$U_n := 220V$ $\quad I_n := 55A$ $\quad \omega_n := 150\frac{rad}{s}$ $\quad R_a := 0.091\Omega$ $\quad L_a := 0.007H$

$\Sigma J := 1.067 kg \cdot m^2$

$U_b := U_n$ $\quad I_b := I_n$ $\quad \omega_b := \omega_n$ $\quad \Psi_{fn} := \frac{U_n - R_a \cdot I_n}{\omega_n}$

$\Psi_{fn} = 1.433Wb$ $\quad R_{ab} := \frac{U_b}{I_b}$

$M_{en} := \Psi_{fn} \cdot I_n = 78.832 N \cdot m$ $\quad m_{mp} := M_{en} \cdot 0.4 = 31.533 N \cdot m$ $\quad m_{mr} := M_{en} \cdot 0.1 = 7.883 N \cdot m$

Željeni dijagram brzine: Vreme nije normalizovano.

$$\omega(t) := \begin{cases} 0 \text{ if } t < 0s \\ \left(50 \cdot \frac{rad}{s^2} t\right) \text{ if } 0s \le t < 1s \\ 50\frac{rad}{s} \text{ if } 1s \le t < 2s \\ \left[50\frac{rad}{s} - 50 \cdot \frac{rad}{s^2} \cdot (t - 2s)\right] \text{ if } 2s \le t < 3s \\ 0 \text{ if } t \ge 3s \end{cases}$$

Momenat opterećenja sastoji se od dve komponente

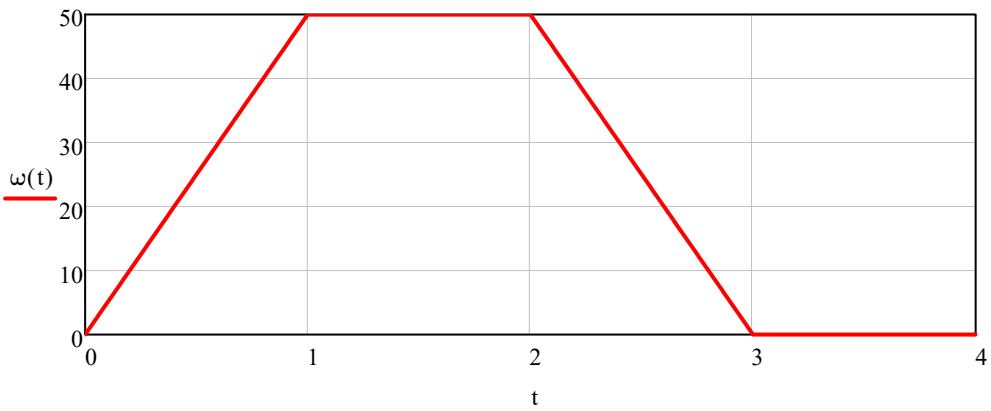
$m_{m1} := m_{mp}$ Potencijalne prirode

Na uzbrdici, m.m1 je pozitivno, na nizbrdici m.m1 je negativno

$m_{m2}(t) := m_{mr} \cdot sign(\omega(t))$ Reaktivne priride

$m_m(t) := m_{m1} + m_{m2}(t)$

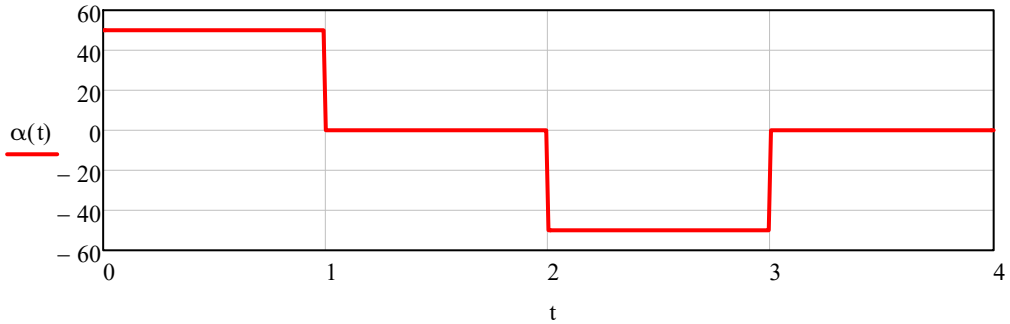
$t := 0s, 0.01s .. 4s$



Moment ima statički i dinamičku komponentu. Dinamička komponenta je proporcionalna ubrzanju.

