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A Series of Module has been designed and developed by author mentioned above with full copyright for a course of **Control System** to demonstrante the concept of control system and its implementation in real life to second year Aerospace engineering students at Tribhuwan University.

MODULE 3: Modelling of System By Simulink

The first step in the control design process is to develop appropriate mathematical models of the system to be controlled. It can be achieved in MATLAB by Simulink.

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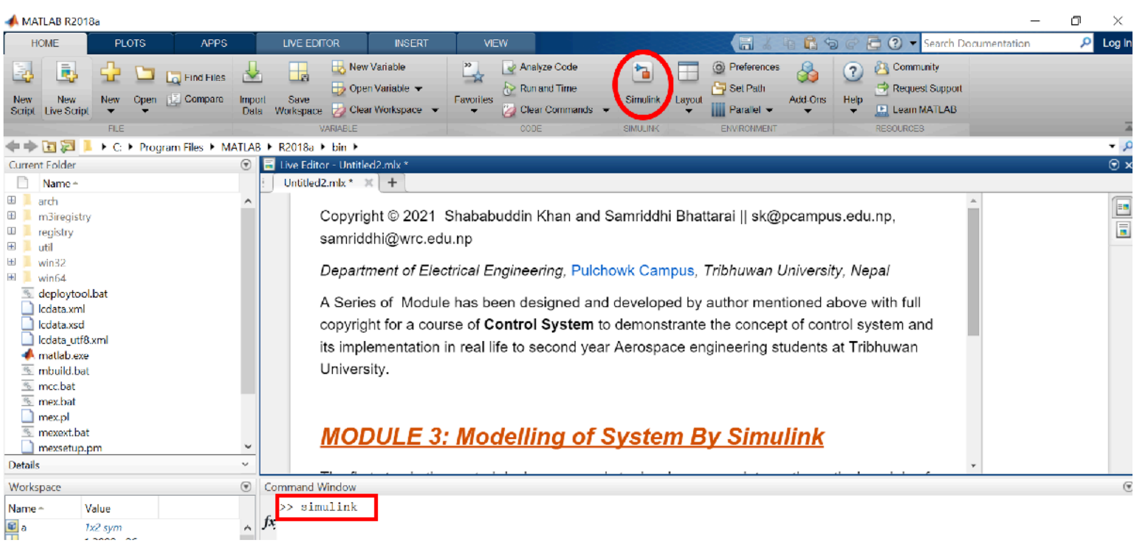
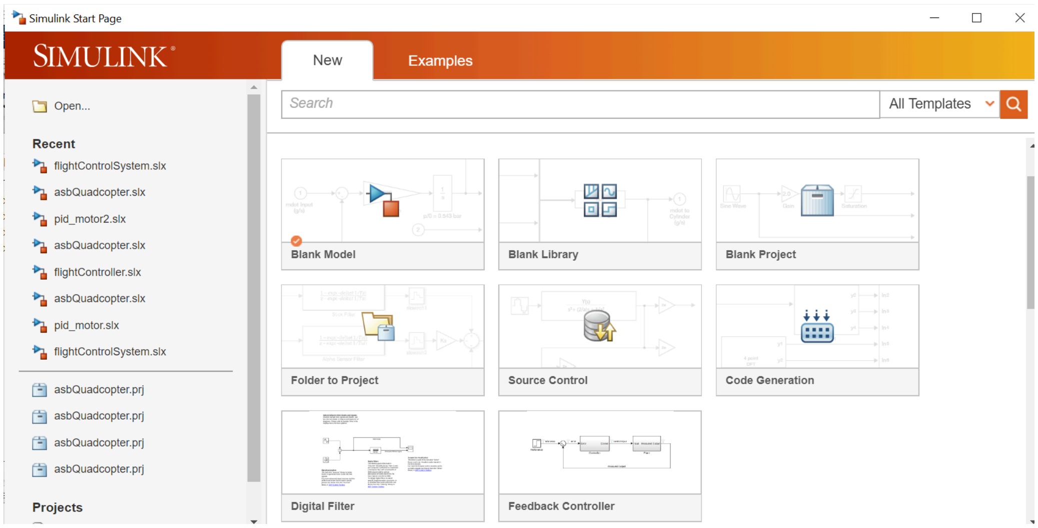
3.1 Understanding the Environment

