Method for Predicting False Alarms

What is the cost of enhanced detection capabilities?

Richard Bijjani

Carl's Mandatory Intro-Clusion

Conclusions:

- Developing ATR for unknown material is possible
- FAR is predictable

Agenda

- Finish ADSA 8 presentation:
  - Preparing for certification
- Develop ATR for new material
- Predict FA impact

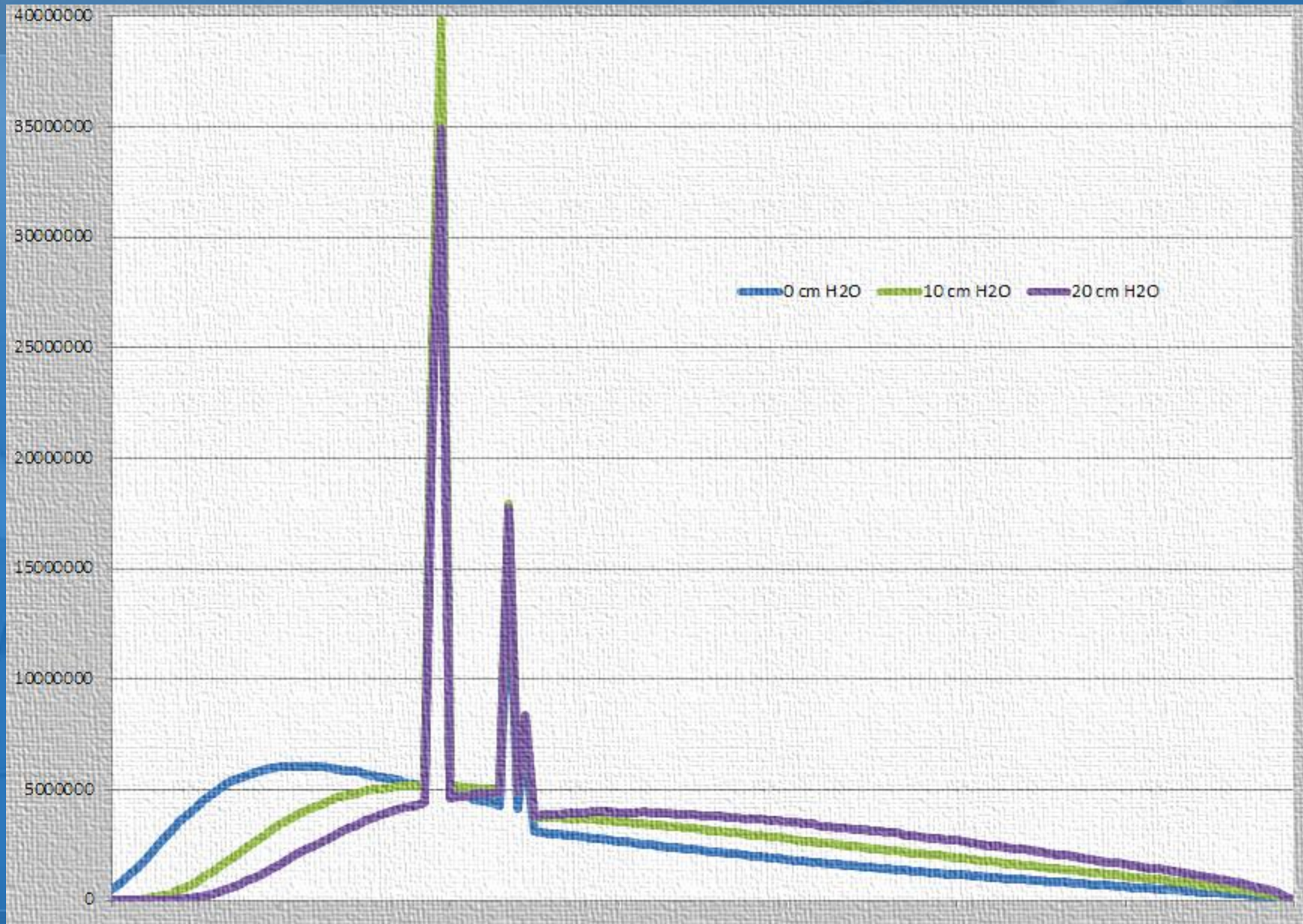
ADSA 8

Carl's Difficult Question

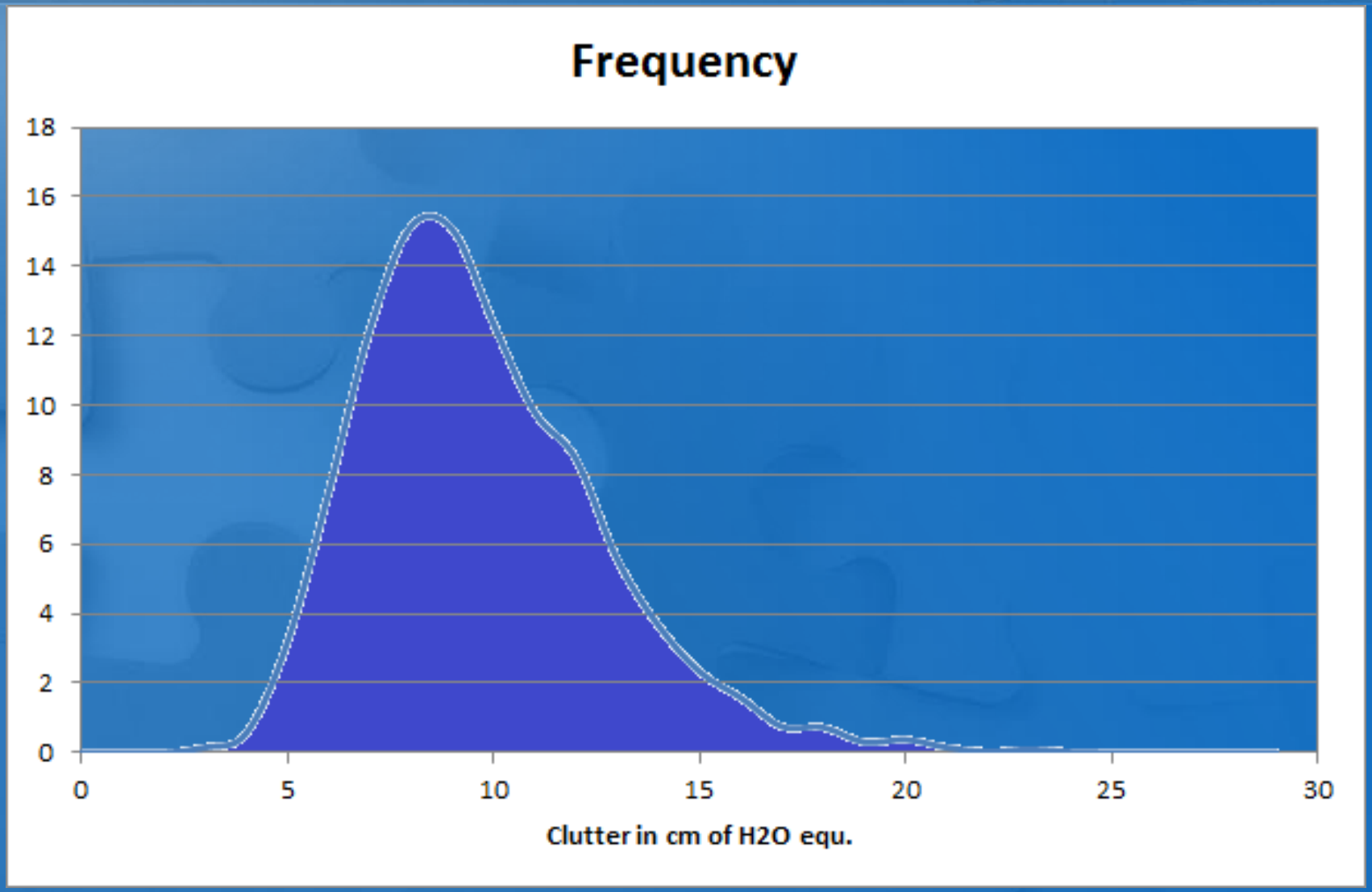
- *Develop an ATR for hypothetical situations in which the following occur:*
  - *statistically insignificant number of samples for training and/or testing*

