Simulations in Mechatronic Design

Title of exercise	Ex. 1 – Modelling of an electric micromotor in the MATLAB / SIMULINK environment		
Name and surname	Harshit Verma	Date	4/11/24
Group	1	No. of points	/7
Academic year	2023/2024		

1. Motor parameters

Motor catalogue number:

Symbol	Parameter name	Catalogue values and units		Parameter values in the model	
J_s	Mass moment of inertia of rotor	1.10	$Kgm^2\,10^{-7}$	$1.10*10^{-4}$	gm^2
K_D	Viscous damping constant	$0.04*10^{-6}$	Nms	$4*10^{-5}$	mNm/rad/s
K_E	Back EMF constant	0.70	v/1000 rpm	6.68	mV/rad/s
K_T	Torque constant	6.7	mNm/A	$6.7*10^{-3}$	mNm/mA
L	Rotor inductance	0.11	mH	$0.11*10^{-3}$	H
I_0	No-load current	10.5	mA	10.5	mA
R_t	Terminal resistance	3.20	Ohms	3.20	Ω
ω_0	No-load speed	8500	rpm	889.66	rad/s

2. Transformed equations of equilibrium of voltages and moments

$$\omega = \int \left(\left(K_t * i - K_D * \omega - M_F * sgn(\omega) \right) / J_s \right) dt$$

$$i = (u - L * (di/dt) - K_E * \omega)/(R_t)$$

3. Compare the obtained responses with the catalogue parameters

Symbol	Parameter name	Catalogue values	Values obtained in simulation
I_0	No-load current	10.5 mA	12.413 mA
ω_0	No-load speed	889.66 rad/s	893.559 rad/s
τ_m	Electromechanical time constant	8 ms	8.3 ms

4. The dialog window of masked model and the *Help* window

Parameters & Dialog | Code | Constraints | Icon

Type	Prompt	Name
	%<MaskType>	DescGroupVar
A	%<MaskDescription>	DescTextVar
	Parameters	ParameterGroupVar
123 #1	Mass moment of Interia [gm^2]	Js
123 #2	Viscous Clamping Contant [mVm/rad/s]	KD
123 #3	Back EMF constant [mV/rad/s]	KE
123 #4	Torque constant [mNm/mA]	KT
123 #5	Rotor Inductance [H]	L
123 #6	No load current [mA]	Io
123 #7	Terminal resistance [ohm]	Rt
123 #8	No-load Speed [rad/s]	wo
123 #9	Supply Voltage [mV]	u
123 #10	Moment of static friction [mNm]	MF

Documentation

Type

Motor Model

Description

The masked model represents the stepper motor. The stepper motor consists of a rotor that is generally a permanent magnet and it is surrounded by the windings of the stator. As we activate the windings step by step in a particular order and let a current flow through them they will magnetize the stator and make electromagnetic poles respectively that will cause propulsion to the motor.

Help

The motor selected is 17N78 from Portescap. The model is represented from the formulas for the simulations mentioned in SIMULATIONS IN MECHATRONIC DESIGN - Modelling of an electric micromotor in MATLAB / SIMULINK environment by Jakub Wierciak.

Cancel | Apply

5. Obtained responses of speed and current of the motor

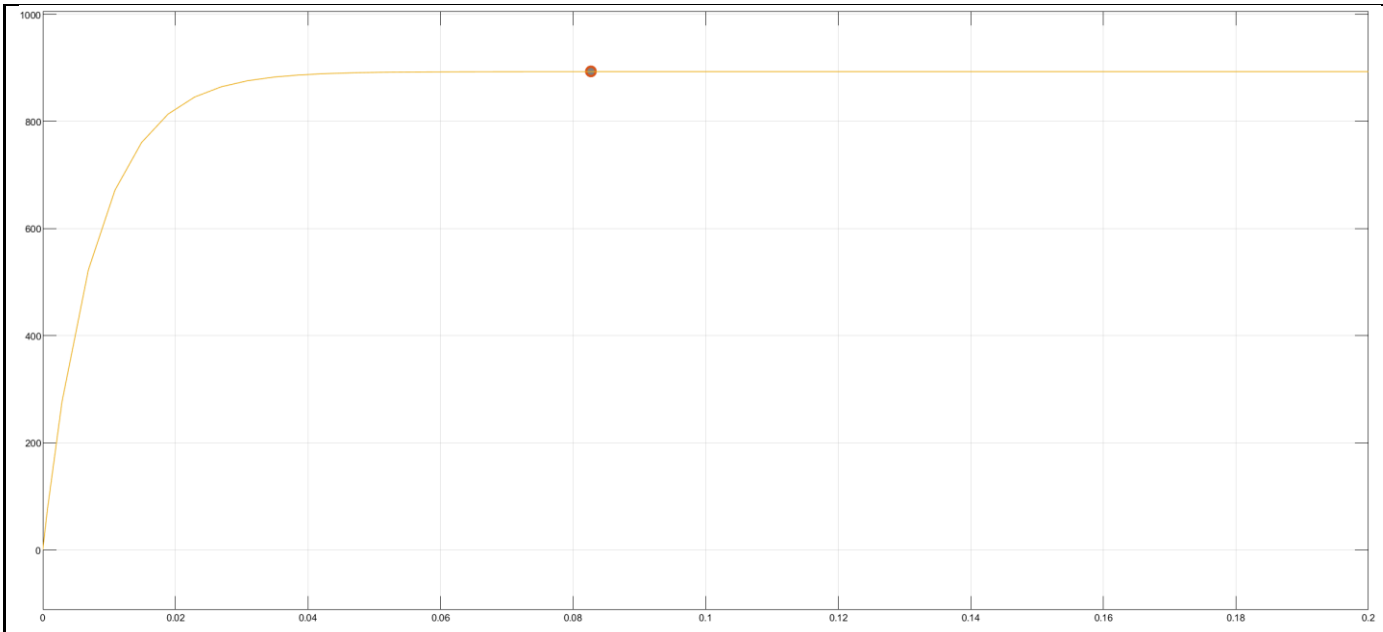

Figure 1 – Current vs time graph

Figure 1 –Angular velocity vs time graph

6. Simulation model