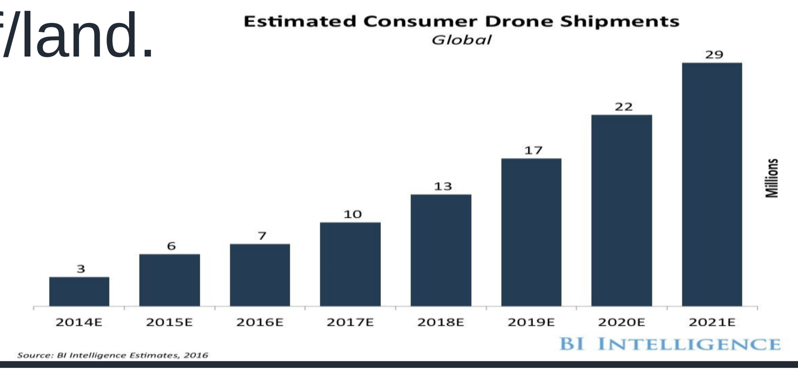
Control System for a Novel UAV

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.

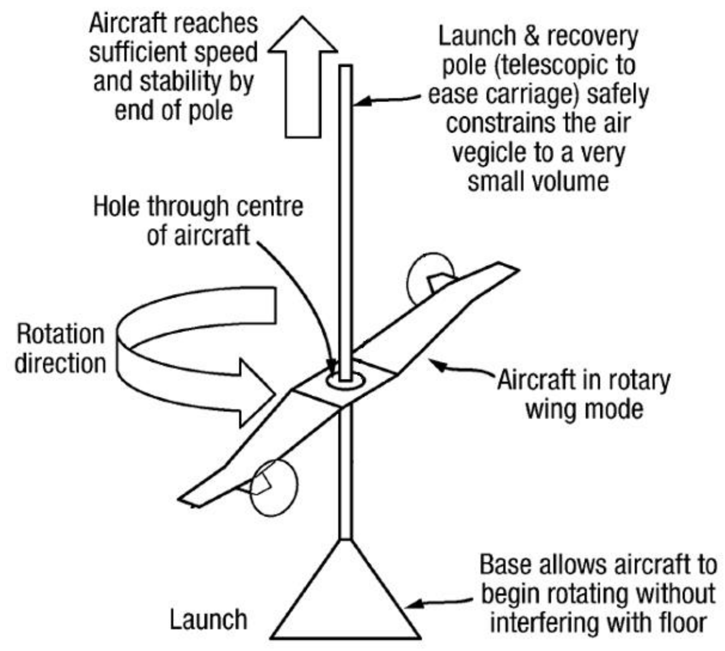
1. Introduction

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

Motivation:
Delivery drones.



2. Problem Statement



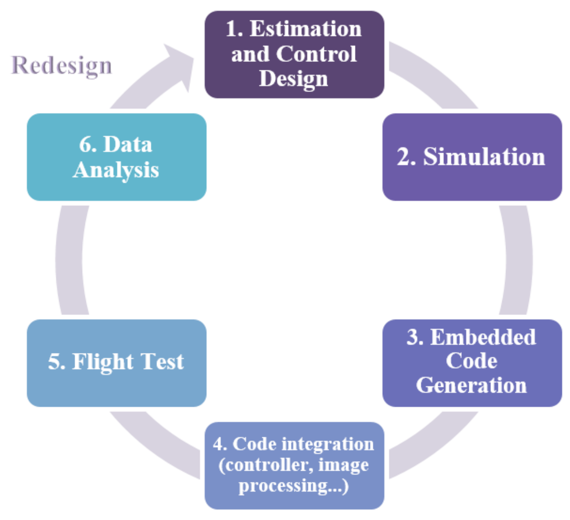
1. Vehicle **horizontally constrained** during launch/recovery (protection against gust and other disturbances for people and infrastructure nearby).
2. Launch/recovery within **small volume**.
3. Automatable process.
4. Optimization of vertical space in housing.

Aims and Objectives

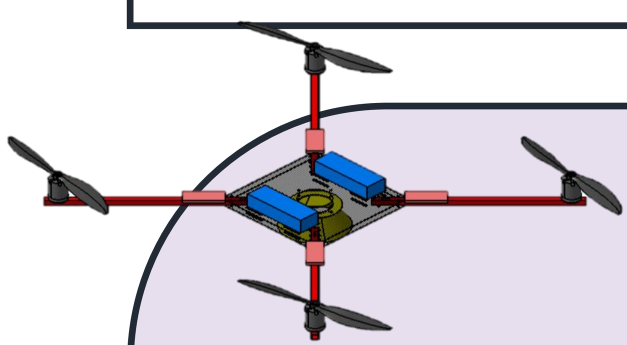
1. Design a suitable platform.
2. Design Control System (Precision Landing).
3. Develop Simulation Model.
4. Test + Analysis of results.
5. Physical Model building + testing.

