Part II, cont

Dynamics and motion control

Modelling of actuators and sensors 2017

Modelling, simulation and analysis of PMSM-machine with inertial load.

When the rotor of the machine is rotating at constant speed and torque, the currents and voltages will be three phase AC. When the machine is at stand still, the voltages and currents will be DC. The data for the motor to be modelled in the following exercises is given below.

Motor to be modelled:
6SM107S-3000 (Note RMS values)
Torque constant K_T = 1,6 Nm/A
Voltage constant K_E=97 mVmin
Rated Torque 23 Nm
Winding resistance Phase-Phase 0.37 ohm
Winding inductance Phase-Phase 3,6 mH
Rotor moment of inertia 104 $kgcm^2$.
Motor pole no.6
Thermal time constant 40 min
Weight standard 32,5 kg

Exercise 7 No-load and short circuit tests

This exercise uses the simscape model: noload_shortcircuit_tests.slx. The purpose of the exercise is to adjust the parameters of the simulation model to the machine to be modelled. These tests is also performed on real machines to determine or verify the parameters of a mechine e.g. the voltage constant.

a) Calculate the no load line voltage and the short circuit current at 1000 rpm. Answer: PMSM_machines_answer.m
b) At which speed is it acceptable to shortcircuit the machine and why?
c) Choose the parameters of the machine model to match the machine data above and verify the choice with no-load and short circuit test.
d) Check the relation between the electrical and mechanical frequency.
e) Write a m- file in order to insert the model parameters automatically, to be used in upcoming exercises.

Exercise 8 DC-current excitation of the machine

Use the simscape model: DC_current_phasor.slx. Use the m-file you made to get the parameters for the machine model.
Inject the following current phasors (stator coordinates)

1) 10A
2) j10A

a) Compare the results and give a qualitative explanation.
b) Measure the phase currents a, b, c and explain their relation to the current phasor in stator coordinates.

Exercise 9 Excitation with synchronous rotating current phasor (stator coordinates) = DC current phasor in DQ rotating coordinate system.

This exercise uses the simscape model: current_phasor_commutation.slx. Use the m-file you made to get the parameters for the machine model. In reality the machine is feed by current controlled voltage sources rather than current sources as in this example. We will study this more in exercises about control.

Inject the following current phasor in DQ-coordinates (rotating coordinates).

1) 10A (pure D current)
2) j10A (pure Q current)

Compare the results from 1) and 2) and give an explanation of the behavior of all the measured mechanical and electrical quantities.