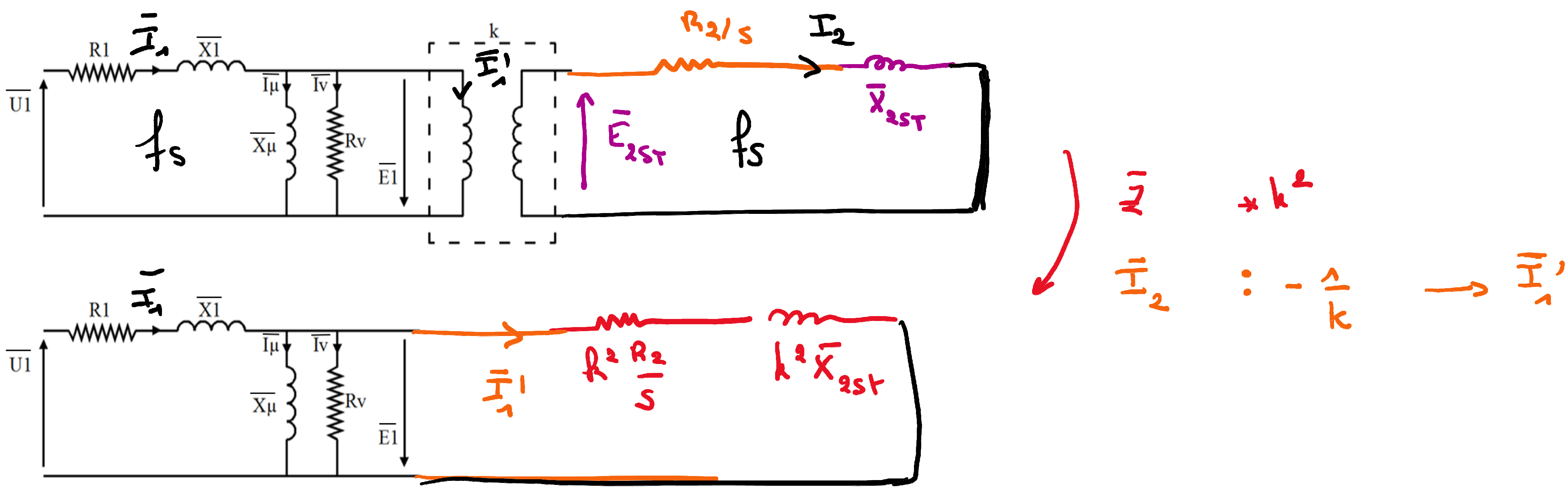
2.8 Equivalent schema niet ideale ASM

2.8.3. Belast → bij draaien → reflectie



2.8 Equivalent schema niet ideale ASM

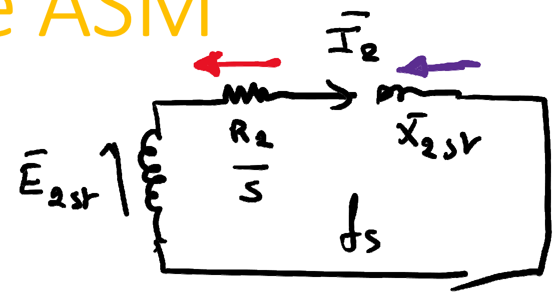
2.8.4. Generator