3. Methodology

1. Software Implementation
2. Hardware Implementation



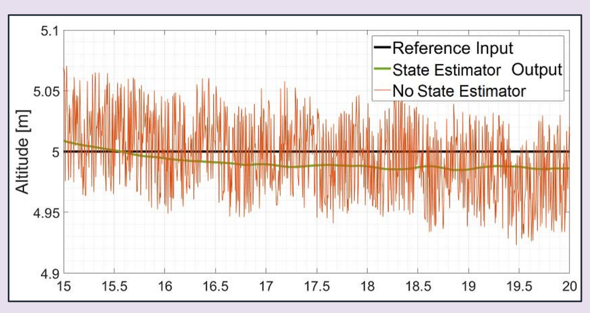
4. Results



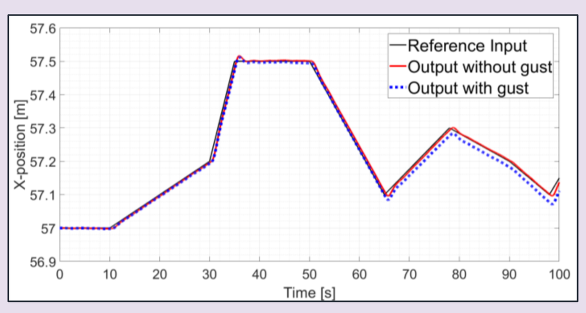
SIMULATION

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

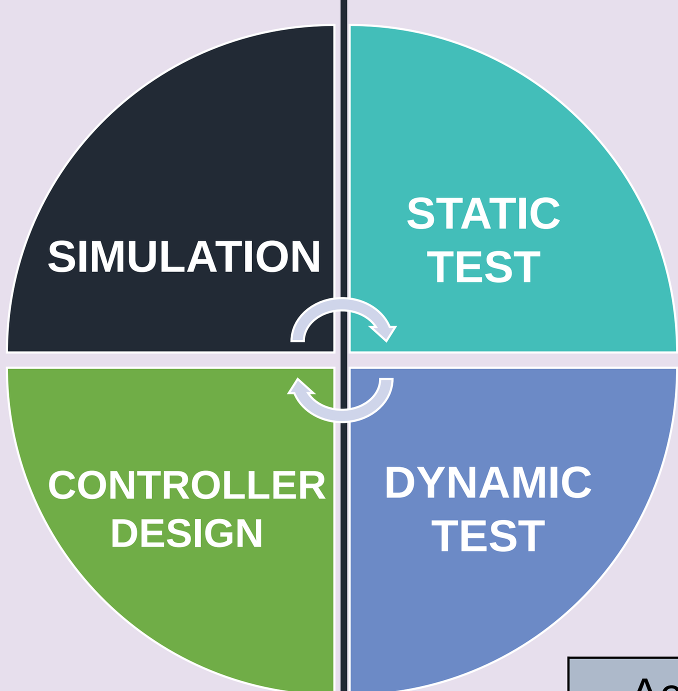
	Altitude	X-position	Y-position
Mean Steady State Error	1.12cm	0.53cm	0.86cm
Max Steady State Error	1.41cm	0.91cm	0.95cm
Overshoot	10.67%	21.78%	29.31%
Settling Time	3.55s	7.19s	8.09s



