EE 462-Utilization of Electrical Energy

Project #0 – Report

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1. Introduction

This Project aims to simulate the acceleration of DC motor with 175 (Hp) power. Rated armature voltage is 500V and rated field voltage is 300V. In order to prevent high starting currents, we will be applying gradually increasing armature voltage. We will observe increasing angular speed of the motor. Following formulas will be used to explain the motor's behavior.

$$Emf = K_e \omega$$

$$K_e = L_{af} I_f$$

$$T_e = K_T I_a$$

$$K_e = K_T$$

$$J \frac{d\omega}{dt} = T_e - T_L - B_m \omega - T_f$$

Parameters

Ra(ohm)=0.1009

La(H)=0.002293 Armature inductance

Rf(ohm)=40.36 Field resistance

Laf(H) =0.3459 Field-armature mutual inductance

Total Inertia(kgm^2) =0.7142 Total inertia of the motor

Bm (Nms)=0.01836 Viscous friction coefficient

Coulomb friction torque (Nm)=18.52

T_L (Nm)= 1200 Torque load

Theoretical Results

Ke(Nm/A) =2.5711 Back EMF constant

Emf (V): 452 Back electromotive force of the motor

Te (Nm)=1222 Electric torque generated by motor

w(RPM)=1800 Angular speed

I_f(A)= 7.43 Field current

I_A(A)= 475 Armature current

According to these results simulation outputs should verify these values.

2. Simulation

In simulation simscape tools have been used. DC machine block has been used to represent the DC motor. We will be directly providing 300V DC voltage to field terminals. In order not to let high currents at the beginning we will use a step by step incrementation in armature terminal voltage.

For all the simulation 1200 Nm input has been used to obtain rated angular speed at the output.

Outputs of the motor has been investigated via demux and scope blocks.

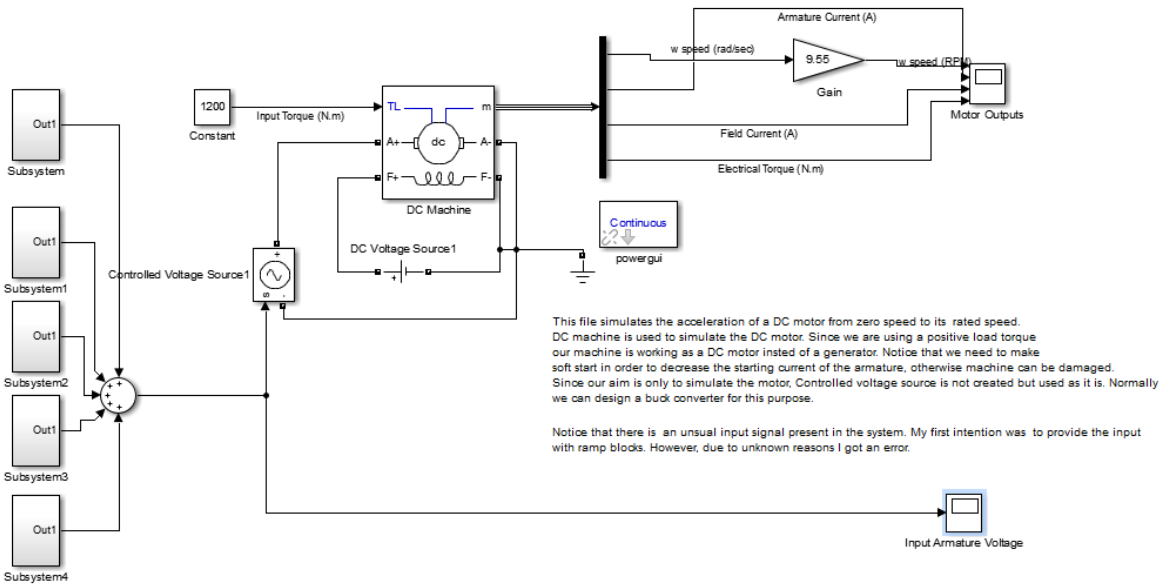

Figure 1: General Block Diagram of the Simulation

3. Inputs and Results

Field terminal voltage is set as 300V.

Armature terminal voltage is as in the following figure.

