in creative ways – really scary ways to the people who invented the device. Usability is not S&T's focus nor is it simple.

C: Even though it is not clearly defined, it must be a focus: technology needs to be simple and usable. Usability is important.

C: I would want something slightly worse in detection, but much easier to use for someone with a high school education.

A: Detection is decided at a higher level.

Q: I have a usability concern: 90% of the work is a Provision AIT or EMD Metal Detector or manual screening. Do we see a major difference in the us-

ability? It does not seem that hard to use. Is it perceived to be difficult to use?

C: I'm talking about concept of operations, which is driven by technology, not the other way around. Now that we have an opportunity to consider the CONOPS, we should do it.

Q: What is easier than a walk through metal detector?

A: No divestiture and minimum false alarm is the ultimate goal (e.g., perhaps terahertz imaging can ultimately be packaged into some solution). We want to fund technology independent of the packaging – i.e. technology developed independently, ultimately to be usable. I have a certain vision of what is perceived to be ease of use. The difficulty is in the use of it.

C: If you get a nice green OK screen once the scanner is complete, that's not the difficulty that I'm referring to. If you have a TSO who is making $10-15/hour, what happens when it's not green? Now what do I do? I have to resolve that. We should be looking for terrorists with bombs, not getting grandma to divest her wallet.

C: The hard part of the use case are the nuisance alarms.

A: If it's not a terrorist with a bomb, we don't want to worry about it.

C: At a checkpoint, the passenger and their divested items take separate paths. The passenger cannot maintain visual contact over their effects and the passenger is scared that items will be stolen.

A: APEX 2020 – what can we do about this CONOPS? Vendors are coming in to present. Lots of vendors talk to us. Make an appointment. Call us.

C: Ease of use? Look at trace. You end up swabbing people and using ETDs. People don't want to be swabbed. Then there are the consumables to stock and deal with. We want something that is cheap, never breaks down, and has no consumables- and no radiation- no false alarms with a really high throughput.

C: It needs to be an informal dialog, not a formal dialog. Formal is through the BAA process, and is constrained. Once you submit a white paper, you can't have conversations about that concept until it resolves. But you can still have a dialog about other developments.

C: We are talking about the concept of operations (e.g., I have to be resolved by a male resolution officer if the scanner alarms). I would love to see a red light or green light.

TSA: Image quality is not relevant. We want to detect with a minimal false alarm. S&T wants to focus on detection. False alarms are higher than we want them to be. We are working on screening that permits walkthrough without posing. The passengers are the users.

C: I am a grandma with the wallet who always gets picked on for screening. Why not take this into consideration? My credit card tells what I've bought for the last XYZ months. Stick the card into a machine so that it will ignore the false alarming necklace that I wear each time I travel. We need a future integrated system. Why aren't we screening people while on the moving sidewalk, rather than just at the checkpoint?

A: For ultimate screening, you need to screen everyone. There are no guarantees that grandma isn't carrying bombs. DARMS is to screen people more easily than others. Goals for 2020 are DARMS, STIP, and higher detection with lower false alarms.

Speaker: Frank Cartwright

Presentation of TSA system architecture and creating the environment that drives involvement of 3rd parties.

Q: Do you want to explain what OTAP is?

TSA: OTAP is the Open Threat Assessment Platform. Everyone from OMB down to OSC have said that we need to do a better job of specifying and modularizing interfaces. OTAP is creating a prototype for such open interfaces using an X-ray screening system as a baseline. Sandia is working with the vendor community to build this prototype and put it into an airport.

Q: How do people participate in this project?

A: Sandia has an RFP out. The mechanics are to go to the website and sign up.

Q: Can you say a few words about what you are looking for?

A: We are looking for 3 things: 1) Vendors that have fully integrated X-ray machines, 2) Software and algorithms, and 3) Hardware components. We are interested in the whole ecosystem. We hope you will partner with us.

Q: Is the focus bags only, or people and bags?

A: We are starting with bags – carry on and checked. The reason is that baggage screening is the chokepoint. If it is successful, we will then move onto

body screening. There is the potential to integrate other things as well. General Dynamics is working on a platform that permits you to put multiple algorithms into place.

Q: TSA is moving to iterative type development. Could STIP or CGUI benefit from iterative development cycles vs. the traditional approach?

C: STIP is identified as a silver bullet. The intent is to be more interactive.

C: STIP is not the silver bullet.

TSA: Complexity of requirements is recognized. We are trying to establish a baseline so we can be more reactive.

Q: What about green space (e.g., data transfer and integration, cyber focus)?

TSA: Cyber is being said more often in the past four months than before.

TSA: Around June, DHS and TSA came out with a mandate: Any piece of TSA connected to the network must support 9 tenets. This is one of the key initiatives that Jill Vaughn is moving forward with the vendors. Two months ago, we had an industry day where the focus was on cyber. A follow-on meeting is scheduled in two weeks.

Q: In terms of TSA's budget, it used to be 50% people, 50% equipment. Where is cyber in the budget?

TSA: TSA will issue an RFP to each vendor requesting the suggestions and budget for making your equipment compliant.

ALERT: Let's consider a tracking system that works to track passengers and items through the secure space. It has been prototyped and secured core funding from S&T OUP with a pilot at RPI, and the software is available. Why is this of interest? Because it is an organizing principle. Data is correlated to the person. Persons and divested items can be correlated and tracked.

ALERT: Nobody seems to own it at S&T. Sociotechnical systems are important. Human in the loop is an important component of what we are trying to do with the checkpoint system. Where does sociotechnical systems fit into this architecture? Or is it nobody's child?

TSA: It has never left from our perspective. The Human Factors group is a key part of the Mission Analysis Division and is very involved. Where do buttons get placed? What is the usability of a system from the perspective of decision making and fatigue, all of which get embedded into the requirements to make

them more holistic and more informed?

ALERT: You can model and understand emotion. If a person is a threat, is there a way to assess the emotional state, and to give the TSO a heads up that there is this type of threat out there?

TSA: Yes, but outside this presentation.

Q: What is your timeline; how long will this take?

TSA: If you look at the technology investment plan, there are objectives within 3 years, objectives within 3-5 years, and objectives within 5-7 years. To put it into perspectives, there have been deliberate pockets of activities over the last few years: e.g., Standardization – where does it exist, where should it exist. We are comfortable with DICOS. Where do we go beyond DICOS?

Q: Separating software and hardware: How can a developer come up with software without co-developing hardware at the same time?

TSA: Some geometry may be required that an algorithm needs to understand. Is there some information that can be exposed and shared, so that it does not become a mystery? Where can that occur? We are exploring this through the OTAP.

C: One approach is a government reference algorithm and government reference hardware. Vendors can develop on the reference hardware, which allows their performance to be benchmarked against the reference algorithm, and highlight the deltas. This is the approach undertaken by DNDO. One customer is CBP. Each port is different. Each deployment needs to be tailored for each application. If no one steps up to define the technology stack, we remain in a perpetual conversation. Will TSA step up and say "we will support service oriented architecture SOAP interfaces"? Otherwise it becomes a very protracted exercise in constant conversation.

TSA: I suspect that will come out. What do we want, where do we want it, and where does it fit? We need to educate ourselves as to scope and boundaries.

Q: Won't that be defined under OTAP?

TSA: Yes, that's one approach we are sponsoring. We are also holding OSC Technical Conferences that lead to targeted BAAs.

Q: How do you handle qualification and certification?

TSA: Yes, testing becomes more complicated. Who are the owners and how

do we start to qualify? We aren't structured to qualify an algorithm. With RFIs and RFPs, you explore the landscape. We can establish reference hardware, but that could stifle innovation.

C: If you establish a reference then vendors might be able to build upon that. A non-operational system as a reference can help to define performance metrics if you design it correctly.

Q: Rather than focusing exclusively on reducing the cognitive load, what about improving cognitive capability (e.g., critical thinking)?

TSA: Automation helps to reduce cognitive load, creating some level of consistency. We are starting to automate some of these features and provide more information, higher resolution, better bounding boxes, and features in the presentation to be able to make a better decision. It is difficult if one manufacturer does it one way and another does it differently.

Q: What is the difference between a nuisance alarm and a false alarm?

TSA: Nuisance Alarm: Jewelry, Bracelets, and Wallets – clear it; False alarm: (???)

Q: I understand the strategy is driven by acquisition. Europe is in a buying frenzy. Should vendors open systems? Or just go to Europe? TSA will be recapitalizing in a few years to replace aging equipment.

TSA: The respective program offices understand the challenges and tradeoffs in checkpoint and checked baggage (e.g., Do we do business the same way? Are there non-material solutions? Do we need to replace the entire fleet? What are the customer needs? How long do we way? Do we push recapitalization out based on capability?).

S: TSA is working with S&T. Plans will change. We are doing algorithm development in a limited manner. ALERT is working on AIT-related stuff independent of vendors. Duke and other universities are working with SureScan. Vendor independent algorithms are some ways off.

Q: What is the potential mechanism for adapting changes to the architecture – i.e. run multiple detection algorithms simultaneously and present them? Or more simply, changes to the common GUI? If someone has a great idea that will help screeners downstream, how will that be rolled in to version 2, 3, 4 or 5? What about new features to help the screener? What would be the mechanism? That is an issue – it might become a little static.

TSA: Each manufacturer is creating a common display. We still need to estab-

lish a relationship with each vendor to make those changes, and to move to a CGUI built from one source that interfaces with all manufacturers via an API, so in the future we can make changes one time.

C: Limited amount of innovation, but now you have one source rather than lots of people trying to improve.

TSA: Why wouldn't a vendor contribute inputs?

C: If we aren't developing it, and don't own it, we don't put in development effort.

TSA: Understood. I'd hate to think that innovation stops just because we have a common platform.

C: Look at Android – everyone can continue to develop it. Samsung and everyone are using it. You have standardization, but you can offload that part, decentralize it, and others can function. The upside is that you have a shared interface, one party is responsible, but not as integrated and tightly coupled.

C: You don't have to do open source architecture. Look at the app stores on Apple's IOS and Google Android platforms.

C: As a vendor, our joint algorithm development with universities results in algorithms that will only work for our geometry. Is the vision that a vendor would collaboratively develop an algorithm with a university, or TSA does a disjoint development (where TSA finds a developer)?

TSA: I think it would be collaborative. Which model is more advantageous?

S&T: We know that is geometry specific. We cannot mandate pairings. But if we want something equivalent to DICOS version 2, that will open the floodgates for small vendors to propose changes for what they need. One problem with DICOS is that it is like a service manual. Can you create clearer documentation? It is too difficult to read. We have to use common sense. There are better things maybe, but what is practical? We have to be pragmatic about how we do things.

C: I can understand wanting to have the UI similar to the user for all systems. There used to be different incompatible equipment, but then the computing industry standardized on the personal computer (PC). IMS' have different sensors, but the final GUI can be the same. The algorithms don't have to be the same.

C: DICOS does provide a forum for people to write algorithms.

C: I don't believe it is done. It should be global, like a USB interface. If I replace a 9800 with an L3, I have to train operators.

C: Even if DICOS isn't the most efficient, it will still be cheaper. Cost is a constraint. It allows operators to be trained. You need to have a DICOS that everyone is compliant to.

C: We need a certified DICOS tester.

C: I think we should replace L3 with an MDI machine.

(Laughter)

C: CGUI is just one piece. It's going to be a faraway day to replace one machine with another.

Speaker: Srikrishna Karanam

Tracking of people and things is a critical part of security. Video is an organizing principle for all data collection for security. DHS did not ask for this project, and it was developed on someone else's money. This is a re-creation of a checkpoint with mock passengers.

Q: I thought the purpose was to track a passenger and where their items are at all times?

A: Yes.

C: You are tracking the person and correlating throughout the system. In the middle you have a measurement system. You can correlate the measurements with the tracking of the people.

C: This is great. This should be extended and made more realistic by adding stress to the mock passengers in this exercise (e.g., $100 incentive to get through as fast as possible).

Q: Didn't different volunteers have different instructions, such as to be concerned about theft of their items, visual connectivity to their personal effects? Did you have someone in the role of trying to steal a bag?

A: Yes.

Q: Did the system detect abnormalities such as one passenger picking up another's bag?

A: Yes.

Q: How will this affect this if one family member puts the bag down, and another family member collects the bag?

A: This was not addressed.

Q: How much did ALERT spend on this?

A: About $100K, but this project was dually funded.

Q: Are tags randomly assigned at the entry point?

A: (???)

C: One challenge in the industry is to positively identify binary explosives where the parts are being smuggled through the checkpoint separately. It would be helpful to be able to use this in combination with X-ray machine detection to detect the individual binary components and then associating them for addressing that small risk.

C: When a person checks in with the TDC, their identity is established that can be linked to the tag in the video.

C: This is an example of low level TRL tech that looks like it has a lot of applications and can be matured.

Q: This looks great, but what were the limitations of this exploratory work?

A: I did not do this work, so I can only speculate: 1) Crowd density (passengers moving in groups, tracking would fail, 2) Family member picking up items placed by another family member.

Q: What are you looking to do with the data from the simulation?

A: Cost benefit analysis. Let's say that TSA decides to add a lane. Using the system, we could analyze crowd flow and how many bags people are using.

C: If you want to do RBS for bag screening, you need to link down the person level. That's where I see the application.

C: And you need to connect to the checked baggage.

Q: Can you talk about the system if it's not a straight pass-through?

A: (???)

C: We will have switchable algorithms for the checkpoint, so we will need to know which person is being scanned. The TDC will drive application of the risk label.

C: All of this is a vehicle. How should this vehicle be used? Now you can track individual and luggage, now how should you use it? A whitepaper was written which describes how to perfect this vehicle. You say we need to correlate other data. Now you've got the vehicle started, it becomes quite possible to correlate all of the other data that you need. Most of the secure areas have this kind of data set up.

C: Multiple laser arrays for baggage handling systems are $100K/array, and you need multiple arrays. This has a significantly lower cost than laser arrays.

C: This can be used to track the movement of TSA officers and for performance management in support of RBS. Integrated with timestamps from TDCs, this can be critical in the overall system architecture.

C: I agree with the need for this for switching algorithms dynamically, tracking explosives, bad guys doing more nefarious things. To see the full promise, it would require the integration of many systems. So far TSA has had trouble with integrating many systems. We tried to do Automated Wait Time and that failed.

C: If your requirement was to track hand luggage all the way to the gate, members of the public might object (e.g., rest rooms).

Q: How long does it take to setup the system?

A: There is a site-survey as preparation. Two weeks total for configuration and implementation.

C: Gatwick uses something similar to track passengers to publically display queuing waits for various security lines and influence passenger choice to avoid lane overcrowding. Gatwick also tracks TSO movements for performance management (e.g., if a screener is observed to be idle 20% of the time, they are coached).

C: It would be valuable to set up a working group to explore the use cases.

Q: Is there any money for this? Should we set up a Kickstarter for crowdfunding? How do they get money?

C: TSA OSC would need to express a requirement that this is important. OSC would then be responsible for implementing it and would sponsor this type

of work.

C: Talk to Sandia to explore funding options.

Q: If you have a lower ceiling, do you need more cameras? Would an airport with a low ceiling need 300 cameras? What would happen to processing requirements?

A: This demo was stitched together for 19 cameras in real time. To go to 300, you would need a powerful computer. It would scale well if you have a powerful computer.

Q: Have you done an analysis of an optimal number of cameras? Airports have a lot of cameras, but far less than 19 per lane.

A: No.

C: Amsterdam airport uses one camera to make sure the right person goes through the AIT.

C: This is an extension of Cleveland. I'm concerned about crowds. When does it fracture to correlate people to their luggage?

A: Yes, this is a concern.

C: You might be able to manage it. We may not be able to keep track of individuals grouped in a crowd of 10, but we can know the max risk score for those 10 people.

Q: What is the efficiency breakdown of turning on that algorithm?

C: Doesn't have to be perfect, but it can be better than the current "one size fits all".

C: If you want this to work, a person will need to hold onto one bag and move thorough the system.

Q: What do you do when a toddler takes off and gets out of the orderly queue?

A: Leash.

Speaker: Henry Medeiros

Presentation on tracking and pose estimation using video of soccer players.

Q: Would this work with a single camera?

A: Yes. This system is scalable and parallelizes very well. The work was performed by one graduate student with 5 cameras in the dataset.

Q: Why does this work?

A: Because tracking is interesting. No one is funding this work. It was a student fellowship.

Q: Is this unsupervised learning?

A: No. There are simple image models. We are just trying to track the red player. The focus is on the tracking model, feeding into a recursive tracker.

Q: Is a Kalman filter used to track the ball?

A: Yes, Random Finite Sets Trackers (RFST), an extension of the Kalman filter. We keep track of this vector. There is an observation model, a vector model. We make a prediction. We keep track of the random set, rather than random vectors, and the cardinality is also random. You can account for targets disappearing and coming back. It works well for articulated targets. As the arm gets occluded, I can account for that.

Q: What is the difference between what is proposed here and the state of the art?

A: The state of the art is also an RFST recently used in vision (born in the radar community), labelled multi burnaly filter and Monte Carlo tracker. It will need lots of samples. Likelihood that it is easy to separate but as players approach, converge. We eliminate the likelihood and overlaps and avoid sampling on top of each other. The state of the art is better.

Q: Have you applied the pose tracking to time of flight 3D cameras?

A: No, we are using it for navigation. We are doing estimating based on scale.

Q: Can you explain time of flight?

A: My camera sends a pulse of IR or laser and generates 2.5D data; image and depth – like LiDAR.

Q: It is easy from a top-down perspective. What does the side view give you that the top view doesn't? Gait?

A: You could fuse both. Overhead view gives you prior information and re-

duces confusion as long as cameras are all calibrated and seeing the same points. It is a very hard problem to capture gait. The system will capture distributions. Each person will be a different point in the distribution. It is a hard problem.

Speaker: Rafi Ron

Q: You want to correlate checked baggage but not the carry-on?

A: Yes, we do. When you check the bag, it goes into an automated system. It has a correlation in the number of false positives and affects the throughput. Since we want the throughput as high as possible and the false positives as low as possible, the only way to do this is to reduce the quality of the check. You want to gain something, you have to lose something. There is no free lunch. There are some bags I need to check more thoroughly, some less thoroughly. I'm willing to live with lower false alarm rate with some passengers.

Q: The core of the issue is that privacy laws in Europe are very strong. You cannot share PNR data within European states. How do you select people to be further checked, and do so in a reasonable manner?

A: We have an issue with Precheck. How do you verify the identity of the passenger – the same passenger that you gave Precheck to? Right now, it is simply looking at the person and the ID. There are better ways to verify the authenticity of the document (e.g., verbal exchange and biometric markers). The current method reduces the power of Precheck, but is easy to fix.

Q: Addressing privacy laws, if we did a credit check, is that against privacy laws? I have a sneaking suspicion that terrorists don't have a credit history.

A: You can learn about the empty half of the cup by learning about the full half. Reduce the population that we want to invest in checking. Relying on screening technology only will deliver a result of a single terrorist while the rest of the population is free; there will always be a group that needs screening. But if the group is smaller, it will be better. Understand the privacy issue. We are willing to surrender it to the banks. We know that they sell this information and we don't know who they are. We give it to Google and Microsoft, but when it comes to the federal government we become suspicious. Regarding privacy, there are solutions to process that information in an encrypted format to send it from A to B.

C: There is a fundamental difference between sharing with Google or sharing with the government. The government has the power to arrest.

A: Local government makes wrong arrests. I have not always been an American, so I don't feel the government is my enemy, I see where the commercial interests are.

Q: Can you suggest some signatures?

A: It needs to be developed and researched thoroughly within the framework of American culture. I use the term "profile" – not in terms of religious or racial – but as legitimate profiles of illegitimate people. CAPPS was in place in the 1980s. It was invented by Northwest Airlines and included designations for selectees or non-selectees. In the aftermath of September 11, we were willing to throw everything away and commit ourselves to a strategy that is not better. We moved too quickly to define strategy that excluded some of the good stuff that was there before September 11. We are trying to do the same thing without reopening all of our strategy.

C: We have 450 airports. This is going to get more expensive.

A: We need to be creative to solve the manpower quality issue. Perhaps focus on selectors for staffing: above average intelligence, strong personality, curious, and not easily bored. Draw from the pool of candidates that in a few years' time are likely to be the business people and scientists. Catch them at the right time in their lives (e.g., those that are coming out of military service). Term limit their posting to 5 years. Avoid creating an over-experienced staffing pool. Start to draw conclusions in an unbiased manner (e.g., If a passenger is walking towards you, you should have already made a decision).

Q: Israel works. Israelis follow orders. There is National Service. Close the gap. Passengers don't know from TSA the threat level. Passengers don't realize the depth of the threat. Would we operate differently?

A: Wrong. Simply recruiting soldiers will help to protect the facility (to funnel people to the checkpoint), however, the experience doesn't serve well except that they have addressed challenges in their lives. We can find out who is good via their record. 60% of the interviewers are women and have no combat experience. Israeli youngsters are not characterized by following directions. Ben Gurion is a drug free zone. We put them on a polygraph. If they did pot in the past, they won't be doing it as long as they are working for us (e.g., it didn't take long before that person felt responsible enough to explain to the division). People feel that they are responsible to the public. There are people with values, intelligence, and commitment. After 5 years, they leave. We offered free mathematic classes, English classes, commitment to service, no shifts 48 hours before exams. We would sponsor social events, such as parties, rock groups to come play for the staff. We've hosted 10-20 marriages

between staff. It helps the parents to be very supportive.

Q: Regarding the risk based approach, if American know they are giving up privacy for security, what happens if it fails?

A: There is no fool-proof system. We only reduce the probability of failure by doing something intelligent. By being politically correct, we immunize ourselves against all types of threats, but we don't improve our security.

C: A lot of this was part of the IATA checkpoint of the Checkpoint of the Future that was briefed to the Senate in 2011. The idea of a lane for selected-only passengers was never tested with the best technology.

A: Agreed. We should do this. If you identify the level of threat but you don't do anything about it, you would be better not knowing. If you get an alarm then you must be able to respond. If not, better not know because your liability is worse if you know and don't do anything about it. God forbid the next underwear bomber is skilled to operate the device, and the aircraft is destroyed. That would be a huge, avoidable tragedy.

C: I like your idea of prescreen level 1, 2, and 3. Your idea of how nicely and selectively you choose your screeners may discourage use here. If you have a very small population that needs to go through this, or if you have retired police officers as your screeners, this is easier.

A: America can solve this problem.

Q: How can TSA do this with 450 airports and millions of passengers?

A: I don't buy that "one airport is one airport". We can deal with airports as a single concept. The cost of security per passenger is probably lower than it is in Israel, but not substantially. Ben Gurion hosts 12-15 million passengers a year – the equivalent to a medium-sized airport in the US. With that number of passengers, we manage to maintain good security.

C: Looking at this in terms of the types of interactions that we apply for screening the public, both have serious consequences but leave different impressions. Consider a blood glucose test. If you don't pass the test, you may not be eligible for a posting. It is an inconvenience but there is no visceral reaction. The problem with separating people according to risk is the concern of false imputation. Those who are selectees in essence have been assaulted even before they pass through the checkpoint, not just inconvenienced. Assurance is needed that you are assumed innocent, not presuming your guilt.

A: You can create protocols and procedures that prevent race or religion in

the analysis.

C: They would send me to a secondary interview.

A: So what? Don't consider yourself better than the immigrants. We see the relationship between law enforcement and the community. It's a bad situation but we have to understand and be sensitive enough not to create another front on this issue.

C: Your system allows the high risk passenger to fly through.

A: Yes. We aren't in the business of passing the buck. I don't recall a single case that prevented a person from flying. We made sure he got a seat on the next flight which was our responsibility. We did not have a no-fly list.

Q: Aren't you handing the problem off to the next stage (Air Marshal)?

A: The Air Marshal is the last resort. You don't want the Air Marshal to be the main back bone of the system. A fight at 30,000 feet is a bad start.

Q: If we implement this across the US, aren't you pushing it to the next stage?

A: We need to share information. We have a high-risk passenger and we searched him thoroughly and can't harm the flight, but we want the Air Marshall to know about him. Richard Reid flew to Israel, and they concluded he was a high-risk passenger and searched him top to bottom. He was allowed to fly. This information was already available to the authorities on the ground.

Speaker: Jun Zhuang

Q: You are validating the models, but how are you generating the models?

A: Some people want to generate simple models, others want complicated models.

Q: What kind of models? Time vs. behavior?

A: See my website for the papers. We set up the models with attackers and defenders, and the models help reveal insights into how to allocate resources to achieve equilibrium.

Q: Do you make assumptions on how a terrorist is supposed to behave? Do you use real world examples?

A: Yes. The models minimize total expected loss and maximize damage. Inputs are derived from the real world.

C: When I started working at Logan, we rolled out the first program in the US, with several categories of behavior. 1) related to the assumption that those involved in an extreme level of violence are higher stress that others. This is a reasonable assumption supported by various theories. We were looking for indicators (e.g., dehydration and sweating as being related to stress). 2) Related to the fact that the person is carrying a weapon. An explosive or a firearm on the body affects the way a person behaves. We looked at how terrorist would do so, how they would need to be dressed. A tight t-shirt and jeans does not have much room for a weapon, so it is assumed they are free of weapons vs. a warm coat on a warm day. 3) Another type of behavior that is unavoidable. This is related to tactical plan of terrorist (e.g., they would try to be in an area where the casualties would be greater so pay more attention to those locations). 4) Proactive type of view. There is something you can trigger, to stimulus, and expect a legitimate person to act in one way and a terrorist in a different way. Presence of a police officer has a different effect if you have a legal gun or if you don't. 5) Verbal interaction. Establish contact on a positive note and engage in casual conversation. Add in information from people who are watching surveillance.

Speaker: Jun Zhang

Q: Right now PD is not 100% imperfect. Modify the game so that that there is some probability it will increase detection.

A: Yes.

Speaker: Amit Ashok

Q: How did you determine the blue distribution?

A: We generated bags from our generated model based on real data from different vendors (% toiletries, books, electronics), containers, heuristic rules to pack a bag. There is 10% probability you have shoes and X % that you have socks. We can argue how realistic that is. We can keep making models more realistic.

Q: How did you model the photoelectric noise?

A: First order photon noise is limited. Need to consider spectral noise,

non-linear effect, charge cloud sharing for photocounting detector. Right now we are doing an idealized system. We are about to start an effort under DHS S&T Targeted BAA 13-05 to incorporate the very realistic model of source detectors and other elements.

Q: Is the source label discrete (0, 1)?

A: We can make it binary. We are not interested in estimating the bag in terms of creating a picture, we just care about the threat. We are looking for a tractable problem.

Q: This is a gigantic state space – all the bags and how to pack them.

A: Generate bag samples, and stream of commerce is completely random. Remove a non-threat item and insert a threat item in its place, minimally perturbing the bag, but crossing the decision boundary. This makes the problem much more tractable.

Q: Did you look at limitations in the similarity in materials (e.g., Water and HP)? Same atoms different ratios?

A: We did not. We generate threats and non-threats in the population. The answer with photoelectric is hard. We are looking at scatter to see if we can answer that question. It is similar to high aspect ratio threats (i.e. sheets). We are looking to determine what is the theoretical best you could do.

Q: So far, you spoke that you are not changing energy bins and not changing fundamentals of the detector, but would like to. What additional information do you think you can get from more bins? Why does going to 4 or 8 give you more?

A: Photoelectric has shape. At 4 you get more information. It's not a straight line; shape as a function of energy, K-absorption peaks. Beyond 4, there isn't help.

Speaker: Suriyun Whitehead

C: One thing you left off is innovation can be equally deployed instead of only by the inventor. Attendees seemed to agree.

Q: Can you define a vendor neutral airport as mixed deployment and multiple vendors?

C: Define "stack".

A: Buy a detector, baggage handling, etc. Everything.

C: Not true. For example, OSARP is not developed by the vendors. I can see a day where the airport would just pay to screen a bag at $1/bag instead of the current deployment method.

C: TSA does this and it is similar to what they do with cargo screening.

C: I prefer the term modularize and componentize as opposed to chopping the system apart.

C: We talk about vendor neutral. Five different vendor airports have a single OSARP. Why not start there? Open up API interfaces. There are data in X-ray not just an image. How is this standardized for third parties? Intermediate steps may be a better path forward.

C: At the checkpoint, particular technology is dominated by two vendors. Is it really multiple vendors?

TSA: These are possibilities but we are not sure what the end state will look like. We will need to take incremental steps going forward. Maybe we need to start at the top-down.

C: An airport wants to buy only from one vendor because they do not want to deal with the complexity. Who will integrate it? What happens when it does not work? Who fixes it when it breaks?

TSA: It is complicated. But we need to do this differently.

C: I think that there are natural dividing points. We should determine where the best places are to break up the current systems and commonality needed, not algorithms.

Q: Why not algorithms?

A: Because they are integral to the hardware.

TSA: We are in that boat now. Boston and Chicago have only one X-ray vendor. If you have two or more then it opens up options.

C: EDS-centric airports challenge splitting on the algorithm. There are very practical issues moving data off of the machine, etc. DIOCOS is great for threat image reports, etc. You could do additional off line algorithms but you do not have that more time. Make a decision before the bag leaves the machine with DICOS. You cannot do this.

C: There is precedence it can be done. For example, OptoSecurity has already done this so it is doable.

C: We said that this is great but there are still issues that OptoSecurity cannot remove the original OEM algorithm results.

Speaker: Harry Massey

Q: Are there many instances of medical hardware vendors sending images to 3rd party algorithms?

A: Yes, images are provided to 3rd party algorithm developers. DICOM enables the data to be extracted for algorithm developers to use in their work. The adoption of the standard on the hardware means that an algorithm is able to receive, read, and process images in the operational screening workflow.

Q: Before DICOM was the market primarily characterized by single vendors controlling each hospital?

A: Yes.

Q: How can one develop standards to achieve the benefits that they bring without the chilling effects on innovation?

C. Because 3rd party vendors are able to innovate, they are not stuck with one system. By understanding the baseline, you reduce risk that it might change from under you. In many instances, when DICOM came around, it enabled a hospital to purchase products that were innovative and leading edge, and able to implemented quickly. In fact it was the lack of innovation that spurred the need for DICOM. DICOM started as a result of the Veteran's administration. They saw the static innovation within their hospital and they were not able to update their equipment as fast as they'd like, so they came to vendors, and vendors came to NEMA, and they were committed to developing a means that you can select the best innovation possible to update. Went from selling 5000 images to 35000 images. The information provided was very important. Companies began to expand and grow and make more money.

C: No doubt that DICOM has been fabulous for the medical community. Decouple acquisition from presentation. I question that there is no online ATR in medical.

C: R2 grew up processing mammography. Hologic purchased that image processing company to add value to their own company. The time nature of the

reading is very time critical. There is no need except for positioning.

C: A radiologist can read on another continent. The need is instantaneous here.

C: There are major differences between medical and security. There is no sale of an image. Images are proprietary SSI, and there is one customer.

C: In the beginning there was only one customer.

C: Every medical facility has the option to choose what it wants and when it wants it. The drivers are tremendously different. Vendors' response is tremendously different. There is no return for image for TSA. Innovation pass through is not an option for this marketplace. There is a single purchaser, and it is not cycled on innovation, but the supply of money from congress. It is perilous to draw parallels to these two markets.

C: The market is a little different, but we aren't thinking about what it could be. It could be applied to sports arenas, every government facility, anywhere that does security screening. Make it easier to deploy. You could get into every government building. It could really expand the market for OEMs today. You need to look at the market from a different perspective.

C: Yes, like the Superbowl.

C: Schools. There are lots of applications. We aren't thinking along those lines today.

C: DICOM 1 was terrible. It took 10 years to fix. Why did that happen? Why won't that happen in security?

A: We need the commitment of the vendor and the government, and standardize. We can be successful.

Q: What does is mean that there is no DICOS policy?

A: As an association, we do not have a decision by electrical manufacturers that this is important enough, and these are the areas that we are going to start yet.

Q: Are you saying that it takes an industry movement, rather than government?

A: Yes.

Speakers: Laura Parker and Rich Lareau

Q: You show bifurcation of particle and vapor. You don't want to give up particle just to get vapor. You need to go for both.

A: This is the problem: You can capture particles quickly by desorption. That is unlikely for vapor, which needs a pre-concentrator and a high volume sensor. It takes a long time.

C: There is a previous system that did both. If you thermally cycle, you can get both.

A: That was with a huge sampling volume though. The big focus has been throughput at the passenger checkpoint; air cargo has different CONOPS.

Q: Why are we talking about trace?

A: Because Carl said so.

(Laughter)

A: Because it's a component of checkpoint. It's a growing emphasis. It's a slight gap of this group.

C: Lincoln Labs says it's a silver bullet.

A: They aren't here. There are pros and cons. Used properly, trace chemical detection works very well. Other agencies trained very well find it to be very effective. The Israeli Prime Minister doesn't go anywhere without a few technologies and trace is one of them, and it works very well.

Q: What about an expanded and upgradeable threat library for HMEs. Is that hand in hand with current threat lists? Does trace lag behind bulk?

A: That is hard to answer. On some, it's a slam dunk for bulk, some it's for trace. A recent algorithm was developed in 2 days and out to vendors. New ones keep popping up throughout the year.

Q: How many liters per minute to flow through?

A: You want a system that is hundreds of liters per minute, if not faster, onto a trap.

Q: If you look at carbon chain, how many carbons are there? 40? 25?

A: We don't look at it that way. 270-300 AMU.

Q: I would prefer to sample all AMU at the same time. Is there a requirement to operate in relatively high humidity?

A: I don't know the latest but 95% sounds about right. There's TSA and other end users (95-98%).

C: If I'm looking for vapor in Alaska and it freezes out, I'm not looking for vapor either.

C: Regarding resolution sensitivity, MS is better because you get to 10000 resolution numbers. With standard mass spec, you get chemical selectivity. With new HMEs, you have to keep updating the chemistry.

A: Yes. High resolution correlates with size. The benefit of IMS can be shrunk and can be pretty cheap.

C: The weak link is sampling.

A: Yes. We are going to discuss that.

C: Non-contact and standoff is for primary use, but you started with trace as a secondary after other things. How do you handle that the upstream stuff is going to bias? If you are only concerned with upstream alarms then you get a different effectiveness.

A: Yes. (???)

C: If you push out from the checkpoint (drive to airport and onto the plane) e.g., parking lot – that can drive RBS. But trace is not a single point of failure at that point. It is a good extra signal you can grab.

A: I'm not convinced that I want that either. I'm starting to like IR or hyper-spectral. Act on it at the checkpoint or the bag. If it pop ups, great, and screen for it at the checkpoint.

Q: What about physical and chemical signatures?

A: You want both. If you want a bag that I can hide from chemistry, I do X. If I want to hide from the physics, I do Y. To do X and Y is tough. If you can measure for both physical and chemical signatures and do it quickly without a lot of extra cost then great!

Q: What about the reverse? When I see trace, it is not used as effectively as possible (e.g., targeted trace, targeted swabbing). Why aren't we using X-ray to prompt trace?

A: That's exactly what's going on today in checked baggage screening. They do that a lot.

Q: At the passenger checkpoint, it's generally random swipes and hand swipes.

A: They do use it at the passenger checkpoint. Yes, I had a small bottle of baby powder. We pulled up X-ray image and swiped the entire image of the bag.

Q: When you focus on non-contact sampling, how do you bridge the issues needed to move beyond? If I need to measure efficacy with an automated sensing device, how do you deal with it in a clean environment (e.g., for a mix system – trace with X-ray)? This is the challenge of integrated systems.

A: This is tough. There are a couple of systems like that. They involve hours of cleaning and high cycle times measured in hours. We will need R&D to come up with the right protocols.

15.3 Day 2 Minutes: October 29, 2015

Speaker: Carl Crawford

Discussion of topics for ADSA14 and out-of-the-box solicited from the audience.

C: Trade space of mass vs. detection. How do false alarm levels change?

C: This may start treading on sensitive information if we focus on detection tradeoffs.

C: Transition of technology into products. Present examples of successful, and non-successful efforts. Include perception from the regulator and government. Include success stories from other fields. Address deployment and transition.

C: Orthogonal concepts and subsystems -- putting systems together. Modeling and simulation are important. IATA developed detection, operational, and cost models to explore how to put them together for different airports.

C: Development of decision aids. How do you create a tool and/or ability to help the TSA to integrate the information and make a decision? How do you scope this out?

C: Tools for designing integrated solutions and fused systems.

C: Allow every airport to select their own solutions.

C: Eliminate the checkpoint all together.

C: Create a lane with no security. Let people who want to accept the risk, take the risk.

C: No screening lanes are the same. When you have a good idea for one airport, transferring it to a different location is difficult and may not be as successful. The Airport of the Future is invented every 5 years.

C: Limit baggage size.

C: Eliminate security but never report terrorist attacks.

C: The goal is not to detect. The goal is to stop people from trying.

C: Electronic bands monitoring, spy on people's computers. The premise is that passengers are not trusted. Rely more on self-testing. Take advantage of hacking but expand the notion of pre-check.

C: Integrating sensor technologies into the check-in process.

C: Use smart phones to self-report suspicious activity.

C: If everyone carried explosives, no one would use explosives.

Speaker: Harry Martz

Discussion of considerations and perceptions affecting redeploying X-ray backscatter at passenger checkpoints.

Q: Can ATR be developed?

A: Rapiscan nearly had it developed. Yes, there are other approaches that could yield very good performance.

Q: What about X-ray exposure to operators and the public? What is the dose to passengers?

A: You can pass through a backscatter scanner 2000 times/year. This number is not a health limit. This dose is considered to be ALARA (as low as reasonably possible). The dose you get inside – 3-5 microrems every time you go through. A few hundred times that is experienced by a passenger on a single New York to Los Angeles flight at 30,000 feet. But the public doesn't want to hear that they are getting that much on a flight. We have set up a gantry around the system, tested with dosimeters, confirmed with the TSL and independent 3rd parties. It is not zero around the side, but is reasonably mitigated without undue trouble.

C: The media can write anything that they want.

C: Is there new information or better information? Can you combat it with better security, if this provides value?

C: Are we so irrationally concerned by safety that we are willing to tolerate additional risk?

C: You have to measure compromised safety vs. value.

C: The perception is that there is an alternative, a non-ionizing alternative. From the public's perception, they are equivalent.

C: X-rays penetrate and may be effective for detection of lots of threats that we aren't entirely responding to.

Q: How much of this is perception of an open vs. closed machine (i.e., big black box)?

C: Millennials are willing to accept science vs. older generations.

C: The backscatter systems were pulled because they are slower. For MMW scanners, you only have to stop and pose for 2 seconds.

C: No one jumps in a microwave oven. There are not enough studies to show that MMW is safe. There has not been a comprehensive exploration that shows that ionizing radiation is that much worse that non-ionizing (e.g., cell phones vs. cosmic rays at 30,000 feet).