ADSA 8

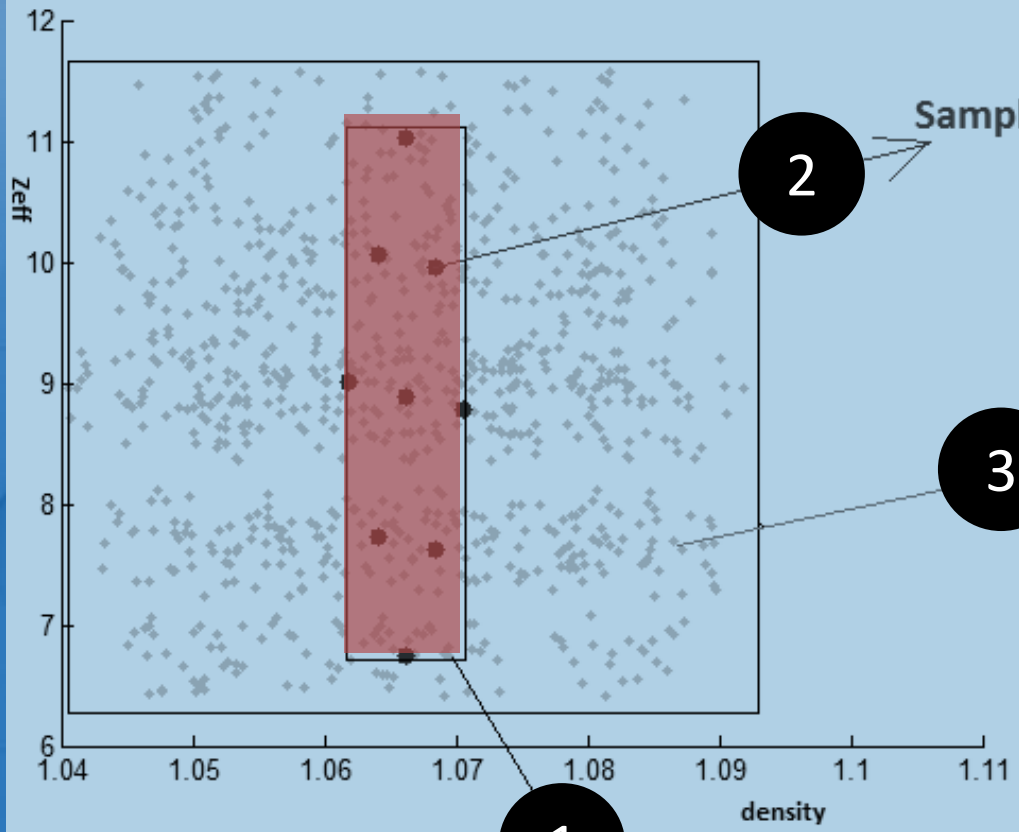
Start with your system's Specs



ADSA 8
Analyze Clutter in Airport Bags



Predict effect of clutter on measured properties of novel explosives



2

Sample explosives from cloud

3

Expected Measured values when placed in bags

1

Cloud as defined by the government with data from national labs and TSL

Algorithm Black Box

- Algorithm Development
  - Concentrate on edge and corner cases first
  - Cycle back to ‘normal’ cases
  - Design and implement an architecture to support current development plan, future improvement plan, and backup plan in case of failure
  - In your schedule allow for failing the test at least once

ADSA 9 Objectives

Method for predicting FAR associated with detecting a novel threat (which has not been scanned yet):

1. Analyze Airport Data
2. Calculate relevant properties of such novel threat (from μCT , EDS scan or theoretical analysis)

   If data from μCT, apply appropriate transformation to EDS in order to maintain density, Zeff (if appropriate) and texture to the appropriate resolution
3. Use data from 1 to develop a realistic clutter model
4. For the threat material apply the appropriate 'cloud' variations in density, Zeff and texture
5. Randomly place the threat under investigation into bags with clutter profiles from 3.
6. FAR prediction will be the statistical result of running step 5 .

