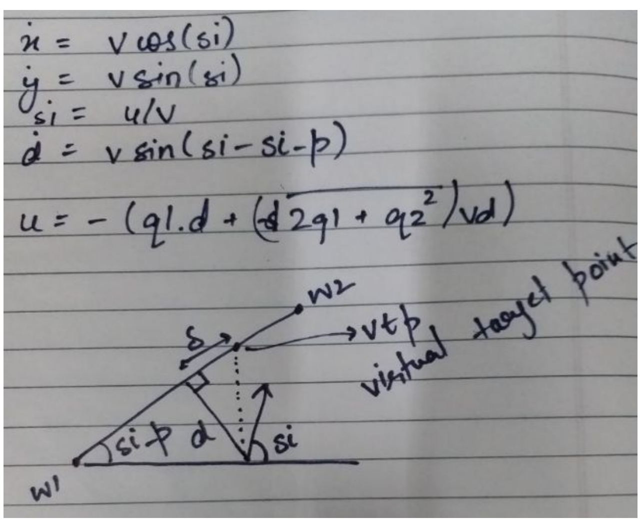
Optimal Path Following for High Wind Flights

Mandeep Singh - 2014145

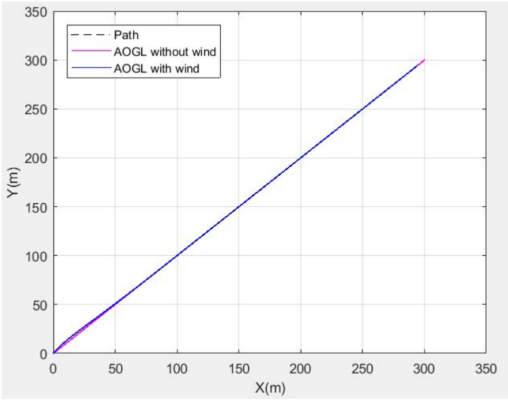
Brief Explanation :
The LQR based optimal guidance law developed in paper uses the UAV position error in state weight due to which as the error increases the desired control input also increases and quickly makes the cross track error zero.
In order to replicate the results Ode45 has been used in matlab. All the parameters has been kept same as mentioned in the paper due to which I am getting similar results.

- Straight Line Following (wind velocity = 0.2 x (Velocity of UAV = 25))

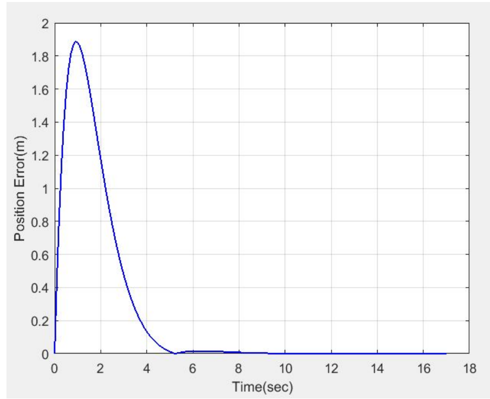
The Procedure used to obtain the below graphs



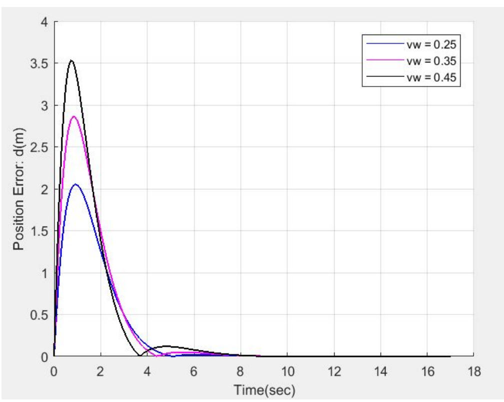
- v = 25 m/sec
- si : current heading angle
- si_p = desired heading angle
- d : cross-track error
- q1 as in paper
- q2 = 1



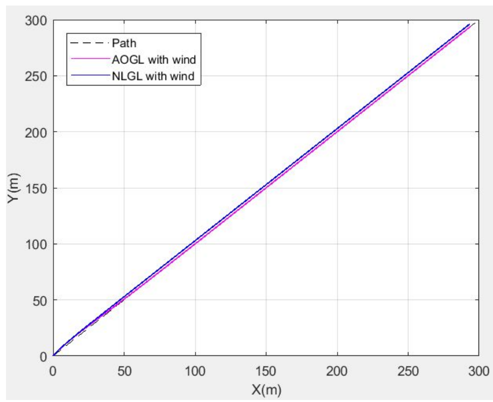
Trajectories



Position Error (Wind enabled)



