

# COE CST Fourth Annual Technical Meeting

## Task 298—Evaluation of ADS-B Payloads

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# Team Members

- People

- AST RDAB POC: Nick Demidovich, Ken Davidian
- Principal Investigator: Pat Hynes
- Technical Investigator: Laura Boucheron
- Undergraduate Researcher: Joshua Michalenko
- Mitre Corporation



# Task Description

- FAA will request truth data (acceleration) from Up Aerospace payload on SL6 on board avionics (IMU)
  - Dr. Boucheron will do comparative analysis of data transmitted from SL-6, SL-7 and SL-8
- Develop a plan, for integration of ADS-B receivers and data flow for use by commercial spaceports based on lessons learned from this task.

# Goals

## Relevance to Commercial Space Industry:

Once procedures and separation standards are developed in conjunction with ADS-B for various classes of rockets, air traffic control would not have to sterilize air space and disrupt other NAS users for most rocket launches (large expendable rockets would be the exception). Most reusable rockets would be able to file a flight plan, making them much easier to launch, as aircraft are today, enabling routine commercial space operations in the NAS.

# Results

## SL-8 launch: 12 November 2013



Data received:

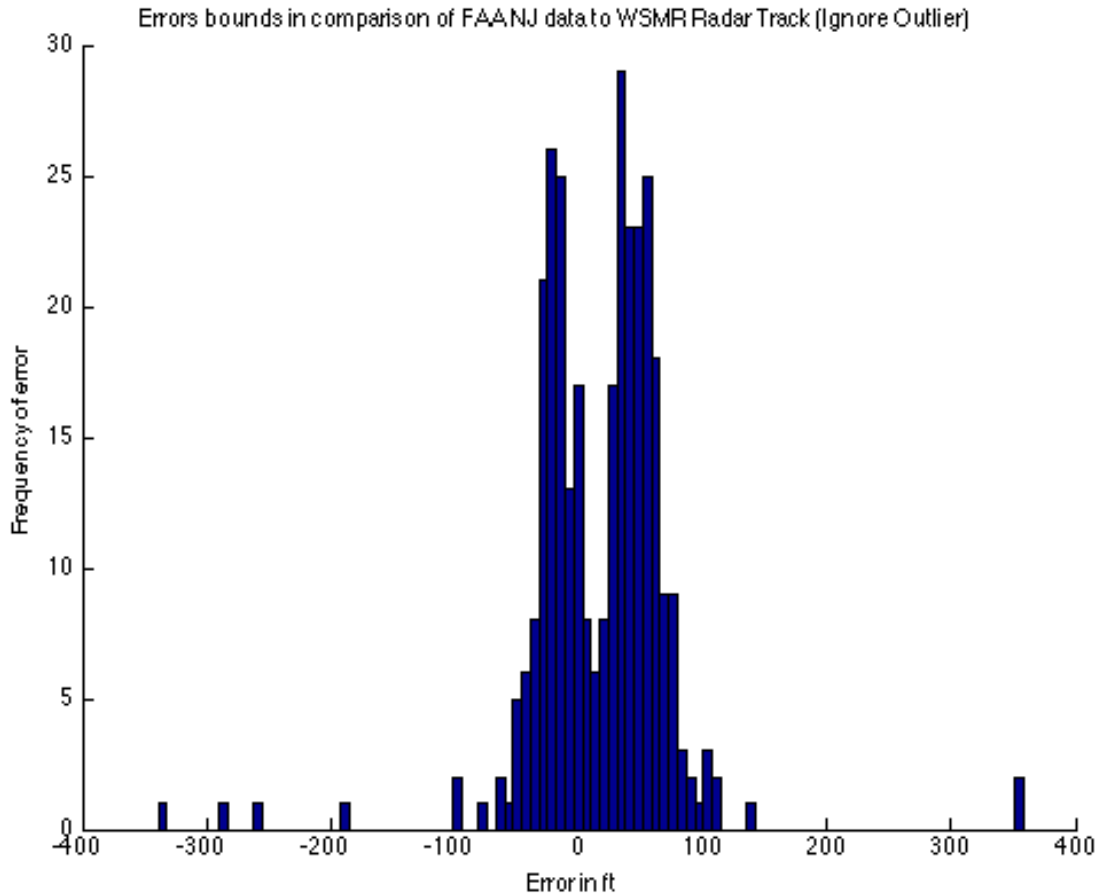
- WSMR radar
- FAA New Jersey Tech Center ADS-B data, including reentry and descent
- ERAU ADS-B data, including reentry and descent
- UpAerospace ADS-B data recorded from FAA Tech Center on-site mobile receiver, including reentry and descent

# Results

- WSMR data has a relative rather than absolute timestamp. We shift ADS-B data relative to WSMR data and search for shift with minimum mean-squared error (MSE).

