State feedback, observer-based feedback
System ("plant")

\[ x[n] \rightarrow q[n] \rightarrow y[n] \]

\[ w[n] \]

\[ A, b, c^T, d \]

\[ \zeta[n] \]
A good model
Observer configuration
State feedback

\[ p[n] + x[n] \rightarrow A, b, c^T \]

\[ g^T \]

\[ q[n] \]
Observer-based controller

\[ w[n] \]

\[ p[n] \]

\[ x[n] \]

\[ q[n] \]

\[ A, b, c^T \]

Plant

\[ y[n] \]

\[ \hat{q}[n] \]

\[ A, b, c^T \]

Observer

\[ \hat{y}[n] \]
Control of inverted Pendulum

Observer-based controller:

\[ \dot{p}(t) = 0, \quad \dot{v}(t) = 0, \quad \xi(t) = 0 \]
\[ x(t) \text{ generated by observer-based feedback} \]
\[ \ell_1 = -7, \quad \ell_2 = -18 \]

State feedback control:

\[ \dot{p}(t) = 0, \quad \dot{v}(t) = 0, \quad \xi(t) = 0 \]
\[ x(t) \text{ generated by direct state feedback} \]
\[ \ell_1 = 14, \quad \ell_2 = 5 \]