COE CST Seventh Annual Technical Meeting

371: Ontological-Based Space Object and Event Knowledge Graph

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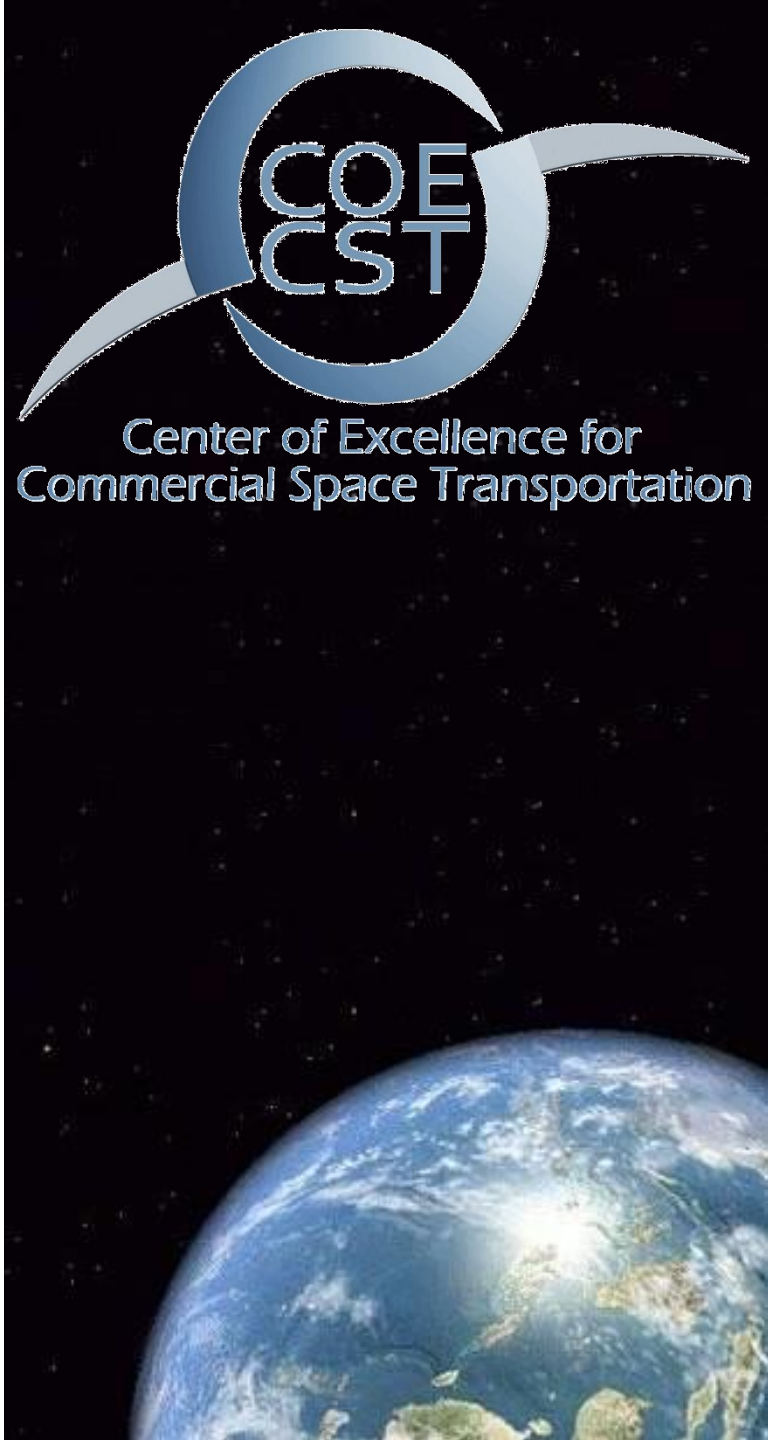
Center of Excellence for Commercial Space Transportation



Agenda

- Team Members
- Task Description
- Schedule
- Goals
- Results
- Conclusions and Future Work

