State-Space Realizations of Transfer Functions

Start with

$$\begin{pmatrix} \dot{x}_1 \\ \dot{x}_2 \end{pmatrix} = \underbrace{\begin{pmatrix} 0 & 1 \\ -6 & -5 \end{pmatrix}}_{A} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} + \underbrace{\begin{pmatrix} 0 \\ 1 \end{pmatrix}}_{B} u, \qquad y = \underbrace{\begin{pmatrix} 1 & 1 \end{pmatrix}}_{C} \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}$$

and consider a new state-space model

$$\dot{x} = \bar{A}x + \bar{B}u, \qquad y = \bar{C}x$$

with

$$\bar{A} = A^T = \begin{pmatrix} 0 & -6 \\ 1 & -5 \end{pmatrix}, \quad \bar{B} = C^T = \begin{pmatrix} 1 \\ 1 \end{pmatrix}, \quad \bar{C} = B^T = \begin{pmatrix} 0 & 1 \end{pmatrix}$$

This is a different state-space model!