Human Portable Rad/Nuc Tripwire Limited Characterization

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Abstract

Recent commercial developments in spectroscopic personal radiation detectors have notably improved their performance. These devices have the potential of providing a new or enhanced capability to law enforcement personnel. Domestic Nuclear Detection Office (DNDO) conducted a limited characterization and operational assessment of some of these detectors.

The purpose of the effort was to support a programmatic decision of one of two paths:

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Abstract (cont'd)

- Procuring current devices to provide capability to operators
- Pursuing a partnership with industry to facilitate further capability development

The programmatic drivers resulted in a compressed test planning cycle. Despite this, the test team successfully developed/implemented data acquisition protocols to interface with these commercial products, and generated an adaptable test design to characterize their detection range.

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Abstract (cont'd)

This report will present an overview of the limited detector characterization, lessons learned from the test and planning cycle, and test results.

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Outline of Discussion

- Background
- Test Purpose
- Test Design & Execution
- Keys to Success
- Results

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Background

The Human Portable Tripwire (HPT) mission is to increase the opportunity and likelihood of detecting and identifying illicit radiological and nuclear (R/N) material through constant, non-deliberate scans by devices that are worn by operators at all times as standard equipment.

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Background (cont'd)

In December 2012, the Department of Homeland Security (DHS) DNDO Systems Engineering & Evaluation (SEED) conducted the HPT Commercial-Off-the-Shelf (COTS) Limited Characterization.

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Our Success Story

Achieved our customers' expectations despite schedule constraints and unforeseen obstacles:

- Effective planning and coordination
- Prioritization of test execution activities
- Flexibility, adaptability, and resourcefulness of the test team
- Support from partner agencies (e.g., U.S. Strategic Command Center for Combating Weapons of Mass Destruction, Defense Threat Reduction Agency)

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Test Purpose

Evaluate spectroscopic personal radiation detectors (SPRDs) and baseline personal radiation detectors (PRDs) against a subset of the performance and suitability requirements to inform an acquisition decision.

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Systems Under Test (SUT)

Six SUTs:

- Three SPRDs
  - Cesium Iodide and Cadmium Zinc Telluride (CZT) technologies
  - Spectral sampling time ranged from 1s to 20s
- Three PRDs
  - Cesium Iodide
  - No R/N identification capabilities

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Acquisition Decision

- Are the performance and suitability of current COTS spectroscopic personal radiation detectors viable to proceed with COTS acquisition?
- Is a customized Commercial Development pathway needed?

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Effective Planning and Coordination

- Frequent test planning working group (TPWG) meetings
  - Outline test scenarios
  - Clarify guidance from the Program Office
- Access to SUTs prior to test execution
  - Allowed data collection team to develop data acquisition strategy and refine data collection tools

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Test Execution Overview

- 10 days to complete testing

Test Execution	Duration
Operational/Suitability Assessment	2 days
Static Detection	2 days
Long Dwell	1 day
Dynamic Detection	2 days
Static Identification	2 days
Hot Wash (Lessons Learned)	1 day

Prioritized Evaluation

Program Manager (PM) identified evaluation criteria in order of importance in the event that the test could not be completed within 10 days:

- Operational/Suitability Assessment by the end-users
- Maximum Detection Distance under static conditions (both detector and threat are stationary)
- Identification of radiological isotopes

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Prioritized Evaluation (cont'd)

- Efficiency and resolution of spectroscopic SUTs
- Maximum Detection Distance under dynamic conditions (either detector or source is in motion), under slow and normal walking speeds (as determined by users, 2 fps* and 5 fps** respectively)

*2 fps is approximately 1.4 mph
**5 fps is approximately 3.4 mph

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Flexibility, Adaptability, Resourcefulness

- Obstacles
  - Linear Motion System (LMS) for dynamic scenarios hadn't been used in years and wasn't functioning.
  - Some SUTs were "in the mail."
  - Lack of necessary source delivery.
  - 80% confidence level requested by the Program Office required 30 trials per test.

