

Date: 10/10/2012  
Location: ACRC  
Aircraft: Thor, GPS FASER  
Pilot: Arion Mangio  
Flights: 4 Thor, 3 GPS FASER

### **Weather**

Partly cloudy with winds up to 14 mph towards the afternoon.  
METAR (Anoka County)

KANE 101345Z 26006KT 12SM SKC 02/M02 A3007  
KANE 101645Z 26012G16KT 12SM SCT045 BKN250 08/M03 A3008

Adhika, Andrei, Arion, Brian, and Will arrived at ACRC around 9:00am to test the revised waypoint guidance algorithm, and to obtain flight data from GPS FASER for Adhika's research. For Thor, a 70x70m and 150x150m square pattern was flown with both the original waypoint guidance algorithm, and the newly revised algorithm. GPS FASER was flown once in manual mode to verify the navigation filter solution and GPS sensor measurements. Once verified, the revised waypoint algorithm was flown with GPS FASER in a 150x150m square, and again in a 600x250m rectangular pattern with limited bank angle and a slower airspeed. All flight ops ran smoothly.

Software used for this flight was [trunk/Software/FlightCode rev 914](#)

Thor flight 73 consisted of tracking four waypoints separated by 150m in a square pattern. The original waypoint guidance algorithm was used ([waypoint\\_guidance](#)), which tracks a straight line if the next waypoint is too close to the aircraft position so that it cannot be reached by turning towards it. A 150x150m square is large enough that the aircraft will not need to enter this reachability maneuver.

Thor flight 74 was the same as flight 73, except a 70x70m waypoint pattern was flown. This pattern is small enough that the reachability maneuver will be executed. Flights 73 and 74 are used as a control group to be compared against the same waypoint patterns flown with the revised waypoint guidance algorithm.

Thor flight 75 was conducted using the revised waypoint guidance algorithm ([waypoint\\_guidance\\_fast](#)). This revision uses the logic that if the next waypoint is too close to the aircrafts current position, the aircraft turns in the opposite direction of the next waypoint until it can be reached by turning in the correct direction. Since the 150x150m square is large enough that the aircraft will not need to enter this reachability maneuver, the actual flight pattern is nearly identical to Thor flight 73.

Thor flight 76 was conducted using the same 70x70m pattern flown in flight 74, but with the revised waypoint algorithm. The effect of the different reachability maneuver is clearly visible in the flight data when compared to flight data from flight 74. There was strong wind throughout this flight which caused the airplane to miss certain waypoints. This resulted in the airplane spiraling in towards those missed waypoints. Increasing the waypoint radius tolerance from 10m to 20m would most likely eliminate this effect, as the airplane was very close to hitting the waypoints that it missed.

GPS FASER flight 3 was conducted to verify the functionality of the three newly configured GPS antennae, and also the performance of the EKF 15 state navigation filter. The airplane was flown in manual mode the entire flight.

GPS FASER flight 4 was conducted to test the waypoint tracking capability of the Ultrastick 125 airframe. The new waypoint tracking algorithm was used ([waypoint\\_guidance\\_fast](#)), and the 150x150m waypoint pattern was flown. The strong winds caused the airplane to consistently miss the downwind waypoint. Perhaps an increased waypoint tolerance would eliminate this effect.

GPS FASER flight 5 consisted of a 600x250 rectangular waypoint pattern. The maximum bank angle was limited to 25 degrees, and the commanded airspeed was reduced to 19 m/s. The purpose of this test was to obtain flight data during long, straight transients for Adhika's research. Again, the downwind waypoint was consistently missed, however, the long, steady transients were obtained which was the intent of the test.

Other software modules used were [waypoint\\_tracker](#), and [EKF\\_15state](#).

## **FLIGHT DATA**

### **Thor Flight 73**

Rx Data: A009, L999, F000, H000

### **Thor Flight 74**

Rx Data: A006, L999, F000, H000

### **Thor Flight 75**

Rx Data: A050, L999, F000, H000

### **Thor Flight 76**

Rx Data: A025, L999, F000, H000

### **GPS FASER Flight 03**

Rx Data: 5v9, A014, L004, F000, H000

### **GPS FASER Flight 04**

Rx Data: A027, L011, F000, H000

### **GPS FASER Flight 05**

Rx Data: A110, L041, F004, H000

**Issues** None