

TRANSPORTATION SECURITY LABORATORY

Simulant Verification and Validation

Mr. Robert Klueg

Branch Chief, Spectroscopy DT&E

Mr. Barry Masters

General Engineer, Spectroscopy DT&E

March 7, 2017

Transportation Security Laboratory

Science and Technology Directorate



**Homeland
Security**

Science and Technology

Motivation and Problem Statement

The security screening community has a documented need for inert simulants for test and evaluation of explosive detection devices



Personnel Inspection

Cargo Screening

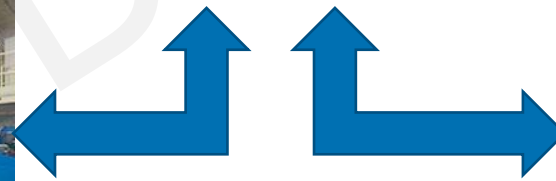


T&E Mission Needs
Operational Testing
Red Team Testing
Vendor Algorithm Training
Homemade Explosives Testing



Baggage Screening

Checkpoint Security



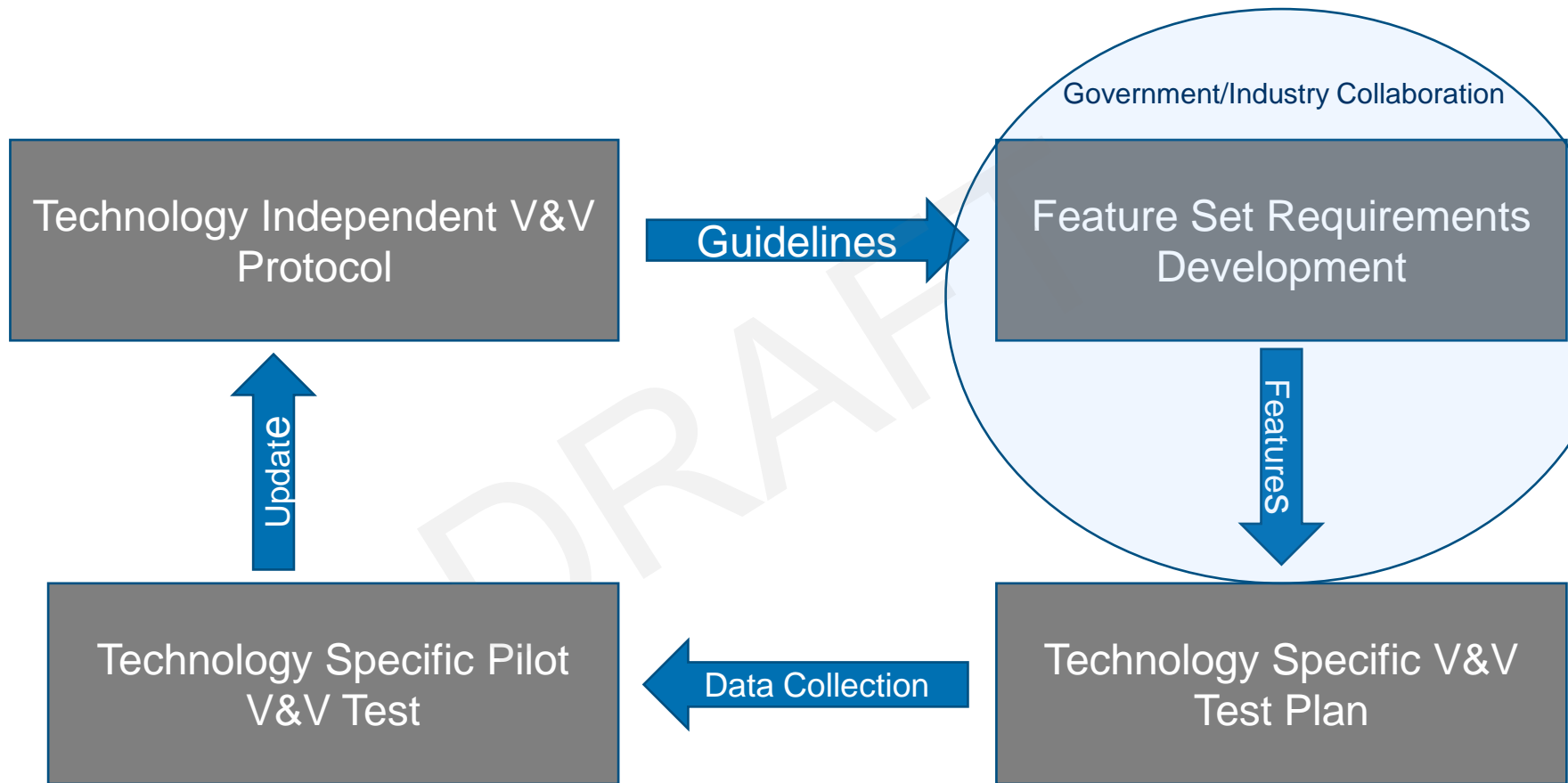
Motivation and Problem Statement

- Proliferation of Homemade Explosives (HMEs) continues to drive need for simulants to support security technology development, testing and training.
 - HMEs are expensive and dangerous to synthesize and handle
 - HMEs pose unique challenges to personnel screening system testing as well as operational and red-team testing.



Testing with live HMEs increases cost, schedule and safety risk

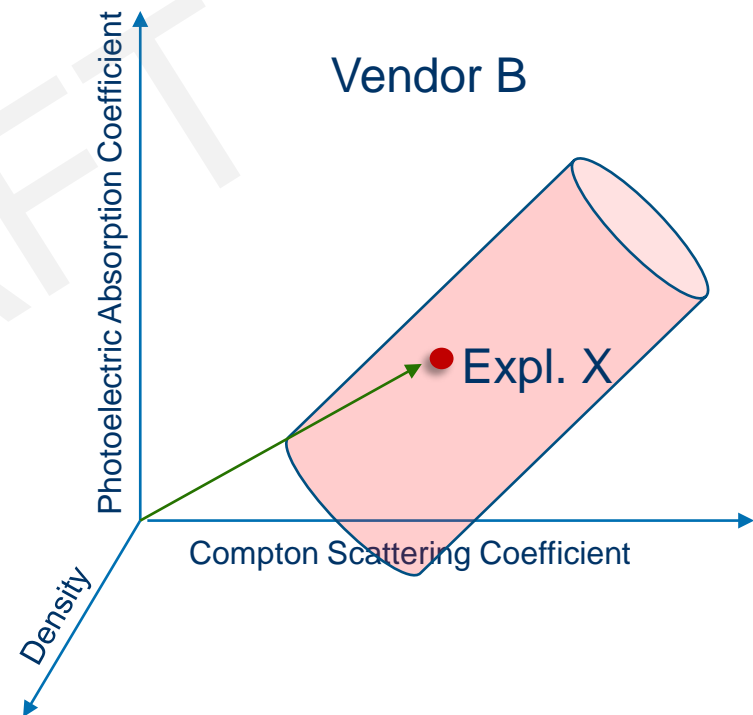
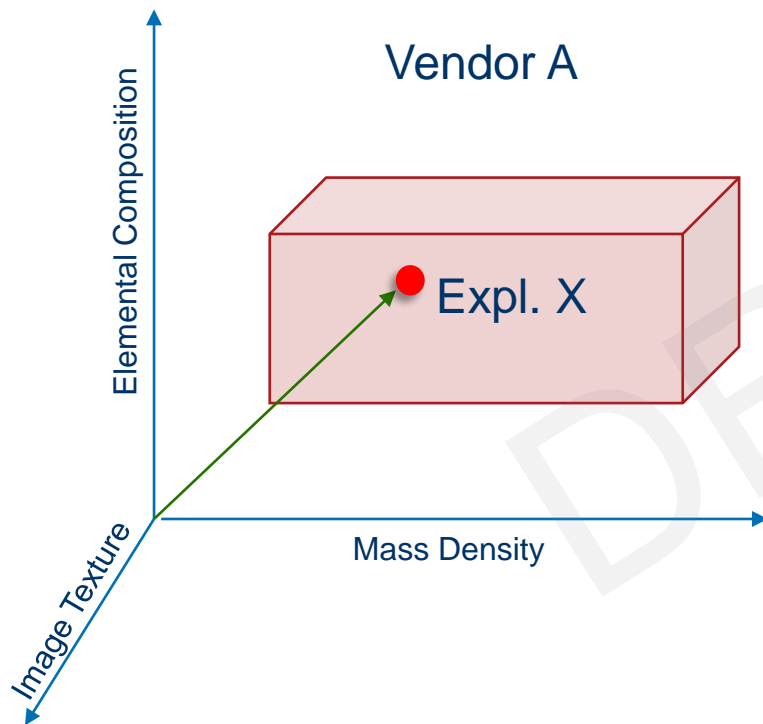
DHS Simulant Verification and Validation Working Group



