

An Application of Radiological Methodologies for the Assessment of Whole Body Screening

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March 2011



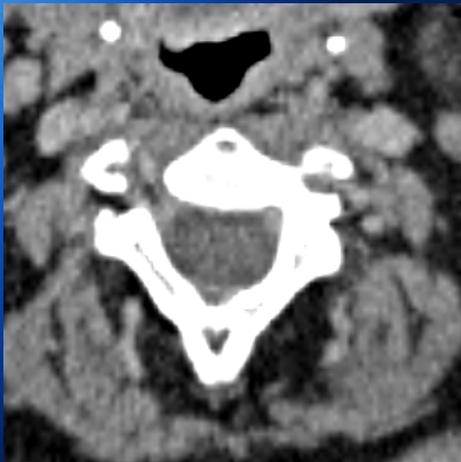
Objectives

- ❑ Understand the challenges associated with XBS screening
 - rate, responsiveness, training/dissemination, automatability, locale
- ❑ Review the medical imaging armamentarium re screening
- ❑ Assess “visibility” of concealed objects as a function of material, size,
- ❑ Assess repeatability and accuracy of the “visibility” measures
- ❑ Use results to assess TSO tools, TSO behavior, TSO environment, sensors, concept of operations, and algorithms

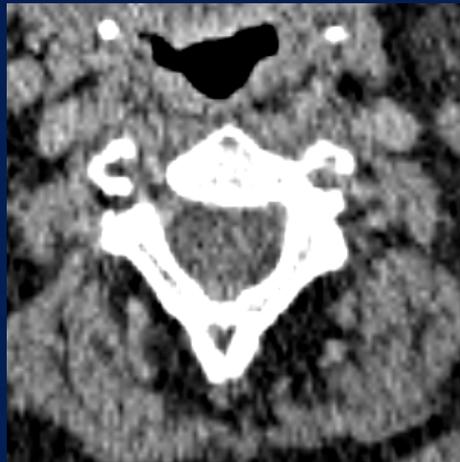
- ❑ Build the Community of Practice (COP)

Conspicuity Assessment in Low-Dose Clinical CT

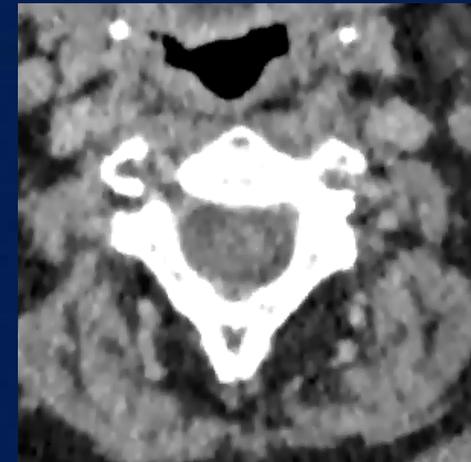
- ❑ Radiology community interested in lowering radiation dose of CT
- ❑ Low-dose CT increases noise
- ❑ Processing has been developed to deal with the increased noise advanced reconstruction and post-hoc processing apply
- ❑ Is conspicuity of anatomical features a useable benchmark?



