Report 01

DC Motor Model

MCT 621

Motion Control and Servo Systems

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Submitted By/

Barakat Ibrahim Hasan Ibrahim

2002603

Introduction

DC motor Simulink Block is generated in this report according to equations. The block is having 2 inputs which are voltage and load torque. And one output which is its angular velocity.

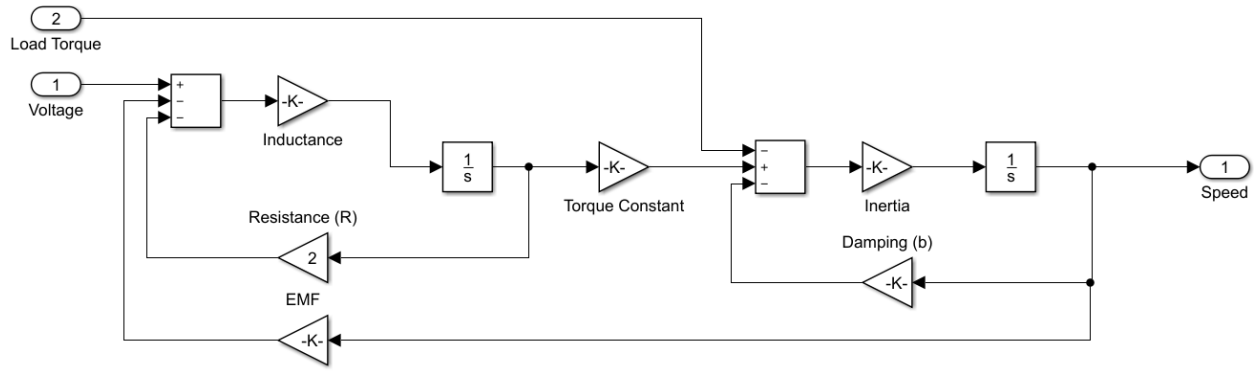
Equations

A linear model of permanent magnet (PM) DC motor can be represented by their mechanical equation and electrical equation as follows.

$$v_a = L_a \frac{dI_a}{dt} + R_a I_a + e_b$$

$$K_m I_a = J_m \frac{d\omega_m}{dt} + B_m \omega_m + T_L$$

where v_a is the applied armature input voltage, $e_b = K_b \omega_m$ is the back electro-motive-force (EMF) voltage, I_a is the armature current T_L is the load torque and ω_m is the rotor angular speed. The dynamic model of the system is formed using these differential equations and Matlab simulink blocks as shown in following pages. The armature reactions effects are neglected since the motor used has either inter-poles or compensating winding.

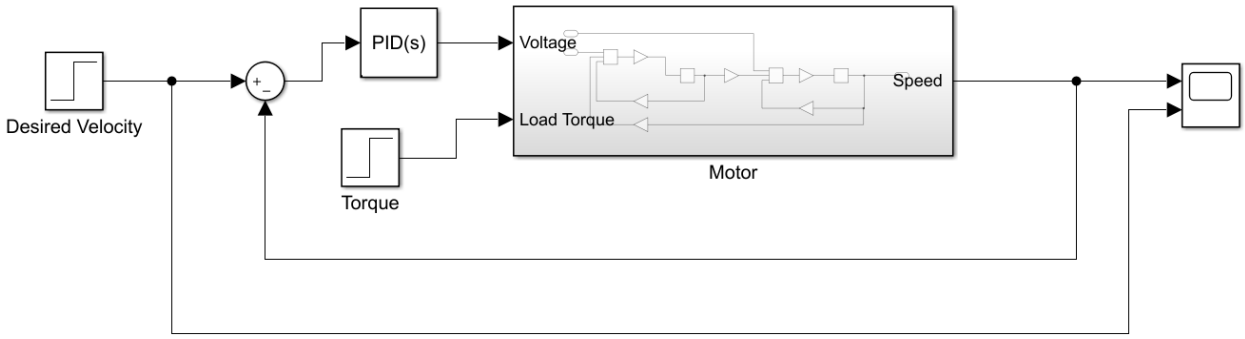


Used Parameters

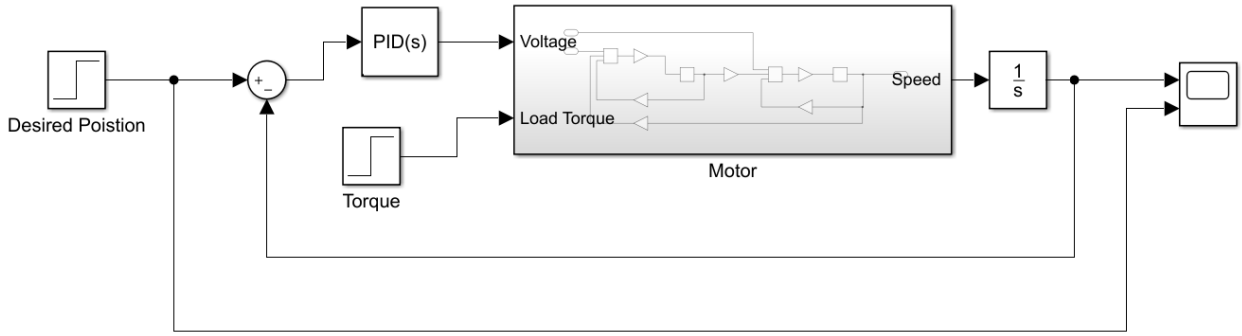
Parameter	Symbol	Value
Moment of Inertia	J_m	$0.000052 \ K_g.m^2$
Friction Coefficient	B_m	$0.01 \ N.ms$
Back EMF Constant	K_b	$0.235 \ {}^{V}/_{ms^{-1}}$
Torque Constant	K_t	$0.235 \ {}^{Nm}/_{A}$
Electric Resistance	R_a	$2 \ \Omega$
Electric Inductance	L_a	$0.23 \ H$

