

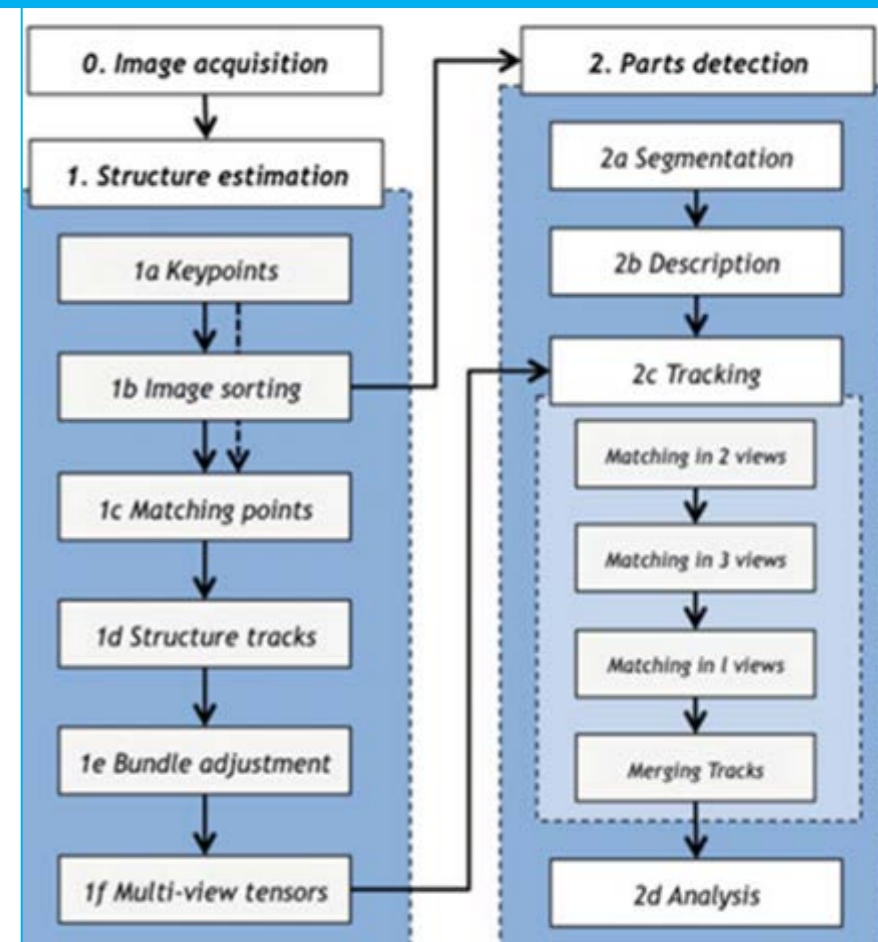
Introduction

Baggage inspection is the principal safeguard against prohibited and potentially dangerous materials at airport Security checkpoints. A reliable automated threat detection system for X-ray baggage imagery would significantly speed up the screening process and could improve airport security. In our project, we would like to improve the baggage inspection system.



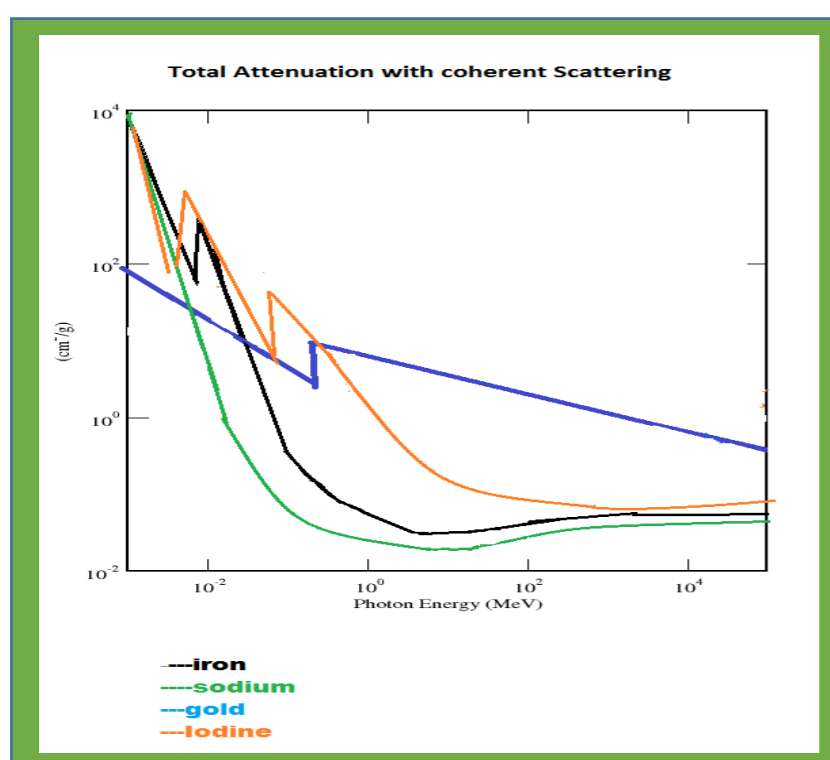
Method

- We have tried to detect objects in a sequence of images. The algorithms and ideas that we used are based on *Merys' works*².
- The general idea of his work is detection of objects such as razor and blades which is conducted by comparing a single SIFT descriptor of a reference object to SIFT descriptors of pre-segmented proposal regions in the image. Detections from different views are combined by tracking sparse SIFT features across images. You can see the Block diagram of the proposed algorithm.

