Autonomous Vehicle Simulation

This Project is about simulating a **Autonomous** Vehicle Design in **SIMULINK** based on the data collected from

1. A Camera,

2. A Radar.

WORK FLOW:

1. We have discussed and divided the work into 3 Models.
    a. **VEHICLE MODEL**
    b. **LANE FOLLOW MODEL**
    c. **OBSTACLE AVOIDANCE MODEL**
2. **VEHICLE MODEL:**
    a. To build the Model we have referred to **LATERAL DYNAMICS** of a vehicle.
        i. $(k1 + k2)\beta + \left(\frac{1}{u}\right)(ak1 - bk2)w - k1(\delta) = m(v^{\circ} + uw)$
        ii. $(ak1 - bk2)\beta + \left(\frac{1}{u}\right)(a^2k1 + b^2k2)w - ak1(\delta) = I_z w^{\circ}$
        iii. $X = \int \cos(\beta + \int wdt)dt * \sqrt{u^2 + v^2}$
        iv. $Y = \int \sin(\beta + \int wdt)\, dt * \sqrt{u^2 + v^2}$
    b. These are the 4 equations that have been Modelled in Simulink as **VEHICLE MODEL**
    c. From the Vehicle Model we obtain the X and Y coordinates of the vehicle.
3. **LANE FOLLOW:**
    a. This model contains a quadratic equation which represents the Road.
        i. $y = x^2 + 5x + 6$
    b. From the road equation we found the distance between the vehicle and left lane of the road , similarly the distance from right lane.
    c. In order to find steer angle we have considered the difference between left lane and vehicle positions.
4. **OBSTACLE AVOIDANCE:**
    a. In this model we have assumed the radar data in the form of POLAR COORDINATES. (Since the radar data in real time is polar in nature)
    b. We have Simulated a POLAR to LOCAL COORDINATE converter to get the coordinates in the form of x , y.
        i. $x' = (x - X)\cos(\alpha) + (y - Y)sin(\alpha)$
        ii. $y' = -(x - X)\sin(\alpha) + (y - Y)cos(\alpha)$
    c. We then assumed a goal position to which our vehicle has to travel.
    d. As for the PATH PLANNING ALGORITHM we have used the method of finding angle between 2 straight lines.
5. **Switch:**
    a. The overall model converts from **LANE FOLLOW** to **OBSTACLE AVOIDANCE** by considering the vehicle speed of the Obstacle.

RESULTS:

1. **Obstacle_Speed > Vehicle_Speed**

Steer Angel	X	Y
0	0.1389	0
0.2779	34.93	-8.276
-1.536	-19.94	87.86
1.524	-21.31	-90.15
1.539	-17.49	-82.21

2. **Vehicle_Speed > Obstacle_Speed**

Steer Angel	X	Y
0	0.1389	0
-0.6228	55.14	45.44
0.003746	0.7303	0.09316
-0.9696	46.12	82.66
-0.008065	1.452	-0.1946