Flexibility, Adaptability, Resourcefulness (cont'd)

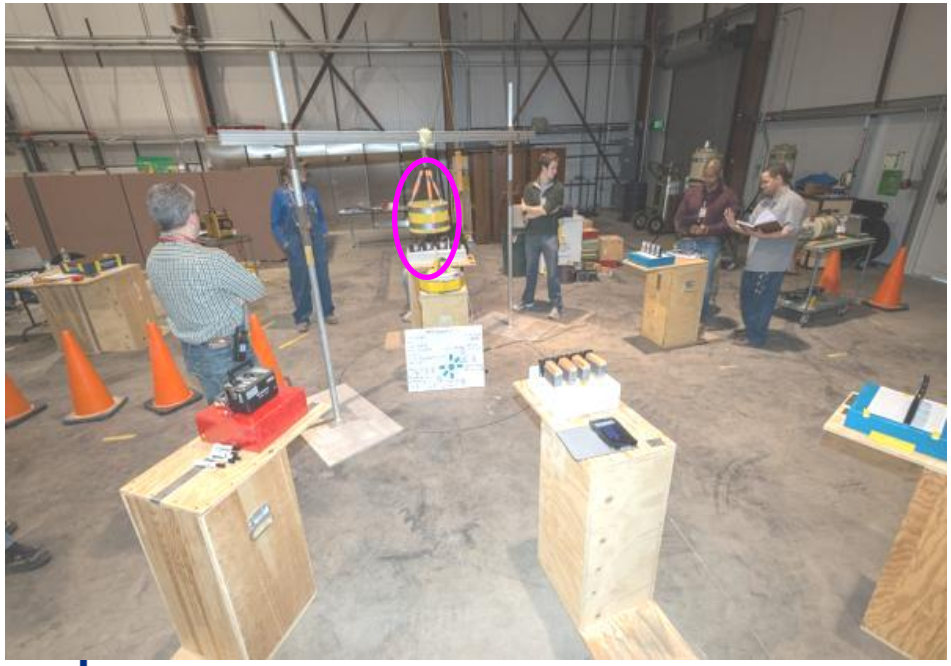
- Solutions
  - Contacted manufacturer for LMS operation manual
  - Team members drove 6 hrs. from NV to AZ to find missing items
  - Field Technical Coordinator (FTC) and team configured shielding to "hide" sources between trials and rotating platforms for anisotropic sources

Flexibility, Adaptability, Resourcefulness (cont'd)

- Solutions
  - Data was aggregated which only required 10 trials per test (assuming identical units of the same system operate similarly to one another)

Maximum Distance Determination

- In a static detection scenario, the SUTs were moved closer to and further away from the source to converge on the maximum detection distance at which the probability of detection (P_D) ≥ 0.8.



