COMPACT ATTITUDE SENSOR SYSTEM USING SR-UKF
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Experimental Flyer Project

- Goal: To create a simple, low-cost, highly maneuverable flyer
- Novel torque generation scheme
- Need for compact, high-speed attitude sensor system
Sensor System Project

Sensor System Board

Sensor Suite
- Magnetometer
- Accelerometer
- Gyroscopes

Microprocessor
- Serial Interface
- Square-Root Unscented Kalman Filter
Sensor Selection

- Magnetometer: MicroMag3 (PNI Corporation)
  - 3-axis magneto-inductive sensor
- Accelerometer: SCA3000 (VTI Technologies)
  - 3-axis capacitive deflection sensor
- Gyroscopes: MLX90609 (Melexis Systems)
  - 3 one-axis capacitive Coriolis force sensor
Circuit Design and Implementation
Square-Root Unscented Kalman Filter

Kalman Filter
- Tracks a state based on noisy, indirect measurements

Unscented Kalman Filter
- Allows for nonlinear process and measurement models

Square-Root Unscented Kalman Filter
- Mathematical formulation that prevents numerical instability
SR-UKF Cycle

- Previous State
  - Time Update
  - Estimated Current State
    - Measurement Prediction
    - Actual vs. Predicted Measurements Compared
      - Update State Based on Difference

Current State
MATLAB GUI
Actual vs. Predicted Measurements

**Magnetometer**

**Accelerometer**
Microcontroller Feasibility Analysis

- MATLAB code converted to C using Embedded MATLAB coder (EMLC)
- Minimum RAM requirements
  - EMLC (no dynamic allocation): 3452 bytes
  - Custom coding with dynamic allocation: 2052 bytes
  - dsPIC30F4012 RAM: 2048 bytes
- Other microcontroller options
  - Questions of processing power
Next Steps

- Implementation on more powerful microprocessor
- Sensor behavior onboard the flyer
  - Magnetic effects from motors
  - Accelerometer reliability during flight
- Adding flyer control system outputs to the time update step of the SR-UKF
Thank You!

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