Modeling of shunt DC motor

As mentioned previously, self-excited DC machines are classified to shunt- connected, series-connected and compound DC machines. In this lecture, the model of DC motor with field winding connected in parallel to the armature winding is presented.

Electrical and mechanical equations of shunt-connected DC machines

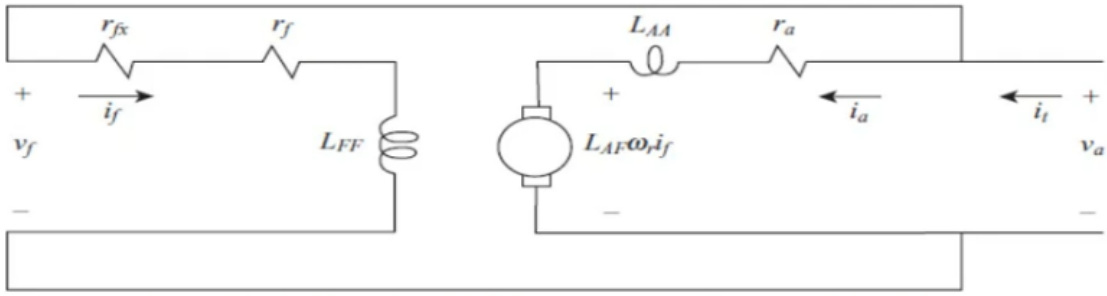


Fig. (1) Equivalent circuit of Shunt-connected DC machine [2]

1. Find the equations which describe the system.

$$v_f = v_a \tag{1}$$

$$v_a = \left(r_a + \frac{dL_{AA}}{dt}\right) i_a + \omega_r L_{AF} i_f \tag{2}$$

$$v_f = \left(r_f + \frac{dL_{FF}}{dt}\right) i_f \tag{3}$$

$$T_e = J\frac{d\omega_r}{dt} + B_m\omega_r + T_l \tag{4.a}$$

$$T_e = L_{AF} i_a i_f \tag{4.b}$$

$$V_a(s) = r_a I_a(s) + sL_{AA} I_a + \omega_r L_{AF} I_f$$

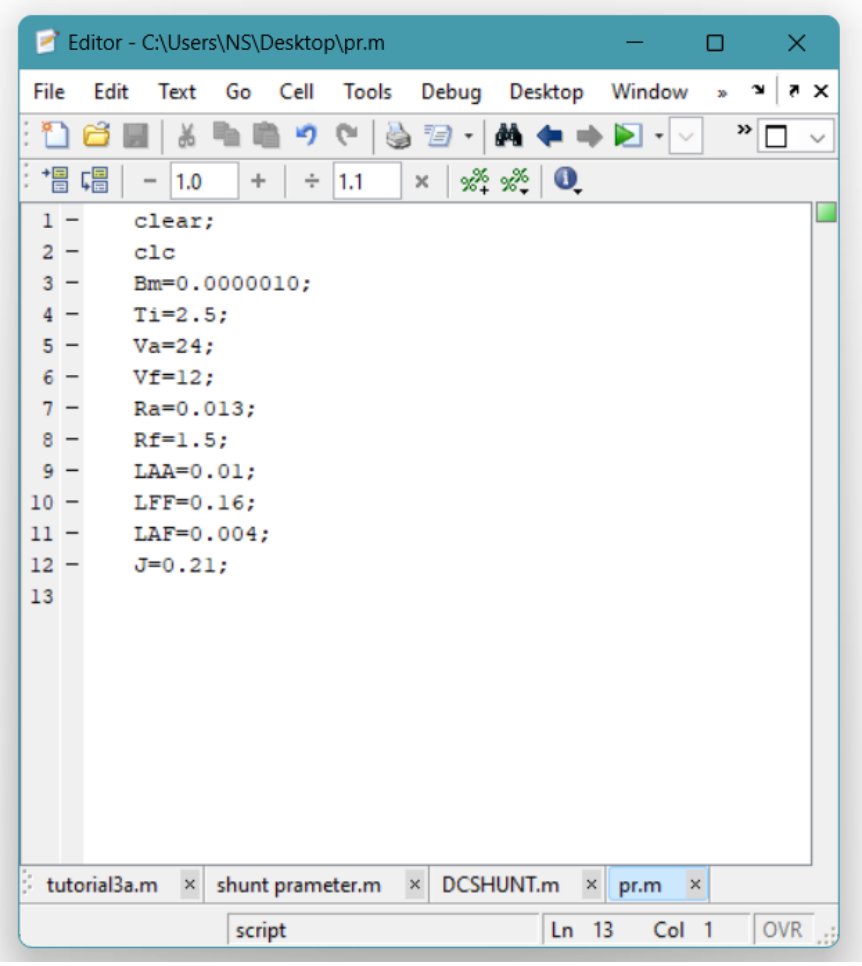
$$\therefore\ I_a(s) = \frac{1}{(r_a + sL_{AA})}\left(V_a(s) - \omega_r L_{AF} I_f\right) \tag{5.a}$$

