

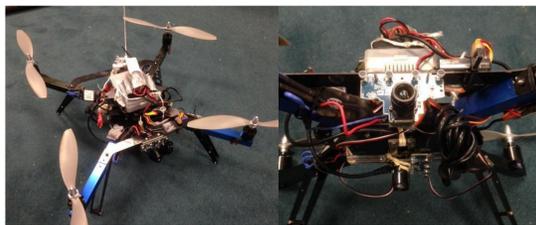
Sam Zeng

Advisors: Drew Bagnell and Martial Hebert

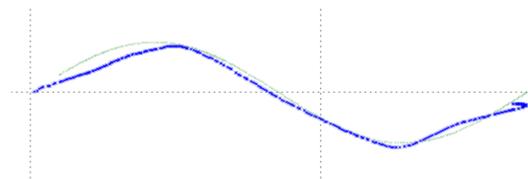
Motivation



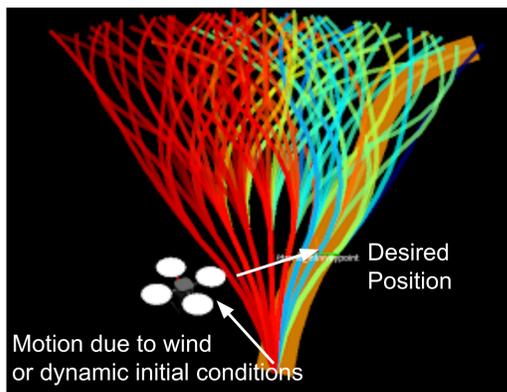
Platform



PID Control

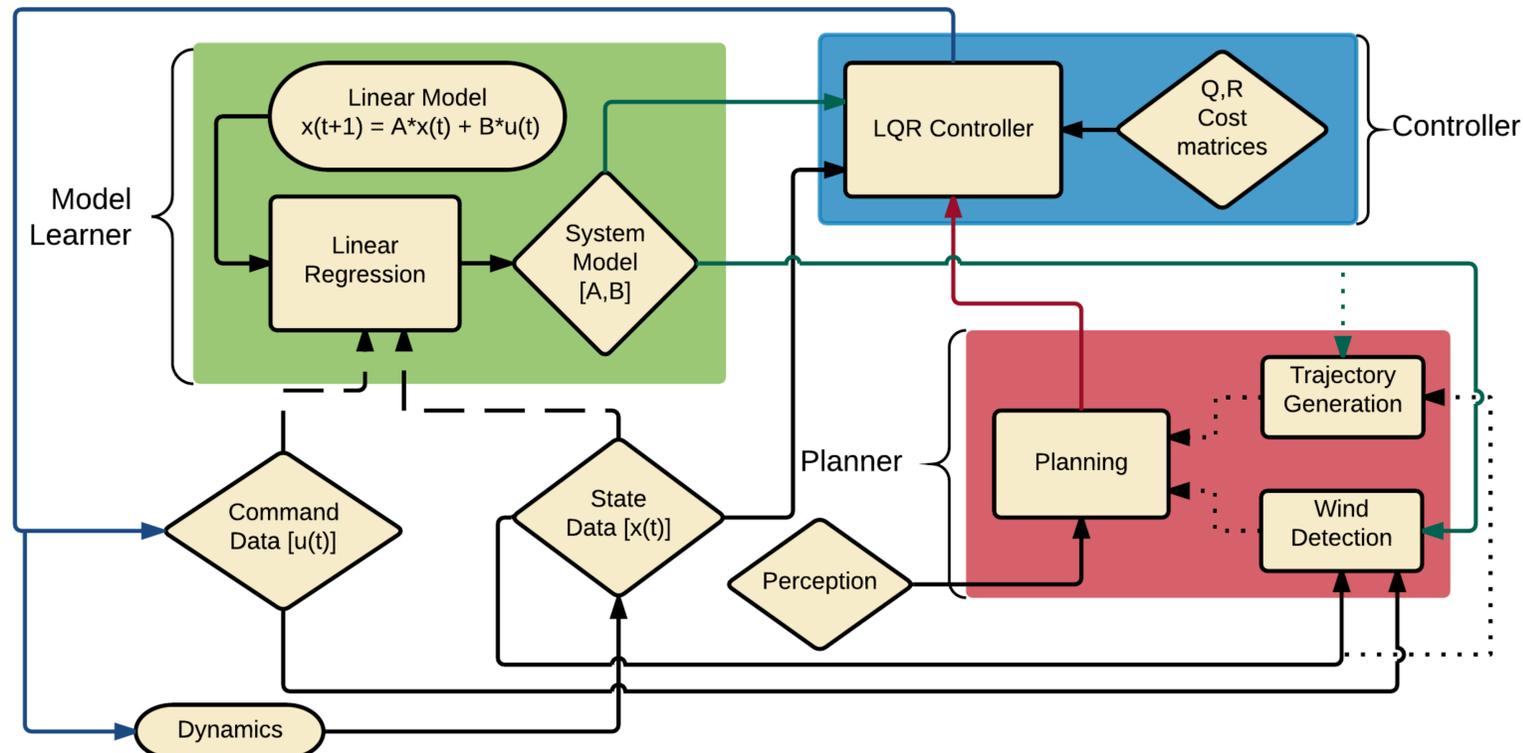


- Follows trajectory well in static testing environment.
 - No wind
 - No initial velocity