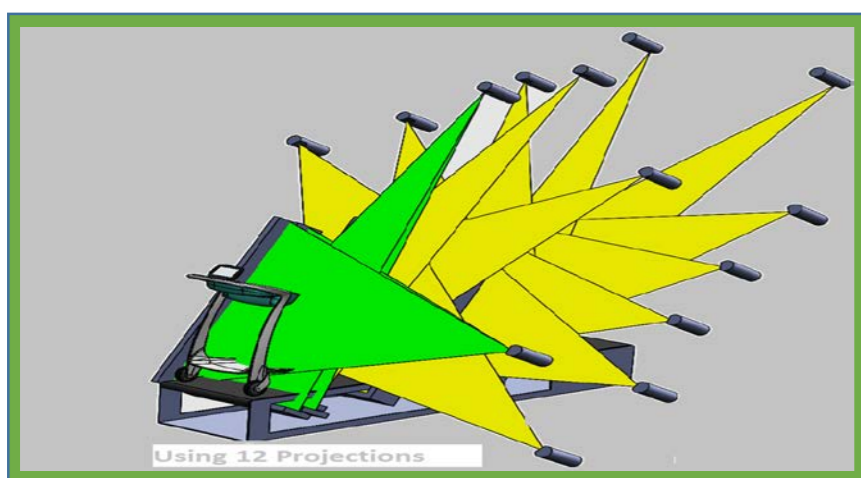


What will be involved in the project

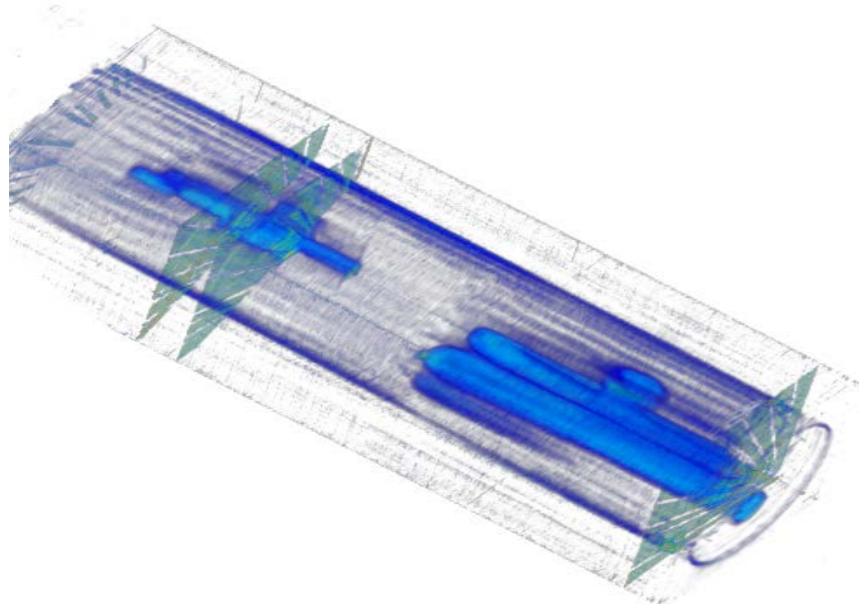
- In this project, multiple energy-selective measurements of the *attenuation*¹ are taken.



- Using many projections can provide us with the advantages of seeing the objects from different views especially when they are cluttered.



- A 3D-image can be reconstructed from projections of an object. The number of projection affects the reconstruction quality. A larger number projections will lead to better reconstruction quality. On the other hand, less projection number can reduce the radiation dose, save time and speed up the baggage inspection. You can see the result of reconstruction algorithm on our data in below.

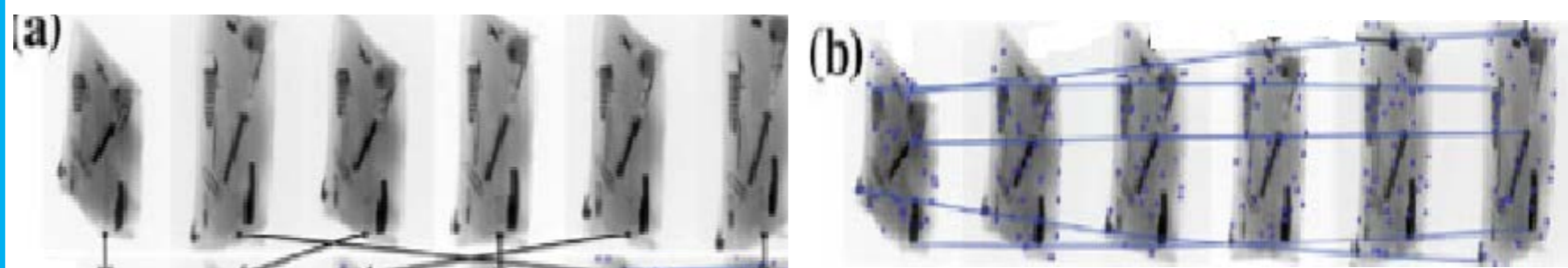


Result

To clarify, we show the result of *Merys' work* for detection of pencil sharpener, clip and zipper slider body. The algorithm consists of the following stages:

- a) Unsorted sequence with six X-ray images. The images are sorted according to their similarity.
- b) Sorted image, key point and structure -from- motion (In this stage points have been matched and looking for all possible structure tracks by considering one key point in each image of sequence.

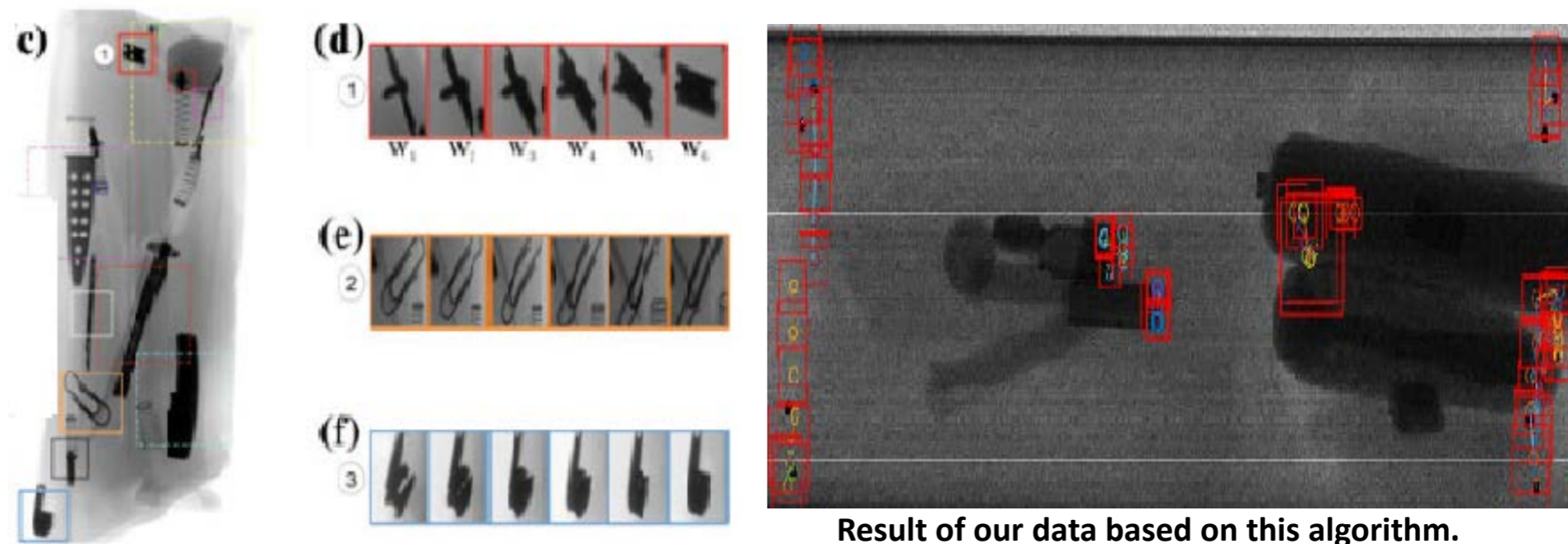
In the end the bundle adjustment algorithms has been used to provide a multi view tensor.



- c) Detection of objects.
- d & e & f) Detection of parts of interest in the sequence

This stage consists of four steps : Segmentation, Description , Tracking and Analysis.

- Merys' work* shows the result only for scenes/bags with little clutter to occlude objects of interest and is not so compatible with all type of objects. You can see the result of the algorithm on our data in below.



Result of our data based on this algorithm.

Future Work

- In future we are looking for some methods that can detect objects in a sequence of images taken from different views such as works done by Mery.
- Using the segmentation information to decrease the necessary number of projections to 4.
- Looking for some methods in classification as well as segmentation that can improve security by using Multi Energy channels and multi views.

Aims

Improvement of the baggage inspection by using Multi-Energy detectors and different projections especially when we have complicated images with poor image resolution, image clutter, high levels of noise and artifact.

References

- Limor Martin, Enhanced information extraction in Multi-energy x-ray tomography for security. 2014
- Mery, X-ray Testing by computer Vision, 2015
- Sidky, Emil Y., Chien-Min Kao, and Xiaochuan Pan. "Accurate image reconstruction from few-views and limited-angle data in divergent-beam CT." *Journal of X-ray Science and Technology* 14.2 (2006): 119-139