$$\alpha(t) := \frac{d}{dt}\omega(t)$$

$$\alpha(t) := \begin{cases} 0 & \text{if } t < 0s \\ \left(50\,\frac{rad}{s^2}\right) & \text{if } 0s \le t < 1s \\ 0 & \text{if } 1s \le t < 2s \\ \left(-50\,\frac{rad}{s^2}\right) & \text{if } 2s \le t < 3s \\ 0 & \text{if } t \ge 3s \end{cases}$$



$$m_e(t) := m_m(t) + \Sigma J \cdot \alpha(t) \qquad i_a(t) := \frac{m_e(t)}{\Psi_{fn}}$$

$m_e(0 \cdot s) = 84.883 \cdot N \cdot m$ $m_e(0.99 \cdot s) = 92.766 \cdot N \cdot m$ $m_e(1 \cdot s) = 39.416 \cdot N \cdot m$ $m_e(1.99 \cdot s) = 39.416 \cdot N \cdot m$

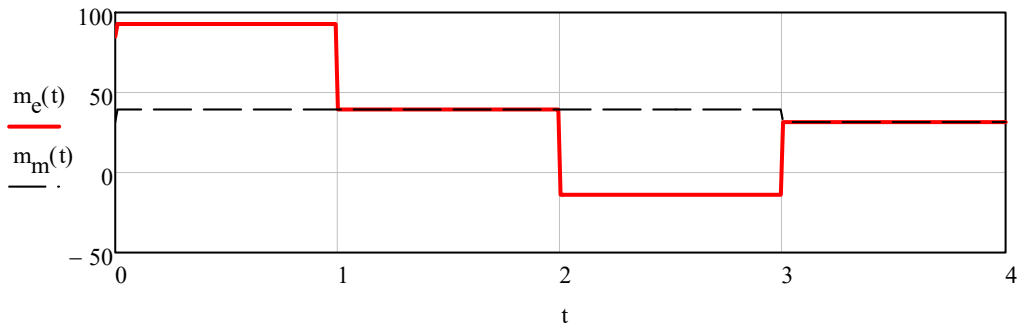
$m_e(2 \cdot s) = -13.934 \cdot N \cdot m$ $m_e(2.99 \cdot s) = -13.934 \cdot N \cdot m$ $m_e(3 \cdot s) = 31.533 \cdot N \cdot m$ $m_e(3.99 \cdot s) = 31.533 \cdot N \cdot m$

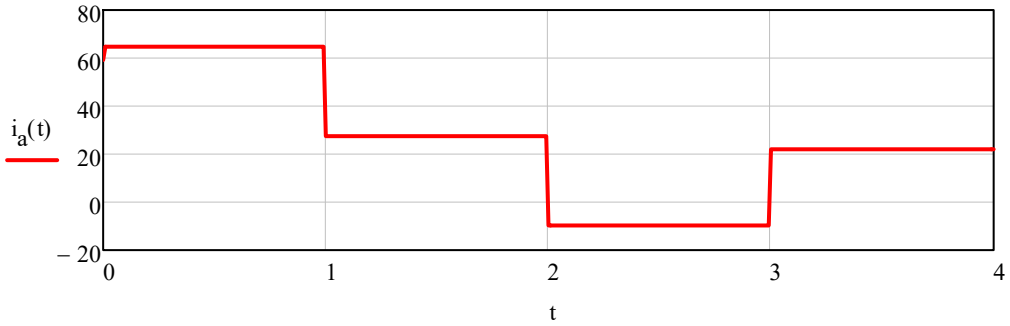
$i_a(0 \cdot s) = 59.222 \cdot A$ $i_a(0.99 \cdot s) = 64.722 \cdot A$ $i_a(1.0 \cdot s) = 27.5 \cdot A$ $i_a(1.99 \cdot s) = 27.5 \cdot A$

$i_a(2.0 \cdot s) = -9.722 \cdot A$ $i_a(2.99 \cdot s) = -9.722 \cdot A$ $i_a(3.0 \cdot s) = 22 \cdot A$ $i_a(3.99 \cdot s) = 22 \cdot A$

$m_m(0 \cdot s) = 31.533 \cdot N \cdot m$ $m_m(0.99 \cdot s) = 39.416 \cdot N \cdot m$ $m_m(1 \cdot s) = 39.416 \cdot N \cdot m$ $m_m(1.99 \cdot s) = 39.416 \cdot N \cdot m$

$m_m(2 \cdot s) = 39.416 \cdot N \cdot m$ $m_m(2.99 \cdot s) = 39.416 \cdot N \cdot m$ $m_m(3 \cdot s) = 31.533 \cdot N \cdot m$ $m_m(3.99 \cdot s) = 31.533 \cdot N \cdot m$