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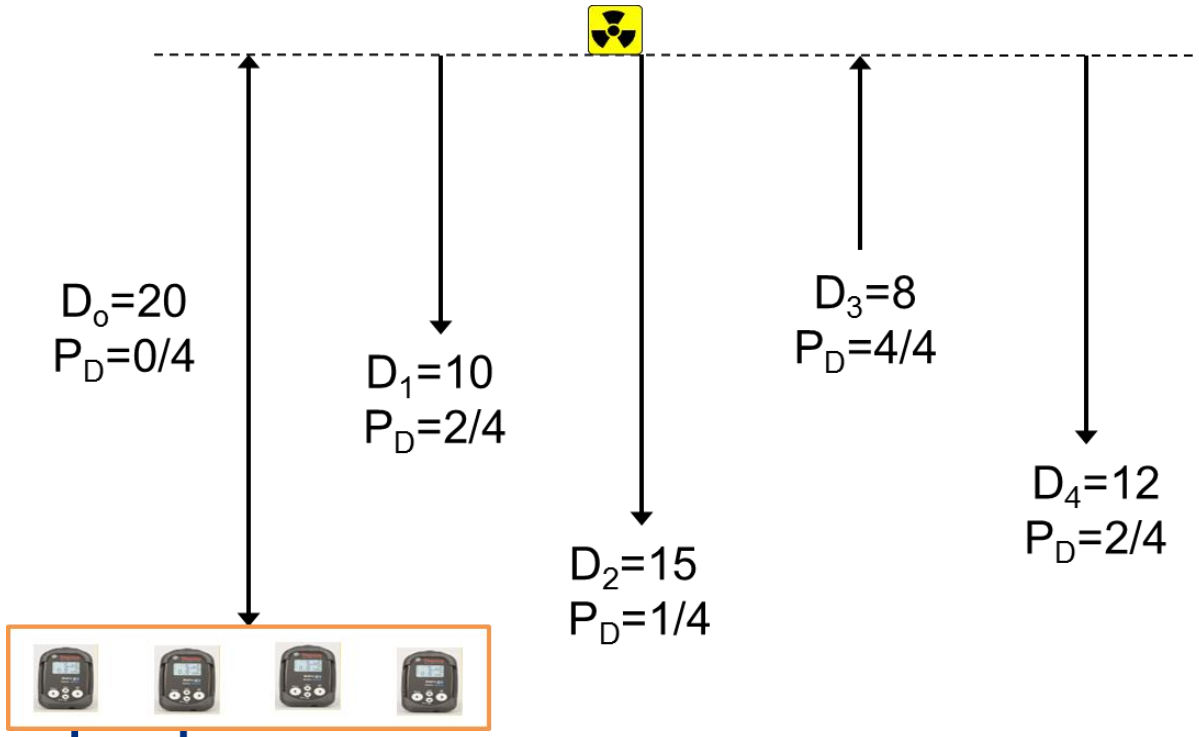
Maximum Distance Determination (cont'd)

- To save time during test execution, the initial distance (D) for each configuration was determined during dress rehearsals through systematic iteration.



