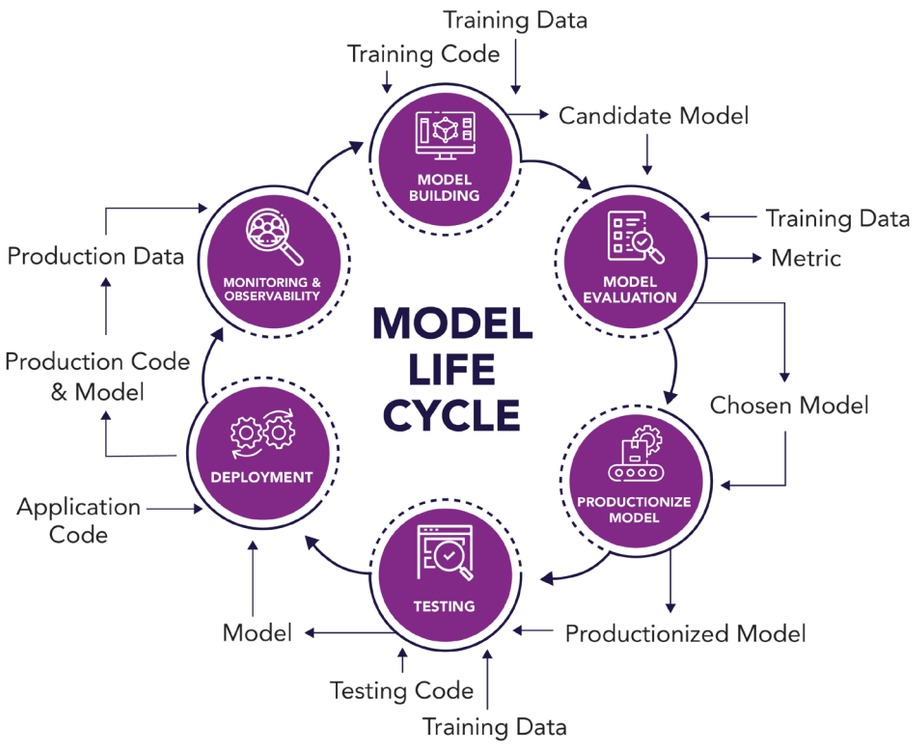

INTELLIGENT DETECTION

By incorporating AI and machine learning into security screening, airports can benefit from a suite of tools capable of detecting even the most sophisticated of threats

Artificial intelligence and machine learning (AI/ML) methodologies have been prominent in technologies across many industries and sectors for quite some time. Aviation, specifically the security screening space, has lagged in large part due to the common practice of using proprietary technologies from multiple manufacturers. With the growing shift to open architecture, security authorities can upgrade their screening operations and take advantage of AI/ML benefits through more advanced, integrated solutions.

There are misconceptions that AI can magically solve problems with little to no intervention. By design, AI-based algorithms are highly effective at identifying patterns in data to create actionable, real-time insights. In contrast, it is virtually impossible for the human brain to quickly process, interpret and analyze large sets of data and effectively connect the dots in the same amount of time. However, the key to taking advantage of emerging AI capabilities is making the ever-increasing volume of scanning data available to deep-learning analytics so that detection algorithms can be improved and deployed as frequently as possible. The controlling path will always be regulatory approval of the new algorithms, but hopefully in time confidence in the ability of AI to make sound recommendations will grow, thus streamlining the approval process.

Airports already employ several threat-detection technologies at checkpoints, such as millimeter-wave people scanners, CT-based or x-ray baggage scanners, and explosive trace detection devices. These alone are not enough to stay ahead of threat actors and minimize disruptions to passengers. AI-based algorithms will soon become a requirement to achieve those goals. When properly integrated with checkpoint systems, AI-based algorithms significantly improve threat detection, reduce human errors in threat-detection decisions and reduce false alarm rates from the systems themselves.

The Leidos approach

From data collection to model training and deployment, Leidos weaves AI into the fabric of its development processes. The accuracy, speed and fairness of decisions made by AI-based algorithms are only as good as the quality of the training data and associated ground truth. The Leidos approach gathers the highest-quality training data sets aimed at minimizing false positives and false negatives through better ground-truth sourcing.

Traditional approaches to detection involve comparison of detected objects with a collection of images and parameters. However, when presented with rotated or oddly positioned detections, these methods are more likely to lead to false negatives and false positives due to inherent limitations. Leidos employs deep learning AI methods to examine hidden relationships within the test data set to form meaningful associations between threats and the features and shapes of objects – similar to the way the neural cortex of the brain operates. Additionally, advances in data set generation ensure these algorithms are built using high-quality images with precise threat labeling. This reduces the ambiguity between true threats and non-threats. The combination results in better determination of true threats.

