COE CST Seventh Annual Technical Meeting

CubeSat Cluster Deployment Tracking

Task 367
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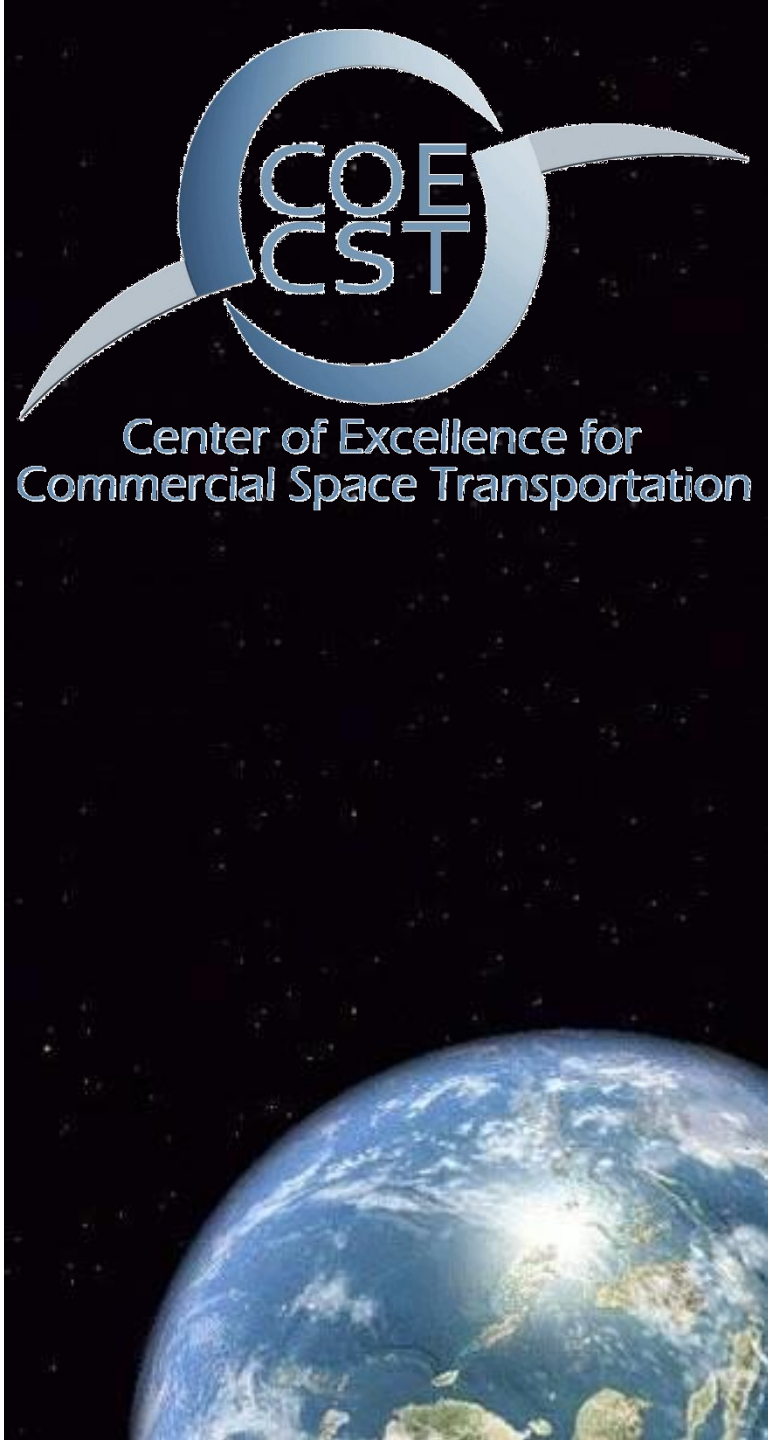
Las Cruces, NM



Agenda

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

Team Members

- People
  - Principal Investigators
    - Penina Axelrad
  - Students
    - John Gaebler
- Organizations
  - University of Colorado Boulder

Task Description

- Clustered CubeSat deployments, where multiple CubeSats are released over a short time span, represent a relatively new and challenging detection and tracking problem.
- Space traffic surveillance and management requires timely, cost effective, and robust approaches to accurately tracking, tagging, and predicting the orbits of large groups of CubeSat class satellites.

Schedule

- Completed:
  - Simulation of 88 CubeSats deployed in close proximity
  - Estimation with a Cardinalized Probability Hypothesis Density filter
- Scheduled:
  - (3 months) Correct issues in CPHD to maintain proper cardinality between independent clusters
  - (3 months) Estimation with a Labeled Multi-Bernoulli filter
  - (3 months) Investigate: sensor scheduling, data fusion, navigation aids, and deployment strategies
  - (3 months) Document findings.

Goals

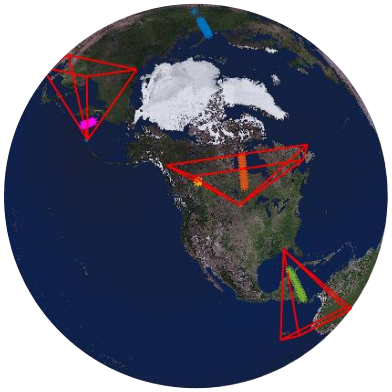
- Maximize likelihood of nominal deployment of all Cubesats (minimize risk of collisions).
- Minimize time to correctly identify each CubeSat.
- Maximize the accuracy of the orbit knowledge of each deployed CubeSat.
- Accurately predict impending collisions with longest possible lead time.

Benefits

- Reducing the time to establish orbits/TLE's for CubeSats allows operators to more quickly begin their operational mission.
- Better orbit predictions, especially after closely spaced deployments, allow for more informed conjunction assessments.

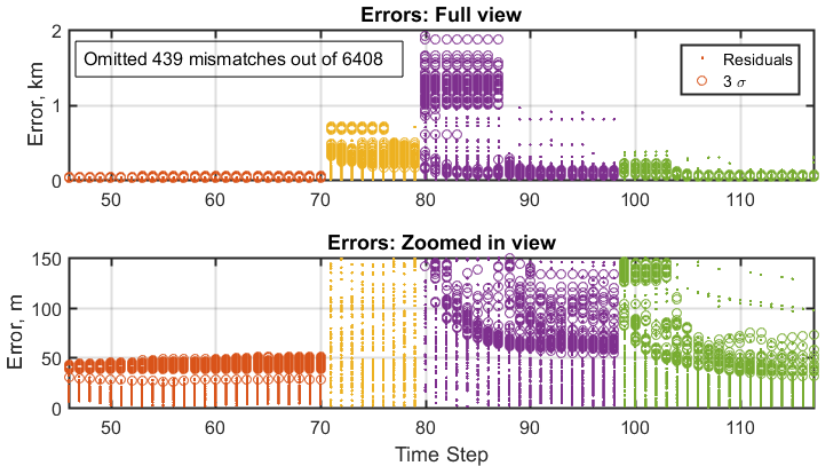
Results

- CPHD allows estimation of targets to within 50 meters 3σ uncertainty after 4 contacts with range-only measurements.
- Compared results of using angles-only, range-only, and range & range-rate measurement



Publications

Gaebler, J.A., Axelrad, P., “CubeSat Cluster Deployment Tracking with a CPHD Filter”, 9th International Workshop on Satellite Constellations and Formation Flying. June 19-21 2017. Boulder, CO. IWSCFF 17-70



Conclusions and Future Work

- Estimation in a clustered environment is challenging
- A CPHD filter is able to estimate multiple targets, but requires advanced modifications to do so

Next Steps

- Implement LMB to include labels
- Study deployment strategies