Team Members

- People
  - PI: Moriba Jah, Ph.D.
  - Drew McNeely (UT Austin, ASE/EM)
  - Dat Vu (UT, CS)
  - Samantha Le May (RMIT, Australia)
  - Jamie Stephens (UT, Business)
  - Daniel Miranker, Ph.D. (UT, CS)
  - Weijia Xu (UT, TACC)
- Organizations
  - Applied Defense Solutions
  - Planet
  - SpaceX
  - Space Environment Research Centre (SERC: Australia)

Task Description

- Develop an openly-accessible and transparent ontology-based knowledge graph for space objects and events that supports the needs of space traffic management, orbital safety, and long-term sustainability of space activities
  - Take the initial steps to develop, implement, and federate a Space Traffic Management/Orbital Safety Data Lake. Set up an online searchable Digital Collection of these documents that is similar in capability to the Framework for Spaceport Operations.
  - Motivate “citizen Science” where people can donate their own sensor/telescope data. Leverage Blockchain technology as a method of STM “cryptocurrency”, authentication/identification, and transparent transaction records
  - Put together a collection of Open Source Software that can be used to support and enable space traffic management and orbital safety analyses and products. Gather tools like GMAT, Orekit, Tensor Flow, and others that are currently Open Source and leverage those to serve the needs of STM/Orbital Safety

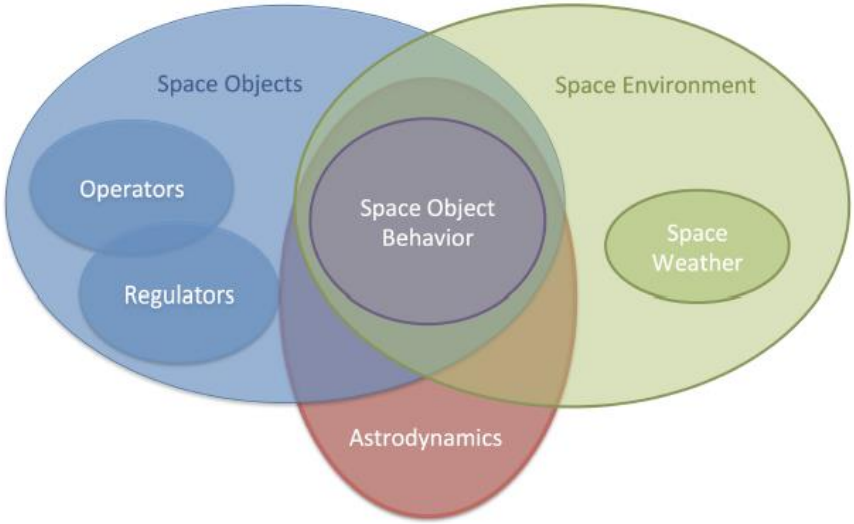
Schedule

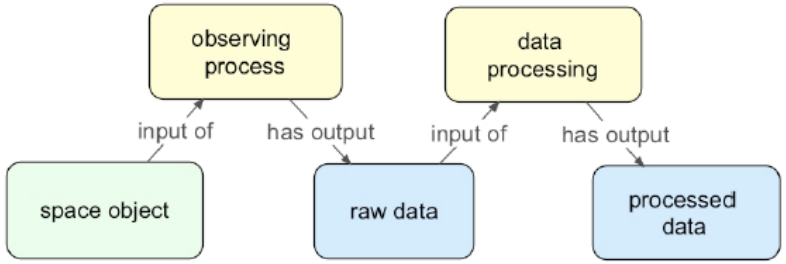
- Oct 2017 start (seed funds in place)
- Assemble multi-disciplinary team internal to UT Austin
- Identify and develop use cases that can help drive the ontology-based knowledge graph development
- Make use of industry and open-source information sources as a seed to the framework
- Develop a ModSim environment to implement and test the approach
- Socialize with the community and demonstrate data analytics capabilities