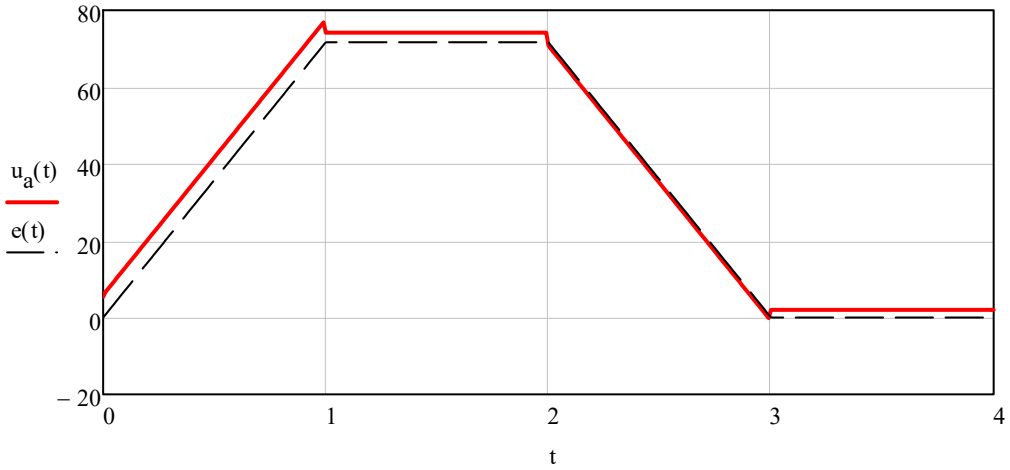




$e(t) := \omega(t)\cdot\Psi_{fn}$ $\qquad$ $u_a(t) := \omega(t)\cdot\Psi_{fn} + R_a\cdot i_a(t)$

$u_a(0) = 5.389\ V$ $\quad$ $u_a(0.999\cdot s) = 77.483\ V$ $\quad$ $u_a(1\cdot s) = 74.168\ V$ $\quad$ $u_a(1.99\cdot s) = 74.168\ V$

$u_a(2.0\cdot s) = 70.78\ V$ $\quad$ $u_a(2.99\cdot s) = -0.168\ V$ $\quad$ $u_a(3.0s) = 2.002\ V$ $\quad$ $u_a(3.99s) = 2.002\ V$



C) $\quad i_{aC}(t) := \begin{cases} 27.5A & \text{if } t < 2s \\ 0 & \text{if } t \geq 2s \end{cases}$ $\qquad$ $m_{eC}(t) := \begin{cases} \Psi_{fn}\cdot i_{aC}(t) & \text{if } t < 2s \\ 0 & \text{if } t \geq 2s \end{cases}$

Od trenutka isključenja, do vremena tx brzina je pozitivna ali opada zato što su obe komponente momenta opterećenja istog znaka. U trenutku tx brzina je jednaka 0, a posle toga, potencijalna komponenta momenta pomaže kretanju, a reaktivna koči, tj. mp je pozitivno, a mr negativno i brzina motora postaje negativna, tj. transportni uređaj ubrzava na nizbrdici. Zato je potrebno aktivirati mehaničke kočnice u trenutku kada je brzina postala jednaka 0.

$$t_x := \frac{50\cdot\frac{rad}{s}\cdot\Sigma J}{m_{mp} + m_{mr}}$$

$t_x = 1.354\ s$

Motor će se zaustaviti posle vremena t1, a zatim će da nastavi da se ubrzava u suprotnom smeru, dok transportni uređaj ne dođe do podnožje uzbrdice kada će se potencijalna komponenta momenta opterećenja izjednačiti sa 0, a kretanje će da traje sve dok se sva kinetička energija uređaja ne potroši na savlađivanje reaktivne komponente opterećenja.