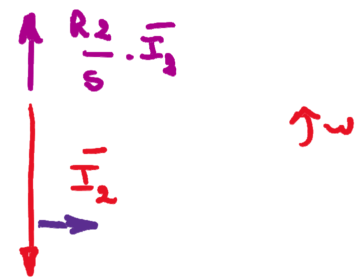
① $n_r > n_s \longrightarrow s < 0$

$\longrightarrow \frac{R_2}{s} \cdot \bar{I}_2$

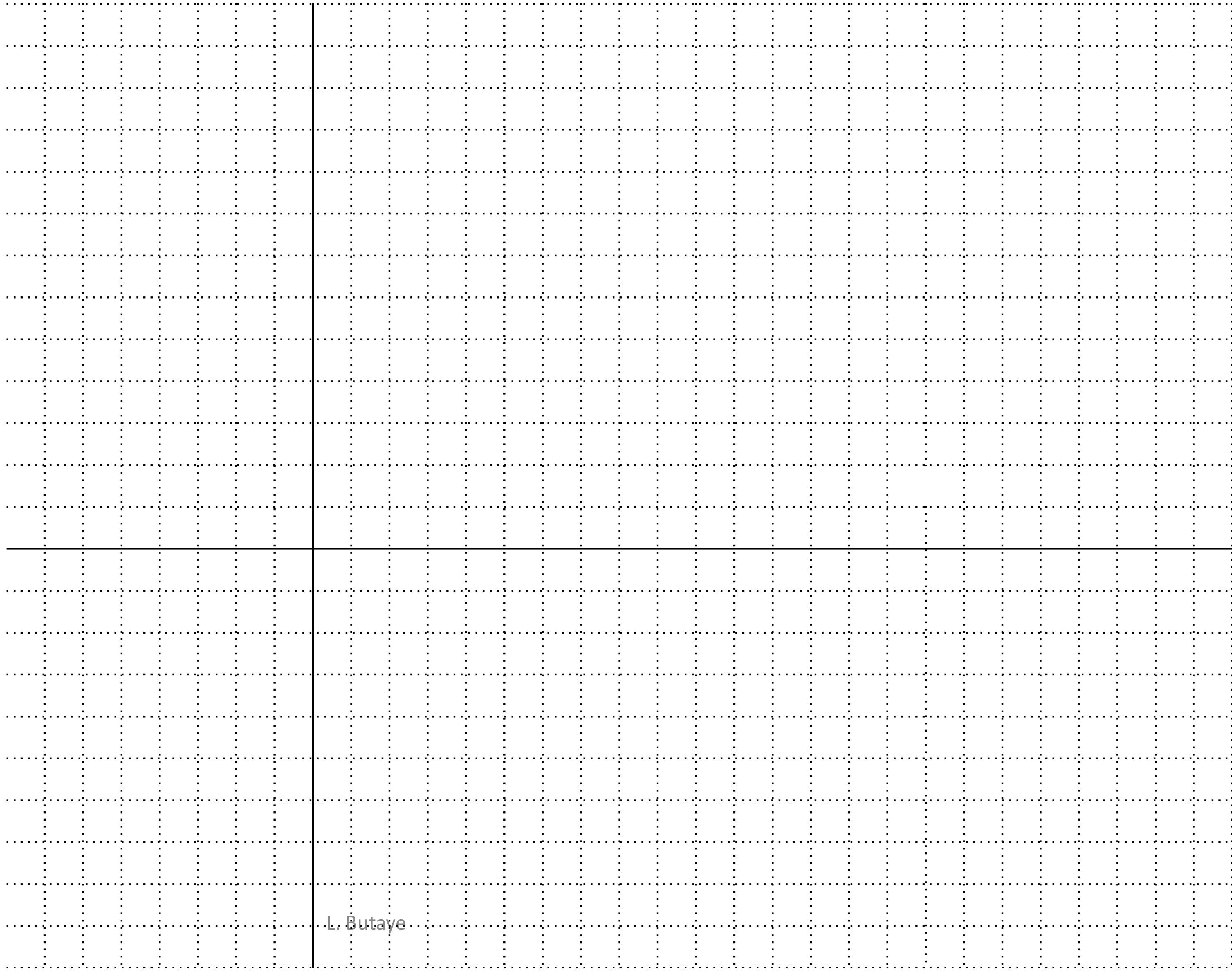
② $\cos \varphi_1 \longrightarrow \varphi_1 > 90^\circ$ CONTROLE

