ED5315: Assignment 4

Date of submission: 10th November 2023

Q1: (4 marks)

Write a computer program using Matlab/Simulink / Python to solve the kinematics for a 6 dof underwater robot.

Using the above program, solve the following:

1. An underwater robot is having a velocity of $[3.0, 0.5, 0, 0, 0.05, 0.00]^T$. The initial orientation of the vehicle is $[0,0,0]$. Plot the velocity of the vehicle wrt inertial frame.
2. Plot the vehicle trajectory in 3D space for 100 seconds of motion.

What is the final orientation of the vehicle?

Q2: (6 marks)

Using Simulink or similar simulation programs, simulate the 6-dof dynamic motion of an AUV for the conditions given below.

Hint: $\dot{v} = M^{-1}(\tau - (C(v)v + D(v)v + g(\eta)))$

$C = [0], \quad \tau = [\, 650 \; 0 \; 0 \; 0 \; 45 \; 0 \,]$

$$M = \begin{bmatrix} 1467 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1467 & 0 & 0 & 0 & 32.274 \\ 0 & 0 & 1467 & 0 & -32.274 & 0 \\ 0 & 0 & 0 & 141 & 0 & 0 \\ 0 & 0 & -32.274 & 0 & 3895 & 0 \\ 0 & +32.274 & 0 & 0 & 0 & 4036 \end{bmatrix}$$

$$g(\eta) = \begin{bmatrix} -196.2\sin\theta \\ 196.2\cos\theta\sin\phi \\ 196.2\cos\theta\cos\phi \\ 216.6048\cos\theta\sin\phi - 1.0791\cos\theta\cos\phi \\ 216.6048\sin\theta - 1.0791\cos\theta\cos\phi \\ 1.0791\cos\theta\sin\phi \end{bmatrix}$$

$$D(v) = U \begin{bmatrix} 37.3 & -17.2 & 28.3 & 0 & 0 & 0 \\ 0 & 875.3 & 0 & 0 & 0 & -1381.5 \\ 0 & 0 & 1447.3 & 0 & 2052.9 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & -3105.3 & 0 & 6497.6 & 0 \\ 0 & 372.1 & 0 & 0 & 0 & 1194.3 \end{bmatrix}$$

(make necessary assumptions for any other required parameters, if any)

Design the dynamical block set with the help of Simulink ® and provide the dynamical block set along with the plot of linear velocity and position for 100 seconds of simulation time.