C: The only health effect with Microwave is heating; you burn yourself. MMW can operate up to 100GHz.

C: Don't underestimate perception.

C: Is flying a right or a privilege? The infrastructure is publically funded.

C: It is not your right to get on an airplane.

C: Scientific literature was published before but it was drowned out.

C: It's a question about control. We choose whether or not to carry a cell-phone, and how we interact with it and where or if we carry it on the person. We can choose to board a flight but we don't get to choose which technology in the checkpoint. The alternatives are unpleasant.

C: People who want security will buy X-ray body scanners and deploy them. At airport checkpoints, it is more politically sensitive that they aren't there. They are used in Israeli airports, not in the public areas of the airports, but they are used for selectees and they are also used at the boarders.

C: It is relevant to risk-based screening.

C: There was a poster that showed that security is better with XBS due to image quality.

C: Threats are different in prisons; threats are internal.

Speaker: Amir Neeman

Discussion of different approaches for meeting throughput and screening objec-

tives for various deployment environments in a cost-sensitive manner.

Q: Have you run simulations if you add a shoe scanner?

A: Yes. It goes back to cost and regulators who must say yes.

C: You don't remove shoes in Europe and in Canada.

A: In some countries you do, and in some you don't. In India, 100% of passengers go through WTMD and that same 100% also get a pat down. But 100% of passengers alarm; they use it as a queue metering device.

A: I only have 2 arms. If I go to a checkpoint where I just have to remove my laptop, that's ok. If it's just my shoes, it's ok. If I have to do both, it is more than twice as slow. Can the model be changed?

C: There are 18 feet of divestiture.

C: The perfect is the enemy of the good. NQR and others had benefits. It would be interesting to hear the government perspective on why they weren't approved.

A: It was about technology capability back then. You have to test against the standard. If the new device or capability adds detection to one threat and nothing else, you have to weigh that against other considerations. A lot of technology had detection and CONOPs problems. If I have to walk in and walk out, how do I fit it into the checkpoint? If it is integrated then we are interested. If MMW works down to the floor, that might work and avoid the need for shoe removal.

A: India added a ramp into the metal detector. It's a low-tech solution.

C: Lifting the liquids ban will be disruptive.

C: Shoe bombs and liquid bombs are in public discourse. The notion that that those were yesterday's threats and don't need to worry about that today is not accurate. Those are real threats today.

C: Deterrence is real. Just because it doesn't detect everything doesn't mean that it doesn't have value. Terrorists were telling in their lone wolf messaging: go around the AIT. AITs are/were far from perfect. If the bad guys aren't going to test them, then it's good enough. It would be good to incorporate deterrence.

Q: What is the value of a system that has a higher false alarm rate system vs. one that has no alarms, i.e. that the system is catching something?

Q: How much random screening do I need to do before they are deterred?

A: CBP, like a lower false alarm rate, allows them to look at people interesting on their own, They would have the time because they are not busy resolving false alarms.

Speaker: Harry Martz

Update discussion of fusion related initiatives, pilots, relevant factors, success stories and challenges. This includes discussion of testing challenges for fused vs. stand-alone systems and fusion coupled through human-in-the-loop.

C: The Advanced Technology Screening Checkpoint prototype was developed, and drawn from 3 manufacturers and comprised of the best of the best. There were 3 sets of integrations and both data fusion and full integration were considered for the integration approach. Because technology for the sub-elements maturate at different rates, we believe that better results are secured through data integration rather than fully integrated on the same box. The system offered better detection but suffered from higher false rates. It was a success.

C: It was less successful combining CT with QR, and QR with X-ray.

Q: Why did it fail?

C: It got as far as pre-cert. The QR was used to focus on sheet explosives, and CT did the rest. The issue was the economic perspective, i.e. the additional cost. There was no tangible return on investment. This combination did not offer a sufficient increase in performance to justify the price premium.

Q: Did it pass certification?

C: No. It would cost additional monies to achieve certification. It was a business decision. The technical achievement was successful and reduced the false alarm rate, but the reduction was not worth the cost.

C: Invision estimated the cost of false alarm rate at $120K per point of false alarm rate.

C: Companies have integrated systems but have a tough time succeeding because the TSA RFP doesn't have a requirement for an integrated system. There are no formal testing protocols in place today for these systems. All tests today are for single systems. It makes it tough to get through sales.

C: The original Invision CTX was a combination of a CT and a projection X-ray. It was successful.

C: The cost goes up when you put more technology in. With IATA, if you have a more expensive lane with more expensive tech, you can improve the efficiency of the other lanes.

C: I disagree. There exists huge amounts of fusion in practice today. A passenger that goes through AIT and then is subjected to a pat down is fusion. ATR is fusion. There is a lack of understanding of the metrics. The second bullet is key. The expectation is that when you fuse two technologies together, it is clean and simple. It is not at all clear when you fuse humans and technology that it is clean and simple.

C: In the sports world, a stadium admits 60,000 people in 1 hour. The owner of the team wants people in their seats as soon as possible.

C: Trace is tested completely separately. Subjecting a system of systems to the same requirements as a standalone system is a challenge.

C: CT with XRD is subjected to standalone certification. We did finish it in Israel and it has good cost value.

C: Different screening stages are a form of fusion. Where co-located, humans are doing the fusion rather than computers.

C: There is no fusion between data on the passengers and on the bag (body born, for binaries), i.e. different people going into checkpoint and bringing different things, and how do you connect them.

Q: How do you go off to a vendor and produce a subsystem that could be integrated?

S&T: DHS is standing up to a joint requirements council. There's Coast Guard, there's Customs, etc., so if another component has a similar requirement, we can integrate the requests.

Speaker: Sondre Skatter

Discussion for integrating ATRs with analog outputs, implications for data analytics and risk, and considerations for presentation of results in backend and frontend displays.

Q: How do you get from analog to a binary decision? Get arrested or not?

Q: Does this box made a decision, or is it at a different level?

A: Do you mean as a decision aid or does the machine make the decision for the TSO? It's on the borderline, so it's up the TSO. Are there mitigating factors? I think that's a saner way to go.

C: Not sure TSA would agree.

C: We train on a lot of things that we come up with. The threats are here, etc. Most of that is based on what we come up with. It may not reflect what is real.

A: Algorithms only know what they have been trained on before. That does not change with analog.

C: If the Pope is coming into town, the threat level is higher and we turn the dial up. Everyone gets enhanced screening.

C: Very interested in the PD/PFA on the left hand side. It is interesting that it does not go down to zero.

A: You are only interested in a certain range. Manufacturers don't necessary have ROC curves. We have points on a curve. Can we make them? Sure we could.

C: Shift liability from machine to a TSO for making a decision. We have a risk assessment module, with 5 modes. Adjust belt speed, different criteria; more modularized.

A: I'm not suggesting that a human should look at a gauge, but feed it into a subsequent system.

C: For data analytics, it makes sense to have analog values.

C: I thought the analog gauge was an indicator to TSO so you can pay extra attention to how high that goes. That assumes TSO has information available to them that is not available to the automated process. It is hard enough to write requirements for red-light green-light declarations. It would be difficult to create requirements for a gauge.

C: But the automated process from TSA's Office of the Chief Risk Officer – i.e. the DARMS concept – is to adjust screening based on external information and the infrastructure and communications that must be in place to enable it.

C: This has to do with information theory and optimal systems.

Q: Is the dial set for the machine and bag? Once the bag has been shown to the machine, the machine makes a declaration. It doesn't matter what that gauge says.

C: There is an analogy in medical imaging. Mammograms are read with algorithms, but they report an analog for the radiologist to make a decision.

C: It happens in security shielding with shield alarms. It's a pain, but there is no reason why the operator can't do different things for threats.

C: The concept of a gauge has been characterized and understood.

Speaker: Eran Gabbai

Presentation of a sensor package for non-contact terahertz screening.

Q: Can you talk about your limits of detection?

A: I am doing detection work on behalf of an Israeli security company. The question was not if THz can detect explosives. The question was "can you do it efficiently and very fast". Take six different materials, for example. If you detect them at a frequency of 1.81GHz, you go to 1.813GHz and detection in less than 1 second (other materials have a different response).

Q: How much explosives do you need to do a detection?

A: 1 pico-mole concentration of a gas. This approach does not need a pre-concentrator, and works by immobilizing a particle in a ring with an equal field from behind. A single particle is all that is required.

Q: What is the size of the wafer?

A: Approximately 1.5 ft2, which accommodates a 10x10 array.

Q: Is this the maximum size?

A: No, we can go bigger.

Q: Does the target need to be stationary?

A: The target does not need to be stationary.

Q: What about clutter?

A: We put complex materials in the field and try to create as much noise as

we can.

Q: Was this targeted to passengers or bags?

A: Passengers to start with, since you can see sweat and fuse with other data.

Q: Power requirements?

A: We need 1 milli-Watt of radiating power; you need 1W as an input.

Q: What is the resolution?

A: At 30-50 MHz, the system can differentiate between 17 water molecules and 18 water molecules.

Q: What is the duty cycle?

Q: (???)

A: If you have 2THz of basic (???), you need 1THz to cover the limitation of continuous waves in the environment.

Speaker: Kris Iniewski

Discussion of a CZT based sensor system for checkpoint applications and advancements beyond traditional implementations.

Q: Do you generate an image?

A: Yes. It supports detection and it shows you the shape. Existing commercial equipment uses High Purity Germanium detectors which operate at very high temperatures and require cooling. CZT operates at room temperature.

Q: There have been manufacturers of photon counting detectors for a while. What are the advances?

A: Those manufacturers have been acquired and captured by medical imaging companies who are very interested. This is the best energy resolution device integrated detector and electronics, and priced competitively.

C: Do you have any real images?

A: We will have them shortly.

C: Coded aperture is interesting. It always shows up and then doesn't work for specific applications (e.g., astronomy, but not nuclear medicine, mainly be-

cause there is a lot of background). This concept is always coming and going.

C: Combined electronics and CZT is an intriguing concept but the verdict is still out. Not sure if coded aperture will work or not. When you open the collimation very quickly, you get lots more photons in a forward scatter scheme, but this creates computational burden on the backend system.

A: Traditional systems are photon starved; this is photon rich and provides a gain of 100 over traditional systems.

Q: Why do you need photon counting for transmission X-ray?

A: It's for forward scattering. The objective is forward scatter.

Q: Why do I need multiple bins for transmission CT?

A: This system does not have bins. We read the energy of every photon that arrives on the detector.

Q: Are you doing the analog-to-digital conversion?

A: Yes. In every system, at some point, we will do A-to-D. The output is in a list form. This photon arrived with this energy.

Q: You read each one and assign it to a list?

A: Yes. 60.4 KeV +/- 2KeV uncertainty.

Q: Does this spec include pile up?

A: There is no pileup here. It is in the range of kilocounts/m2 for this application. You run into an issue in high energy CT.

Speaker: Jun Zhang

Discussion of the validity of using a high-resolution library of image patches to build a higher resolution image for detection purposes from a low resolution scan based on patch substitution.

Q: You take your low resolution patch and replace it with the high resolution patch from the training set. So this is somebody else's tumor? If you are scanning and you are going to use that scan image, why do this?

A: If we process the low resolution scan image and compare the scan image patches against the database of low-resolution patches, and if a match is

found, we can substitute in the corresponding high-resolution patch from the database for the scan image patch. So we replace patch for patch. The patch is very small, so it doesn't cover the whole tumor.

Q: What if the training data is not similar to the data you are trying to reconstruct?

A: Then it doesn't work.

C: When you reduce the high res and downgrade, it needs to look like the low resolution.

C: But the mapping is not unique. This is image processing. It's not magic.

C: It's ok for a conference photo to do patching.

A: It does fill in the missing detail in correct ways.

A: It does well with OCR.

C: A JPEG is compressive sensing. You're throwing away high frequency detail. The problem is that you don't know where the important part of the image is.

A: We are not replacing someone's high res head with someone else's. We are only replacing a piece of their ear. In other words, you don't assume some kind of global security; this is about local security. It works well in some applications and poorly in others. You must be selective about the application.

C: Looks to be more cosmetic, rather than recovering the information.

A: New information looks similar, but it is not recovery.

C: This may work well with houses, but houses are all similar. If I'm looking for a small blemish on a corner of a window and it's small, it's tough. If it's large, I don't need resolution enhancement.

C: This might work quite nicely on a standardized test of spatial resolution.

Q: Aren't you taking something that is poorer resolution and replace it with something that is at Nyquist, so it's not beating Nyquist?

A: With Nyquist, you need the sample to have a perfect recon. You need to sample 2 times as high as the highest frequency, and recon is linear interpolation. This technique can beat linear interpolation if the requirements are satisfied.

Q: You don't have good quality images of luggage. Typically, you won't have ground truth to compare it with. How will you know?

A: No. No two bags are similar because of clutter.

Q: If somebody packed something that has never been seen before, then what?

Q: If I have an X-ray system, to train this, I need to have higher resolution images on my own system. How do I do this?

Q: Why do we have someone else presenting someone else's work?

ALERT: Sometimes people don't want to present the work. Someone applied it to X-ray transmission. Their system was lower than competition. They applied the technique to scans of objects, a suitcase. People carry similar items.

C: Better resolution results in better detections. This isn't just perception.

C: People perceive that resolution is a measure of quality.

Q: Could this technique be used in a reverse way for consistent objects (e.g., laptops, etc.) and highlight where the low resolution scan is different than expected?

C: This is compressive sensing.

Q: We lose information after recon and more after detection. What if you apply this to raw data?

C: How would you get back to high res? You can lower the belt speed and get higher res; do this as an offline process. Operationally, you run a much faster speed.

Speakers: Charles Bouman and Sherman Kisner

Discussion of an implementation approach for reducing the computational burden of iterative CT reconstruction methods that is geometry independent.

Q: Are you aware of a rapid CT benchmarking website for back projection algorithms? Have you tested for accuracy and speed?

A: No. This isn't the same thing. It's an indirect comparison. It's a bit of a different problem. I need to investigate it.

A: There's two approaches – simultaneous methods – a sequence of forward

and back projections – we aren't using that. That requires geometry specific preconditions.

A: We think the advantages of this method are very rapid convergence and not geometry specific. It can be applied robustly through a wider range of applications without tuning.

Q: Did you measure cache hit rates?

A: Yes. We have a paper in Principles and Practices for Parallel Computing. It received good reviews. All the details are in there. Yes, cache hit rates went way up. A tool for the CPU called vtune taps into the CPU and gives you counts. Doing this on the GPU is harder. There it's exploring in the dark. If you are using CUDA, you can get cache hits from that.

A: L2 cache hit rates skyrocket. L1 went from 0.1% to 10%. We have been working with people at NVidia.

Speaker: Matthew Merzbacher

Discussion of the stakeholder logistics and lead times for deploying new ATRs, vendor incentives and technical debt, requirements co-development, and shifting the focus of pilots towards embracing experimentation and iterative learning as part of requirements development.

Q: Is your testing visual or automated?

A: Automated.

Q: Should TSL automate?

A: Sure, but that's not the major time suck.

C: There was grave concern over false alarm impact.

A: Some airports are designed on the margin.

C: This is just fear.

A: Airports are working. They don't want to change.

Q: Should industry jointly develop requirements with TSA (What you can do vs. what they want you to do)?

A: The earlier we are involved in requirements the better. Not because we

want to tune them. Instead, it might be "oh wow we didn't know that you could do that."

Q: If I removed the policy, what are you talking about in terms of refresh?

A: ATR is less than 1 year, no problem. We had an 18 month wait for a regulatory approval abroad for a cable change.

Q: One of the goals was to lower the cost per checked bag. There is an economic number. Doesn't that drive requirements for the vendors?

A: We have never been incentivize for false alarm reduction, even when we've done it.

Q: If we are giving up detection in one material it doesn't meet requirements? What is my expected dollar losses when I lower overall by still deploying an algorithm that detects all of the others?

C: Take, for example, existing algorithms that don't detection certain HMEs, and future ones that do; we are comparing one to the other. There are a few things to dig into it. Different parts of the organization are responsible for different things.

A: Anything we can do in parallel, it will be ready when the longest pole in the tent completes.

Q: What is TSA willing to allow for opening bags? 3%? 5%? Where is that today?

TSA: That's one aspect of this problem as to why it take so many years. There are OSARP changes that are sensible. What I'm trying to set the stage for is doing some experimentation. TSA has done pilots in not the smartest way as a lead into what we are going to deploy unless it causes real problems, full throttle. There is no iterative learning loop. Go to the field, be happy, and then write the requirement. They assume that you have to write a requirement before you do iterative learning.

C: Back in the day, what would be the target for FAR? How much is 1% FAR? Approximately $25M. What is it that we can sustain, and what makes economic sense? We opened the door to more technologies other than EDS. We need to think outside of the box.

TSA: Some of the reasons listed are fairly good, some are fairly bad. If we get a piece of intelligence that terrorist X is buying Tonka trucks, we are not sure if they are buying them for their kids or filling them with C4. We should go to

TSIF and stuff them with C4 and collect data. If I could, I would like to push out an algorithm for the detection of C4 in Tonka trucks in a month. We can't send those pictures of C4 in Tonka trucks to the field because it will be leaked out to the press and someone will be killed because they sent us that information. We have to protect our source.

Q: What about deploying something and changing windows in the field. Why not just deploy a new ATR?

A: Integration is not a trivial thing with a new ATR. It is not as simple as downloading an app from the app store. There is technical debt. Unless someone has a project to do that, no one will.

C: This is kind of the direction that ALERT is going in. And having an ATR that has tuning is easier than dropping in an ATR – the integration and the testing parts.

Q: Why don't you make your performers all have Top Secret security clearance, then you solve the problem.

TSA: We are trying to push so that nobody needs them.

C: You will upset the vendors.

TSA: I hope not. I think it will be in their interest.

A: The best model is for us to use a conforming format. Have them show success, and then work with us to integrate onto our machine. Switching on a bag-by-bag basis between theirs and ours, that's how it will work.

Q: Can they just buy your machine, download the images, and build algorithms? Do they need your help with source code?

A: We are happy to sell machines but it's expensive.

C: There is a revenue stream for vendors to license that format and all the characteristics.

Q: Are you concerned about losing the service revenue?

A: We make money on hardware and service; we make little money from selling algorithms.

Q: So doesn't that make the argument for separating algorithms from hardware?

A: Wait for the 3rd party discussion later.

Q: That one algorithm can run on system A or B or C or D?

A: That is not proved.

C: An algorithm developer might be reluctant to give it to the vendor to tune.

Q: Why don't you improve the product?

A: It takes effort. Why should we do that? If no one is going to pay us for it, then we can't justify doing it. Engineers cost money. The reason we are fast is that we know the "gotchas" – this corner case, that corner case, etc.

Q: Why do the results differ from when they are put in the field? Regression testing is a huge piece but it may have a negative impact on what other parts of the system are affected.

A: I couldn't agree more. We have this implied fusion that we don't discuss: algorithm, OSR, CBRA. If we change our bounding boxes, it's going to change OSR that has nothing to do with the algorithm performance. I have no answer on how to assess that quickly or in advance. A phased rollout still takes time. The more we can decouple the pieces and work on them in parallel, the better.

A: ATR is just a small percentage. There's also mis-tracked bags.

Speaker: Jonathan Ullman

Discussions of an approach for avoiding overtraining and using algorithm competitions to draw in participants.

Q: How much do you need to perturb the data?

A: It comes from a distribution. Intrinsic Noise is 1/root n. You need to add more noise than intrinsic. It converges to zero as you have more samples,1/cube root n.

C: What you are saying is that there is uncertainty about the assessment of your value. We should not assume that if you are first on the leaderboard, there is a statistical phenomenon associated with that ranking, and it is not necessarily the truth.

A: Just because you do well on training data does not mean you will do well on unseen examples. But lots of people are paid to make this assumption. There are statistical processes to map, quantitative guarantees.

C: The realization is that statistics come with certain limitations but a different approach is that I will share as much as I can about how you did, and less statistical information to understand the deep root of the problem. You still need to test. There are governments who are more open to co-development, and they are happier with the result.

A: If you are running these competitions, give out data and we'll think really hard with the data. It's hard to discipline yourself. Why are the competitions exciting? Turn the natural competitive nature of nerds to a problem that there aren't usually classifiers. For some applications, it makes sense to bring the smart people in a room to work on it. You want some quantitative methods to discipline yourself.

C: There is uncertainty associated with our knowledge no matter what you do; a degree of uncertainly with our understanding of phenomenology. It is not an unreasonable assessment. Offer a new way of testing fundamental understanding of base knowledge.

Q: You only provide feedback to the best classifier so far. Is the winner worse than if you gave more information?

Q: In a mathematical sense, no. In a practical sense, this is a bit more problematic.

C: It's hard to plug in technology without people being upset.

Q: What if I'm smart and I take the Netflix data and I slice it up?

Q: What if you use a priori knowledge. Do you improve or not (e.g., you know physics or something can't be measured, etc.)?

A: People incorporate all sorts of a priori knowledge to squeeze out performance. I suspect the answer is yes.

Speaker: Chad Johnson

Discussions of the degree to which a small startup can participate in solutions development.

Q: What data do you need in an ideal world? X-ray of explosives from TSL?

A: Our client has experience having done this in the past; the variety of the data, the different challenges of detecting certain threats. We couldn't see those challenges in advance. TSL has designated some things as classified

because they don't want to reveal them. Without a system of our own, we try to make our work appealing so that they take us. They know what they are looking for, we don't. It is not a list of threats. If you have a threat and you put it on the belt, it's going to harden. We only know what we are exposed to. We do not know the corner cases.

Q: Are they willing to provide images of explosives?

A: We have images with explosives from TSL. The more data, the merrier. The false alarm data we have is not practical to (???).

Q: How many different bags do you need?

A: In the thousands. The problem is constrained to some degree by the bags that we have since that's all that we have to train on.

Q: Thousands for all explosives?

A: Categories within that.

Q: How many thousands?

A: We have 1300 now. We would like 5000. Variety is critical.

Q: In terms of labelling the ground truth or where it is, what do you need?

A: For success of segmentation, we need an accurate mask. If we are concerned about a tuning or classification change, we tune up our classifier.

Q: Do you need money from TSL? You are a private company.

A: Yes. To improve the algorithm, we need to keep acquiring more data and keep improving the algorithm.

A: We are working with incumbent firms who already have relationships with TSA or non-incumbent.

C: The incentive doesn't seem to be big enough; if our algorithm were better, and if we can come to some arrangement, etc.

C: It feels like these guys are the goat on the stake in Jurassic Park.

C: How much data? What's lacking? What do you need in the dataset? To enable 3rd parties, you need lots of data, and it should be well labelled. Incentives for vendors to participate with 3rd parties are all over the place. Even incumbents are not a monolithic block to work with 3rd parties. There are a

lot of assumptions but not all bearing out.

A: Our commercial partners have brought a lot of information to us: threat category, how it's aligned, and what type of object that conceals it. We wouldn't have been aware of it. For ratio of threats to non-threats for a training set, variety trumps quantity. Different airports, different times of the year.

Q: Why hasn't one of your clients acquired you?

A: There was discussion of a more permanent role. It is hard to build a system without personnel onsite for supervision. Our work was good but they didn't like the barriers of our assistance to continue tuning and fixing issues. They only wanted our assistance to get started.

Speaker: Piero Landolfi

Discussions of how there is room for large vendors, small startups, and some of the hidden factors that affect cost structure.

Q: It was earlier stated that algorithms for EDS are not profitable. It is profitable for AT vendors (e.g., $10M).

A: You confirmed it. If there is a business reason for it, then it makes sense. There are a lot of hidden costs with standard interfaces. Different software release cycles are never going to go perfectly smoothly. Service interactions cause problems and certification issues. You're going to have indirect cost driving impact as well. For my job running an engineering organization, it's the little things: regression testing. library, computer, OS, driver, etc. We need a strategy for handling it.

Q: For 3rd party testing, someone needs to do regressing testing. Should we hire someone or should the vendor do it?

A: Very good idea to use independent party to validate. You don't share a lot of IP there.

Q: Should the government fund 3rd parties?

A: Yes, if there are good ideas. If they need a little bit of help then that's ok.

Q: What if they become competitors and they generate IP?

A: It's part of the industry. We get funded. It's not a huge market: Large investments, complex system, complex hardware and complex software. Whatever they feel is necessary.

Q: Morpho sent 4 people here. Why?

A: The expected answer is that ALERT is a great opportunity and should be funded. In fact, these discussions are good. The idea stimulation is good, and we can frequently combine it with other things.

Speaker: John Beaty

Discussions of how ALERT encourages innovation, supported by the funding structure and sponsorship of DHS, and encourages the involvement of third parties and traditional vendors.

Q: Is ALERT working?

A: This gathering is a great example of interaction with 3rd parties. I would like to hear from people in the audience. Is it working?

C: Stratovan was a major contributor to Task Order 1. That was part of the seed money that got them started. For Telesecurity, it was the same thing.

C: It's all about competitive advantage. 30 years ago everything was in-house, IBM and the big companies. It was all built in-house and they sequestered it. To be competitive, you have to reach out. Vendors really like the access to see what the small companies and labs are doing. What pops up on screen is interesting and a paradigm of where business has gone over the recent years.

C: Clearly it is working. There are more representatives from TSA and DHS over time. Does ALERT fall under DHS?

A: DHS S&T Office of University Programs (OUP) provides the fundamental grant. ALERT is comprised of 15 major institutions with 30 separate programs running concurrently in that area. We try and do and listen to what is going on at ADSA, where the innovation is going, and have a program in that specific area. Those 30 are the base of innovation. Another chunk of funding comes from the DHS S&T Explosives Division (EXD). EXD has supplied the transition money. When we try to transition technologies into the security enterprise, we write a whitepaper/proposal with the innovator and the commercial enterprise – approximately a 12-18 month transfer. All of the principal investigators (PI) also write proposals and grant requests and it doubles the money we get from OUP. Every PI is funding above and beyond the ALERT seed finding. The amount of funding in the security enterprise is approximately $5M above what is coming in over DHS S&T.

S&T: It's a national competition that ALERT won: 6-12 months building a

coalition of universities. It is DHS's intent not to fund one university because we want a lot of outreach and to go through annual reviews. You see the workshop, and all of the PIs have to write annual reports and all are online. 30+ reports are a dissertation. All are meant for peer review. The amount of effort to sustain (financial) and the satisfaction of our government sponsors is substantial. We are 2.5 years in the middle of our second term. In 2.5 years, we will be going for our 3rd. It is a significant effort above the research that is being conducted.

Speaker: David Schafer

Discussions of how working with a vendor can be successful and some of the hidden costs and challenges that the government mandates of adoption of a standard resulted in better outcomes, and the challenges affecting international harmonization.

C: That is a fantastic example. The government defined the standard for BHS IRD, and how it is much easier. One company did a serial interface, Ethernet controller, and everyone was different. During integration, there was lots of finger pointing. Airports want happy customers, and before standards, the government spent lots of money and vendors spent lots of money.

A: Government sets the requirement. All sides, the integrators, the BHS, and the inspection scanner had to conform. It was beneficial to vendors. You had to do more work to meet the standard, but once you did, it was done and it worked.

C: We have different requirements between the US, Europe, and Asia.

A: Yes. There's been so much more activity in that area recently. These are the harder problems to solve. How do you get 37 countries together to agree on standards for inspection systems? One doesn't want to spend the money and sees the problem down here. We are now seeing at the checkpoint that it leads to harder problems like harmonize testing.

A: I just got back from Brussels last week listening to ECAC testing new standards, 6 week for each algorithm. Over there, the companies pay a fee to submit for testing so you are talking about hundreds of thousands of dollars.

A: In the US, we still pay but not for lab time.

Q: How hard would it be for a 3rd party to do reconstruction if they understanding the details of the machine?

A: You can do reverse engineering if you need to. You would need to bring your own computer because how do you interface with everything. Where do you put it?

Q: Can you be specific about why it's hard to reconstruct?

A: There are things about a good reconstruction: How stable of an X-ray source, does focal spot move with rotation, non-linear response of detector, move thermally with time. Lots of stuff that vendors are integrating into sub-systems have been learned over time; it is much easier to work with the vendors. If you want to do this kind of thing, go to the company. Bring knowledge and insight and see if it's applicable to their system. That's better than "I'm going to put raw data on the market and see who can do a better reconstruction".

TSA: I almost feel that the term "3rd party" is being thrown around as a pejorative. We are all trying to produce a system that defeats bad guys. Whoever produces the system, I don't care. Government at the top of pyramid is baloney. If you think that we have the knowledge to put together these systems, we need an OEM to (???) and OEMs bring a ton of value. The question is "who can collaborate best to provide the best overall value?"

Speaker: Andrea Schultz

Discussion of the SAFETY Act, its applicability, eligibility, the application process, and whether or not it is a gate for selling screening technology.

Q: Does a company go through this once or by product?

A: We review products. You can wrap similar products up in a single application. If they seem similar but operate differently, they will have two separate applications (e.g., for building perimeter protection from vehicles -- Bollards, vs. hydraulic). These differ significantly in terms of maintenance and activation.

C: Newark is not an airport. They use different technologies.

A: The technology was their security plan. The port authority of NY-NJ submitted this for approval. It is not TSA's area of responsibility. Intrusion detection, training staff, operational maintenance plan, we want to see that you have logs that you check the maintenance twice a day, every day.

Q: Can you deploy equipment without the SAFETY Act?

A: Yes, it is entirely voluntary. It is an inducement to deploy more technology. More commercial buildings are making it prerequisite for suppliers.

Q: Once you submit, are you covered?

A: Once you are approved, you are covered.

Q: Do you have any statistics on how many times this has been invoked?

A: Zero. Since September 11, there has been no declaration by the Secretary of Homeland Security of a terrorist event.

Q: Is this protection domestic only?

A: No. The Secretary declares world-wide. This is relevant if we have an interest, and a technology facing liability at home. It does not apply in a war-zone.

Q: Does it apply to only US entities?

A: Eligibility is not limited to US entities.

Q: When is the right time to go through this process? Prototype stage, etc.?

A: When does your risk become a factor? As soon as you go to a field deployment, your liability becomes a factor. Much of the information we want to know in the application is in your test plan.

Q: Have you done only hardware or also software?

A: We have approved cyber-security software solutions. Congress is taking a hard look at cyber across government and private industry. We are talking to them about expanding for cyber beyond terrorism. We are in discussions with the House of Representatives right now. A resolution was passed in the House last year but never made to the senate.

Speakers: Harry Martz and Carl Crawford

Discussion of the nature of the challenge and the need to engage the Europeans more actively.

C: The problem is not looking for a needle in the haystack. That's an easy problem to solve with a metal detector. Instead, it's like a looking for a needle in a garbage dump, or looking for a short piece of hay in a haystack.

C: Encourage European regulators and customers of screening technology to engage with this conference to discuss their needs.

C: They were here at the last one but we can't do this twice a year. We should have a big and a small ADSA.

16. Appendix: Presentations

This section contains the slides presented by speakers at the workshop. The slides appear in the order that talks were given as shown on the agenda. Some of the presentation slides have been redacted to ensure their suitability for public distribution.

PDF versions of selected presentations can be found at the following link: https://myfiles.neu.edu/groups/ALERT/strategic_studies/ADSA13_Presentations.

16.1 Carl Crawford: Workshop Objectives

Thirteenth Advanced Development for Security Applications Workshop (ADSA13):

Screening of Personnel and Divested Items at The Checkpoint – Part 2

Workshop Objectives

Carl R. Crawford
Csuptwo, LLC

1

ADSA12 + ADSA13

- Perspectives: passenger, TSA, airlines, airports
- Resulting in three competing goals
  - Strengthen security
  - Increase operational efficiency
  - Improve passenger experience
- No silver bullets
- Possible solutions: risk based screening, improved conceptions of operation, fused systems and data, improved extant equipment, vendor neutral airports
- Complete list in handouts
- ADSA13: focus on ADSA12's recommendations

2

Rule #3 – Public Domain

- Do not present classified, SSI, FOUO or proprietary material
- Presentations, minutes and proceedings will be placed in the public domain
  - After review for SSI and classified material

3

Rule #2 – Speaker Instructions

- 2nd slide has to be "so what who cares"
  - State how technology will improve explosive detection
  - Optimum presentation: stop at 2nd slide
- Don't get trapped into developing the whole story before giving the bottom line.
- Move most slides into backup

4

Rule #1 – Open Discussions

- This is a workshop, not conference
- Conversation and questions expected at all times, especially during presentations
- Moderator responsible for keeping discussions initiating discussion
  - Will *try* to allow speakers to complete their introduction
- Much more time for discussions at this ADSA

5

BACKUP SLIDES

6

DHS Tactics

- Augment abilities of vendors with 3rd parties
  - Academia
  - National labs
  - Industry other than the vendors
- Create centers of excellence (COE) at universities
- Hold workshops to educate 3rd parties and discuss issues with involvement of 3rd parties
  - Algorithm Development for Security Applications (ADSA)
- Forage for technology in other fields

7

Equipment Requirements

- Probability of detection (PD)
- Probability of false alarm (PFA)
- FA resolution
- # types of threats
- Minimum mass
- Minimum sheet thickness
- Total cost of ownership
  - Purchase price
  - Siting
  - Labor
  - Maintenance
- Extensibility
- Ability to fuse
- Compatible with risk-based screening
- False alarm resolution methodologies
- Siting
- HVAC, space, weight shielding
- Throughput
- Safety

8

Questionnaire

- Request for everyone to answer questions preferably during the workshop
- ~10 questions – 10 minutes
- Available via Survey Monkey

https://www.surveymonkey.com/s/ADSA13

SurveyMonkey.com
because knowledge is everything

9

Minutes

- Minutes will be taken of discussion
  - Sensitive information to be redacted
- Please identify yourself and institution first time you speak
- Suriyun Whitehead, thank you for taking minutes

10

Archival Materials

- Final reports and presentations from previous ADSAs
- Final reports from projects to CT-based EDS
  - Segmentation
  - Reconstruction
  - ATR

  https://myfiles.neu.edu/groups/ALERT/strategic_studies/

11

Acknowledgements

- Northeastern University (NEU)
- Awareness and Localization of Explosives-Related Threats (ALERT) DHS Center of Excellence
- Department of Homeland Security (DHS)
- Presenters
- Participants

12

Acknowledgements

- Speaker selection
  - Laura Parker, DHS
  - George Zarur, DHS/TSA (retired)
- Content
  - Suriyun Whitehead, Booz Allen Hamilton

13

Logistics

- Melanie Smith, lead
- Deanna Beirne
- Kristin Hicks
- Teri Incampo
- Anne Magrath

Let them know if you need support during or after workshop.

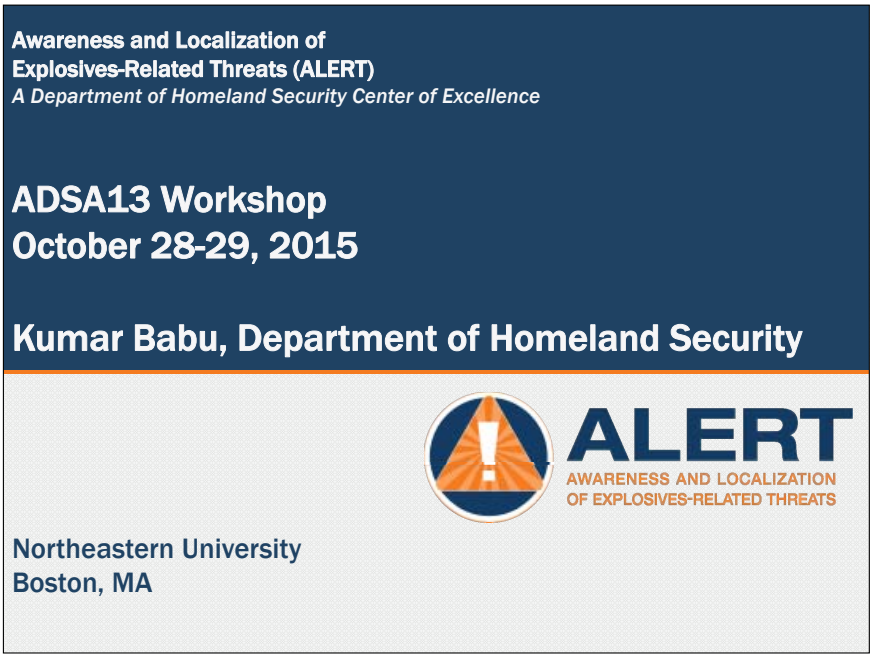
14

Final Remarks

- "Terrorism causes a loss of life and a loss of quality of life," Lisa Dolev, Qylur
- Need improved technology
- Thank you for participating

15

16.2 Kumar Babu: DHS Apex Program Overview



16.3 Srikrishna Karanam: Full Scale Airport Security Checkpoint Surveillance using a Camera Network

Full Scale Airport Security Checkpoint Surveillance using a Camera Network

Srikrishna Karanam, Ziyan Wu and Rich Radke

Dept. of Electrical, Computer, and Systems Engineering, Rensselaer Polytechnic Institute, Troy NY

Rensselaer

This material is based upon work supported by the U.S. Department of Homeland Security under Award Number 2008-ST-061-ED0001. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied of the U.S. Department of Homeland Security.