③ V.D. Ideale Generator





2.8.4. Generator

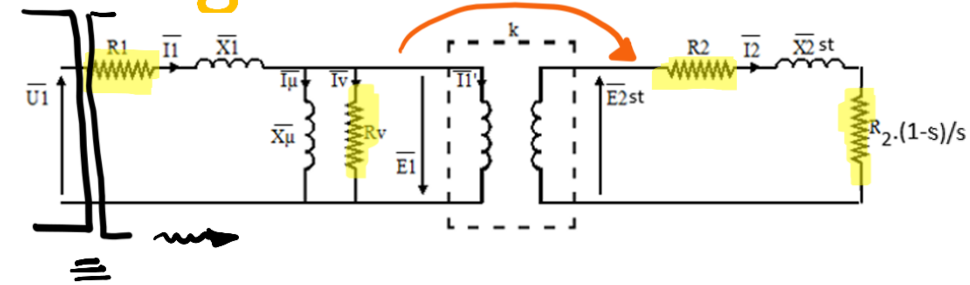


P_L

2.9 Actieve vermogenverdeling - rendement

MOTOR

2.9.1 Stator



NET $P_1 = P_{toe}$

$$= \sqrt{3}\, U_{L1} I_{L1} \cos\varphi_{F1} = 3\, V_{F1} I_{F1} \cos\varphi_{F1}$$ (100 %)

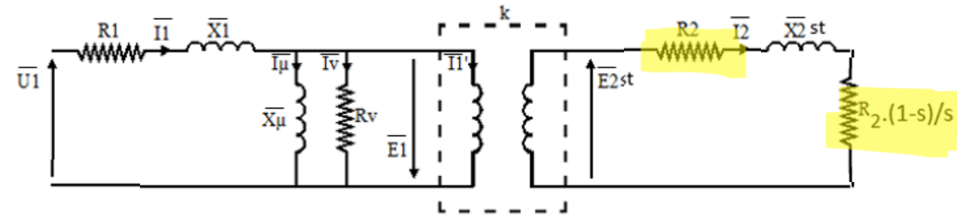
$$P_{cu,STATOR} = 3 R_1 I_1^2$$

$$P_{Fe,STATOR} = 3\, U_1 I_0 \cos\varphi_0 - 3 R_1 I_0^2$$

$$P_L = P_1 - P_{cu,STATOR} - P_{Fe,STATOR}$$

2.9 Vermogenverdeling - rendement

2.9.2 Overdracht van stator naar rotor



LUCHTSPLEETVERMOGEN = P_L

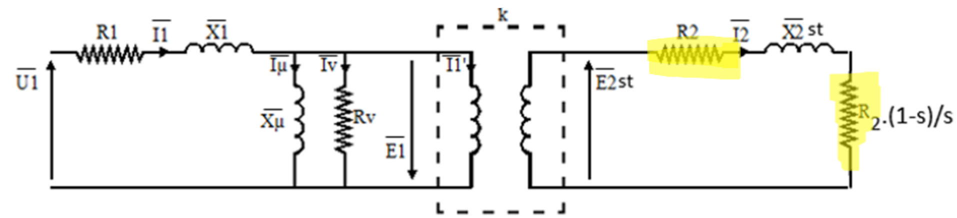
$$\boxed{P_L} = P_1 - P_{cu,STATOR} - P_{Fe,STATOR}$$

$$= 3 \cdot \frac{R_2}{s} \cdot I_2^2$$

$$\underbrace{R_2 + R_2 \frac{1-s}{s}}_{\frac{R_2}{s}}$$

2.9 Vermogenverdeling - rendement

2.9.3 Rotor



$P_L = 3\,\frac{R_2}{s}\,.I_2^2$

$P_{cu,R} = 3.R_2\,I_2^2$

$P_{Fe,R} = \ll B, d, m$ → $f_R = s_n \cdot f_S$ → VERW. 1,5 Hz

0,03

50 Hz

INWENDIG $P_i = 3.R_2\,\frac{1-S}{s}\,.I_2^2$

P_v → wrijvingsverliezen, ventilatieverliezen

$P_{as} = P_m = P_2$

100% P_{toe}

MOTOR $\eta = \frac{P_{as}}{P_{toe}}.100\% = \frac{P_2}{P_1}.100\%$

GENERATOR:

OEF ROTOR

$$\overbrace{= P_L = \frac{P_{cu,R}}{s} = P_i \frac{1}{1-s}}^{OEF} \begin{cases} n_r \rightarrow s \\ 1\,kW \end{cases}$$

$$P_L = 3 \cdot \frac{R_2}{s} I_2^2$$

$$P_{cu,R} = 3 \cdot R_2 I_2^2 = P_L \cdot s = P_{cu,R} = P_i \cdot \frac{s}{1-s} \quad ?$$

$$P_i = 3 \cdot R_2 \frac{1-s}{s} \cdot I_2^2 = P_L \cdot (1-s) = P_{cu,R} \cdot \frac{1-s}{s} = P_i \quad ?$$

2.9 Vermogenverdeling - rendement

MOTOR

KOPPEL

$\frac{\omega_r}{1-s} =$

$n_r = n_s(1-s)$

2.9.3 Rotor

$P_L = P_i/(1-s) = M_i \cdot \omega_r \cdot \frac{1}{1-s}$ → $M_i = \frac{P_L}{\omega_s}$

*

$P_{cu,R} =$ /   /

$P_i = P_v + P_{as}$ → $M_i = \frac{P_i}{\omega_r}$ *

MOTOR

$M_i = M_v + M_{as}$

GENERATOR

$M_{as} = M_v + M_i$

$P_v = \begin{cases} \text{vent. v.} \\ \text{wrijv. v.} \end{cases}$ → $M_v = \frac{P_v}{\omega_r}$

$n_r \to \omega_r$

$P_n = P_{as}$ → $M_{as} = M_n = \frac{P_n}{\omega_r}$

n_r

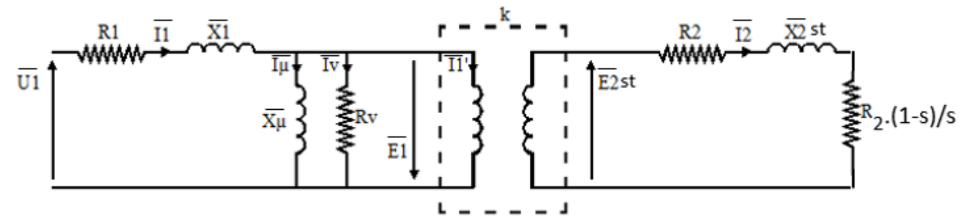
$P = M . \omega$

2.9 Vermogenverdeling - rendement

2.9.3 Rotor

$\neq f_r = s \cdot f_R$

└ verschilfreq



!!

Opm. 1

ω_r

rad/s

n_r

$n_r = n_s(1-s)$

$\frac{60\, f_s}{p}$

Opm. 2

GENATOR

MOTOR

2.10 Inwendig koppel

Koppel-toerentalkarakteristiek

$$\frac{E_1}{k} \approx \frac{U_1}{k}$$

$P_i = 3 \cdot \frac{R_2}{s} \cdot I_2^2$ en ω_s en $I_2 = \dfrac{E_{2ST}}{\sqrt{\left(\frac{R_2}{s}\right)^2 + X_{2ST}^2}}$

$$\Rightarrow \quad M_i \cong \frac{1}{\omega_s} \cdot 3 \cdot \frac{U_1^2}{k^2} \cdot \frac{s \cdot R_2}{R_2^2 + s^2 \cdot X_{2,ST}^2}$$

M_i i.f.v. de slip ..... i.f.v. toerental

$\longrightarrow$ onafh. verand.

