

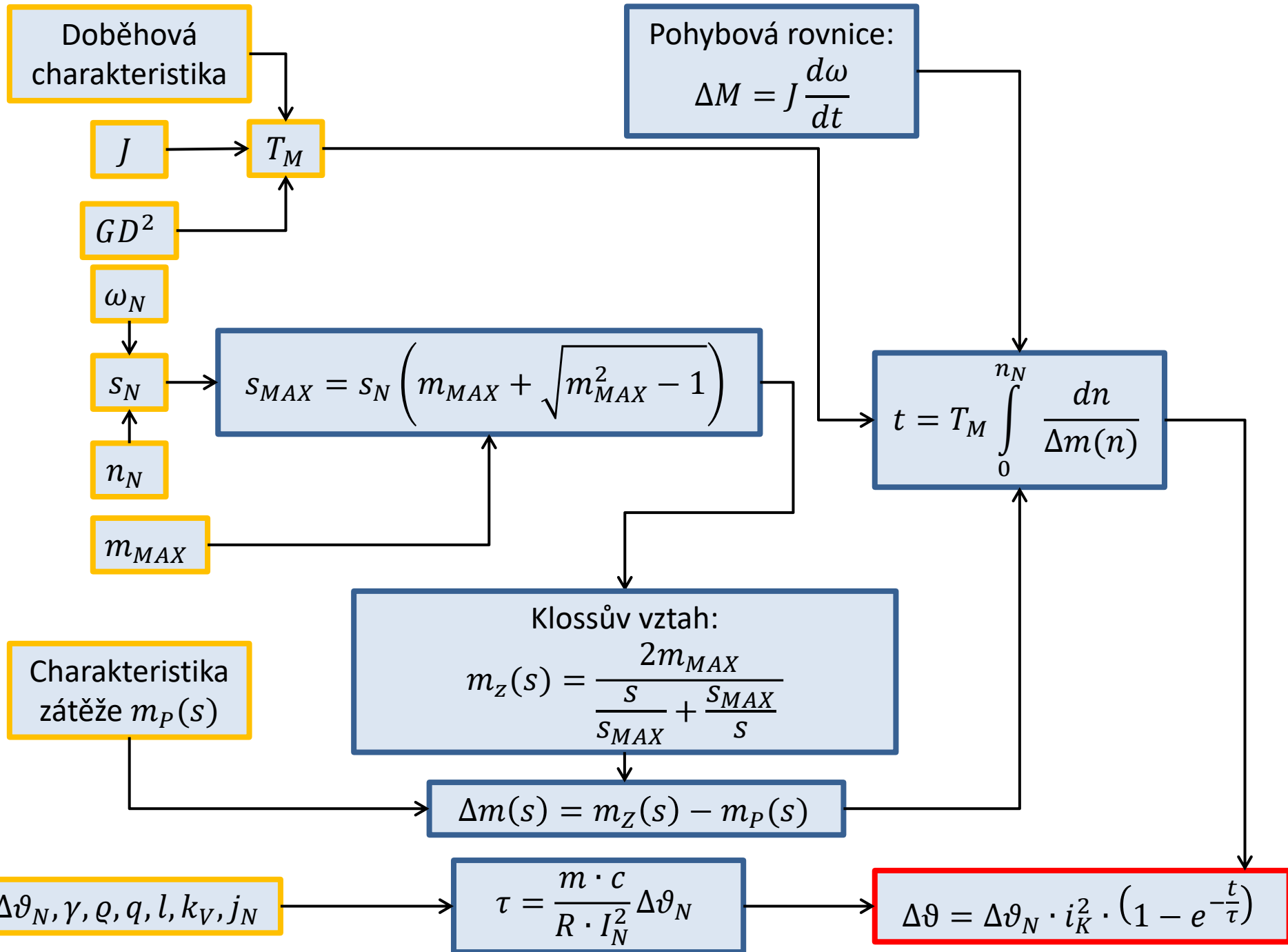


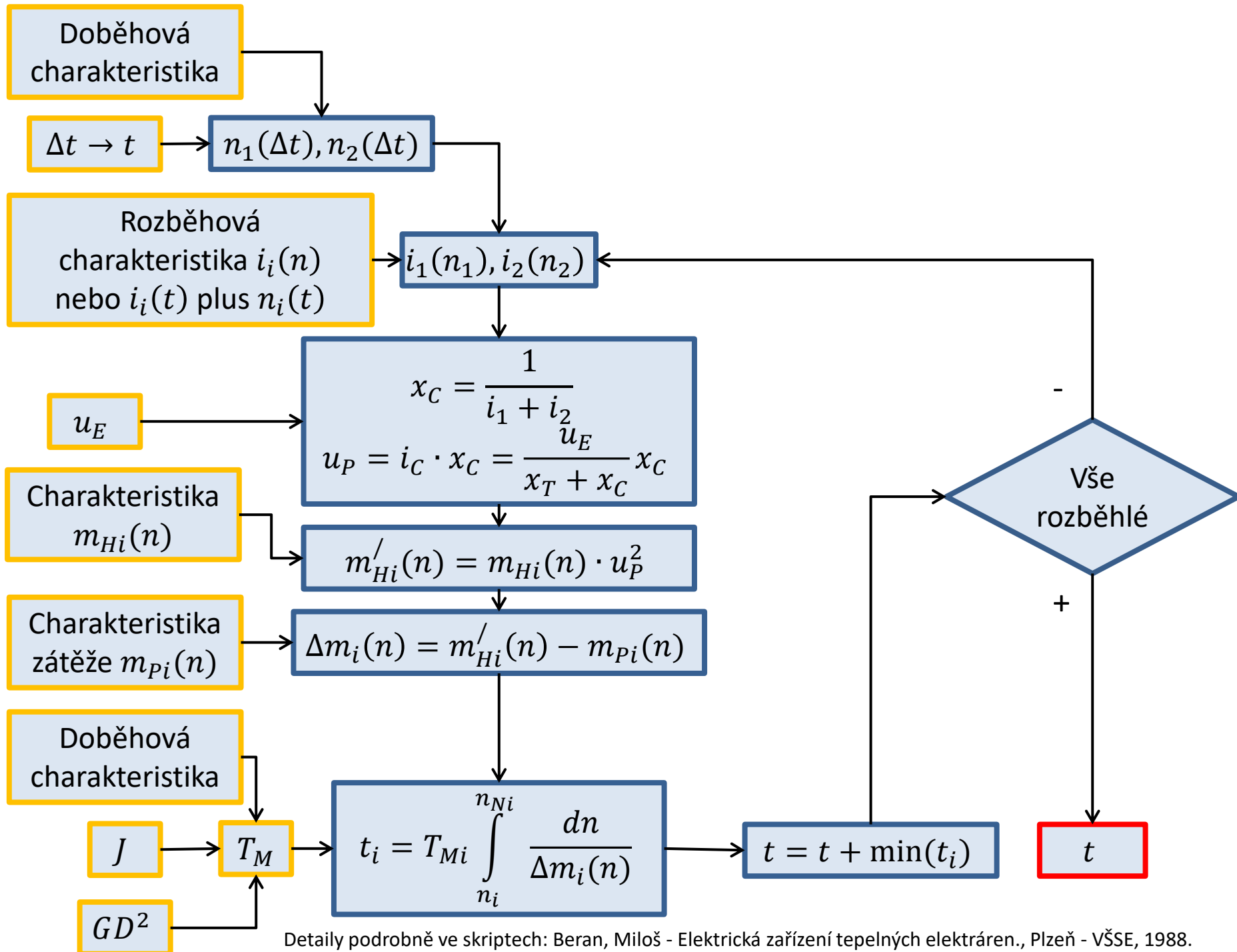
ZÁPADOČESKÁ
UNIVERZITA
V PLZNI

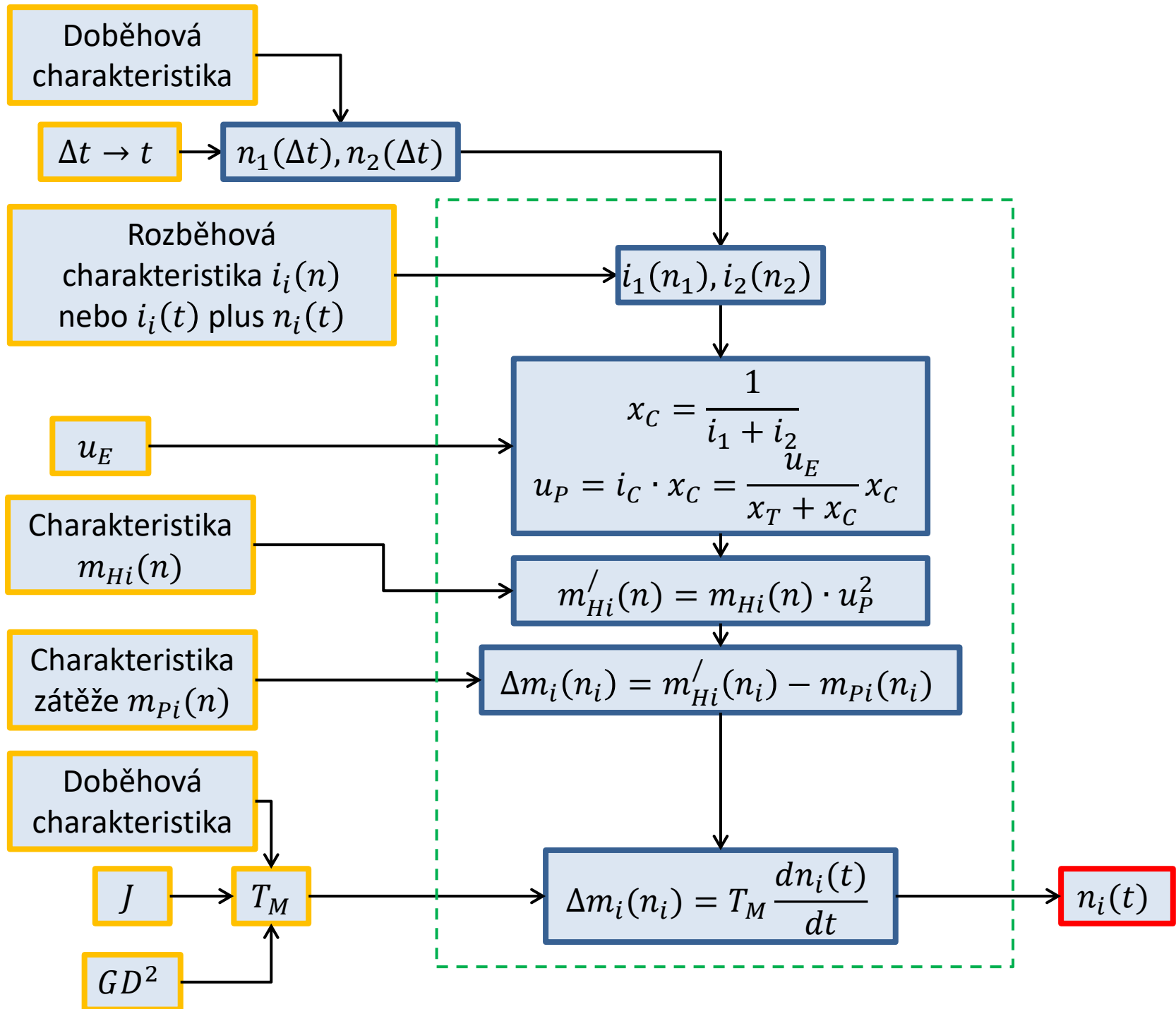


KEE / E2 – Elektrárny 2

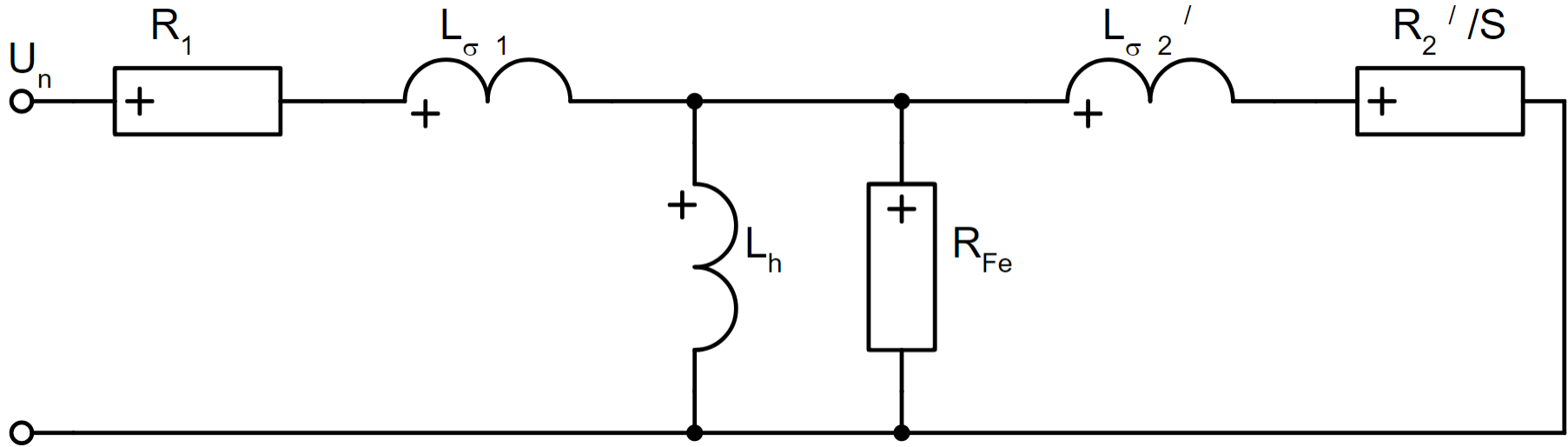
Výpočet kontroly rozběhu asynchronních pohonů simulací jejich dynamiky



