

## Ex. 1st order + time delay plant

Given  $y = h_p(s)(u+v)$ ,  $h_p(s) = k \frac{e^{-Ts}}{1+Ts}$

State space description (putting  $v=0$ )

$$y = k \frac{e^{-Ts}}{1+Ts} u = e^{-Ts} \underbrace{\frac{k}{1+Ts}}_x u$$

State space description defining state  $x$

$$x = \frac{k}{1+Ts} u \Rightarrow (1+Ts)x = ku \quad \left\{ \begin{array}{l} y = e^{-Ts} x \end{array} \right.$$

Inverse Laplace transform gives

$$\dot{x} = -\frac{1}{T}x + \frac{k}{T}u$$

$$y = x(t-T)$$

Common to define  $\left\{ \begin{array}{l} \text{with } v \neq 0 \\ \dot{x} = Ax + B(u+v) \end{array} \right.$

and then

$$A = -\frac{1}{T}, \quad B = \frac{k}{T}$$

Problem, Write m-file to simulate system with a PI-controller.

Solution See main-ex-1st-pluss-delay.m