FBP recon CT
Standard dose



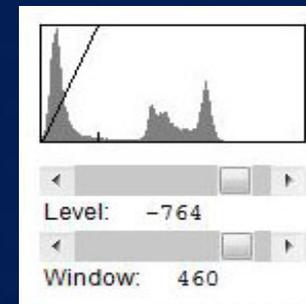
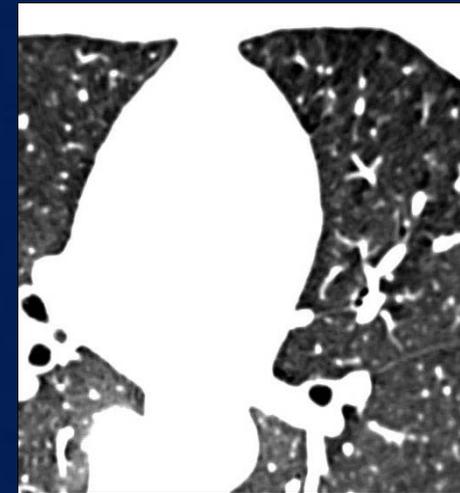
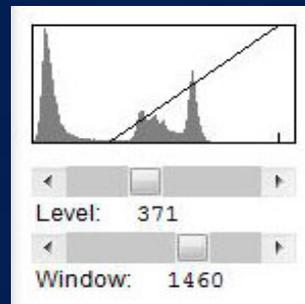
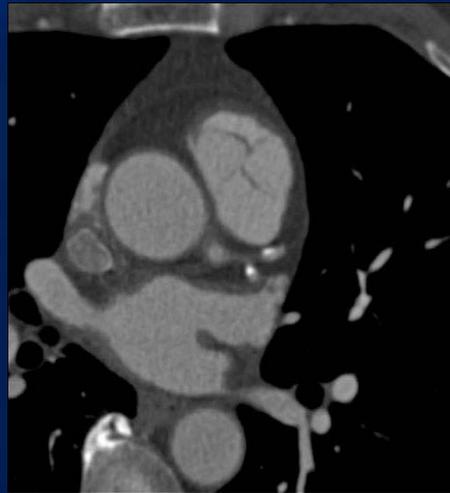
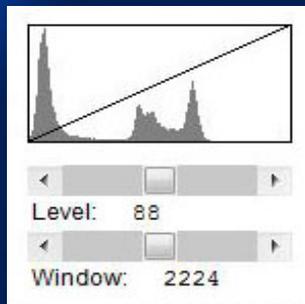
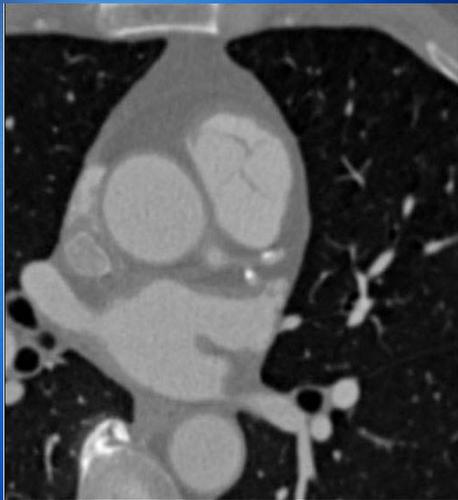
FBP recon CT
10X lower dose



Iterative recon CT
10X lower dose

Conspicuity Assessment Clinical CT W&L

Medical Imaging adjusts the map between content and brightness
- concentrate on the appropriate datarange



Approach

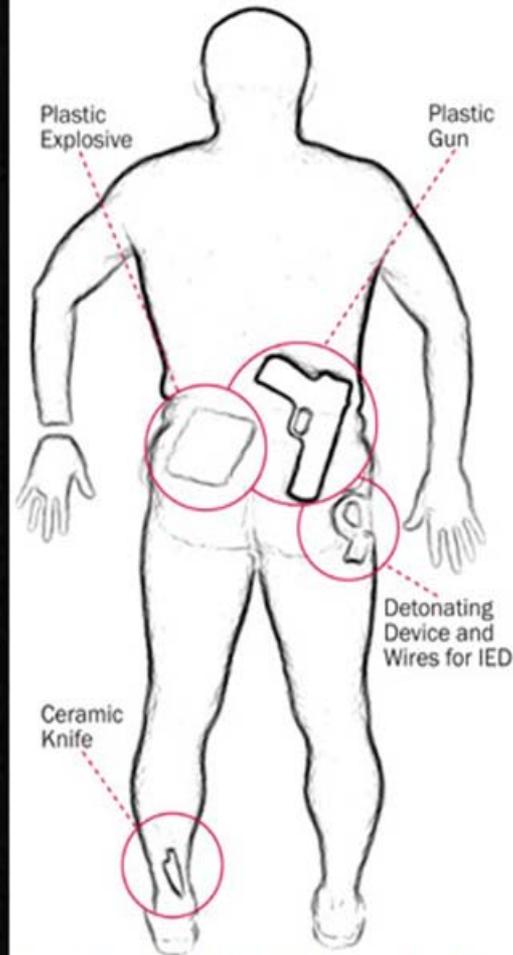
- ❑ Experienced medical imaging personnel acted as TSO's
 - Three PhDs from Department of Radiology, MGH
 - Assessed *conspicuity* of assorted objects within XBS images
- ❑ Conspicuity scale
 - 1 = cannot be separated from background based on contrast
 - 2 = marginal contrast difference
 - 3 = average contrast difference
 - 4 = clear contrast difference
 - 5 = maximal contrast difference
- ❑ Conspicuity is expected to directly relate to probability of detection, and inversely related to probability of false alarm