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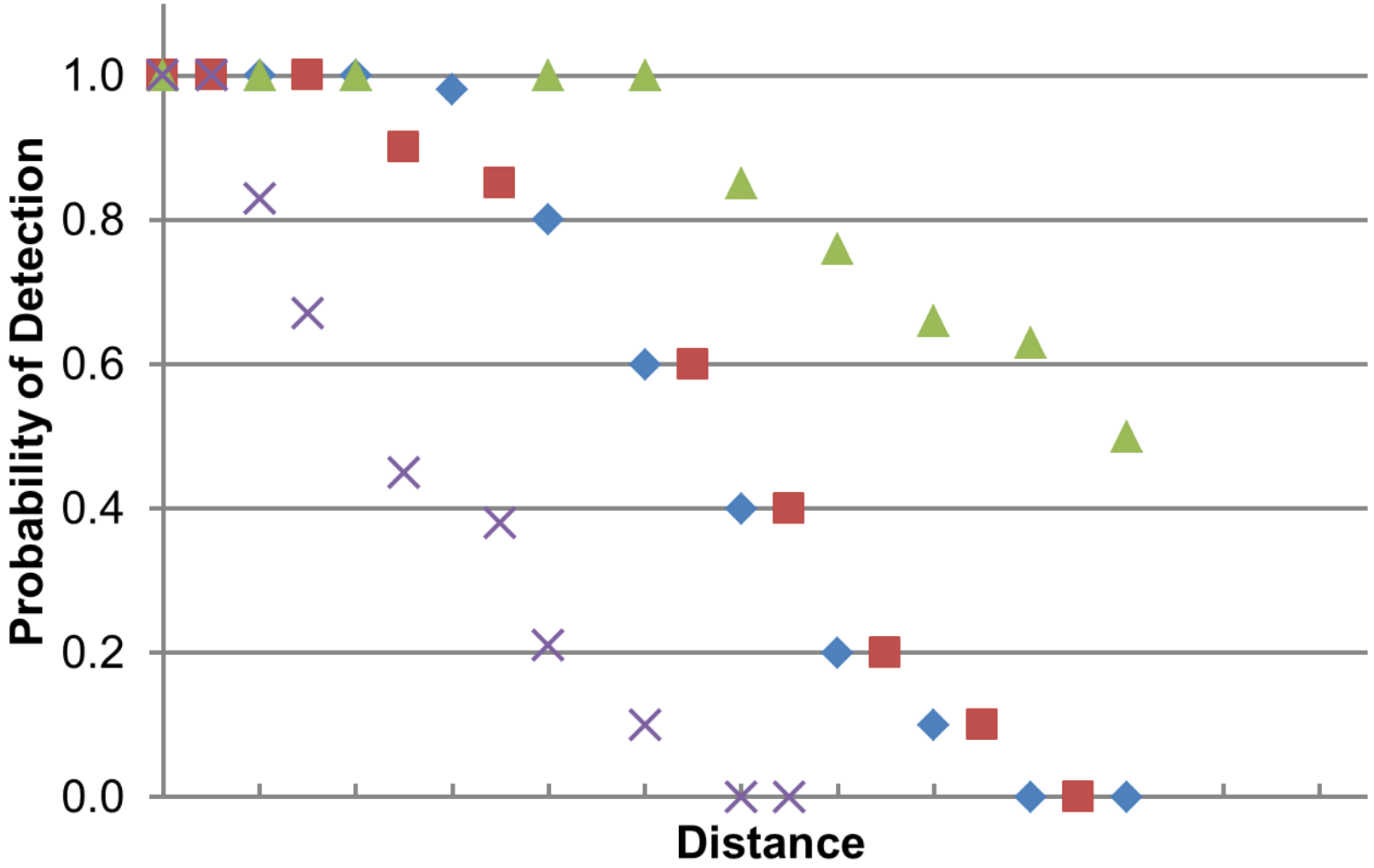
Expected Results



