Direct MRAC

$$z(k) = \theta^{*T} \phi_p(k)$$

$$z = \bar{u}_p = W_m(z)\, u_p$$

$$\phi_p = \left[\frac{W_m(z)\alpha^T(z)}{\Lambda(z)} u_p ,\ \frac{W_m(z)\alpha^T(z)}{\Lambda(z)} y_p ,\ W_m(z)\, y_p ,\ y_p \right]^T$$

$$u_p(k) = \theta^T(k)\, \omega(k)$$

$$\varepsilon(k) = \frac{z(k) - \theta^T(k)\phi_p(k)}{m_s^2(k)} ,\quad m_s^2(k) = 1 + \phi_p^T(k)\phi_p(k)$$

$$\bar{\theta}(k+1) = \bar{\theta}(k) + \gamma\varepsilon(k)\bar{\theta}_p(k)$$

$$\bar{c}_0(k+1) = c_0(k) + \gamma\varepsilon(k)\, y_p(k)$$

$$c_0(k+1) = \begin{cases} \bar{c}_0(k+1) & \text{if } \bar{c}_0(k+1)\,\mathrm{sgn}(c_0^*) \geq \beta_0 \\ \beta_0\,\mathrm{sgn}(c_0^*) & \text{otherwise} \end{cases}$$

where $\bar{\omega}(k) = [\omega_1^T(k), \omega_2^T(k), y_p(k)]^T$, $\bar{\phi}_p(k) = W_m(z)\,\bar{\omega}$

$$\bar{\theta}(k) = [\theta_1^T(k), \theta_2^T(k), \theta_3^T(k)]^T$$