



Control law:

$$u(t) = \hat{\mathbf{K}}_c(t)\mathbf{x}(t) + \hat{L}(t)r(t)$$

Adaptation law:

$$\begin{aligned}\dot{\hat{\mathbf{K}}}_c(t) &= \gamma \mathbf{B}_{mc}^T \mathcal{P} \mathbf{E}(t) \mathbf{x}^T(t) \\ \dot{\hat{L}}(t) &= \gamma \mathbf{B}_{mc}^T \mathcal{P} \mathbf{E}(t) r(t)\end{aligned}$$

where  $T_S$  is sampling time,  $e = y - y_m$ ,  $\gamma > 0$  is the adaptation gain,  $\mathbf{x}(t) = [y(t), \dot{y}(t)]^T$ ,  $\mathbf{E}_m(t) = [e_m(t), \dot{e}_m(t)]^T$  and matrix  $\mathcal{P} = \mathcal{P}^T$ .