Induction motor simulation

Induction motor simulation is a part of the Introduction to Electrical Drives course. The goal of this simulation is to demonstrate the operation of an induction motor driving a mechanical load in different types of dynamic situations.

The simulation can be opened from the simulator's startup menu and the opening view is similar to figure 1. The basic controls of the simulation are explained in the user manual.

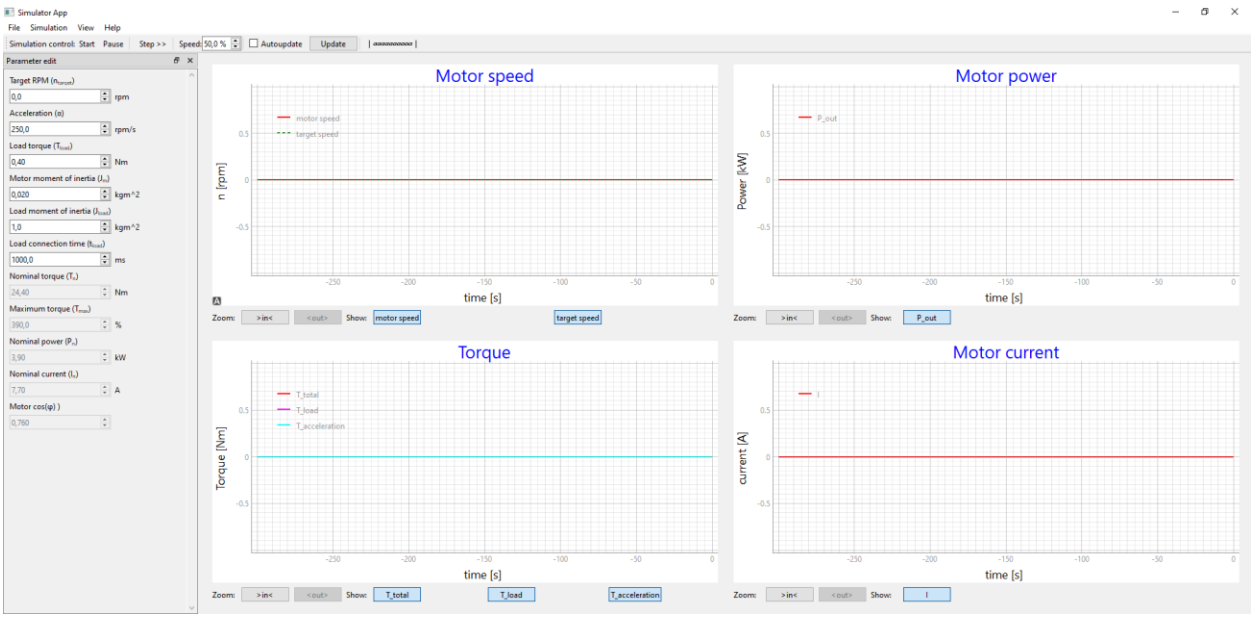

Figure 1. Simulation view of the induction motor simulation.

The simulation view consists of four time domain graphs. Motor speed shows the motor speed and motor target speed, in rpm (revolutions per minute), where target speed is target speed is the speed the motor is accelerating to. The Torque graph shows the total torque the motor is experiencing, and the torque components resulting from the load and acceleration. The motor power graph shows the mechanical output power of the motor. And the motor current graph shows the phase current drawn by the motor.

When the simulation is started the motor has speed of zero rpm. The user can give a speed target for the motor, in which case the motor will accelerate to that speed at the user given acceleration rate. When the speed is reached the motor will keep the speed at that point. The acceleration causes the motor to experience dynamic torque simultaneously affecting

the power and the input current of the motor as well. The acceleration of the system is affected by both the load and motor moment of inertia. The load is designed to be variable where additional load can be added or parts of the load can be removed by changing the loads moment of inertia (J_{load}). How fast the load is connected is controlled by the load connection time. Load torque represents the steady state torque of the load. Experimenting with these relationships is the main goal of this simulation. The editable simulation parameters are expanded on table 1. The default motor in the simulation is ABB 3GBA 112 410-ADDIN (Datasheet).

Table 1. Parameter edit parameters, symbols, units and definitions.

Parameter	Symbol	Unit	Definition
Target rpm	n_{target}	rpm	Target speed command for motor
Acceleration	α	rpm/s	Motor acceleration rate. This rate is a "target" as well as motor cannot exceed its maximum torque.
Load torque	T_{load}	Nm	Steady state torque of the load driven by the motor
Motor moment of inertia	J_m	kgm^2	Moment of inertia of the motor
Load moment of inertia	J_{load}	kgm^2	Moment of inertia of the load
Load connection time	T_{load}	ms	Time it takes to connect a new load by adjusting J_{load}
Nominal torque	T_n	Nm	Nominal torque of the motor
Maximum torque	T_{max}	%	Percentage of nominal torque the motor can reach
Nominal power	P_n	kW	Nominal output power of the motor
Nominal current	I_n	A	Nominal input phase current of the motor
Motor Cos(ϕ)	-	-	Electrical power factor of the motor