Airport Data

- Find *all* objects in a bag set and calculate relevant features
- Save data in a csv or other file format *(avoid need to re-run algorithm many times)*
- For each object generate an entry, e.g.

Bag #	Object #	Density	Volume	Mass	Zeff	Texture	Thickness	…	..
3576	7	1.254	378	474	7.92	0.96	7.9	…	..

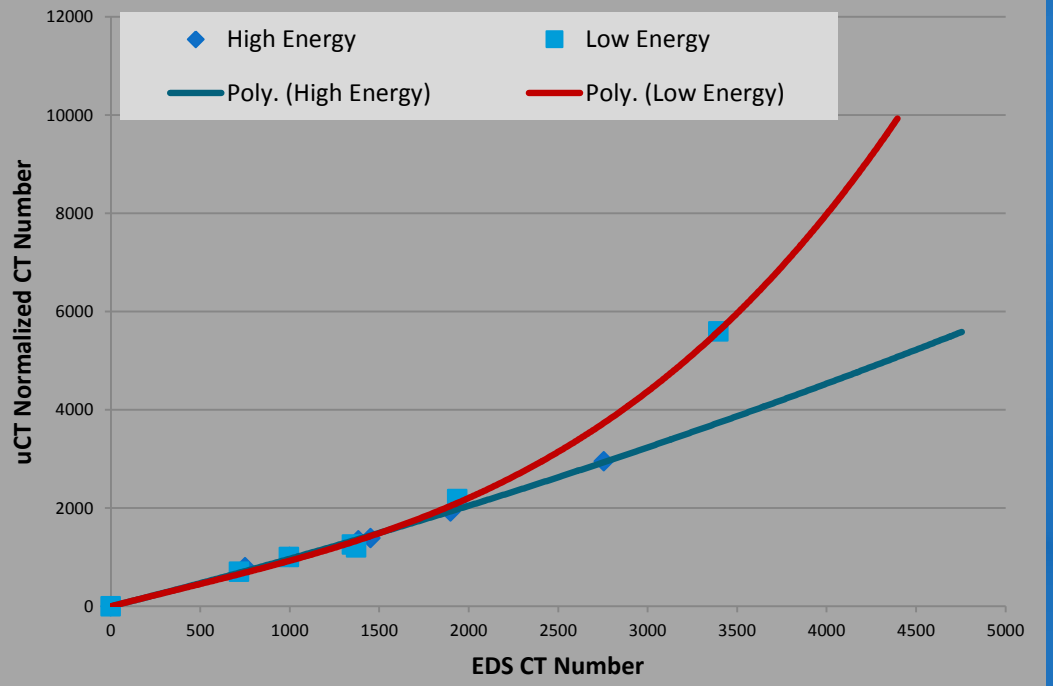
µCT to EDS

- Use reference material values to map voxel values between the 2 systems (any 2 systems)
- Exact same reference material should be scanned in both systems e.g.

		graphite	Delrin	H2O	Al	Novel Explosive
uCt	Lo	1197	1256	1000	5593	1134
	Hi	1384	1342	1000	2950	1064
EDS	Lo	1330	1360	1003	3328	?
	Hi	1431	1365	1008	2734	?