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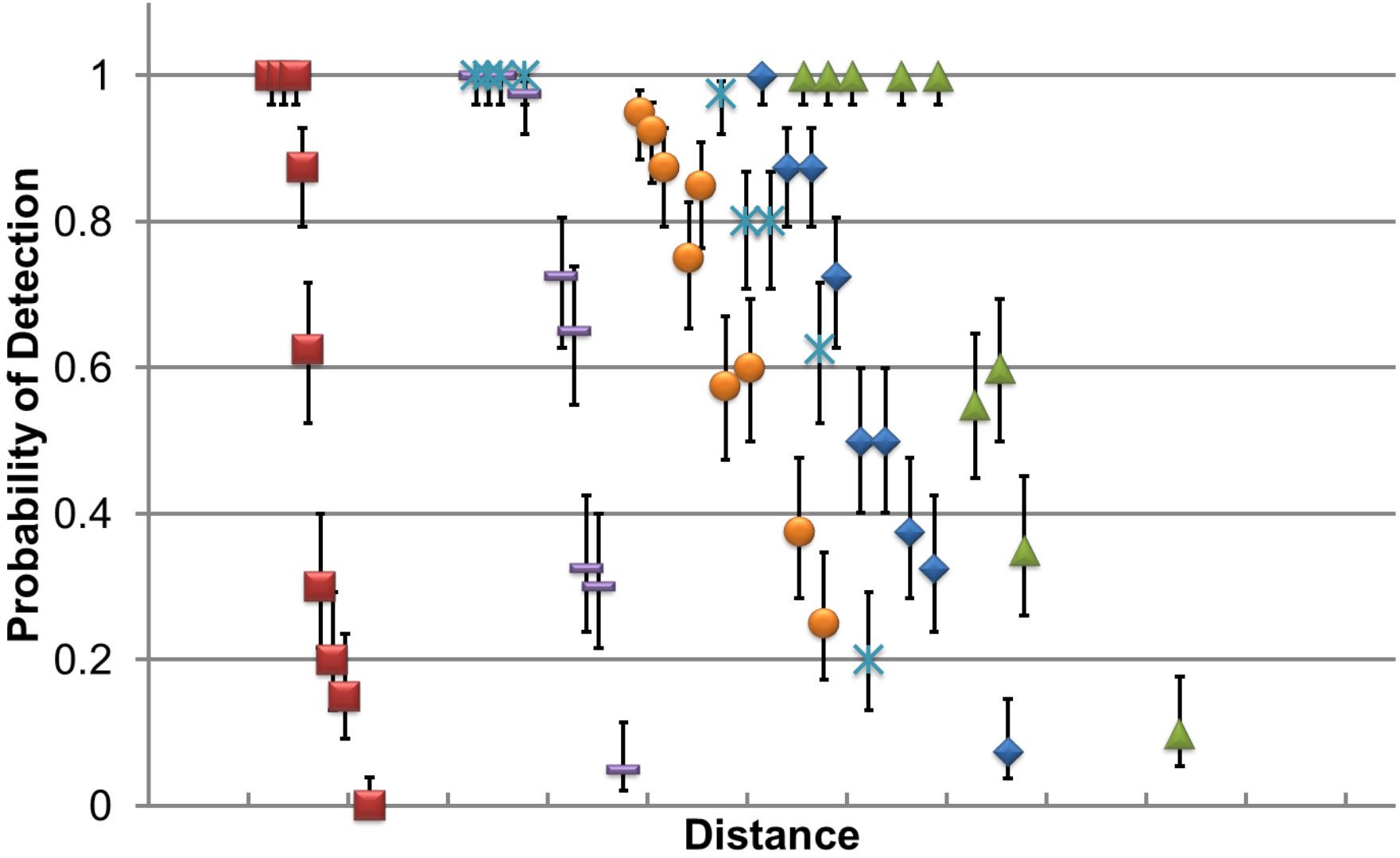
Actual Results



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Support from Partner Agencies

- USSTRATCOM provided an additional test scientist with R/N and testing expertise.
- DTRA provided operations as well as previous test results for similar SUTs.
  - Additional operators relieved already strained personnel resources.
  - Previous test results aided in test design and helped outline expectation of SUT performance during the HPT limited characterization.

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Our Success Story

Achieved our customers' expectations despite schedule constraints and unforeseen obstacles.

- Effective planning and coordination
- Prioritization of test execution activities
- Flexibility, adaptability, and resourcefulness of the test team
- Support from partner agencies (e.g., DTRA)

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Benefits of HPT Limited Characterization

- Contributed to the decision to proceed with a COTS acquisition
- Enabled the program office to further refine user requirements development
- Identified areas where COTS could be improved and enabled DNDO to provide vendors with user feedback prior to the procurement decision
- Data collection for static and dynamic detection provided valuable input to existing and future modeling efforts.

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  - Shaunna Haynes
  - Katrina Wright

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BACKUP

Acronyms

- COTS Commercial-Off-the-Shelf
- CZT Cesium Iodide and Cadmium Zinc Telluride
- D Distance
- DTRA Defense Threat Reduction Agency
- HPT Human Portable Tripwire
- LMS Linear Motion System
- P_D Probability of Detection

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Acronyms (cont'd)

- PM Program Manager
- PRD Personal Radiation Detector
- R/N radiological and nuclear
- SPRD Spectroscopic Personal Radiation Detector
- SUT System Under Test
- TPWG Test Planning Working Group