Partnering with Industry ensures validity of simulants

Necessity of Industry Involvement

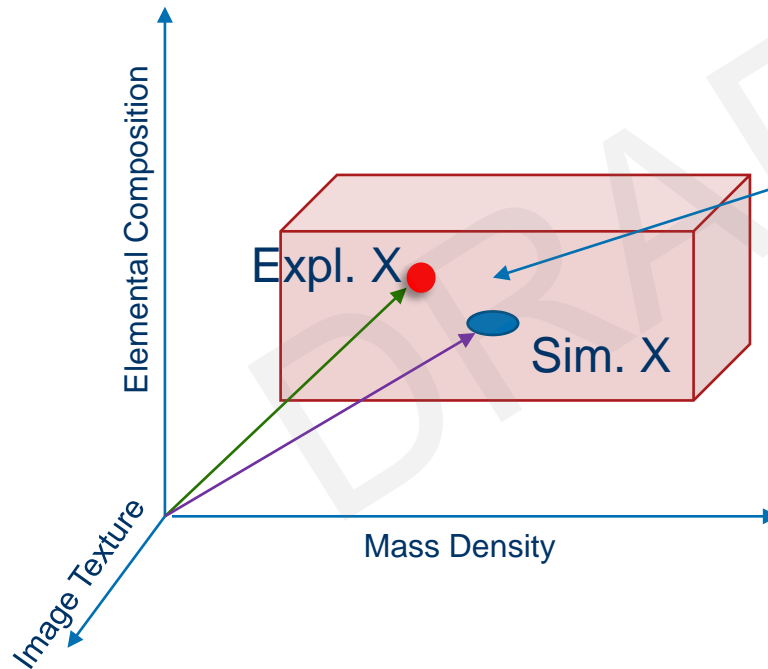
- Defining the feature space
 - Vendors use some common features for material discrimination
 - Unique (proprietary) features applied as well



Features measured by the security technology establish the detection space

Necessity of Industry Involvement

- What is a meaningful difference?
 - How close do two measurements of a feature have to be to be considered equivalent
 - Does the closeness of two measurements of one feature affect how close a pair of measurements of another feature need to be?



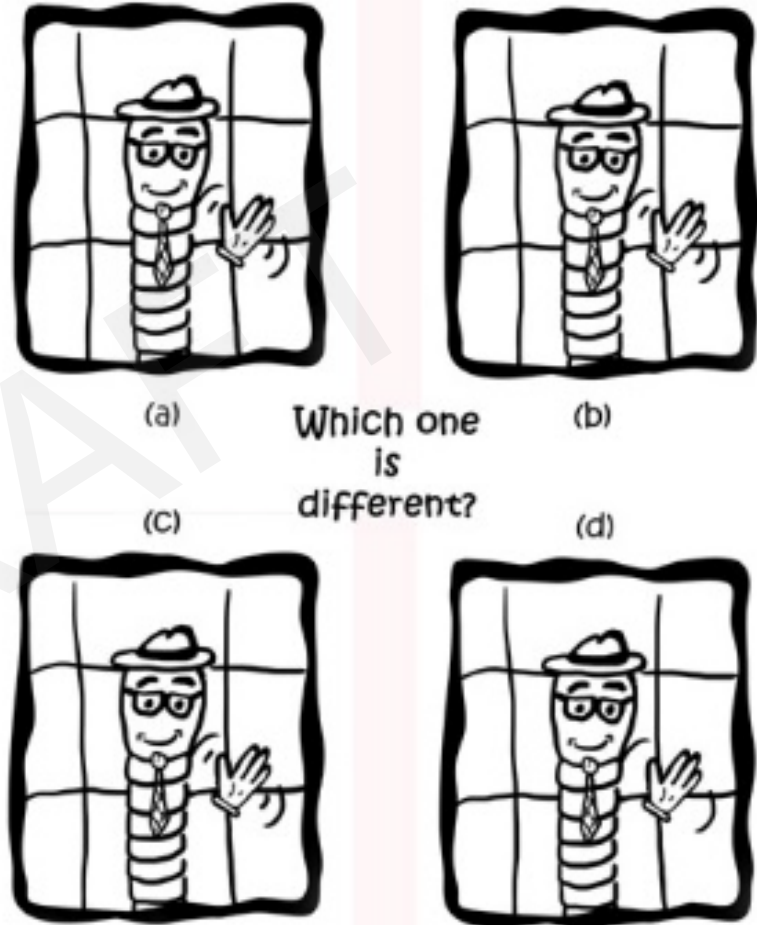
Is Simulant X close enough to Explosive X to be a valid simulant?