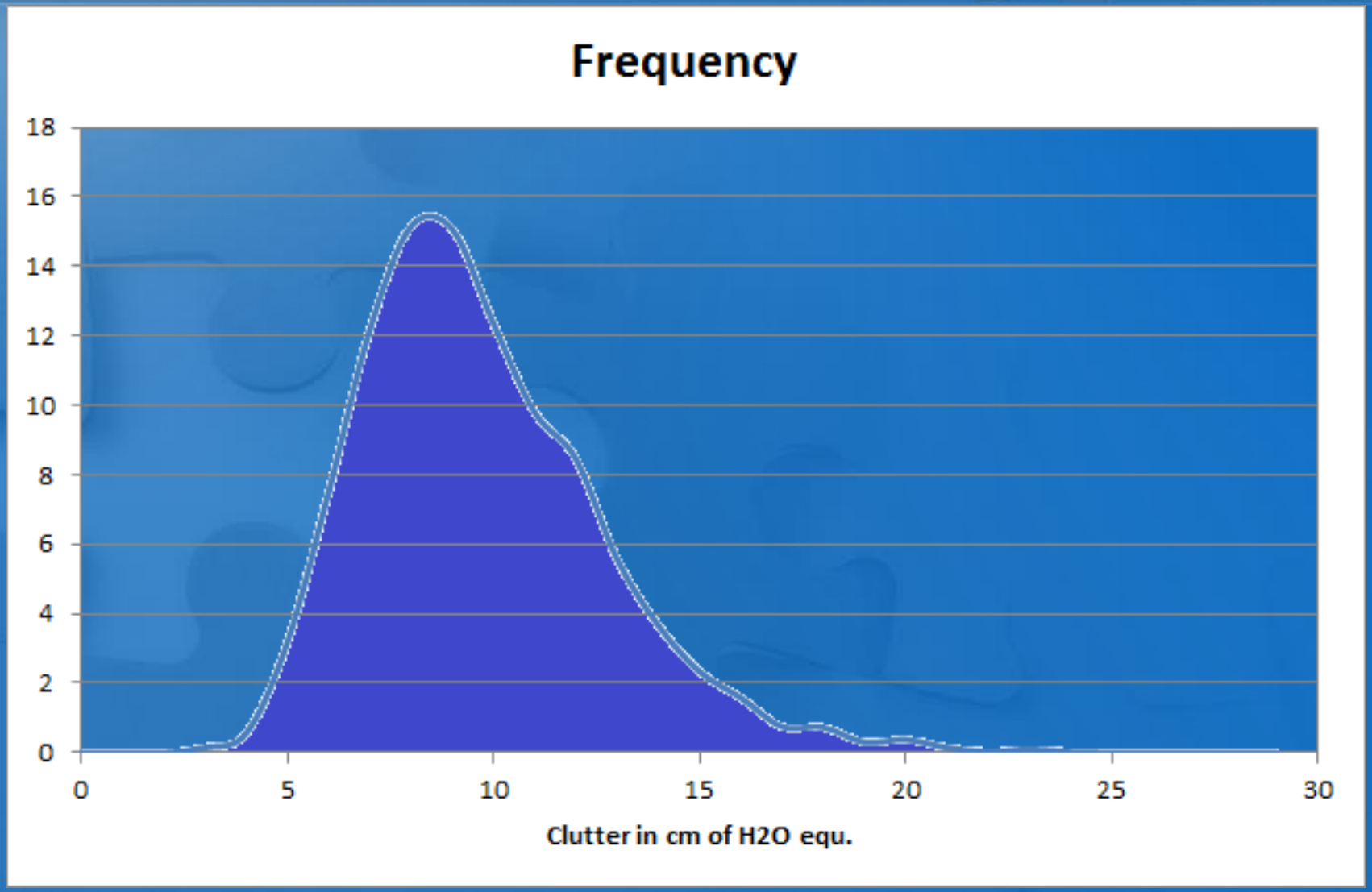
- Predicting values of unknown threat on EDS is then easily deduced

