Control System for a Novel UAV

The potential shown by UAVs dedicated to commercial tasks (e.g., package delivery) has led to an increasing desire in developing UAVs able to take-off/land within reduced areas. Thus, this project investigates the feasibility of a novel UAV which may be able to be launched/recovered within a pole member.

1. Introduction

Background: ongoing desire to reduce/minimize ground space to take-off/land.
Motivation: Delivery drones.

2. Problem Statement

1. Vehicle horizontally constrained during launch/recovery (protection against gust and other disturbances for people and infrastructure nearby).
2. Launch/recovery within small volume.
3. Automatable process.
4. Optimization of vertical space in housing.

Aims and Objectives

1. Design a suitable platform.
2. Design Control System (Precision Landing).
3. Develop Simulation Model.
4. Test + Analysis of results.
5. Physical Model building + testing.

3. Methodology

1. Software Implementation
2. Hardware Implementation

4. Results

Cascade Control + State Estimator:
- Pre-processing: all signals.
- Complementary filter: attitude.
- State Estimator: position and linear velocity.

<table>
<thead>
<tr>
<th></th>
<th>Altitude</th>
<th>X-position</th>
<th>Y-position</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Steady State Error</td>
<td>1.12cm</td>
<td>0.53cm</td>
<td>0.86cm</td>
</tr>
<tr>
<td>Max Steady State Error</td>
<td>1.41cm</td>
<td>0.91cm</td>
<td>0.95cm</td>
</tr>
<tr>
<td>Overshoot</td>
<td>10.67%</td>
<td>21.78%</td>
<td>29.31%</td>
</tr>
<tr>
<td>Settling Time</td>
<td>3.55s</td>
<td>7.19s</td>
<td>8.09s</td>
</tr>
</tbody>
</table>

NOISE + BIAS REJECTION

GUST REJECTION

5. Conclusions

- Simulation Design: based on the worst case (noise, bias and wind) → very robust design / poor performance (settling time and overshoot).
- State Estimator improves overall performance significantly (disturbance rejection).
- Simulation model too conservative.
- Non-modelled effects increase stability of the system in reality.
- Further tests are needed (especially outdoors) → validation and verification.

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BAE SYSTEMS

INSPIRED WORK