$M_i = f(s)$

2.10 Inwendig koppel

Koppel-toerentalkarakteristiek

$$\mathbf{M_i} \cong \frac{1}{\omega_s} \;.\; 3 \;.\; \frac{U_1^2}{k^2} \;.\; \frac{\mathbf{s} \;.\; R_2}{R_2^2 + \mathbf{s}^2 \;.\; X_{2,ST}^2}$$

$\mathbf{M_i}$ i.f.v. de **slip** ..... i.f.v. toerental

$\mathbf{M_i}$ = f(**s**)

2.10 Inwendig koppel

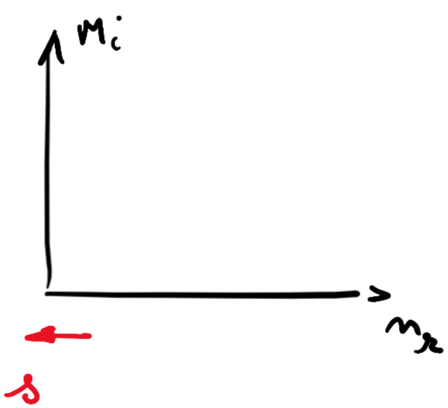
$U_1 \simeq E_1$

Koppel-toerentalkarakteristiek

$$M_i \simeq \frac{1}{\omega_s} \cdot 3 \cdot \frac{U_1^2}{k^2} \cdot \frac{s \cdot R_2}{R_2^2 + s^2 \cdot X_{2,ST}^2}$$

Afhankelijk van $\omega_s \rightarrow f_s$
Afhankelijk van U_1^2
Afhankelijk van R_2
Afhankelijk van $X_{2,ST}$
Afhankelijk van s → functie van s

parameters
"cte"



2.10 Inwendig koppel

Koppel-toerentalkarakteristiek

$$M_i \cong \frac{1}{\omega_s} \cdot 3 \cdot \frac{U_1^2}{k^2} \cdot \frac{s \cdot R_2}{R_2^2 + s^2 \cdot X_{2,ST}^2}$$

$$\Rightarrow \qquad M_i \cong C^{te} \cdot \frac{s}{R_2^2 + s^2 \cdot X_{2,ST}^2}$$

2.10 Inwendig koppel

Koppel-toerentalkarakteristiek

Teken

$$M_i \cong C^{te} \cdot \frac{s}{R_2^2 + s^2 \cdot X_{2,ST}^2}$$

Bijzondere punten

FORMULE | FYSISCH

1. $\boxed{s = 0} \longrightarrow M_i = 0$ | $s = 0 \rightarrow n_r = n_s \rightarrow v_{rel} \rightarrow E_2 = 0$!