How can industry share information without disclosing proprietary features and methods?

Validation criteria depend on proprietary features and detection thresholds

Blinded Analysis of Candidate Simulants

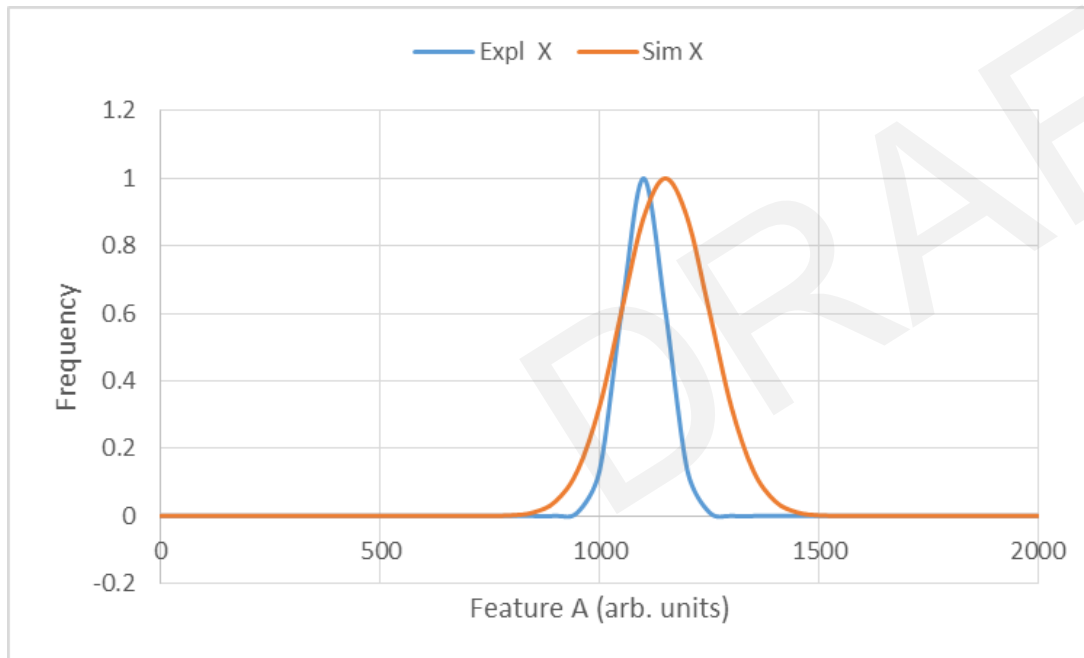
- Government could provide industry with unlabeled candidate simulant and explosive images. Can industry tell the difference?
- If they can, provide Government with **structured feedback** to improve design characteristics.
- Collaboration intended to improve design and verification/validation process not to improve an individual simulant



Blinded studies protect proprietary information and aid in simulant development

Blind Analysis of Candidate Simulants

- Structured Feedback should concentrate on the validity of material property distributions NOT features derived from those distributions.



