

NEW IMAGING TECHNIQUE ALLOWS IMPROVED FOREIGN BODY DETECTION

Author: Monica J. Emerson

Supervisors: Line Clemmensen, Hildur Einarsdottir

MOTIVATION

Would you like to find an insect in your food?



OR...

get injured while eating because of this?



CAN WE FIND ORGANIC MATERIALS SUCH AS INSECTS, PLASTICS OR WOOD USING X-RAYS?

DATA

Selection of foreign bodies

Different absorption, refraction and scattering properties

Different sizes

Suggestions NEXIM collaborators and Japanese survey



a) 4x4x4 mm



b) 3x3x3 mm



c) 2x2x2 mm

Figure 1. Turkey with different sized foreign bodies.

DESIGN

GMM
Gaussian Mixture Model

Mahalanobis distance

Hard threshold

Results evaluation

Figure 2. Steps in the design process of an automated foreign object detector.

NEW TECHNOLOGY

Soft matter cannot be identified with conventional X-ray, but it is found in higher contrast in other imaging modalities, such as phase-contrast and dark-field, based on refraction and scattering properties.

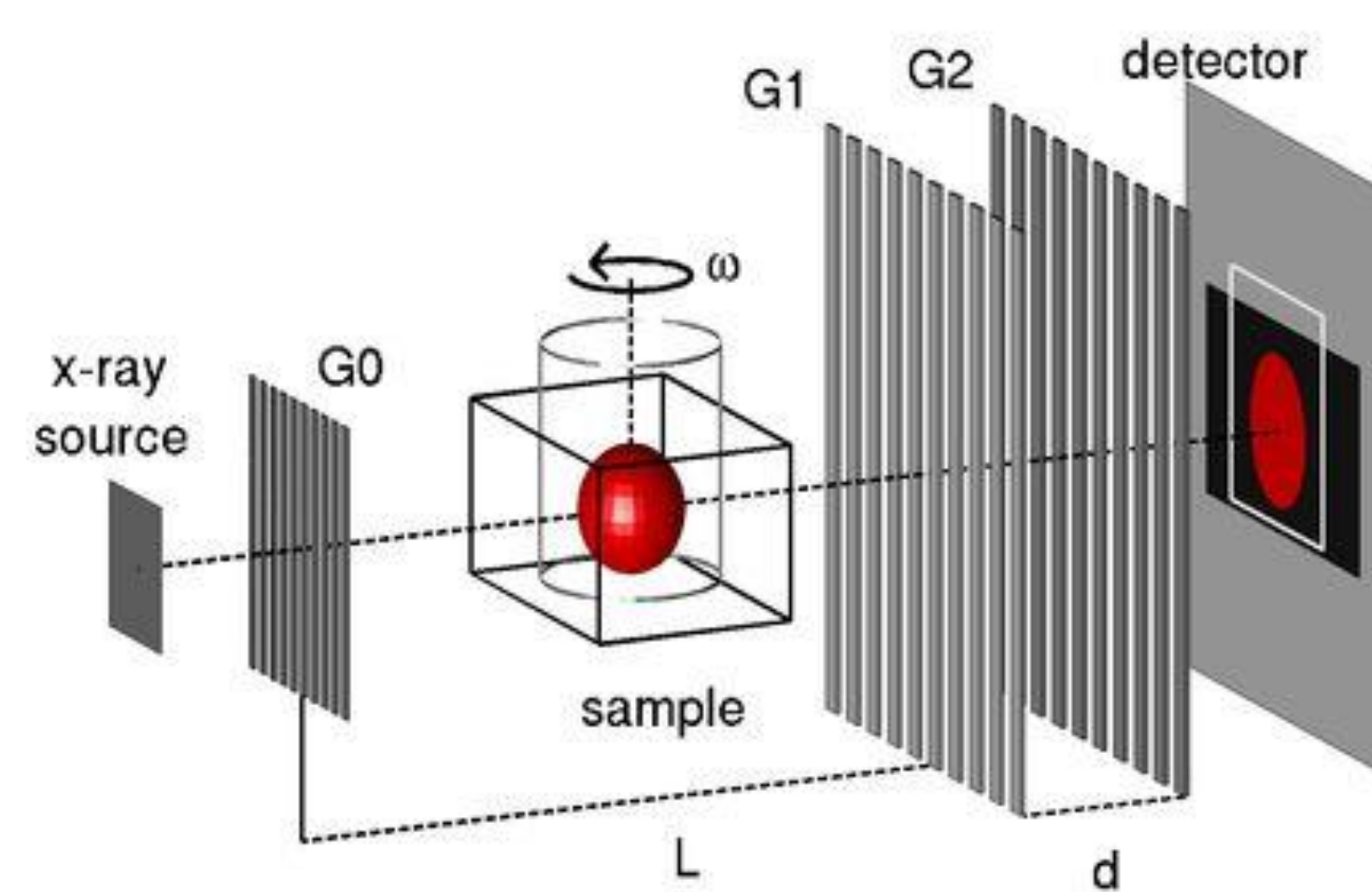


Figure 3. Sketch of a Talbot-Lau interferometer (Bech M., X-ray imaging with a grating interferometer, KU, 2009)

In Figure 4, the GBI (Grating-Based Interferometry) modalities are illustrated for turkey. As can be seen, foreign bodies are seen with varying contrast between the different modalities. Glass, metal and stones can be detected easily by the difference in intensity from the absorption modality (transmission). On the contrary, soft and hard plastic, rubber, insects and wood are better enhanced in the other modalities.

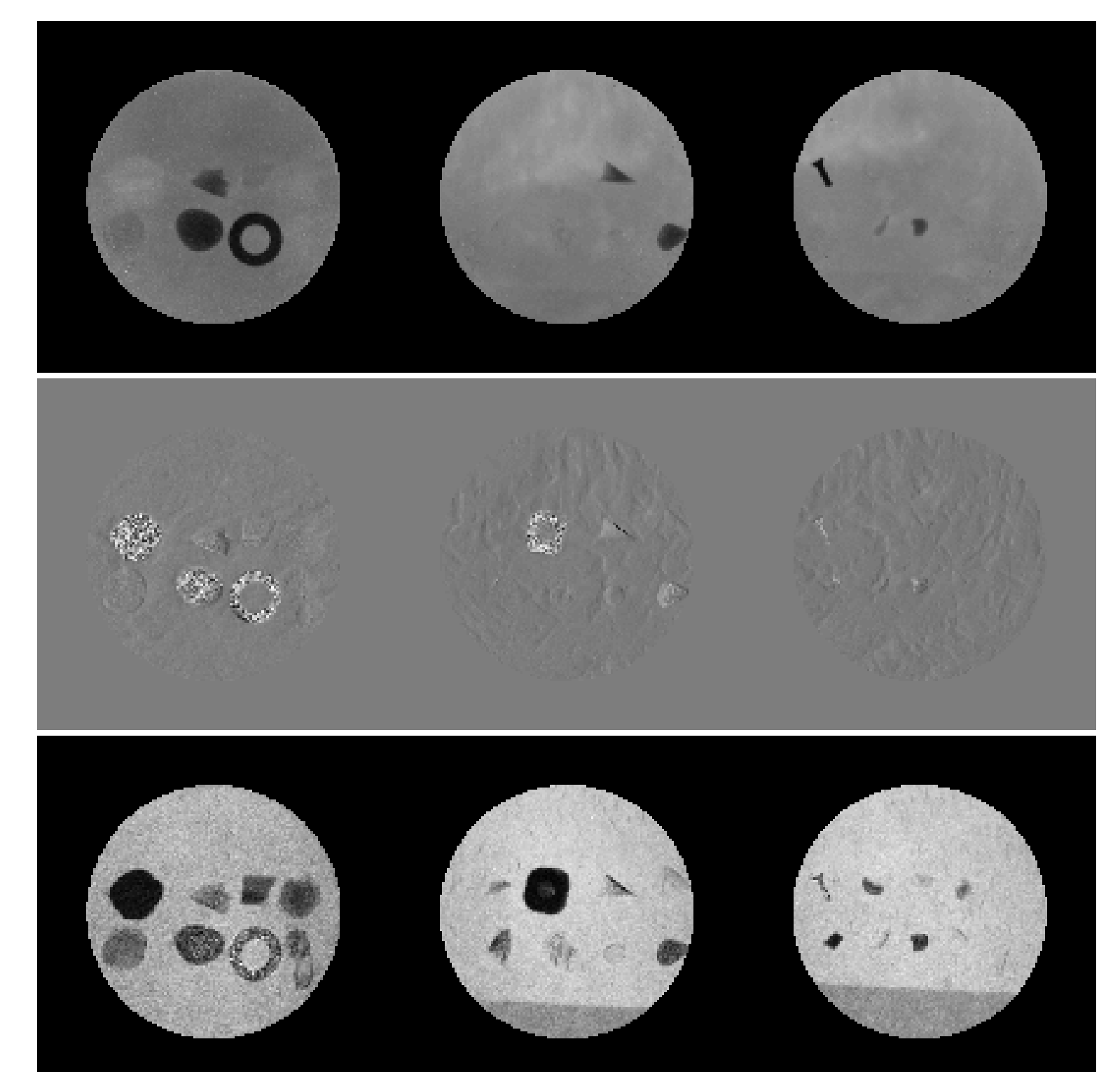


Figure 4. GBI modalities: Absorption, refraction and scattering.

RESULTS

Figure 5 shows the ROC curves for each of the models with different thresholds.

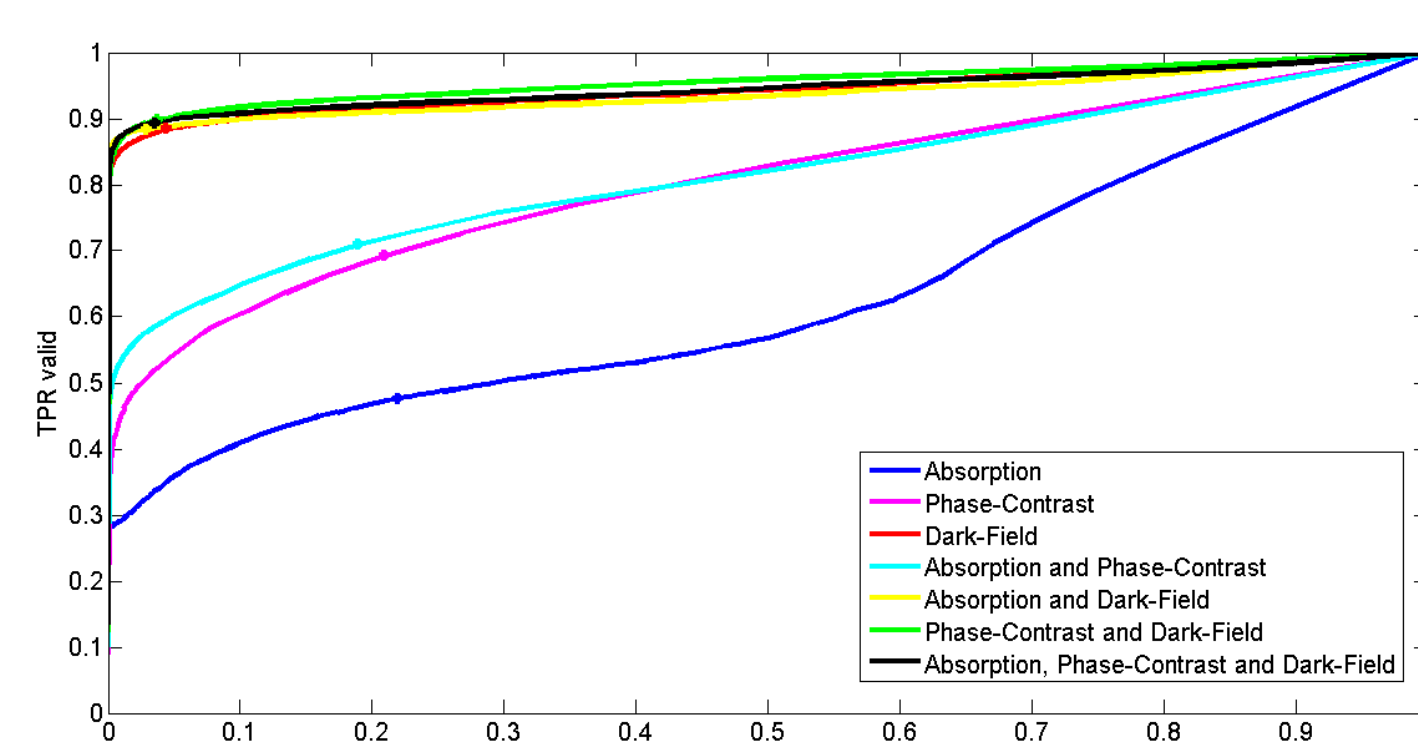


Figure 5. ROC curves for each model.



ABSORPTION
VS
PHASE CONTRAST AND DARK FIELD



CONCLUSION

Grating-based interferometry (GBI) allows to detect organic matter and performs much better than typical X-ray when there is a mix of organic and non-organic foreign bodies.

As a consequence, a quality assurance conveyor belt solution with GBI would be much more efficient than one with typical X-rays for industries where organic materials are potential foreign bodies.