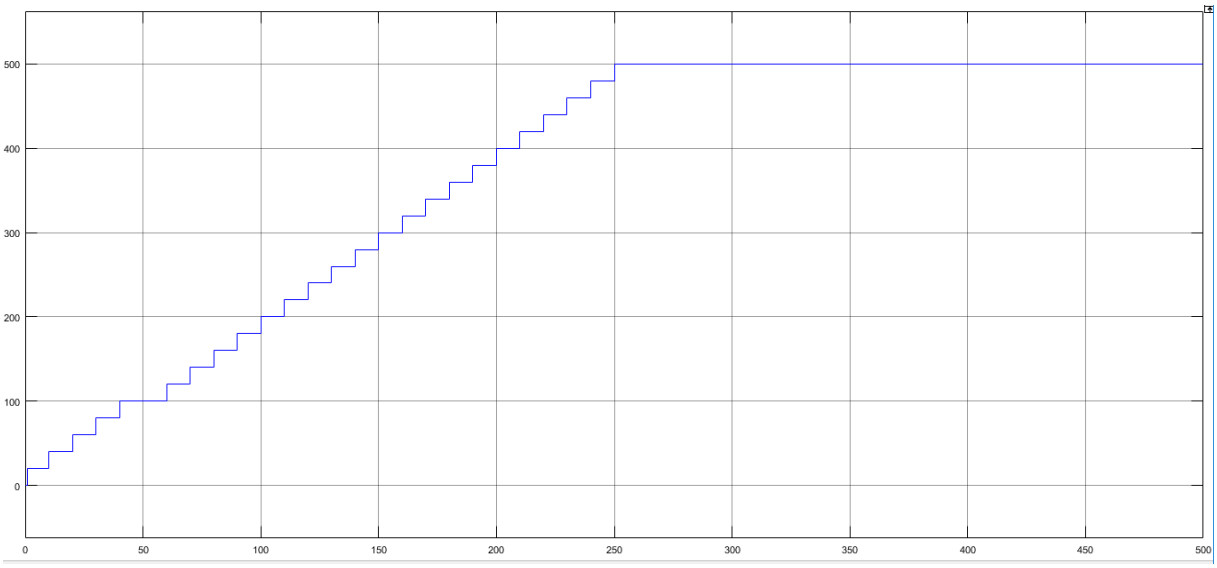

Figure 2: Armature Terminal Voltage vs Time Graph

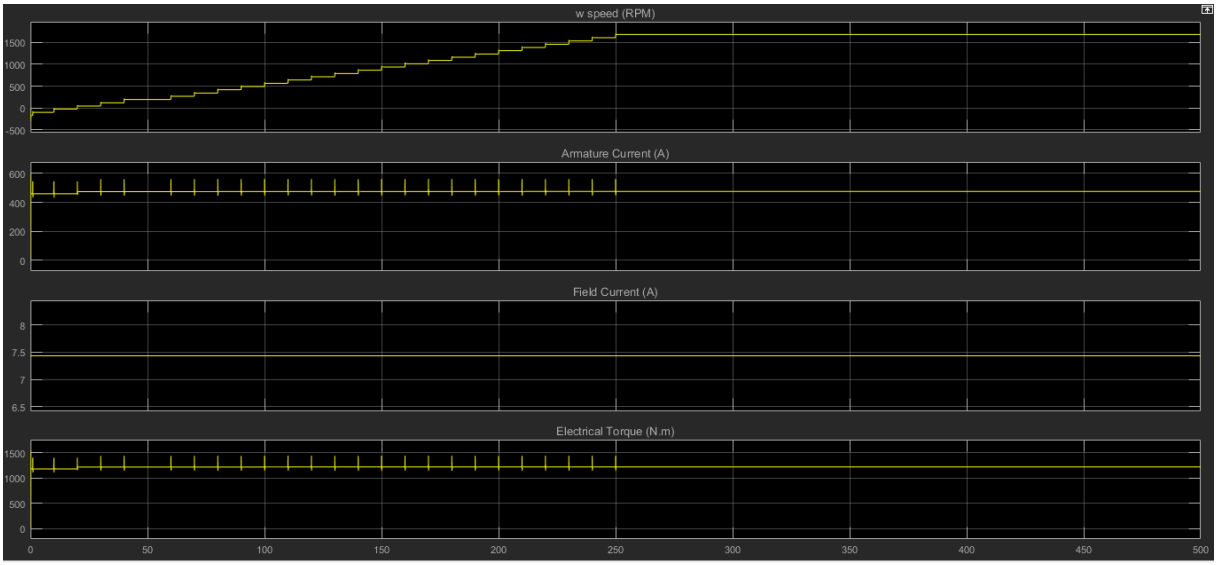

Figure 3: Angular Speed, Armature Current, Field Current, Electrical Torque vs Time Graphs

The theoretical results mentioned above were verified by the simulation.

w= 1679 RPM

I_a= 475 A

T_e= 1222 Nm

I_f=7.4 A

4. Conclusion

Theoretical expectations and simulation results are the same. Therefore, Matlab simulink has successfully simulated the behavior of the DC motor.

5. Bibliography

- MATLAB Help Documents
- *Mohan, N. (2011).* First course on power electronics*. Hoboken, NJ: Wiley.*