µCT to EDS



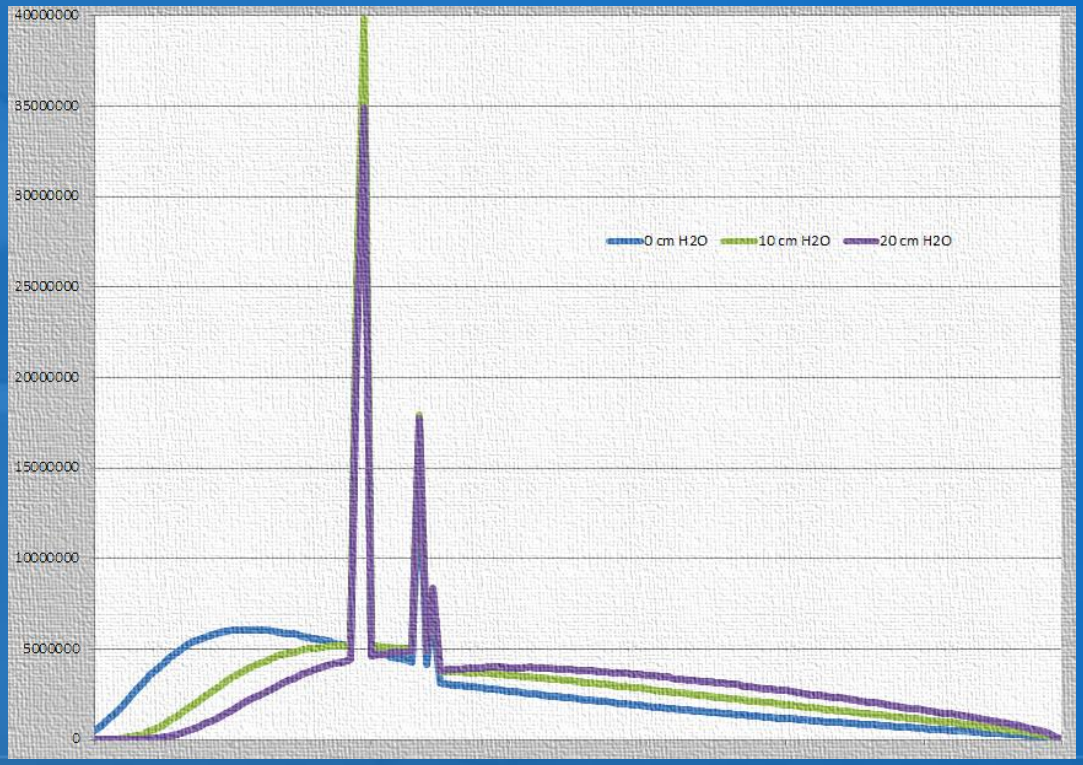
		graphite	Delrin	H2O	Al	Novel Explosive
uCt	Lo	1197	1256	1000	5593	1134
	Hi	1384	1342	1000	2950	1064
EDS	Lo	1330	1360	1003	3328	**1108**
	Hi	1431	1365	1008	2734	**1061**

Clutter Model



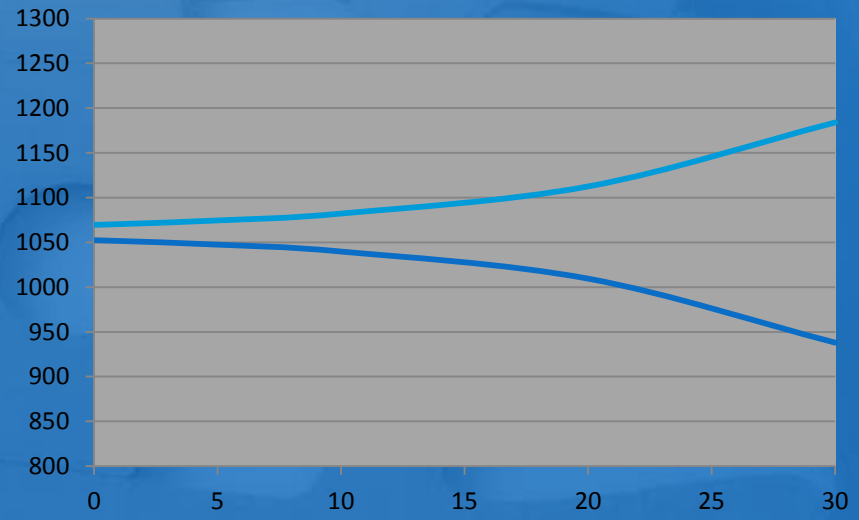
Clutter Model

- Using publically available x-ray simulation programs like spekCalc, predict spectrum hardening for each clutter index

