

# X-ray classification of Special Nuclear Materials using image segmentation and feature descriptors

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## Abstract

Reliable inspection techniques are crucial for the safe storage and transport of nuclear materials. Among the factors to be considered is the morphology of Special Nuclear Materials, typically stored in packages of multiple layered cannisters. X-ray radiography allows visual inspection of the material inside, without risking exposure. However, some morphologies of material have visual similarities which risks errors being made when determining package contents from radiographs. Image processing techniques can automate the classification of radiographs in a deterministic way, thus providing a valuable inspection aid to nuclear storage facilities. In this paper, segmentation methods are proposed to identify the nuclear materials inside the package, and feature extraction methods are designed that derive multiple descriptors of the shape and morphology of the segmented material. Machine learning is then used to train a model that uses only the extracted feature descriptors to classify radiographs into 3 different morphologies; powder, pellets and clinker. This technique is tested on 138 X-ray images and initial results are very promising.

*Keywords:* Classification, Machine Learning, Morphology, Special Nuclear Material, X-ray