Separation Principle

$$\begin{bmatrix}\dot{x}(t)\\ \dot{e}(t)\end{bmatrix} = \underbrace{\begin{bmatrix}A-BK & BK\\ 0 & A-LC\end{bmatrix}}_{A_{\text{cl}}}\begin{bmatrix}x(t)\\ e(t)\end{bmatrix} \quad \equiv \quad \begin{bmatrix}\dot{x}(t)\\ \dot{\hat{x}}(t)\end{bmatrix} = \begin{bmatrix}A & -BK\\ LC & A-LC-BK\end{bmatrix}\begin{bmatrix}x(t)\\ \hat{x}(t)\end{bmatrix}$$

- Notice the above dynamics for the OBC are equivalent
- What are the evalues of the closed loop system above?
- Since A_{cl} is block diagonal, the evalues of A_{cl} are

$$eig(A-BK)\bigcup eig(A-LC)$$

- $eig(A-BK)$ characterizes the **state control dynamics**
- $eig(A-BK)$ characterizes the **state estimation dynamics**
- If the system is obsv. **AND** cont. $\Longrightarrow$ evalues(A_{cl}) can be arbitrarily assigned by properly designing K and L
- If the system is detect. **AND** stab. $\Longrightarrow$ evalues(A_{cl}) can be stabilized via properly designing K and L