$$t_1 := 2\cdot s + t_x$$

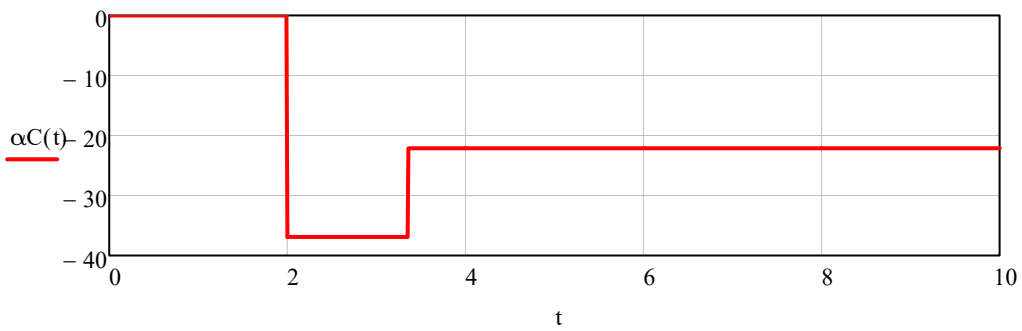
$$t_1 = 3.354\ s$$

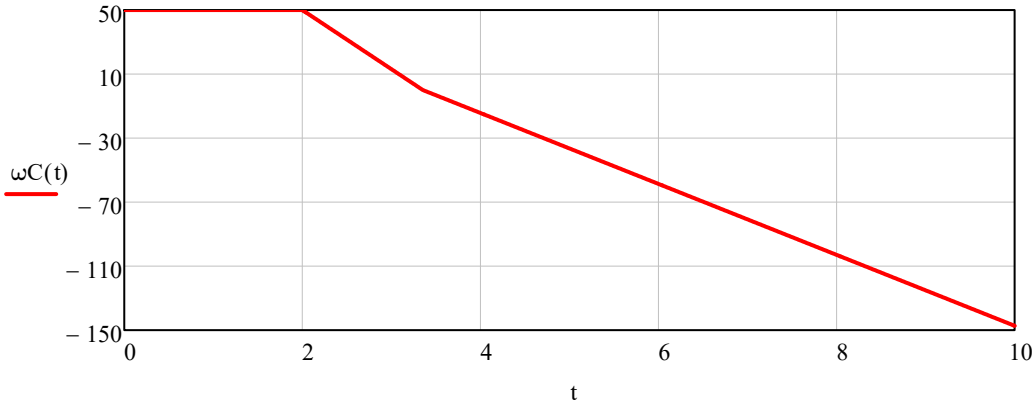
$$m_{mC}(t) := \begin{cases} m_{mp} + m_{mr} & \text{if } t < t_1 \\ m_{mp} - m_{mr} & \text{if } t \geq t_1 \end{cases}$$

$$\alpha C(t) := \begin{cases} 0 & \text{if } t < 2s \\ -\dfrac{m_{mC}(t)}{\Sigma J} & \text{if } t \geq 2s \end{cases}$$

$$\omega C(t) := \begin{cases} 50\dfrac{rad}{s} & \text{if } t < 2s \\ 50\dfrac{rad}{s} + \alpha C(t)\cdot(t - 2\cdot s) & \text{if } 2s \leq t < t_1 \\ 50\dfrac{rad}{s} + \alpha C\left(2\cdot s + \dfrac{t_x}{2}\right)\cdot t_x + \alpha C(t)\cdot\left(t - t_1\right) & \text{if } t_1 \leq t \end{cases}$$

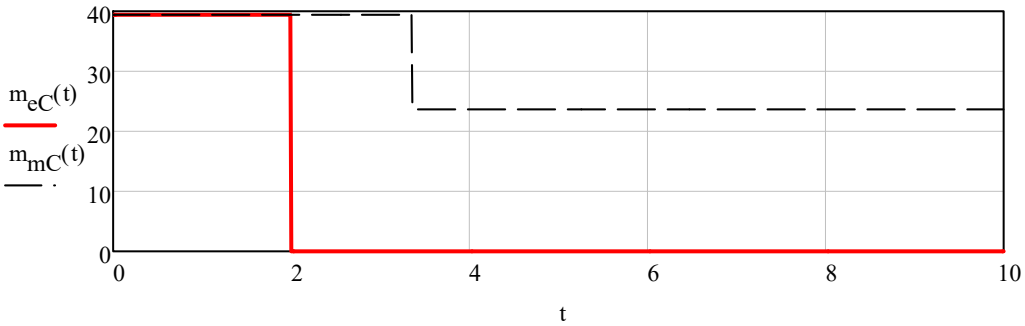
$$t := 0s, 0.01s .. 10s$$

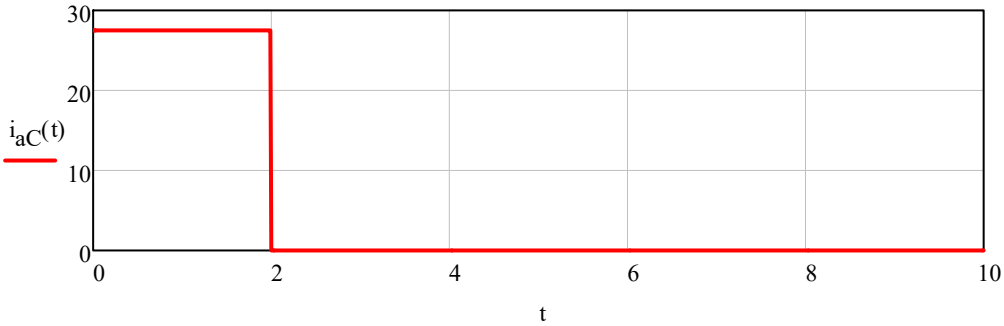




$e_C(t) := \omega C(t) \cdot \Psi_{fn}$ $\qquad$ $u_{aC}(t) := e_C(t)$

$t := 0s, 0.01s .. 10s$






100
50
0
− 50
− 100
− 150
− 200
0
2
4
6
8
10
t
$u_{aC}(t)$
$e_C(t)$