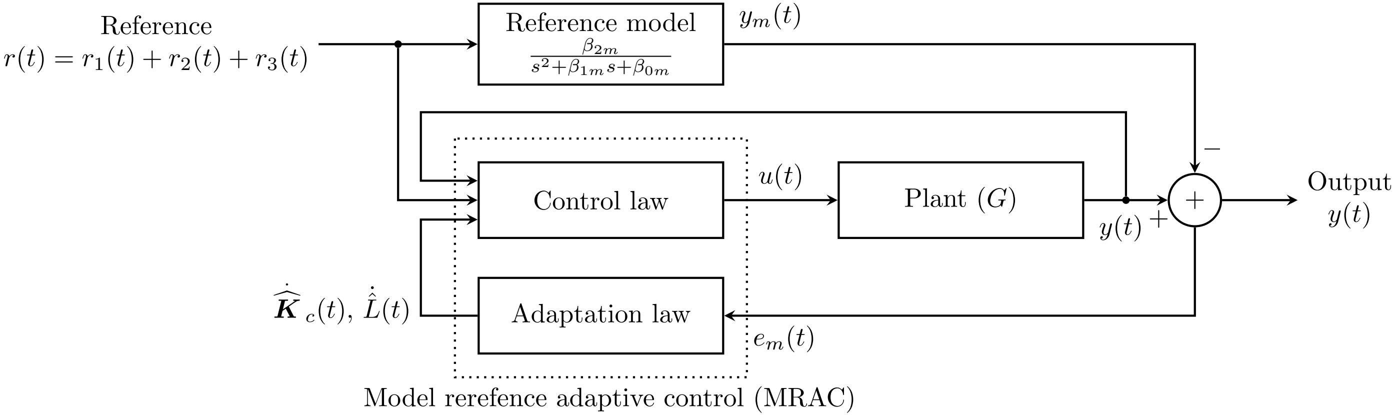

Model:

$$\dot{\boldsymbol{x}}_m(t) = \boldsymbol{A}_{mc}\boldsymbol{x}_m(t) + \boldsymbol{B}_{mc}r(t)$$

$$\boldsymbol{A}_{mc} = \begin{bmatrix} 0 & 1 \\ -\beta_{0m} & -\beta_{1m} \end{bmatrix}, \qquad \boldsymbol{B}_{mc} = \begin{bmatrix} 0 \\ \beta_{2m} \end{bmatrix}, \qquad \boldsymbol{x}_m(t) = [y_m(t),\ \dot{y}_m(t)]^T$$

Control law:

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

Adaptation law:

$$\dot{\widehat{\boldsymbol{K}}}_c(t) = \gamma\boldsymbol{B}_{mc}^T\mathcal{P}\boldsymbol{E}(t)\boldsymbol{x}^T(t)$$
$$\dot{\hat{L}}(t) = \gamma\boldsymbol{B}_{mc}^T\mathcal{P}\boldsymbol{E}(t)r(t)$$

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

$$\boldsymbol{A}_{mc}^T\mathcal{P} + \mathcal{P}\boldsymbol{A}_{mc}^T = -\boldsymbol{I}_{2x2}$$