ALERT

Problem

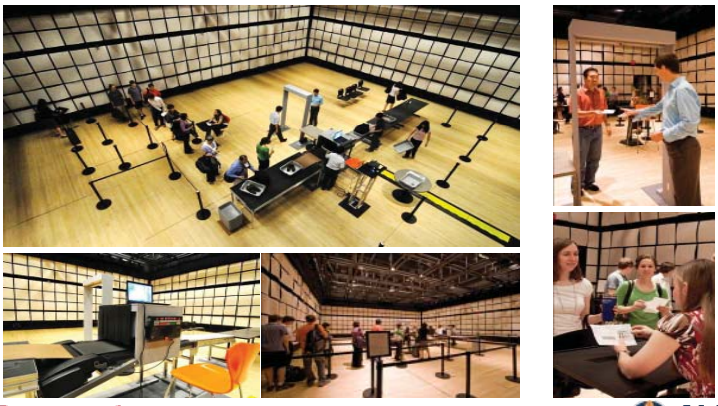
- Real-time analysis of throughput at checkpoints is critical, e.g.:
  - How much did a change in protocol/queue design improve speed?
  - How many bags/bins for the average passenger?
  - Where did a lost/stolen bag event originate?
- We developed a computer vision system that automatically tracks passengers and bags

Photo: oddharmonic/Flickr

Rensselaer

ALERT

Simulation environment



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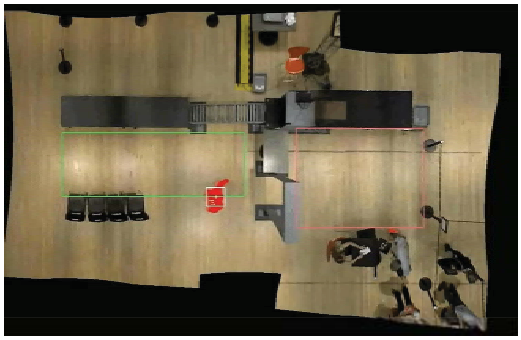
Results from our system



Video available from: https://www.youtube.com/watch?v=BpxGXTcayBs

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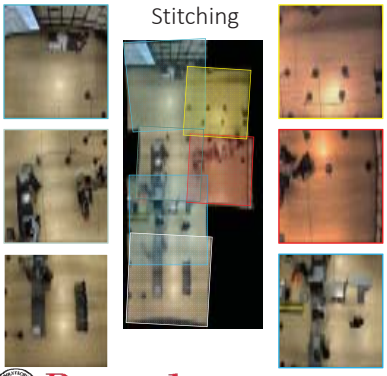
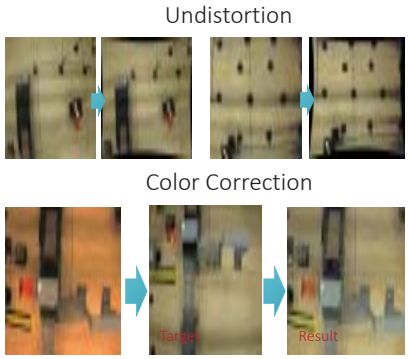
Calibration, undistortion, color correction





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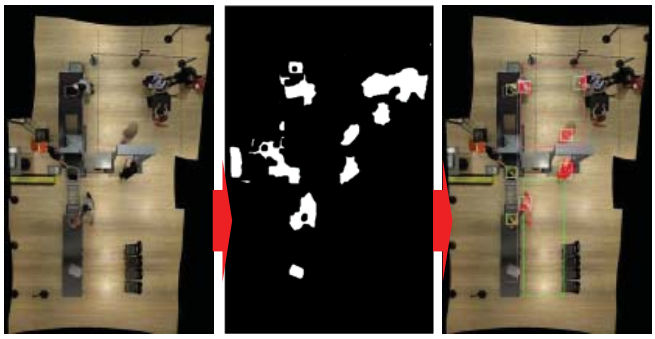
Foreground detection



- Segment foreground to detect people
- Classify blobs into passengers and bags

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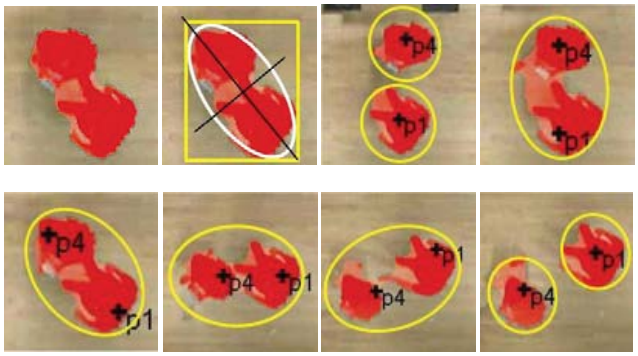
Passenger tracking



- Deal with passenger merging and splitting events

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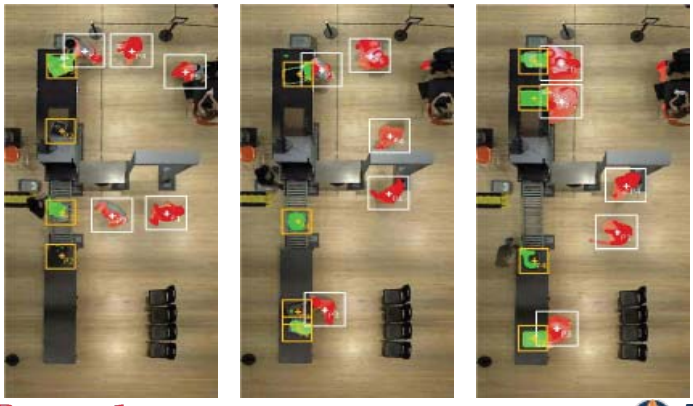
Baggage association



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Performance statistics

4 runs of simulation, 25 minutes

	Ground Truth	Detected	False Alarm
Passengers	47	47	0
Bags	71	67	3
Normal	69	64	0
Wrong	2	2	1

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ALERT

Next steps and limitations

- Partner with a real airport to design camera network and apply real-time, robust computer vision algorithms
- Extend to data aggregation and flow analysis
- Incorporate post-checkpoint analysis, e.g., “tag and track”
- Critical issues: camera height, angle, placement; lighting variations; crowd density; groups of people

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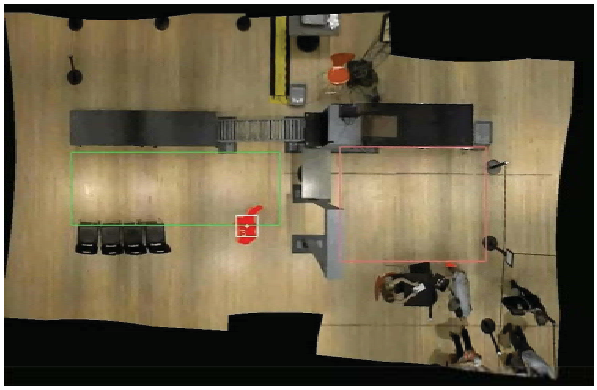
ALERT

Thanks!



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ALERT
AWARENESS AND LOCALIZATION OF EXPLOSIVE-RELATED THREATS

16.4 Henry Medeiros: Human Pose Estimation from Static Video Images

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Human Pose Estimation from Static Video Images

Henry Medeiros
Marquette University
henry.medeiros@marquette.edu

Marquette University ADSA13 - October 28-29, 2015 1

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Motivation

- **Objective:**
  - Measure the positions and orientations of the body parts of individuals in an image
  - A particular arrangement of image patches must correspond to a reasonable configuration of body parts
- **Approach:**
  - Use articulated body model
- **Who cares?**
  - Activities consist of combinations of poses
  - Robust human detection and localization
  - Humans have complex articulated shapes – traditional monolithic detectors perform poorly
  - Provide inputs to ATRs for people being screened by body scanners
  - Assist tracking of passengers and divested items at the checkpoint

Leeds Sport Pose (LSP) dataset

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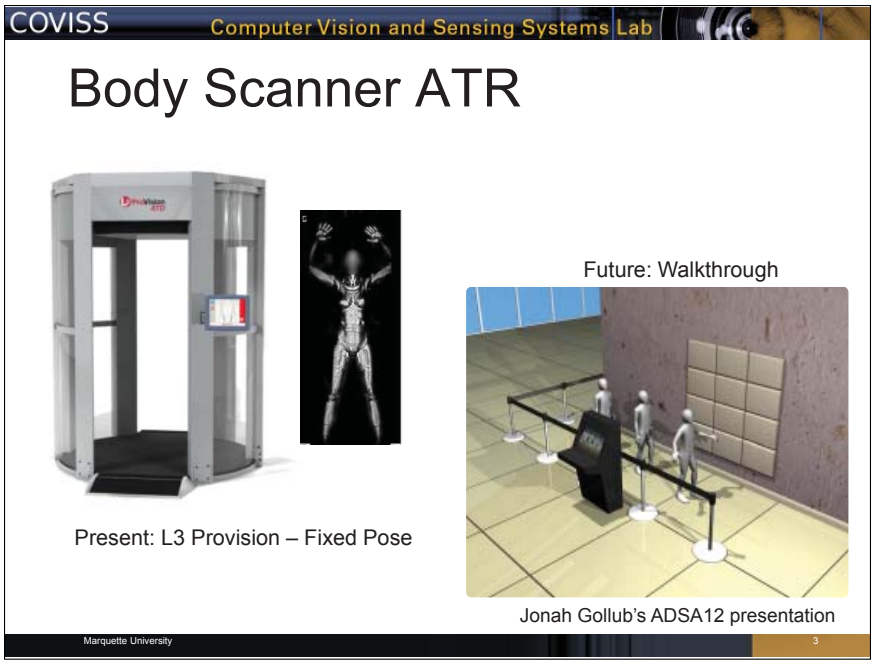
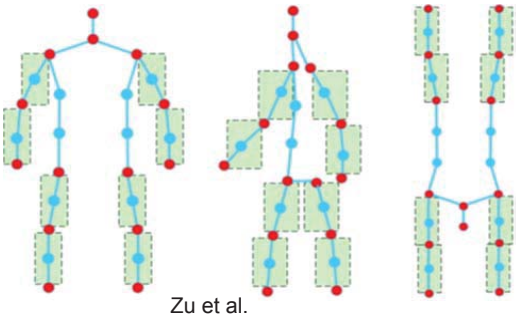

COVISS
Computer Vision and Sensing Systems Lab
Body Scanner ATR
Present: L3 Provision – Fixed Pose
Future: Walkthrough
Jonah Gollub's ADSA12 presentation
Marquette University
3


COVISS
Computer Vision and Sensing Systems Lab
Qualitative Results
Outperforms state-of-the-art by approximately 3% on multiple complex datasets
Marquette University
4

COVISS Computer Vision and Sensing Systems Lab

Zhu et al.'s Pose Estimation*

- **Two stages approach**
  - Detect upper body from three pre-defined categories using simplified model
  - Select pose-specific model according to upper body detection and then perform full body pose estimation
- **Pose-specific Models**
  - Frontal view
  - Side view
  - Handstand



Zu et al.

*Zhu et al. "Human pose estimation with multiple mixture parts model based on upper body categories," *Journal of Electronic Imaging* 24(4), 043021 (Jul/Aug 2015).

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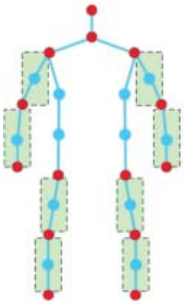
Mixture of Parts Model

- Inspired on Yang and Ramanan's Mixture of Parts Model
- The cost to fit a model to an image is comprised of three terms:
  - Appearance
  - Deformability
  - Compatibility



Zu et al.

Leeds Sport Pose (LSP) dataset

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Quantitative Results

	Zhu et al.	State of the art
Upper body detection	93%	89%
Pose estimation	65% - 71%	63% - 69%

Buffy dataset

Leeds Sport Pose (LSP) dataset

UIUC people dataset

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Target Tracking in Videos

Henry Medeiros
Marquette University
henry.medeiros@marquette.edu

Marquette University ADSA13 - October 28-29, 2015 8

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Motivation

- **Objective:**
  - Estimate the locations of multiple targets frame-by-frame
  - Information from one frame must influence decision on the following frame
- **Approach:**
  - Recursive stochastic estimation
- **Who cares?**
  - Temporal information is also important
  - Improve robustness of detectors
  - Associate detections between frames
    – opens up the possibility of making conclusions about sequences of events
  - Assist tracking of passengers and divested items at the checkpoint

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Improving Detection Robustness

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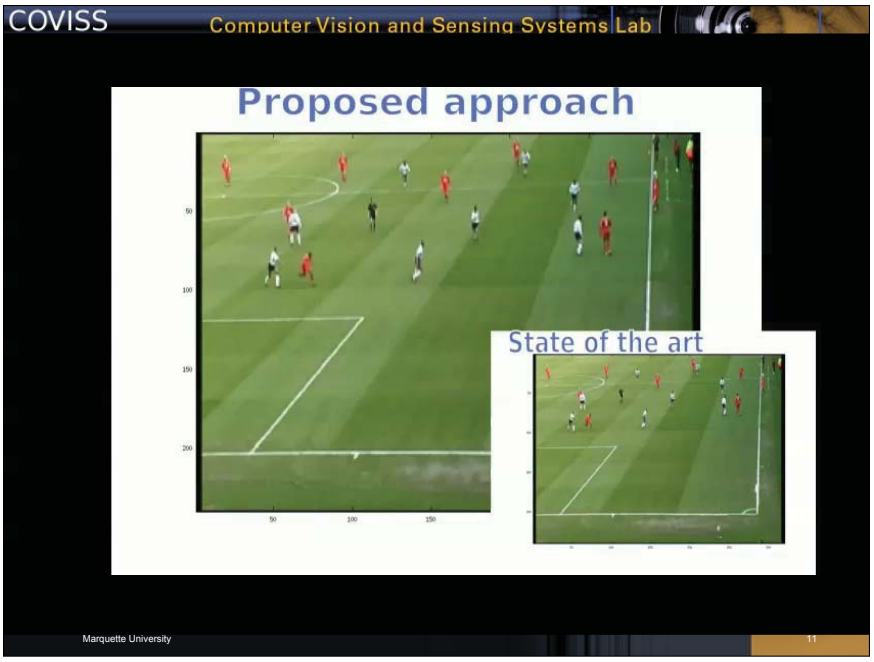
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Computer Vision and Sensing Systems Lab
Proposed approach
State of the art
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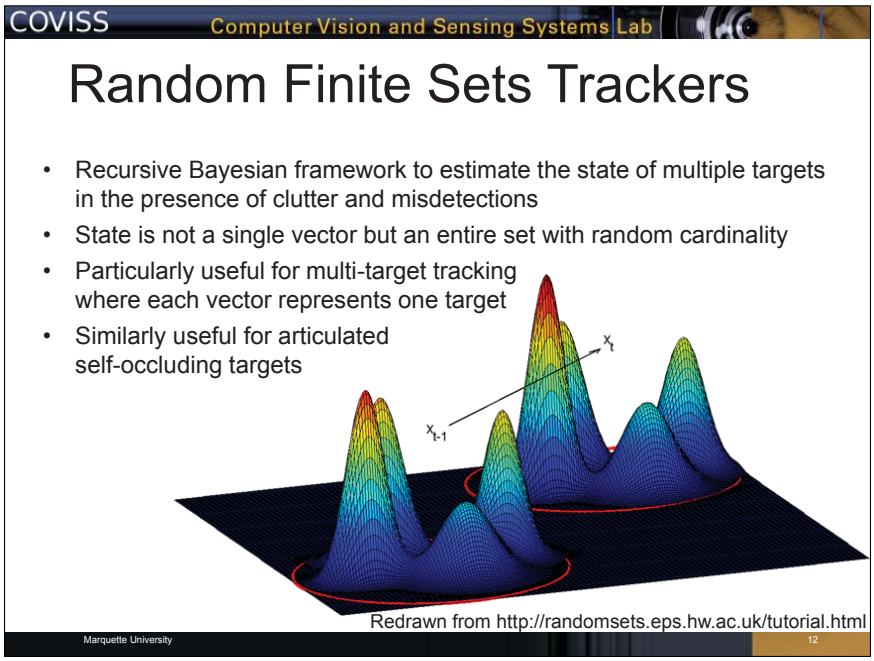
11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Computer Vision and Sensing Systems Lab
Random Finite Sets Trackers
• Recursive Bayesian framework to estimate the state of multiple targets in the presence of clutter and misdetections
• State is not a single vector but an entire set with random cardinality
• Particularly useful for multi-target tracking where each vector represents one target
• Similarly useful for articulated self-occluding targets
x_t
x_{t-1}
Redrawn from http://randomsets.eps.hw.ac.uk/tutorial.html
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12

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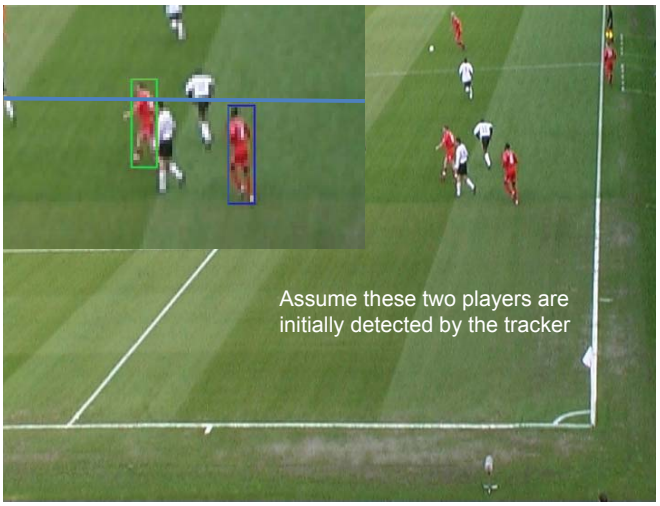
Monte Carlo Tracker



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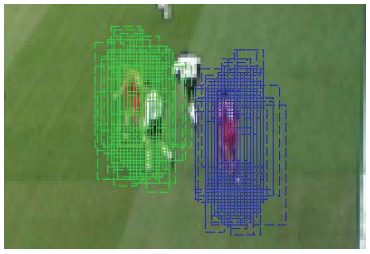
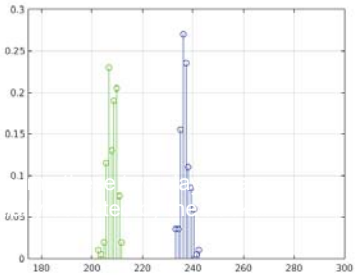
Monte Carlo Tracker



- Image samples are collected (Monte Carlo approach)



- Likelihoods proportional to desired target color
- Easy to estimate target position for well separated targets (e.g., mean)

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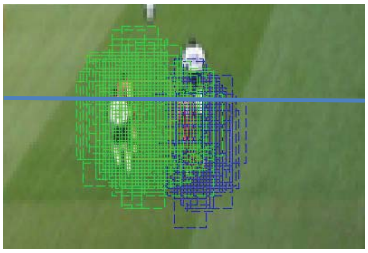
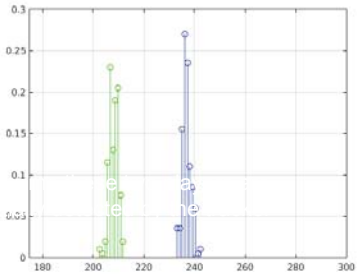
Monte Carlo Tracker





- Image samples are collected (Monte Carlo approach)
- When targets approach, particles get mixed up
- We mitigate this problem by reducing the importance of overlapping samples

- Likelihoods proportional to desired target color
- Easy to estimate target position for well separated targets (e.g., mean)

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Discussion

- **Main limitations**
  - Likelihood model is the weakest link - Zhu's method could be used as a pose likelihood estimator
  - Proper use of temporal information dependent on good dynamic model – Articulated model can be used to learn pose transitions from videos
  - Computationally expensive – but highly parallelizable
- **How it could be adapted to security?**
  - Integrated with Zhu's method – pose tracker for walkthrough body scanner ATR

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Extra Slides

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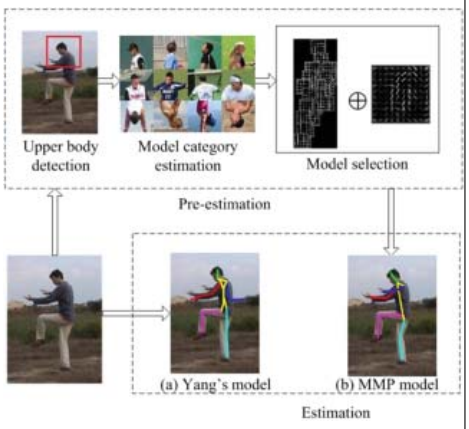
Zhu's Upper Body Detection

- Hierarchical approach
- Detect upper body from three categories
- Estimate pose for specific category



Zhu et al.

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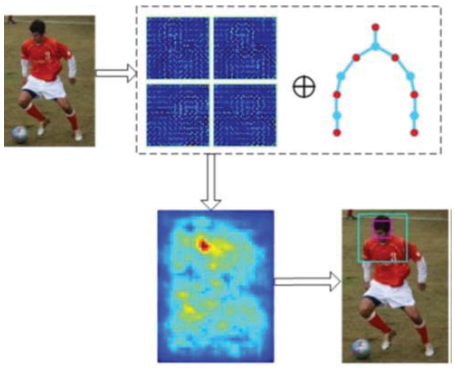
Upper Body Detection

- Three categories
  - Front view
  - Side view
  - Handstand
- Three matching conditions
  - Appearance
  - Deformability
  - Compatibility



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Experimental Results - Upper Body

Zhu et al.

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Experimental Results - Upper Body

Dataset	Method	Detection rate
Buffy	Eichner et al.[19]	89.01
	Ferrari et al.[6]	88
	Niebles and Fei-Fei[26]	73
	Ours	93.56

Zhu et al.

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Experimental Results – Pose Estimation

Dataset	Method	Torso	Head	U. leg	L. leg	U. arm	L. arm	Total
LSP	Yang and Ramanan[4]	92.6	87.4	66.4	57.7	50.0	30.4	58.9
	Johnson and Everingham[8]	78.1	62.9	65.8	58.8	47.4	32.9	55.1
	Tian et al.[5]	**95.8**	**87.8**	69.9	60.0	51.9	32.8	61.3
	Johnson and Everingham[7]	88.1	74.6	**74.5**	66.5	53.7	37.5	62.7
	Pishchulin et al.[14]	88.7	85.1	63.6	58.4	46.0	35.2	58.0
	Fang and Yi[15]	91.9	86.0	74.0	**69.8**	48.9	32.2	62.8
	Ours	94.5	86.9	72.05	62.45	**57.95**	**39.75**	**64.6**
UIUC	Wang et al.[11]	86.6	68.8	56.3	50.2	30.8	20.3	47.0
	Tian et al.[5]	**98.8**	**96.8**	**78.7**	64.2	62.2	39.5	68.5
	Ours	97.57	95.95	78.34	**64.98**	**66.19**	**49.19**	**71.1**

Zhu et al.

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Experimental Results - Failures

- Double counting
- Occlusion
- Incorrect model selection

Zhu et al.

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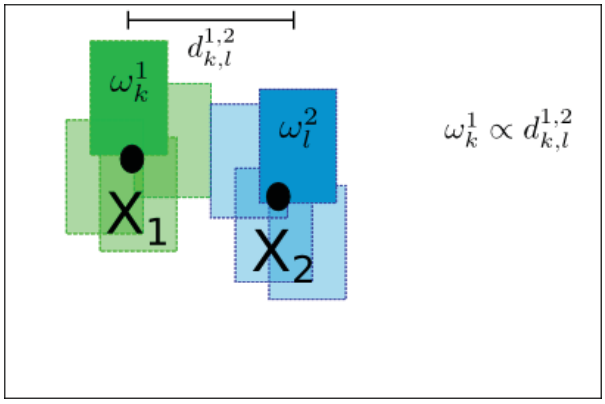
Interactive Likelihoods



- Particle weights proportional to distance to particles from other vectors
- Precludes samples from different vectors to overlap

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The Multi-Bernoulli Filter

- A multi-Bernoulli RFS is given by the union of several independent Bernoulli RFS
- A Bernoulli RFS is empty with probability r or a singleton with probability 1-r
- A non-empty Bernoulli RFS has a spatial distribution p(.) over the state space
- The cardinality distribution of a multi-Bernoulli RFS depends on the existence probability of each individual Bernoulli RFS
- A labeled multi-Bernoulli RFS is a multi-Bernoulli RFS in which the state space is augmented with unique labels

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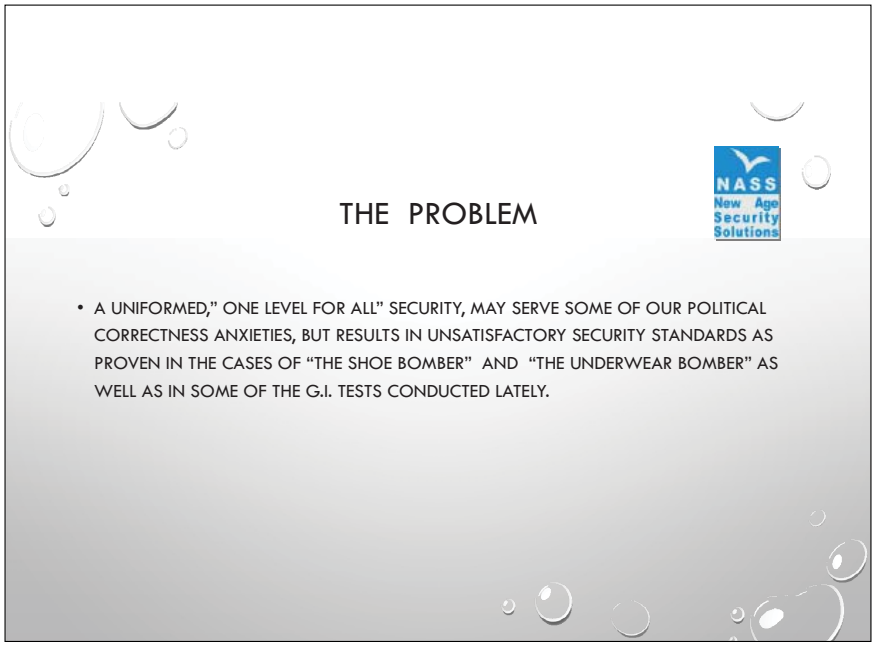
16.5 Rafi Ron: "Risk Based" Strategy in Aviation Security



THE SOLUTION

- **A MULTI-LAYER RISK BASED STRATEGY :**

PHASE 1 – BEFORE ARRIVAL AT THE AIRPORT - CLASSIFICATION OF PAX TO RISK GROUPS BY USE OF ANALYTICAL TOOLS AND VARIOUS DATA BASES, THAT GO BEYOND CHECKING AGAINST LISTS OF NAMES.

PHASE 2 – CHECK IN – THE DETERMINED RISK GROUP IS MARKED ON THE BOARDING CARD USING A CODE SYSTEM.*

PHASE 3 - AT THE AIRPORT – BEHAVIOR PATTERN RECOGNITION THROUGH OBSERVATION AND FOLLOWING MEASURES (IMPLEMENTED THROUGHOUT THE PROCESS). CHECKED BAGS ARE TAGGED IN ACCORDANCE TO RISK CLASS. THE HBS SYSTEM RECOGNIZES THE RISK CLASS AND IMPLEMENTS A COMPATIBLE SCREENING PROTOCOL.

PHASE 4 - AT THE DOCUMENT CHECK POSITION – VERIFICATION OF DOC AUTHENTICITY AND DIRECTING THE PASSENGER TO THE CHECK LANE DEDICATED TO HIS/HERS RISK CLASS.

PHASE 5 – AT THE CHECKPOINT – GRADUAL SECURITY PROTOCOLS ARE IMPLEMENTED AT THE VARIOUS LANES ACCORDING TO RISK CLASS. HIGH RISK PAX WILL BE SUBJECTED TO RECHECK OF DOCS, A SHORT INTERVIEW A DETAILED SCREENING OF CARRY-ON BAGS AND A THOROUGH MANUAL PET DOWN. DURING THE CHECK, THE CHECKPOINT SCREENER WILL HAVE ACCESS TO IMAGES OF CONTENTS OF THE CHECKED (BELLY) BAGS.

PHASE 6 – DURING BOARDING AND THROUGHOUT THE FLIGHT, GATE AND CABIN CREWS WILL CONTINUOUSLY OBSERVE PAX BEHAVIOR AND RESPOND ACCORDING TO PROTOCOLS AND TRAINING. AIR MARSHALS (IF PRESENT ON BOARD) WILL BE INFORMED ABOUT "HIGH RISK" PAX AND THEIR SITTING.

* RISK CLASS CAN BE UPGRADED AT ANY POINT IN THE PROCESS.

When you can't afford to fail

THANK YOU FOR YOUR ATTENTION

RAFI RON

CEO

NEW AGE SECURITY SOLUTIONS INC.

RAFI@NASSCORP.COM

WWW.NASSCORP.COM

16.6 Jun Zhuang: Validating Models of Adversary Behaviors

Validating Models of Adversary Behaviors

Dr. Jun Zhuang
Associate Professor
Department of Industrial and Systems Engineering
University at Buffalo
Email: jzhuang@buffalo.edu;
Web: http://www.eng.buffalo.edu/~jzhuang/

Presentation to
13th Workshop on Advanced Development for Security Applications (ADSA13)
October 28-29, 2015

1

Summary

- Big Picture
  - Knife; shoe/cartridge/underwear bombs
  - Aviation vs. train/shopping mall/stadium/marathon…
- Validating Models of Adversary Behaviors
  - Should models be validated? YES!
  - Can models be validated? Sometimes…
  - How would models be validated?
    - Based on real scenario;
    - With/without data
    - Thought Experiments, Expert opinion, Interviews
    - Validation Exercises, Simulation, Case Studies
- Balancing Congestion and Security in the Presence of Strategic Applicants with Private Information

2

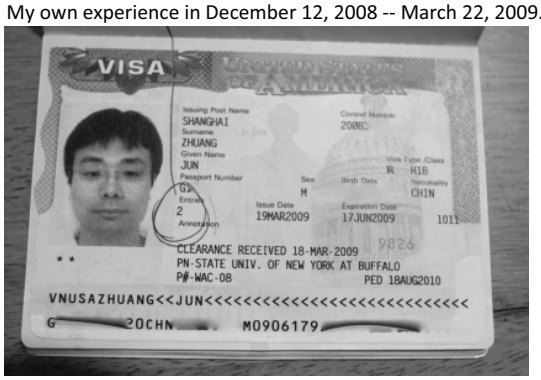
Robust Security Screening Games

- My own experience in December 12, 2008 -- March 22, 2009.

3

Robust Security Screening Games

- My own experience in December 12, 2008 -- March 22, 2009.



- Wang, X. and J. Zhuang. "Balancing Congestion and Security in the Presence of Strategic Applicants with Private Information, *European Journal of Operational Research*, 212(1): 100-111, 2011.
- Zhuang, J. (PI) "Robust Approval Process in the Face of Strategic Adversaries and Normal Applicants," supported by National Science Foundation, 08/15/2012-07/31/2016, $295,958.

4

Debates about Airport Screening

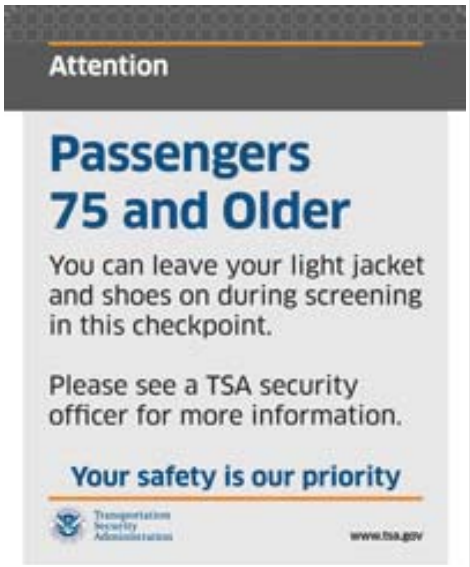
- Pat-down, Advanced Imaging Technology
- How to improve passenger experiences

5

Progress on Risk-based Screening (RBS)

6

Progress on Risk-based Screening (RBS)



- Security screenings play an important role in many fields:
  - Airport security screening
  - Visa issuance
  - Cargo inspection
- What are the trade-offs?
  - In-depth examination of applicants reduces security risk
  - In-depth examination can entail high congestion which can deter normal applications
  - This may in turn conflict with the approver's interests
- Key Contribution: Considering strategic normal applicants

TSA Pre✓ NEXUS

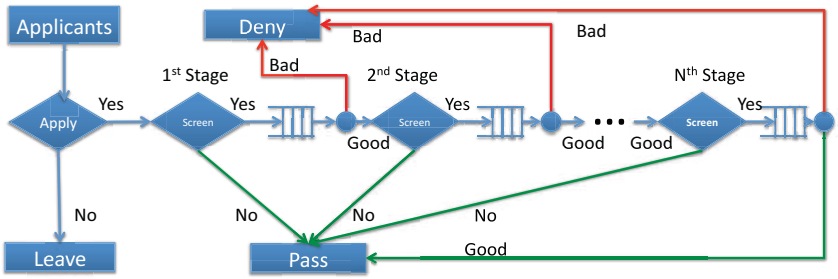
Novelty of This Research

- It allows strategic decisions by all types of potential applicants
- Potential applicants could adapt their behavior according to a disclosed security policy; e.g.,
  - Smugglers may choose the weakest port to enter
  - Leisure travelers may choose not to travel because of congestion, hassle, inconvenience
  - Foreign students may no longer apply to U.S. schools because of the long waiting period for visas
- Very few research has simultaneously considered both the good and bad applicants' strategic behavior and congestion in determining the optimal screening policy

9

An Overview of the *N*-stage Model with Errors

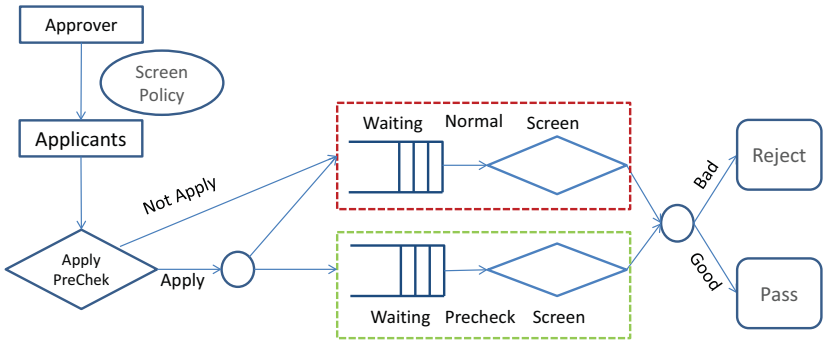
The Flow Chart



- Applicants:
  - Unobservable attributes: good/bad
  - Observable attributes: age, nationality, gender, education, travel pattern, etc.
- Approver decides the screening probabilities based on applicants' observable attributes

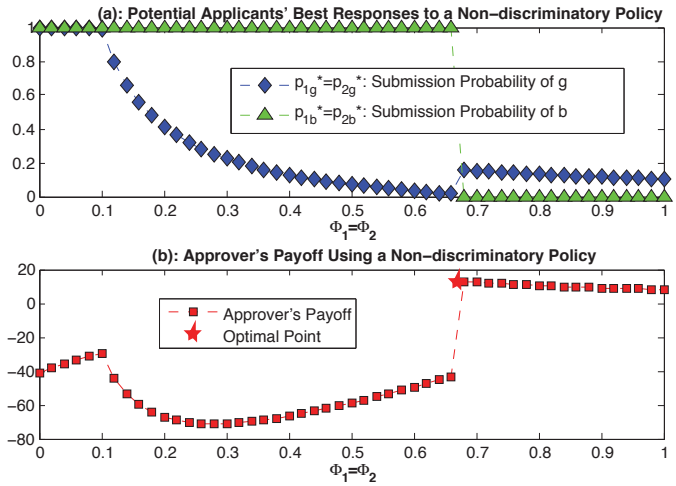
10

A Simplified Framework for Expedited Security Screening



11

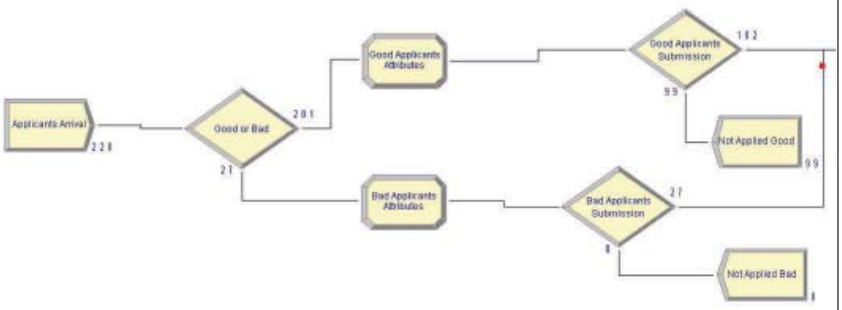
Preliminary Results for balancing Congestion and Security



Reference: Wang, X. and J. Zhuang. "Balancing Congestion and Security in the Presence of Strategic Applicants with Private Information, *European Journal of Operational Research*, 212(1): 100-111, 2011.

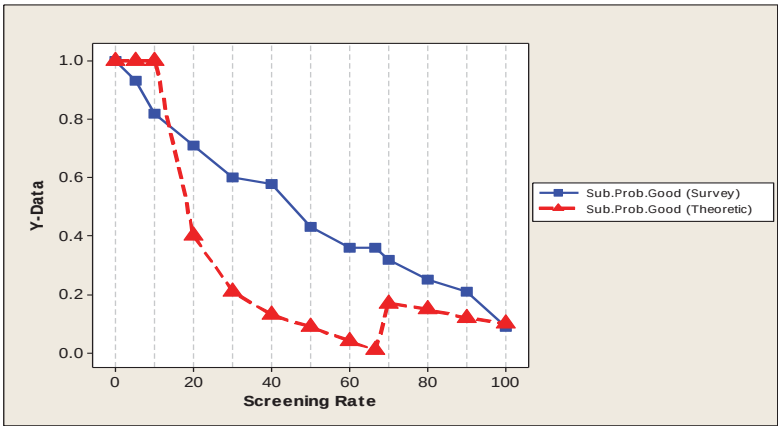
12

A Sample Simulation

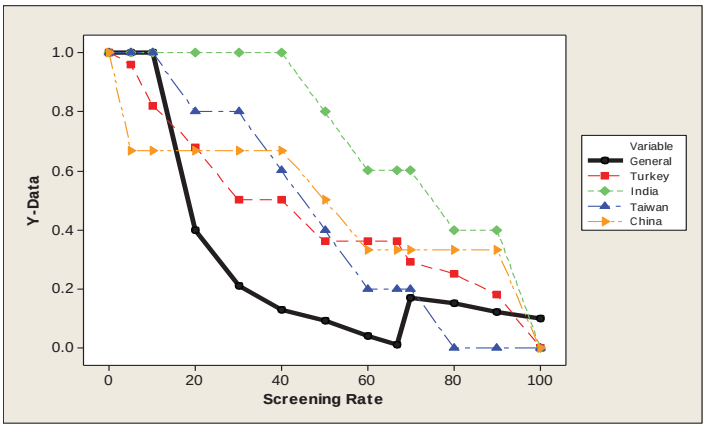


13

Comparison with Survey Results

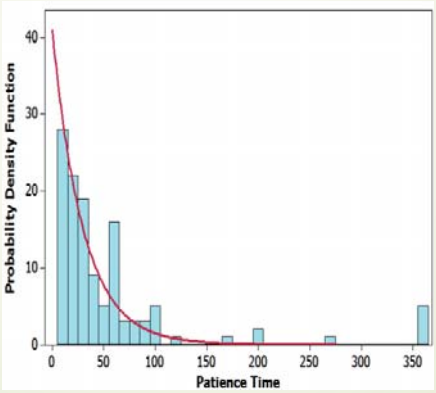


Sorted by Nationality



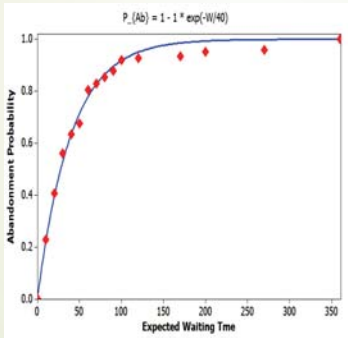
Patience Time

- Survey results showed that, patience time follows exponential distribution.



