NASA Dryden Status

Aerospace Control & Guidance Sub-committee
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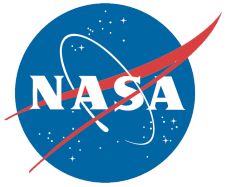


Ikhana Project Update

- Successful completion of 2008 Western States Fire Mission
  - Ames sensor Showed improvements
  - Governator requested support for Northern California wildfires (1000+)
    - Positive feedback from fire commanders on benefit of near real time imageries
- ARTS III research controller software/hardware
  - Passed SIL integration @ General Atomoics
  - Dryden integration and ground tests in planning
  - Further research TBD

- Dryden developed Fiber Optic Wing Shape Sensing
  - Successful flight tests: 4 dedicated to FOWSS and 7 'piggyback'
  - 100Gb data collected with on-going analysis
  - Initial results are very good for demo of this technology

The Integrated Resilient Aircraft Control (IRAC) Project will conduct research to advance the state of aircraft flight control to provide onboard control resilience for ensuring safe flight in the presence of adverse conditions.

- Objective: Improve handling qualities during a failure of a control surface using adaptive controls
- Goal # 1: If a failure occurs during flight, the Neural networks will improve piloted flying qualities.
- Rule # 1 Adaptation should Never make the control system behavior worse.
- During Flight Test with some failures, the previous neural network made the aircraft behavior worse in some cases.
- The Gen 2 Neural network algorithms were updated to improve tracking performance and increase HQ ratings

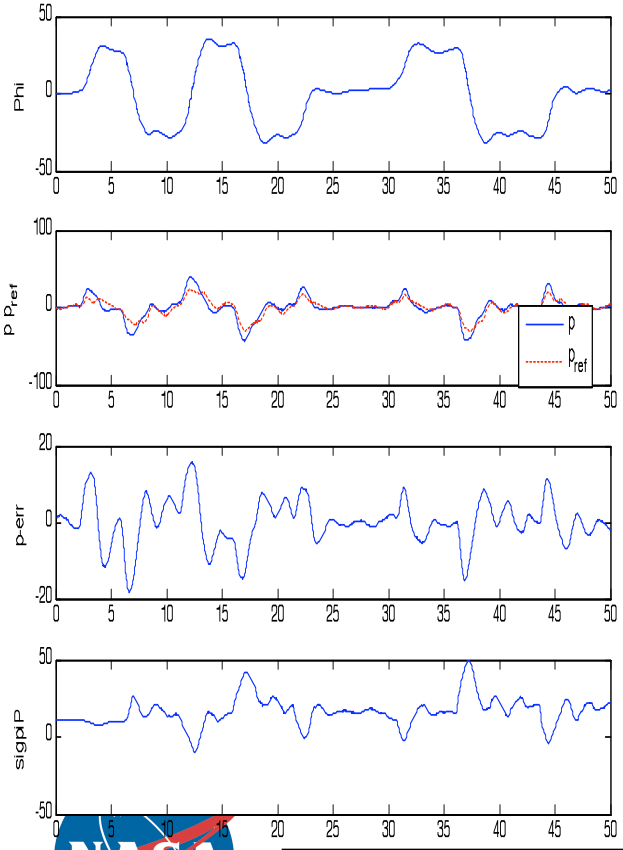
Comparison topics for Study:

- Gen2: Original Neural Networks
  - Based on Calise's Method / Lyapunov Method
  - Has Vectored Dead-bands
- Gen2a: Improved Neural Networks
  - Based on Calise's Method / Lyapunov Method
  - Has scalar Dead-Bands for P,Q,R
  - Has a Decay term on NN weights
  - Has A beta reference model & increased yaw axis importance

