Robust Spatiotemporal Reasoning from Natural Language Text

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Projects on Time and Space

- TimeML: Create a standardized markup language for identifying temporal information in language (iARPA)

- TARSQI: Develop a toolkit that creates a temporal profile for a text (iARPA)

- Spatiotemporal Reasoning: Identify motion as expressed through language (NSF, NGA)

- Spatiotemporal Tracking: Integrate Image and language data to track moving objects: jointly with GMU (NGA)

What is Solved

✓ Mapping from language about times and events to an Interval Temporal Logic for temporal reasoning

✓ Mapping from language about space and object motion to a Dynamic Interval Temporal Logic for Space

✓ Building Trajectories: A program that, given a spatial annotation scheme and a temporal annotation scheme, automatically constructs the inferred motion of an individual entity from textual sources;

✴ Translating spatiotemporal expressions into VB representations

What has Failed

• Identifying Temporal Ordering of events with machine learning algorithms alone is not possible; fairly large rule sets are needed as well.

• SpatialML is not expressive enough to encode the spatial expressions encountered in natural language.

• Using available lexical resources for motion verbs and spatial concepts proved inadequate for our task. (Wordnet, VerbNet, FrameNet).

• RCC8 is inadequate for expressing spatial terms in language.

What is On-going and Missing

- Object Tracking using multiple data sources (images and language)

- Developing richer spatiotemporal logics for applications

- Mapping language expressions to concepts in spatiotemporal ontologies;

- Multi-modal integration of spatial and temporal information.

What is Next

• Annotating images and movies with spatiotemporal attributes for better image indexing and retrieval, as well as automatic verbal description generation.

• Integrating spatiotemporal analysis with other qualitative reasoning efforts, to create what-if, counterfactual scenario generation.

• Extending temporal and spatial linguistic analysis capabilities to other languages.