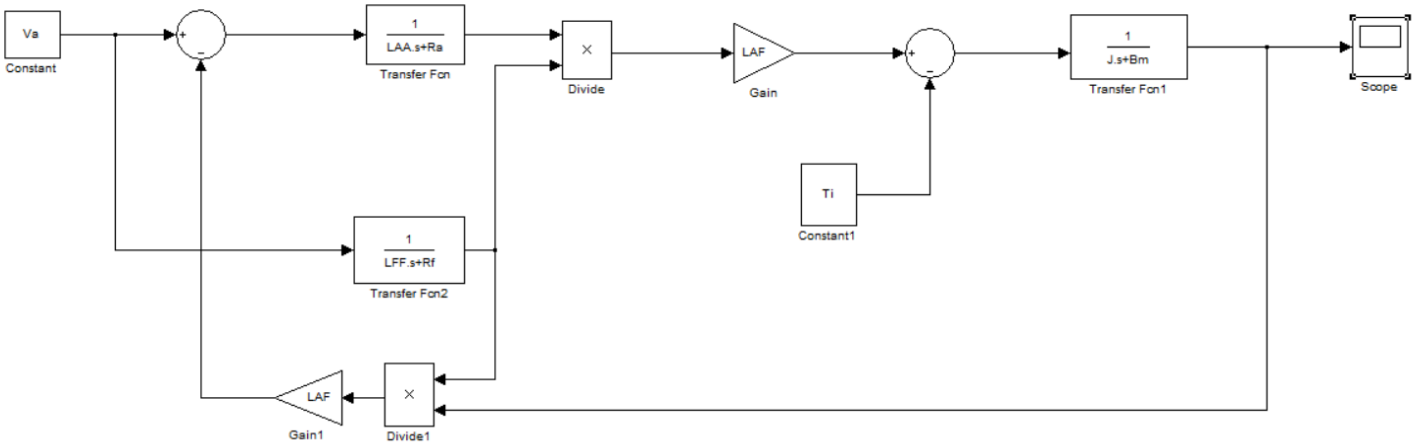
$$V_f(s) = \left(r_f + sL_{FF}\right) I_f(s)$$

$$\therefore I_f(s) = \frac{1}{(r_f + sL_{FF})} V_f(s) \tag{5.b}$$

$$T_e(s) = (sJ + B_m)\omega_r(s) + T_l(s) \quad , T_e(s) = L_{AF} I_f I_a(s)$$

$$\therefore\ \omega_r(s) = \frac{1}{(sJ + B_m)}\left(L_{AF} I_f I_a(s) - T_l(s)\right) \tag{5.c}$$

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LAF
Gain
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Transfer Fcn2
LAF
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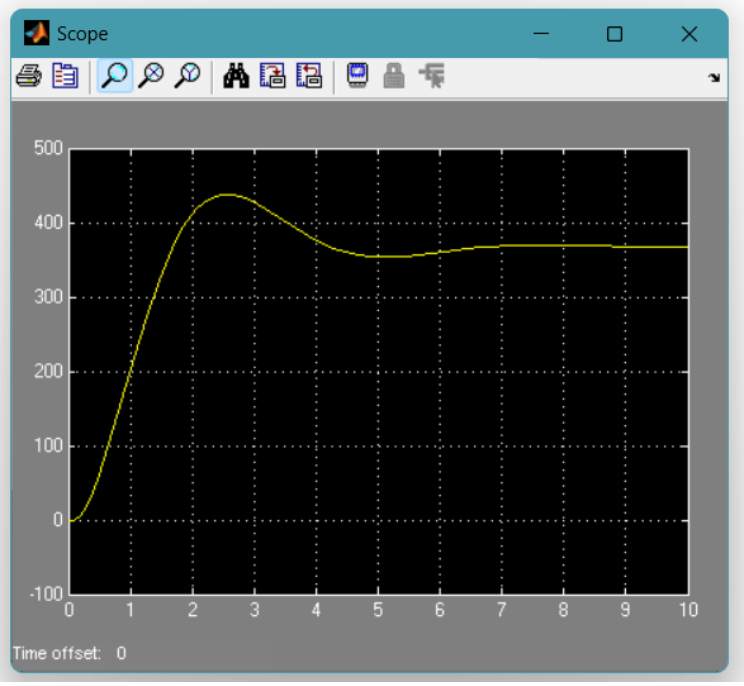
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