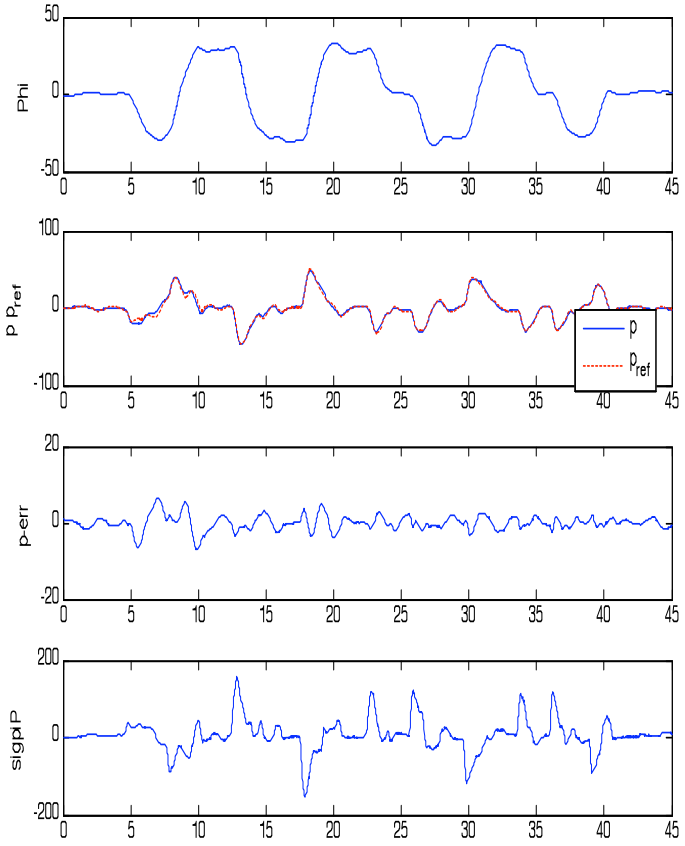
Gen2 & Gen2a Sigma Pi Flight Results

- **Flight Condition: Flt 230, Mach 0.75 / H = 20,000 ft.**
- **Task: Bank-to-Bank Captures**
- **Failure: Left Stabilator Jammed at +3.5 deg (trim)**

