Instruction of simulation exercise

DC Motor Supplied with a Thyristor Rectifier

The aim of the exercise is to get familiar with the control system, impact to the AC line and properties of the drive system with a DC motor supplied with a thyristor rectifier. The simulation model includes:

- *Electrical Drive* – reversing drive system, consist of two thyristor rectifiers, a separately-excited DC motor and a load torque setpoint block *load_profile*.
- *Control system* – speed control system, which includes control algorithm, speed setpoint block *speed_prof,* speed change rate setpoint block *Speed_ramp* and a system which enables appropriate rectifier depending on the operation type.

Plan of the exercise

1.For three values of the speed setpoint (eg. 10%, 50%, 90%) observe the steady-state armature current *Ia* and armature voltage *Ud* for the load torque equal to eg. -90%,-50%,-10%, 10%, 50%, 90%. Then change the value of the excitation voltage to 180V and repeat measurements. Comment the obtained results.

2. Set the nominal value of the excitation voltage. For the same values of the speed and load torque as previously perform an analysis of the impact of the converter to the AC line. When a simulation is finished, open the window *Control signals,* click *Analysis* and then *Characteristics*. Next check *Define Range* and set the time interval equal to 20 ms (eg. 1.4 - 1.42) during the steady state of the drive. In the area *Power Analysis* for the phase *A* choose as a signals *u(t)* and *i(t)* respectively source voltage *UL1* i and current *IL1*. Click the *Calculate* button. Comment the obtained values of the following quantities: the RMS and THD coefficient of *IL1*, active power P and reactive power Q, power factor *lambda* and first harmonic power factor *cos (p1)*.

3. For two steady-state operation (eg. speed 10%, torque 10% and speed 90%, torque 90%) perform calculations of harmonics of line current. To do this, when the simulation is finished, open the window *Control signals,* click *Analysis* and then *Fourier*. Next check *Define Range* and set the time interval equal to 20 ms (eg. 1.4 - 1.42) during the steady state of the drive. In the area *Select Curve(s)* check line current *IL1* and then set the *n_max* parameter to 50. Click *Calculate*. Comment the obtained results.

4. For three values of the speed setpoint (eg. 80%, 10%, -80%) for motor and brake operation (torque setpoint eg. 60% and -60%) observe transients of mechanical (torque and speed) and electrical (motor and line voltages and currents) quantities. Notice the rectifier and inwerter operation of the converters and phase shift between line voltage and current. Comment the obtained results.

5. Observe the impact of the load torque change (eg. from 60% to -60%) on the motor speed during operation with constant speed setpoint (eg. 80%). Comment the obtained results.