Modeling of series DC motor

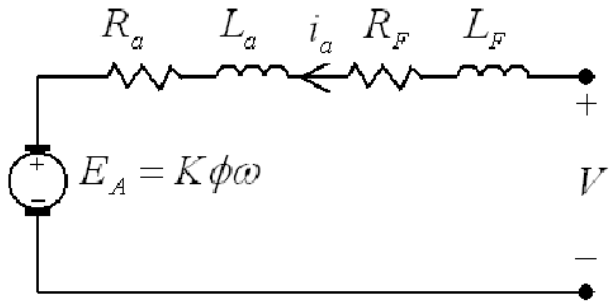
What is DC Series Motor?

The DC Series Motor is similar to any other motor because the main function of this motor is to convert electrical energy to mechanical energy. The operation of this motor mainly depends on the electromagnetic principle. Whenever the magnetic field is formed approximately, a current carrying conductor cooperates with an exterior magnetic field, and then a rotating motion can be generated.

DC Series Motor Circuit Diagram

In this motor, field, as well as stator windings, are coupled in series by each other. Accordingly, the armature and field current are equivalent.

Huge current supply straightly from the supply toward the field windings. The huge current can be carried by field windings because these windings have few turns as well as very thick. Generally, copper bars form stator windings. These thick copper bars dissipate heat generated by the heavy flow of current very effectively.



In a series motor electric power is supplied between one end of the series field windings and one end of the armature. When voltage is applied, current flows from power supply terminals through the series winding and armature winding. The large conductors present in the armature and field windings provide the only resistance to the flow of this current. Since these conductors are so large, their resistance is very low. This causes the motor to draw a large amount of current from the power supply. When the large current begins to flow through the field and armature windings, the coils reach saturation that results in the production of the strongest magnetic field possible.

The strength of these magnetic fields provides the armature shafts with the greatest amount of torque possible. The large torque causes the armature to begin to spin with the maximum amount of power and the armature starts to rotate.

DC Series Motor Advantages

- Vast starting torque
- Easy assembly and simple design
- Protection is easy
- Cost-effective

DC Series Motor Disadvantages

- The motor speed regulation is fairly poor. When the load speed increases then the machine speed will decrease
- When the speed is increased, then the DC series motor's torque will be decreased sharply.
- This motor always needs the load before running the motor. So, these motors are not suitable for where the motor's load is totally removed.

Simulation

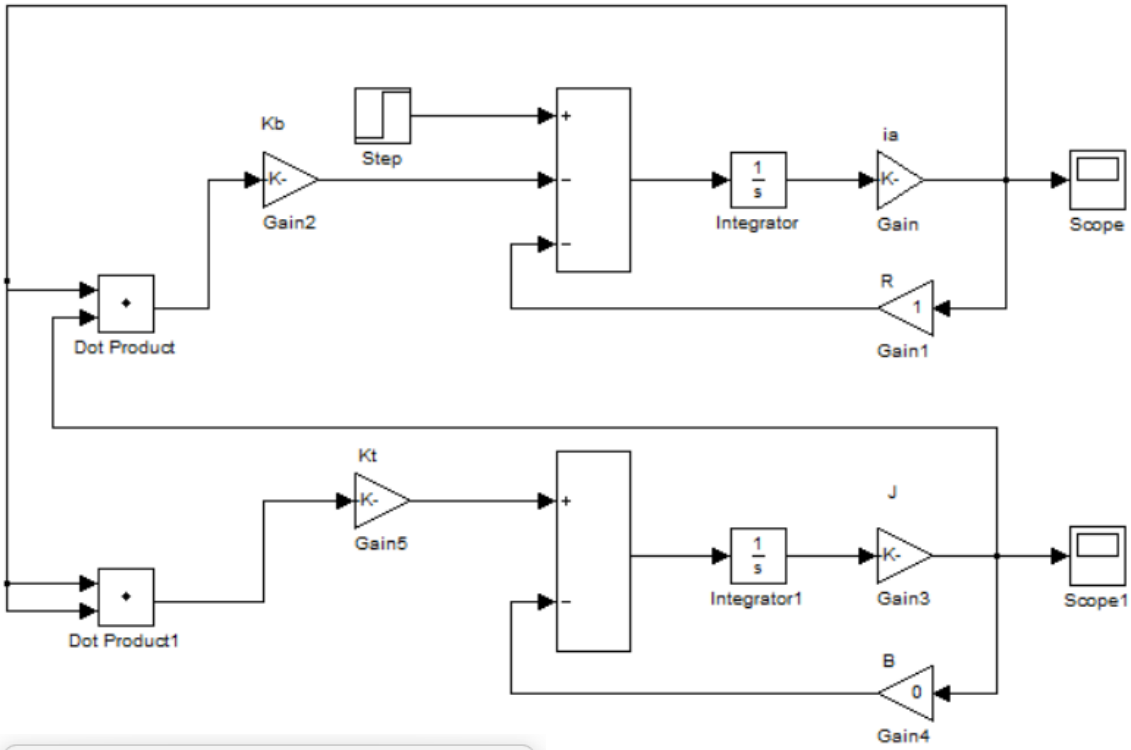
$i_a = \frac{1}{L_a + L_f} \int v_a - (R_a + R_f) i_a - K_b K_\varphi i_a \omega$ المعادلة الكهربائية