3.1.1 Opening Simulink

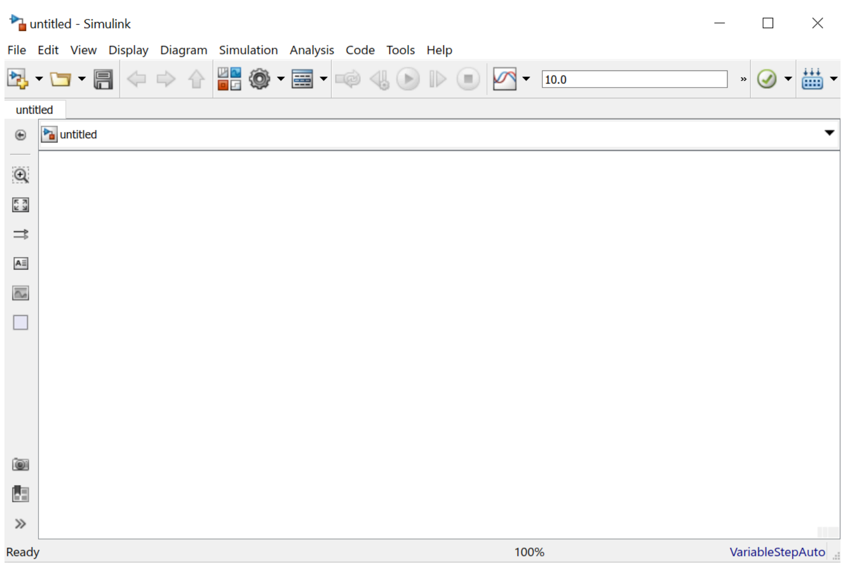


```
% Opening a Simulink by Script
simulink
```

3.1.2 Simulink Start Page

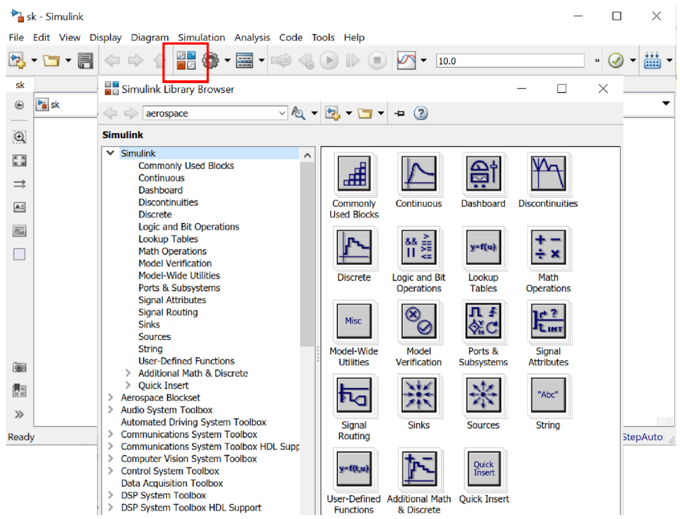


3.1.3 Simulink Workplace




```
% Can Create a new simulink file by script
%new_system('sk');
% Open New Created Simulink File By Script
open_system('sk')
```

3.1.4 Simulink Library Browser



3.2 Modelling of Armature Ccontrolled DC Motor By Simulink Elements

```
% Parameters of DC Motor
J = 3.2284E-6;
b = 3.5077E-6;
Kt = 0.0274;
Ke = 0.0274;
R = 4;
L = 2.75E-6;
```

