ME 425_525
HW # 2
Motion Control of a Mobile Robot
Due: 04/11/2025, Time: 23:55

1. Derive the system description in polar coordinates (Equation (3.53) in the Textbook) using Equations (3.50)-(3.52).

2. Simulate the positioning controller developed in class for the nonholonomic, differential-drive wheeled mobile robot. To this end, do the following:

    - Build a Simulink model for the kinematic model of the mobile robot using the polar representation that you derived above.

    - Add a controller block to your Simulink model to implement the control laws covered in class (Equations (3.56) and (3.57) in the Textbook).

    - Simulate the system with various initial conditions, $(\rho_0, \alpha_0, \beta_0)$. For that purpose, you can select $\rho_0 = R$, initial position of the robot is on the circumference of a circle with radius R, and the goal is at the center of this circle. In other words, you are going to park the robot at the center of the circle. Note that for $\alpha_0 \in (-\frac{\pi}{2}, \frac{\pi}{2}]$, the forward direction of the robot points toward the goal, and for $\alpha_0 \in (-\pi, -\frac{\pi}{2}] \cup (\pi/2, \pi]$, it points the reverse direction.

    - Plot the resulting motion trajectories. Discuss your results and comment on the stability of the system.

    Your homework report must include all the details (Matlab/Simulink source files, simulation results in terms of various plots, and the discussion of the results along with your comments).