Modeling Abandonment

- According to survey results, there is a non-linear relation between waiting time and abandonment probability.

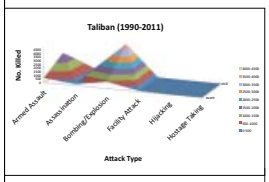


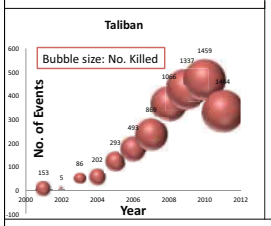
- Red dots represent abandonment probability at corresponding waiting time.
- Blue line shows, non-linear regression model. SSE of the model is 0.0105.
- We obtained following model by regression analysis:

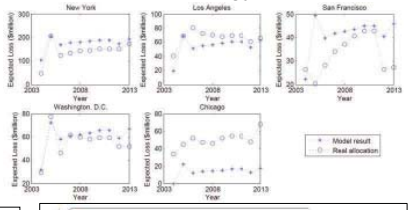
$$P_{Ab}^{nonlin} = 1 - e^{\frac{-W}{\tau}}$$

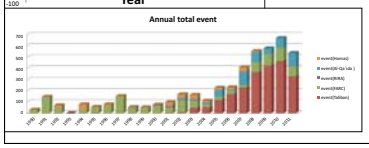
Validating Models of Adversary Behavior

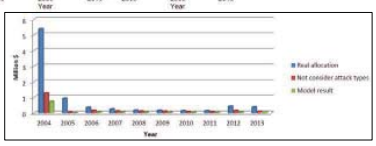
- We are validating a class of multi-period, multi-type, multi-target attacker-defender games
  - Using data from Global Terrorism Database and DHS Urban Area Security Initiative
- Attackers have multiple attack modes:
  - Assassination, armed assault, bombing/explosion, hijacking, hostage taking, etc.
- Compare "optimal" strategy v.s. real allocation?











Other Methods for Model Validating

- Thought Experiments
- Simulation
- Validation Exercises
- Case Studies
- Interviews with decision makers (and potentially with "attackers")
- Experiments:
  - Use student subjects as proxies for terrorists
  - These games would be later replicated with more knowledgeable subjects (e.g., terrorism experts)



19

- Second Conference on Validating Models of Adversary Behavior, Buffalo/Niagara Falls, NY, Aug 2-5, 2015.
  ttp://www.eng.buffalo.edu/~jzhuang/Conference13/





Thank you for your time!!
Any questions/comments?

Collaborations are welcome!

Contact:
Dr. Jun Zhuang
Associate Professor
Department of Industrial and Systems Engineering
University at Buffalo
Phone: 1-716-645-4707
Email: jzhuang@buffalo.edu;
Web: http://www.eng.buffalo.edu/~jzhuang/

21

Image Sources

- Slide 6
  - http://i.imgur.com/BQsZXku.jpg
  - http://i.huffpost.com/gen/345432/thumbs/r-AIRPORT-SCREENING-SHOES-large570.jpg
- Slide 7
  - http://www.cristyli.com/?m=201012
- Slide 8
  - http://www.cnn.com/videos/us/2015/04/17/lead-dnt-foreman-tsa-groping.cnn

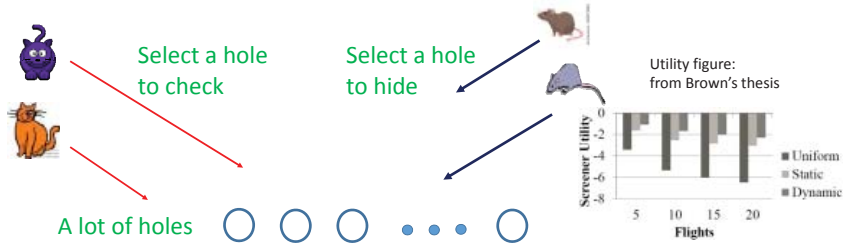
16.7 Jun Zhang: Game Theory- An Outside Party Perspective

Game Theory
– An Outside Party Perspective

Jun Zhang
Department of Electrical Engineering and Computer Science
University of Wisconsin-Milwaukee
junzhang@uwm.edu

1

What does game theory do for security?



- Game theory: allows cats to generate their best strategy given: 1) fewer cats than holes and 2) mice can learn the cats' strategy and best exploit it
- Potential benefit to security: allow for "intelligent" adversaries, efficient use of resources and improved security
- Does it solve the "needle-in-hay-stack problem?" No

2

How does game theory work?

- Assume:
  - Finite detection resources (e.g., metal detectors, TSA agents [body search], microwave detectors, explosive detectors, and CT scanners)
  - Terrorists can learn our security strategies and counter in the optimal way
- Generate our optimal strategy by solving a max-min problem like this (Brown, 2015, USC)

$$
\begin{aligned}
\max_{d_\theta, n_{\psi,\xi}} \quad & \textstyle\sum_\theta W_\theta d_\theta \\
\forall \theta, \tau, m, \xi \in \theta. \quad & d_\theta \le U_\sigma(\vec{x}_\xi^1, \ldots, \vec{x}_\xi^\eta, \mu_{\xi,m}^\tau), \\
\forall \tau, \xi. \quad & \vec{x}_\xi^\tau = \frac{\sum_\psi n_{\psi,\xi}^\tau \vec{E}_{\psi,\xi} + (N_\xi^\tau - \sum_\psi n_{\psi,\xi}^\tau)\vec{E}_{\delta,\xi}}{N_\xi}, \\
\forall \tau. \quad & n_{\psi,\xi}^\tau \in conv(P^\tau)
\end{aligned}
$$

- But what's the basic idea here?

3

Basic idea through a simple example

- Suppose we have: N holes, one cat, and one mouse
- The game: "Stackelberg game"
  - The mouse chooses a hole to hide
  - The cat chooses a hole to search
  - If they choose the same hole, the cat wins; otherwise, the mouse wins
  - The mouse can learn the cat's strategy and counter in the best way (e.g., if the cat [definitely] chooses the first hole, the mouse will not choose the first hole)
- The game theory question: what's the cat's best strategy?

4

Example continued

- The cat's general strategy: select the ith hole with probability p_i
- The mouse's optimal counter: choose the jth hole if p_j is the smallest among all p_is, i.e., min
- The cat's optimal strategy: make p_j as large as possible, i.e., max
- The result: "Stackelberg equilibrium", max-min
  - The cat chooses a random hole with probability $1/N$ for each hole
  - The mouse does the same
- Another way to view the result: the cat's optimal strategy presents maximum entropy (uncertainty) for the mouse

5

A real (security) game

- Cats
  - Cats of different types (different detector types), each with different effectiveness
  - Multiple cats of each type
  - Cat teams and their different effectiveness
  - The number of cats and cat teams
- Mice
  - Also come in different types (different risk levels)
  - The cats do not know which type of mice is coming to hide (only know a prior)
- Consequences
  - Some miss detections (e.g., missed explosives) are more costly than others (e.g., missed guns)
- Results: large LP (linear programming) problems (e.g., page 3)

6

Related work

- "Probability-based" resource allocation (Jacobson et al, 2006-13)
  - Optimizing resource allocation to maximize probability of detection
  - Under-screening is better than over-screening
- How it compares with game theory: let's look at a simple example
  - Two passengers, one with risk level 1 and one with risk level 2 (higher probability of bringing in dangerous material)
  - But suppose we can only check one of them
  - Probability based: will check the higher risk level passenger
  - Game theory: will pick a random passenger to check
- More general criticisms of game theory from literature
  - Assumptions not realistic; solutions too complex to compute, etc.
- Potential remedies (Bier et al, 2009): game theory inspired solution
  - Use the basic max-min idea and find suboptimal formulations and/or solutions

7

Test game theory on real airport data

- How? Start with data collecting at a real airport, including
  - Detection resources: the number, type, and effectiveness of detection resources
  - Passenger arrival rate: number of people per hour
  - Passenger clear rate constraint: the minimum number of passengers that need to be cleared per hour
  - The two rates maybe different at different time of day and different day of the week
  - Cannot collect terrorist data easily – simulate using a model (with type, risk level, and banned-material parameters)
- Next
  - Simulate the airport using the data collected above
  - Generate game theory optimal detection resource allocation strategy
  - Test this on simulated airport data
- Finally
  - Compare the game theory PD and PFA with a bench mark (e.g., the current TSA resource allocation)

8

The problem of "needle in the hay stack"

- What is the problem?
  - No dangerous materials get through or
  - PD < 10^{-9} , with reasonable PFA, or passenger clearance rate (e.g., 10000 per hour)
- At present time, a possible way to achieve this: have a very large amount of detection resources
- Without that, any technique, including game theory, may not be able to achieve that.
- Example:
  - 1 mouse, m cats to check N holes, m<N.
  - Optimal GT cat strategy: check each hole with p=m/N
  - PD = m/N; to achieve high PD, need more cats

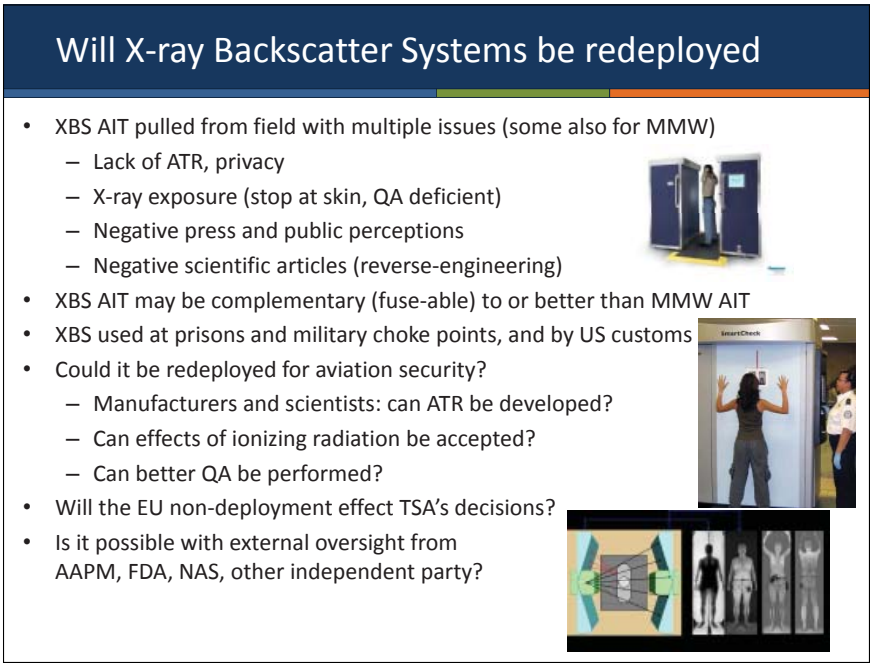
9

Summary and Future Work

- Game theory is a new and potentially promising approach for improving security and resource allocation
- The best part: allows to account for "intelligent" terrorists
- But it does not solve the "needle-in-hay-stack problem"
- Future work:
  - Test game theory with real airport data
  - Develop game theory inspired approaches

10

16.8 Harry Martz: Airport Passenger Screening Using Backscatter X-Ray Machines



BACKUP SLIDES

3

Will X-ray Backscatter Systems be redeployed (cont'd)

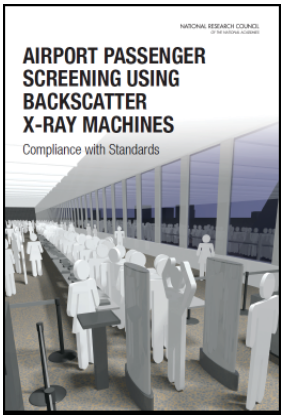
- If ATR developed for XBS AITs, will they be redeployed even though there are MMW AITs?
- XBS used at prisons and military choke points, and by US customs, so why not airports?
- Will the EU non-deployment effect TSA's decisions?

- Why do you think they will
  - Be redeployed?
  - Not be redeployed?
- What is required for them to be redeployed?
- What will keep them from being redeployed?

Transportation Security Administration

4

NAS Study: Committee, Staff and Subcontractors



Committee
HARRY E. MARTZ, JR., E.O. Lawrence Livermore National Laboratory, *Chair*
BARBARA J. McNEIL, Harvard Medical School, *Vice Chair*
SALLY A. AMUNDSON, Columbia University Medical Center
DAVID E. ASPNES, North Carolina State University
ARNOLD BARNETT, Massachusetts Institute of Technology
THOMAS B. BORAK, Colorado State University
LESLIE A. BRABY, Texas A&M University-College Station
MATS P.E. HEIMDAHL, University of Minnesota, Minneapolis
SANDRA L. HYLAND, Consultant, Falls Church, Virginia
SHELDON H. JACOBSON, University of Illinois, Urbana-Champaign
JAY LOEFFLER, Massachusetts General Hospital
C. KUMAR N. PATEL, Pranalytica, Inc.
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Staff
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ERIK B. SVEDBERG, Senior Program Officer, Study Director
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HYEKYUNG (CLARISSE) KIM, Christine Mirzayan Science and Technology Policy Graduate Fellow
HEATHER LOZOWSKI, Financial Associate
NEERAJ P. GORKHALY, Research Associate
JOSEPH PALMER, Senior Project Assistant

Subcontractors
WESLEY BOLCH, Computation Team (University of Florida)
DAVID HINTENLANG, Measurement Team (University of Florida)

5

Summary of the NAS Study

HEALTH & SAFETY STDS	What are the relevant health and safety standards?	• American National Standards Institute / Health Physics Society (ANSI/HPS N.43.17) specifies limits for equipment for non-medical radiation applications
RADIATION EXPOSURE	Are passengers or bystanders receiving a radiation dose that exceeds relevant safety standards?	• Regardless of measurement technique or modelling approach, all measurements and computations agree dose is at least 5X below the ANSI/HPS limit. • No measurable dose for operators and bystanders.
SYSTEM DESIGN	Are the system design and operating procedures sufficient to prevent overexposure to passengers and bystanders?	• The system design and safety interlocks appear to be sufficient to prevent increase in radiation exposure. • Over-exposure would occur after 16 hours at full x-ray dose in case of machine malfunction.

6

NAS Study: A study supported by new NAS information

This study goes beyond the traditional Academy report that by tradition mainly relies on committee member expertise and deliberation on preexisting information.

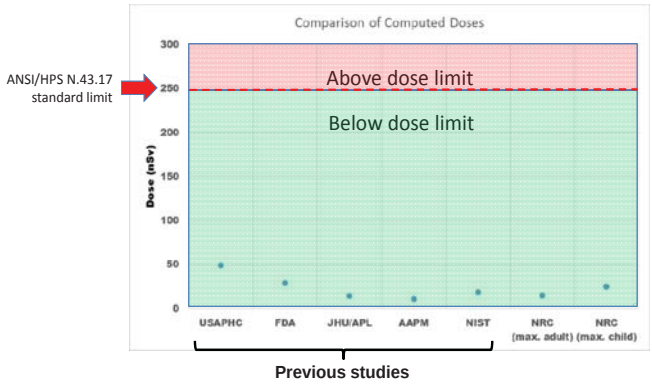
In this study the committee subcontracted with experts to make new independent , and in some cases novel

- Measurements – including x-ray radiation measurements on both historical (Rapiscan Secure 1000) as well as potential future x-ray backscatter machines (AS&E SmartCheck)
- Computations – using the most recent modeling approaches and the measurements, determined typical radiation exposures as well as exposure to a variety of body sizes and in worst-case AIT malfunction scenarios.

Even though the x-ray radiation doses were measured and some safety interlocks were tested it was not possible to investigate all safety interlocks that protect a person being screened, operators, and bystanders from radiation overexposure.

7

Measurements and computations results



* ANSI/HPS N.43.17 limits radiation dose exposure per screening to less than 250 nSv for up to 1000 screenings per year

8

Evaluation of System Design and Procedures

Limitations of Evaluation:

- The X-ray based Advanced Imaging Technologies (AIT) have been removed from airports but the committee was able to inspect the interior of Rapiscan and AS&E X-ray AITs in laboratories.
- Committee was not given
  - The opportunity to independently test how all the interlocks perform in different situations
  - A demonstration of interlock checks at the manufacturer level
  - Detailed electrical and mechanical drawings and computer codes and documents describing internal functions at the most fundamental level of the machine

Key Findings:

- The X-ray backscatter machines appear to adhere to ANSI recommended safety mechanisms.
- Acceptance and inspection tests previously used during deployment appear to be sufficient to ensure the installed machines continue to meet ANSI requirements.
- Based on NAS measurements and computations, a screening must extend over 60 seconds to expose an individual to radiation that exceeds ANSI limit for a standard screening.

Key Recommendations:

- Future testing procedures should at a minimum continue to follow ANSI requirements, and include daily verification of safety parameters by a test piece.
- Future X-ray backscatter AITs should have an independent mechanism to ensure that screening time does not exceed time needed to acquire the necessary images.

9

Advanced Imaging Technology (AIT) in Airports

2008	TSA introduces X-ray backscatter AIT Rapiscan Secure 1000
2009	Umar Abdulmutallab attempts to detonate plastic explosives inside underwear on Northwest airlines 250 Rapiscan AITs are deployed across US airports
2012	Congress mandates privacy software for AITs
2013	Rapiscan fails to introduce software. All Rapiscan AITs removed from airports.
2015	740 millimeter wave AIT units across US airports Next-generation millimeter wave units being evaluated Next-generation x-ray backscatter units being evaluated

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X-ray Backscatter AITs Studied by NAS

RAPISCAN SECURE 1000

- Located at National Institute of Standards and Technology (NIST), Gaithersburg, MD
- Previously deployed at LaGuardia airport

AS&E SmartCheck HT

- Second-generation AS&E SmartCheck undergoing evaluation by TSA
- Located at Transportation Systems Integration Facility (TSIF), VA

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Technical Details

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Outline

- Advanced Imaging Technology (AIT) used by Transportation Security Administration (DHS/TSA)
- X-ray backscatter technology
- Study request to the National Academy of Sciences (NAS)
- Study scope and methods
- Radiation protection standards
- Review of previous studies
- Measurements and computations
- Findings and recommendations

Transportation Security Administration

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Advanced Imaging Technology (AIT) in Airports

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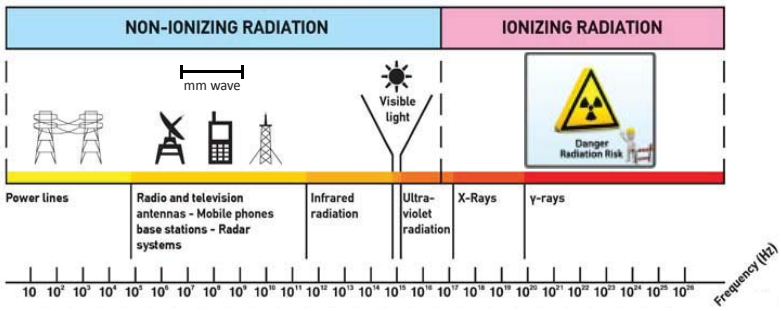
Advanced Imaging Technology (AIT)

Advanced Imaging Technology (AIT) uses one of two types of radiation to penetrate clothing and create a reflected image of the body:

- non-ionizing radiation (millimeter waves)
- ionizing radiation (x-rays)



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X-ray Backscattering: Advantages

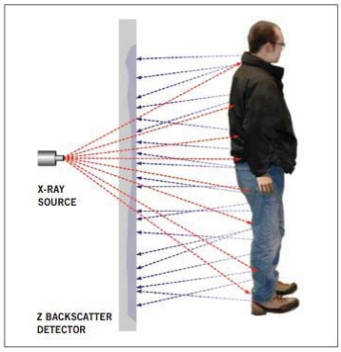

Image formed on detector on the same side as x-ray source:

- Eliminates need to set up detector on opposite side of target

Distinguishes high-Z (metallic) and low-Z (non-metallic) materials:

- Identifies anomalies on people such as metal, plastic, organic threats, e.g., knives, explosives & drugs

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X-ray Backscatter AITs Studied by NAS

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- Previously deployed at LaGuardia airport

AS&E SmartCheck HT

- Second-generation AS&E SmartCheck undergoing evaluation by TSA
- Located at Transportation Systems Integration Facility (TSIF), VA

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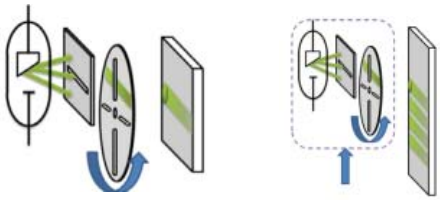
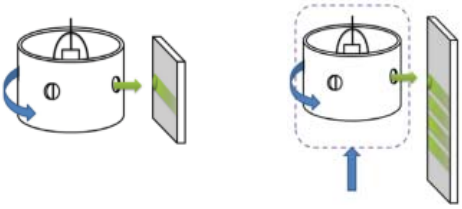
X-ray Backscatter AITs Rastered Pencil Beam

RAPISCAN Secure 1000



AS&E SmartCheck HT



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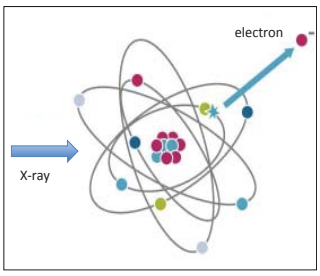
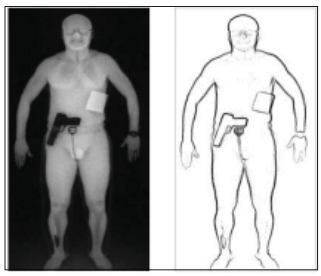
X-ray Backscattering: Concerns

Exposure to Ionizing Radiation	
Person Being Screened	Bystander
• Subgroups: children, pregnant women • Cumulative effects on frequent fliers • Potential for overexposure	• Scattered radiation to bystanders • Cumulative effects on operators • Potential for overexposure

Privacy

- Congressional mandate (2012) – Automated Target Recognition (ATR) to display potential threats on generic figure, rather than image of body





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Components of the NAS Study

HEALTH & SAFETY STANDARDS	What are the relevant health and safety standards?
RADIATION EXPOSURE	Are passengers or bystanders receiving a radiation dose that exceeds relevant safety standards?
SYSTEM DESIGN	Are the system design and operating procedures sufficient to prevent overexposure to passengers and bystanders?

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Relevant Quantities & Standards

X-ray Properties	
Kerma (K)	**Half Value Layer (HVL)**
• Energy transferred from x-rays to a kilogram of matter • Measured in Gray (Gy), where 1 Gy = 1 J/kg • Provides value of X-ray intensity at a given location	• Thickness of aluminum needed to reduce X-ray intensity by half • Measured in millimeter (mm) • Provides understanding of X-ray spectrum
Radiation Exposure	
Effective Dose (E)	**Reference Effective Dose (E_{ref})**
• Sum of doses to specific organs or tissues, multiplied by tissue weighting factor • Measured in Sievert (Sv) • Accounts for sensitivity of different tissues	• Product of air kerma and HVL • Measured in Sievert (Sv) • Provides dose for comparison to standard limits
ANSI/HPS N43.17 (2009)	
Upper Limits for Exposure	**Guidance for Design & Operation**
• E_{ref} per screening: 250 nSv • E_{ref} per 12-month period: 250,000 nSv • E_{ref} in case of machine malfunction: 250,000 nSv	• Fail-safe mechanisms (hardware and software) • Operating procedures • Warning labels, training, and maintenance

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Compliance with the ANSI/HPS N43.17 2009 Standard

Backscatter systems must conform to ANSI/HPS N43.17, 2009, a consensus radiation safety standard.

- Provides guidelines for both manufacturers and users of systems and covers dose to subject, interlocks, operational procedures, and information to be provided to the travelers by the operators.

  - ❑ Sets per screening limit of **250 nSv** reference effective dose.
  - ❑ Sets a 12-month period limit of **250,000 nSv** reference effective dose (1,000 screens per year).
  - ❑ Sets a limit of **250,000 nSv** reference effective dose in case of machine malfunction

Compliance with Federal Requirements

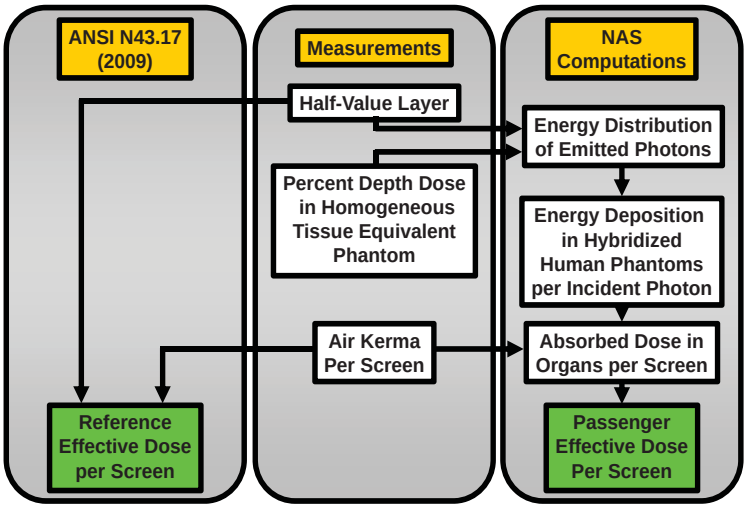
Manufacturers need to comply with:

- Federal Food, Drug and Cosmetic Act, Chapter V, Subchapter C
- Applicable requirements of Title 21 of the Code of Federal Regulations 1000-1005.

System Operators need to comply with:

- Occupational Safety and Health Administration ionizing radiation safety limits as promulgated in Title 29 of the Code of Federal Regulations, Part 1910.1096.

Measurements & computations to determine dose



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NAS Review of Previous Studies

Rapiscan 1000 measured by:

- US Food and Drug Administration (FDA)
- Johns Hopkins University Applied Physics Laboratory (APL)
- US Army Public Health Command (USAPHC)
- National Institute of Standards and Technology (NIST)
- American Association of Physicists in Medicine (AAPM)

Key Findings:

- Inside screening area: Exposure per screening is about a factor of 10 below ANSI limit of 250 nSv.
- Outside screening area: Detectors failed to distinguish AIT X-ray scatter signal from background, possibly due to use of detectors designed for higher-energy X-rays.

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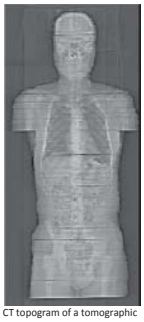
NAS Study: Differences from previous studies

- Detectors calibrated for appropriate energy range
- Fabricated custom-made layers of tissue equivalent materials with realistic internal anatomy (shown below left) to mimic response of tissues in low-energy range
- Computations incorporate irradiation geometry, skin sensitivity, failure mode, and digitized phantoms with realistic morphology

Phantom based on: (a) segmented CT scan data set; (b) computational adult female hybrid data set; (c) computational adult male hybrid data set



CT topogram of a tomographic physical phantom

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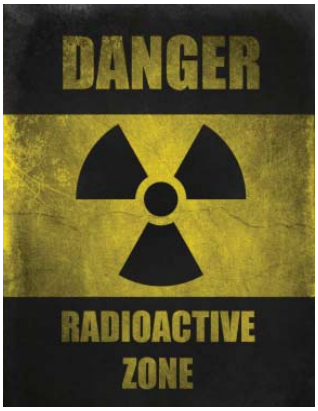
NAS Study: Other Considerations

Some concerns addressed:

- Can higher-energy X-rays penetrate tissues beyond surface layers?
- Is it possible to have peak X-ray doses delivered to radio-sensitive portions of the skin?
- Are there sufficient safety mechanisms (e.g., interlocks) to prevent overexposure?
- What is exposure to operators outside scanning area from leakage or scattering of X-rays?
- What are exposure levels for pediatric passengers and developing fetuses?



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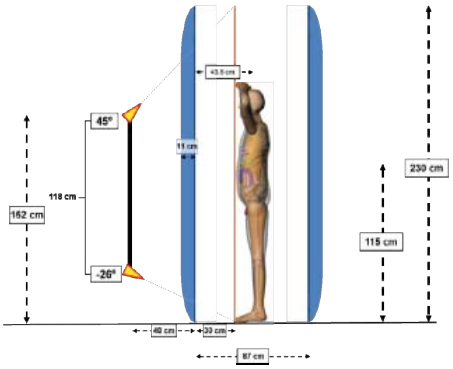
NAS Study: Measurements

Quantities Measured:

- **Half-Value Layer (HVL):** Determine energy distribution of X-rays incident on passengers
- **Percent Depth Dose (PDD):** Measure dose as a function of depth into tissue
- **Air Kerma:** Measure kerma in various locations within screening area
- **Dose outside screening area:** Determine dose per screening at various locations outside scanning area



Not to scale

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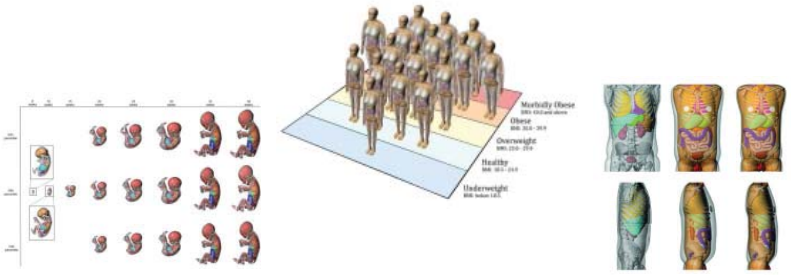
NAS Study: Computations

Effective dose to reference and at-risk populations:

- Combine measurements, radiation-tissue interaction processes, and anatomically realistic phantoms
- Passengers simulated by suite of hybrid digitized phantoms, including male and female adults and children
- Assess dose to developing fetus at selected gestation periods
- Special attention focus on surface and near-surface tissues (e.g., skin and eye)



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Key Results of Measurements & Computations

- Reference effective dose is an order of magnitude (10X) less than ANSI limit of 250 nSv

	HVL (mm)	50% DD (mm)	Air Kerma (nGy)	E_{ref} (nSv)
Rapiscan (anterior)	0.92	~11	30.6	3.5
Rapiscan (posterior)	0.85	~11	29.8	3.2
AS&E (per side)	1.1	~12.5	113	15.5

- Radiation measured outside screening area is statistically indistinguishable from zero

	Air Kerma per Scan (nGy)	Standard Deviation (nGy)
Rapiscan leakage (rear exterior)	3.6	6.0
Rapiscan scatter (operator side)	7.3	3.5
AS&E leakage (rear exterior)	0.23	0.83
AS&E scatter (operator side)	2.8	0.25

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Adult Results of Measurements & Computations

- Absorbed dose to tissues and organs for adult phantoms is less than 50 nGy per screen
- Effective dose to an adult phantoms is ≤15 nSv per screen

	U.S. Adults				
	5th	25th	50th	75th	95th
Male Absorbed Dose					
Thyroid Dose (nGy) per Screen	31	27	24	24	16
Skin Dose (nGy) per Screen	44	43	43	42	42
Eye Lens Dose (nGy) per Screen	44	44	42	42	39
Female Absorbed Dose					
Breast Dose (nGy) per Screen	26	23	23	20	18
Thyroid Dose (nGy) per Screen	22	21	17	11	4
Skin Dose (nGy) per Screen	46	45	44	45	46
Eye Lens Dose (nGy) per Screen	46	44	43	37	32
Adult Effective Dose					
Effective Dose (nSv) per Anterior Scan	12	10	9	7	4
Effective Dose (nSv) per Posterior Scan	3	3	3	2	2
Effective Dose (nSv) per Screen	15	13	12	9	6

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Pediatric Results of Measurements & Computations

- Absorbed dose to tissues and organs of pediatric phantoms were all less than 60 nGy per screen
- Effective dose to pediatric phantoms is less than 26 nSv per screen

	U.S. Children		
	5th	50th	95th
Male Absorbed Dose			
Thyroid Dose (nGy) per Screen	47	45	47
Skin Dose (nGy) per Screen	49	49	48
Eye Lens Dose (nGy) per Screen	60	60	60
Female Absorbed Dose			
Breast Dose (nGy) per Screen	43	39	32
Thyroid Dose (nGy) per Screen	47	44	48
Skin Dose (nGy) per Screen	49	46	48
Eye Lens Dose (nGy) per Screen	60	54	60
Effective Dose			
Effective Dose (nSv) per Anterior Scan	20	18	16
Effective Dose (nSv) per Posterior Scan	6	5	5
Effective Dose (nSv) per Screen	26	23	21

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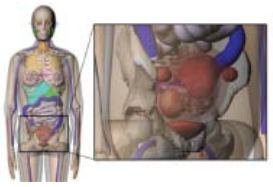
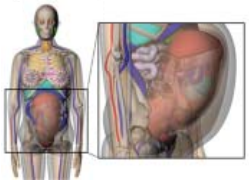
Developing Fetus Results of Measurements & Computations

- Whole-body absorbed dose to fetus for three stages of fetal development is less than 10 nGy per screen





	Three Stages of Fetal Development								
	15 Weeks PC			25 Weeks PC			38 Weeks PC		
Absorbed Dose (nGy)	Anterior	Posterior	Screen	Anterior	Posterior	Screen	Anterior	Posterior	Screen
Whole Body	7.2	1.3	8.5	3.4	0.6	4.0	3.4	0.9	4.3
Brain	3.7	2.3	6.0	0.8	1.4	2.2	0.5	2.7	3.2
Lungs	8.3	0.9	9.2	5.1	0.2	5.3	2.6	0.2	2.7
Thyroid	5.8	1.4	7.2	2.5	0.4	2.9	1.3	0.3	1.6
Active Bone Marrow	13.9	2.5	16.4	6.4	1.8	8.1	8.4	2.7	11.1

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Key Results of Measurements & Computations

- Absorbed dose to locations of radiosensitive skin cells, at depths 50 to 100 um, were not significantly larger than dose averaged over complete layer of skin

	Stylized Phantom	Hybrid Phantom
Absorbed Dose per Screen (nGy)		
Target - Total Skin	37.3	43.5 *
Target - Radiosenstive Layer	37.9	44.2 **
Ratio (Total Skin / Radiosensitive Layer)	1.02	

- Gender-averaged dose with adult hybrid
** Hybrid phantom total skin dose x 1.02

- Localized absorbed doses for stationary beam and normal scan duration were on the order of 1,000,000 nGy for the lens of the eye and skin, and 7,000 nGy for the breast.

Tissue	Normal Screen nGy	Failure Mode 1 nGy	Failure Mode 2 nGy	Tissue Reaction Threshold	
				nGy	Gy
Lens	43	29,000	1,100,000	500,000,000	0.5
Skin	44	26,000	870,000	2,000,000,000	2
Breast	23	310	7,400	--	

Failure Mode 1 - Beam fixed vertically but not horizontally (chopper wheel operational)
Failure Mode 2 - Beam fixed vertically and horizontally (chopper wheel not operational)

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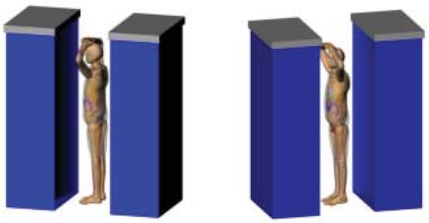
Summary of Measurements & Computations

- No individual, without regard to age and weight, would exceed ANSI limit (250 nSv per screen).
- Absorbed dose per screen to the developing fetus at any of three stages of fetal development is less than 0.0002% of the recommended limit for radiation protection of the fetus during the entire gestation period.
- Dose received by lens of the eye, skin, or female breast under worst-case AIT malfunction scenarios for a normal scan duration are at least 2 orders of magnitude below tissue-reaction thresholds where tissue injury might occur.
- Agreement between estimated dose results from the NAS study and previous studies confirms that the computations performed in the previous studies all comply with the ANSI standard



35

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Key Findings:

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- Acceptance and inspection tests previously used during deployment appear to be sufficient to ensure the installed machines continue to meet ANSI requirements.
- Based on NAS measurements and computations, a screening must extend over 60 seconds to expose an individual to radiation that exceeds ANSI limit for a standard screening.

Key Recommendations:

- Future testing procedures should at a minimum continue to follow ANSI requirements, and include daily verification of safety parameters by a test piece.
- Future X-ray backscatter AITs should have an independent mechanism to ensure that screening time does not exceed time needed to acquire the necessary images.

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Summary of the NAS Study

HEALTH & SAFETY STDS	What are the relevant health and safety standards?	• American National Standards Institute / Health Physics Society (ANSI/HPS N.43.17) specifies limits for equipment for non-medical radiation applications
RADIATION EXPOSURE	Are passengers or bystanders receiving a radiation dose that exceeds relevant safety standards?	• Regardless of measurement technique or modelling approach, all measurements and computations agree dose is at least 5X below the ANSI/HPS limit. • No measurable dose for operators and bystanders.
SYSTEM DESIGN	Are the system design and operating procedures sufficient to prevent overexposure to passengers and bystanders?	• The system design and safety interlocks appear to be sufficient to prevent increase in radiation exposure. • Over-exposure would occur after 16 hours at full x-ray dose in case of machine malfunction.

