Wind Measurement with UAV

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Date: April 24, 2020

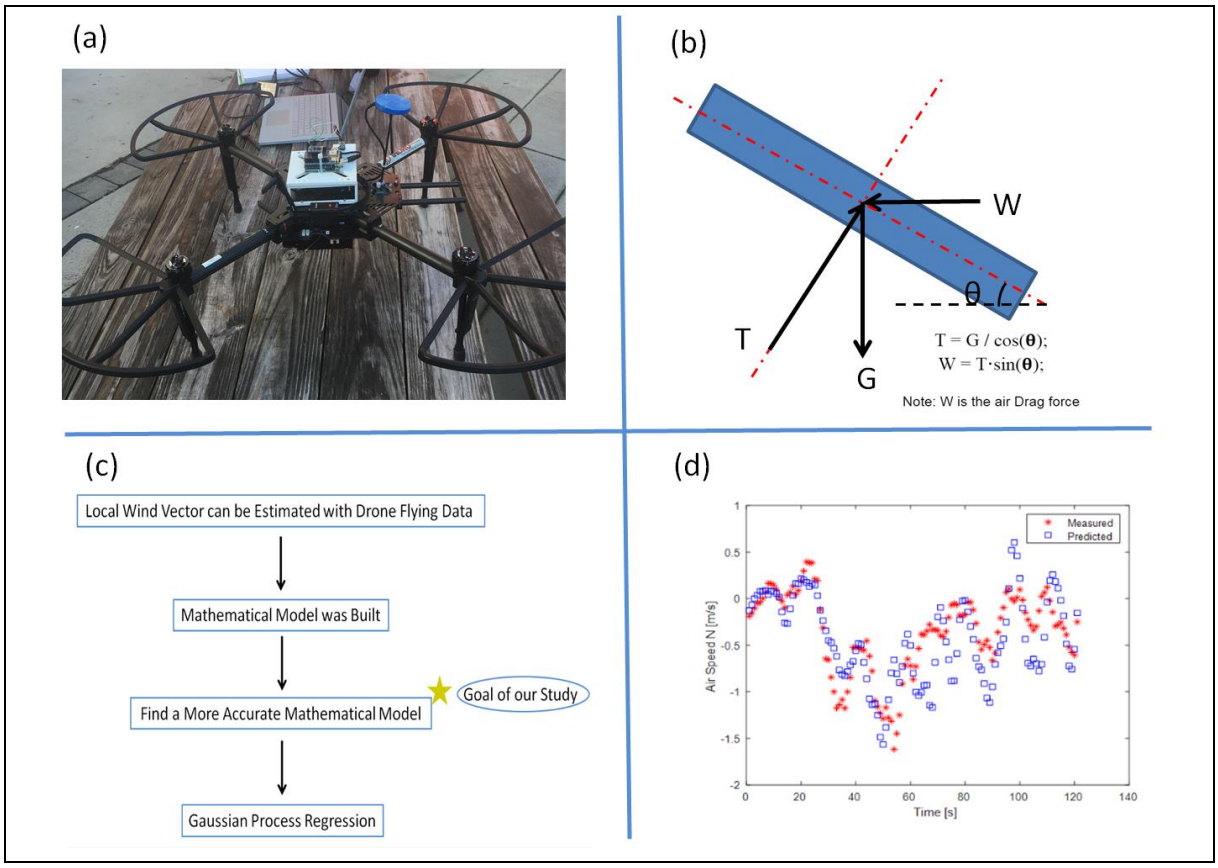

Figure 1: (a) Quadrotor used for this project (DJI frame and Pixhawk Controller). (b) Quasi-static free body diagram on a drone's side view (T: thrust force from rotor; G: gravitational force; W: air drag force). (c) Introduction to the project in flow chart. (d) GPR prediction result on field test data

Wind measurement has been a constant subject of research since its application is highly regarded and widely adopted in many areas, such as gas source localization and energy harvesting. In most meteorological services, only an average wind speed and direction is provided, but the real situation is rather complicated, and wind vectors could change locally. As unmanned aerial vehicle has been developed into a light-weighted and precisely-controlled device, it is now having a lot of extended use other than cargo transportation. In this project, we propose a method for wind vector estimation, which utilizes a quadrotor and a supervised machine learning algorithm, Gaussian Process Regression (GPR). The GPR in this method only uses signals collected by UAV's flying data, and there is no need to add airflow sensors to the UAV. The verification result using datasets acquired with a Simulink drone model and field test

data is incorporated in this study. Results demonstrate the advantage of the proposed method in terms of prediction accuracy, comparing to previous relevant studies.

For future work, we can combine GPR with wind forecasting from the meteorological service to downsize our data training range for a specific mission. Also, we can try using the sparse Gaussian process method with optimization algorithm for data sampling to improve the computational efficiency.