Ideal Closed Loop Control Block Diagram

1. Velocity



2. Position



Tuned PID Parameters

Velocity

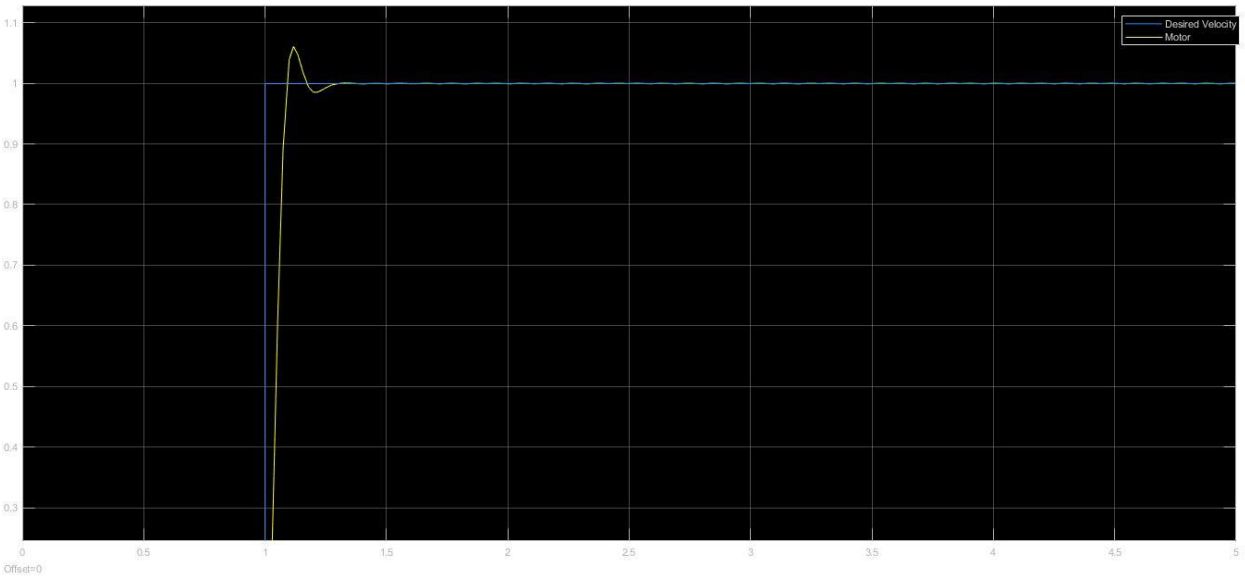
Parameter	Symbol	Value
Proportional	P	0.135543358908684
Integrator	I	8.75873319223285
Derivative	D	-0.00291149276467624

Position

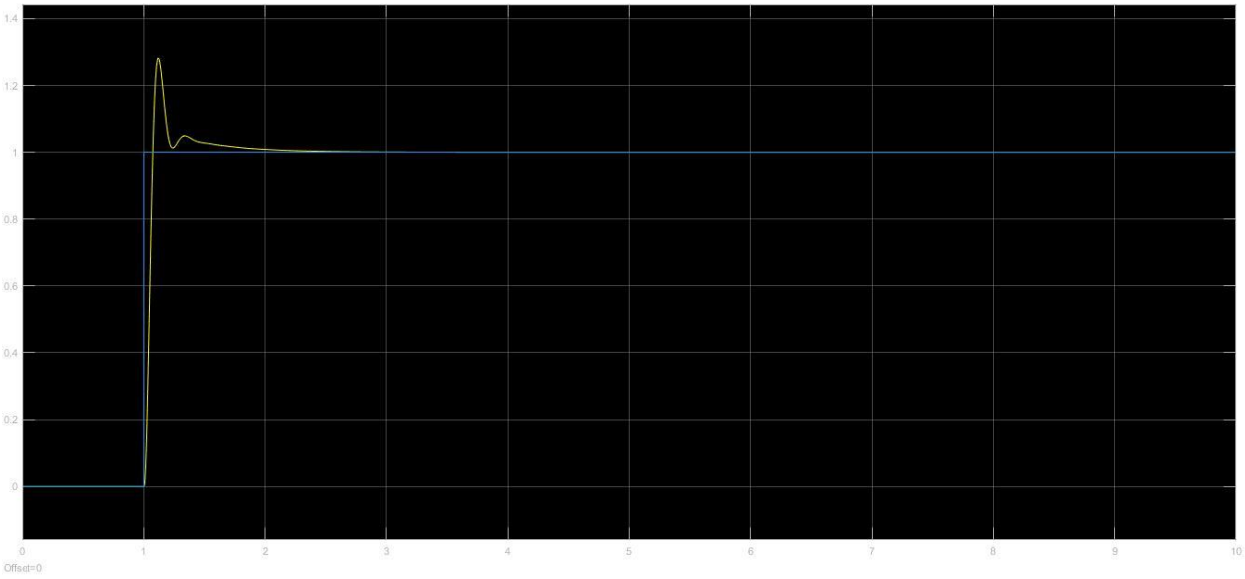
Parameter	Symbol	Value
Proportional	P	8.87419991192869
Integrator	I	19.9549307770635
Derivative	D	-0.00329477712149354

Results

Velocity



Position



Conclusion

The Tuned PID controller for the given motor in the ideal case outputs a smooth results in both position and velocity manners.