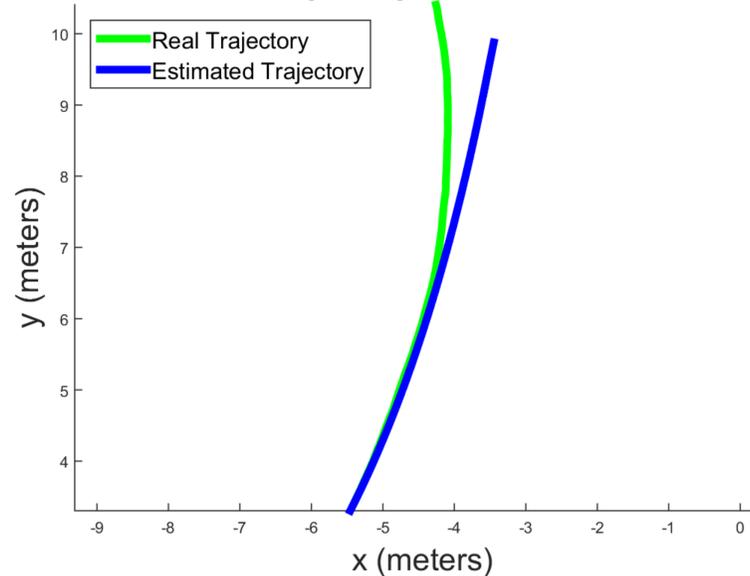
- Control failure accounts for >80% of our crashes during tests in forests.[1]
 - Most caused by wind
 - Dynamic initial conditions amplify problem.

System Modeling



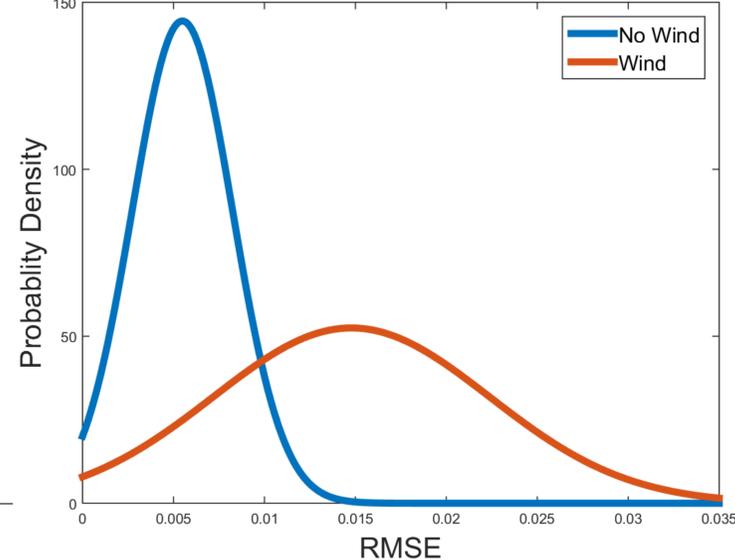
Model Evaluation

Trajectory Estimation



Wind Detection

PDF of Modeling Error In Windy and Calm Conditions



Future Work

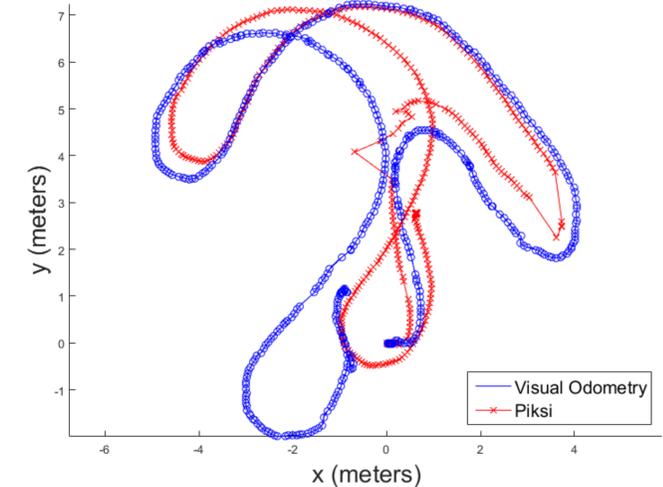
- Move from wind detection to active with control correction with online learning.
- Generate dynamically feasible trajectories based on current state estimate.

LQR Control

- For a linear time invariant system:
 - $x(t+1) = A*x(t) + B*u(t)$
- Minimize quadratic cost function:
 - $c(x,u) = x^T Q x + u^T R u$
 - Q determines cost of state errors
 - R determines cost of control inputs

State Estimation

Piksi vs Visual Odometry



- Model learning requires accurate state estimation.
- Piksi RTK GPS used for ground truth.
- ~5% error/distance traveled

Acknowledgements

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- I would also like extend my thanks all those who made RISS possible.

References

[1] Dey *et al.*, "Vision and Learning for Deliberative Monocular Cluttered Flight", *Field and Service Robotics*, Toronto, CA, 2015