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Title

EXERCISE 3 - INDUCTION MACHINE MODELING

Course Name

EE-565 Industrial Electronics II

1 GUIDELINES

Consider the induction machine described in Tab. 1 and answer the following questions:

Table 1 Parameters

P_n	2 200 kW	U_n	220 V	$\Omega_{m,n}$	150 rad s^{-1}	R_r	1 Ω	L_{ls}	4 mH	L_m	90 mH	J	0.05 N m
I_n	8.8 A			f_{sw}	5 kHz	R_s	0.8 Ω	L_{lr}	4 mH	p	2	k_F	0.005 5 N m s

2 TASKS DESCRIPTION

1. Verification of the PLECS model: using on the PLECS model `Exercise3_model_skeleton_2025.plecs`, complete the mathematical model. Your PLECS model should run with the speed, voltage and torque profiles provided in the skeleton. Display scope of the model with the Mathematical Model matching the Switched Model profiles.
   Hints: Starting from the induction machine model in a common reference frame presented in the lectures (stator flux-oriented reference frame or rotor flux-oriented reference frame for instance), some rearrangement is needed to obtain a convenient model for simulations. The following steps are recommended:
   (a) Express the rotor's electrical model in terms of rotor flux, stator current, and slip frequency.
   (b) Express the stator flux as a function of the stator current and the rotor flux.
   (c) Express the stator's electrical model as a function of the stator voltage, stator current, stator electrical frequency, rotor flux and its derivative.
   (d) Express the rotor flux derivative as a function of the rotor flux and stator currents.
   (e) Finally you can link the stator voltages with the stator currents, their derivative, and the rotor flux.

   The expression of the stator model can be written with the total equivalent resistance $R_{tot} = R_s + \frac{L_m^2}{L_r^2} \cdot R_r$ and the equivalent inductance $L_\sigma = L_s - \frac{L_m^2}{L_r}$.

2. What happens for the model when the $U_s \geq \sqrt{2}U_n$ and why?
3. What happens when a load torque is applied?