Data Analytics
for International Safeguards

The International Atomic Energy Agency (IAEA) is responsible for verifying the peaceful use of nuclear energy across the globe. The scope of the verification task is increasing due to the spread of nuclear energy technologies to new countries and the development of new facilities such as spent fuel repositories. Combined with the increasing availability of open source and geospatial information, the IAEA is facing data analytics challenges across its safeguards verification workflow.

Sandia has the high-performance computing resources, a deep technical bench on data analytics, and legal, technical, and operational knowledge of international nuclear safeguards that makes us uniquely suited to develop and evaluate emerging data analytics techniques for pressing safeguards problems.

Adapting for the Future

Data analytics is an increasingly visible field, with fast-evolving capabilities and applications across the global nuclear security and nonproliferation domain. Sandia is developing an Initiative on Data Analytics for Global Nuclear Security and Nonproliferation that will combine our advanced analytical capabilities with nonproliferation domain expertise and domain specific data to ensure continuing verification of international safeguards in a new data-rich environment.

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Current Research Areas

Current Research in Data Analytics for International Safeguards

In collaboration with the U.S. Department of Energy's National Nuclear Security Administration and through internal research initiatives, Sandia has been developing and evaluating novel data analytics capabilities and approaches to support international nuclear safeguards for almost four decades. Our most recent work focuses on these capabilities:

Deep learning for image and video analysis

Sandia is applying existing, deep learning algorithms to enhance image and video classification aimed at two safeguards verification activities

1. The collection and analysis of open source multimedia data
2. The assessment of safeguards surveillance data collected at nuclear facilities.

Semantic graphs for multimodal data integration and analysis

Sandia is using expert elicitation and unattended machine learning to look for spatio-temporal patterns within multimodal sensor data in a Sandia testbed to understand how unattended safeguards systems might be used together.

Safeguards process modeling and anomaly detection

Sandia is applying novel machine learning methods to models of safeguarded nuclear facilities to better understand how multiple sensors distributed throughout the facilities, either safeguards sensors or operator-owned sensors, might be used to enhance detection of diversion of nuclear materials or misuse of the facility.

Machine learning for remote sensing analysis

Sandia is examining how increased collection rates combined with machine learning algorithms are used to discover and classify nuclear operations to support safeguards verification.

Graph analysis of nuclear fuel cycle networks

Sandia is utilizing recent advances in computational power to more deeply explore patterns in large graphs that might indicate the development of safeguards-relevant capabilities.

Cognition-informed processes for in-field safeguards activities

Sandia's multidisciplinary research team is evaluating the cognitive impacts of how information is provided to users, focusing on the role of map information on indoor, escorted wayfinding; knowledge transfer over extended time periods; and visual and spatial list information and task tracking.

Application of open source tools for safeguards data analysis

Sandia has also been involved in the evaluation of commercially available systems to support data analytics for international nuclear safeguards, including:

- Enhanced search for disparate safeguards data
- Open source platforms to classify safeguards-relevant images
- Crowdsourcing to support analytics of non-sensitive safeguards data.

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