ED5315: Assignment - Underwater Robotics 2024

Date of submission: 4th November 2024

1. Write a program using MATLAB/ Simulink/ Python to solve the kinematics for a 6 DoF underwater robot and solve the following: [4]
   - The robot is having a velocity of [0, 3, 3, 0.05, 0, 0]^T. The initial orientation of the vehicle is [0, -10^o,0]. Plot the velocity of the vehicle with respect to the inertial frame.
   - Plot the vehicle trajectory in 3D space for 150 seconds of motion.
   - Find the final position and orientation of the vehicle

2. Using Simulink or any simulation program, simulate the 6-DoF motion of an AUV
   Hint: $\dot{v} = M^{-1}(\tau - (C(v)v + D(v)v + g(\eta)))$
   Use the values given below and make suitable assumptions when necessary.

$$\tau = [150 \;\; 50 \; 0 \; 0 \; 0 \; 0]$$

$$M = \begin{bmatrix} 1500 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1500 & 0 & 0 & 0 & 35 \\ 0 & 0 & 1500 & 0 & -35 & 0 \\ 0 & 0 & 0 & 145 & 0 & 0 \\ 0 & 0 & -35 & 0 & 4000 & 0 \\ 0 & 35 & 0 & 0 & 0 & 4200 \end{bmatrix}$$

$$C = [\,0\,]$$

$$g(\eta) = \begin{bmatrix} -205 * sin\theta \\ 205 * cos\theta * sin\emptyset \\ 205 * cos\theta * cos\emptyset \\ 220 * cos\theta * sin\emptyset \; - \; 1.1 * cos\theta * cos\emptyset \\ 22 * sin\theta \; - \; 1.1 * cos\theta * cos\emptyset \\ 1.1 * cos\theta * sin\emptyset \end{bmatrix}$$

$$D(v) = \begin{bmatrix} 42.5 & -19.8 & 31.1 & 0 & 0 & 0 \\ 0 & 92.0 & 0 & 0 & 0 & -1450 \\ 0 & 0 & 1500 & 0 & 2100 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -3200 & 0 & 6700 & 0 \\ 0 & 380 & 0 & 0 & 0 & 1250 \end{bmatrix}$$

Provide the dynamic model of the AUV and provide the model along with the plots of linear velocity, position, and 3D trajectory for 150 seconds of simulation time. The initial pose of the AUV is given as [0 0 100 0 0 0]. [6]