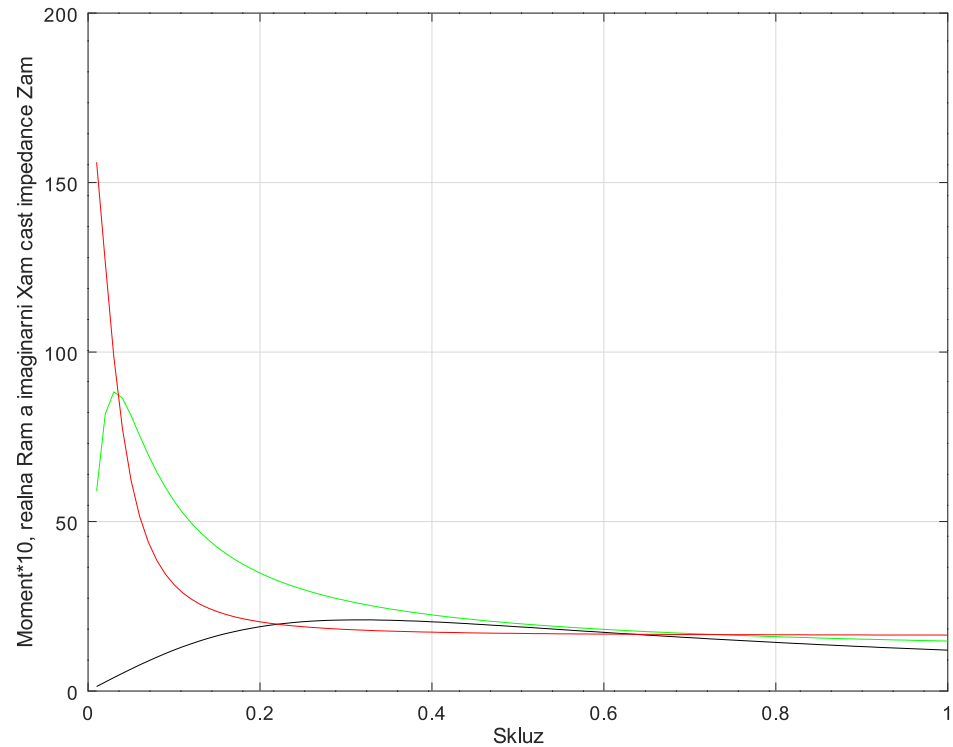
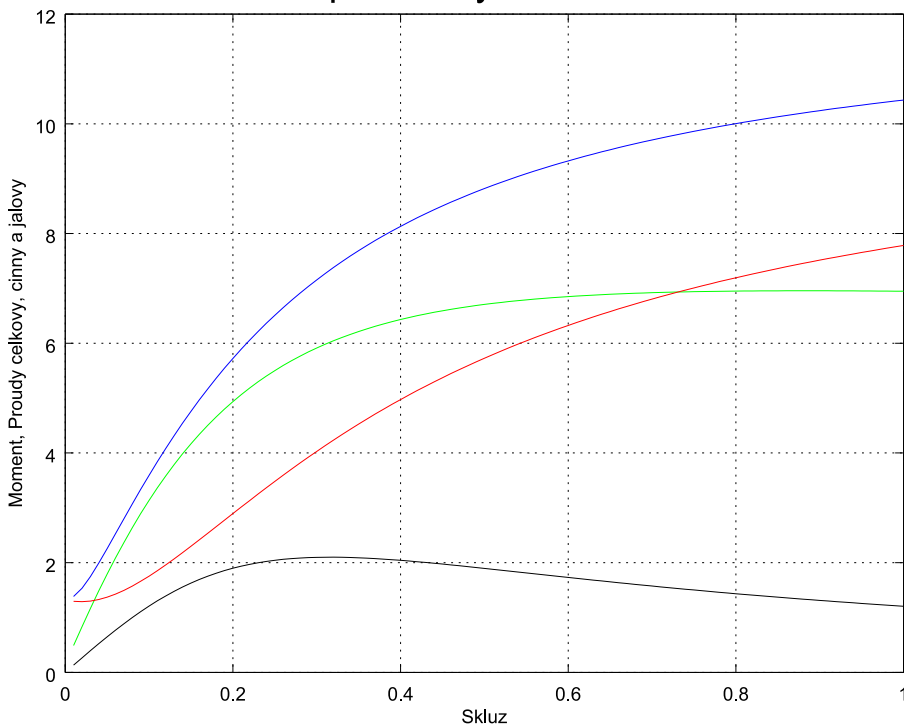




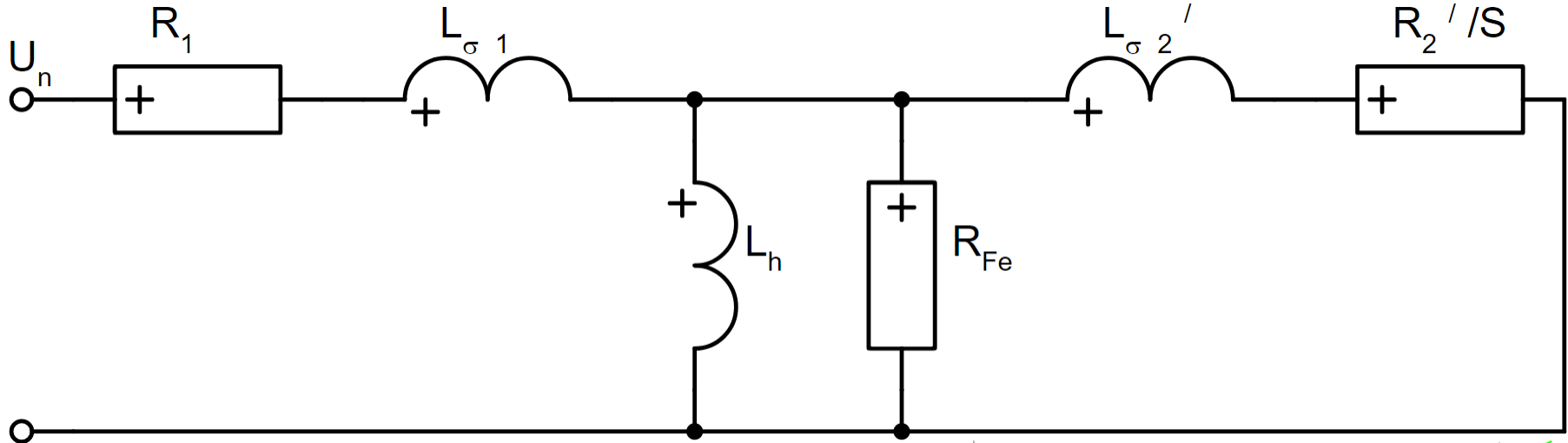
Dynamika asynchronního pohonu



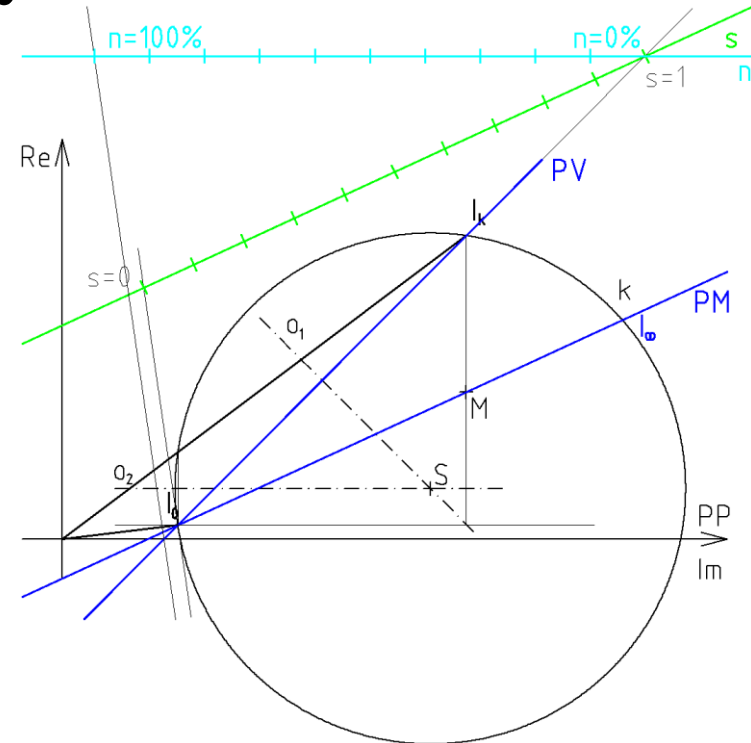
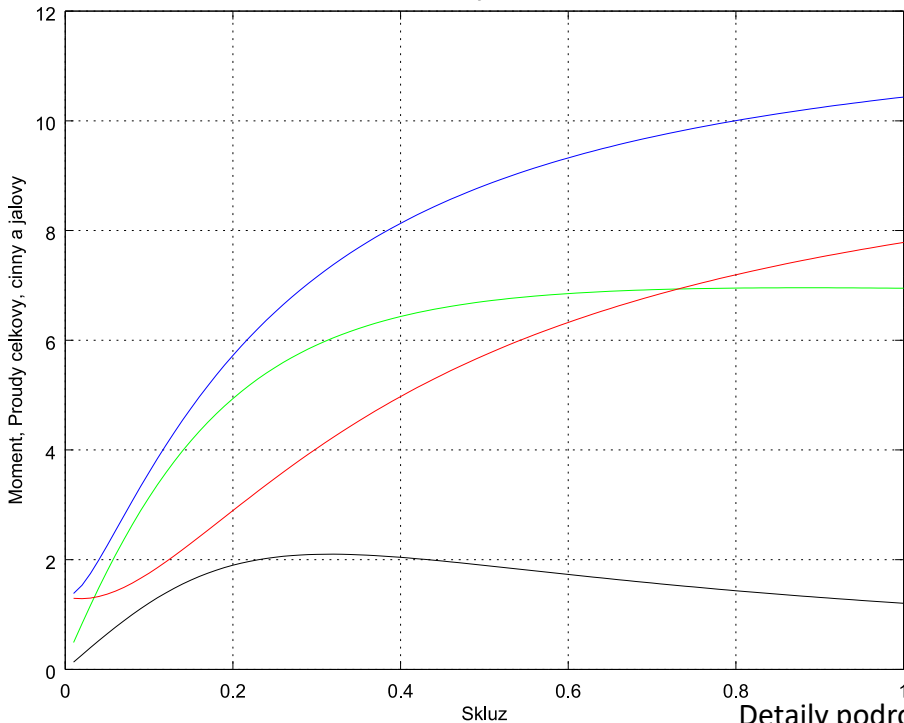
Moment a proud asynchronního motoru



