STERG

SOLAR THERMAL ENERGY RESEARCH GROUP

State Estimation of Drones

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Problem Statement

- Automate Tasks at CSP Plants
- Heliostat Calibration
- Computer Vision Algorithm
- Accurate State Estimation

Background

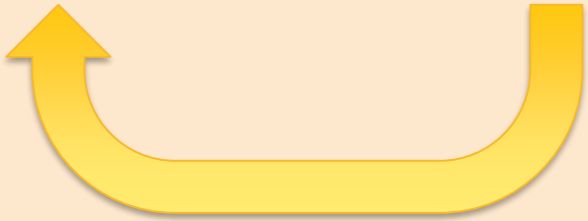
- What is State Estimation ?
- How does it work ?
- Better Estimation – Better Control

Background

Hardware

Background

Barometer Phenomena

Head Wind	Tail Wind
	

Research Question

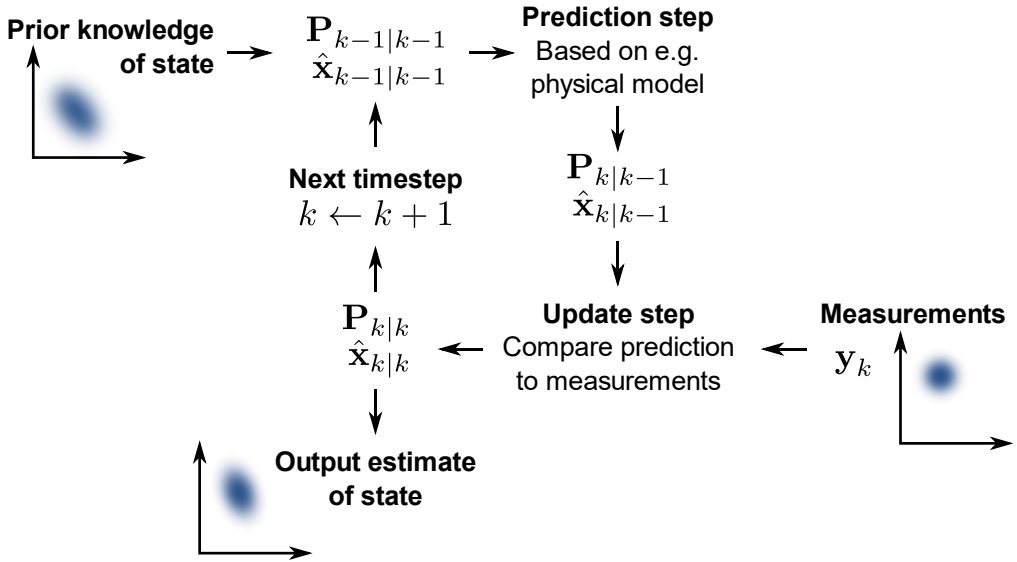
- How and to what degree can the altitude estimate of a multirotor aerial vehicle be improved?

Methodology

- Current Methods of State Estimation
- Sensors used
- Data Collection & Analysis
- Kalman Filter & Simulations

Methodology

Kalman Filter



Methodology

Kalman Filter

Prediction:

$$\hat{x}_k^- = A\hat{x}_{k-1} + Bu_k$$

$$P_k^- = AP_{k-1}A^T + Q$$

Update:

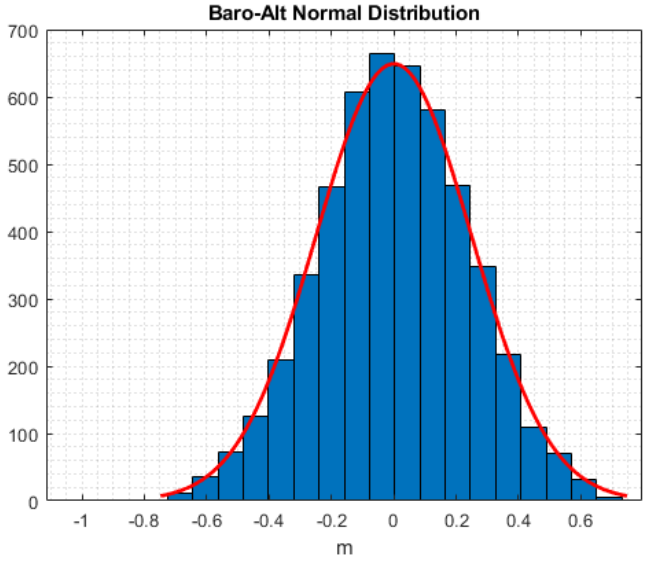
$$K_k = P_k^- H^T (HP_k^- H^T + R)^{-1}$$

