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systems

AS&E[®]

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Rapiscan Multi-Energy Portal (MEP) with Emphasis on Automatic Detection of Illicit Materials

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CARGO SCANNING & SOLUTIONS

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Requirements for Successful NII ML Algorithms

Challenge: High-performance Cargo NII ML algorithms require:

1. Significant-sized image data sets with labelled targets present in large numbers
2. Equal-sized data set with no target present
3. New training for each conveyance; data set size depends on complexity of conveyance and cargo homogeneity
 - a. Simple conveyance/simple task: a few thousand images
 - b. Complex conveyance/complex task: 100K images

Problem: Targets of interest are not present in large numbers of images and manual acquisition of images is expensive, time consuming, and difficult

Solution: Automated X-ray acquisition plus Threat Image Projection (TIP) with SOC data can be used to generate Synthetic Data

Results: Preliminary test of a few hundred images of weapons TIP train on SOC commerce data (33K images). Detection in real cargo resulted in a 96% detection with 3% false alarms rate

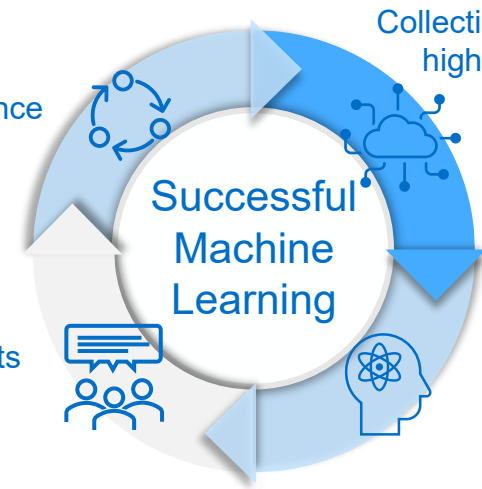
Continuous Algorithm Improvement Process

Utilize updates to continually improve algorithm performance

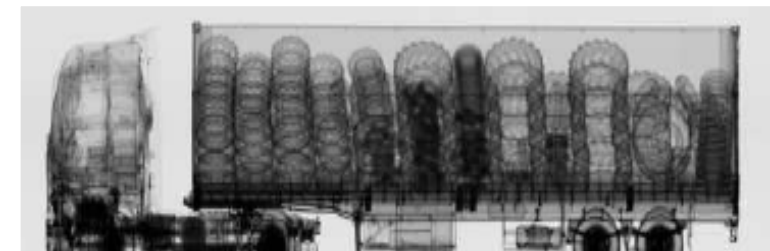
Collection of consistent, high quality and high volume of data

Domain experts guide data scientists with a production implementation

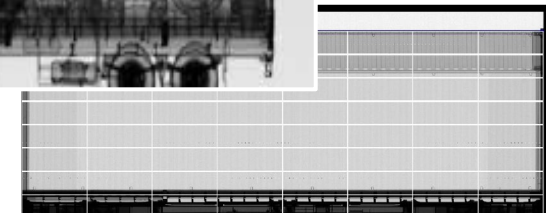
Data scientists curate and label data



Example: Empty Container – Cargo Container



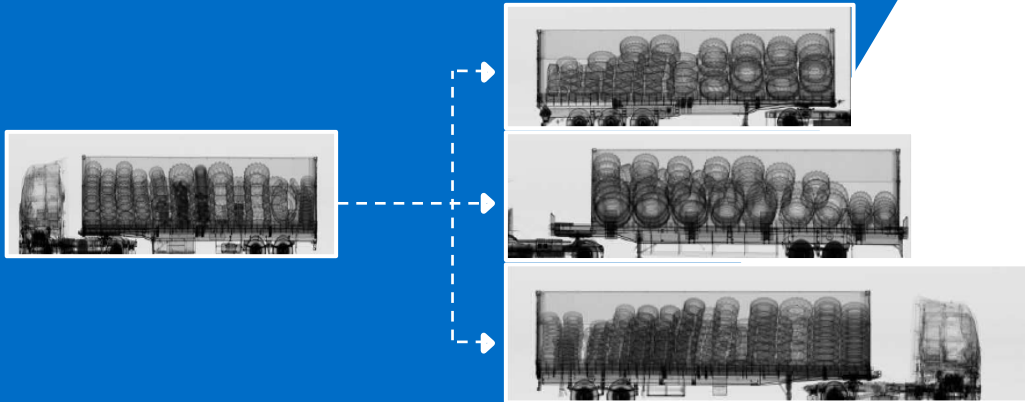
Filled



Empty

iinsight Similar Cargo

For Eagle[®] M60, P60, G60, T60, M25,
P25, R60/90, and OmniView[®]