Conspicuity Assessment in Backscatter Survey

please note: all images are from the public-domain/fabricated

The New York Times

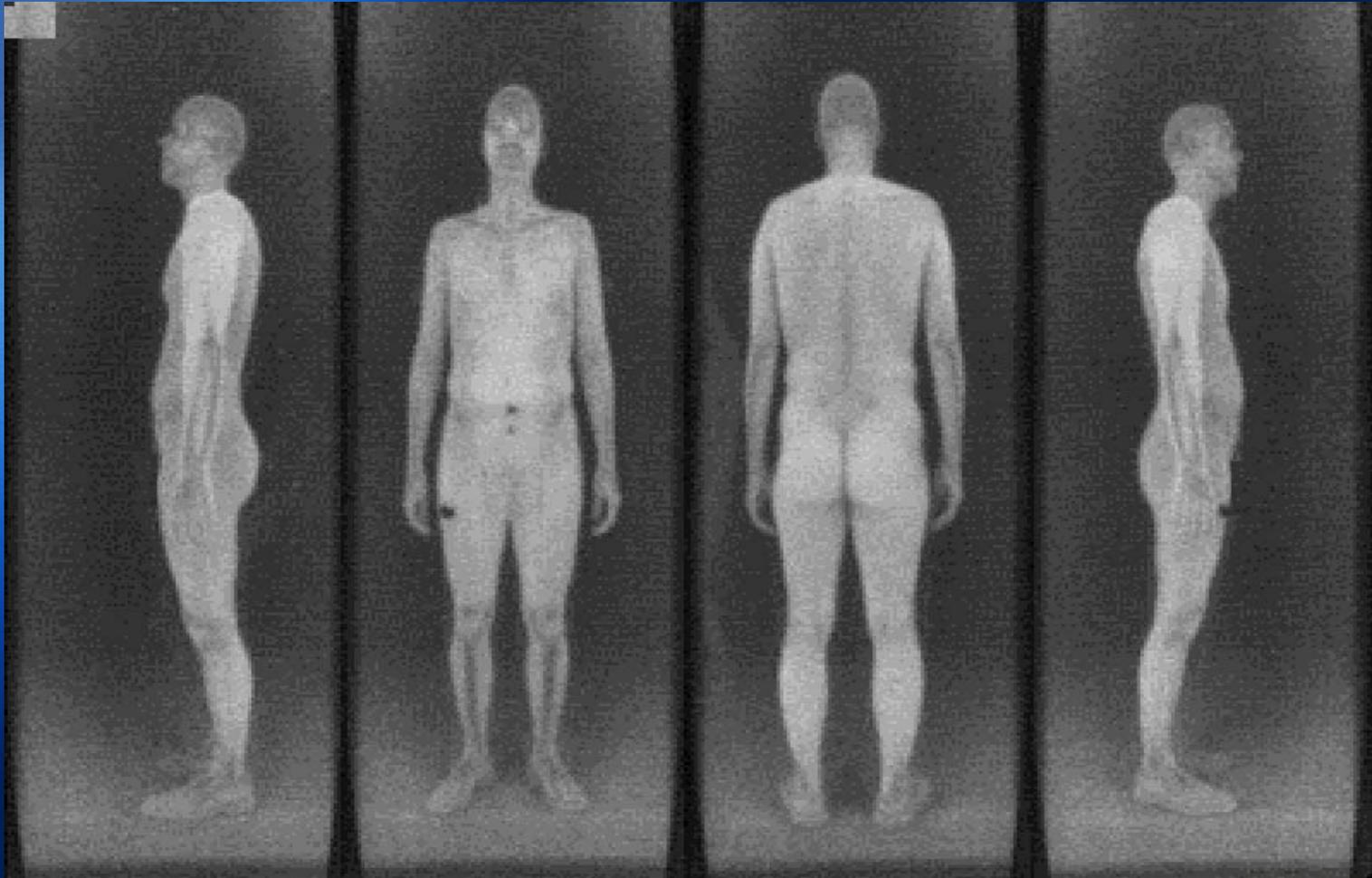
October 9, 2005



American Science and Engineering, via Agence France-Presse

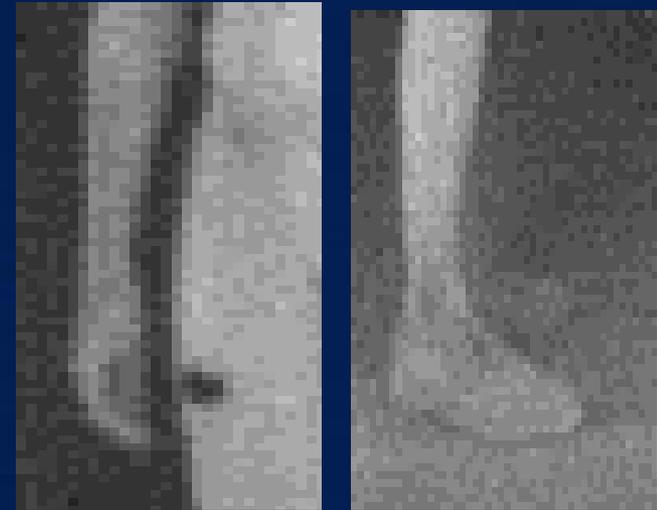
RECOMMEND

Conspicuity Assessment in Backscatter Survey



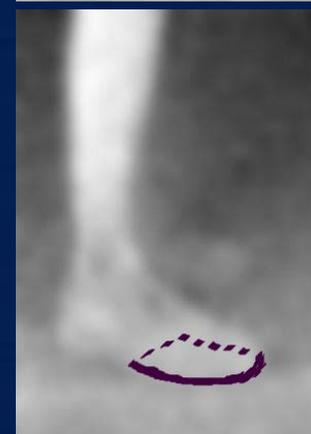
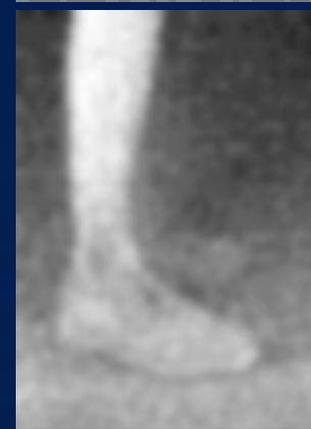
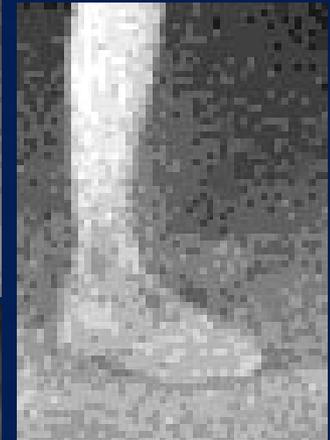
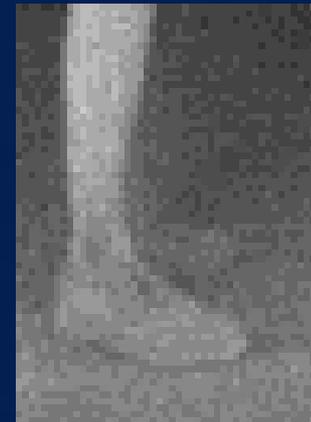
Procedure

- ❑ Utilized XBS data provided by Sandia National Labs
 - Volunteer subjects imaged with XBS scanner
 - Subjects had various concealed objects
 - Identities and locations of concealed objects were recorded in “ground truth” files
- ❑ Observes and tabulated results from examination of 400 images involving 390 objects placements on the bodies of volunteer subjects



Common Screening Issues

- ❑ Physics: minimal dose = sensing noise
- ❑ Identities and locations of objects of interest are not known
- ❑ Results from examination of images involving objects characteristics on the bodies of volunteer subjects must be representative to be generalized
- ❑ So... validation demonstrates efficacy
- ❑ Measure outcomes to learn
- ❑ Plan iteration to permit learning to adapt viz. the disease indications



Results

- ❑ Three readers yielded highly correlated results on conspicuity of objects
 - Inter-reader agreement increased over repeated trials
 - Read times decreased over repeated trials
- ❑ Related conspicuity to objects placed on subjects
 - Material, size, location, and subject pose
- ❑ Developed algorithms to enhance conspicuity
- ❑ Related (subjective) conspicuity to objective imaging metrics
- ❑ Final results are contained in SSI documents submitted to DHS

Conclusions

- ❑ There is meaningful synergy between medical image analysis and security screening
 - Image processing algorithms
 - Image quality assessments
 - Conspicuity of features of interest
 - Extract the meaning efficiently
- ❑ Our work has contributed to a rigorous understanding of the factors which impact conspicuity
- ❑ The methodology developed can be applied to other whole body screening modalities
- ❑ The methods can be automated and benchmarked

