ID-5004W: AI in Predictive Maintenance, Reliability, and Warranty
April – July 2023

Home Assignment - 03

Due: Sunday, May 28th

Instructions

- Make any additional assumptions if needed and justify your assumption.
- Please submit your own work.
- Attach the codes and results for the respective questions if MATLAB or any software is used.

Problem - 1: Differential equation to State-space representation

What will be the state-space representation for the system given by the following differential equation?

$$\frac{d^3y}{dt^3} + 6\frac{d^2y}{dt^2} + 11\frac{dy}{dt} + 10y = 8u(t)$$

Problem - 2: Differential equation to Transfer function

What will be the transfer function for the system given by the following differential equation?

$$A\frac{d^2y}{dt^2} + B\frac{dy}{dt} + Cy = Px + Q\frac{dx}{dt}$$

Problem - 3: Transfer function to State-space representation

Find the State-space representation of the following transfer function:

$$\frac{C(s)}{R(s)} = \frac{24}{s^3 + 9s^2 + 26s + 24}$$

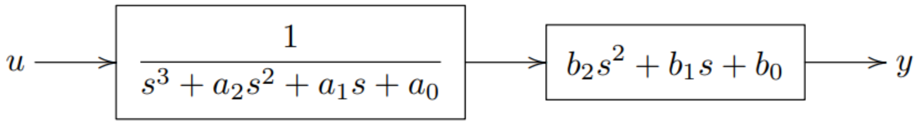
Problem - 4: Transfer function to State-space representation

For a system with transfer function H(s), what is the matrix A in the state space from?

$$H(s) = \frac{3(s-2)}{s^3 + 4s^2 - 2s + 1}$$

Problem - 5: Transfer function to State-space representation

Find the State-space representation of the following system:



Problem - 6: State-space representation to transfer function

Find the transfer function of the system described by the state equation $X' = AX + BU$. The output is given by Y = CX for:

(a) $A = \begin{bmatrix} -4 & -1 \\ 3 & -1 \end{bmatrix}; B = \begin{bmatrix} 1 \\ 1 \end{bmatrix}; C = \begin{bmatrix} 1 & 0 \end{bmatrix}$

(b) $A = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix}; B = \begin{bmatrix} 0 \\ 1 \end{bmatrix}; C = \begin{bmatrix} 1 & 0 \end{bmatrix}$

Problem - 7: State transition matrix

Find the state transition matrix for a system, $A = \begin{bmatrix} 0 & -2 \\ 1 & -3 \end{bmatrix}$