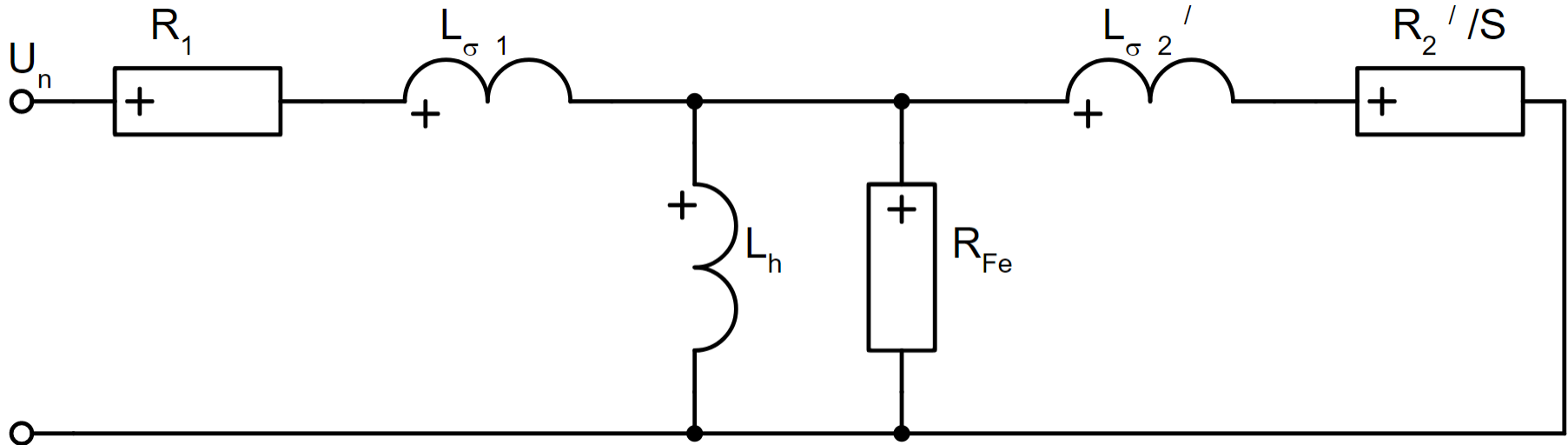
Dynamika asynchronního pohonu



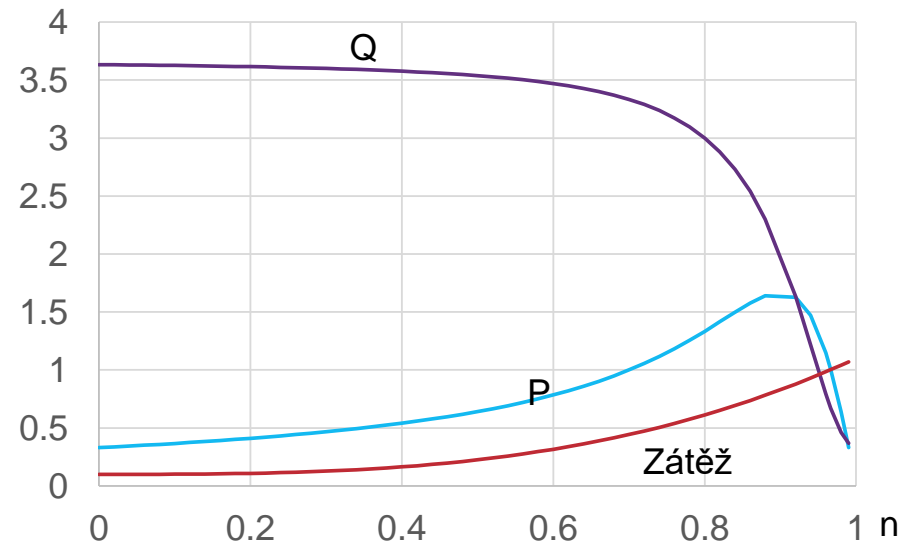
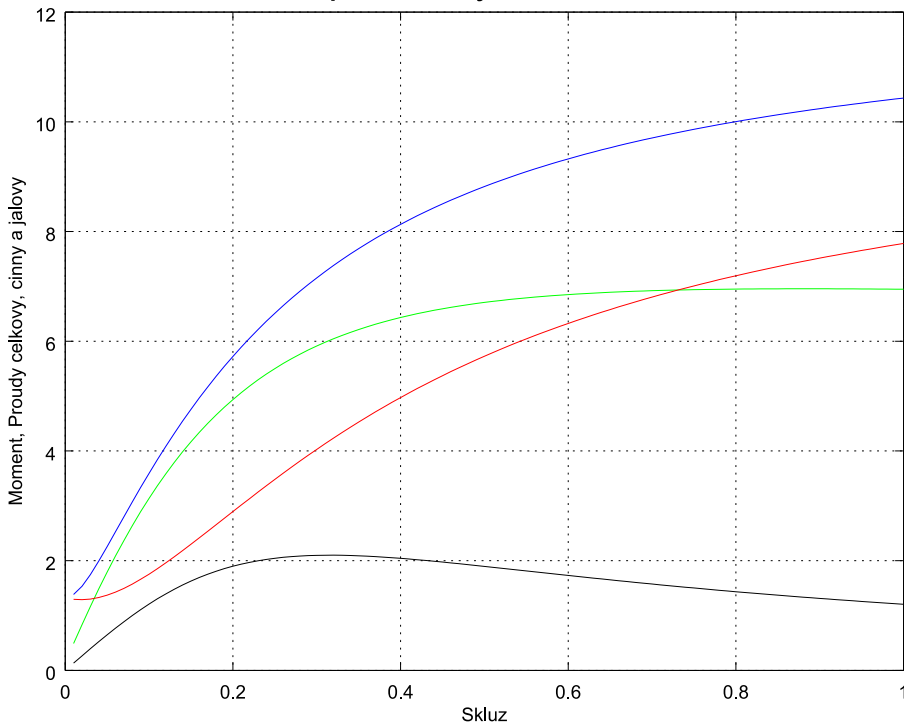
Moment a proud asynchronního motoru



Dynamika asynchronního pohonu

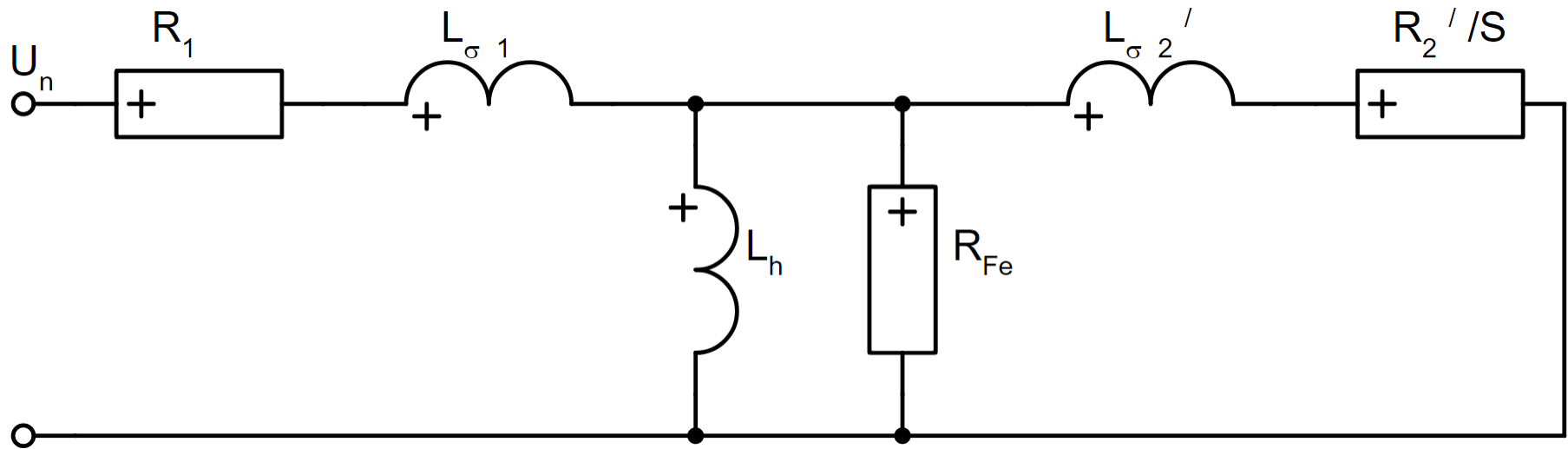


Moment a proud asynchronního motoru



Dynamika asynchronního pohonu

Jednoduchý model asynchronního motoru řešený rovnicemi



Náhrada impedance motoru provedena jako:

$$Z_{am} = R_1 + j X_{\sigma 1} + \frac{1}{\frac{1}{R_{Fe}} + \frac{1}{j X_h} + \frac{1}{\frac{R_2'}{S} + j X_{\sigma 2}'}}$$

Což odpovídá velikosti reálné části impedance:

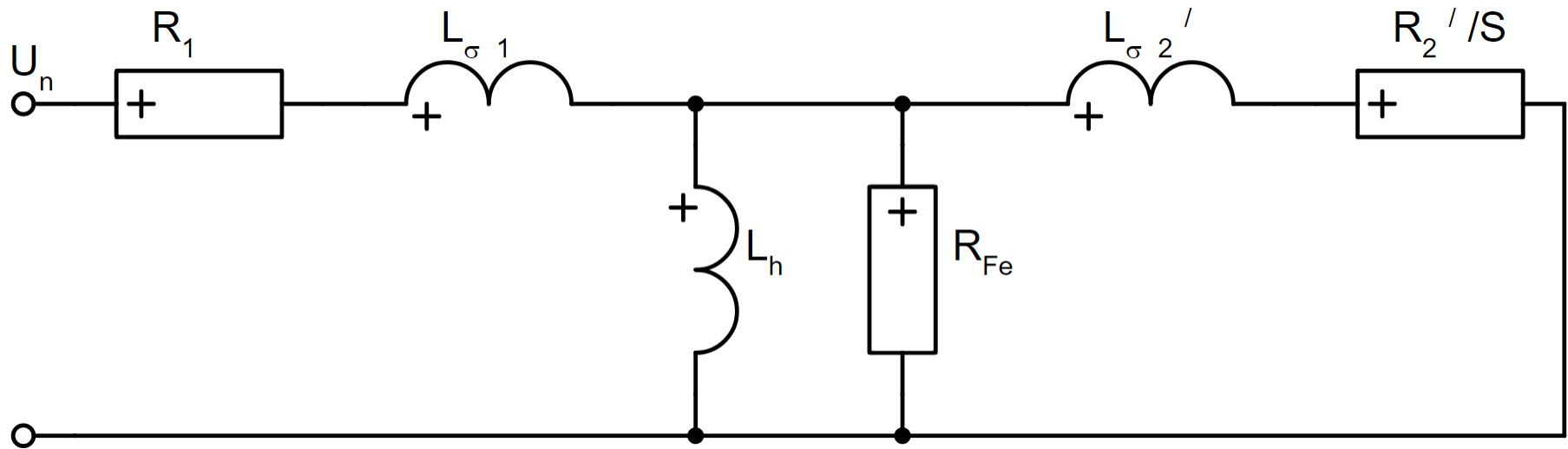
$$R_1 + R_{Fe} X_h^2 \cdot \frac{R_2'^2 + R_2' R_{Fe} S + S^2 X_{\sigma 2}'^2}{R_2'^2 (R_{Fe}^2 + X_h^2) + 2 R_2' R_{Fe} S X_h^2 + S^2 (R_{Fe}^2 (X_h^2 + 2 X_h X_{\sigma 2}' + X_{\sigma 2}'^2) + X_h^2 X_{\sigma 2}'^2)}$$

a záporně vzaté velikosti imaginární části impedance:

$$R_{Fe}^2 S X_h^2 \cdot \frac{2 R_2' R_{Fe} X_h + S (R_{Fe}^2 (X_h + X_{\sigma 2}') - X_h^2 X_{\sigma 2}')}{(R_2'^2 (R_{Fe}^2 + X_h^2) + 2 R_2' R_{Fe} S X_h^2 + S^2 (R_{Fe}^2 (X_h^2 + 2 X_h X_{\sigma 2}' + X_{\sigma 2}'^2) + X_h^2 X_{\sigma 2}'^2)) (R_{Fe}^2 + X_h^2)} + \frac{X_h^3}{R_{Fe}^2 + X_h^2} - X_h - X_{\sigma 1}$$

Dynamika asynchronního pohonu

Jednoduchý model asynchronního motoru řešený rovnicemi



Parametry identifikované z chodu naprázdno:

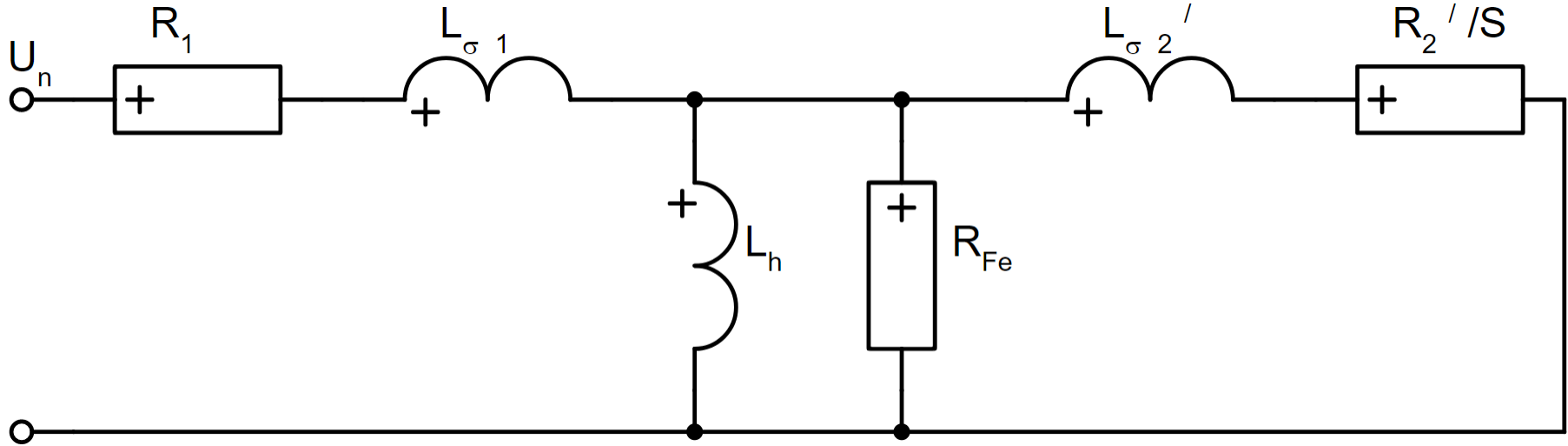
$$R_{Fe} = U_n^2 [kV] \frac{10^6}{dP_0 [W]} \quad Y_0 = \frac{I_0}{U_n [kV] \frac{10^3}{\sqrt{3}}} \quad X_h = \frac{1}{\sqrt{Y_0^2 - \frac{1}{R_{Fe}^2}}}$$