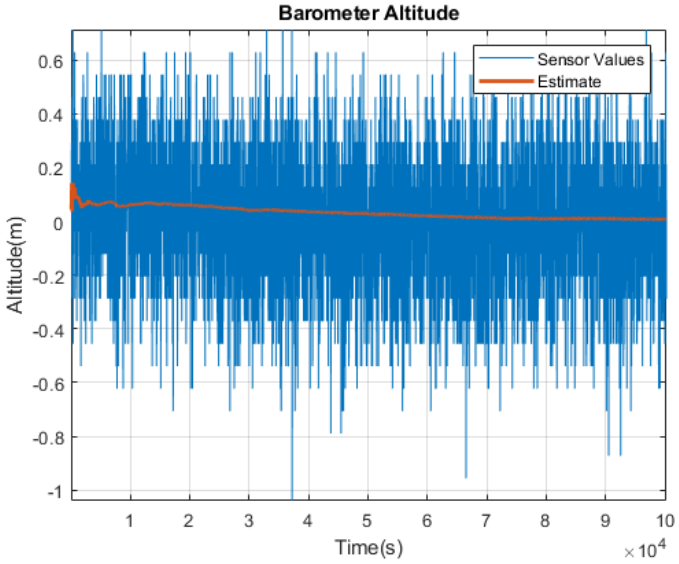
$$\hat{x}_k = \hat{x}_k^- + K_k(z_k - H\hat{x}_k^-)$$

$$P_k = (I - K_k H)P_k^-$$

Results

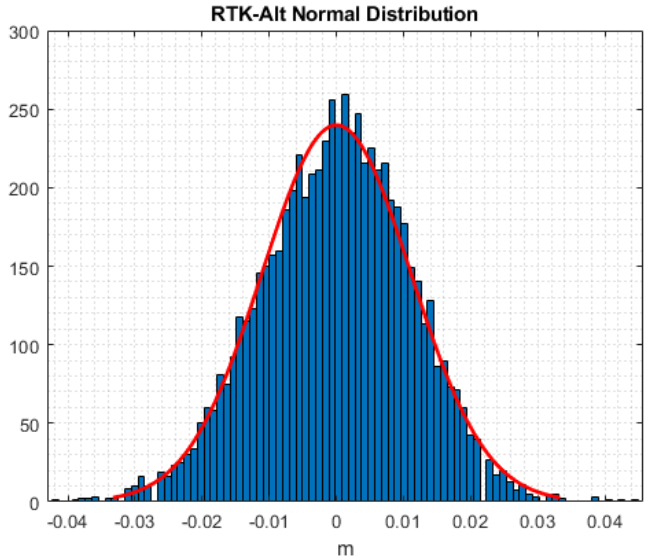
Barometer - Pixhawk

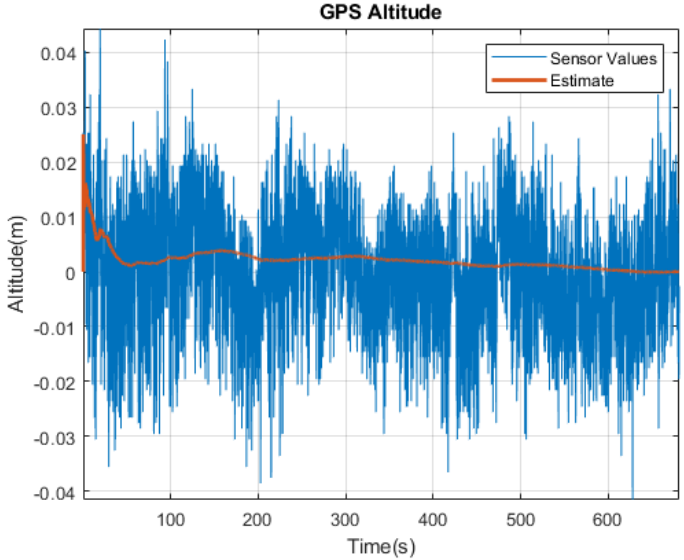




Results

Piksi RTK GPS



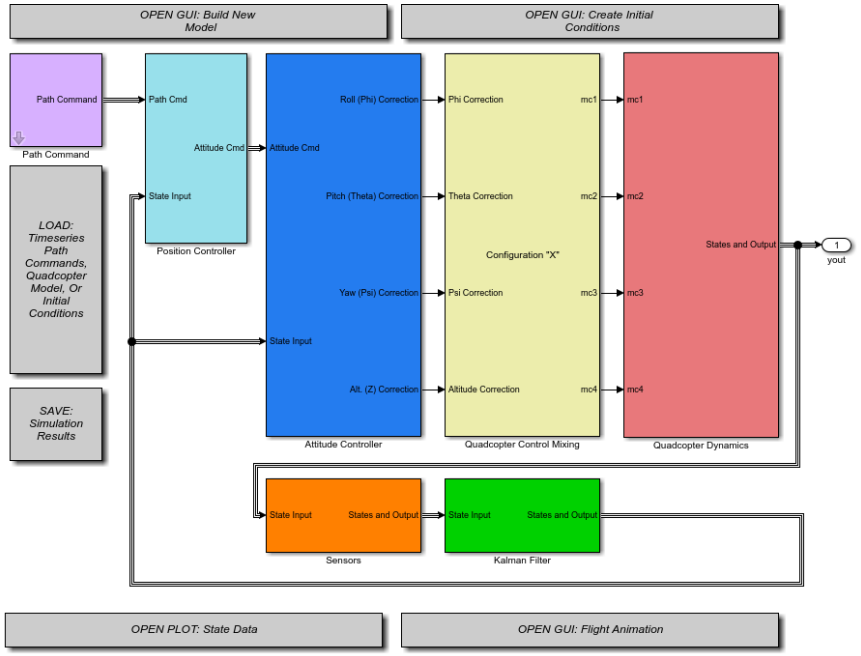


Analysis

- Effectiveness of Kalman Filter
- Sensor Noise
- Computational Load

Further Development

- Sensor Fusion
- Simulations
- Evaluation



Conclusion

- Performance
- Accuracy
- Sensor Fusion
- Simulations

Thank You

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