Classification-aware methods for explosives detection using multi-energy X-ray computed tomography

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Motivation

• In luggage inspection, higher detection accuracy and lower false alarm rates are needed.
• Multi-Energy X-ray Computed Tomography (MECT) is a non-destructive scanning technology with the potential for enhanced material discrimination.
• Through the principled application of machine learning and optimization methods, significant improvement of existing MECT systems may be obtained.

Our focus:
Optimizing information extraction from MECT measurements for increased discrimination between explosive and benign materials

Materials and X-rays: The LAC
• X-ray interaction with materials captured by the Linear Attenuation Coefficient (LAC): \( \mu \)
• Function of X-ray energy
• Material “signature”
• MECT measurements contain LAC info.

Methods examined:
• Photo-Compton model (Photo-Compton)
• Singular Value Decomposition (SVD) [7]
• Sequential Linear Discriminant Analysis (SLDA) [8]
• Non-parametric Discriminant Analysis (NDA) [9]
• Heteroscedastic Extension of Linear Discriminant Analysis (HELDA) [10]
• Local Discriminant Embedding (LDE) [11]

Results of this study may lead to an improved CT based explosive detection system:

- The choice of features is not trivial.
- It is possible to do better than with photo-Compton.
- It is possible to do better than with just 2 coefficients.

Research to Reality

Next step: Incorporating the basis selection procedure into the complete MECT problem.

References: