

## **Cargo X-ray Image Anomaly Detection using Intelligent Agents (CXIAD)**

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### **Abstract**

Our technical concept applies FORELL's unique intelligent agent technology to learn rules for detection of anomalies in images created by high energy x-rays, thereby reducing operator load, reducing false positives, and reducing inspection time. Our technology is unique in the creation of anomaly detection rules that are automatically generated through a unique intelligent agent learning capability. In addition, our agents have an inherent ambiguity resolution capability, to identify objects not seen before. This generalization capability is especially applicable to the x-ray imaging detection domain, because not everything in the universe can be learned. Our intelligent agents have an inherent reasoning capability that will help operators discern much quicker. In our approach we will transform the image data to a reduced number set of numeric data for each grid in the x-ray, called a sub-scene. FORELL will use pixel data to produce a coefficient based description of each sub-scene within an image. Because pixel data can be associated with density, the coefficient data will contain information an intelligent agent can associate with objects it has been trained to recognize. In the learning mode sub-scenes with known truth are used to train intelligent agents to recognize anomalous areas within an image. This information can then be used for alert processing.

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### **Benefits**

The benefits gained will 1) reduce false positive detections, 2) reduce the time required for cargo container inspection results from the reduction in false positive reports, 3) reduce the time the operator spends examining an X-ray scan. The ability to improve detection of explosives or radio-active materials at points of entry into the US will significantly help in Homeland Security. The applicability of FORELL Intelligent Agent Technology is broad. The specific detection rules and algorithms that will be created here are specific to the detection of anomalies in X-ray images. Potential commercial applications could be sea port cargo inspection, airport cargo inspection, cruise ship baggage inspection and airport baggage inspection.

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**Keywords:** X-ray, radiography, non-intrusive inspection, signal processing, imaging, detection, false positive

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