$I_2 = 0$

$F = 0$

$M = 0$

2. $\boxed{\begin{matrix} s \sim +\infty \\ s \sim -\infty \end{matrix}}$

$s \sim +\infty \longrightarrow M_i \sim 0$

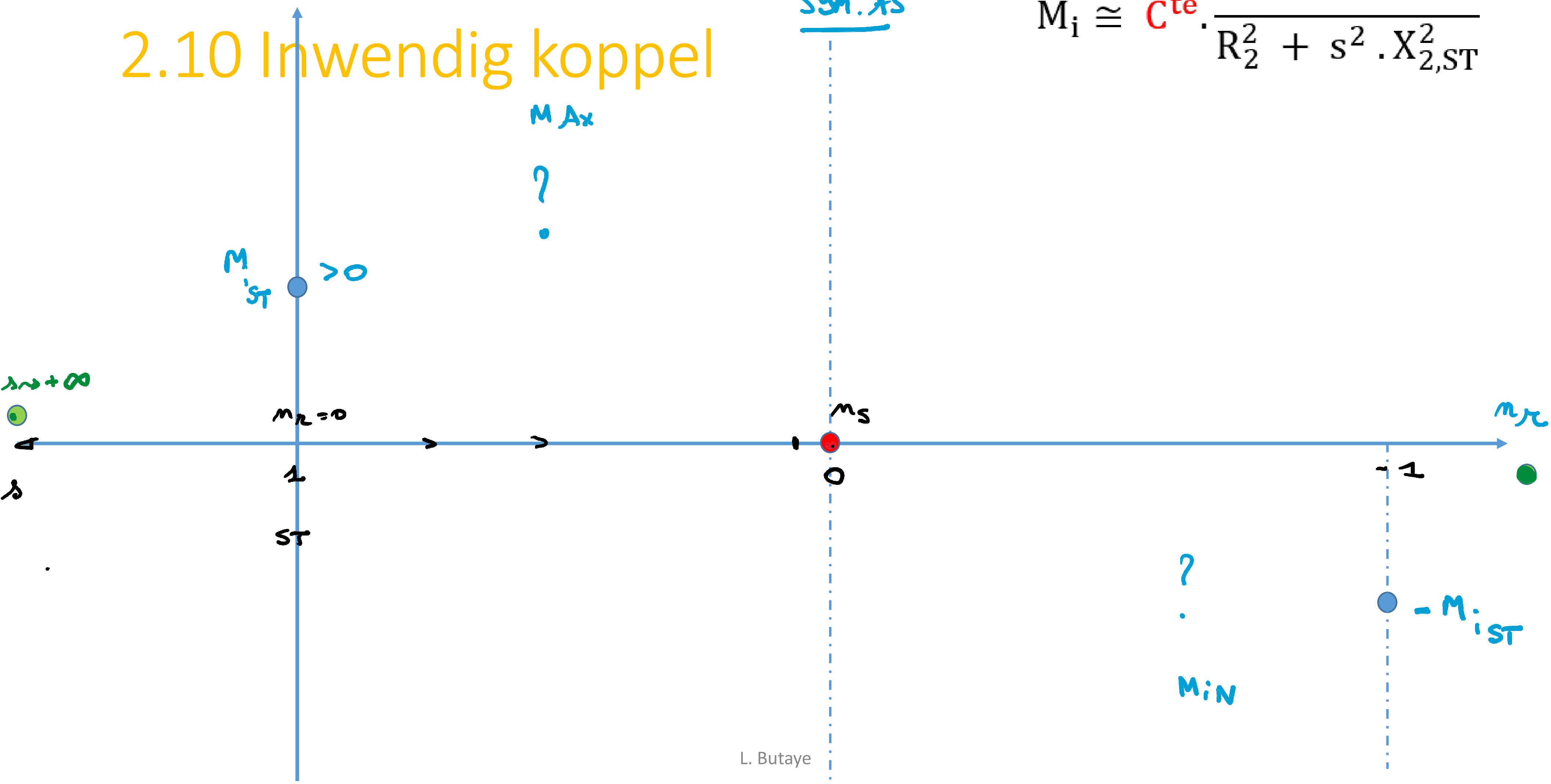
$s \sim -\infty \longrightarrow M_i \sim$ "0"

3. $\boxed{s = 1 \longrightarrow M_{ST}} = c^{te} \cdot \frac{1}{R_2^2 + X_{2ST}^2} > 0$

$s = -1 \longrightarrow -M_{iST}$

2.10 Inwendig koppel

$$M_i \cong C^{te} . \frac{s}{R_2^2 + s^2 . X_{2,ST}^2}$$



2.10 Inwendig koppel

$$M_i \cong C^{te} \cdot \frac{s}{R_2^2 + s^2 \cdot X_{2,ST}^2}$$

Koppel-toerentalkarakteristiek

PLAATS MAX / MIN $\longrightarrow \dfrac{dM_i}{ds} \equiv 0$

$$\rightarrow \frac{(R_2^2 + s^2 X_{2ST}^2) \cdot 1 - s \cdot (0 + X_{2ST}^2 \cdot 2s)}{(R_2^2 + s^2 X_{2ST}^2)^2} \equiv 0$$

$$\rightarrow R_2^2 + \underbrace{s^2 X_{2ST}^2 - 2s^2 X_{2ST}^2} \equiv 0$$

$$\rightarrow R_2^2 - s^2 X_{2ST}^2 \equiv 0$$

kwadr $\rightarrow$ 2 opl

$$\xrightarrow{\sqrt{\ }} s_k = \pm \frac{R_2}{X_{2ST}}$$

KIPSLIP