Obdobně z chodu nakrátko:

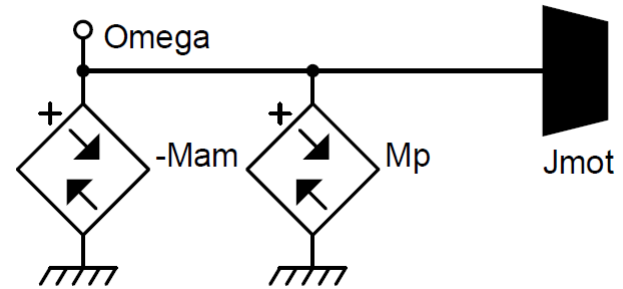
$$R_k = \frac{\Delta P_K}{3 \cdot I_K^2} \quad Z_K = \frac{U_K}{\sqrt{3} \cdot I_K} \quad X_\sigma = \sqrt{Z_K^2 - R_K^2} \cdot \frac{f_N}{f_{MĚŘÍCÍ}} \quad R_2' = R_K - R_1$$

R_1 měřeno ohmickou metodou.

Dynamika asynchronního pohonu



Moment Pohonou MechanickaZatez Setrvacnost



Moment aproximován pomocí Klossova vztahu:

$$M_{am} = 2 \cdot \frac{m_{max}}{\frac{s}{s_{Max}} + \frac{s_{Max}}{s}} M_n u_p^2$$

Skuz pro bod zvratu a jmenovitý:

$$s_{Max} = s_N (m_{max} + \sqrt{m_{max}^2 - 1}) \quad s_N = \frac{N_s - N_n}{N_s}$$

Momentová charakteristika zátěže

$$M_p = \left(m_{p0} + \left(\frac{1-s}{1-s_N} \right)^{Exp} (1 - m_{p0}) \right) M_n$$

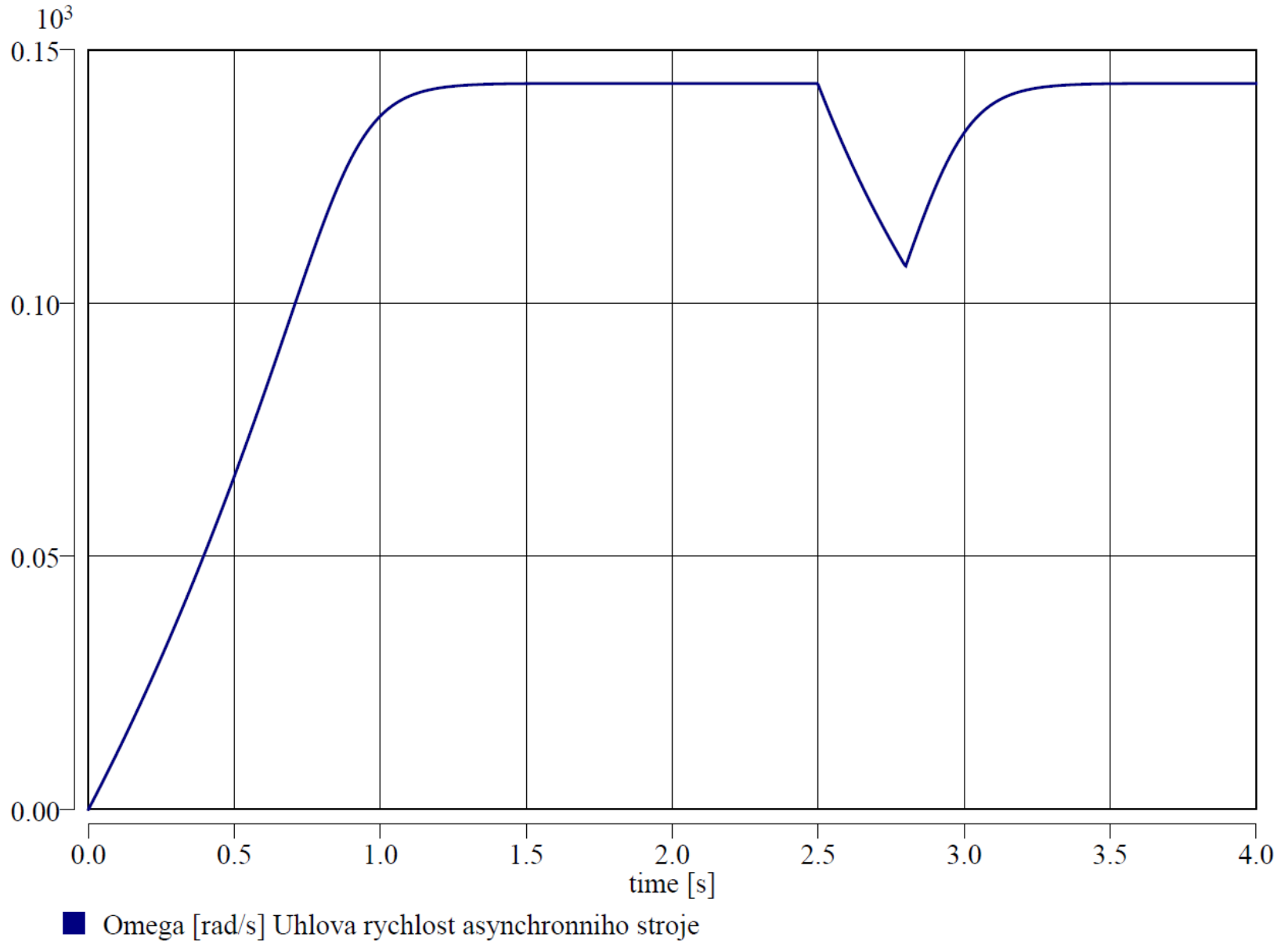
Náhradní reaktance transformátoru:

$$X_t = \frac{u_k[\%]}{100} \cdot \frac{U_n^2 [kV] \cdot 1000}{S_{nt} [kVA]}$$

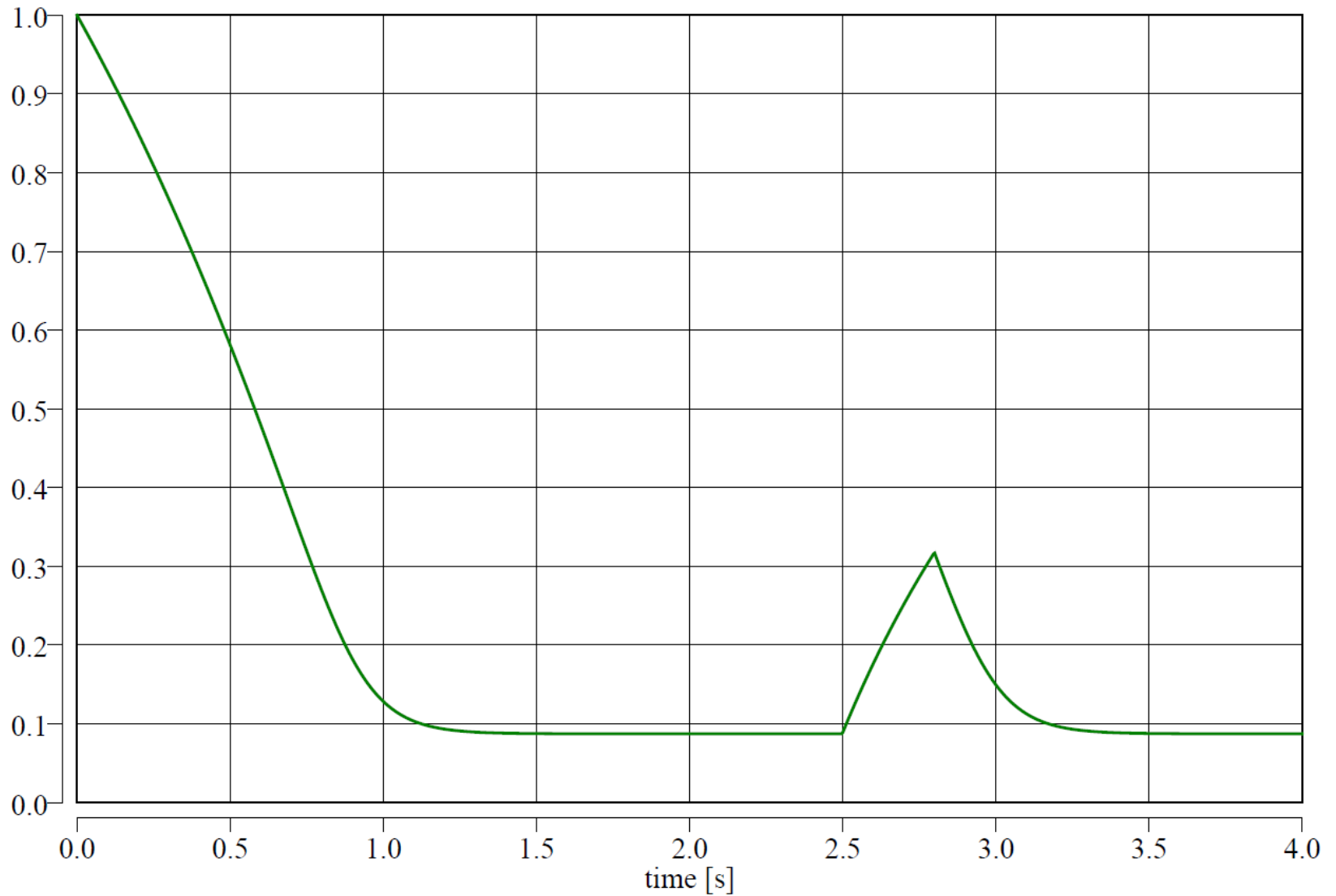
Poměrné napětí na asynchronním stroji:

$$u_p = \frac{Z_{am}}{X_t + Z_{am}}$$

Dynamika asynchronního pohonu

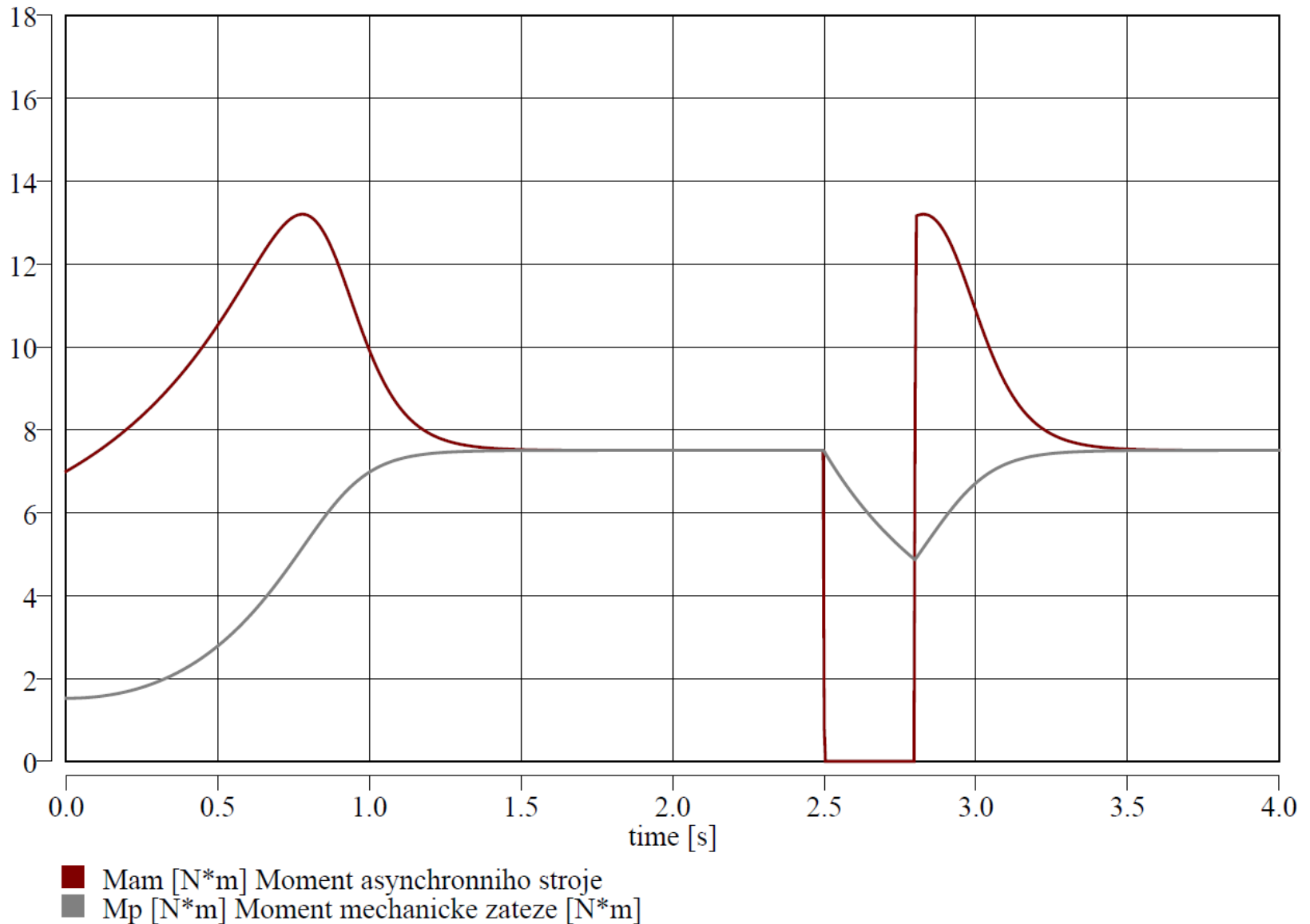


Dynamika asynchronního pohonu

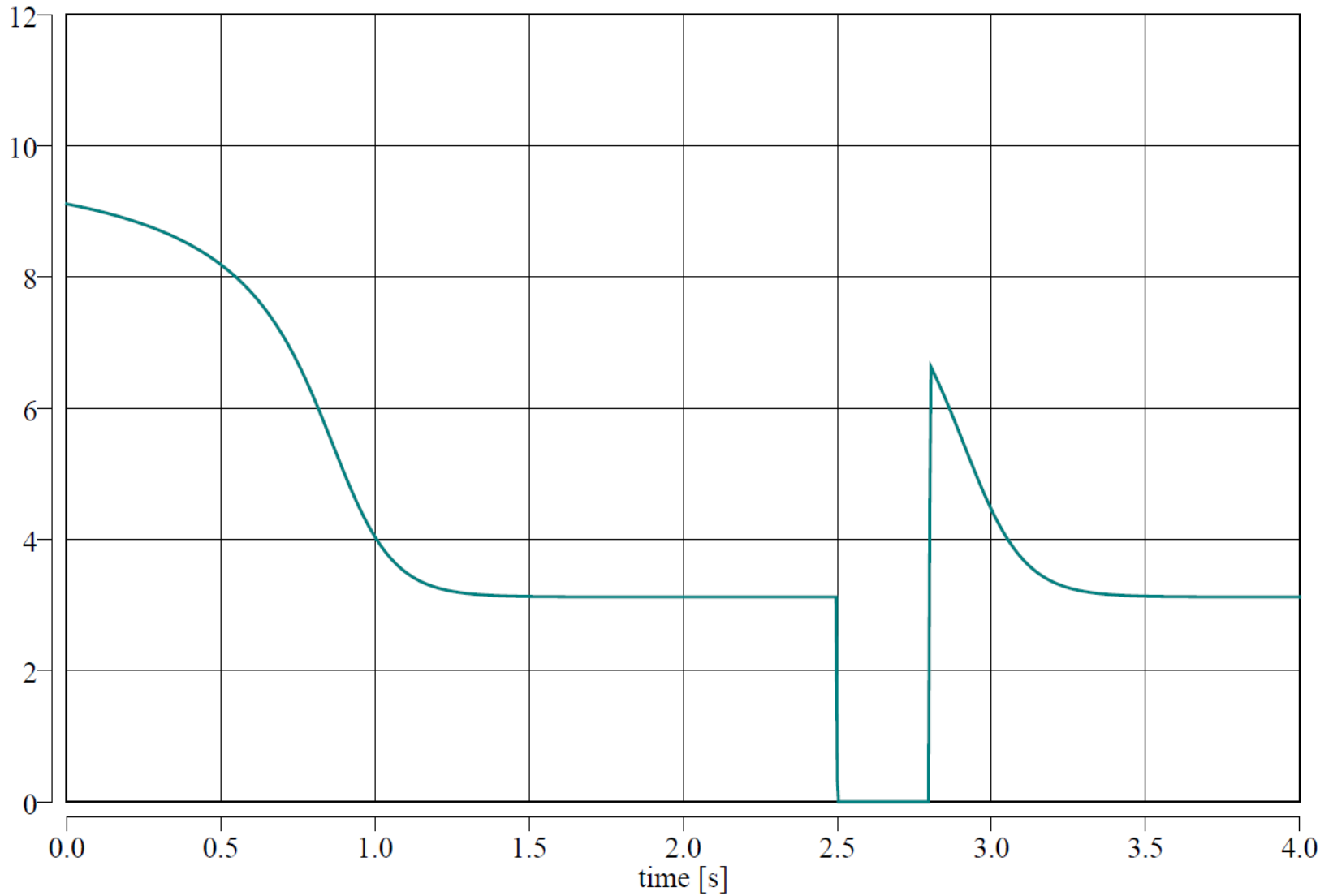


■ Skluz [-] Skluz asynchronního stroje

Dynamika asynchronního pohonu

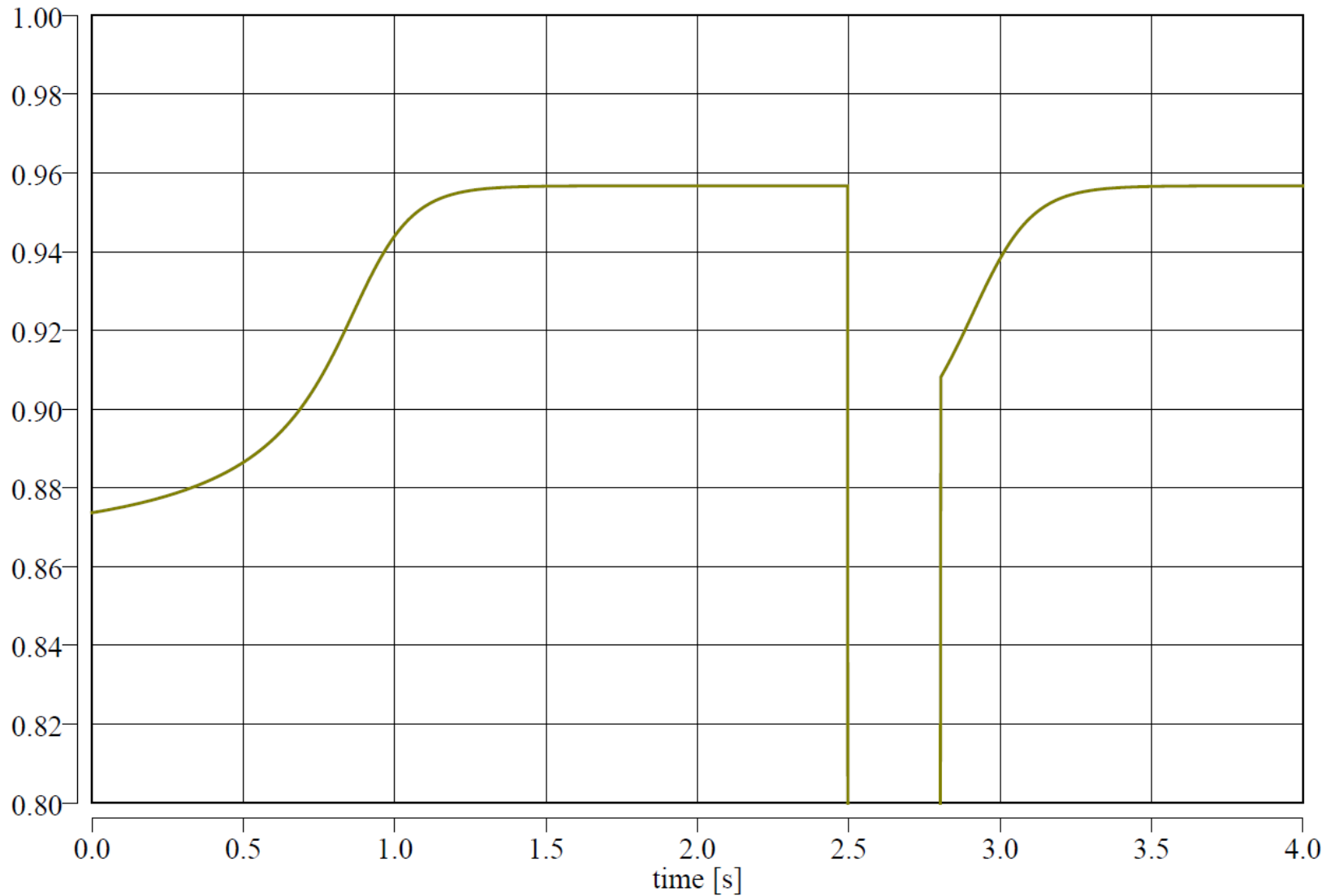


Dynamika asynchronního pohonu



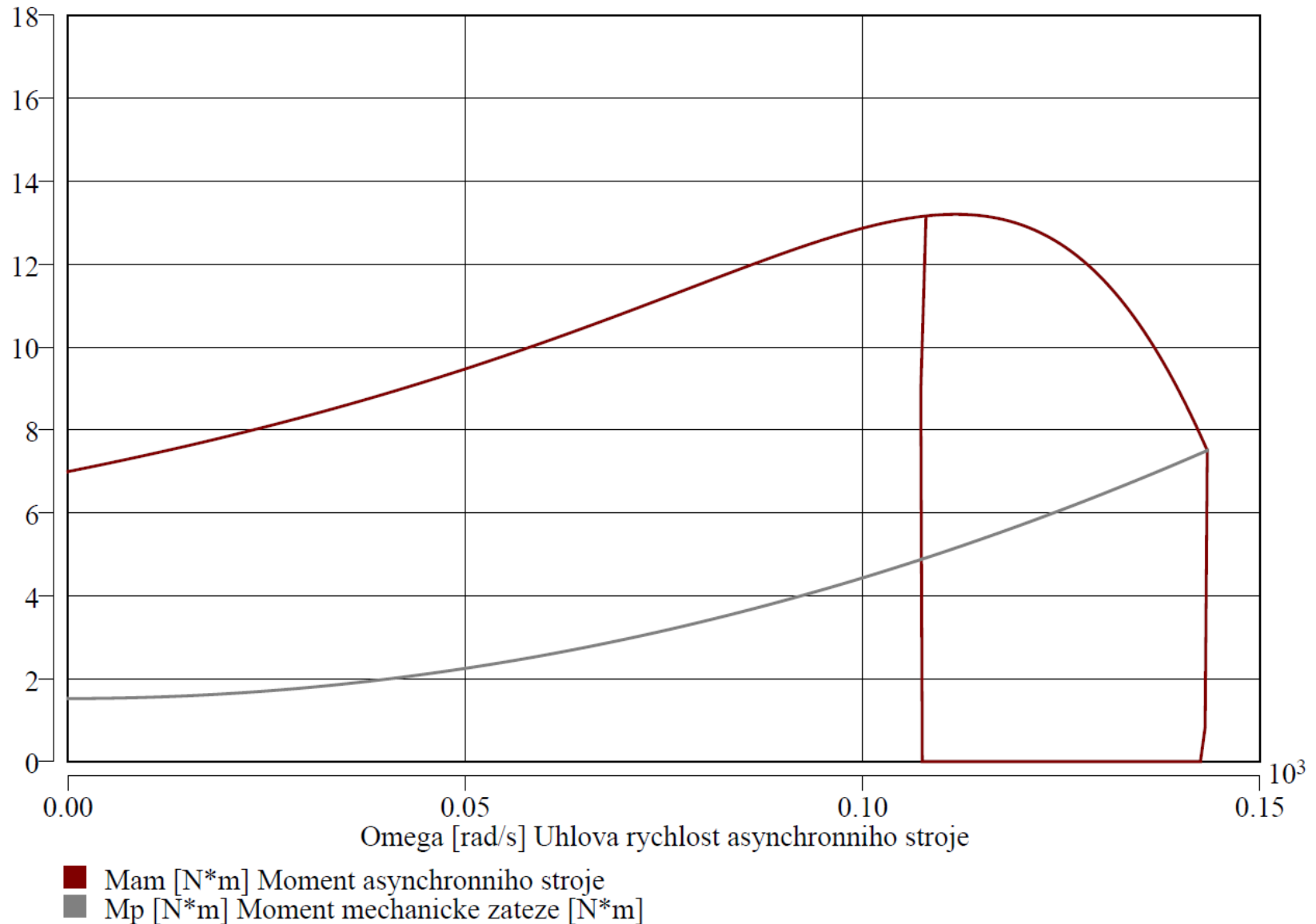
■ I_s [A] Proud asynchronního stroje

Dynamika asynchronního pohonu



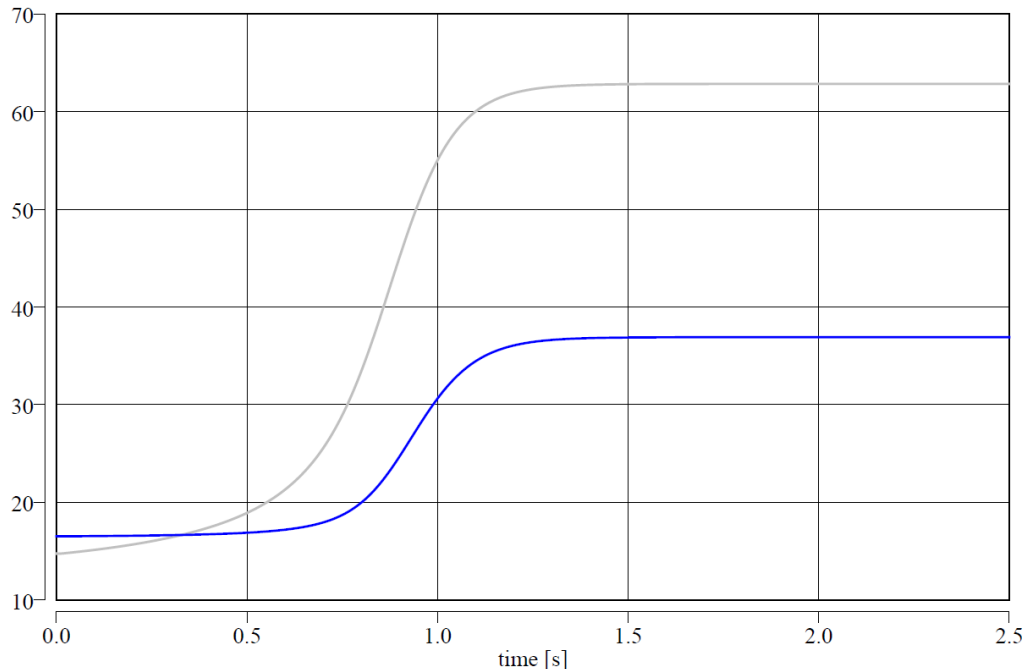