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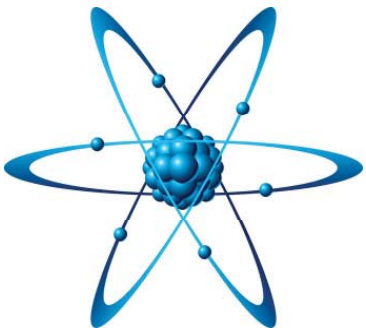

Advanced Imaging TECHNOLOGY

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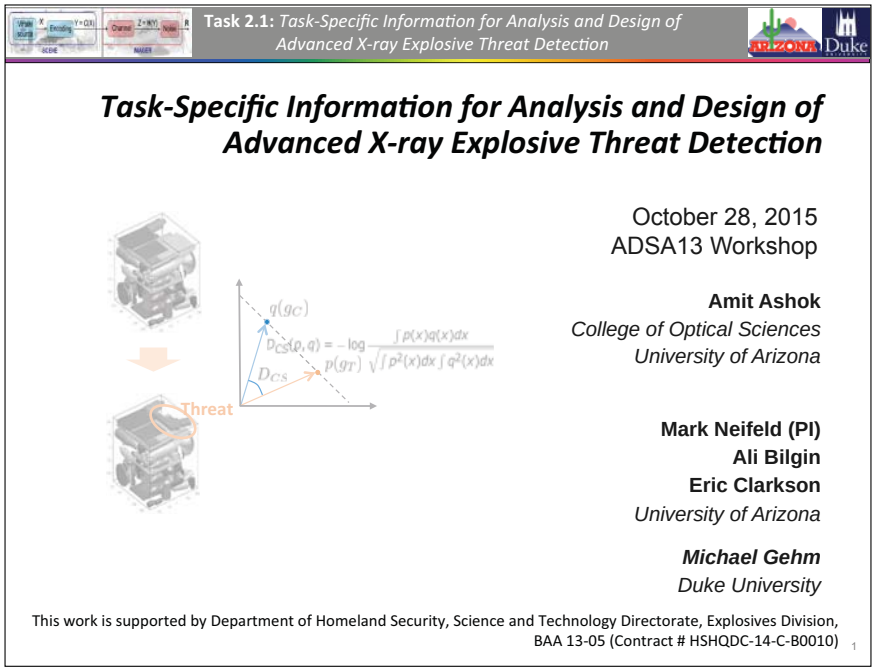
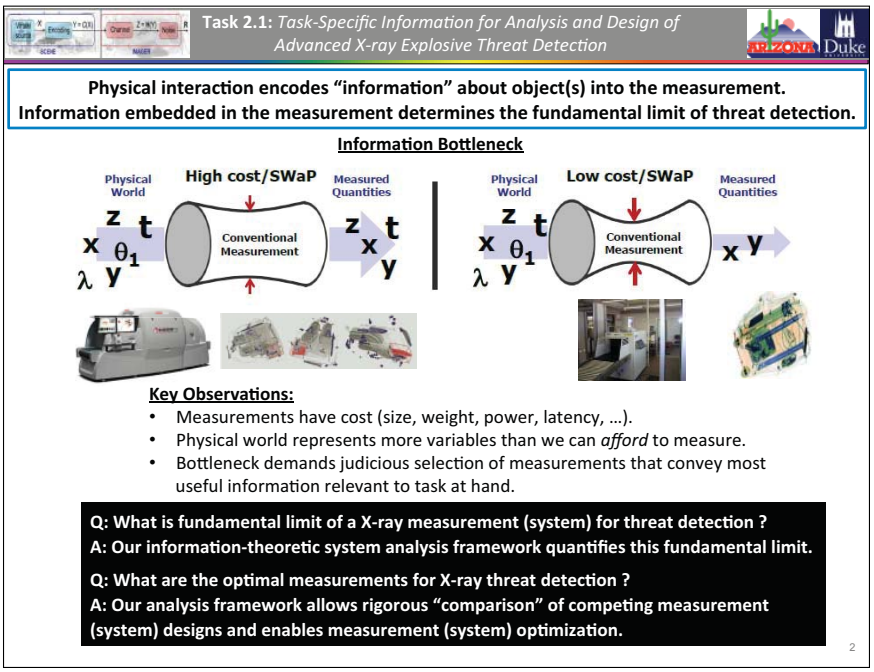
16.9 Amit Ashok: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection

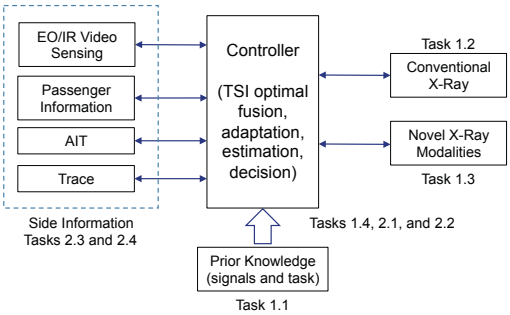




Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Project structure

Our work products will be theory and related analysis/design so the "system concept" presented below is notional and intended to provide structure/context to our explorations.



Thrust 1 – Application of Current TSI Tools
Task 1.1 - Signal and Task Priors
Task 1.2 - TSI Analysis and Design for Current Systems
Task 1.3 - Application of TSI to new Modalities
Task 1.4 - Exploration of Adaptive TSI Strategies

Thrust 2 – Extension of Current TSI Tools
Task 2.1 - Game Theoretic Approaches
Task 2.2 - Joint Detection and Estimation
Task 2.3 - TSI Optimal Fusion from Heterogeneous Data
Task 2.4 - TSI Optimal Measurements on Graphical Models

3

Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Staffing & Org Chart

Program Lead
Mark Neifeld–U. Arizona

Thrust 1 – Application of Current TSI Tools (*Gehm*)

Task 1.1
Signal and Task Priors
Amit Ashok–U. Arizona

Task 1.2
TSI Analysis and Design for Current Systems
Michael Gehm–Duke U.

Task 1.3
Application of TSI to new Modalities
Michael Gehm–Duke U.

Task 1.4
Exploration of Adaptive TSI Strategies
Mark Neifeld–U. Arizona

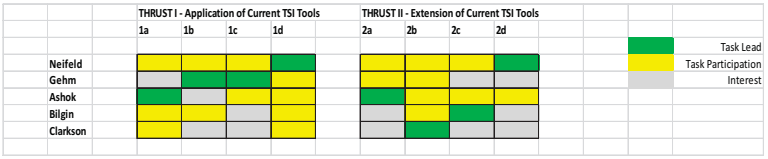
Thrust 2 – Extension of Current TSI Tools (*Ashok*)

Task 2.1
Game Theoretic Approaches
Amit Ashok–U. Arizona

Task 2.2
Joint Detection and Estimation
Eric Clarkson–U. Arizona

Task 2.3
TSI Fusion from Heterogeneous Data
Ali Bilgin–U. Arizona

Task 2.4
TSI Measurements on Graphical Models
Mark Neifeld–U. Arizona



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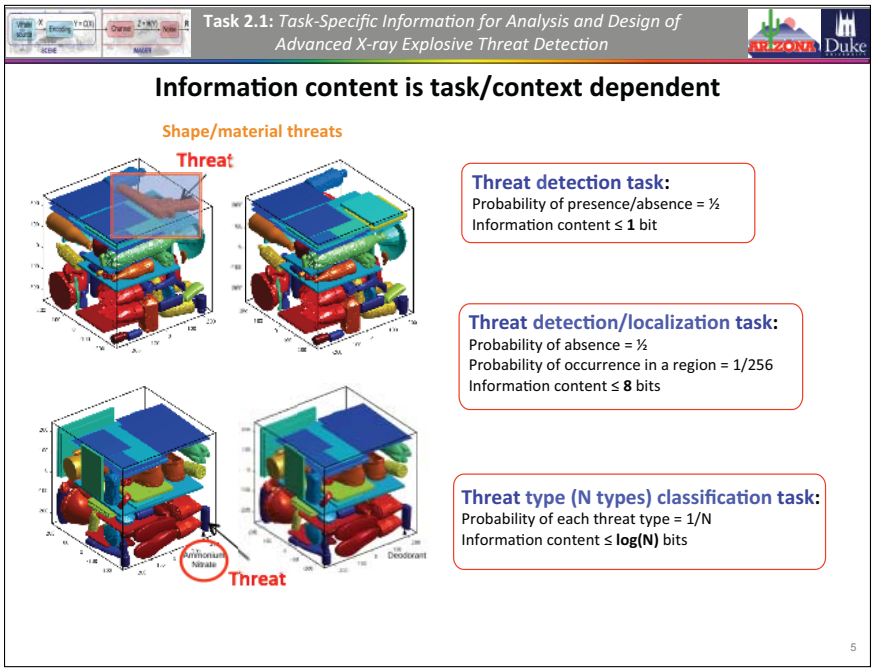
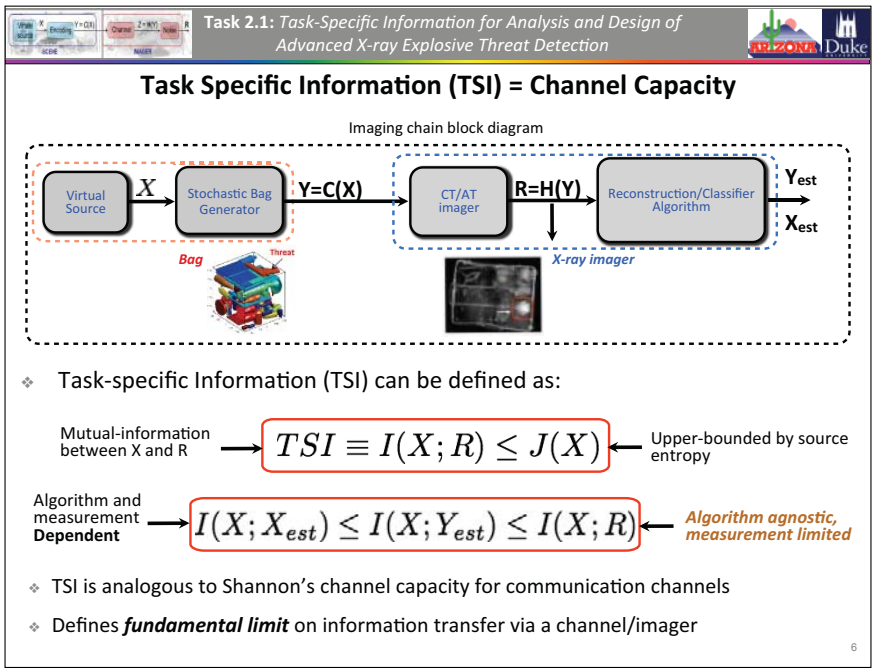
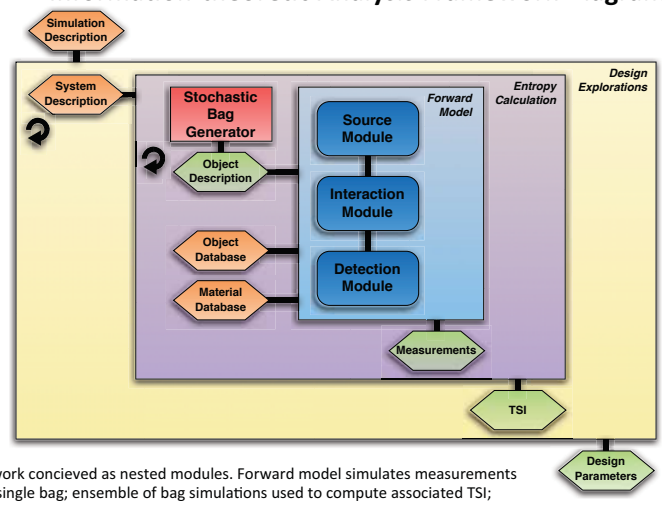

Task 2.1: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection
Information content is task/context dependent
Shape/material threats
Threat
Threat
Threat detection task:
Probability of presence/absence = ½
Information content ≤ 1 bit
Threat detection/localization task:
Probability of absence = ½
Probability of occurrence in a region = 1/256
Information content ≤ 8 bits
Threat type (N types) classification task:
Probability of each threat type = 1/N
Information content ≤ log(N) bits
5


Task 2.1: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection
Task Specific Information (TSI) = Channel Capacity
Imaging chain block diagram
Virtual Source
X
Stochastic Bag Generator
Y=C(X)
CT/AT imager
R=H(Y)
Reconstruction/Classifier Algorithm
Yest
Xest
Bag
X-ray imager
Task-specific Information (TSI) can be defined as:
Mutual-information between X and R
$TSI \equiv I(X;R) \leq J(X)$
Upper-bounded by source entropy
Algorithm and measurement Dependent
$I(X;X_{est}) \leq I(X;Y_{est}) \leq I(X;R)$
Algorithm agnostic, measurement limited
TSI is analogous to Shannon's channel capacity for communication channels
Defines fundamental limit on information transfer via a channel/imager
6

Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Information-theoretic Analysis Framework Diagram



Framework concieved as nested modules. Forward model simulates measurements from a single bag; ensemble of bag simulations used to compute associated TSI; variation in system description produces parameter sweep or ultimately optimization.

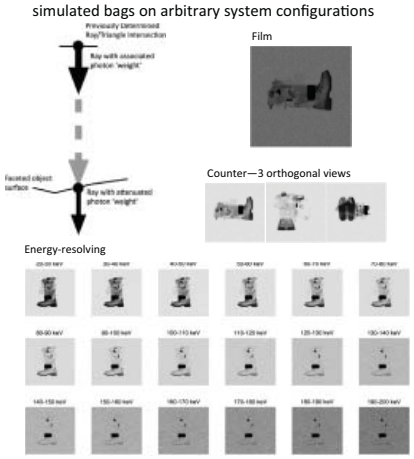
7

Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Framework components

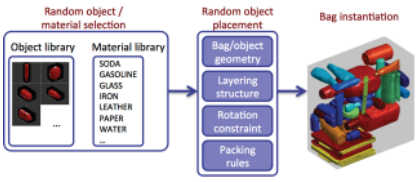
Radiography Forward model

- We had developed a ray-tracing-based forward model of transmission imaging that utilized high-performance graphics APIs to allow ultra-rapid measurement of simulated bags on arbitrary system configurations



Stochastic bag generator

- We had developed a tool for automatically creating large numbers of simulated bags—the *Stochastic Bag Generator (SBG)*. The SBG draws from object / material libraries and uses tunable heuristics to pack the bags.



- We had developed a number of methods for generating the surfaces in the object library.

8

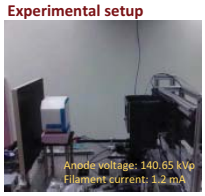
Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Validation of transmission imaging forward model

Custom phantom

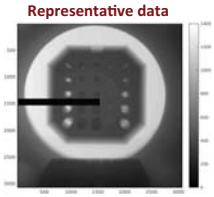
Delrin body;
Variety of 'slug' sizes and materials

Experimental setup



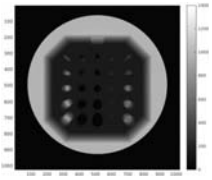
2D integrating detector;
Broadband tungsten cone-beam source

Representative data



Dead pixels on array;
Support table and spatial filter visible

Simulation



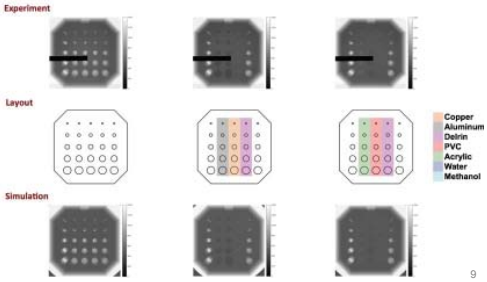
No free parameters;
Good qualitative agreement

Plotting [ln(counts)]^3 to better use dynamic range of display

When then took all experimental data (12 material configurations from 3 different views) and performed one best fit to extract an overall scale parameter (for ADC vs. photon counts, source uncertainty, etc.) and a DC offset for each configuration (for scatter background)

Representative results shown to right

Agreement now semi-quantitative (few percent)



9

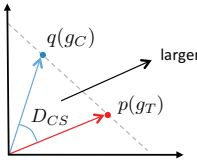
Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Framework components

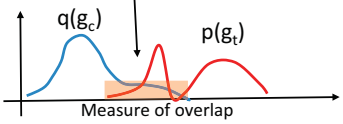
Information-theoretic metric: Cauchy-Schwartz Mutual Information

- Cauchy-Schwarz divergence based mutual information (CSMI) is computationally tractable and scalable

$$D_{CS}(p,q) = -\log \frac{\int p(x)q(x)dx}{\sqrt{\int p^2(x)dx \int q^2(x)dx}} \longrightarrow -\log cos[\angle(p,q)]$$



larger angle → larger class separability



- Scalable CSMI implementation suitable for *Poisson mixture model* (shot noise limited model)

$$J_{CS} = D_{CS}(p(g,\mathcal{C}), p(g)\cdot p(\mathcal{C}))$$

Computational complexity

$O(K^2N)$

bags

Measurement dimensionality

10

Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Stochastic (Threat) Bag Ensembles

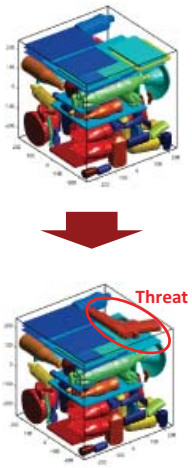
Two fundamentally different threat classes
- Shape-based (*object geometry* distinguishes from non-threat objects)
- Material-based (*object composition* distinguishes from non-threat objects)

Unrelated to *screening guidelines*
- Currently, prohibit primary alarming based on shape.

Threat ensembles created via the stochastic bag generator (SBG)
- Stochastic bag ensembles (SBEs)

Shape-based SBE
- 10k threat and 10k non-threat bags
- Threat/non-threat bags generated/arranged in pairs
- Threat bags are identical to non-threat partner, except 1-2 items replaced with threat objects
- Threat objects: ***Gun, knife, wiring***

Volume	Volume range (cm^3)	Geometric mean (cm)
A	1–8	1–2
B	64–216	4–6
C	512–1000	8–10
D	1728–3375	12–15
E	4913–8000	17–20



Material-based SBE
- Multiple ensembles at differing *threat volume ranges.*
- At each volume, 10k threat and 10k non-threat bags
- Threat/non-threat bags arranged in pairs
- Threat bags are identical to non-threat partner, except a single object has had its material composition switched from a common false-alarm material to a true threat material
- Common false-alarm materials: Playdoh, peanut butter, NaCl, water/NaCl, water/sugar
- Threat materials: ***Gunpowder, AN, gasoline, H_2O_2, MEKP***

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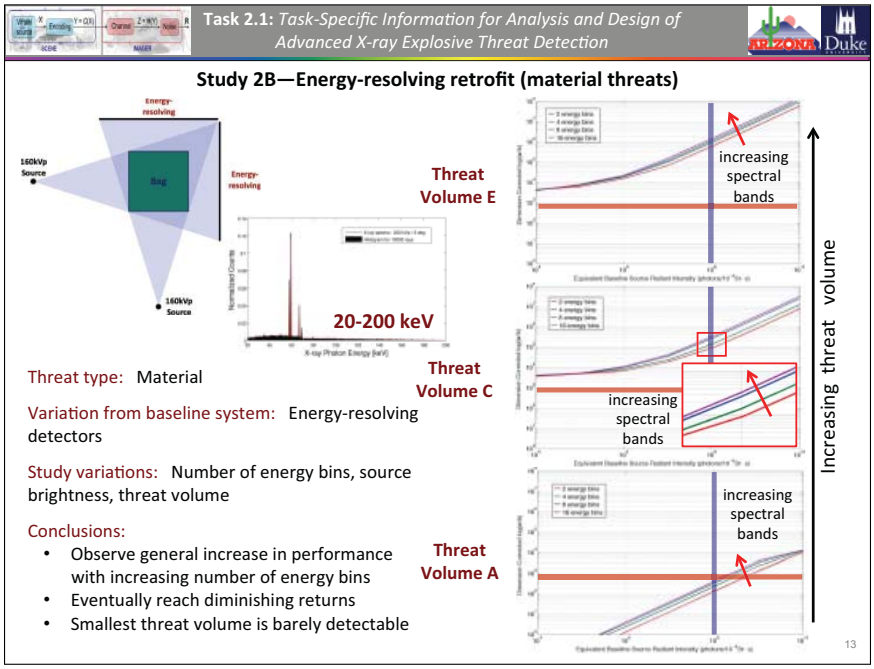
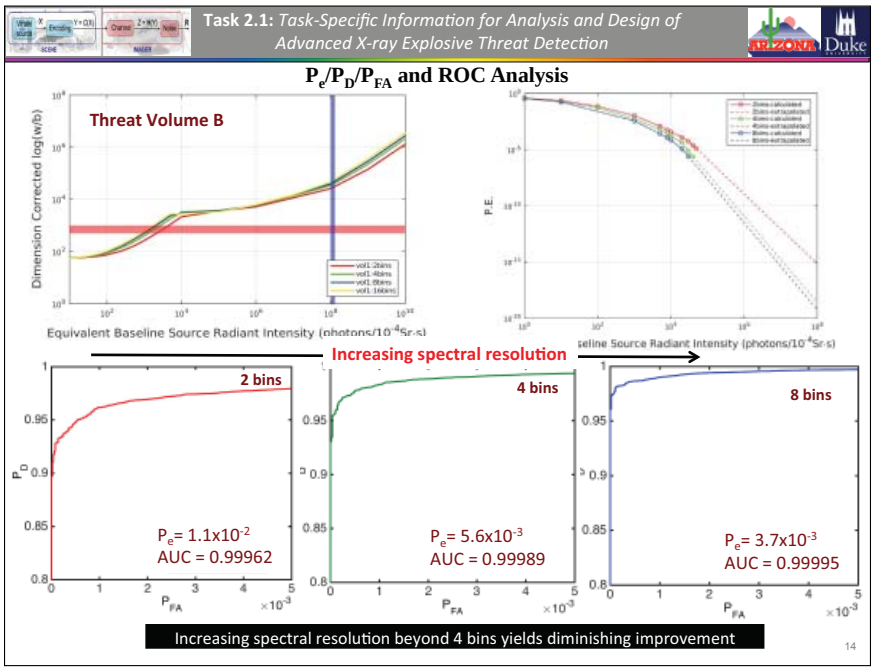
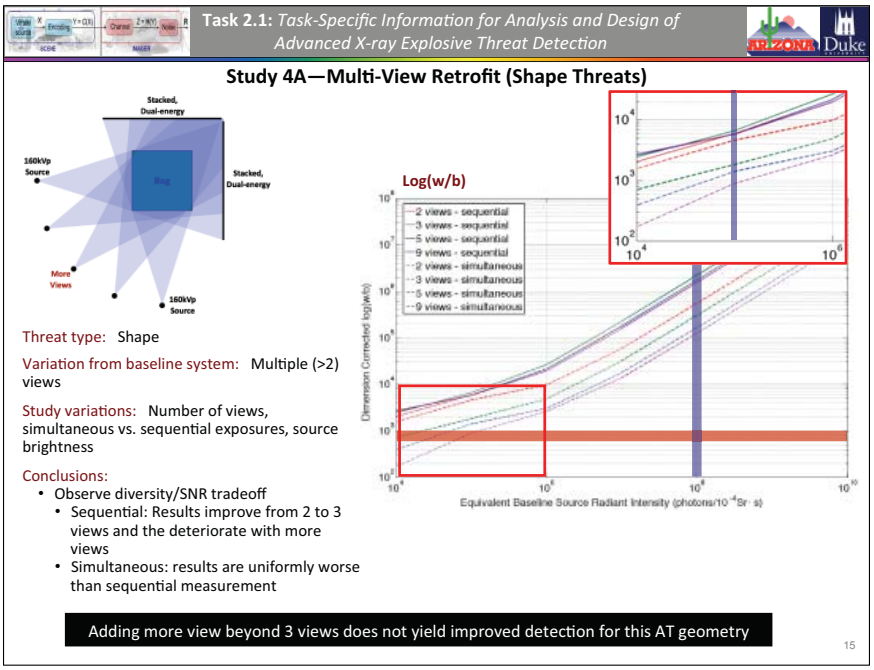
Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

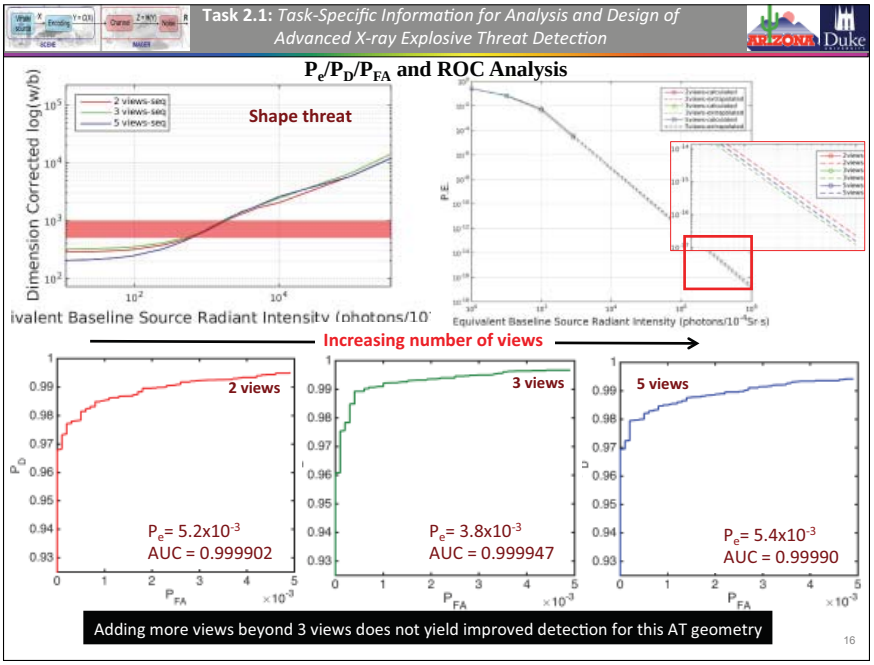
Selected results

12


Task 2.1: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection
Study 2B—Energy-resolving retrofit (material threats)
Energy-resolving
160kVp Source
Bag
Energy-resolving
160kVp Source
20-200 keV
Threat Volume E
Threat Volume C
Threat Volume A
increasing spectral bands
increasing spectral bands
increasing spectral bands
Increasing threat volume
Threat type: Material
Variation from baseline system: Energy-resolving detectors
Study variations: Number of energy bins, source brightness, threat volume
Conclusions:
• Observe general increase in performance with increasing number of energy bins
• Eventually reach diminishing returns
• Smallest threat volume is barely detectable
13

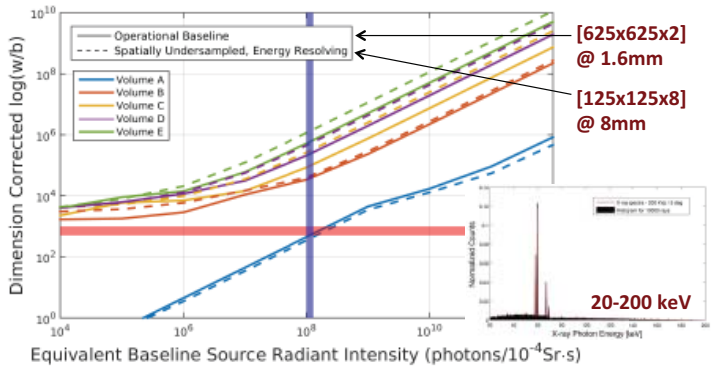

Task 2.1: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection
$P_e/P_D/P_{FA}$ and ROC Analysis
Threat Volume B
Dimension Corrected log(w/b)
Equivalent Baseline Source Radiant Intensity (photons/10⁻⁴Sr·s)
P.E.
Increasing spectral resolution
2 bins
4 bins
8 bins
P_D
P_{FA}
P_e= 1.1x10⁻²
AUC = 0.99962
P_e= 5.6x10⁻³
AUC = 0.99989
P_e= 3.7x10⁻³
AUC = 0.99995
Increasing spectral resolution beyond 4 bins yields diminishing improvement
14


Task 2.1: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection
Study 4A—Multi-View Retrofit (Shape Threats)
Stacked, Dual-energy
160kVp Source
Bag
Stacked, Dual-energy
More Views
160kVp Source
Log(w/b)
2 views - sequential
3 views - sequential
5 views - sequential
9 views - sequential
2 views - simultaneous
3 views - simultaneous
5 views - simultaneous
9 views - simultaneous
Dimension Corrected log(w/b)
Equivalent Baseline Source Radiant Intensity (photons/10⁻⁴Sr·s)
Threat type: Shape
Variation from baseline system: Multiple (>2) views
Study variations: Number of views, simultaneous vs. sequential exposures, source brightness
Conclusions:
• Observe diversity/SNR tradeoff
• Sequential: Results improve from 2 to 3 views and the deteriorate with more views
• Simultaneous: results are uniformly worse than sequential measurement
Adding more view beyond 3 views does not yield improved detection for this AT geometry
15


Task 2.1: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection
Pe/PD/PFA and ROC Analysis
2 views-seq
3 views-seq
5 views-seq
Shape threat
Dimension Corrected log(w/b)
Equivalent Baseline Source Radiant Intensity (photons/10⁻⁴Sr·s)
Increasing number of views
2 views
3 views
5 views
Pe= 5.2x10⁻³
AUC = 0.999902
Pe= 3.8x10⁻³
AUC = 0.999947
Pe= 5.4x10⁻³
AUC = 0.99990
PD
PFA
×10⁻³
Adding more views beyond 3 views does not yield improved detection for this AT geometry
16

Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

Reduction in measurements with no loss of performance



- Spatially undersampled, energy-resolving system outperforms operational baseline system
- Spatial undersampling *reduces* measurements by 25x while energy-resolution *increases* measurements by 4x.
- Net reduction of measurement number is 25/4 = 6.25

Reduction in measurement number by > 5x while improving information-theoretic performance limit.

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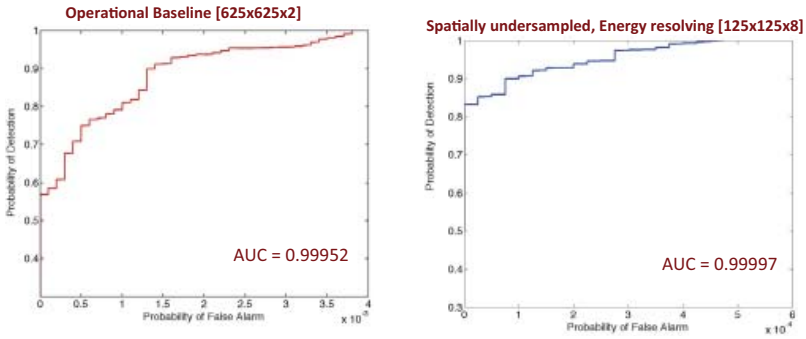
Task 2.1: *Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection*

$P_e/P_D/P_{FA}$ and ROC Analysis

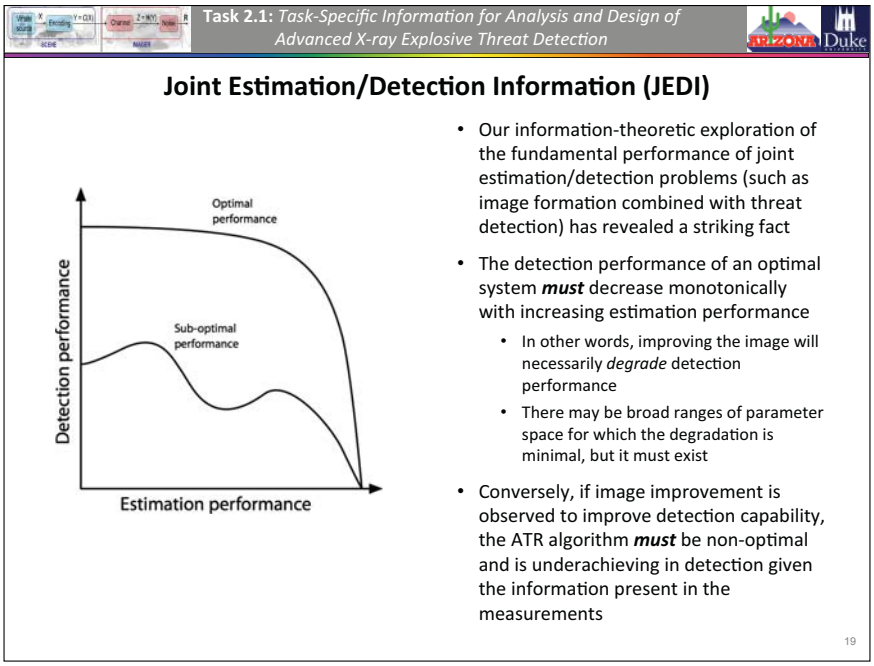


Threat Volume B

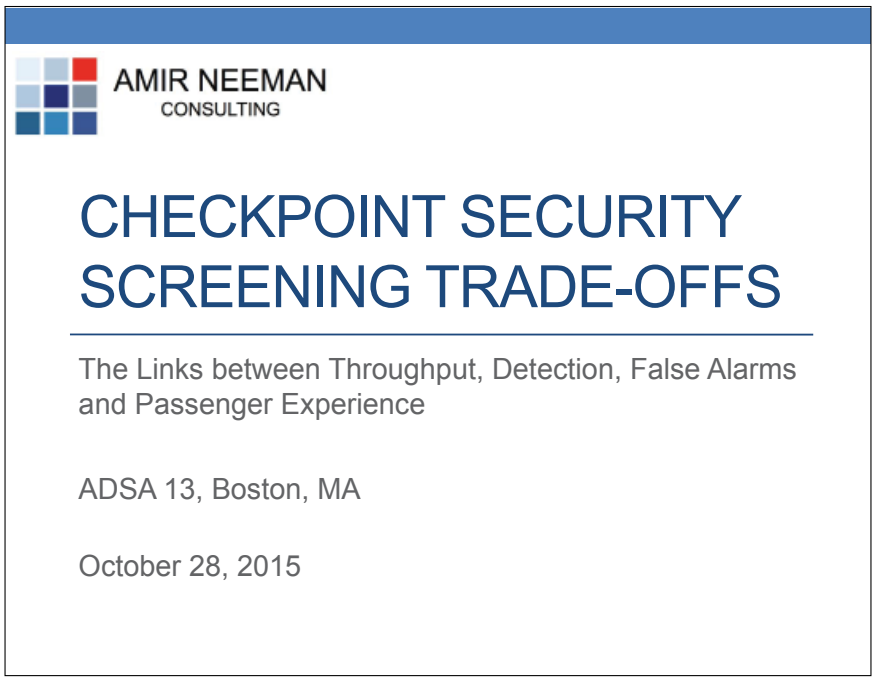
- ROC analysis confirms the log[w/b] comparison between operational baseline and spatially undersampled, energy resolving system

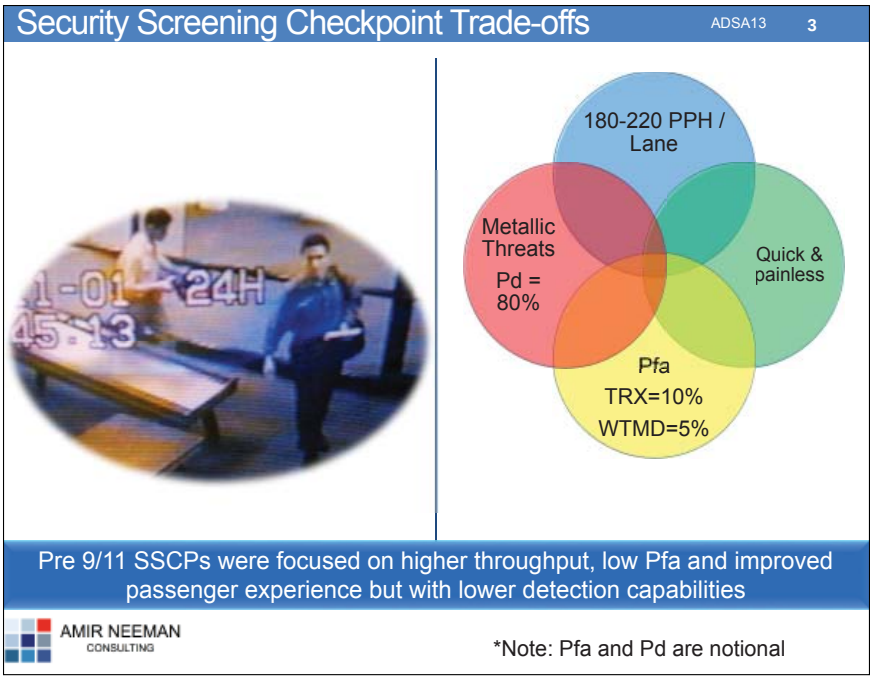
Reduction in measurement number by > 5x while improving information-theoretic performance limit.

