

0. Make sure to complete the work on Lab 2 with the data we collected in the lab!

1. Given the state variable model,

$$\dot{x} = \begin{bmatrix} 4 & 8 \\ 8 & 4 \end{bmatrix}x + \begin{bmatrix} 1 \\ -1 \end{bmatrix}w_1$$

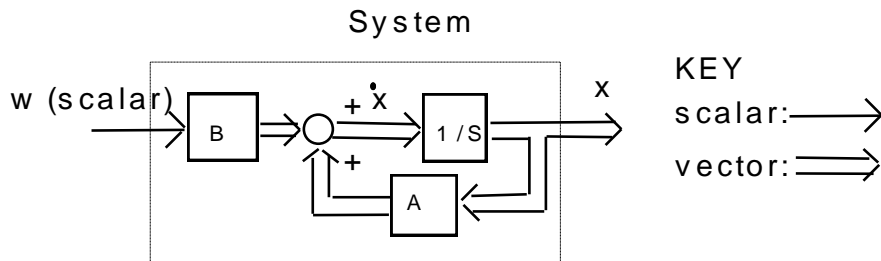
$$y = \begin{bmatrix} -2 & 2 \end{bmatrix}x$$

- a) Find a similarity transformation and transform the model into decoupled form
- b) Which eigenvalues (modes) of the system are controllable? Which are observable? Which are stable?

Next, Consider the state variable model in phase-variable form:

$$\dot{x} = \begin{bmatrix} 0 & 1 \\ 5 & -4 \end{bmatrix}x + \begin{bmatrix} 0 \\ 1 \end{bmatrix}w$$

- d) Find the eigenvalues of the system. Is the system asymptotically stable?
- e) Find a full-state feedback control which sets the closed-loop eigenvalues to $\{-5, -6\}$
- f) Draw the vector block diagram for the closed-loop system starting with the following:



- g) What is the settling time of the closed-loop system (i.e., how fast will the *decoupled* states decay to 2% of their initial values)?