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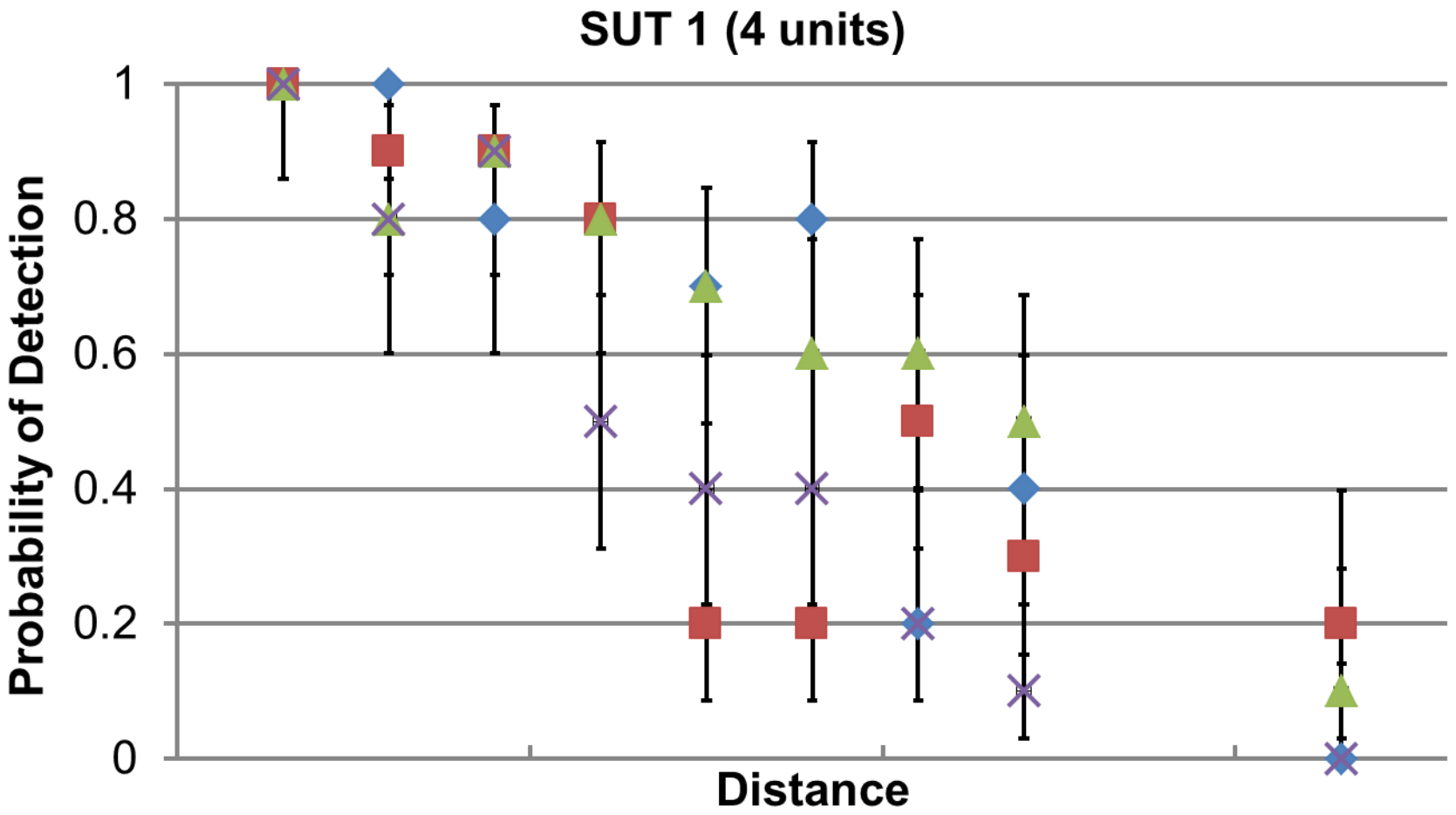
Static Detection of SNM