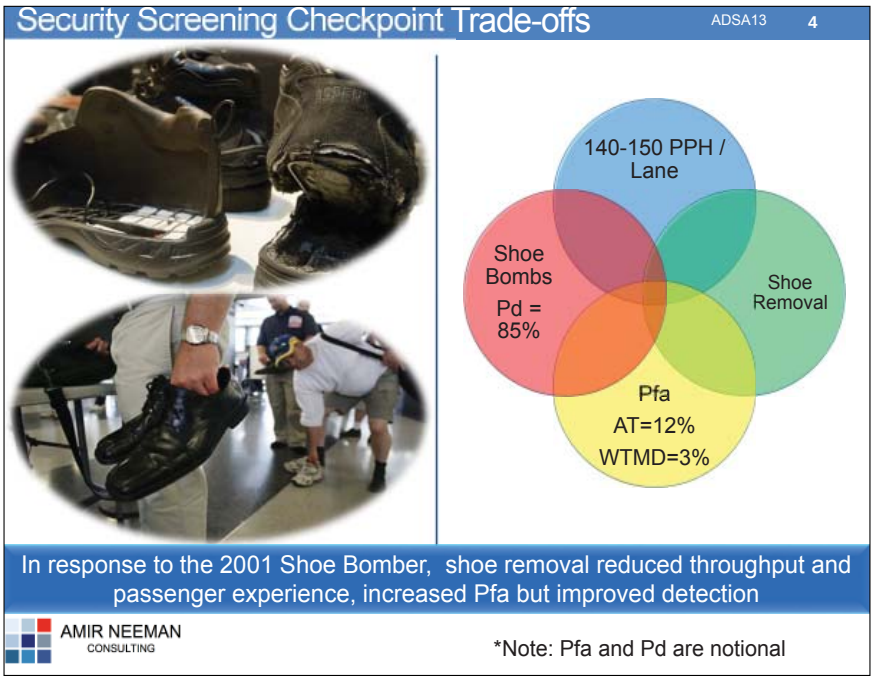
18

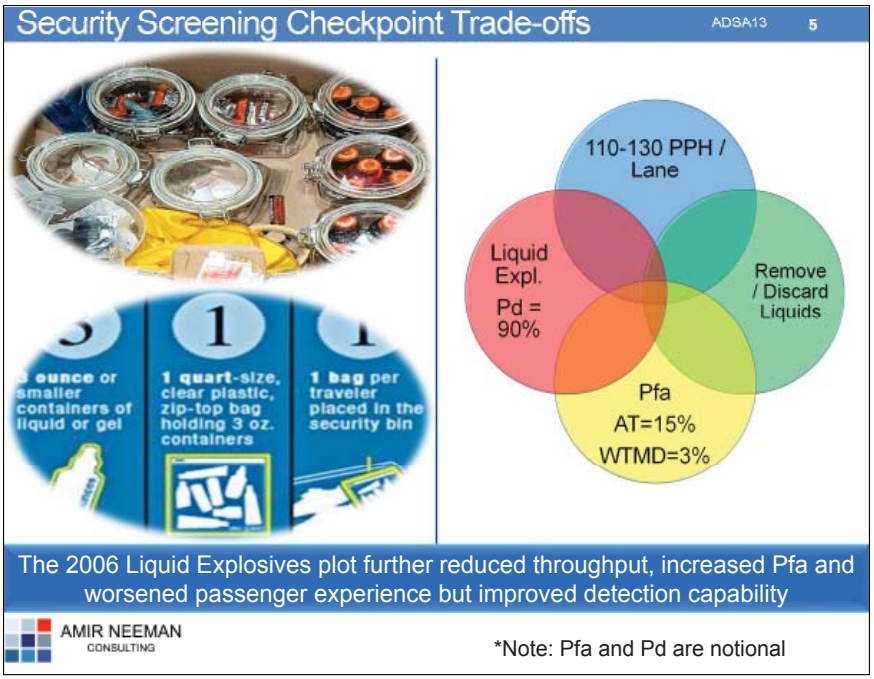

Task 2.1: Task-Specific Information for Analysis and Design of Advanced X-ray Explosive Threat Detection
Joint Estimation/Detection Information (JEDI)
Optimal performance
Sub-optimal performance
Detection performance
Estimation performance
Our information-theoretic exploration of the fundamental performance of joint estimation/detection problems (such as image formation combined with threat detection) has revealed a striking fact
The detection performance of an optimal system must decrease monotonically with increasing estimation performance
In other words, improving the image will necessarily degrade detection performance
There may be broad ranges of parameter space for which the degradation is minimal, but it must exist
Conversely, if image improvement is observed to improve detection capability, the ATR algorithm must be non-optimal and is underachieving in detection given the information present in the measurements
19

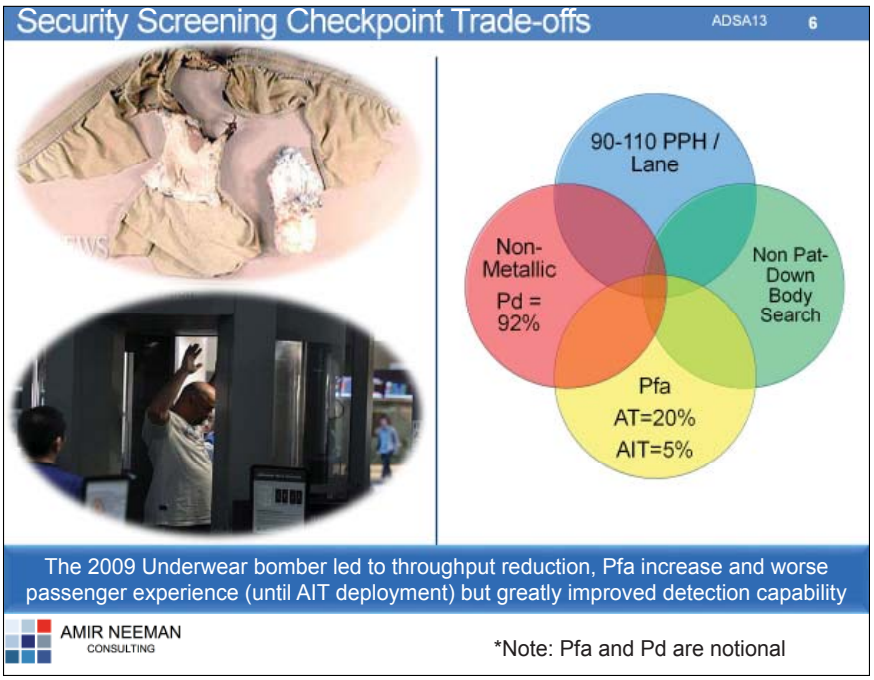
16.10 Amir Neeman: Checkpoint Security Screening Trade-Offs




Security Screening Checkpoint Trade-offs
ADSA13
3
180-220 PPH / Lane
Metallic Threats
Pd = 80%
Quick & painless
Pfa
TRX=10%
WTMD=5%
Pre 9/11 SSCPs were focused on higher throughput, low Pfa and improved passenger experience but with lower detection capabilities
AMIR NEEMAN
CONSULTING
*Note: Pfa and Pd are notional

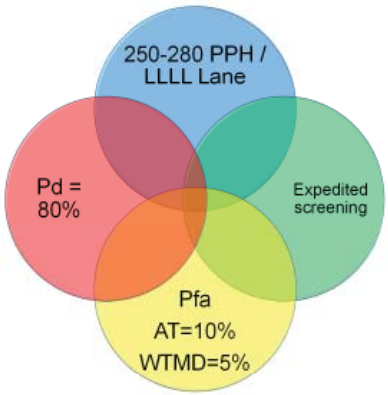

Security Screening Checkpoint Trade-offs
ADSA13
4
140-150 PPH / Lane
Shoe Bombs
Pd = 85%
Shoe Removal
Pfa
AT=12%
WTMD=3%
In response to the 2001 Shoe Bomber, shoe removal reduced throughput and passenger experience, increased Pfa but improved detection
AMIR NEEMAN
CONSULTING
*Note: Pfa and Pd are notional


Security Screening Checkpoint Trade-offs
ADSA13
5
ounce or smaller containers of liquid or gel
1
1 quart-size, clear plastic, zip-top bag holding 3 oz. containers
1 bag per traveler placed in the security bin
110-130 PPH / Lane
Liquid Expl.
Pd = 90%
Remove / Discard Liquids
Pfa
AT=15%
WTMD=3%
The 2006 Liquid Explosives plot further reduced throughput, increased Pfa and worsened passenger experience but improved detection capability
AMIR NEEMAN
CONSULTING
*Note: Pfa and Pd are notional


Security Screening Checkpoint Trade-offs
ADSA13
6
90-110 PPH / Lane
Non-Metallic
Pd = 92%
Non Pat-Down Body Search
Pfa
AT=20%
AIT=5%
The 2009 Underwear bomber led to throughput reduction, Pfa increase and worse passenger experience (until AIT deployment) but greatly improved detection capability
AMIR NEEMAN
CONSULTING
*Note: Pfa and Pd are notional

Security Screening Checkpoint Trade-offs

ADSA13 7



Pre√ in 2011greatly increased throughput, reduced Pfa and improved passenger experience (for Pre√ base) but lowered detection (mitigated by pre-screening)

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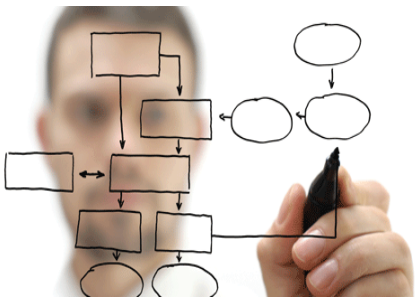
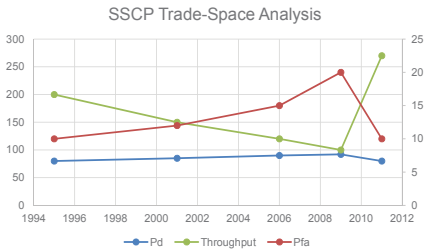
*Note: Pfa and Pd are notional

So What? Why Should We Care?

8

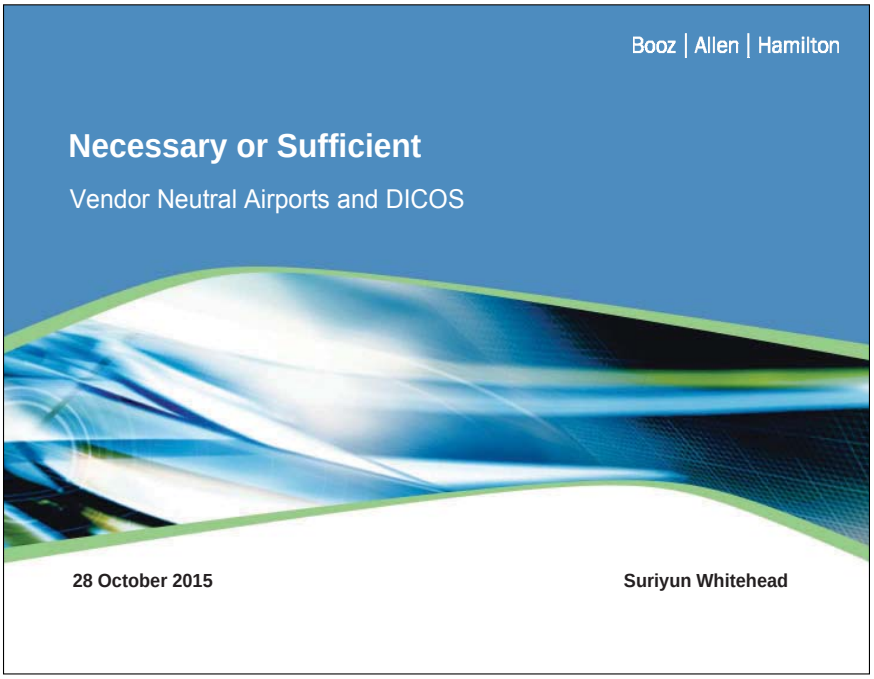
- SSCPs are an integrated and complex system of systems
- Multi-factorial trade-space analysis (part of a systems analysis approach) is critical
  - Stochastic and realistic simulation modeling
  - Operational Utility Evaluations
  - Human factors analysis
  - Trade-space analytical tools (e.g. TSCAP)
- Design, develop and deploy SSCP elements as part of an integrated system

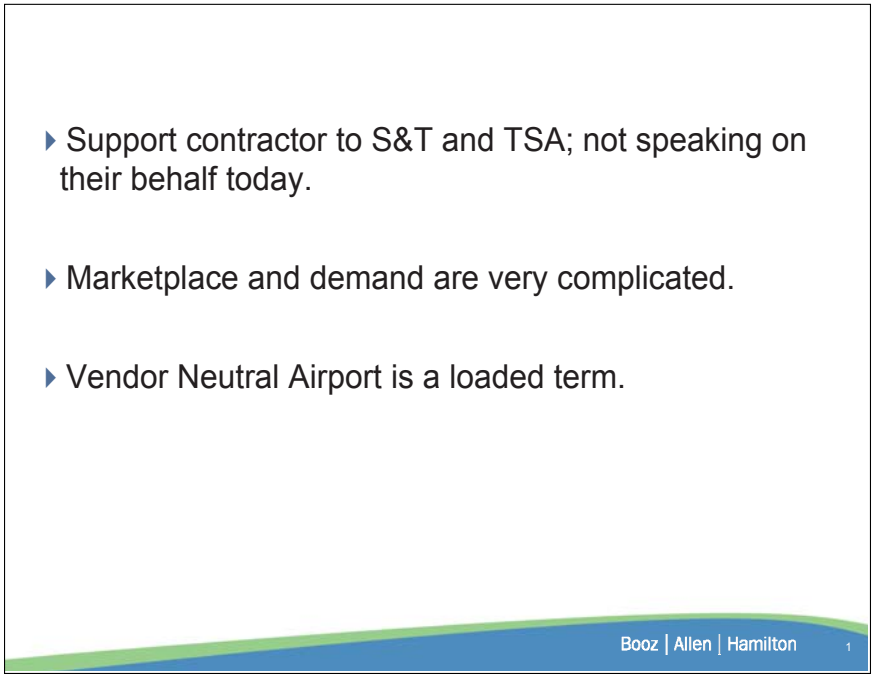




AMIR NEEMAN CONSULTING

16.11 Suriyun Whitehead: Necessary or Sufficient-Vendor Neutral Airports and DICOS





Benefits of Vendor Neutral Airports to the TSA

- Today: Scanners networked with proprietary networks and protocol, vendor by vendor, or standalone black boxes.
  - Airports locked to specific vendors.
  - Limitations in cost, speed, innovation, redundant efforts.
- Next Steps: Mixed deployments, multiple vendors.
  - Interoperability and a system perspective will help streamline technology investment and enhance delivery of security capabilities.
  - DICOS is the provisional standard image format.
- Are Vendor Neutral Airports Necessary? Answer: Complicated.
- Is DICOS the correct protocol? Answer: Complicated.

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A Complex Market for Screening Technology

- Vendor equipment is capable.
  - Meets TSA requirements in the field.
  - Proprietary stack – formats and interfaces.
- This room – testament to multiple vendors, and multiple options.
- Are we doing everything we can?
  - Does a standard image format help? Does DICOS help? What else is needed?
- Vendor Neutral Airports will lead to questions.
  - How to integrate, how to test, how to maintain, who is responsible for issues?
  - Once you have standards, can anyone be an integrator? Can anyone provide maintenance for deployed technology?

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Accelerate the Development and Deployment of New Capability

- Capabilities require:
  - Creation: Access to and format for data.
  - Deployment: Opportunity to plug in to the workflow.
  - Control: Method of managing workflow.
- People are saying that DICOS is not sufficient nor necessary to achieve this aim.
- DICOS is:
  - Method to encapsulate images, spectra, detection results and operator decisions.
  - Protocol to transmit this information.
  - Can be extended to support CONOPs and execution.
  - Broad but not all encompassing.
- DICOS is not:
  - A silver bullet.
  - Simple, self describing.

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Standardization of Formats

- Applications
  - Risk Based Screening, Networked, Viewing, Load Balancing, third party algorithms (ATR, recon, OSR, TIP)
- Standardize the image format to meet TSA needs?
  - Today and Tomorrow
- What's missing?

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DICOS and/or Something Else (TIFF? VTK? UIO? …)

- DICOS and its associate documentation is onerous, but:
  - It has been tested and it works.
  - Any other possible standard and its documentation would be onerous and would have to be tested.
    - ~Man-decade into DICOS and man-century into DICOM foundation.
- If you were to create a new DICOS, we might not start with DICOM, but we aren't in a situation where we must start from scratch.
- Everyone who has used DICOS has done a good job.
- I conclude its not worth switching.

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Questions

- How can stakeholders both realize the benefits of standards and deliver innovation? Are there limits?
- What else do we need?
- Does this result in a race to the bottom?
- Is the future market that enables vendor neutral airports viable and sustainable?

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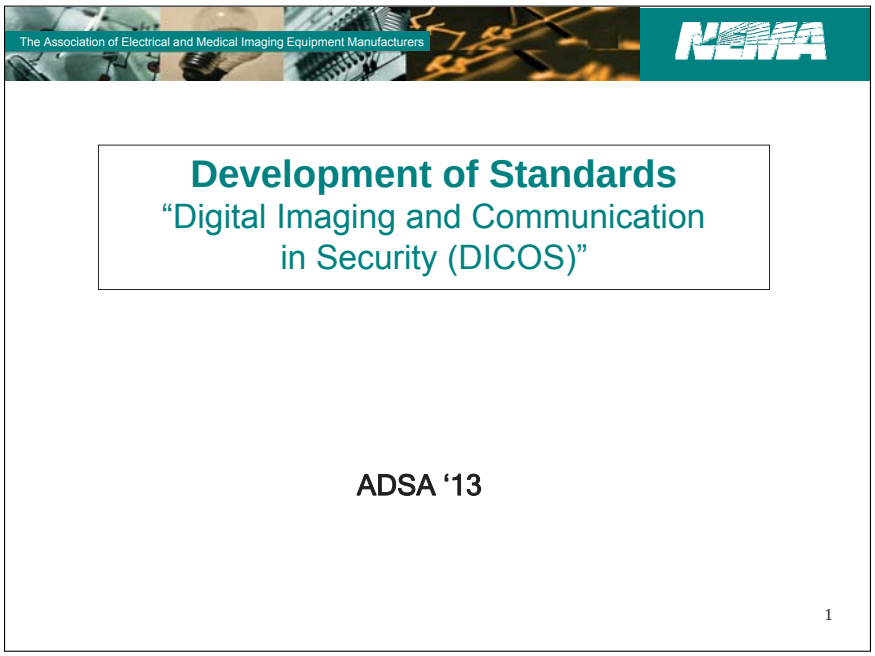
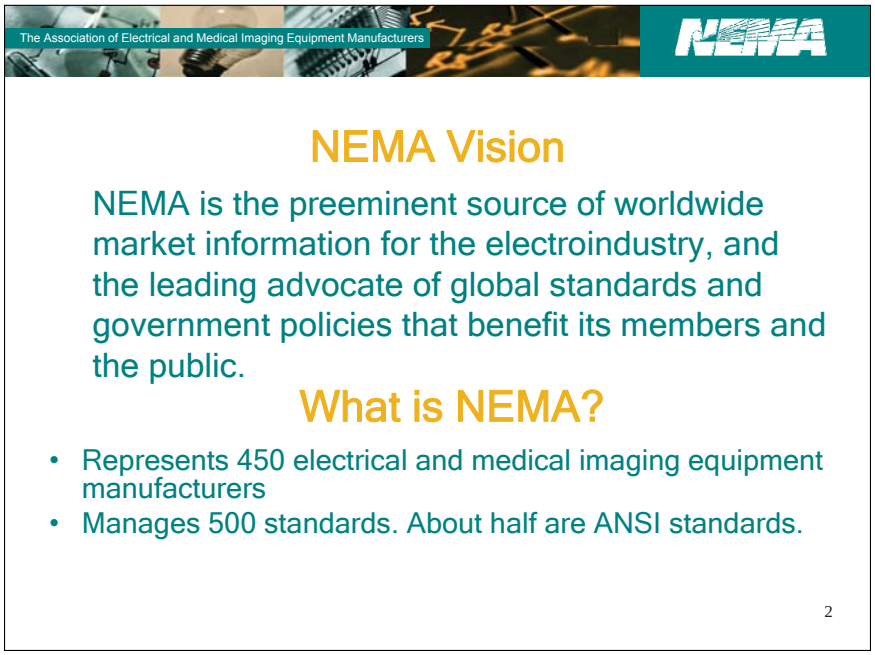
BACKUP

DICOS

- **A tool for a complex problem:**
  - **It is not trivial to capture all of the information needed.**
- Advertises notorious structured meta data.
- Extensible to new modalities.
- Simplified access via toolkits.
- Reflects vendor input and consensus agreement.
- Alternative formats don't offer anything better.

16.12 Harry Massey: Development of Standards- "Digital Imaging and Communication in Security (DICOS)"





The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA

A NEMA standard defines a product, process, or procedure with reference to:

- Nomenclature
- Composition
- Construction
- Dimensions
- Tolerances
- Safety
- Operating characteristics
- Performance
- Ratings
- Testing
- The service for which it is designed

NEMA believes that standards play a vital part in the design, production, and distribution of products destined for both national and international commerce. Sound technical standards benefit the user, as well as the manufacturer, by improving safety, bringing about economies in product, eliminating misunderstandings between manufacturer and purchaser, and assisting the purchaser in selecting and obtaining the proper product for his particular need.

3

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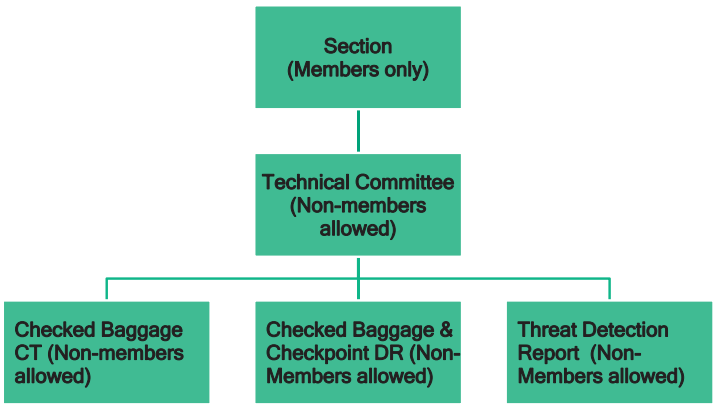
Industrial Imaging & Communications Section



4

The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA

Challenges

- Open standards development arena vs. security-sensitive/classified information
- Extensibility
- International implementation
- Group culture, speed and consensus

5

The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA

First, There Was DICOM

NEMA Medical Division, representing a majority of the medical imaging equipment manufacturers, developed a standard for digital imaging and communications in medicine-DICOM, which is successfully deployed in clinics, universities and hospitals throughout the world using equipment from different suppliers.

6

The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA

DICOS Builds on DICOM

- The medical industry standard for transferal of radiological images and other medical information between computers.
- Patterned after the Open System Interconnection of the International Standards Organization.
- Enable digital communication between diagnostic and therapeutic equipment and systems from various manufacturers.
- Includes x-ray, CT and ultrasound, among other modalities.
- Enables network and component integration in the sending and receiving digital images and related information.
- Covers most image formats for all of medicine.
- A specification for messaging and communication between imaging machines.

7

The Association of Electrical and Medical Imaging Equipment Manufacturers

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Top Issues/Priorities

- Provide technical leadership for DHS and TSA
- Connect industry and government resources.
- Influence the market to provide quality, innovative products.
- Potential future opps., such as other digital scanning-imaging security application that require transfer of imaging types, such as port security.
- Active participation by members, DHS, TSA in standard development.
- Technical “Vision”
- Operational “Insight” (Define In-Use Environment)

8

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Current initiative-Smart Grid

- NEMA defines Smart Grid as the national electric grid enhanced with monitoring, analysis, control and communications capabilities.
- Such enhanced capabilities are intended to improve reliability, energy efficiency, capacity, security, consumer participation and the utilization of renewable resources and distributed generation.

As a policy, what is DICOS?

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The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA

Contact

Harry Massey
703-841-3287
harry.massey@nema.org
Rosslyn, VA 22209

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The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA

Other Materials

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The Association of Electrical and Medical Imaging Equipment Manufacturers

NEMA

Digital Imaging and Communications in Security (DICOS)

NEMA Developed DICOS Standard

- DICOS-conformant images can be evaluated using Automatic Threat Detection (ATD/ATR)
- Based on DICOM, the new standard facilitates interoperability of security-imaging equipment
  - DICOS also allows transfer of images for secondary inspection
- Supported by DHS and TSA

DICOM = Digital Imaging and Communications in Medicine

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DICOS

Development of a Data Representation & Data Transmission Standard* for Checked Baggage and Checked Point applications

- CT: B and C Interface
- DR: B and C Interface
- AIT (Passenger)
- Threat Detection Report (TDR): Establishes common format for ATD results for above scenarios
- Other modalities: QR, THZ, MM Wave, etc.

Consensus Road Map for Phased Implementation per DHS Priorities

13

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Technical Committee Deliverable

- Scope: DICOS provides a data interchange protocol and interoperable, extensible file format to facilitate data interchange (demographic information, X-ray radiographs, CT images, material specific information, trace detection signatures, threat assessment, etc.) of objects of inspection (checked or carry-on baggage, parcels, personnel, etc.) for security screening applications.
- Elements of Overall Hierarchy
  - From Aggregate Traveler through Scan Level
  - Excluding (but coordinated with) DR- , CT-, or other technology-specific objects
  - Coordinated with Threat Detection Reports (TDRs)

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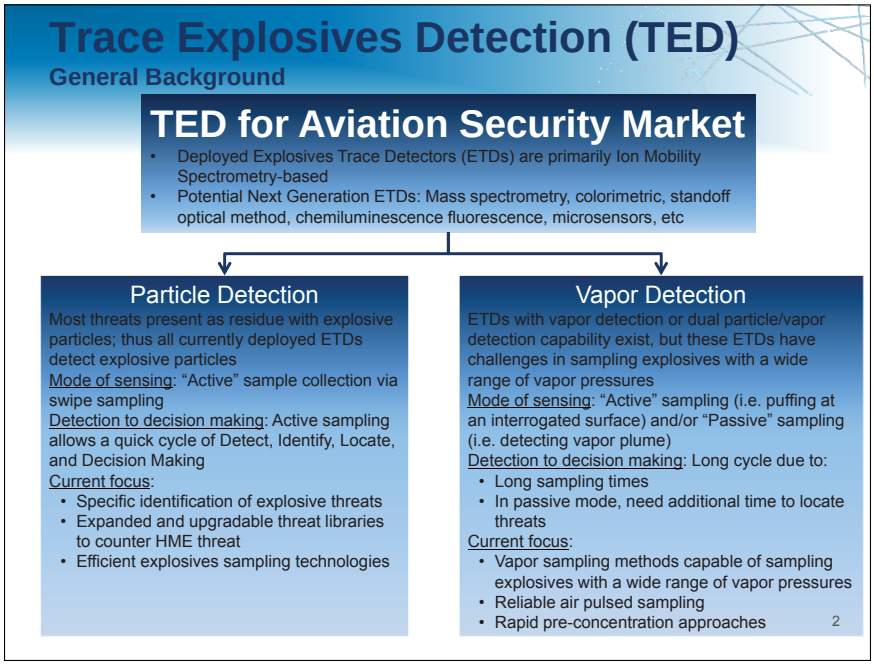
CT, DR Threat Detection Deliverables

- Data representation standard for CT scans of Checked Bags at B Interface
- CT modules and attributes below scan level (excluding Threat Detection)
- Data representation standard for DR scans of Checked Bags and Checkpoint at B Interface
- DR modules and attributes below scan level (excluding Threat Detection)
- Data representation standard for threat detection reports (TDRs), including both automated detection and operator on-screen resolution information, and compiling TDRs from multiple producers at multiple levels (see Worldview).
- Identifying the structure of TDRs associated with data from a producer, or multiple producers scanning the same object.

15

16.13 Laura Parker & Richard T. Lareau: Advances in Trace Detection



Ion Mobility Spectrometry

- **Pros**
  - Fast
  - High detection sensitivity to most explosives
  - High detection rate
  - Low false alarm rate
  - Works at atmospheric pressure
  - *Low maintenance (^{63}Ni sources)*
  - *Low cost*
  - *Easy to operate*
- **Cons**
  - Limited threat library
  - Resolution
  - Selectivity
  - *Affected by pressure and humidity*

Homeland Security
Science and Technology

3

Needs

- **DHS needs ETDs that have high P_d, low P_{fa}, expanded and upgradable threat library, rugged and portable (for field use), few consumables, and inexpensive *(& low MTBF)***
  - Selective
  - Sensitive
- **Focus on Sampling**
  - Non-contact sampling
  - Remote or standoff sampling/detection
  - New materials for collection

Homeland Security
Science and Technology

4

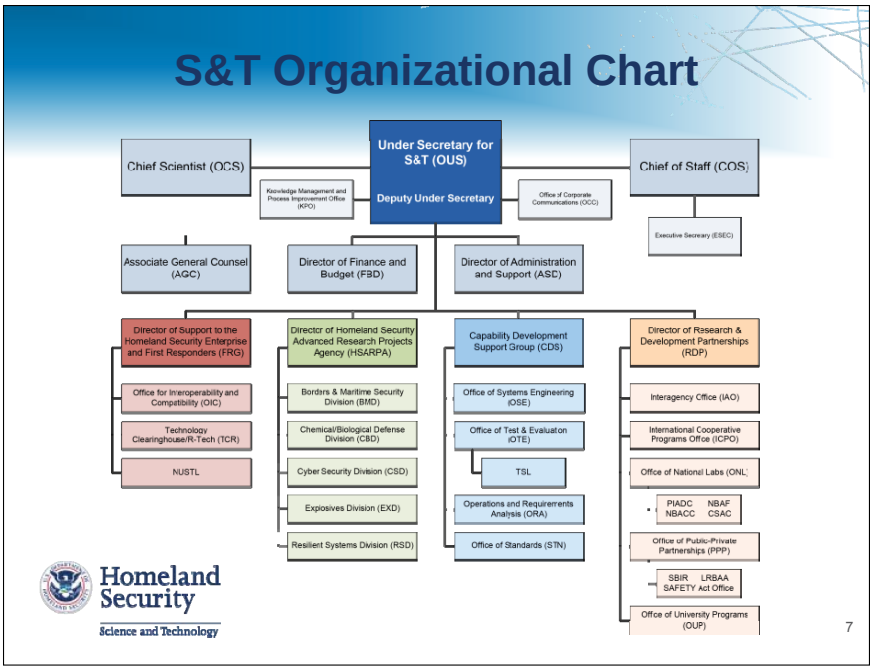
Q&A
Discussion

Homeland Security
Science and Technology

5

Homeland Security
Science and Technology

6


S&T Organizational Chart
Under Secretary for S&T (OUS)
Deputy Under Secretary
Chief Scientist (OCS)
Knowledge Management and Process Improvement Office (KPO)
Office of Corporate Communications (OCC)
Chief of Staff (COS)
Executive Secretary (ESEC)
Associate General Counsel (AGC)
Director of Finance and Budget (FBD)
Director of Administration and Support (ASD)
Director of Support to the Homeland Security Enterprise and First Responders (FRG)
Office for Interoperability and Compatibility (OIC)
Technology Clearinghouse/R-Tech (TCR)
NUSTL
Director of Homeland Security Advanced Research Projects Agency (HSARPA)
Borders & Maritime Security Division (BMD)
Chemical/Biological Defense Division (CBD)
Cyber Security Division (CSD)
Explosives Division (EXD)
Resilient Systems Division (RSD)
Capability Development Support Group (CDS)
Office of Systems Engineering (OSE)
Office of Test & Evaluation (OTE)
TSL
Operations and Requirements Analysis (ORA)
Office of Standards (STN)
Director of Research & Development Partnerships (RDP)
Interagency Office (IAO)
International Cooperative Programs Office (ICPO)
Office of National Labs (ONL)
PIADC NBAF
NBACC CSAC
Office of Public-Private Partnerships (PPP)
SBIR LRBAA
SAFETY Act Office
Office of University Programs (OUP)
Homeland Security
Science and Technology
7


S&T Mission
To deliver effective and innovative insight, methods and solutions for the critical needs of the Homeland Security Enterprise.
Homeland Security
Science and Technology
8

16.14 Carl Crawford: Call to Order Day 2

Thirteenth Advanced Development for Security Applications Workshop (ADSA13):

Screening of Personnel and Divested Items at The Checkpoint – Part 2

Call To Order
Day 2

Carl R. Crawford
Csuptwo, LLC

1

Reminders

- Fill out questionnaire on Survey Monkey
- End at 4:00 PM today
  - Please stay to end if possible
- Comments welcome after conclusion

2

ADSA14 Provisional Topics

- Orthogonal technologies – development and test
- Deterrence
- Simulants – development and testing
- Dealing with the needle in the haystack
- Improving statistical significance of testing
- Anomaly versus threat detection
- Nuisance alarms reductions
- Third party review of third parties
- Airport case studies (Gatwick)
- Human in the loop and the complete loop
- Civil rights and privacy concerns
- Other customers (sports venues, federal buildings, mass transit)
- DICOM history and APIs (wg-23)

3

16.15 Harry Martz: Review of Previous ADSAs Addressing Fused Systems (ADSA05 & ADSA06)

Review of Previous ADSAs Addressing Fused Systems
(ADSA05 and ADSA06)

Harry Martz
Lawrence Livermore National Laboratory

1

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344 LLNL-PRES-679538

Summary

- There is no silver bullet
- Have to combine (fuse, integrate) multiple technologies to achieve performance (PD, PFA, throughput, operating cost) required
- No infrastructure to support this within the government: specification, integration, testing, deployment, networking, etc.
- Most previous fusion attempts have failed for many reasons, e.g., engineering issues and data may be correlated
- We should learn from the past successes and failures

2

Backup Slides

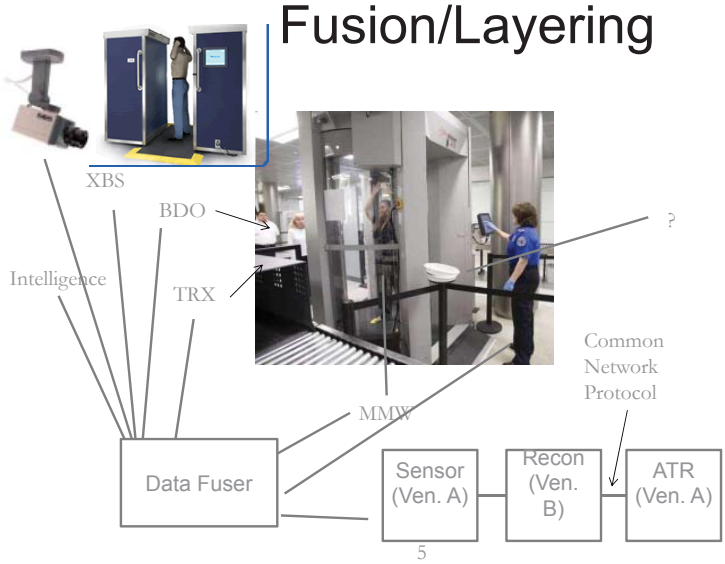
3

Fused systems: So What? Who Cares?

- Why are systems being fused (layered)
  - In the field by TSA
  - By manufacturers?
- Have we figured out there is no silver bullet?
- What has worked in the past?
- What hasn't worked?
- Can we end up with better results if we fuse at the beginning of development vs. at the end?
- Should testing be on fused systems instead of individual systems?

4

Fusion/Layering



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Conclusions

- Fused systems recommended because present technology may be near limits for detection, throughput and operating costs
- Fusion types/examples
  - Hardware : CT + XRD, TRX + NQR
  - Data : risk based screening (Precheck) or combining images and ATR results from multiple devices
- Fusion already deployed (denoted layering)
  - Precheck, LBS, AT2, AIT, WTMD
  - EDS + ETD
- Emphasis has been on retrospective data fusion instead on designing fused systems that improve detection performance
  - Two devices combined may not lead to better performance because of correlation of features & nonlinear effects with PD/PFA
- Changes required to support fusion: requirement specs, funding, testing, system integration, networking, standards, and concept of operations.

6

Silver Bullets Missing

- Improved performance required
  - Detection: PD, PFA, mass, sheet thickness, more threats
  - Performance: throughput, divestiture
  - Cost: operating and need for TSOs
- Present equipment may be at limits
- No silver bullets – nothing on horizon
- Fusion recommended
- Fusion already deployed

7

Fusion Types

- Hardware
  - Two types of hardware in parallel – “or” results
  - Also known as layering
- Data
  - Outputs: combine outputs of multiple systems
    - ATR, images, spectra, risk
  - Inputs: control operation of device based on another device
    - RBS

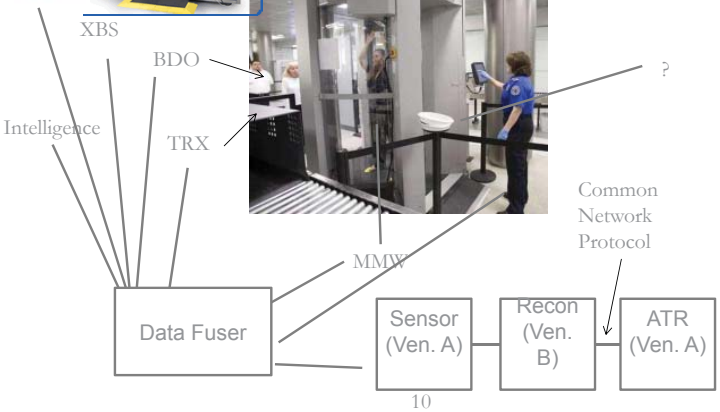
8

Fusion Today

- LBS + AT2
- EDS + ETD
- Precheck + WTMD, AIT

9

Fusion/Layering



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Previous Attempts

- Emphasis has been on retrospective data fusion instead on designing fused systems that improve detection performance
  - Two devices combined may not lead to better performance because of correlation of features & nonlinear effects with PD/PFA
- Need more prospective studies to assess efficacy
  - Paper predictions, simulations

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Changes Required for Fusion

- Present TSA procurement policies not optimized for fused systems
  - Requirement specs: for pieces of systems that can later be fused
  - Funding: for pieces that can be fused; tied to requirement specs
  - Testing: test pieces separately and combine results virtually
  - system integration: field integration required
  - networking, standards: new open standards
  - concept of operations: will change depending how equipment is connected

12

16.16 Sondre Skatter: ATRs with Analog Outputs-Developing and Test

ATRs with Analog Outputs - Developing and Test

Sondre Skatter
ADSA13 Workshop
October 29th, 2015

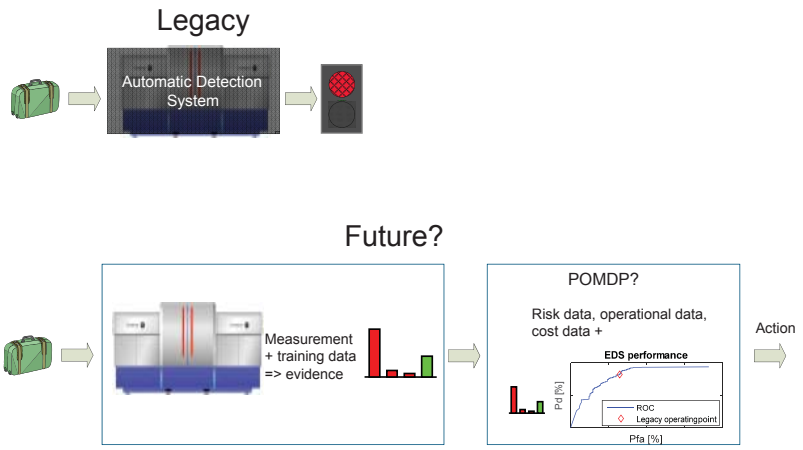
SAFRAN Morpho

WHAT IS IT? WHY DO I CARE?

