Date: 09/08/11
Location: Tri Valley
Aircraft: Thor,FASER
Pilot: Arion Mangio & James Rosenthal
Flights: 2 FASER

Weather
Sunny, light northwest winds, temps around 80F.
METAR KLVN 081648Z AUTO 34005KT 10SM CLR 24/16 A3027 RMK AO2=

Link to Flight Data

We took Thor and FASER to Tri Valley to do functional flight checks on the revised software (Thor) and to do the maiden flight on the fully instrumented FASER.

Takeoff and landing was done from the gravel strip leftover from the old runway. We cleared most of the larger rocks. Takeoff was no problem, but landings were difficult with FASER due to the long rollout distance.

The controller used for all flights was the composite student controller, with the following gains:
pitch_gain[3] ={-0.6, -0.09, 0.08}; group 1, v1
roll_gain[3]={-0.45, -0.022, 0.05}; group 3, v1

Software used was /trunk/Software/FlightCode/ rev 576 for flight 1, rev 578 for flight 2.

We did one flight with Thor for warmup. Initial performance was nominal, then Arion did some aerobatics. After landing, it appeared we were not getting telemetry data. I attempted to dump the flight data, but the file was empty. We tried to run another controller but with no success. We didn't do any further troubleshooting with Thor, but moved on to FASER.

FASER Flight 1: pitch/roll doublets. Takeoff went well, initial flying under manual control for pilot familiarization and trimming. Investigated various landing configuration schemes (full wing flaps, inner flaps only, clean). Several stalls were performed, benign pitch break with slight left roll. Engaged the controller twice. Throttle setting seemed a bit low. Rudder trim setting was way off, resulting in a sustained 5deg sideslip flat turn. Roll/pitch doublets went fine. Landing was challenging due to the small runway and the folding prop makes it hard to slow the aircraft down.

FASER Flight 2: pitch/roll doublets. Increased the throttle by 5%, but ground tests showed this seemed to greatly increase the power output. Also zeroed out the rudder trim and updated the elevator/aileron trims based on the first flight data set. Similar flight profile as flight 1. Power setting under closed loop was definitely too high, making it difficult to complete the command sequence on one straight leg. We also shifted the CG slightly backwards for this flight to reduce the up elevator required during slow flight.

Videos: http://www.youtube.com/watch?v=14jKWx0-jOg
http://www.youtube.com/watch?v=rfXdAimBx6U
http://www.youtube.com/watch?v=OTin0thjQYc

Issues:

1. Troubleshoot Thor. COMPLETE: no issues found.
2. Determine best CG placement for FASER.
3. Investigate throttle response for FASER ESC. COMPLETE: replacing ESC with castle creations ESC w/data logging.

Flight Data Analysis

Alpha-Beta Sensors: Initial analysis of the alpha/beta data and the software revealed that incorrect geometry was used for the sensors, resulting in erroneous rate corrections to the alpha/beta signals. A script has been attached to this flight report to correct this error. The signals are quite noisy, but indicate expected trends during doublets and match reasonably well to the simulation prediction.

Time Skew: The alpha/beta corrections also show the alpha/beta data is 2 time steps ahead of the IMU data. This was due to the removal of the delay between the SPI read/write calls in IMU_iSensor.c. The delay was removed to speed up the DAQ, but this inadvertently caused the a two DAQ cycle (20msec period) delay in the data. Adding in a one tick delay (cyg_thread_delay(1)) was sufficient to remove the delay. This was verified by inputting a 1Hz square wave simultaneously to a GPIO line on the MPC and the ADC input on the IMU.

Inertias: Initial simulation data matched poorly in yaw rate. Reducing the Ixz inertia value to 1/4 its original value resulted in a much better match to the flight data.

Rudder polarity: The rudder PWM calibration data for FASER had the incorrect polarity, resulting in an unstable yaw damper. This is noticeable in the flight data.

Back to Flight Reports