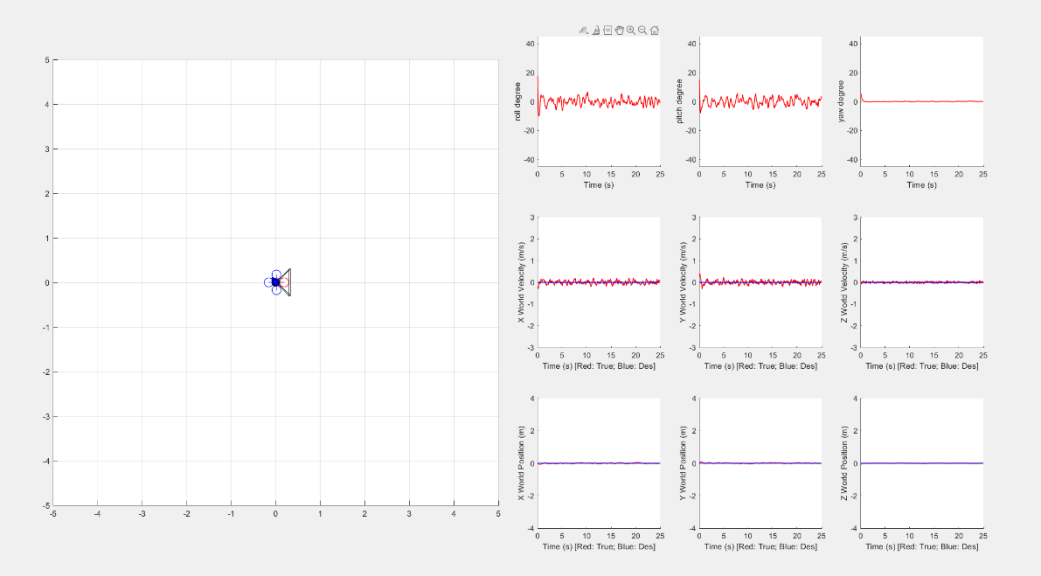
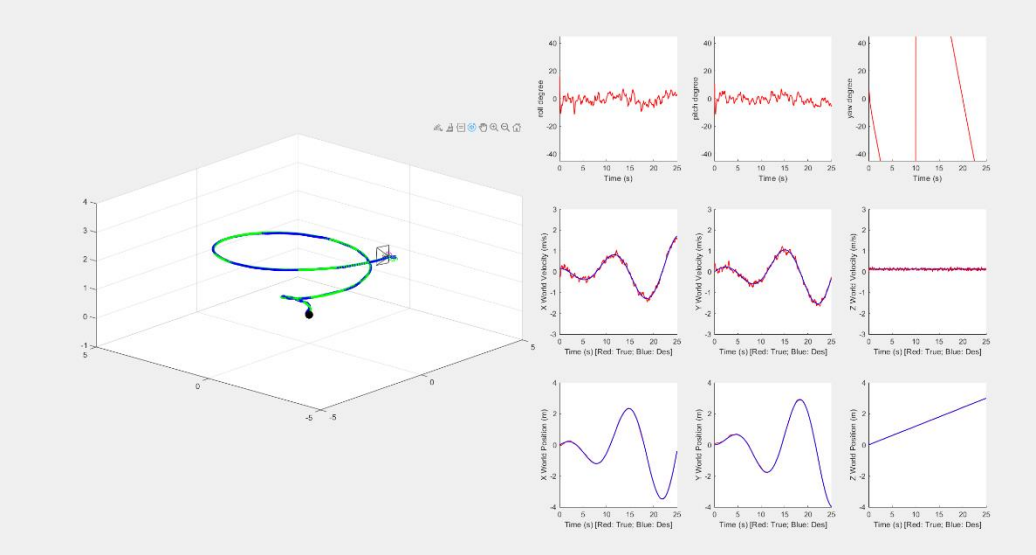
Project 1 Phase 1

