Date: 8/7/2012
Location: ACRC
Aircraft: Thor, FASER
Pilot: Arion Mangio
Flights: 5 Thor, 5 FASER

Weather
Sunny, light breeze in the morning turning to a steady wind around 8 knots in the afternoon.
METAR (Anoka County)

KANE 071545Z 02008KT 10SM SKC 27/16 A3001=
KANE 071745Z 34007KT 10SM SKC 28/12 A3001=
KANE 071950Z 35007KT 10SM SKC 29/13 A3000=

Adhika, Andrei, Arion, Tim, and Will arrived at ACRC around 9am to test the newly installed Crescent GPS sensor on Thor, and to see how the EKF 15 state nav filter performed. Also, FASER was flown for the first time since December 2011 to verify its flight capabilities. The first to flights of the day were simple manual control of Thor to see the nav filter performance with the new GPS. The filter worked very well, so the next three flights were baseline, altitude/speed, and heading controller validation flights with Thor. In the afternoon, FASER was flown using the same three layers of controllers that were used on Thor. There were only three tests to conduct, however, there was an issue with FASER losing it's pressure sensor data (altitude and airspeed readings) after a certain amount of time. The first baseline controller test ran flawlessly. The altitude/speed tracker test took three runs to get all the data required. The heading tracker test worked for a short amount of time, at the end of which the pilot had to take over control to prevent a stalled aircraft. Since the pressure sensor data was being lost quicker and quicker with each flight, further flight tests were aborted.

Software used for this flight was trunk/Software/FlightCode rev 869

Thor flight 57 consisted of basic manual control of the aircraft, flying in a landing pattern configuration around the runway. This flight was used to collect data from the EKF 15 state filter. Upon review of the flight data, it was observed that the filter performed well, except for a few instances on the base leg where GPS signal was dropped briefly. Software modules used were baseline_control, straight_level, EKF_15state

Thor Flight 57
Rx Data: A020, L041, F000, H000

Thor flight 58 was conducted in the same manner as 57, but the airplane was flown randomly, away from the base leg area of the pattern where GPS signal was lost previously. The resulting output of the nav filter looked perfect, therefore allowing the next three controller validation tests to be executed. The same software was used as in flight 57.

Thor Flight 58
Rx Data: A084, L051, F000, H000

Thor flight 59 was a series of maneuvers conducted using the baseline controller to compare to the next level controller which tracks altitude and airspeed. It involved approximate 180

degree turns at a 45 degree bank, six-second doublets, and 45 degree constant banks. During the 45 degree bank spirals, the airplane lost about 25 meters over 50 seconds. The next flight (60) tested the same maneuvers, but with the altitude/speed tracker as the outer loop. Software modules used were baseline_control, baseline_valid, EKF_15state

Thor Flight 59

Thor flight 60 included the altitude/airspeed hold, and consisted of the same maneuvers as flight 59, in addition to three cases of simple straight and level flight. The airplane maintained airspeed within +/- 3 meters during straight and level flight, and +/- 5 meters during maneuvers. Software modules used were steady_level_tracker, alt_speed_test, EKF_15state

Thor Flight 60
Rx Data: A003, L012, F000, H000

Thor flight 61 tested the psi tracker performance. The test included 180 degree turns, and rectangular patterns. The controller performed very well, tracking to within +/- 5 degrees during a 7 knot wind. Software modules used were heading_tracker, psi_commands, EKF_15state

Thor Flight 61
Rx Data: A021, L033, F002, H000

FASER flight 05 was the same test as Thor flight 59 -- baseline control testing. It used the same software, the only difference being the gains for the controllers, which are included in the controller code. During the 45 degree banking circles, the airplane lost close to 80 meters. It also lost significant altitude during the earlier basic maneuvers. This was due to too low trim throttle setting - 50%. There were lots of oscillations throughout the test. This may be due to the windy day, or a lack of robustness of the controller. Future flight tests during a calm day is necessary to verify what the problem is. Software modules used were baseline_control, baseline_valid, EKF_15state

FASER Flight 05
No Rx Data

FASER flight 06, 07, & 08 were the same tests as Thor flight 60 -- altitude/airspeed tracking performance -- split up into three segments. The pressure sensor data was lost at some point during each flight, resulting in aborted experiments. This is an issue that needs investigating. As for performance, the airplane tracked altitude to +/- 3 meters during steady level flight, and +/- 5 meters during maneuvers. Software modules used were steady_level_tracker, alt_speed_test, EKF_15state

FASER Flight 06
No Rx Data

FASER Flight 07
No Rx Data

FASER Flight 08
No Rx Data

FASER flight 09 was the same as Thor flight 61 -- heading tracking testing. Again, the pressure sensor data was lost mid-flight, and the airplane had to be landed. The data loss seemed to happen quicker and quicker with each flight test, so additional tests were not conducted. This test will have to be repeated once this issue is resolved. Software modules used were heading_tracker, psi_commands, EKF_15state

FASER Flight 09
No Rx Data

Issues Pressure data loss with FASER, oscillations in FASER altitude/airspeed tracking performance