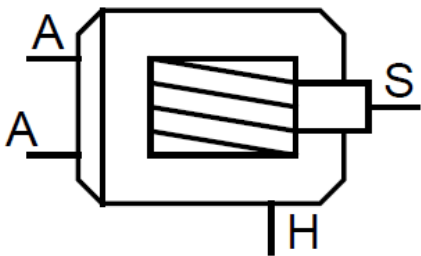
■ U_p [-] Pomerne napeti na asynchronnim stroji

Dynamika asynchronního pohonu

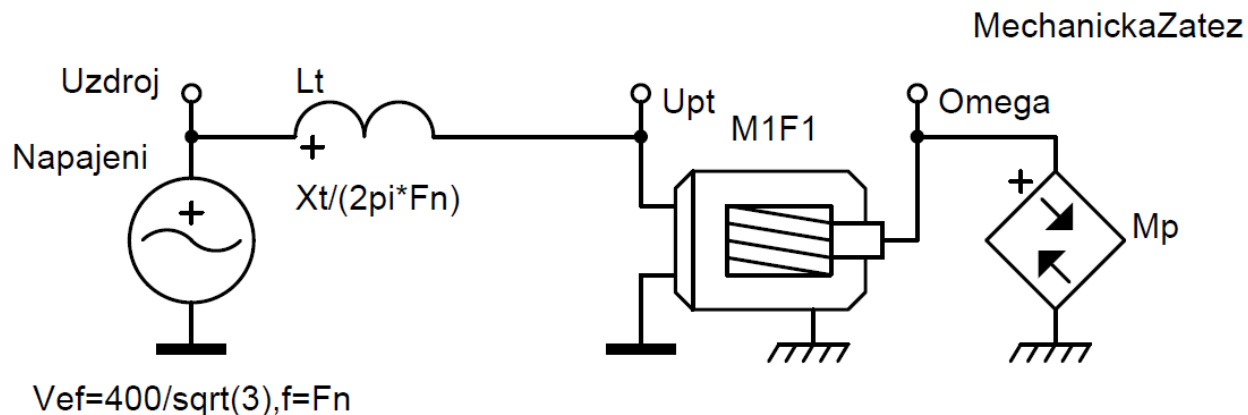
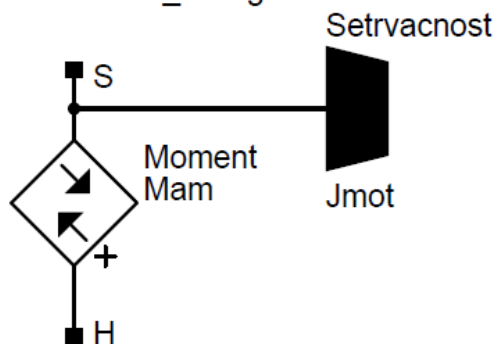
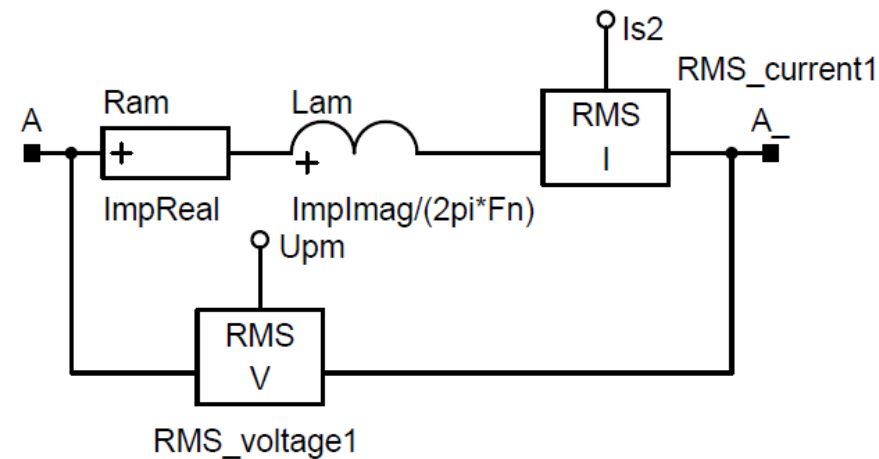


Dynamika asynchronního pohonu

Jednoduchý jednofázový model asynchronního motoru

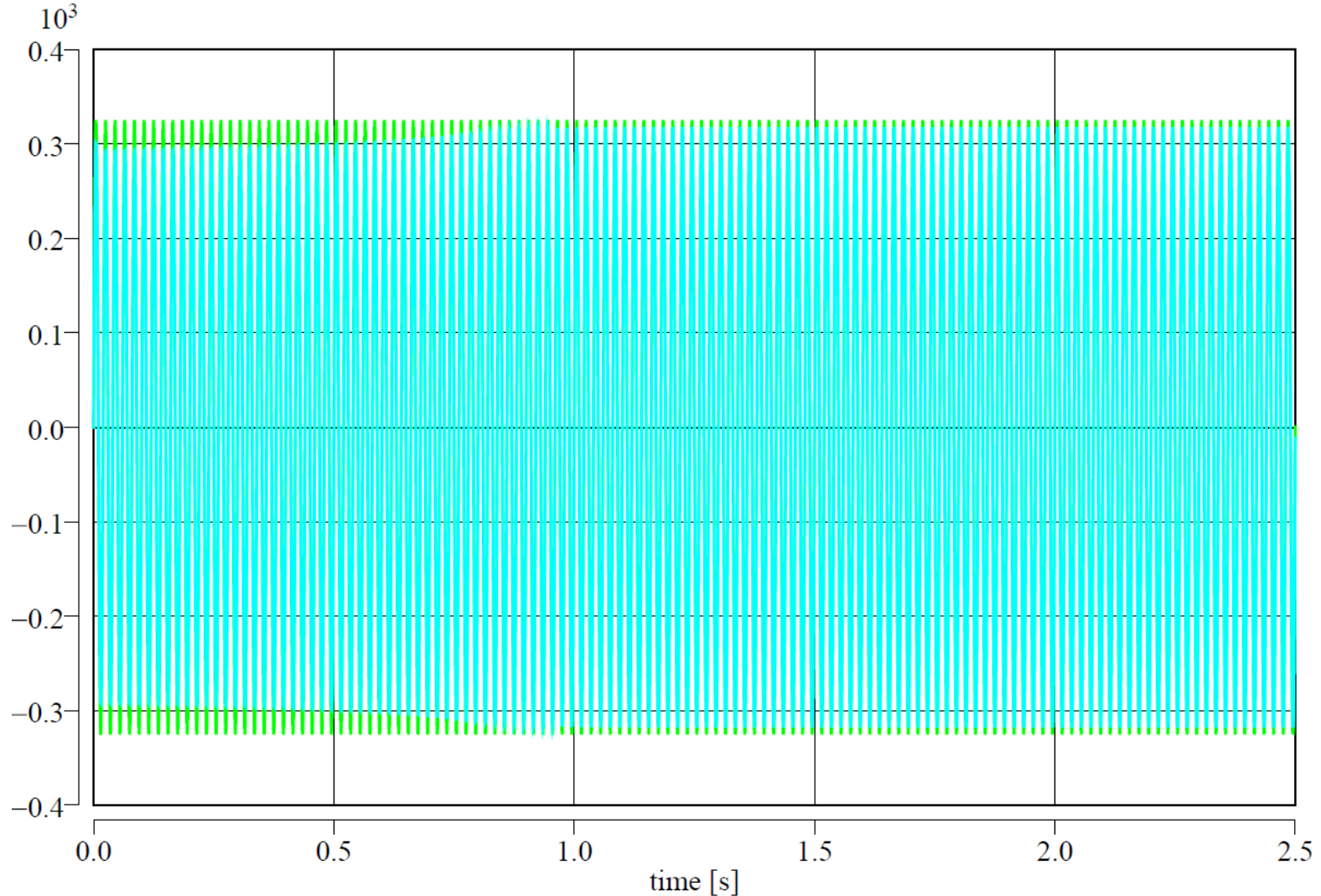


■ MIF1.ImpReal [Ohm] Realna cast impedance motoru of MIF1
■ MIF1.ImpImag [Ohm] Imaginarni cast impedance motoru of MIF1