1. Figure

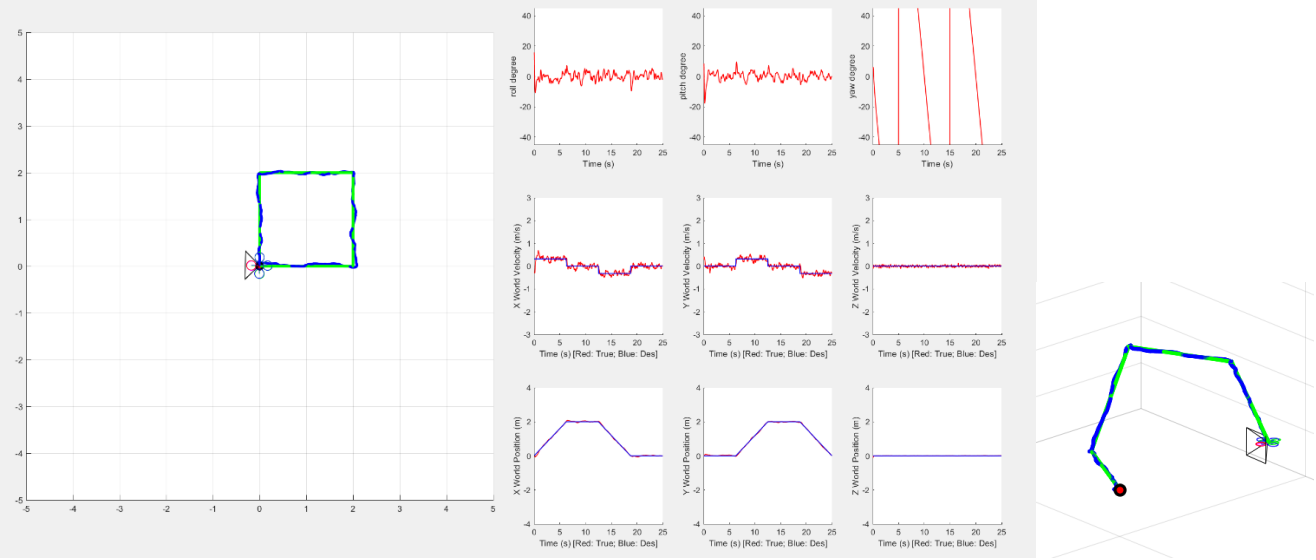
Hover Trajectory:



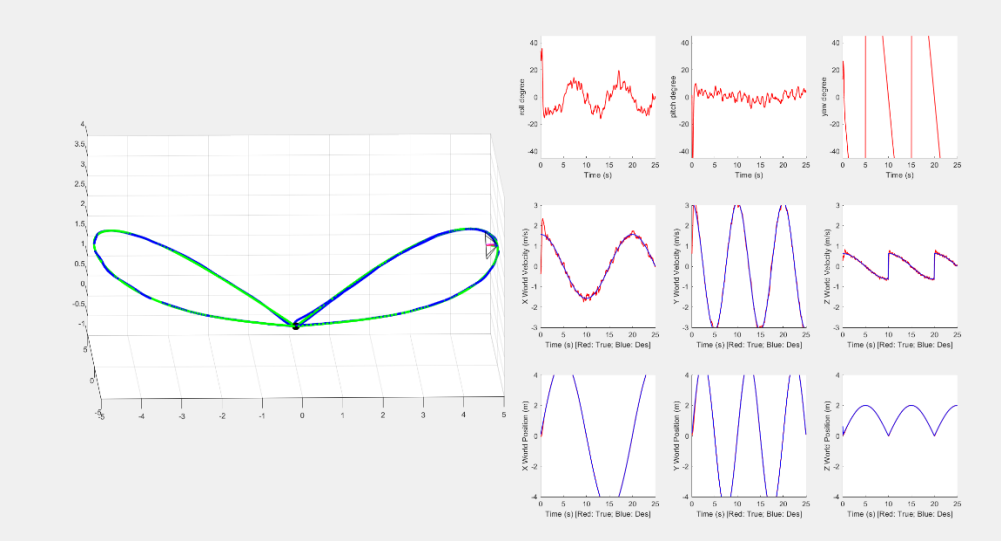
Circle Trajectory:



Square Trajectory:



Inf (8) Trajectory:



Controller Statistics

	Pos_RMS	Vel_RMS
Hover	**0.02353**	**0.074797**
Circle	**0.023703**	**0.075564**
Square	**0.026799**	**0.084381**
Inf	**0.05509**	**0.18465**

PID gains

	Kp	Kd
Pos_x	**8.5**	**5.2**
Pos_y	**8.5**	**5.2**
Pos_z	**36**	**16**
Att_pitch	**800**	**60**
Att_roll	**800**	**60**
Att_yaw	**100**	**30**

Analysis

Design such a PD controller is not hard, but tune the hyperparameters of the controller is time consuming and annoying. I found several things that may effect the controller performance. First, the calculated Force “F” is assumed to be the Z axis force on equilibrium points. However, if we consider project the force to current body frame, the controller become non-linear. At first, I use Ziegler-Nichols method to tune Kp and Kd. It can only provide a rough idea of how large Kp and Kd are. It still need manual tuning to make the system a better performance.

Some thoughts:

I found that it is really hard to make the system perform well in every cases. So I need to tune the K gains for different trajectories and balance the result. I think we still need introduce nonlinear to system controller for better performance. I think we can keep outer loop position control as PID while change inner loop attitude control to another controller like LQR or MPC.