**Learning from Semantic Interactions**

**BACKGROUND & MOTIVATION**

Geospatial Data  
GIS  

Machine learning tools help turn raw data into maps and other GIS information products but high numbers of false alarms reduce tool effectiveness and analysts patience.

Most machine learning tools used in geospatial mapping can only learn from labels.

**INNOVATION**

Learning from examples of **Relationships** enables tools to capture more information from analysts and produce more accurate data products.

**DESCRIPTION**

Our machine learning advances enable tools to learn from examples of geospatial semantics.

Semantic interactions include visual merging, splitting and labeling and are encoded as nodes and edges within a graph.

Predictions from traditional tools are not consistent with relational constraints.

Our computationally efficient (O(N)) MinMax relational learning method.

Tool outputs now consistent with Relational Constraints (e.g. transitivity).

With very little training, analysts quickly learn to use merge and split interactions (in addition to labels) to complete image quantification tasks (right).

Our relational learning methods exploit the richer Interaction to produce tools that have higher accuracy compared to tools that just use labels, or tools that use merges heuristically (left).

**ANTICIPATED IMPACT**

LANL’s new machine learning tools can learn from semantic user interactions to produce more accurate mappings between geospatial imagery (and video) and semantic knowledge bases (at less cost).

**PATH FORWARD**

Current Phase – LDRD:

- Develop theory and algorithms for tools and demonstrate impact in image analysis applications in materials microscopy.

Phase 2 – Geospatial Applications:

- Identify collaborators, data and problems in the geospatial domain to advance and generalize our approach.
- Demonstrate and validate our prototype tools in the geospatial domain using large scale problems.

Phase 3 – Multi-Sensor Semantics:

- Identify use-cases for semantic interactions in multi-sensor / multi-model applications.

**Potential End Users:** Analysts who spend too much time annotating and analyzing unstructured data such as image and video.

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**CURRENT TECHNOLOGY READINESS LEVEL (TRL) 3**

- We have used our framework to develop research prototypes in image analysis and data fusion.