- Traditional ATRs: binary alarm/clear decision
- Pre-set, certified operating points
- Limited flexibility for fusing with other systems or within risk-based screening
- "Analog outputs": something continuous…
- Challenges:
  - specifying requirements of systems that need to be fused,
  - testing, deployment, maintenance

SAFRAN Morpho 1

A MORE TRANSPARENT, EVIDENCE-BASED DETECTION SYSTEM

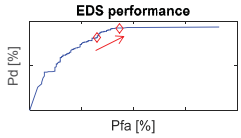


SAFRAN Morpho 2

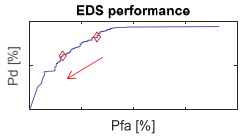
EXAMPLES / SCENARIOS

- **Depending on the prior beliefs (outside of ATR), one could effectively select different operating points on the ATR ROC**

Case 1): Passenger is selectee + threat alert level high
-> Move up on the ATR ROC curve



Case 2): Pre-check passenger, threat level moderate
-> Move down the ATR ROC curve



The analog output allows extracting higher performance from an ATR when the context is changing (from information sources outside of ATR)

SAFRAN Morpho 3

THE ROC CURVES…

- **Seems great.. How do we get our hands on these ROC curves?**
- **The EDS certification and procurement protocol does not require ROC**
  - EDS must issue alarm/clear decision on bags

- **So… there are no ROC established for legacy systems (at least not necessarily)**
- **Can we build these curves? Yes**
- **Is there more than one way to do so? Yes**
- **How do we test and verify these? Probably best to make it part of the TSL test process**

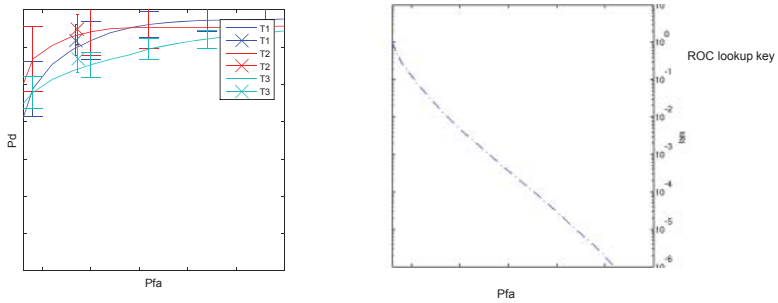
SAFRAN Morpho 4

MAKING AND TESTING ROC

- **ATR developer would have to:**
  - Provide a single parameter that links to a ROC provided
  - Can be done with various approaches, typically involving likelihood functions for each threat material
  - Would have to also spend more time optimizing performance in low Pfa or high Pd range (away from legacy operating point)
- **Regulator (TSL):**
  - During system testing, more emphasis would be placed on characterization
  - Scanning the normal threat and false alarm data sets, regulator would collect the “single parameter”, which is the key into the ROC curve
  - Regulator can thus:
    - Validate ROC provided by ATR developer
    - Revise this ROC based on gov’t data
  - “Certify” the ROC, including the key parameter

SAFRAN Morpho 5

EXAMPLE ROC



SAFRAN Morpho 6

16.17 Eran Gabbai: Novatrans and TeraSafe Intro

Novatrans *and* TeraSafe Intro

Eran Gabbai CTO

Tuesday, October 27, 2015

Israeli sister companies branched from Weismann Institute of sciences

More then 30 granted IP

75M$ investment

Partner with IBM for production next generation TeraChipe (THz source and sensor)

Looking for partners for commercialization in the Homeland market

1

PAGE 1

NOVATRANS™

TeraMetric overcoming *the* brickwalls

Lack of power resolution and water penetration limits' the use of THz in the market place

- **Terametric 100 +**
  - Full fledged TeraChip
    - Better resolution
      - Linewidth 30-50MHz
    - 3 orders of magnitudes power increase
      - 1mW @ 1THz
    - Better sensitivity
      - SNR: 90dB @1THz
      - No water sensitivity

PAGE 2

NOVATRANS™

Why TeraMetric

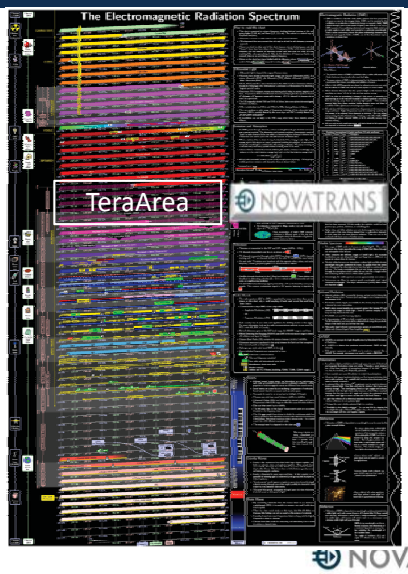
- **definition**
  - excellent spatial resolution
- **Insight**
  - Sensitive to Inter-molecular bonding (Vs IR)
    - Spectroscopy
- **Penetration**
  - Imaging
- **Human Safe**
- **No water sensitivity**

PAGE 3

NOVATRANS

What Is TeraHertz?

Gamma-Ray
X-Ray
UV
Visible Light
IR
Terahertz Gap
300-3,000GHz
Microwave Communication
Microwave
WiFi
Radio



4

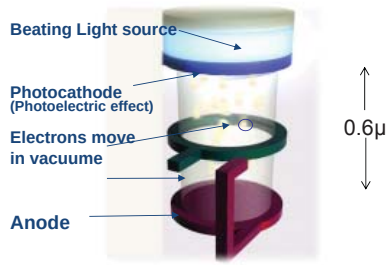
PAGE 4

NOVATRANS

The TeraChip: A New Breed Of THz Source

- Electrons move in *Nano vacuum tube*, not in silicon
- THz speeds are enabled
- No heat generated
- Human safe

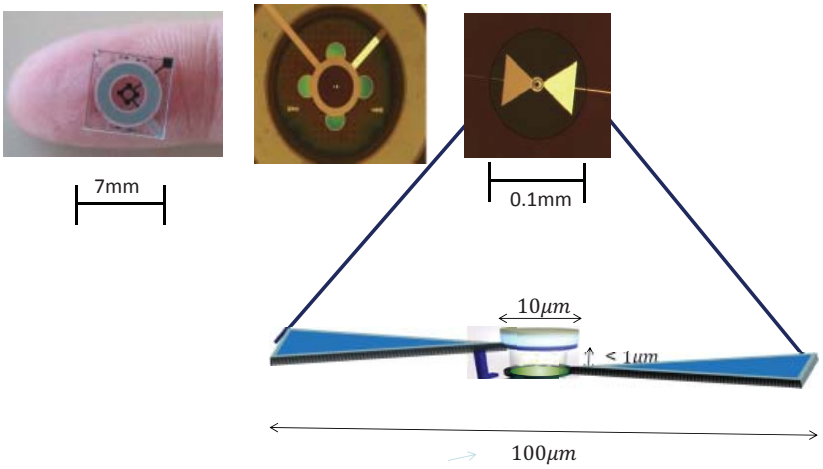
TeraChip – Key elements



PAGE 5

NOVATRANS

TeraChipe - THz Source

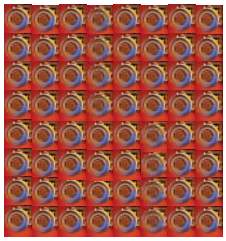


PAGE 6

NOVATRANS

THz Imaging Panel

- **TeraChip array**
  - Homeland Security
  - Industrial imaging applications



PAGE 7

NOVATRANS™

Phase - I Work with market leaders

- **Sell general purpose systems**
  - TeraChip
  - Programmable
- **Setup joint ventures with market leaders**
  - Homeland security detection spectrum of needs
  - Develop special purpose TeraChips, as required
    - Program generic system to an application-specific system

PAGE 8

NOVATRANS™

Phase I I – Mass Quantity Applications

- **Team up with System Integrators**
- **Define & develop THz modules for industrial & para-military processes**
  - Homeland Security
  - Communication
  - Medical
  - Online industrial process monitoring

PAGE 9

NOVATRANS™

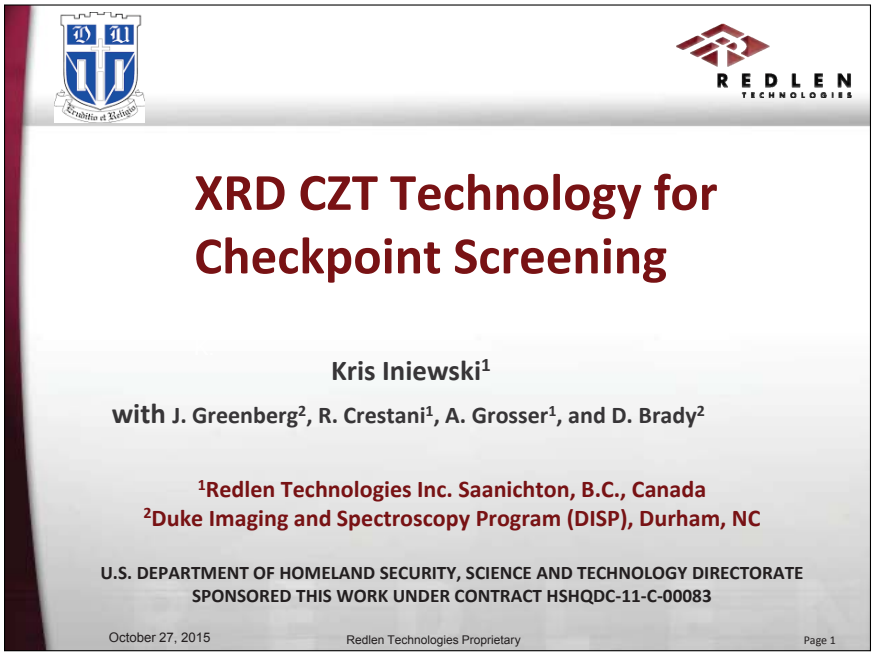
Questions?

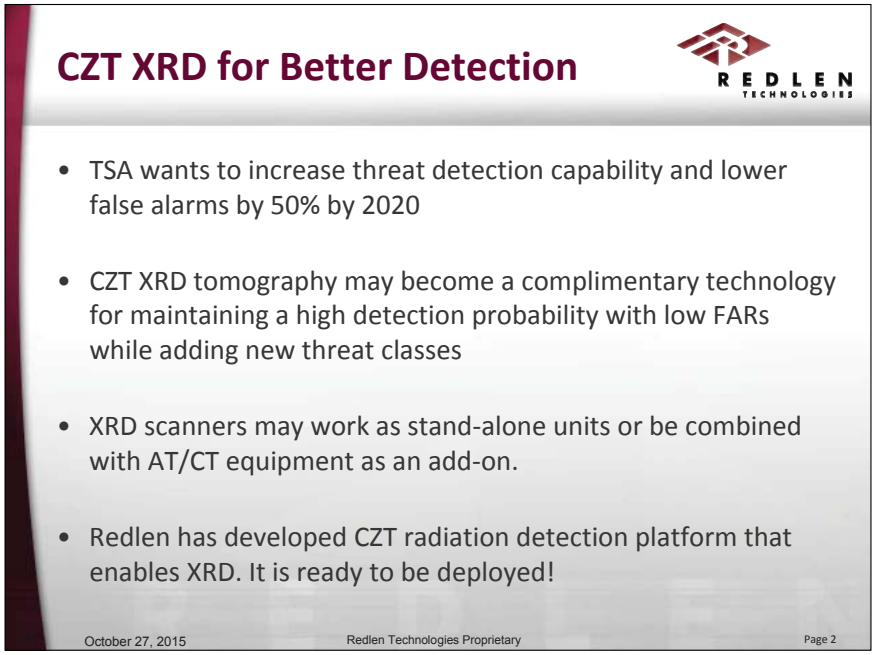
Thank You

PAGE 10

NOVATRANS™

16.18 Kris Iniewski: XRD CZT Technology for Checkpoint Screening





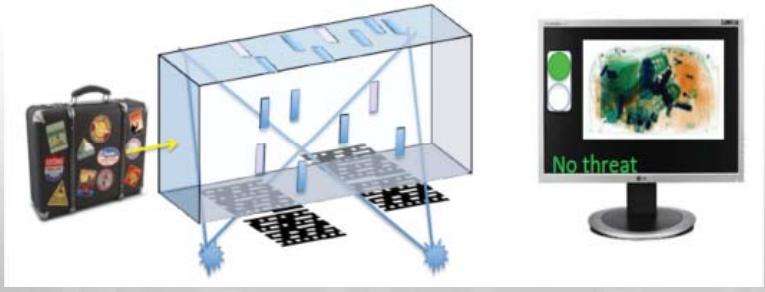
Motivation

- Transmission-based imaging systems (AT/CT) are the cornerstone of checkpoint screening.
  - high-resolution
  - multi-dimensional images
  - mass and density based threat detection
- Sufficient for detecting some classes of threat materials
- NOT sufficient to identify some types threats
  - home-made explosives (HMEs) and liquids and gels (LAGs) whose density/Zeff properties can't be differentiated from stream of commerce with sufficient accuracy to guarantee safety with an acceptably low false alarm rate (FAR)
  - This weakness in differentiation capability has very much slowed the addition of detectable new threat types

October 27, 2015 Redlen Technologies Proprietary Page 3

CZT XRD Technology

- Use coded aperture – 100x sensitivity gain
- Use state-of-the-art CZT detectors – material classification
- Use state-of-the-art software and algorithms – throughput

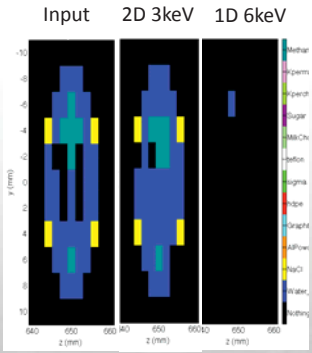


October 27, 2015 Redlen Technologies Proprietary Page 4

CZT Detectors for XRD

REDLEN TECHNOLOGIES

- A key prerequisite requirement for XRD tomography technology is excellent spectroscopic ER of the detectors used in the scanner:
  - CZT Detectors fulfil the requirements for next-generation systems at checkpoints due to their very good energy resolution (2-3keV) at RT
  - Some scanners were certified using HPGe detectors (which has superior energy resolution to that of CZT) but required liquid cooling resulting in much higher systems costs



October 27, 2015 Redlen Technologies Proprietary Page 5

XRD CZT Detector Module

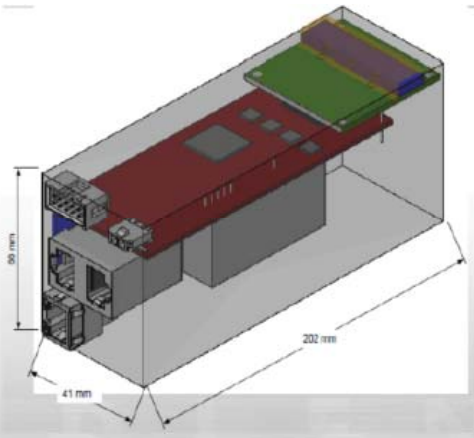
REDLEN TECHNOLOGIES

Main Characteristics:

- 10 kcps/mm2 count rate
- 2-3keV Energy Resolution
- Heat sink/shield

Interfaces:

- +12V/GND
- Built-in -600V HV supply
- JTAG (firmware, debug)
- 100Mb/s Ethernet
- Command/Event Port
- +5V EIA-485 Frame Clock Module Sync/daisy chain



October 27, 2015 Redlen Technologies Proprietary Page 6

Key Redlen Contributions

REDLEN TECHNOLOGIES

- Developed highly integrated detector technology platform (CZT + electronics)
- Applied the technology in XRD tomography to demonstrate scanner functionality
- Redlen aims to provide CZT technology platform as a building block for all OEMs that are interested in building XRD scanners
- Redlen is pursing application of CZT technology in medical imaging CT that can be leveraged in baggage scanning CT

October 27, 2015 Redlen Technologies Proprietary Page 7

16.19 Jun Zhang: Image Super Resolution

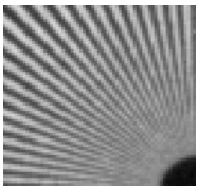
Image Super Resolution

Jun Zhang
Department of Electrical Engineering and Computer Science
University of Wisconsin-Milwaukee
junzhang@uwm.edu

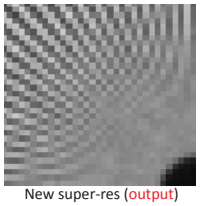
1

Super Resolution

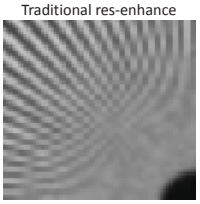
High-res (GT)



Low-res (input)



Traditional res-enhance



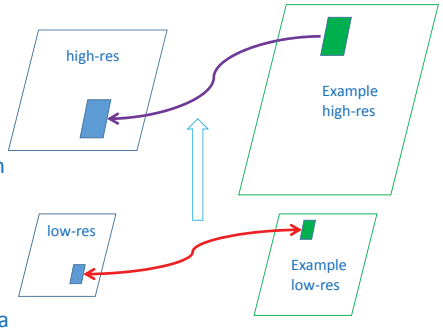
New super-res (output)

- Super-resolution:
  - Low-res image to high-res image
  - "Beats Nyquist limit" by using constraints and training data
  - The constraints: cross-res correlation
- Potential benefits to security:
  - Better quality images from less expensive scanners
  - Better image quality without hardware upgrades
  - Better ATR performance
- Conditions for super-res to work:
  - The constraints have to be valid and the high-res image to be recovered has to be similar to those in the training data

2

How super resolution work: basic idea

- Start with a low-res image
- Also a database of high-res example images (and their low-res versions)
- Apply this constraint/assumption: if a patch in the low-res image is similar to an example low-res patch, the corresponding high-res example patch can be used to recover a high-res patch
- In other words: low-res similarity implies high-res similarity
- "Beat Nyquist limit" by using extra information in training data
- Many ways to implement the basic idea



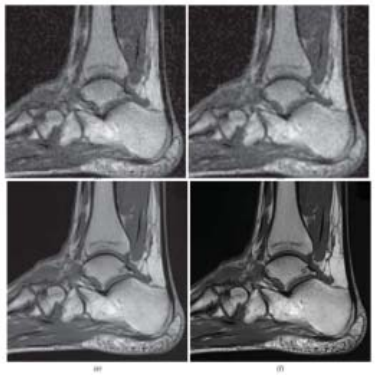
3

One implementation: using sparse representation

- Trinh et al (2014, IEEE Trans. IP) applied to MRI images
- Use example images to construct two dictionaries, D_l (low-res) and D_h (high-res)
- For each input low-res patch, p_l , find its representation under D_l, with $p_l = D_l a_l$, where a_l is coefficient vector
- Use a_l to reconstruct the high-res patch, with $p_h = D_h a_l$
- How was the constraint applied? a_l is used for high-res representation
- Sparse representation: a_l is found through l_1 minimization

4

Their results



- 1st row: low-res and interpolation result
- 2nd row: super-res and ground truth
- From Trinh 2014
- Images in example database are similar to the high-res ground truth

5

Another implementation

- Peleg and Elad (2014, IEEE Trans IP), applied to natural images
- Use example images to construct two dictionaries, D_l (low-res) and D_h (high-res)
- For each input low-res patch, p_l , find its representation under D_l, with $p_l = D_l a_l$, where a_l is coefficient vector
- Use a_l to predict high-res representation, with a_h=$F(a_l)$, where $F(\cdot)$ is a trained prediction function/network
- Reconstruct the high-res patch, with $p_h = D_h a_h$
- Other innovations: cluster-based predictions, multi-level reconstruction, and overlapping patches, etc.

6

Their Results

- From: Peleg and Elad (2014 IEEE Trans. IP)
- 1st row: interpolation of low-res and super resolution
- 2nd row: Peleg and Elad and ground truth

7

Advantages/Disadvantages of Using a Dictionary

- Advantages:
  - More adapted to the signals/images of interest
  - More sparse representations
- Disadvantage:
  - more computations need to obtain representation coefficients (compared with using an orthonormal basis)

8

Summary and Future Work

- Super resolution can "beat Nyquist limit" using training examples
- For this to work: the examples need to be similar to the images to be recovered/enhanced
- Future work
  - Apply to security images for ATR
    - Perform super resolution on images obtained with fewer views
    - See if this improves PD and PFA
  - A major problem for ATR: image artifacts; does super resolution help?
    - Test to see if super resolution help to reduce artifacts and improves PD and PFA

9

16.20 Charles A. Bouman & Sherman Jordan Kisner: High-Performance Iterative CT Reconstruction using Super-Voxel Technology

High-Performance Iterative CT Reconstruction using Super-Voxel Technology

High Performance Imaging (HPI)

Charles A. Bouman, HPI/Purdue University
Sherman Jordan Kisner, HPI
Sam Midkiff, HPI/Purdue University
Anand Raghunathan, HPI/Purdue University

Support by DHS SBIR (HSHQDC-14-C-00058)
and ALERT DHS Center

"This material is partially based upon work supported by the U.S. Department of Homeland Security, Science and Technology Directorate, Office of University Programs, under Grant Award 2013-ST-061-ED0001. The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S. Department of Homeland Security.

Overview

Opportunity

Model-based iterative reconstruction (MBIR) can improve detection probability (P_D) and reduce false alarms (P_{FA}) by reducing artifacts in X-ray CT reconstructions relative to FBP and direct Fourier methods. (ALERT TO3/TT)

Problem

MBIR is too computationally expensive to be practical for security CTX scanners (~1000x more computation than traditional methods)

Solution:

- PSV-ICD: Parallel super-voxel optimization for MBIR
- Unlocks hardware potential based on algorithmic/computer architecture co-design
- Increases processor efficiency by factor of ~20
- Allows for efficient parallelization on GPU and CPU architectures

Support

- ALERT
- DHS SBIR (HSHQDC-14-C-00058)

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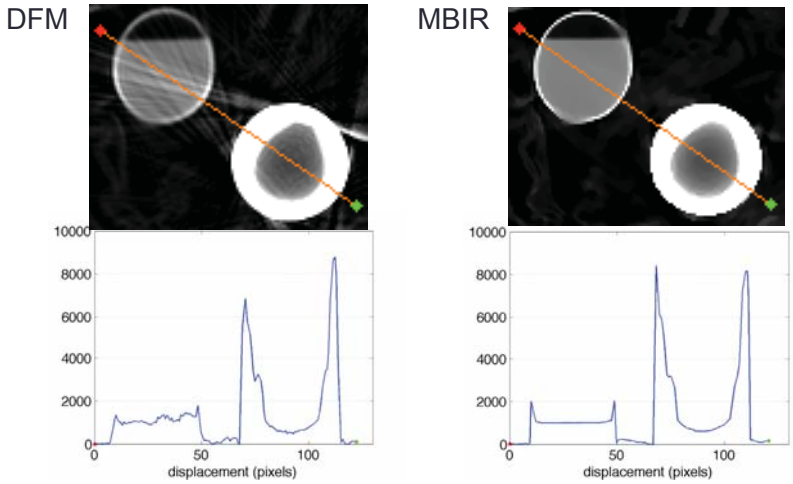
Results: artifact reduction



S.J. Kisner, C.A. Bouman, et al., "Innovative Data Weighting for Iterative Reconstruction in a Helical CT Security Baggage Scanner", *The 47th IEEE Int'l Carnahan Conf on Security Technology (ICCST)*, Medellin, Colombia, 2013.

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MBIR ALERT Transition Task

- In collaboration with Morpho Detection, we investigated the application of fully 3D MBIR in an EDS system for aviation security
- Demonstrated significant potential for,
  - Improved segmentation
  - Reduction of false alarms
  - Improved operator experience
  - Reduced cost of additional detection
- First study to evaluate IQ from iterative reconstruction in baggage screening

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What is limiting MBIR reconstruction time?

- Rough example
  - Benchmark: 512 channels; 512 views; 400 slices; 512x512 resolution.
  - Processor: 20 core, 2.6 GHz Intel Xeon-E5 => 1.64 TFLOPS
  - Baseline reconstruction time on single core: **9035 sec**
  - Theoretical 3D reconstruction time: **1.65 sec** ← **Wow!**
- Conclusion:
  - Hardware is fast enough, but we need to use it more efficiently
- What are the limits to hardware efficiency?
  - Operations per second => Not really the problem
  - Memory access speed => Yeah, that's a problem
  - Parallelization => Need to keep all those cores busy

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Efficient Computation of MBIR

- **Memory bandwidth**
  - (L1 cache speed)=10*(L2 cache speed)=100*(Main memory speed)
  - Reduce cache misses
  - Keep data local
  - Increase **data reuse** ← **Very important**
- **Parallelization**
  - 1,000 to 4000 cores on a modern processor (or vector units)
  - Must keep these busy
  - Increase **independent operations** ← **Very important**
- How do we increase **data reuse** and **independent operations**?

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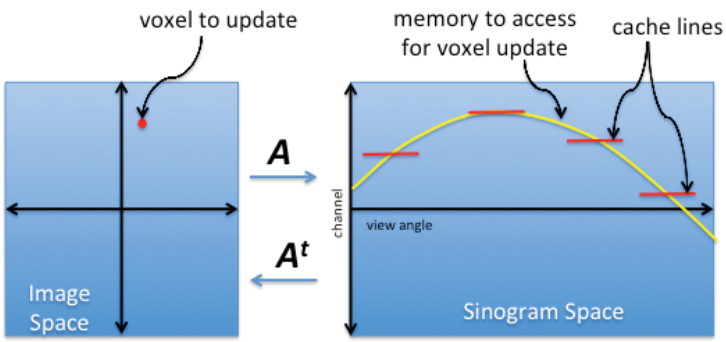
MBIR Cache Access Patterns

- Traditional ICD memory access patterns
  - Wasted cache
  - Little memory reuse



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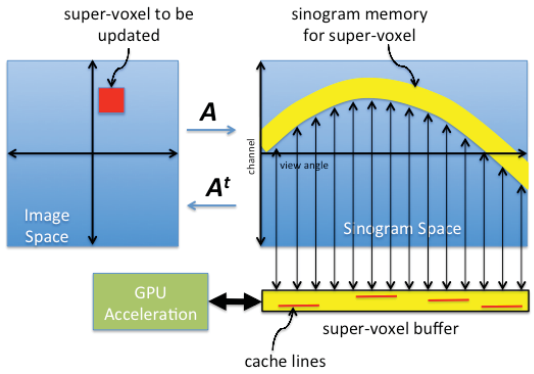
Super-Voxel-ICD Cache Access Patterns

- Super-voxel (SV): rectangular array of voxels to be updated
- Super-voxel buffer (SVB): cache buffer containing sinogram data
  - *No cache waste*
  - *Great deal of memory reuse*



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But what about parallelization?

Parallelization Hierarchy

- **Intra-voxel parallelism:**
  - Parallelism within update of single voxel
- **Intra-SV parallelism:****
  - Parallelism across multiple voxels in an SV
- **Inter-SV parallelism:****
  - Parallelism across different SVs
- **Inter-slice parallelism:**
  - Parallelism across different slices of the 3D volume

Comments:
- Parallelisms are orthogonal
- Listed in fine to cores grain order

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Reconstruction Performance Goals

- Benchmark 3D recon problem
  - 4 GPUs (<$10,000)
  - Number of channels = 512
  - Number of views = 512
  - Number of slices = 400
  - Spatial Resolution = 512x512
  - Reconstruction time < 15 sec
- Equivalent benchmark Single Slice TO3 recon problem
  - 1 GPU
  - Number of channels = 1024
  - Number of views = 720
  - Number of slices = 1
  - Spatial Resolution = 512x512
  - Reconstruction time < 420 msec

$$\text{TO3 Recon time} < 15\text{ sec} * \frac{1\text{ slice}}{400\text{ slices}} * \frac{720\text{ views}}{512\text{ views}} * \frac{1024\text{ channels}}{512\text{ channels}} * \frac{4\text{ GPUs}}{1\text{ GPU}} = 420\text{ msec}$$

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Multicore performance evaluation

Data

- Imatron-300 (ALERT TO3)
- 720 views, 1024 channels
- single slice recon, 512x512 image size
- ~3200 test slices

Multicore CPU Hardware

- two Intel Xeon-E5 2660 (2.6 GHz), each with 10 cores
- cache size per core: L1 32KB, L2 256 KB, L3 25 MB shared

GPU benchmark hardware

- Nvidia Tesla K40
- 15 streaming multiprocessors (SMs)
- For each SM, private L1 cache 64KB
- L2 cache 1.5MB shared across all SMs

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Preliminary speed-up for multicore

ALERT Task Order #3 test data set

- 512x512 image size; 720 views; 1024 channels; 1 slice

- T_r = total reconstruction time
- N_F = no. of floating points operations (FLOP) per equit
- N_e = number of equivalent iterations
- O_F = Theoretical FLOPS of CPU/GPU
- E_F = Processing efficiency

Factor	Baseline ICD	SV-ICD(1)	PSV-ICD(4)	PSV-ICD(16)	PSV-ICD(20)
O_F (GFLOP)	83	83	332	1331	1664
N_F (GFLOP)	18.52	18.38	18.38	18.38	18.38
N_e (equits)	4.6	4.0	4.1	4.1	4.2
E_F (efficiency)	**0.41%**	**5.95%**	**4.24%**	**3.54%**	**3.92%**
T_r (sec)	**253**	**15.0**	**5.28**	**1.69**	**1.27**
T_{opt} (sec)	1.03	0.89	0.22	0.06	0.05
Speedup		16.9x	45.2x	150x	199x

*Intel Xeon-E5 2660 (2.6 GHz), 1-20 cores

Summary

- MBIR offers great potential in baggage screening applications and improvement in EDS performance
  - Improved image quality and resolution
  - Reduced artifacts
  - Increased design flexibility
- PSV-ICD provides a cost-effective solution for MBIR implementation
  - ~20x efficiency increase (memory reuse)
  - Linear parallelization (parallelization)
  - *More to come …*

16.21 Carl Crawford: Setting the Stage

Thirteenth Advanced Development for Security Applications Workshop (ADSA13):

Screening of Personnel and Divested Items at The Checkpoint – Part 2

Setting the Stage

Carl R. Crawford
Csuptwo, LLC

1

Point of This Session

- Terrorists are evolving quickly
- May take too long to respond to intelligence information about emerging threats
  - Many new threats are detected because they fall into extant detection windows
- ATR deployment lengthy because of may reasons including:
  - Understanding new threat
  - Creating samples and studying safety
  - Writing detection specs
  - Funding vendors
  - Testing
  - Deployment
- Today's purpose is discus how to deploy new ATRs more quickly

2

16.22 Matthew Merzbacher: Reducing the Time for Deploying New ATRs

Reducing the Time for Deploying new ATRs

Matthew Merzbacher

/ October 29, 2015 /

SAFRAN Morpho

GOAL

- **Benefit to TSA: Faster deployment of advances in detection**
  - Respond quickly to evolving threats
  - Improve P_D/P_{FA}
  - Improve on-screen resolution
  - Provide better downstream data for alarm resolution
- **What are the barriers and what can be done?**
- **Problem: Current Fielding of ATR is extremely slow**
  - Performance validation is not the big problem!

SAFRAN Morpho 1

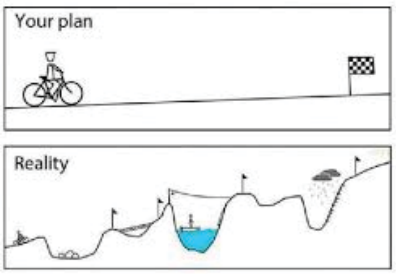
EDS CASE STUDY

- **RAD / UltraFAR**
  - Reduce FAR by half while keeping as much detection as possible… Quickly!
- **Approach: Tuning Iterations and feedback using Emulators [Agilish]**
- **What worked**
  - Five iterations in 3 months (three iterations assessed at TSL)
- **What didn't work**
  - Moving target (first iteration lost "too much")
  - Deeper changes left off table in rush to iterate
- **What maybe worked**
  - No final requirement meant…
    - Capability determines requirement
    - Easier to declare victory
  - Policy changes stalled field test

SAFRAN Morpho 2

WHY IS IT SO SLOW?

- **Long delays from Problem ID to Go**
- **ATR Development is not slow**
  - Varies depending on task
- **Internal testing / integration takes a little longer**
  - Statistical Validation
  - Putting the algorithm on the scanner (architectural challenge)
- **Testing Time takes still longer**
  - Performance Testing (emulators!)
  - **Impact Testing is hard/slow**
- **Fielding takes <u>much</u> longer**
  - No "Big Switch" (a good thing)
  - Policy involved



- **Another Example: RTM**
  - Specification: <long>
  - Internal Development: < 1 year
  - Regulatory Testing (multiple regulators): 6 months
  - Field: 7-12 years (and counting)

SAFRAN Morpho 3

PROPOSAL: PUT THE CART BEFORE THE HORSE

- **Instead of developing algorithms and then fielding them, let's…**

  Field algorithms and then develop them!

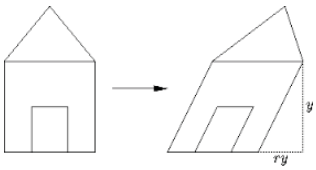
- **Allows us to start working on the policy and architecture issues now!**

- **Can we adapt algorithms in the field when necessary?**
  - How would this work?

SAFRAN Morpho 4

BULK DETECTION APPROACH

- **Target Definition:**
  - Density Range ($\rho_1 - \rho_2$) and Atomic Number Range ($Z_1 - Z_2$)
  - Minimum Mass (m)
  - Configurations & Concealments
  - Desired Detection (P_D, P_{FA})



- **Quickly Achievable**
  - Open a window in CT value and Z_{eff}
  - Requires straightforward transfer function from target definition to window
    - CT is probably *close to* density
    - Z_{eff} is probably *close to* Atomic Number
    - Estimated Mass is probably *close to* Mass
  - FA estimates against internal databases provide a good estimate of impact

SAFRAN Morpho 5

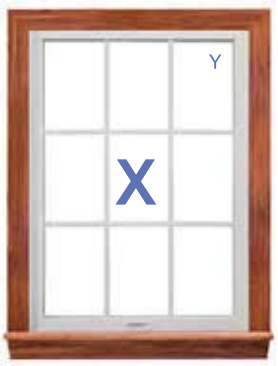
TECHNICAL CONCERNS

- **Presumes transfer function works across entire domain**
  - Can be pre-validated for areas of potential interest
- **Transfer function is not "affine" beyond CT , Z, and estimated mass**
  - Special cases will break for configurations and concealments
  - Sheets (and some bulks) are hard
    - Thinness and bendiness adds complexity
  - ATR may use additional features / morphology: more features mean more trouble
  - Even for those CT/Z/m, the transfer function is not perfectly "affine"
- **How can we know quickly when detection doesn't track well? And what's "good enough"?**

SAFRAN Morpho 6

OTHER CHALLENGES

- **Requirements: Defining / Controlling the windows is critical**
  - Is everything equal inside the window?
  - How does that affect transfer?
- **Operational impact hard to assess in advance**
  - OSR and other downstream resolution
- **ATR development issues are easier to solve than:**
  - Update strategy (Networking)
  - Control & Command – avoiding exuberant local personnel?
  - Policy concerns



SAFRAN Morpho 7

FINAL IDEA [IF TIME PERMITS]

- **Windows are not currently associated with specific materials**
- **Could identify one (or more) windows for each material**
  - Windows overlap
  - Detection becomes a logical "or"
  - Allows independent development on a material-by-material basis
  - Challenges in presentation of results
- **Allow material-level fusion with other technologies**
  - If they grok the same materials
- **Maybe DICOS can help!**

SAFRAN Morpho 8

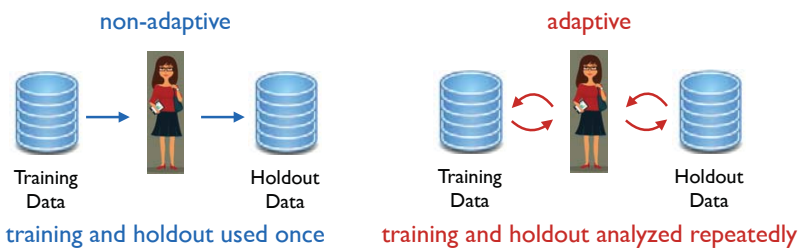
SUMMARY

- **Need faster deployment of advances in detection**
  - Respond quickly to evolving threats
  - Improve P_D/P_{FA}
  - Provide better downstream data for alarm resolution (human & non-human)
- **Testing/Validation is not the time-consuming part!**
- **Technical issues are easier than requirements, control & policy issues**

SAFRAN Morpho 9

16.23 Jonathan Ullman: Preventing Overfitting in Adaptive Data Analysis

Preventing Overfitting in Adaptive Data Analysis

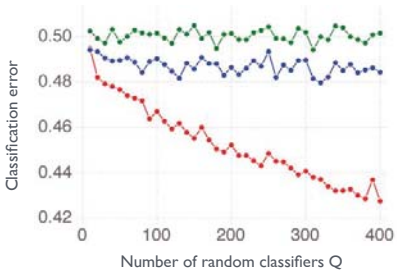


Jonathan Ullman
Northeastern University
College of Computer and Information Science

Based on a body of work by Raef Bassily, Avrim Blum, Cynthia Dwork, Vitaly Feldman, Moritz Hardt, Kobbi Nissim, Toniann Pitassi, Omer Reingold, Aaron Roth, Adam Smith, Thomas Steinke, Uri Stemmer, and myself.

(Not) Overfitting in Adaptive Data Analysis

- Classical techniques for preventing overfitting do not work when the same training data is analyzed adaptively.
- This problem is pervasive, robust, and hard to solve.
- Perturbing the results of the analysis can help.
- Work may be adaptable to preventing over-training when testing automatic threat recognition (ATR) algorithms



Suppose you try to classify purely random data…

1. Submit Q completely random classifiers
2. Receive training error for each one
3. New classifier is the majority of the random classifiers that did "well"

How well will you classify…

…the training data? …fresh data?

Graph reproduced from
Moritz Hardt, "Competing in a data science contest without reading the data."

(Not) Overfitting in Adaptive Data Analysis

- Classical techniques for preventing overfitting do not work when the same training data is analyzed adaptively.
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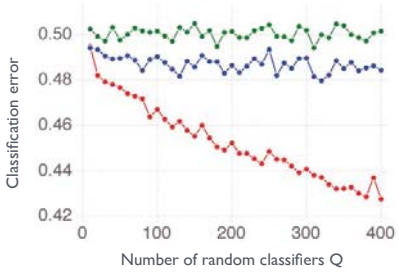


Suppose you try to classify purely random data…

1. Submit Q completely random classifiers
2. Receive noisy training error for each one
3. New classifier is the majority of the random classifiers that did "well"

How well will you classify…

…the training data? …fresh data?

Graph reproduced from
Moritz Hardt, "Competing in a data science contest without reading the data."

Problem is pervasive, hard to solve

- Not the result of malice, error, or p-hacking
  - Overfitting occurs even if you faithfully, correctly apply classical statistical significance testing and control for multiple comparisons.
- "Garden of Forking Paths" (Gelman, Lokem)
  - Identifies numerous examples of unreproducible studies where data was analyzed in an adaptive fashion
- Competitors in Kaggle competitions (classification contests) frequently report that the "leaders" of the competition perform substantially in final test
  - Leaders are based on a single holdout set used for all submissions
  - Final scores are based on a new holdout set

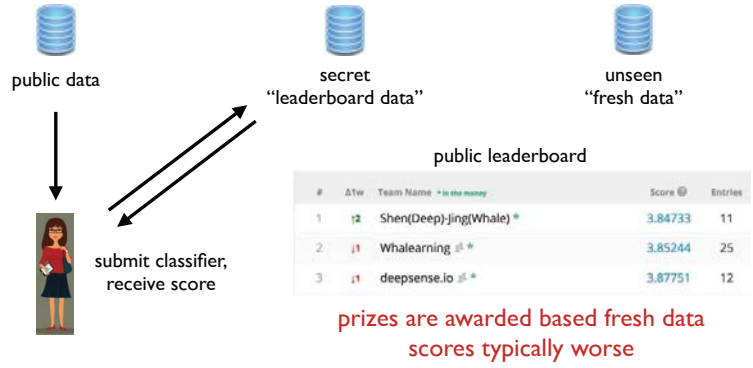
Problem is pervasive, hard to solve

- Injecting noise into what you reveal about the dataset can help prevent overfitting
  - For example, don't report exact performance on the training data
- But, there won't be a one size fits all solution
  - In many scenarios, can overfit even with very noisy responses*
- Rest of the talk: combatting overfitting in "classification competitions"
  - We have found many more scenarios where we can (or can hope to) prevent overfitting

*Moritz Hardt and U, "Preventing false discovery in interactive data analysis is hard."
*Thomas Steinke and U, "Interactive fingerprinting codes and the hardness of preventing false discovery."

