Tailsitter

Objective: Design guidance, navigation, and control strategies for tailsitter UAVs. Challenges include attitude estimation, and transitions between hover and level flight.

Principle Investigators: Tim McLain, Randy Beard

Sample Publication: Nathan B. Knoebel, Stephen R. Osborne, Deryl O. Snyder, Timothy W. McLain, Randal W. Beard, Andrew M. Eldredge "Preliminary Modeling, Control, and Trajectory Design for Miniature Autonomous Tailsitters," *AIAA Conference on Guidance,Navigation, and Control*, Keystone CO, 2006, paper no. AIAA-2006-6713.

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Problem Summary

1: VTOL MAV Aerodynamic Modeling: Develop a preliminary design tool for low Reynolds number aircraft via a modified numerical lifting line algorithm.

2: Adaptive Autopilot for VTOL MAVs Develop an adaptive autopilot capable of control in both hover and cruise flight modes.

3: Enhanced Attitude Estimation Develop and implement attitude estimation algorithms capable of large attitude angles and high-performance maneuvers that are suitable for the sensors and processors used on MAVs.

Approach

1. Represent attitude with unit quaternion
2. Derived a novel extended Kalman filter for attitude estimation.
3. Developed inner feedback loops based on adaptive control around unit quaternion.
4. Developed adaptive speed controller for power control.

Results

Successful flight test in 2005-2007.

Hover to level transition.

Level to hover transition.

Long term hover.

Autonomous take-off and landing. (Landing is still rough.)