Dynamika asynchronního pohonu

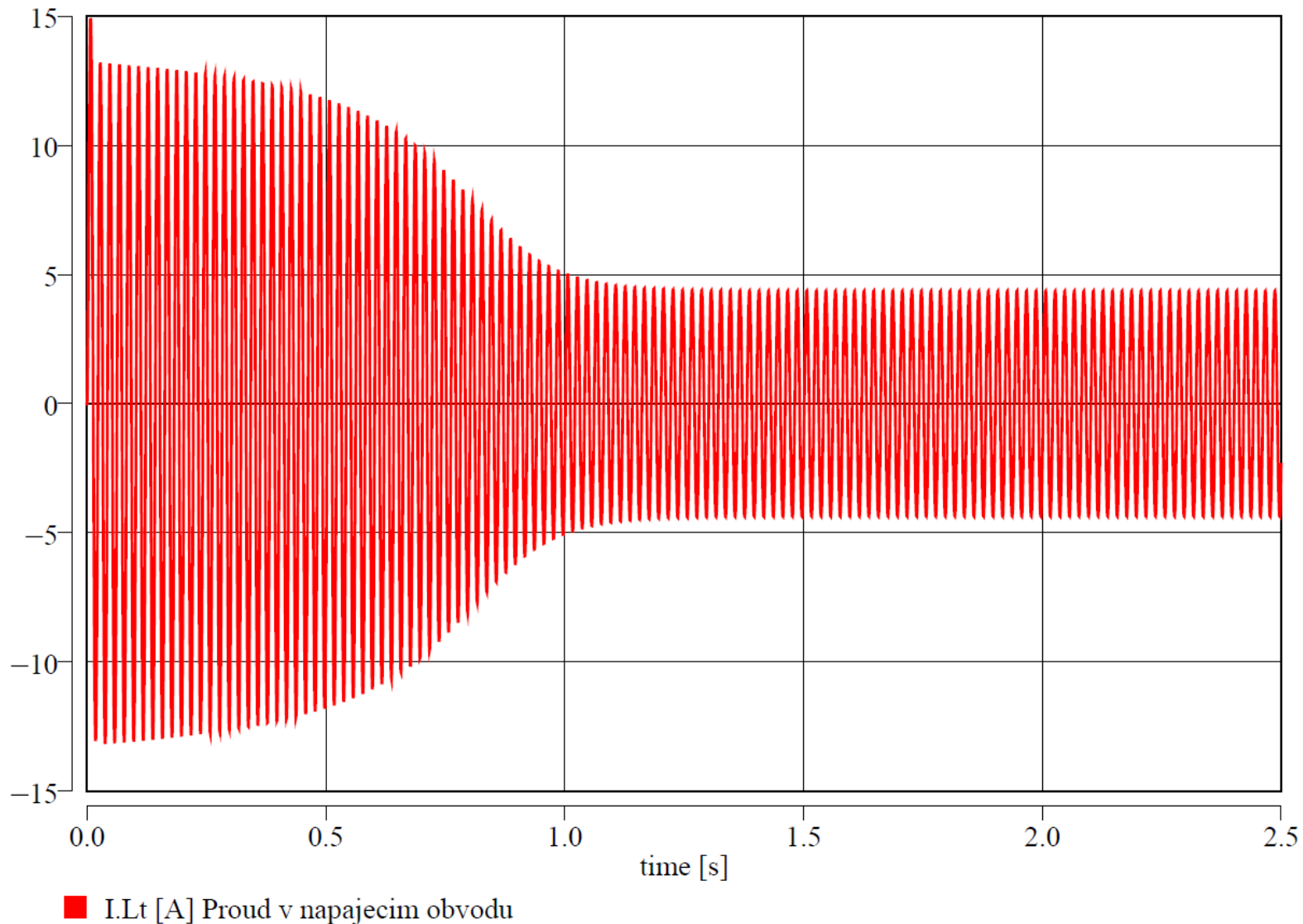
Jednoduchý jednofázový model asynchronního motoru



- Uzdroj [-] Napeti napajecihho zdroje
- Upt [-] Napeti na svorkach asynchronniho stroje

Dynamika asynchronního pohonu

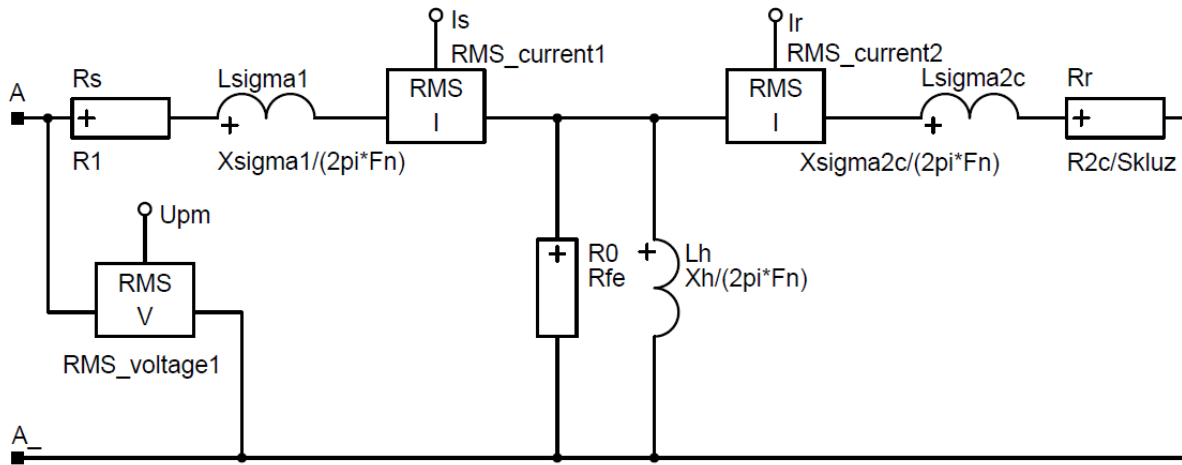
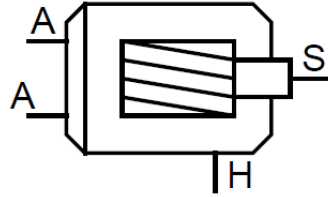
Jednoduchý jednofázový model asynchronního motoru



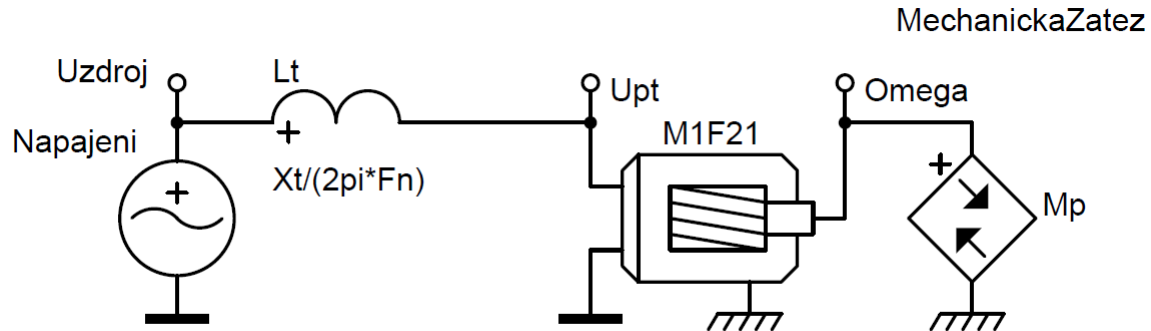
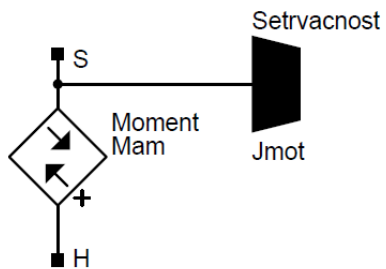
Dynamika asynchronního pohonu

Jednofázový model asynchronního motoru

s kompletním obvodem a momentem odvozeným z proudu



$$M_{am} = \frac{3 \cdot R_2' \cdot I_r^2}{s \cdot \omega_S}$$

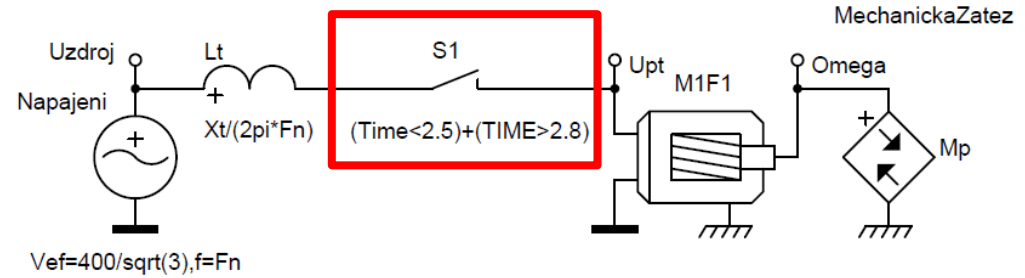


$V_{ef}=400/\sqrt{3}, f=Fn$

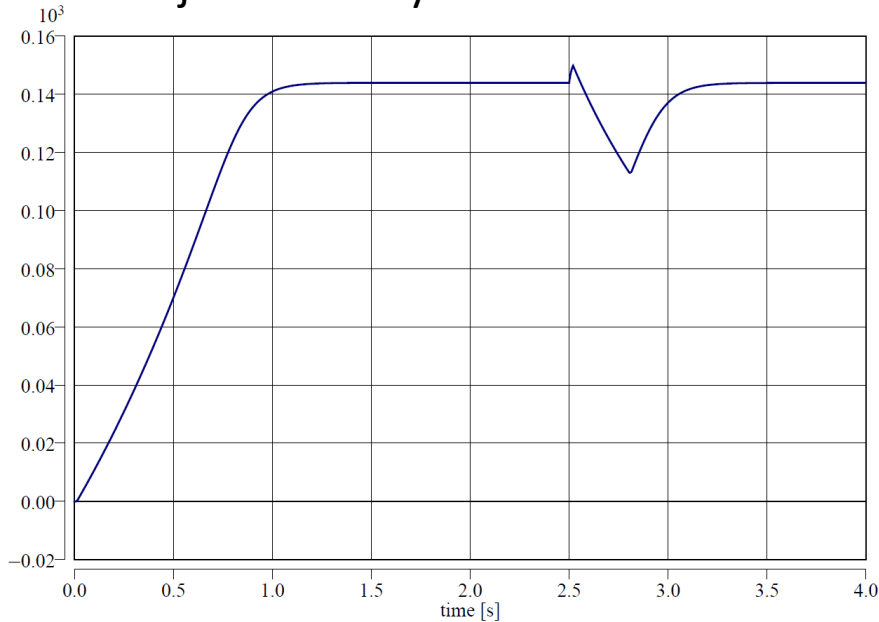
Dynamika asynchronního pohonu

Porovnání jednoduchého a kompletního modelu

Přerušení napájení

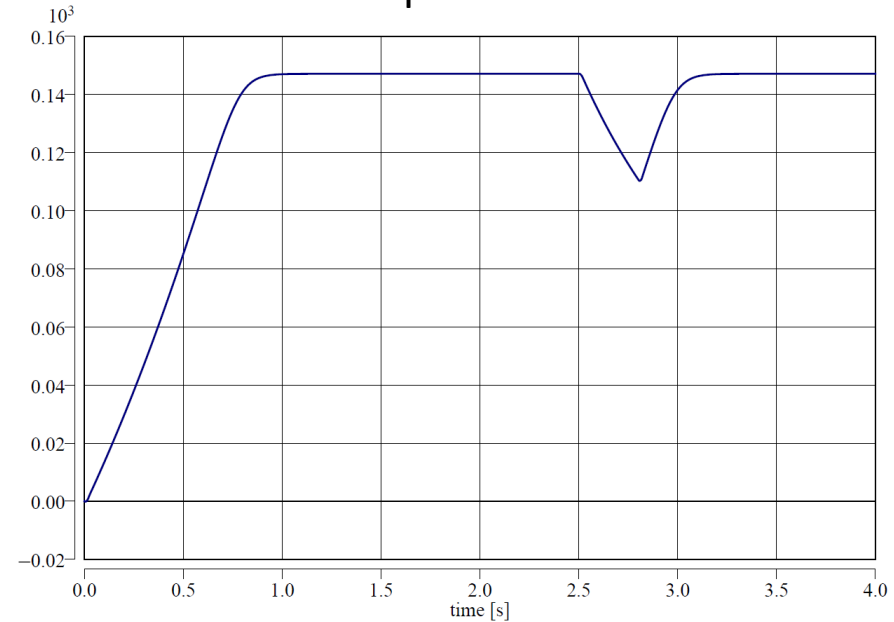


Zjednodušený model



■ Ω [rad/s] Uhlova rychlost asynchronního stroje

Model s kompletním obvodem

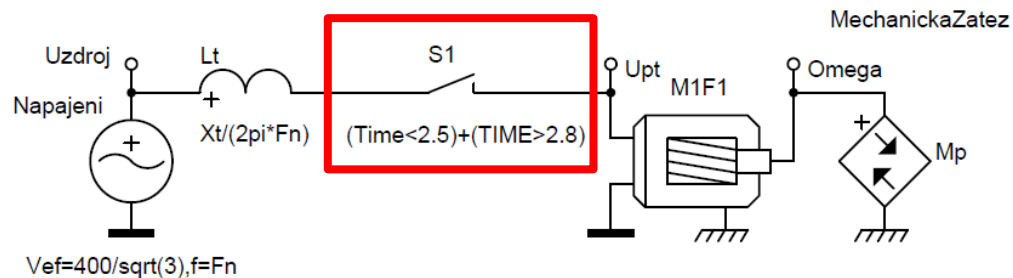


■ Ω [rad/s] Uhlova rychlost asynchronního stroje

Dynamika asynchronního pohonu

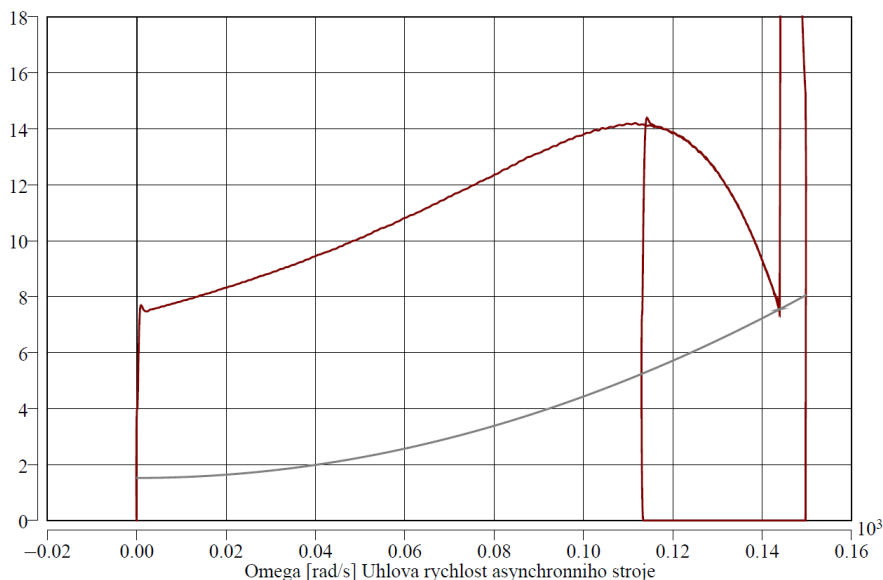
Porovnání jednoduchého a kompletního modelu