AI and threat detection imaging systems

ProVision, Leidos's flagship people scanner, was developed over 20 years ago. Since that time more than 2,600 units have been deployed worldwide. ProVision 3, the newest model scheduled for commercial release in early 2023, leverages many of the technological advances previously outlined. It features a more sophisticated antenna arrangement, a greater depth of field, enhanced deep-learning-based AI algorithms, a data-collection system and gender-neutral threat detection. The systems and their AI algorithms keep more than five million travelers safe each day. This product line features state-of-the-art data-science techniques that provide

ABOVE LEFT
Flow chart of MLOps framework to deploy reliable and efficient machine learning models in production environments

ABOVE
Mosaic's real-time dashboards provide a centralized view of all checkpoint data

BELOW
ProVision, ClearScan and ProPassage all have a role to play in the modern security checkpoint

gender-neutral screening coupled with high-resolution detection below 3mm.

ClearScan is the computed tomography (CT) cabin baggage scanner offered by Leidos. The AI-based technology was designed to deliver the highest level of threat detection while providing a more seamless and convenient experience for passengers, as approved liquids and electronics can be kept in cabin baggage. The AI-based algorithms scan more than 40 million bags per month looking for prohibited items and protecting the traveling public. The algorithms automatically screen for large and small prohibited items, assisting screening officers with the identification of many prohibited items – even items that have been taken apart in an attempt to cheat the security check.

The Leidos approach to creating and maintaining AI-based algorithms in the ProVision and ClearScan product lines includes key capabilities such as data augmentation to train the models to be less dependent on shapes and positioning; data set verification methods to improve labeling of training data; an improved image preprocessing pipeline to capture the fidelity of images being analyzed by the algorithm; synthetic data development based on 3D models to add variety to the test and training sets; full data set collection through real models with various densities, threat placements and physical sizing; synthetic and real data set combinations for training, modeling and validation purposes; training and refined algorithm validation; comparison of 'before' and 'after' states using various ML and statistical tools to predict real-world testing outcomes; bundling and testing the algorithm into the ClearScan software stack; and design intent performance validation and verification.

> When properly integrated with checkpoint systems, **AI-based algorithms** significantly improve threat detection

AI and explosive trace detection systems

Leidos B220 HT and H150E are desktop and handheld explosive trace detection systems (ETDs) used for accurate, real-time detection of explosives and drugs using ion mobility spectrometry (IMS). The AI-based algorithms continually look for thousands of substances that are present in extremely low concentrations. By way of analogy, the concentrations being detected and flagged are less than that of a packet of sugar being dumped into an Olympic-sized swimming pool.

The Leidos approach to creating and maintaining AI-based algorithms in the ETD product line includes data augmentation to train the models to be less dependent on nominal substances; data set verification methods to improve labeling of training data; an improved data preprocessing pipeline to capture the fidelity of substances being analyzed; synthetic data development to add variety to the test and training sets; full data set collection through use of real substances; synthetic and real data set combinations for training, modeling and validation purposes; training and refined algorithm validation; comparison of the 'before' and 'after' states using various ML and statistical tools to predict real-world testing outcomes; bundling and testing the algorithm into the B220 HT/H150E software stacks; and design intent performance validation and verification.

AI and enterprise security software

Airport security authorities are looking for a holistic security management system for their operations. To this end, Leidos developed Mosaic, an integrated, cybersecure and scalable open architecture platform. It brings together disparate security components into a single, cloud-ready, enterprise system. This platform further expands the value of AI-based algorithms as each system data set is no longer siloed. When integrated into the Mosaic platform, the comprehensive data set provides timely, accurate and repeatable insights while creating a centralized view of the entire checkpoint. By leveraging AI, Mosaic also enables advanced risk assessments, real-time forecasts and automated control functions.

Importance of MLOps within the Leidos AI/ML framework

Finally, MLOps is a development methodology that aims to deploy reliable and efficient machine learning models in production environments. Throughout the development, Leidos evaluates algorithm candidates using MLOps and the model lifecycle. As such, much of the tasking is repeated through an iterative process to improve algorithm performance. By employing the MLOps framework, the continuous integration and delivery of the dozens of Leidos AI algorithms are constantly being improved and customers can reap the latest benefits when they decide to update. ■

Seamless travel from curb to gate

Leidos facilitates secure, efficient passenger movement while enhancing passenger experience through fully-integrated security detection solutions in airports worldwide.

- Mosaic – Enterprise Solutions
- ClearScan – CT Scanner
- B220 HT – Trace Detection
- ProVision – People Scanner
- ProPassage – Automated Tray Return
- H150-E – Trace Detection

Leidos.com/security-detection

leidos