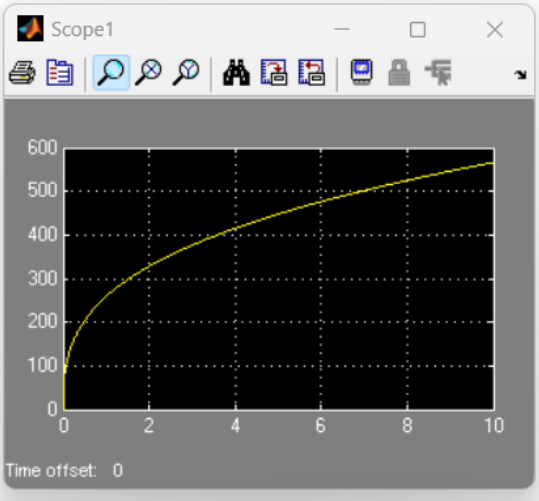
$\omega = \frac{1}{J} \int K_b K_\varphi i_a \text{^} 2 - B\omega$ المعادلة الميكانيكية

Motor Parameters		**Value**
Armature Resistance	Ra	1
Field Resistance	Rf	1
Armature Inductance	La	0.036
Field Inductance	Lf	0.036
Inertia	J	0.015
Friction	B	0
Back EMF constant	Kb	0.0063
Torque constant	Kt	0.0063

Sol:

Block	Parameters	Library
Step	Step time=0 Initial value=0 Final value=100	Math operations
Sum	List of signs=+--	Math operations
Sum1	List of signs=+-	Math operations
Gain	Gain=1/0.036	Math operations
Gain1	Gain=1	Math operations
Gain2	Gain=0.0063*16.667	Math operations
Gain3	Gain=1/0.015	Math operations
Gain4	Gain=0	Math operations
Gain5	Gain=0.0063*16.667	Math operations
Integrator	Initial condition=0	Continuous
Integrator1	Initial condition=0	Continuous
Dot Product		Math operations
Dot Product1		Math operations
Scope		Sinks
Scope1		Sinks


Kb
Gain2
Step
Integrator
ia
Gain
Scope
R
Gain1
Dot Product
Kt
Gain5
J
Integrator1
Gain3
Scope1
Dot Product1
B
Gain4


Scope1
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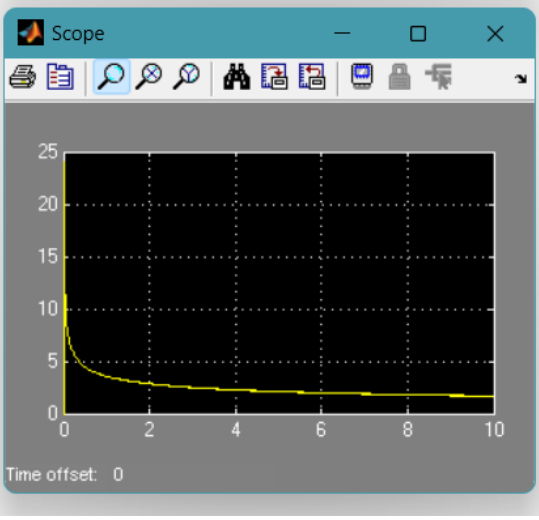
500
400
300
200
100
0
0
2
4
6
8
10
Time offset: 0


Scope
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20
15
10
5
0
0
2
4
6
8
10
Time offset: 0