Přerušení napájení

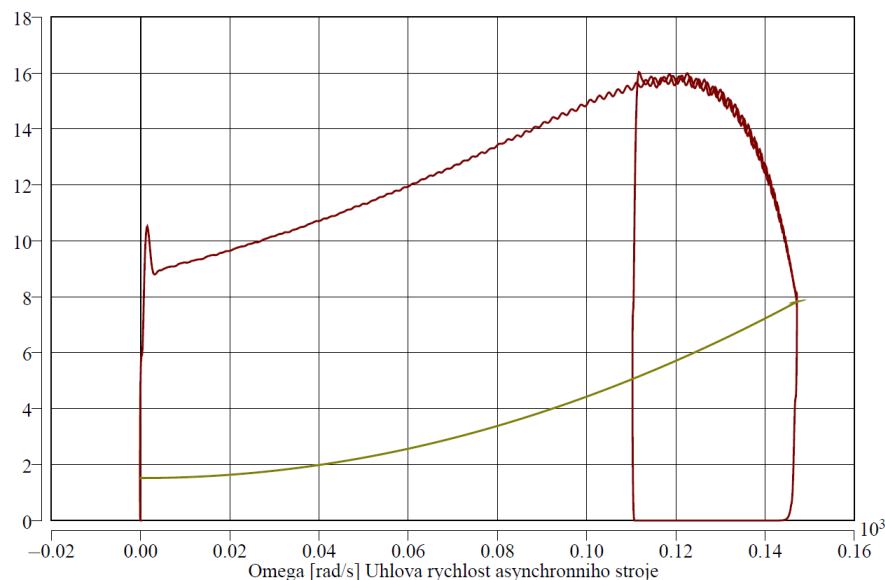


Zjednodušený model

Model s kompletním obvodem



■ M1F1.Mam [N*m] Moment asynchronniho stroje of M1F1
 ■ Mp [N*m] Moment mechanicke zateze [N*m]

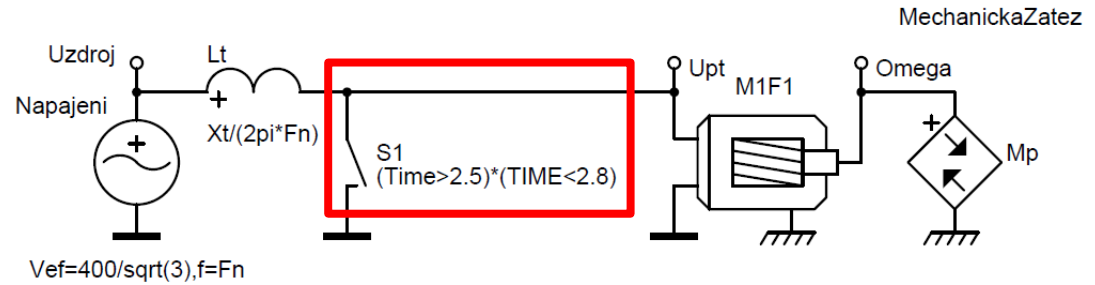


■ M1F21.Mam [N*m] Moment asynchronniho stroje of M1F21
 ■ Mp [N*m] Moment mechanicke zateze [N*m]

Dynamika asynchronního pohonu

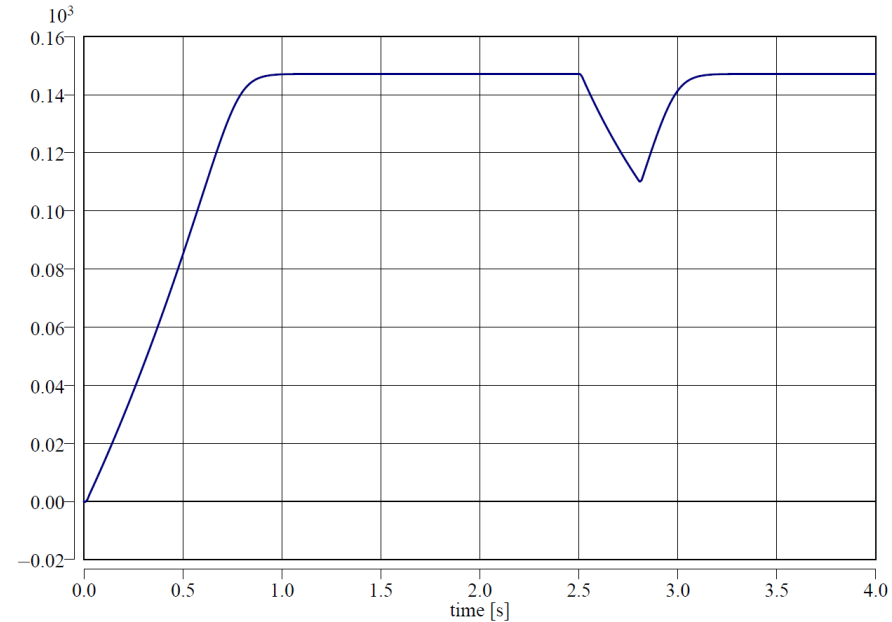
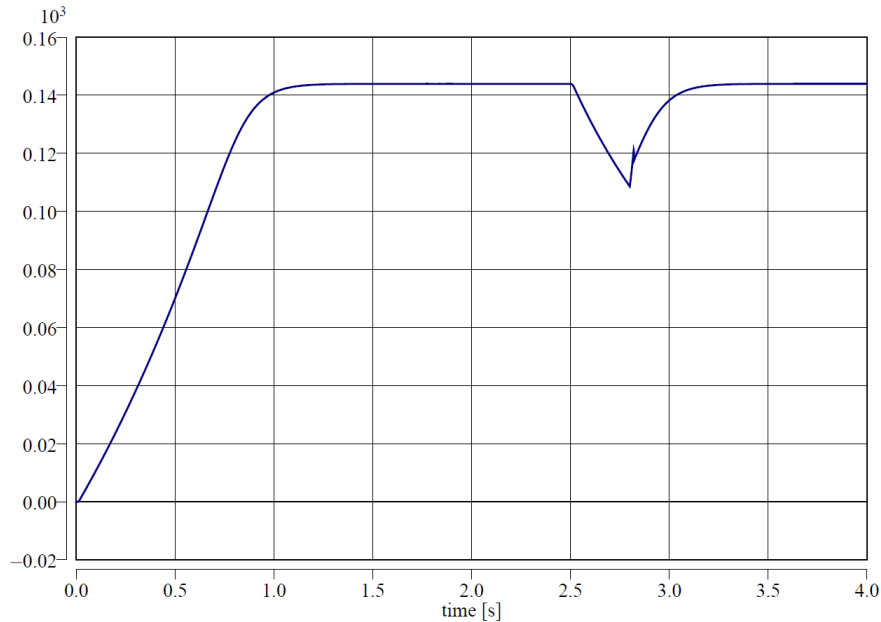
Porovnání jednoduchého a kompletního modelu

Zkrat na napájení



Zjednodušený model

Model s kompletním obvodem

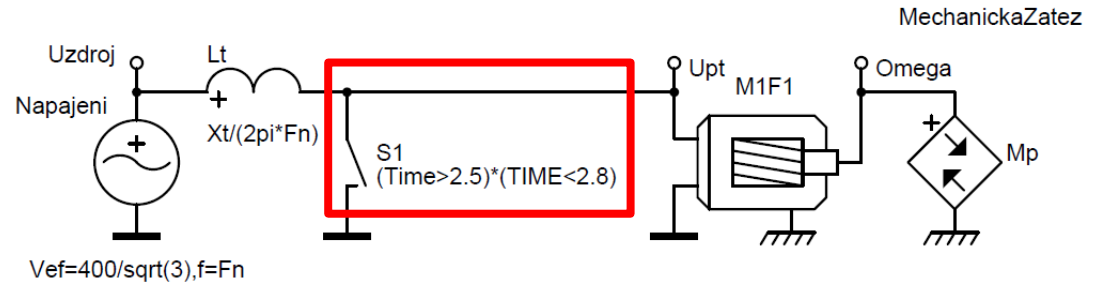


■ Ω [rad/s] Uhlova rychlost asynchronního stroje

Dynamika asynchronního pohonu

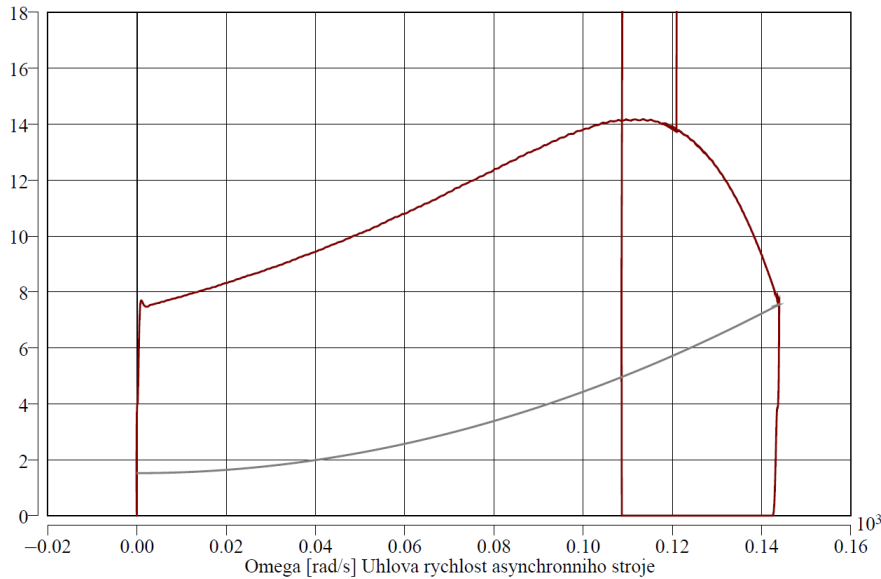
Porovnání jednoduchého a kompletního modelu

Zkrat na napájení

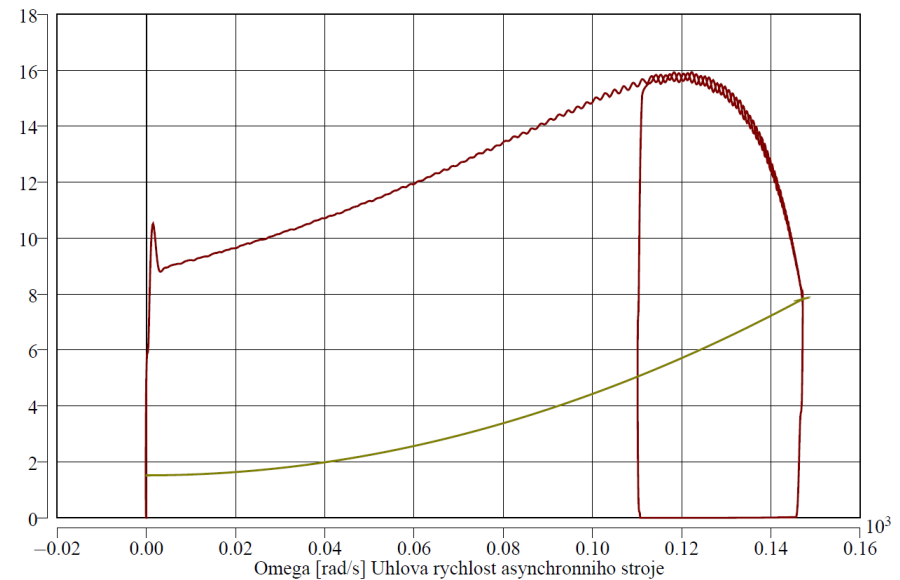


Zjednodušený model

Model s kompletním obvodem



■ M1F1.Mam [N*m] Moment asynchronního stroje of M1F1
■ Mp [N*m] Moment mechanické zátěže [N*m]



■ M1F21.Mam [N*m] Moment asynchronního stroje of M1F21
■ Mp [N*m] Moment mechanické zátěže [N*m]