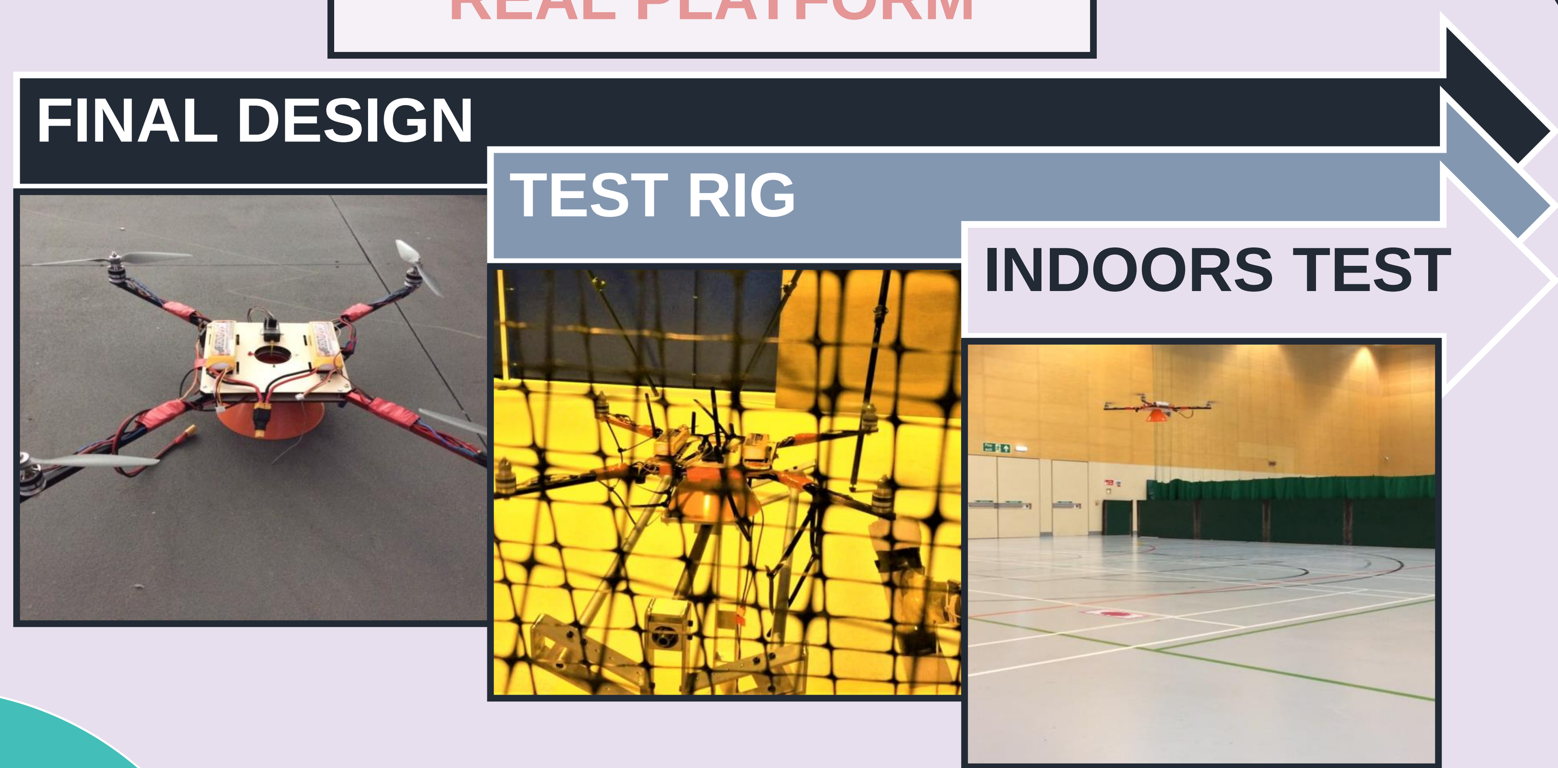
NOISE + BIAS REJECTION

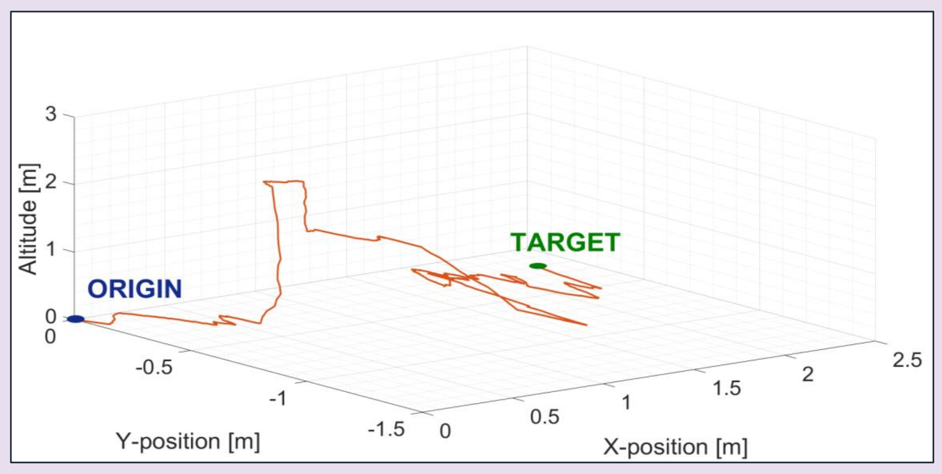


GUST REJECTION



REAL PLATFORM





	Altitude	X-position	Y-position
Accuracy	~ ± 10cm	~ ± 5cm	~ ± 5.5cm

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.

Anabel López Pujazón

Autonomous Vehicle Dynamics and Control MSc

BAE SYSTEMS

INSPIRED WORK