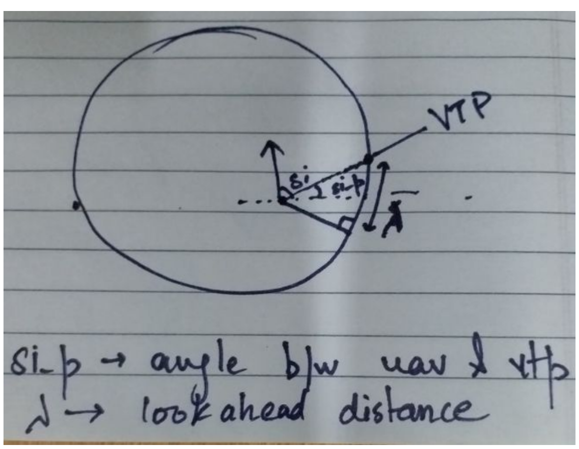
Position Error for AOGL

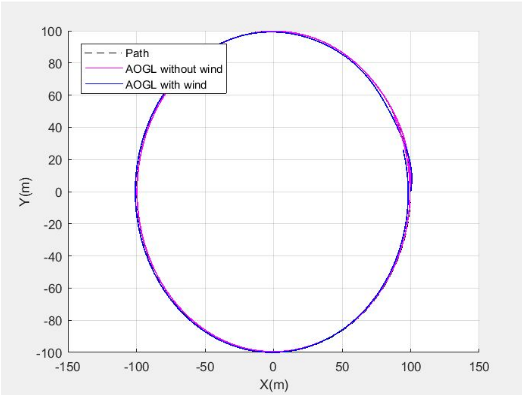


Comparison AOGL vs NLGL

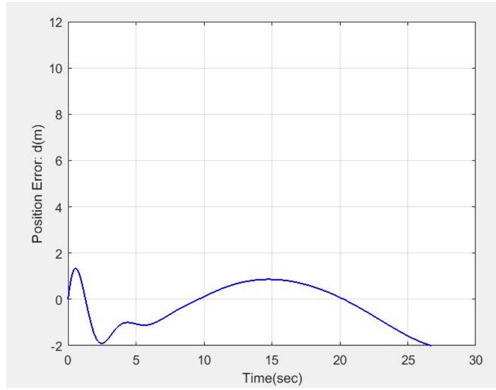
- Circular Path Following (r = 100m)

  The procedure used to obtain the below graphs

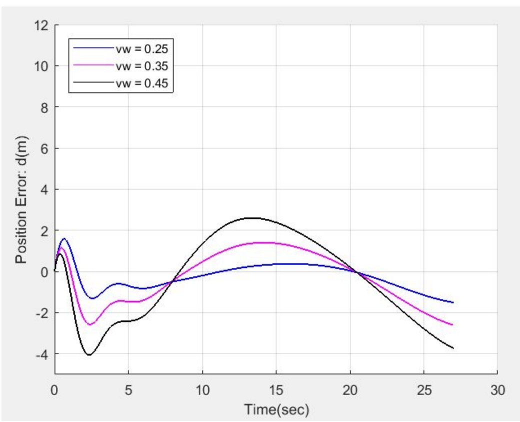




Trajectories



Position Error (Wind Enabled)



Position Error of AOGL

EXTRA WORK

Some new methods were explored to extend the LQR based path following for UAVs from 2D to 3D. Two main trajectories were considered 3D Zig-Zag LQR based Line Following and LQR based 3D

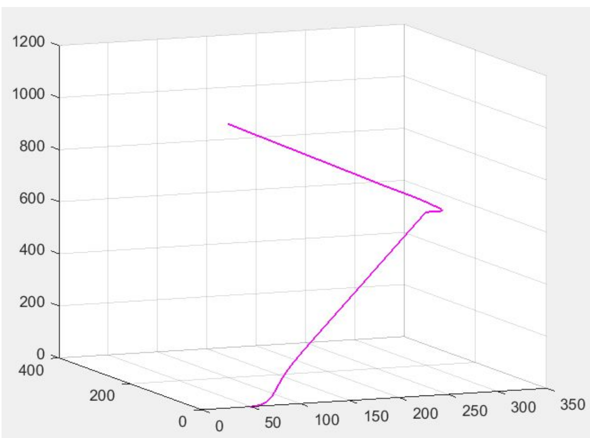
Circular Path Following. In both the scenarios another LQR Guidance law is designed for z axis which means there are two LQR guidance law working in a decoupled manner.

In 3D the equations of motion get modified in the way :

x_dot = v*cos(si)*cos(si_z)
y_dot = v*cos(si)*sin(si_z)
z_dot = v*sin(si_z)

si is the angle from x axis in xy plane and si_z is the angle from xy plane in +z direction.

- LQR based 3D Zig-Zag Line Following



- LQR based 3D Circular Path Following - (Hellical)