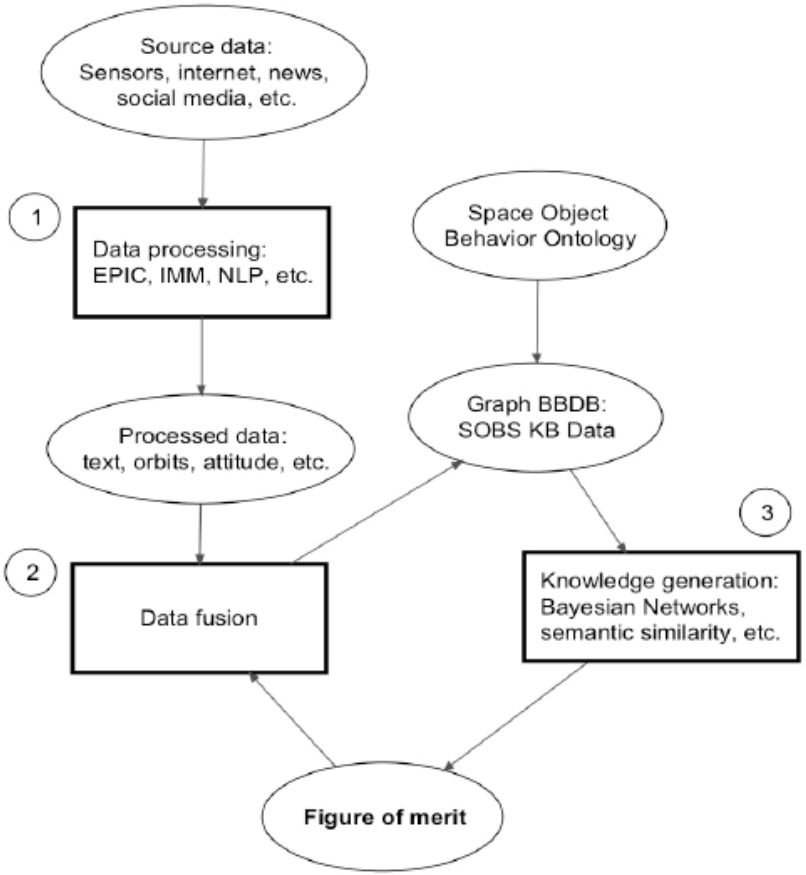
Goals

- The methodology will enable us to use an open architecture, with the capability to accept information from multiple sources, use interchangeable software modules to compute space traffic products and populate a master catalog (knowledge graph), and allow alternate approaches to predict and analyze potential space hazards and threats. This group of collaborators from government, industry and academia, is needed now as this is a long term solution to an already difficult problem facing the commercial space transportation industry's ability to assure successful, safe, space operations.
- The approach will be designed to maximize the use of commercial capabilities.
- Transparency is a key principle; however, classified and/or sensitive U.S. space operations will be protected appropriately, both by technical means and via operational procedures.

Results


Space Objects
Space Environment
Operators
Space Object Behavior
Space Weather
Regulators
Astrodynamics


observing process
data processing
input of
has output
input of
has output
space object
raw data
processed data


Source data: Sensors, internet, news, social media, etc.
1
Data processing: EPIC, IMM, NLP, etc.
Space Object Behavior Ontology
Processed data: text, orbits, attitude, etc.
Graph BBDB: SOBS KB Data
3
2
Data fusion
Knowledge generation: Bayesian Networks, semantic similarity, etc.
Figure of merit

Conclusions and Future Work

- Focus should be on developing and delivering a body of evidence of space activities and behaviors that can support decision-making processes
- Develop and implement a framework for Hard/Soft Information Fusion
- Investigate the development and implementation of a “Rosetta Stone” for uncertainty quantification
- The Space Object and Event Knowledge Graph must be dynamic
- Develop and implement a *Lingua Franca* that is both human and machine readable/writable as a common space domain management language
- The community must be engaged in the process via collaborative experiments and information exchanges