Building Future Safeguards Capabilities
SYMPOSIUM
ON INTERNATIONAL SAFEGUARDS

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Semantic Graphs for Safeguards Data Integration, Pattern Matching, and Event Classification

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The data collected for analysis of safeguards relevant information is complex and heterogeneous in nature, ranging from in-field measurements, satellite imagery, reports, declarations, and other open sources related to a State's nuclear activities. As part of ongoing IAEA verification activities for nuclear facilities and State evaluations, inspectors and analysts must correlate and analyze these data, which is often a highly manual and time-consuming process, especially with increasing data volume and varying data types, formats, and frequencies.

To help the safeguards inspector and analyst more efficiently review data, we use semantic graphs to intuitively integrate these heterogeneous data, classify safeguards relevant events of interest, and identify anomalies. Low level data and their relationships are generalized and abstracted as graph nodes and edges, incorporating different data sources, all in a single data structure. Multifaceted graphs can be constructed that merge data from different domains, representing relationships that may be physical, temporal, administrative, or even social. For this paper, we use an exemplar of in-field C/S and NDA measurements for a safeguarded nuclear facility and created a model of the movement of nuclear materials in containers and casks. By converting in-field safeguards data into a semantic graph and ingesting into a graph database, we show how semantic queries are used to match our model against clusters of data to identify, segment, and classify patterns in the data that match the profile of a material movement, whether declared or not. That is, the spatiotemporal relationships inherent in safeguards data is analyzed to extract higher order meaning to find patterns in vast amounts of data. Our semantic graph methodology can be applied to ingest data and identify other safeguards relevant events inside nuclear facilities and the State evaluation level to help discover complex and subtle activities.

Which "Key Question" does your Abstract address?

TEC2.7

Which alternative "Key Question" does your Abstract address? (if any)

TEC3.1

Topics

TEC2

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