Non-Intrusive Inspection and Detection for Border Security

Pacific Northwest National Laboratory's (PNNL's) deep knowledge of machine learning (ML) operations supports automated training, testing, and deployment of operational artificial intelligence (AI) algorithms for border security and other national security purposes.

SYSTEMS INTEGRATION

PNNL has a long history of integrating non-intrusive inspection (NII) equipment in all forms. PNNL understands the real-world challenges of integrating AI with deployed operational systems, and the rigorous quality assurance required to build trusted models and software.

Working with the U.S. Department of Homeland Security (DHS) Countering Weapons of Mass Destruction Office, PNNL has led the systems integration of Radiation Portal Monitors since 2003, including all facets of integration and various post-install tasks. PNNL provides similar support to the U.S. Customs and Border Protection (CBP) NII division, including testing and evaluation of X-ray imaging systems and support to the Multi-Energy Portal project under deployment at multiple points along the southern U.S. border.

DATA PIPELINES

PNNL's data pipeline work transcends multiple DHS organizations. PNNL has developed tools in use around the world to ingest and transmit inspection data in a secure and scalable manner. Funded by the DHS Science and Technology Directorate, the Common Viewer Air (CVAir) pilot project uses Amazon Web Services (AWS) to transport computed tomography passenger baggage data from originating international airports for targeted flights destined for the United States. Imagery and metadata are then made available to a U.S. command center that screens bags before arrival. The system integrates with participating commercial airlines so that upon landing in the United States, most baggage is automatically checked on to domestic destinations while routing bags requiring additional inspection to the forward inspection station.

To enable use of best-in-class automatic threat recognition algorithms for the project, PNNL led a group of government and industry partners to

develop and implement an open data exchange specification, which was adopted by the equipment vendor for CVAir. Further, PNNL's deep expertise in securing AWS resources and integrating them with our Cybersecurity Operations Center provides access to a trusted, government authorized, accredited system, meeting all security requirements for government and commercial partners.

DATA ARCHITECTURE

For over 18 years, PNNL has supported the CBP Office of Field Operations by integrating a diverse set of data systems to capture inspection data, officer adjudication, ML analysis, and equipment service request information. These efforts provide near-real-time situational awareness, on-demand investigation support, and long-term official record data retention. Our staff provide the data architecture expertise necessary to assure that data provenance and integrity required for law enforcement actions is maintained across all aspects of these databases.

CLOUD ENGINEERING

Building on many years of software and IT engineering expertise, PNNL is an established leader in using modern cloud computing platforms to achieve the massively scalable computing resources required to operate and analyze data from NII equipment.

For CBP, PNNL has provided subject matter expertise to design, plan, and migrate big data systems to the cloud for several near real-time data pipelines for inspection equipment at ports of entry

around the world. Our skills in scalable cloud native application development and expertise in data engineering have modernized existing platforms while allowing scalability for newer high-resolution radiation detection systems and many different generations of imaging systems, both old and new.

ML ENABLED AUTOMATED THREAT REDUCTION

PNNL supports CBP NII clients in development and deployment of several ML algorithms for automated threat reduction, including

- Design and implementation of novel ML methods,
- Training of these methods on PNNL's computation resources or through cloud services,
- Embedding ML methods into an operational data pipeline, and
- Human-machine teaming of algorithms with CBP analysts through front-end development and concept of operations recommendations.

MULTIDISCIPLINARY EXPERTISE

PNNL's NII ML team includes NII equipment scientists, computer vision scientists, and data engineers. The team includes and interfaces with other PNNL staff developing ML techniques to address our sponsors' biggest challenges, including for the National Nuclear Security Administration, Department of Defense, and the intelligence community.

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