## Executive Summary

## Introduction

## Literature Review

## Methodology

1 Determine the UAV dynamic model.

2 Introduce MPC. How is it implemented in this project?

3 How to use the data to train the Gaussian regression model and select the length scale method.

4 How to collect data to train the Gaussian model in what environment to collect data (wind, machine speed, trajectory radius),

5 How to determine the control performance, RMSE,

6 Why PCA is used and how it is implemented.

#### EXPERIMENTS AND RESULTS

Design the experiment.

Introduction the trajectory equation，

Introduce the gazebo experimental environment, how the sensor receives information and how to release control signals.

experiment 1： in no wind condition, compare the performance of dynamic model and offline GP model(with fixed data set), use different velocity and radius, The purpose of this experiment is whether GP can model mismatch between dynamic model and real drone.

experiment 2： The same number of training points as experiment 1(100points), collect the training set under the influence of wind in a fixed direction and fixed strength, and the control performance of the three models MPC was compared. Dynamic model, no wind model, fixed wind model. The purpose is to verify that GP model can model the effect of wind on motion model.

experiment 3， offline, changed the number of training set points, and observed the average time spend of MPC optimization.

experiment 4, offline, Changes the number of training set points to observe the control performance

experiment 5，Set up the online GP structure, using muti threading, add gust, change the wind direction and force after a period of time, compare the result of using online GP with that of using offline mismatch. Objective To show that online GP can learn real-time wind changes.

experiment 6，Change the number of training set points, check the solver compile time, set the appropriate model update time and training set size.

experiment 7，use PCA to compress the training set dimensions and compare RMSE under different compression dimensions.

## Discussion

## Conclusion and Recommendations

## References

## Appendices