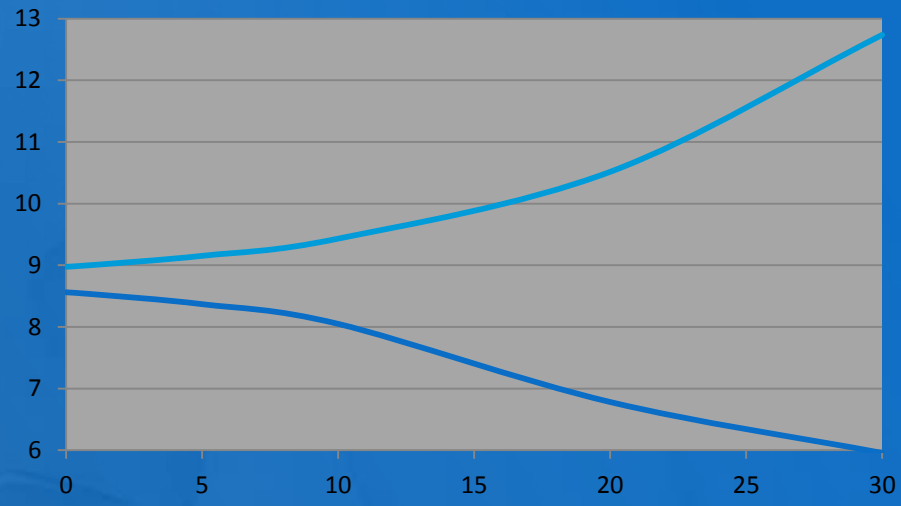


‘Cloud’ Dilation

- Dilate the values of the theoretical cloud by the noise predicted from clutter.