Operator Assist

- Aids in determining what is “normal” when it comes to cargo not previously seen
- Retrieves saved images that are most similar to the current image based on image texture and intensity distributions
- Image analysts choose from a set of retrieved images that best match the current cargo
- The selected image is displayed side-by-side with the current image for comparison

Machine Learning (ML) Algorithm Development

- Automatically select images from a large data set with a target cargo type
- No prior training required, works with non-homogeneous cargo

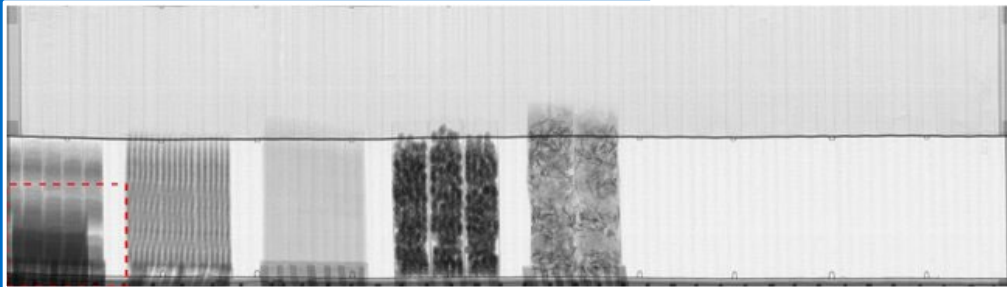
insight Object Detection

Conventional ML

Bottle Detection



Cigarette Detection



- Based on targets that occur frequently in SOC Cargo images
- Utilizes Rapiscan Container Segmentation and a CNN-based Algorithm
- Training on Rapiscan | AS&E Eagle G60 and implemented across M60, P60, G60 products
- Highlights any region of the cargo that appears to contain identified objects
- Aids in the detection of large quantities of unobstructed, uniformly-packaged bottles of liquid or cigarettes

Threat Data Generation

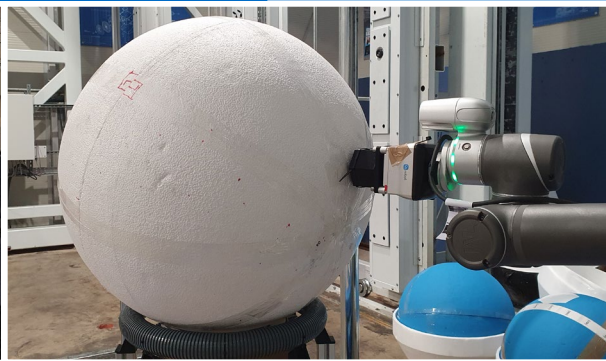
Rapiscan Test Facility



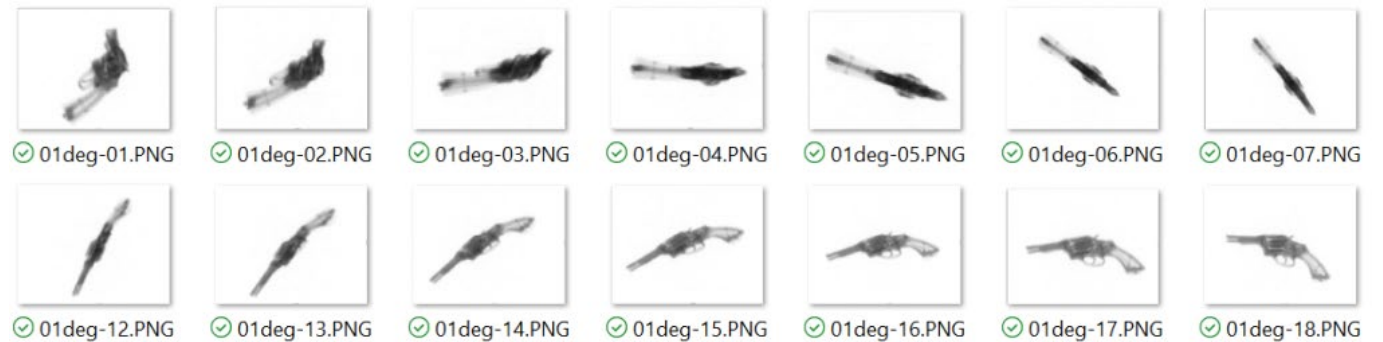
- 4/6MV linac duplicates product performance in deployed systems
- Detector array matches Rapiscan HE x-ray systems
- Gantry system enables variable rate and height transport
- Polystyrene sphere sample holder with low/uniform attenuation
- Robotic integration 360 Degree rotation
- Accommodates samples from small handgun to pallet sized
- Automated operation for long duration testing