# Results

## FAA NJ data



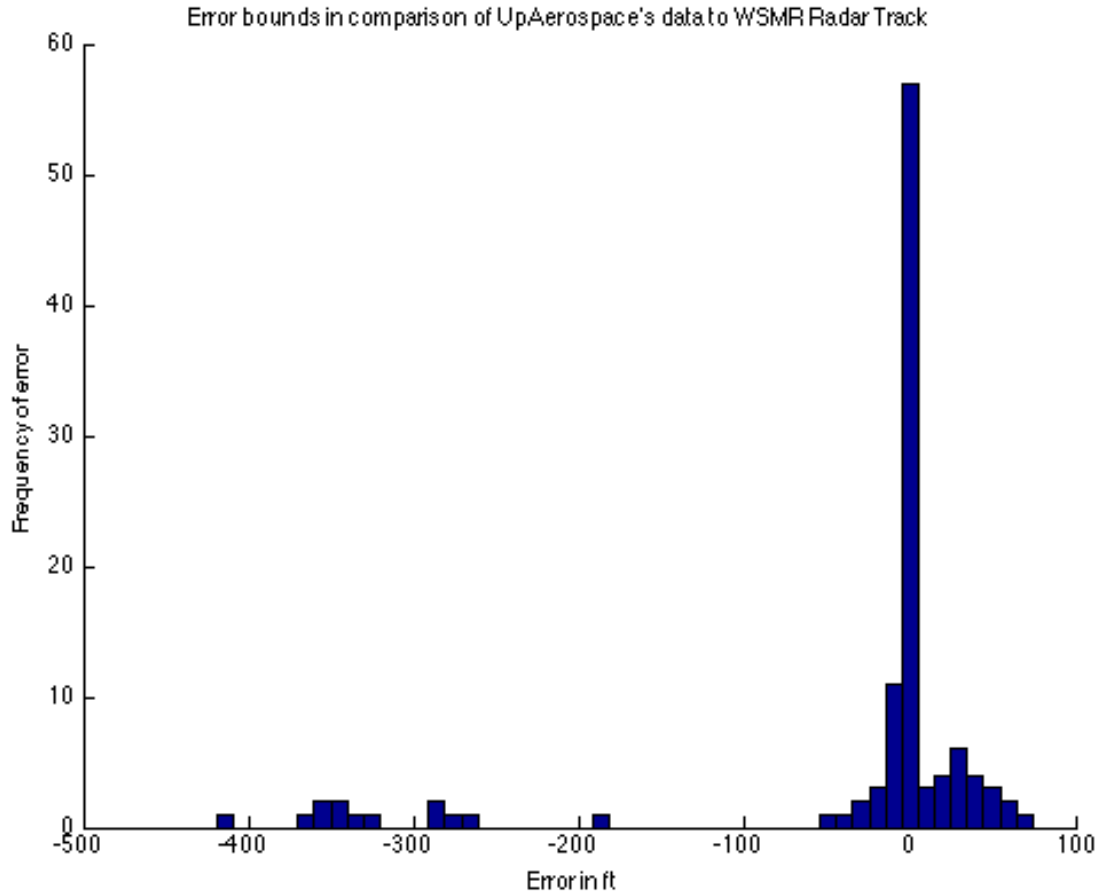
Minimum MSE of  $5.7421e+06$  ft for shift of 298 seconds.

Minimum MSE alignment of WSMR and ADS-B data,

- Maximum absolute error with outlier = 1706.8 ft
- Maximum absolute error without outlier = 358.3 ft
- Mean error without outlier = 47.0922 ft
- Standard deviation = 102.45 ft

# Results

## UpAerospace Data



Minimum MSE of  $6.1454e+07$  ft for shift of 334 seconds.

