CHEM-E7190/2022: Exercise III - Stability, Controllability, Observability

1. Take the linearised dynamic model of the jacketed vessel from Exercise II utilizing your chosen steady-state values.

   Please answer for the following questions and explain your results.

   (a) Calculate the stability of the system

   (b) Calculate the controllability gramian of the system.

   (c) Calculate the controllability matrix and the controllability of the system.

   (d) Calculate the observability gramian of the system.

   (e) Calculate the observability matrix and the observability of the system.

2. Observer

   (a) If your C matrix is following do you need observer to have the knowledge of all of the states of your system?

   $$C = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

   (b) If you can only measure T and T_j do you need observer to have the knowledge of all of the states of your system? What if you can measure only volume V?

3. Design and simulate LQR for your system and analyse the results. What happens if you arbitrarily choose the eigenvalues?