Date: 3/30/12
Location: ACRC
Aircraft: Thor
Pilot: Arion Mangio
Flights: 2 Thor

Weather
Cloudy, Calm to light easterly winds, temps around 55F.
METAR KANE 302050Z 16003KT 10SM BKN022 OVC036 12/06 A2981=

Arion, Ryan, and myself took Thor to ACRC to gather data during simulated loss of control trajectories. Both flights were flown entirely under manual control. Pilot commands are logged under variables such as "de_in" for manual elevator command.

The LOC sequences attempted were as follows:

1. Roll Upset: Pilot rolls the aircraft to approximately 60 degrees bank angle at a low airspeed and power setting, simulating a roll disturbance (e.g. wake turbulence encounter). Pilot lets the pitch angle fall well below the horizon before initiating recovery inputs. Pilot applies inappropriate recovery inputs; in this case, gradual pull to full up elevator prior to leveling the wings. This results in an accelerated stall and LOC event. Variations on this maneuver was to use higher power settings.

2. Yaw Upset: Similar to the Roll Upset, except the pilot uses the rudder to initiate the disturbance. A variation on this maneuver was to hold a certain amount of rudder input in throughout the maneuver, simulating a stuck actuator.

3. Sustained Post-Stall Flight: Pilot enters a normal power-off stall, pulling the elevator to maximum nose up deflection and holds this input. Pilot attempts to maintain a wings level attitude.

Software used was trunk/Software/FlightCode rev 792

Thor Flight 34

Onboard video (left wing), Rx data: A011, L018, F000, H000

The following is a breakdown of the timing of each LOC maneuver:

<Start time, Stop Time>, <Maneuver>, <Notes>

1. <219,230>, LOC1, right turn. Roll/yaw departure. Video 0:39
2. <248,262>, LOC1, right turn. Roll/yaw departure. Video 1:10
3. <284,295>, LOC1, right turn. Roll/yaw departure. Video 1:45
4. <315,335>, LOC1, left turn. NO departure. Video 2:24
5. <365,380>, LOC1, left turn. NO departure. Video 3:05
6. <405,420>, LOC1, right turn. Roll/yaw departure. Video 3:50
7. <435,450>, LOC2, right rudder impulse. Roll/yaw departure similar to LOC1. Video 4:23
8. <465,482>, LOC2, sustained right rudder, -6deg. NO departure
9. <495,507>, LOC2, sustained right rudder, -15deg. NO departure

10. <530,545>, LOC2, sustained right rudder, -17deg. NO departure
11. <560,577>, LOC2, sustained right rudder, -7deg. NO departure
12. <605,640>, LOC3, 20% throttle. Roll oscillations, no departure
13. <680,710>, LOC3, 16% throttle. Roll oscillations, no departure

Thor Flight 35

Onboard video (left wing),Rx data: A031, L010, F000, H000

The following is a breakdown of the timing of each LOC maneuver:

[Start time, Stop Time], <Maneuver>, <Notes>

1. <180,208>, LOC3, 20% throttle. Roll oscillations, no departure. Video 0:38
2. <240,263>, LOC3, 0% throttle. Roll oscillations, no departure. Video 1:36
3. <300,326>, LOC3, 24% throttle. Roll oscillations, no departure
4. <360,387>, LOC3, 24% throttle. Roll oscillations, no departure
5. <411,437>, LOC3, 0% throttle. Roll oscillations, no departure
6. <465,490>, LOC3, 0% throttle. Roll oscillations, no departure
7. <520,550>, LOC3, 41% throttle. Roll oscillations, no departure
8. <587,626>, LOC3, 41% throttle. Roll oscillations, no departure
9. <666,700>, LOC3, 41% throttle. Roll oscillations, no departure

Issues

1. Initially started with the old micronav_ahrs.c filter. However, on first startup, the Euler angles on the display were not updating correctly, so the 15-state EKF was used, despite known deficiencies. The Euler angle data in these two flights needs to be post-processed.
2. Manual pilot feedthrough was deemed to be too noisy and a little too laggy to be used this time. The reader can be pared down to 4 channels to reduce the noise, and switching to digital servos will allow faster PWM frame rates to decrease the time delay.
3. Polarity of angle of attack is incorrect. Need to swap the tubes on this sensor.

Flight Data Analysis

- Angle of attack data during the LOC trajectories is solid until the sensed pressure gets too low, and the AoA algorithm blows up. Better resolution/lower noise pressure sensors (ie $$$) are the only way to address this issue.

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