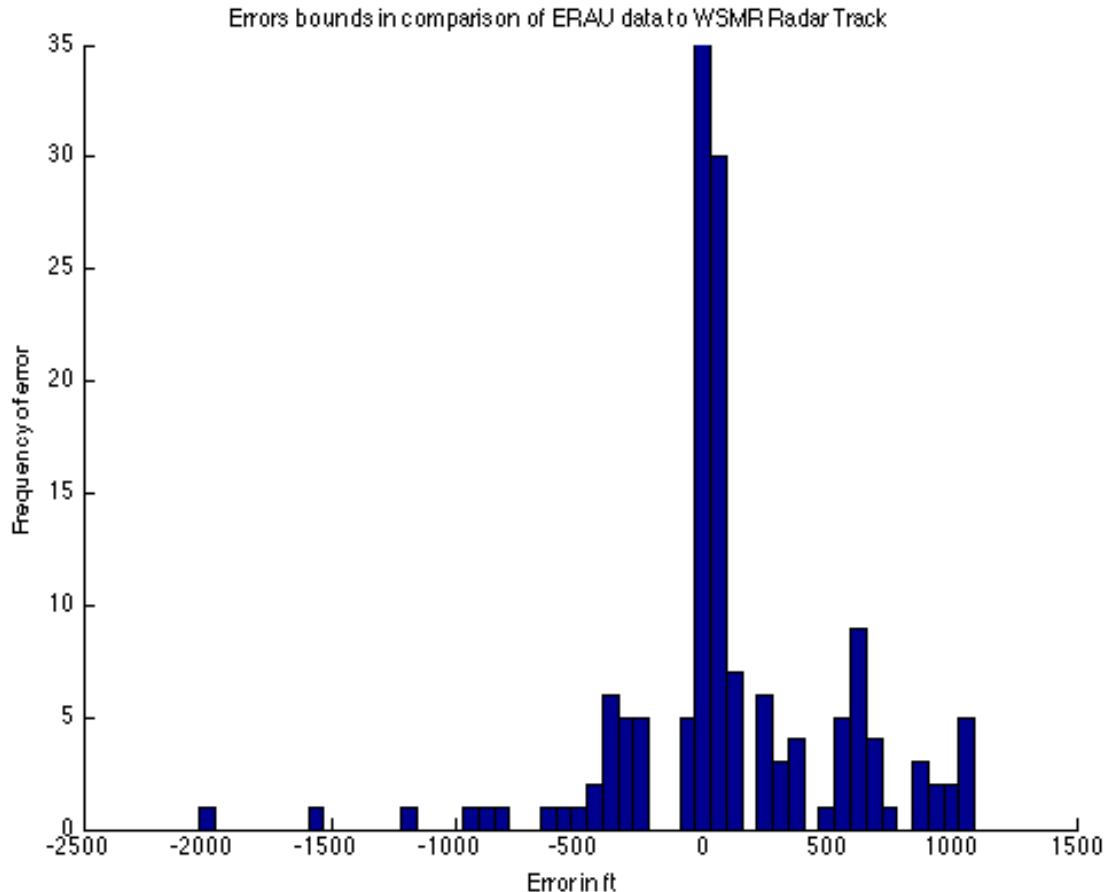
Minimum MSE alignment of WSMR and ADS-B data,

- Maximum absolute error = 419.3 ft
- Mean error = -33.2 ft
- Standard deviation = 108.1 ft



# Results

## ERAU data



Minimum MSE of  
1.6203e+07 ft for shift of  
332 seconds.

Minimum MSE  
alignment of WSMR and  
ADS-B data,

- Maximum absolute error= 2020.3 ft
- Mean error= 102.1 ft
- Standard deviation= 311.95 ft

# Conclusions and Future Work

- ADS-B data from SL-8 displays errors with mean absolute value ~tens of feet compared to WSMR radar
- A few errors ~hundreds of feet
- Lack of absolute time-stamps in WSMR radar complicate analysis and computation of the alignment of data and MSE analysis may introduce a bias to the accuracy results
- Future work will continue analysis of the altitude errors, as well as latitude and longitude errors for all data received for both SL-7 and SL-8 launches.