Gen2 Results



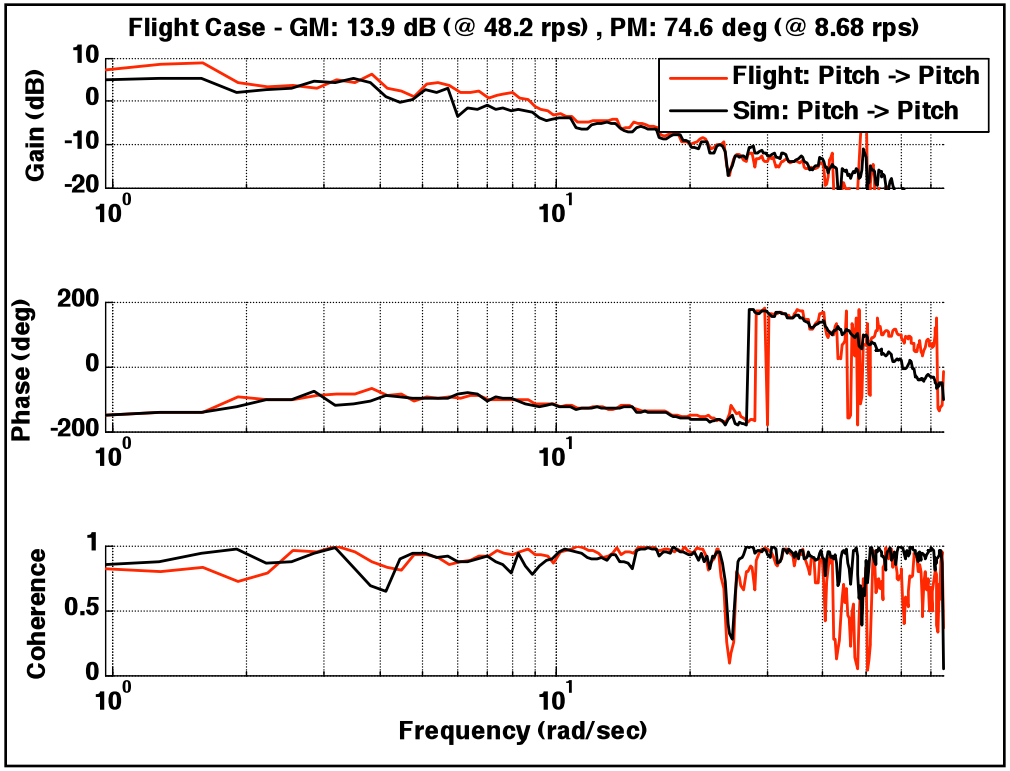
Gen2a Results



Handling Qualities ratings improvement	
Gen2	Gen2a
Gross Acq HQR: 4	Gross Acq HQR: 3
Fine Tracking HQR: 3	Fine Tracking HQR: 2

X-48B Blended Wing Body

- 28 flights completed (as of Oct 1)
- Initial slats extended and slats retracted envelope has been cleared
- Flight results providing data for simulation updates



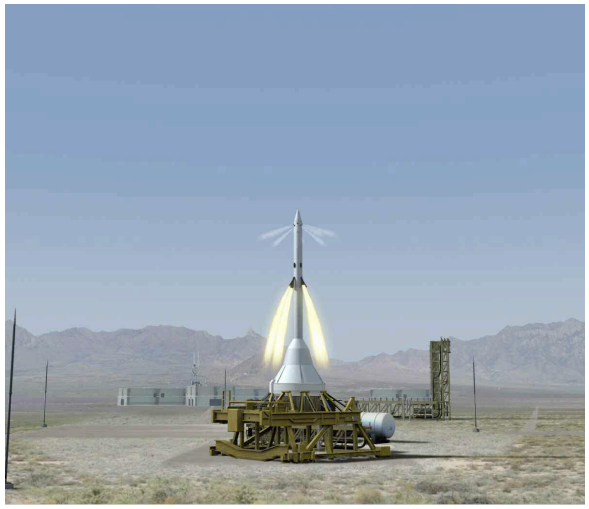
- Stall onset characterization has begun
  - Recoverable from incipient stall
  - Control effectiveness reduced
- Testbed for adaptive flight control research for flights in 2010

SOFIA

- Stratospheric Observatory for Infrared Astronomy
  - 2.5 m diameter German built infrared telescope
  - Open port cavity
    - » ~21°-60° viewable elevation range
  - Platform is Boeing 747 SP
    - » Capable of 6+ hours of observation time
- Closed door envelope clearance complete
  - Structural substantiation emphasis
  - Flight dynamics and handling qualities relatively unaltered by the modification
- Open door flights scheduled winter 2009
  - Envelope clearance with a cavity acoustics focus
  - Basic telescope systems characterization
  - Goal for first limited science missions by the end of 2009
  - Autopilot interface development to support science mission navigation requirements is ongoing

Orion CEV Launch Abort Systems Tests

- Dryden is leading the test activities for the Launch abort systems test. Tests will be conducted at White Sands, NM
- Pad Abort 1 (PA-1): Tests the basic functionality of the launch abort system from the pad in its preliminary design configuration.
- Ascent Abort 1 (AA-1): Tests the ability of the launch abort system to function while the spacecraft is traveling through the period of maximum dynamic pressure.
- Ascent Abort 2 (AA-2): Tests the ability of the launch abort system to function as the spacecraft breaks through the speed of sound.
- Pad Abort 2 (PA-2): Continues to refine the data collected on PA-1 on a more production-like crew module.
- Ascent Abort 3 (AA-3): Tests the ability of the launch abort system to perform in the event it is tumbling due to a loss of control of the launch vehicle.



Current activities

- **hardware testing and integration of the PA-1 crew module at DFRC**
- **preparation for PA-1 FTRR**
- **AA-1 design**

To Fly What Others Imagine …