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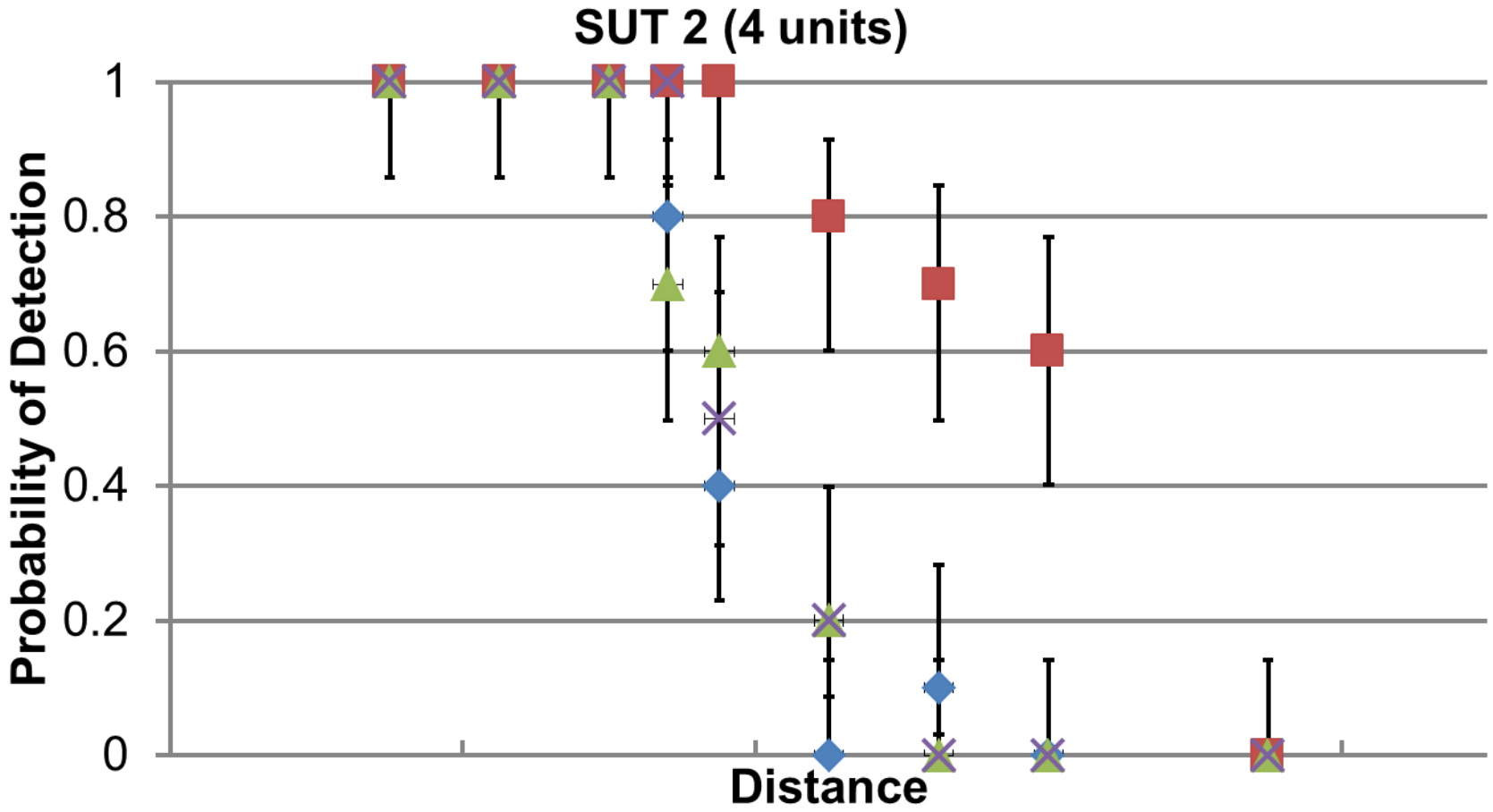
Static Detection of SNM (cont'd)



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