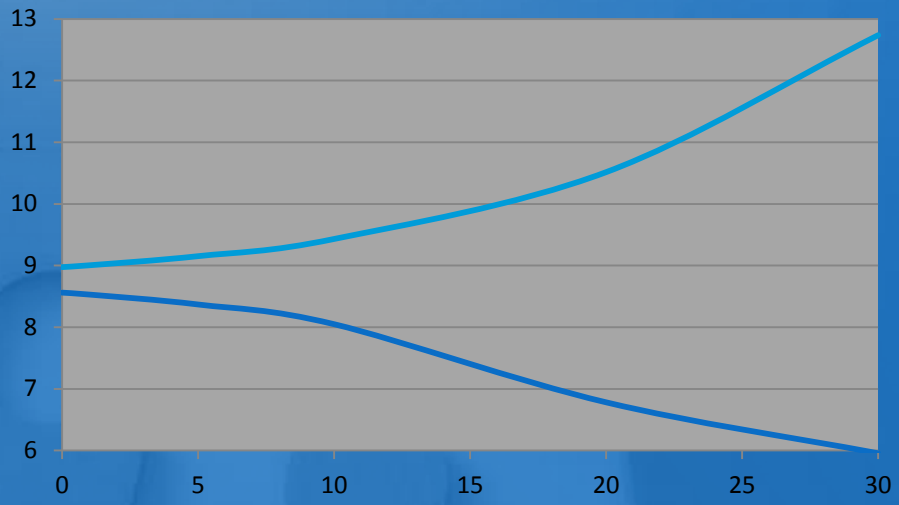
Density Range vs. Clutter



Zeff Range vs. Clutter

Myth

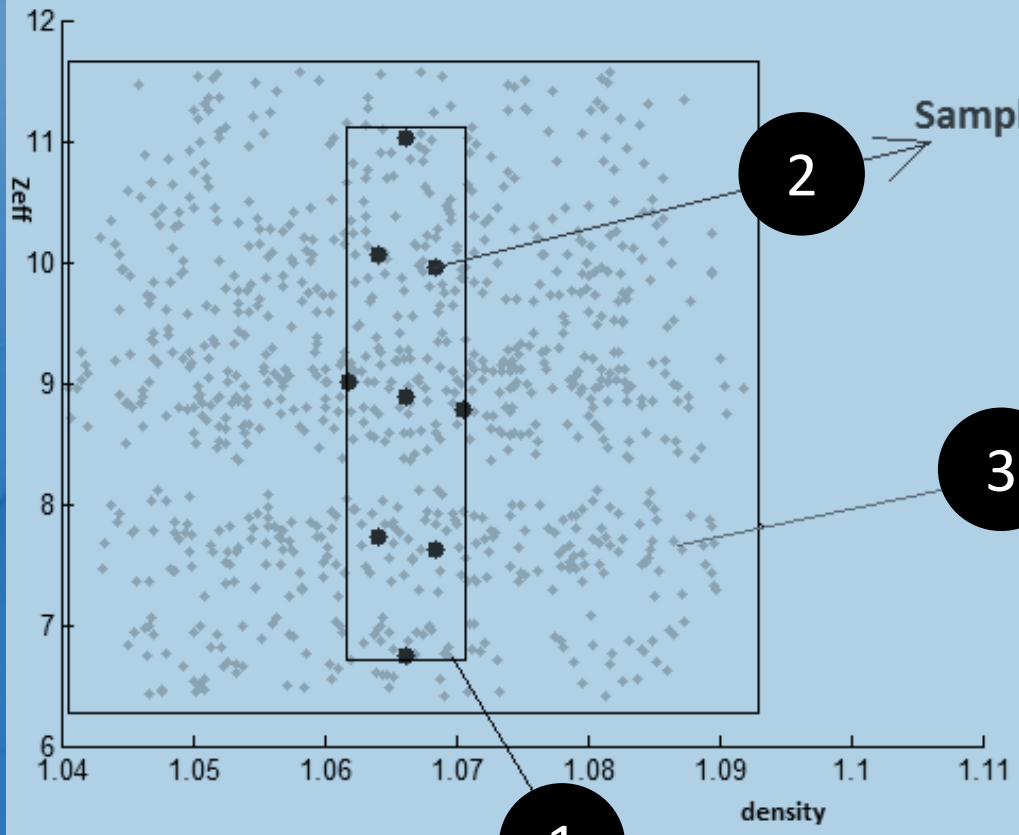
- Zeff is useless because it is sensitive to clutter



Zeff Range
vs. Clutter

False

Simulate effect of placing exp. in bags



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Sample explosives from cloud

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Expected Measured values when placed in bags

1

Cloud as defined by the government with data from national labs and TSL

1. Constant Window (minimum detection window)
2. Could be constant
3. Cloud due to clutter varies with assumed clutter value

Predict FA

- For each bag in data set, calculate number of objects that overlap the dilated threat window
- Predict overall *additional* FAR by identifying the objects in the bag that did not already alarm but will alarm if this novel threat is to be detected.

Questions we should be asking

- Can we *(or will we be likely able to)* find all the explosives on the 'list' using current machines?
- What capabilities do we need from the next generation systems?
- What are the appropriate Alarm Resolution Tools for this threat?

Prioritized List of Problems

Current or new technologies will need to tackle the following problems in a cost effective and operationally acceptable manner. In order to detect more explosives, FA need to be reduced.

1. True Alarms
2. Shield or Partial Shield alarms
3. Clutter, artifact correction
4. Improving measurement accuracy
5. Identifying new relevant features
6. Signal conditioning

Questions