

DATA ASSOCIATION USING THE MINIMUM-FUEL METRIC

Morgan Baldwin

**Texas A&M Engineering Experiment Station
400 Harvey Mitchell Pkwy S., Suite 300
College Station, TX 77845**

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Technical Memorandum

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**AIR FORCE RESEARCH LABORATORY
Space Vehicles Directorate
3550 Aberdeen Ave SE
AIR FORCE MATERIEL COMMAND
KIRTLAND AIR FORCE BASE, NM 87117-5776**

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//SIGNED//
MORGAN BALDWIN
Program Manager Technology Branch

//SIGNED//
PAUL HAUSGEN
Technical Advisor, Spacecraft Component

//SIGNED//
CHRISTOPHER D. STOIK, Lt Col, USAF
Deputy Chief, Spacecraft Technology Division
Space Vehicles Directorate

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14. ABSTRACT Framework Implementation. Incorporate existing theory accounting for boundary condition uncertainty and maneuver detection hypothesis testing. In particular, the prototype code used to generate results in previous literature will be rewritten to accommodate more general test cases and data inputs. The grant was descoped due to the PI moving to another institution. The only part of the work completed was algorithms that were given to AFRL. The algorithms were modified to enable different test cases to be used.					
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The Principal Investigator (PI) for the the grant moved to Georgia Tech. It was determined that the grant with Texas Engineering Experiment Station should be terminated and a new grant awarded with Georgia Tech since the PI has the expertise needed for this work. During the time the grant was being worked, a couple things were completed:

- 1) Algorithms previously completed by the PI were delivered to AFRL.
- 2) The provided algorithms were generalized to allow AFRL a more diverse set of cases to be tested.

The PI's last day of work at TEES was 13 July 2012. All expenditures after that date were for administrative needs. The other work proposed under the original grant will be completed under another grant to be awarded in the future to the PI's news institution.

APPENDIX

Data Association Using a Minimum-Fuel Metric

Final Report for FA9453-12-1-0214

Marcus J. Holzinger
Assistant Professor
School of Aerospace Engineering
Georgia Institute of Technology

For reference purposes, the Statement of Work (SOW) and list of Deliverables are included in Appendices A and B, respectively. Table 1 summarizes the current status of each SOW item and deliverable.

Table 1: SOW and Deliverable Status		
Item	SOW Status	Deliverable Status
1	Complete	Delivered
2	Suspended	-
3	Suspended	-

Progress

Statement of Work item 1 has been completed and the associate code has been delivered to Morgan Baldwin. This directly corresponds to a delivery of Deliverable 1.

Planned Work

The contract with TAMU has been terminated to be re-awarded to the Principal Investigator at Georgia Tech; there is no further planned work under this specific contract.

A Statement of Work

The specific tasks for the validation aspect of the effort are enumerated below. Specific tasks to be completed by TAMU are identified.

1. **Framework Implementation.** Incorporate existing theory accounting for boundary condition uncertainty and maneuver detection hypothesis testing.. In particular, the prototype code used to generate results in previous literature will be rewritten to accommodate more general test cases and data inputs.
2. **Compare Results.** Compare the control distance metric data association techniques against other data association approaches (e.g., Mahalanobis distance, orbit element gating) using simulated data . After the proposed approach has been implemented and internally tested, the results will be compared with previously proposed and currently used approaches such as Mahalanobis distance and orbit element gating. As the project progresses, different data association methods will be compared.
3. **Extend Theory .** The theoretical approach to reducing variational cost conservatism will be pursued using analytical methods. After a satisfactory theory accounting for boundary condition variations has been developed, it will be compared with both the more conservative quadratic cost upper bound and the unscented transform approach recently developed in the literature.

B Deliverables

There are several deliverables associated with this proposed effort. Each will be delivered in electronic format.

1. **Framework Software.** The MATLAB software implementation of the fuel distance UCT correlation, maneuver detection, and maneuver characterization. This deliverable corresponds to SOW item 1.
2. **Comparison Report.** A report will be written summarizing the performance of various maneuver detection / data association algorithms, as well as descriptions of the associated test cases. This deliverable corresponds to SOW item 2.
3. **Theory Summary.** Theoretical advances generated under this effort will be summarized in written form. It is intended that this written summary will be formalized as a conference paper or journal article. This deliverable corresponds to SOW item 3.

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