Classification Competitions and the Ladder

- How does kaggle run machine learning competitions?



prizes are awarded based fresh data
scores typically worse

*Avrim Blum, Moritz Hardt, "The Ladder: A Reliable Leaderboard for Machine Learning Competitions"
*Bassily, Nissim, Smith, Stemmer, Steinke, U, "Algorithmic Stability for Adaptive Data Analysis"
*Dwork, Feldman, Hardt, Pitassi, Reingold, Roth, "Preserving Statistical Validity in Adaptive Data Analysis"

Classification Competitions and the Ladder

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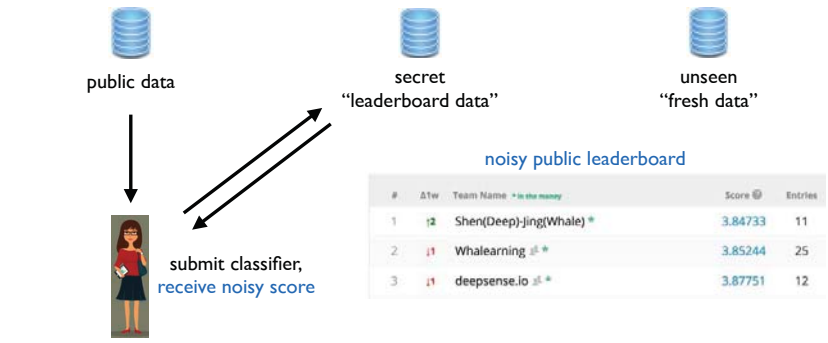

#	Δ1w	Team Name	Score	Entries
1	↑2	Shen(Deep)-Jing(Whale)	3.84733	11
2	↓1	Whalearning	3.85244	25
3	↓1	deepsense.io	3.87751	12

only report if classifier is better than all previous classifiers

scores on fresh data guaranteed to be similar ($\pm \log(k)/n^{1/3}$) to leaderboard scores

*Avrim Blum, Moritz Hardt, "The Ladder: A Reliable Leaderboard for Machine Learning Competitions"
*Bassily, Nissim, Smith, Stemmer, Steinke, U, "Algorithmic Stability for Adaptive Data Analysis"
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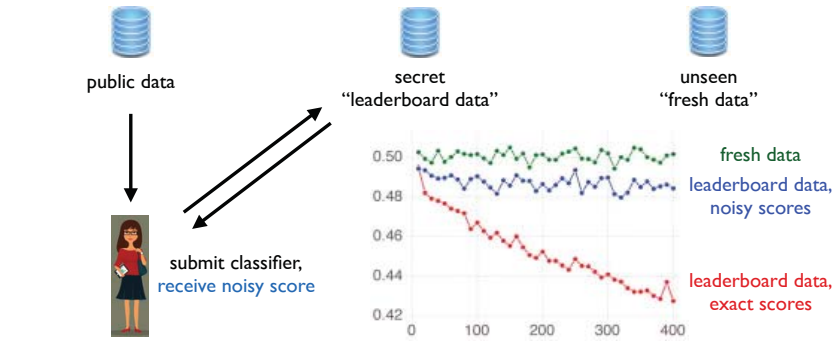
Classification Competitions and the Ladder

- How does kaggle run machine learning competitions?



only report if classifier is better than all previous classifiers

Scores on fresh data guaranteed to be similar to leaderboard scores

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*Dwork, Feldman, Hardt, Pitassi, Reingold, Roth, "Preserving Statistical Validity in Adaptive Data Analysis"

Conclusion: fixing adaptive analysis

- Classical techniques for preventing overfitting do not work when the same training data is analyzed adaptively.
- This problem is pervasive, robust, and hard to solve.
- Perturbing the results of the analysis can help.
- Work may be adaptable to preventing over-training when testing automatic threat recognition (ATR) algorithms

Thank you.

16.24 Carl Crawford: Working with Third Parties

Thirteenth Advanced Development for Security Applications Workshop (ADSA13):

Screening of Personnel and Divested Items at The Checkpoint – Part 2

Working With Third Parties

Carl R. Crawford
Csuptwo, LLC

1

Point of this Session

- Discuss the status of DHS's objective to increase involvement of third parties in the development of advanced explosive detection equipment
- This was directive given to ALERT along with the creation of the ADSA workshops
- Let's go back to ADSA01 …

2

High-Level Summary

- Terrorists are still lurking
- Vendors of security equipment doing good job
- Need to involve more smart people
- Workshop's goal is to fund smart people in this room to develop algorithms for eventual deployment by vendors

3

Am I a Terrorist?

4

Goals

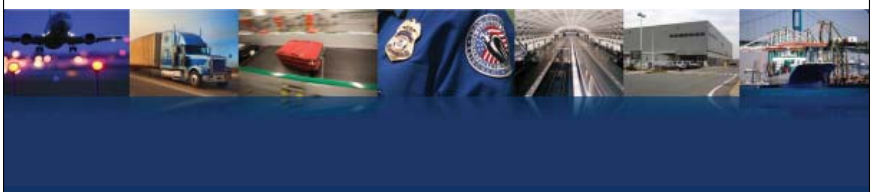
- Provide an analysis of the opportunities and research barriers associated with next-generation algorithms for Homeland Security applications, using the integrated checkpoint as a basis of discussion.
- Consider the following questions:
  - What will be the consequences of maintaining the current trajectory using existing technologies and strategy?
  - How can we foster out of the box solutions using new technologies and strategy?
- Facilitate academia's involvement, especially the medical imaging community, in DHS's new algorithm development strategy.
- Address specific questions posed by DHS.
- Identify 3rd parties who can submit to the RFI and BAA.

5

16.25 Frank Cartwright: System Architecture

System Architecture

Office of Security Capabilities



Transportation
Security
Administration

OSC

OSC Requires a Forward-Looking Architecture

To further advance RBS, OSC requires a screening system architecture to outline their current and future business and equipment needs to minimize acquisition risk when developing new capabilities.

Why architecture?

Architecture provides a conceptual model of the current and future system structure, its components, and the relationships between them. Specifically, TSE System Architecture will outline the future security screening system.

A Screening System Architecture will help OSC achieve:

Standardization

- Enable interoperability and modularity of transportation security equipment (TSE)
- Reduce the cognitive burden on TSOs, increasing their effectiveness
- Facilitate the acquisition of components instead of system suite, allowing for modular repairs and upgrades

Acquisition Planning

- Assist programs in developing integrated technology roadmaps for future acquisitions
- Provide analysis to define technological requirements for future screening system
- Enable a platform shift in screening capabilities; specify needs to vendors

RBS Implementation

- Identify technological standards and equipment necessary to further define and implement RBS
- Develop and define risk-based functionality and automation in the screening system
- Provide common system understanding of how TSE will perform during screening and what data will be employed to make RBS decisions

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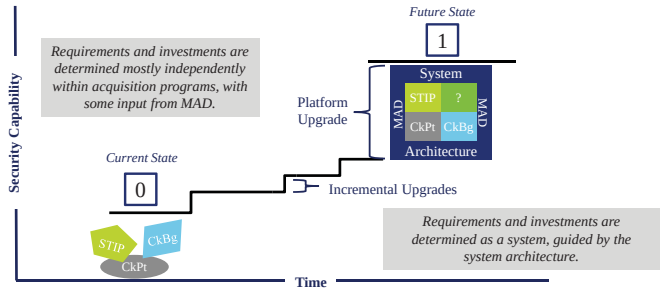
2

OSC

System Architecture Objectives

"Over the next few years, TSA will focus on developing a comprehensive system architecture that will allow TSA to proactively identify gaps and define capabilities at a system level. TSA will collaborate with industry to develop this shared vision for the future state of aviation security where business, data, and next-generation platforms combine to enable near real-time decision-making and response capabilities to combat emerging and evolving threats."

- TSA's *Strategic Five-Year Technology Investment Plan for Aviation Security*



A comprehensive system architecture program will allow OSC and TSA to proactively identify capability gaps and define targeted screening capabilities to address those gaps by enabling an integrated and modularized security screening system.

Transportation Security Administration

3

OSC

Enterprise Architecture Approach

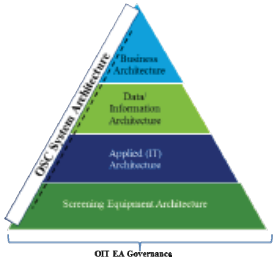
TSA utilizes an Enterprise Architecture (EA) approach to align *people, processes, information and technology* and become a high performing organization.

Enterprise Architecture Benefits:

- Increasing effectiveness and efficiency of business through use of information and technology.
- Developing a flexible and scalable business model and secure architecture that allows for easy integration of new mission requirements and technology.
- Maximizing use of technology and resources to minimize redundant and/or manual business processes.

OSC System Architecture Approach:

- OSC's System Architecture will be comprised of multiple architecture levels and will define current and future screening capabilities needs while pulling on relevant EA domains to apply them to the screening system.



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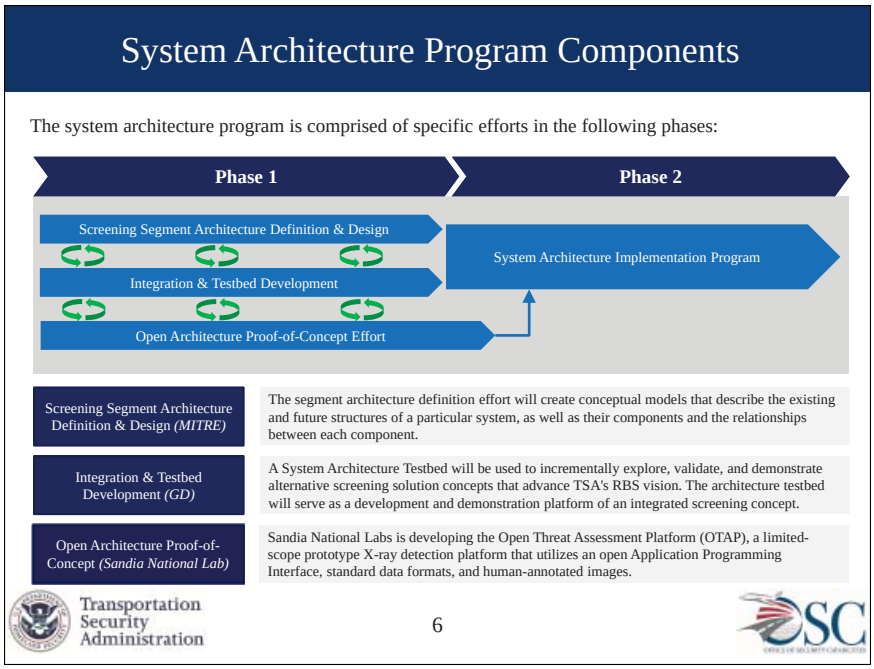
OSC


System Architecture Program Components
The system architecture program is comprised of specific efforts in the following phases:
Phase 1
Phase 2
Screening Segment Architecture Definition & Design
Integration & Testbed Development
Open Architecture Proof-of-Concept Effort
System Architecture Implementation Program
Screening Segment Architecture Definition & Design (MITRE)
The segment architecture definition effort will create conceptual models that describe the existing and future structures of a particular system, as well as their components and the relationships between each component.
Integration & Testbed Development (GD)
A System Architecture Testbed will be used to incrementally explore, validate, and demonstrate alternative screening solution concepts that advance TSA's RBS vision. The architecture testbed will serve as a development and demonstration platform of an integrated screening concept.
Open Architecture Proof-of-Concept (Sandia National Lab)
Sandia National Labs is developing the Open Threat Assessment Platform (OTAP), a limited-scope prototype X-ray detection platform that utilizes an open Application Programming Interface, standard data formats, and human-annotated images.
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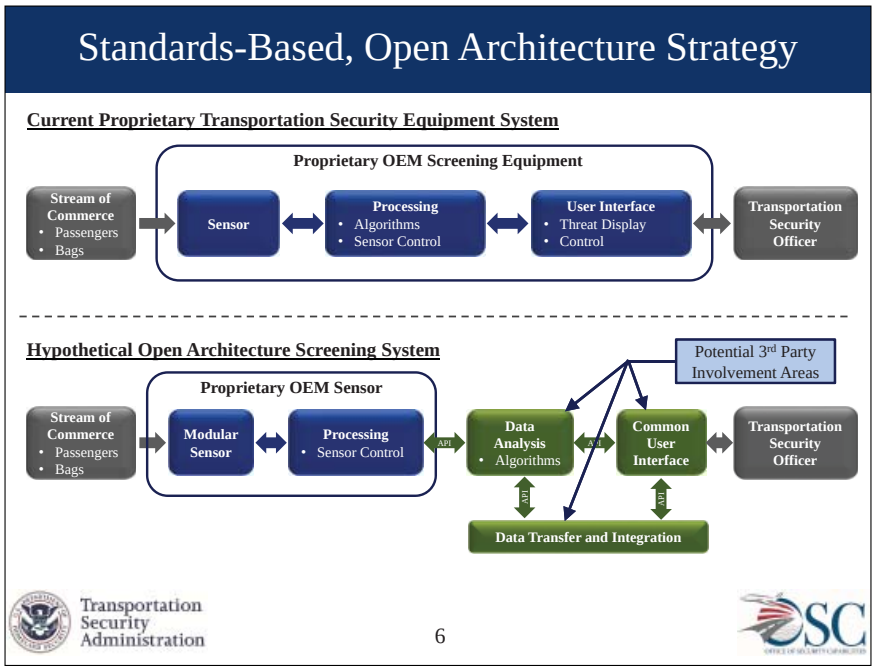
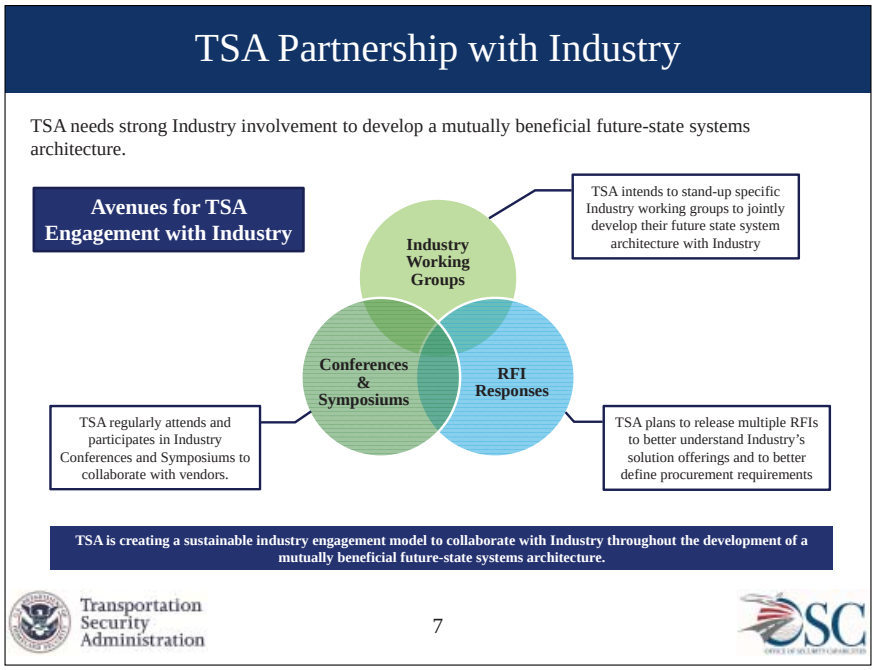

Standards-Based, Open Architecture Strategy
Current Proprietary Transportation Security Equipment System
Proprietary OEM Screening Equipment
Stream of Commerce
Passengers
Bags
Sensor
Processing
Algorithms
Sensor Control
User Interface
Threat Display
Control
Transportation Security Officer
Hypothetical Open Architecture Screening System
Potential 3rd Party Involvement Areas
Proprietary OEM Sensor
Stream of Commerce
Passengers
Bags
Modular Sensor
Processing
Sensor Control
API
Data Analysis
Algorithms
API
Common User Interface
Transportation Security Officer
API
API
Data Transfer and Integration
Transportation Security Administration
6


TSA Partnership with Industry
TSA needs strong Industry involvement to develop a mutually beneficial future-state systems architecture.
Avenues for TSA Engagement with Industry
Industry Working Groups
TSA intends to stand-up specific Industry working groups to jointly develop their future state system architecture with Industry
Conferences & Symposiums
RFI Responses
TSA regularly attends and participates in Industry Conferences and Symposiums to collaborate with vendors.
TSA plans to release multiple RFIs to better understand Industry's solution offerings and to better define procurement requirements
TSA is creating a sustainable industry engagement model to collaborate with Industry throughout the development of a mutually beneficial future-state systems architecture.
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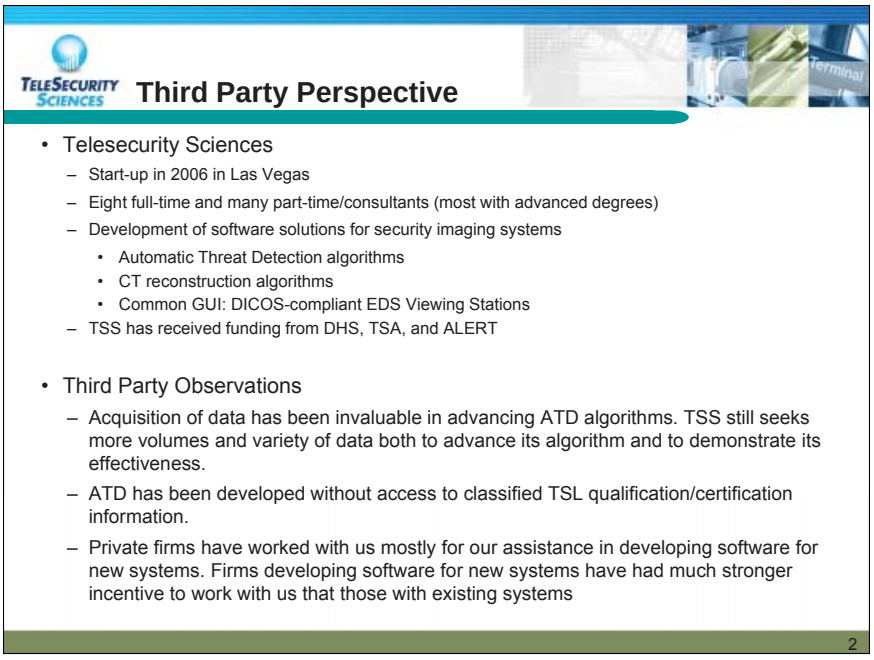
16.26 Chad Johnson: Third Party Perspective on Third Party Involvement



16.27 Pierfrancesco Landolfi: Vendor Perspective on Third Party Involvement

VENDOR PERSPECTIVE ON THIRD PARTY INVOLVEMENT

Pierfrancesco Landolfi
ADSA13 Workshop
October 29th, 2015

SAFRAN Morpho

WHY DO I CARE (NOT SURE ABOUT YOU)

- **Third party involvement is generally positive**
  - Opportunity to explore low TRLs technologies
  - Great recruiting opportunity!
- **Only works if there is an incentive**
  - Easier with academia/national labs than companies
  - Needs to follow standard market rules
  - Needs funding and/or provide competitive advantage
- **Role of the government should be**
  - Set goals/Define mission
  - Provide incentives (funding for low TRL and procurement incentives for higher TRLs). Funding to third party directly is ok.
  - Help making connections (ALERT workshops are a good example)

SAFRAN Morpho 1

SOME SUCCESSFUL EXAMPLES

NORTHEASTERN UNIVERSITY
BOSTON, MASSACHUSETTS
LVX VERITAS VIRTVS
FOUNDED A.D. 1898

Eruditio et Religio

PURDUE
UNIVERSITY

SAFRAN Morpho 2

LESSONS LEARNED AND PITFALLS

➔ **Things to repeat**

- Be ready to re-define success ("Bouman, ADSA 11")
- Need a champion at the vendor
- Identify early scope of the program and keep the pulse on
- Work out IP details early and set expectations for future roles
  - Be prepared to pay more for exclusivity

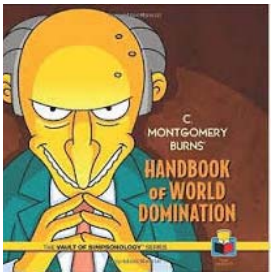
➔ **Things to avoid**

- Not invented here mentality – parties need to acknowledge each other expertise
- Government forces solution/third party to vendor - it should create opportunities and the partnerships & solutions will come forth

SAFRAN Morpho 3

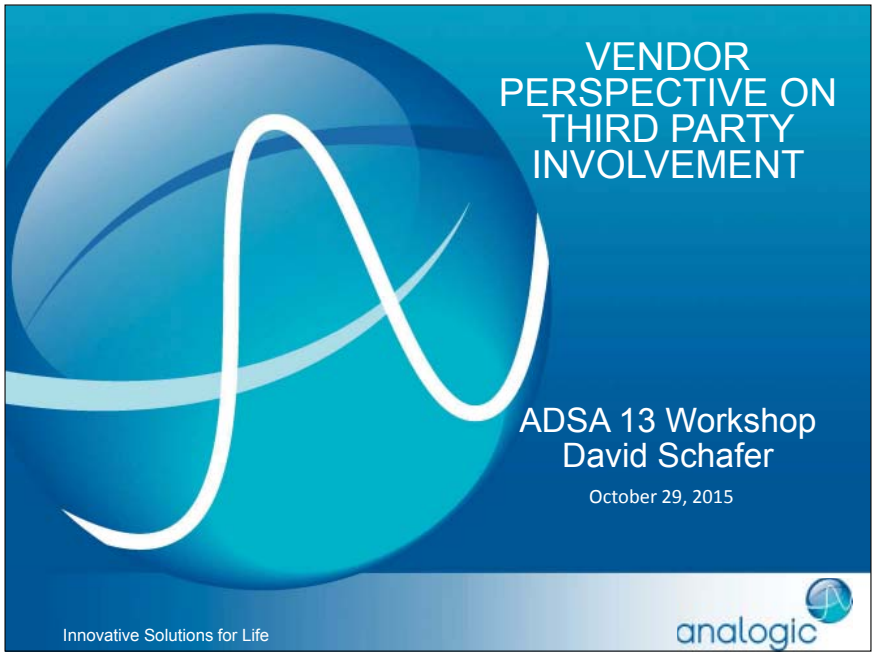
CONCLUSION

- **Third party involvement is generally positive, but …**
- **Only works if there is an incentive**
  - Needs to follow standard market rules
  - Funding or competitive advantage
  - Great recruiting opportunity!



SAFRAN Morpho 4

16.28 David Schafer: Vendor Perspective on Third Party Involvement



Third Party – how did I miss the first two parties?

- Third Party Definition : Other than TSA and direct equipment vendor
  - Academia, National Labs, Companies, Consultants
- Technology opportunities – positives
  - Something vendor can't or won't do?
    - High Technical risk , Early development (feasibility stage)
    - Resource limitations, Technical capability
    - Do something a new, different, unique way
  - Add value to product - better, faster, cheaper
- Issues / Roadblocks - negatives
  - Who controls the program?
  - Is it a directed effort between third party and equipment vendor?
  - Is the goal set too high?
  - Finger pointing?

Innovative Solutions for Life

analogic

Example Project - Reconstruction

- Scanner geometries and content of raw data varies substantially from system to system
  - Source specifics (spectrum, power, number of sources, etc)
  - Detectors (geometry, efficiency, energy detection)
  - System speed, tunnel size, etc

  3rd Party working directly with vendor has best chance for success

- General techniques (eg. Iterative reconstruction) research
  - Adapted by individual vendors for specific systems

Example Project - Detection Algorithms (ATR)

- Scanner data varies from system to system (even within vendor)
  - General algorithms are at minimum tuned to a system
- Successful projects
  - Direct, Subcontract type programs (ALOG has been "3rd party"

Innovative Solutions for Life

analogic

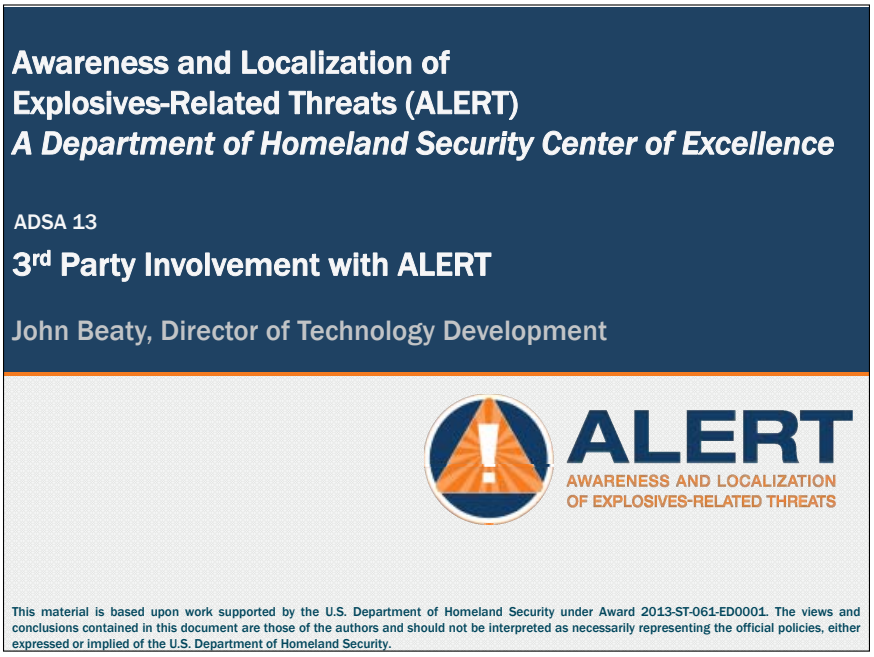
Example Project – Operator Interface

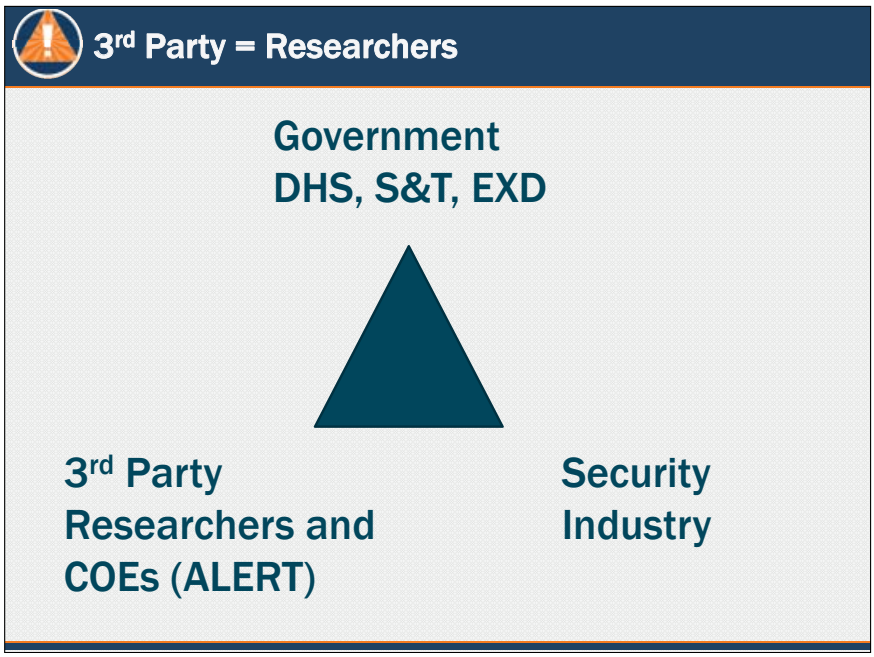
- Positives:
  - Use image data from scanner
    - Open formats?
    - Work with human factors experts
    - Provides common interface for screeners
    - Not limited to a single image source
- Negative
  - Performance may vary by machine
    - Needs tailoring for each system
- Somewhat analogous to medical imaging
  - Third party tools exist
  - Separate viewing stations to review standard format images

Innovative Solutions for Life

analogic

16.29 John Beaty: Third Party Involvement with ALERT





So-What-Who-Cares about ALERT 3rd Party Involvement?

- So What?
  - ALERT is a Major Source of 3rd Party Involvement for EXD.
  - ALERT Works in the Public Domain (non-SSI, non-Secure). All Program Results are Presented to the Public/Security Enterprise (presentation, publication, posters, , ,).
  - ALERT Provides Research Data Sets (CT image, projection, instrument, and Real World Video) to 3rd Party Researchers.
  - ALERT Has Learned How to Work with the Government, Security Industry and Users.
- Who Cares?
  - Everyone in the Explosives Detection Security Enterprise Cares

ALERT Has Learned to Work with Industry

- We Live in an SSI, Security, ITAR, Proprietary, Secret Sauce World. Can You Navigate It?
- Every Company Is Jealous of Its Competitors
- Can You Work with One Company and Not Be/Look Preferential to Other Companies or to DHS, S&T, EXD, OUP?
  - No, But You Can Be as Fair as Possible, Listen and Adjust
- Data is King

ALERT 3rd Party Involvement, 30 + Programs

- ALERT is the Major Source of 3rd Party Involvement for S&T, EXD:
- Thrust R1 – Characterization & Elimination of Illicit Explosives
  - 7 Projects involving 9 PIs and 6 Other Faculty
- Thrust R2 – Trace & Vapor Sensors
  - 10 Projects Involving 10 PIs and 8 Other Faculty
- Thrust R3 – Bulk Sensors & Sensor Systems
  - 6 Projects Involving 3 PIs and 12 Other Faculty
- Thrust R4 – Video Analytics & Signature Analysis
  - 10 Projects Involving 11 PIs and 6 Other Faculty

ALERT Other 3rd Party Involvement, 20 + Research Groups

- ALERT has Captured and Managed 6 Programs Involving More Thank 20 non-ALERT 3rd Party Laboratories
- Segmentation of Objects from Volumetric CT Data (2011-2012)
  - Funded 5 University and Industry Collaborators
- Reconstruction Advances in CT-Based Object Detection Systems (2012-2013)
  - Funded 10 University and Industry Collaborators
- Advances in Automatic Threat Recognition CT-Based Object Detection Systems (2013-2014)
  - Funded 8 University and Industry Collaborators.

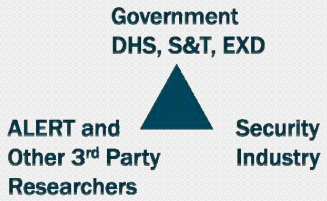
ALERT Task Order 3rd Party Involvement

- In-the-exit and tag-and-track a Video Analytics System providing Value to Large Airports (2013-2015)
  - Funded 4 University and Industry Collaborators
- Improved Millimeter Wave Radar AIT Characterization of Concealed Low-Contrast Body-Bourne Threats (2015-2017)
  - Funding TBD University and Industry Collaborators
- Standardization of Procedures and Methodology to Measure Trace Explosives Sampling Efficiency and Baseline Performance
  - Funding TBD University and Industry Collaborators

ALERT Works in the Public Domain

- ALERT's Research is Conducted in the Non-SSI, and Non-Secret Domain
  - Potential Sensitive or Secure Problems are/were address in the data sets and research, using simulants (rubber sheets), analogous situations and non- Security Tools (medical CT instrument).
  - ALERT Established Systems and Procedures to Protect 3rd Party Researchers from Presenting or Publishing SSI or Secret Data, or Research.
- All 3rd Party Research under ALERT's Control is Published or Presented in the Public Domain.

ALERT Works all Three Parties, Researchers, Security Industry, and Government



- ALERT is a 3rd Party Researchers and Works Easily with Other Researchers
- ALERT Works with All of the Security Industry
  - Knows Everyone
  - Works to Gets Everyone Involved
  - Has Built the Appropriate Safe Guards (MOU, NDA, Fire Walls, Information Protection Plan, Data Plan, , ,) for Industry
  - Provides Public Access to ALERT Research and Data
- ALERT Works Well with S&T, EXD and OUP

16.30 Andrea T. Schultz: SAFETY Act

What is Eligible for SAFETY Act Protections?

The SAFETY Act liability protections apply to a wide range of technologies, including:

- Products
- Services
- Software and other forms of intellectual property

Threat and Vulnerability Assessment Services

Detection Systems

Blast Mitigation Materials

Screening Services

Sensors and Sensor Integration

Cybersecurity capabilities

Decision Support Software

Security Plans / Services

Crisis Management Systems

Venue Security

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What protections are available?

Liability cap

Exclusive action in federal court

No joint and several liability for non-economic damages

No punitive damages or prejudgment interest

Limitations on the use and deployment

Limited term

Liability protections associated apply only to acts that occur during the term

All benefits of Designation plus…

Assert Government Contractor Defense

Placed on SAFETY Act's Approved Products list for Homeland Security

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Developmental Testing & Evaluation (DT&E) Designation

For technology that:

- Is in a prototype stage
- Has lab tests that are not operational in nature (too controlled)
- Indicated potential effectiveness
- Has a testing scenario identified and "customers" to prove relevant metrics
- Limited term (up to 3 years) and limited number of sites

DT&ED

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Is Technology Effective?

- Successful testing in operational environment
- Operational testing
  - Evidence of performance metrics, including:
    - Probability of Detection
    - False Positive and False Negative Rates
    - Limits of Detection (and why that limit is relevant)
    - Maintenance and Training
- Suitable performance of past deployments documented
- Domain expertise appropriate and available
- In/external audits favorable
- Customer feedback favorable
- QA plans documented
- Repeatability proven

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Criteria for Certification

Designation is a prerequisite for issuing Certification.

To receive Certification, a Qualified Anti-Terrorism Technology (QATT) must also be shown to:

- Perform as intended
- Conform to the Seller's specifications
- Be safe for use as intended
  - Seller is required to provide safety and hazard analyses

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Are Users Protected?

SAFETY Act Protections Extend to Users

(whether Designation or Certification)

"Such cause of action may be brought only against the Seller* of the QATT** and may not be brought against the buyers, the buyers' contractors, downstream users of the Qualified Anti-Terrorism Technology, the Seller's suppliers or contractors, or any other person or entity…"

Preamble to Final Rule, 6 CFR Part 25, page 33150

***Seller**- any person, firm, or other entity that provides a QATT to customer(s) and to whom a Designation has been issued.

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SAFETY Act Coverage Summary

	DTED	Designation	Certification
Effectiveness Evaluation	Needs more proof, but potential exists	Proven effectiveness (with confidence of repeatability)	Consistently proven effectiveness (with high confidence of enduring effectiveness)
Protection	Liability cap only for identified test event(s) and for limited duration (≤3yrs)	Liability cap for any and all deployments made within 5 year term	Government Contractor Defense (GCD) for any and all deployments made within 5 year term

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Timeline: SAFETY Act Application

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Who are the SAFETY Act Reviewers?

- Reviewers from the FFRDCs, non-profits, Federal Government, Federal & National Labs, and Academia
- Three Technical Reviewers and two Economic Reviewers per application
- 100+ trained reviewers (SMEs) in areas of:
  - Cyber
  - Chemical
  - Biological
  - Economic
  - Explosives
  - Rad/Nuclear
  - Human Factors

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Online Materials

Check out the Printer Friendly Materials and the FAQs!

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Additional Information

- Online: www.safetyact.gov
- FAQs
- Help Topics
- Step-by-Step User Guide
- SAFETY Act Fact Sheet
- Help Desk: Online form for questions requiring an individual response
- Email: SAFETYActHelpDesk@dhs.gov
- Toll-Free: 1-866-788-9318

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16.31 Harry Martz: Perspectives on Screening of Personnel and Divested Items at the Checkpoint

Perspectives on:
Screening of personnel and divested items at the checkpoint

What was heard?
What was not heard?
What's next?

Harry Martz, Carl Crawford

ADSA13, Oct. 29, 2015

This work was performed under the auspices of the U.S. Department of Energy by Lawrence Livermore National Laboratory under Contract DE-AC52-07NA27344. LLNL-PRES-679537

What Did We Hear?

- Long range BAA 14-2
- Talk to Kumar before submitting a whitepaper
- TSA wants 300 passenger and 600 bags per hr.
- CT and XRD at checkpoint is pretty good
- AIT ATR could be improved
- System architecture will enable third parties
- Open architecture Proof-of-Concept
- DNDO is looking at developing gov't reference hardware and software
- Video analytics can be used to track people and their items
- Risk-based security strategy in aviation security

What Did We Hear? continued

- Validating models of adversary behaviors
- Game theory:
  - Best part is accounts for intelligent terrorists
  - But it does not solve the "needle in-hay-stack problem.
- Advanced material discrimination
- Development of standards: DICOS
- Advances of trace detection
- 3rd parties contracting 3rd parties
- Topics for ADSA 14
- Will XBS be redeployed
- Throughput and financial considerations

What Did We Hear? continued

- Review of previous ADSAs assessing data fusion
- ATRs with analog outputs
- THz advances
- CZT detectors
- Super resolution
- Iterative CT reconstruction
- Why do security technologies need to detect
- What is optimal High PD *OR* low false alarms

What Did We Hear? continued

- CBP prefers lower false alarms so they can focus other high risk areas
- Reducing the time to deploy new ATRs
- Preventing false discovery in adaptive data analysis
- 3rd party, vendor, etc. perspective on 3rd party involvement
- ALERT is an expediter
- In the beginning there was no baggage handling standard;
  - TSA required the bag handlers to define a standard;
  - Beneficial to both sides and
  - Gov't should set standards
- Safety Act

Additional Audience Comments on "What We Heard"

- ?

What We Did Not Hear?

- Proof that the Israeli RBS would apply in the US
- RBS metrics and how will they be measured/used
- DICOM
  - How benefited medical imaging
  - How problems w/ rolling out DICOM can be avoided for DICOS
- Third parties
  - How the stakeholders (TSA, vendors, 3p) will benefit
- Differences between perspective on Level 1, 2, 3 etc. and fusion of the levels/technologies
- Why have shoe screening technologies failed
- Airlines, TSOs, etc.
- Quantifying deterrence and displacement

What We Did Not Hear?

- CONOPS details
- Details of spiral development
- How is a part of a integrated system get integrated
- Harmonized testing, standards, etc.

What Can Be Done To Solve the Checkpoint Problem?

- Risk based screening (under-screening)
- Better CONOPS
- Orthogonal technologies system and data integration
- Standards
  - Systems interfacing
  - Data integration
  - Testing in lab and field
- Better MMW, NMR, NQR and X-ray hardware and reconstruction software

What Can Be Done To Solve the Checkpoint Problem? continued

- Grand challenges/task orders
  - Reconstruction and ATR for sparse view CT, MMW
  - Speeding up CERT/QUAL testing
    - More statistical
    - Human in the loop
  - Simulated system, bag and people data sets
  - Quantifying deterrence and displacement

?

ALERT

AWARENESS AND LOCALIZATION
OF EXPLOSIVES-RELATED THREATS

Awareness and Localization of Explosives-Related Threats

Northeastern University — 360 Huntington Avenue — Boston MA 02115
phone: 617.373.4673 — fax: 617.373.8627 — web: www.neu.edu/alert

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