PS Ball with
weapon



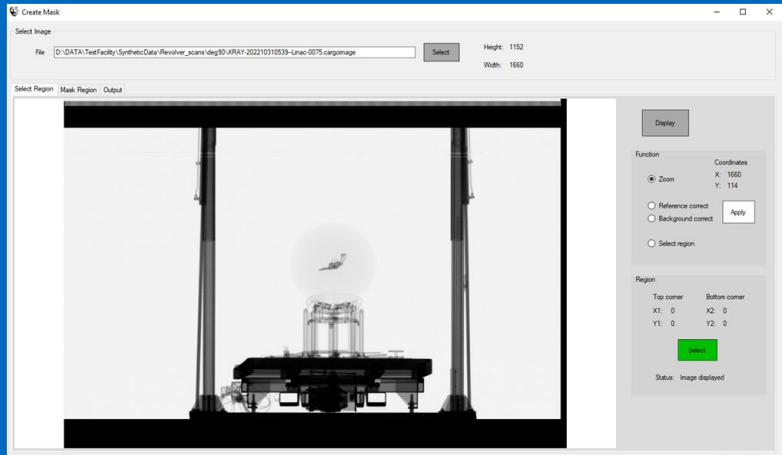
6-Axis Robot



Example handgun images

Synthetic Data Automated Processing

Automated Tool for Image Segmentation



Example Segmented Target Images



Revolver
358 images

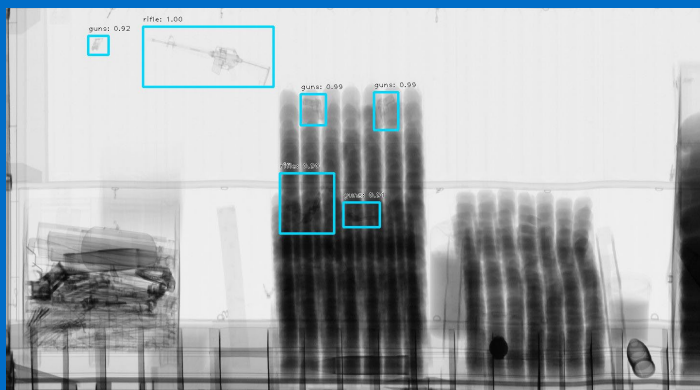


Pistol
359 images

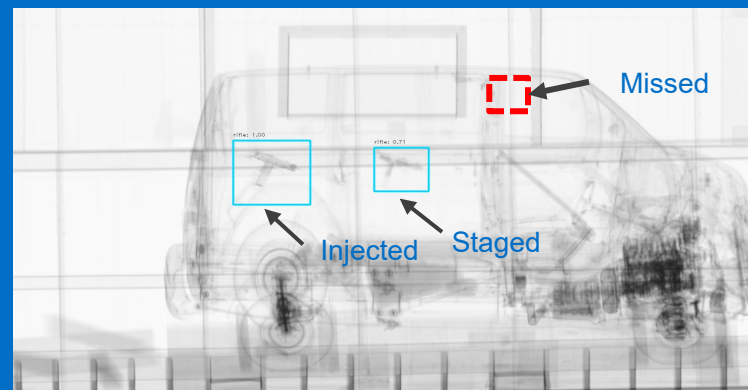


Uzi
147 images

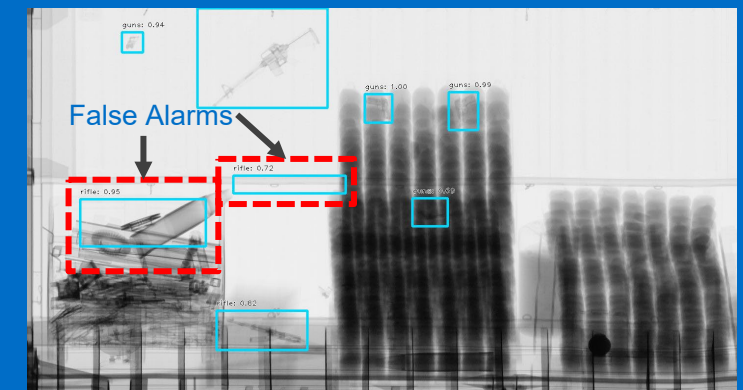
Example Results with Real-World Cargo



100% Accuracy



Missed Weapon



False Alarm

Thank You!

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