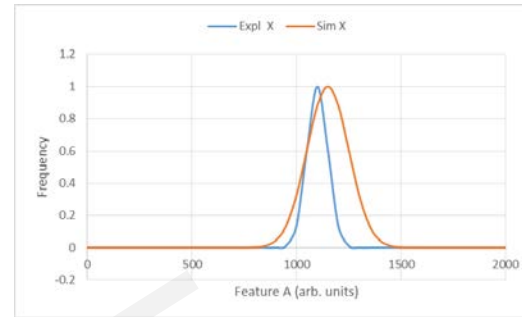
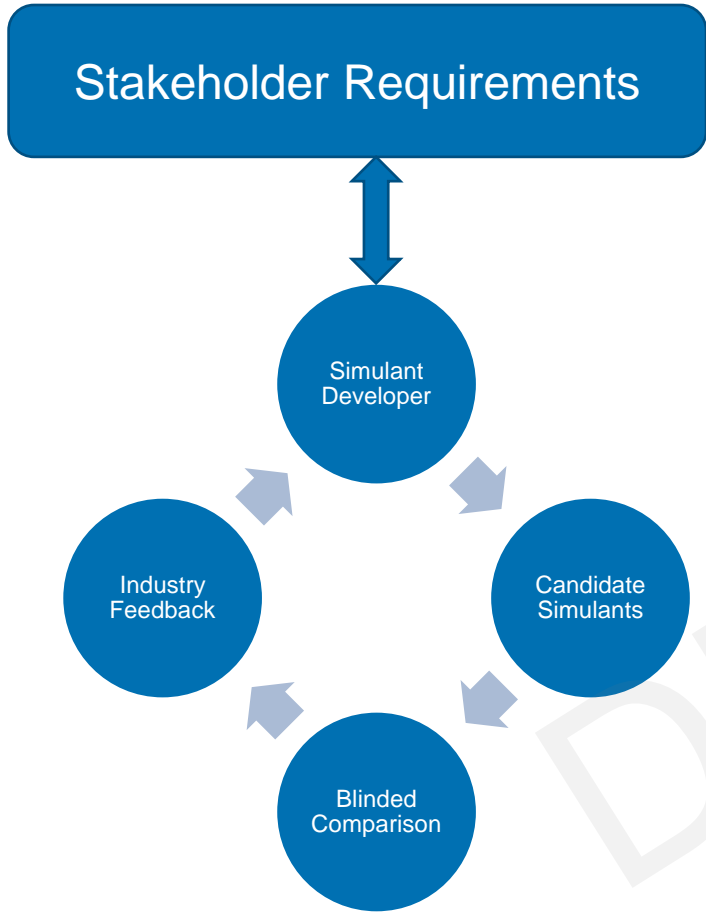
Derived Features

Mean
Mode
Variance
Skewness

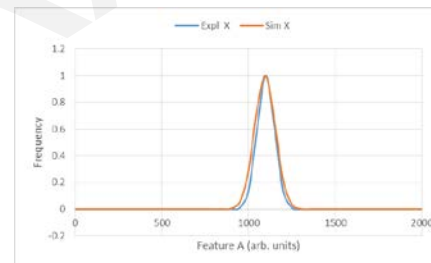
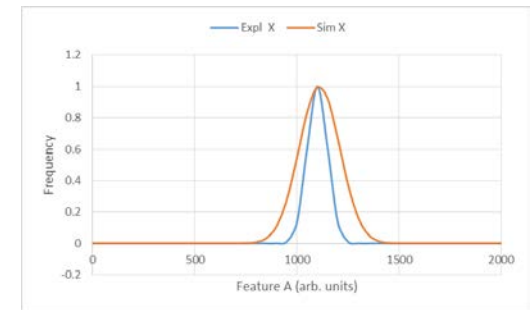
-
-
-
-

Industry feedback can be structured to protect proprietary information

Government/Industry Partnership



Iteration #2



Iterative evaluation of exemplar simulants increases validity of the evaluation process

Conclusions

- There is a significant need for validated simulants.
 - Operational testing, T&E using HMEs, developmental testing at vendor facilities, Red Team Testing
- Proposed solution: Blinded comparisons conducted between Government and Industry to refine V&V process
 - Iterative blinded comparisons of exemplar simulants and explosives refine the simulant verification and validation process and inform stakeholder requirements
 - proprietary detection features and discrimination methods are protected via comparisons to material property distributions and not specific derived features
- Validated simulants improve outcomes for industry
 - Enables industry to collect more data decreasing performance risk
 - Design issues encountered and resolved earlier in the system development process reducing overall risk
 - Decreased time to market for industry products

Validated simulants reduce overall risk to Government and Industry

Transportation Security Lab Contacts

Mr. Robert Klueg
Branch Chief, Spectroscopy DT&E
Robert.Klueg@hq.DHS.gov
Office: 609-813-2872
Cell: 202-280-9432

Ms. Seyhun Byrne
Division Chief, DT&E
Seyhun.Byrne@hq.DHS.gov
Office: 609-813-2725

Mr. Barry Masters
General Engineer, Spectroscopy DT&E
Barry.Masters@hq.DHS.gov
Office: 609-813-2722

Dr. Christopher D. Smith
Director, TSL
Christopher.D.Smith@hq.DHS.gov
Office: 609-813-2707



Homeland Security

Science and Technology