REPORT

1. Theory:
    a. Linearization: It is achieved by differentiating (Jacobian) around the equilibrium points since nonlinear systems act like linear systems near the equilibrium points.
    b. State Feedback Control: SFC relies on current states to decide the input to the system. It can be achieved by:
        i. $U = -Kx$
2. Step Results:
    a. $\begin{bmatrix} 0 & \pi & 0 \\ 0 & 0 & 0 \\ 0 & 0 & \pi \\ 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \pi \\ 0 \\ \pi \\ 0 \end{bmatrix}$ → This equ^n pos^n was not provided by MATLAB
    b. linear_A = 4×4

0	1.0000	0	0
12.5769	0	-11.9611	0
0	0	0	1.0000
-16.9227	0	46.1565	0

linear_B = 4×2

0	0
1.7250	-4.4345
0	0
-4.4345	14.8902

    c. System is unstable
    d. C = 4×8

0	0	1.7250	-4.4345	0	0	74.7378	-233.8759
1.7250	-4.4345	0	0	74.7378	-233.8759	0	0
0	0	-4.4345	14.8902	0	0	-233.8759	762.3251
-4.4345	14.8902	0	0	-233.8759	762.3251	0	0

System is controllable

    e. poles = 1×4 complex

-1.0000 + 0.0000i -2.0000 + 0.0000i -1.0000 - 1.0000i -1.0000 + 1.0000i

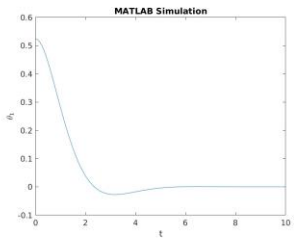
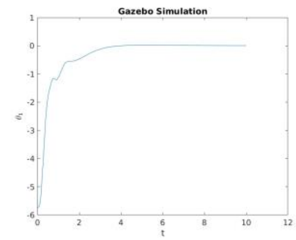
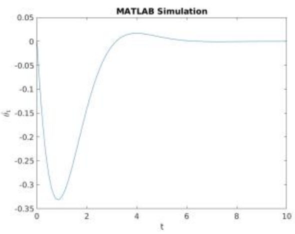
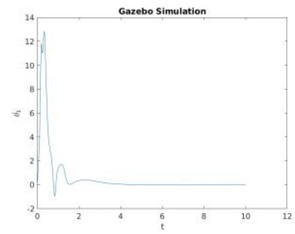
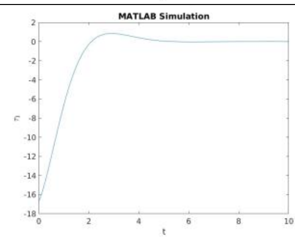
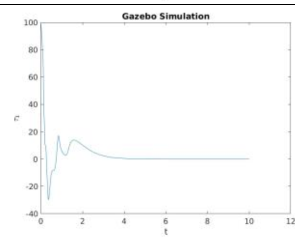
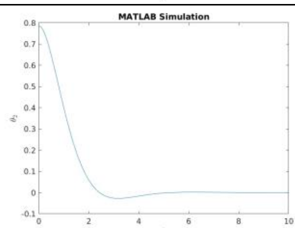
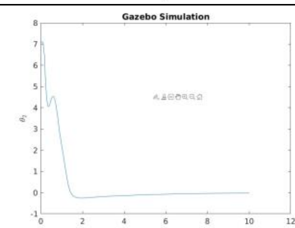
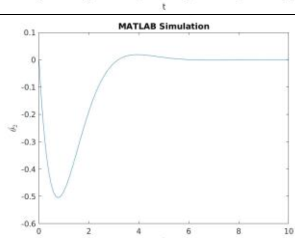
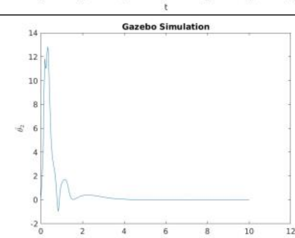
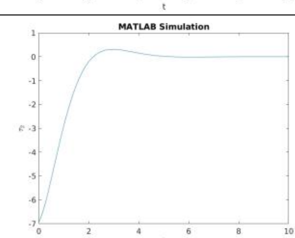
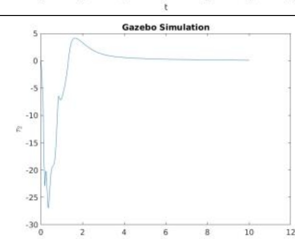
K = 2×4

23.9371	6.4042	5.2636	0.1559
6.0097	1.8868	4.7955	0.2022

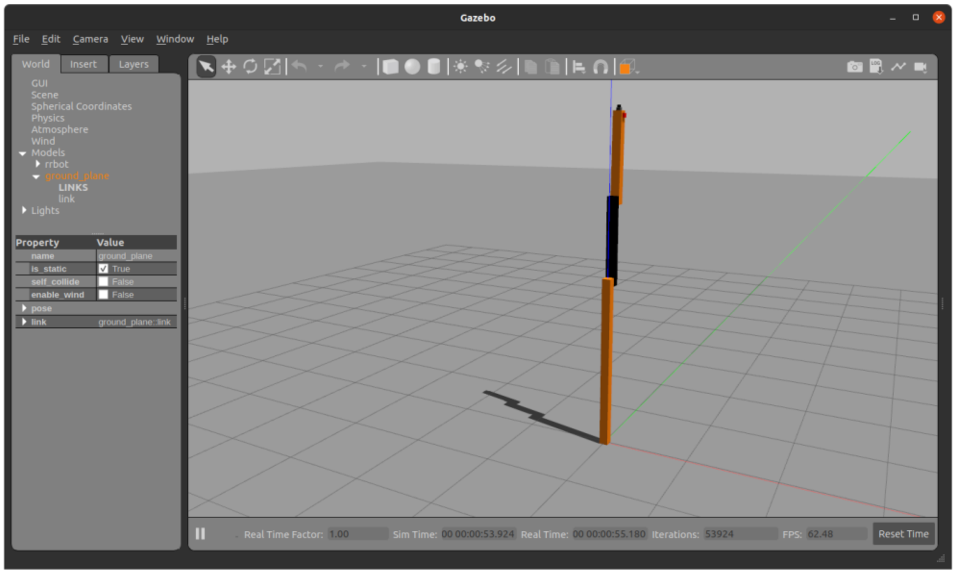
A_SF = 4×4

0	1.0000	0	0
-2.0655	-2.6804	0.2250	0.6277
0	0	0	1.0000
-0.2582	0.3049	-1.9085	-2.3196

3. Trajectory Plots

	MATLAB	Gazebo
$\theta_1\ vs\ t$		
$\dot{\theta}_1\ vs\ t$		
$\tau_1\ vs\ t$		
$\theta_2\ vs\ t$		
$\dot{\theta}_2\ vs\ t$		
$\tau_2\ vs\ t$		

4. From Gazebo results I found that due to absence of friction, the torque on motor is significantly different and much smoother in MATLAB simulations than Gazebo Simulation.

5. 
Gazebo
File
Edit
Camera
View
Window
Help
World
Insert
Layers
GUI
Scene
Spherical Coordinates
Physics
Atmosphere
Wind
Models
rrbot
ground_plane
LINKS
link
Lights
Property
Value
name
ground_plane
is_static
True
self_collide
False
enable_wind
False
pose
link
ground_plane::link
Real Time Factor:
1.00
Sim Time:
00 00:00:53.924
Real Time:
00 00:00:55.180
Iterations:
53924
FPS:
62.48
Reset Time