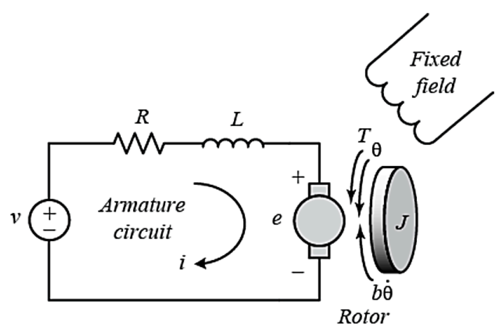


Fig: Equivalent DC Motor

For Armature Control,

In Electrical Circuit,

$$v = R\,i + L\,\frac{\mathrm{di}}{\mathrm{dt}} + e$$

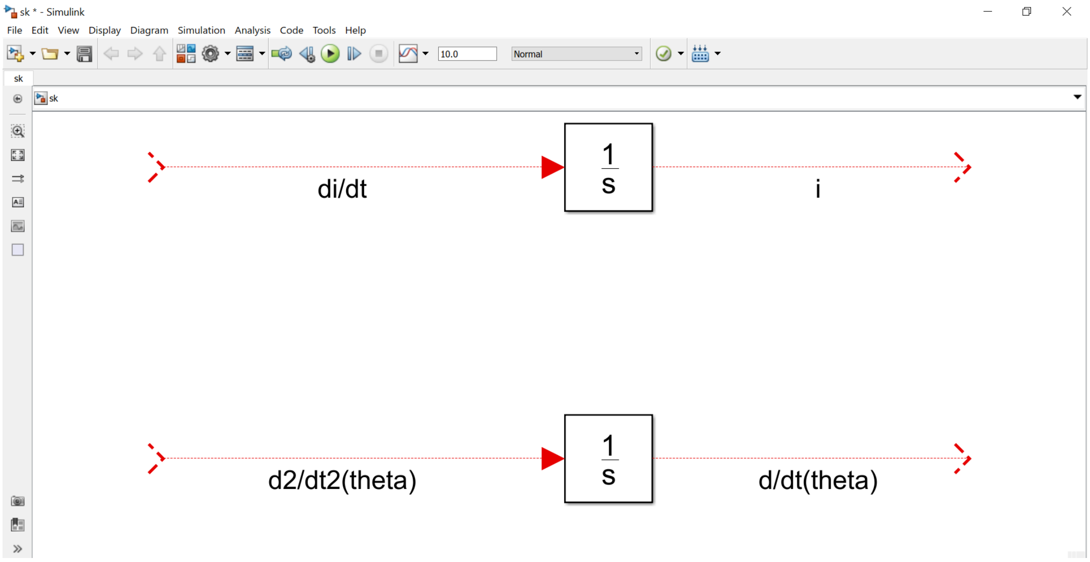
$$\frac{\mathrm{di}}{\mathrm{dt}} = \frac{1}{L}\left[v - R\,i - e\right] = \frac{1}{L}\left[v - R\,i - K_e\frac{d\theta}{\mathrm{dt}}\right]$$

In Rotational Part,

$$T = J\,\frac{d^2\theta}{\mathrm{dt}^2} + b\,\frac{d\theta}{\mathrm{dt}}$$

$$\frac{d^2\theta}{\mathrm{dt}^2} = \frac{1}{J}\left[T - b\,\frac{d\theta}{\mathrm{dt}}\right] = \frac{1}{J}\left[K_t\,i - b\,\frac{d\theta}{\mathrm{dt}}\right]$$

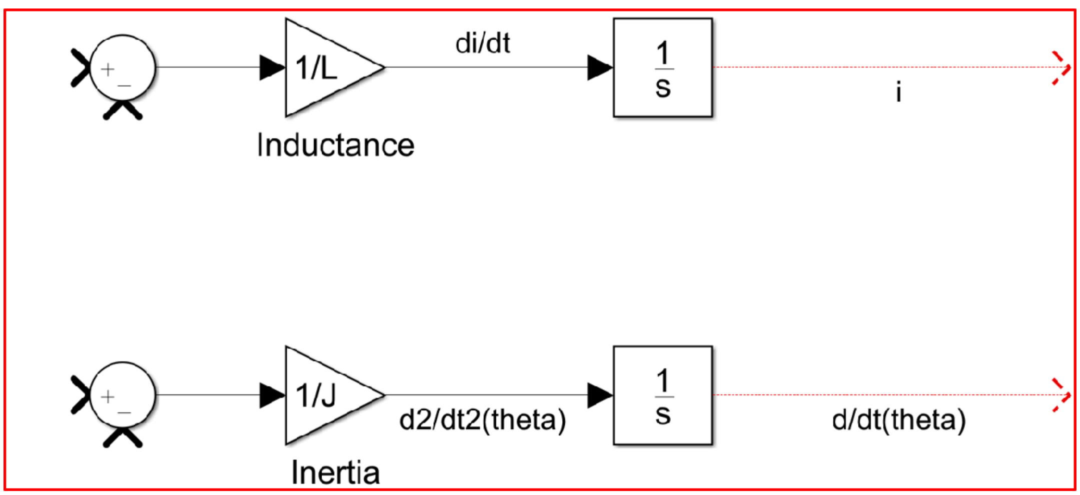
Find Input parameters from Output



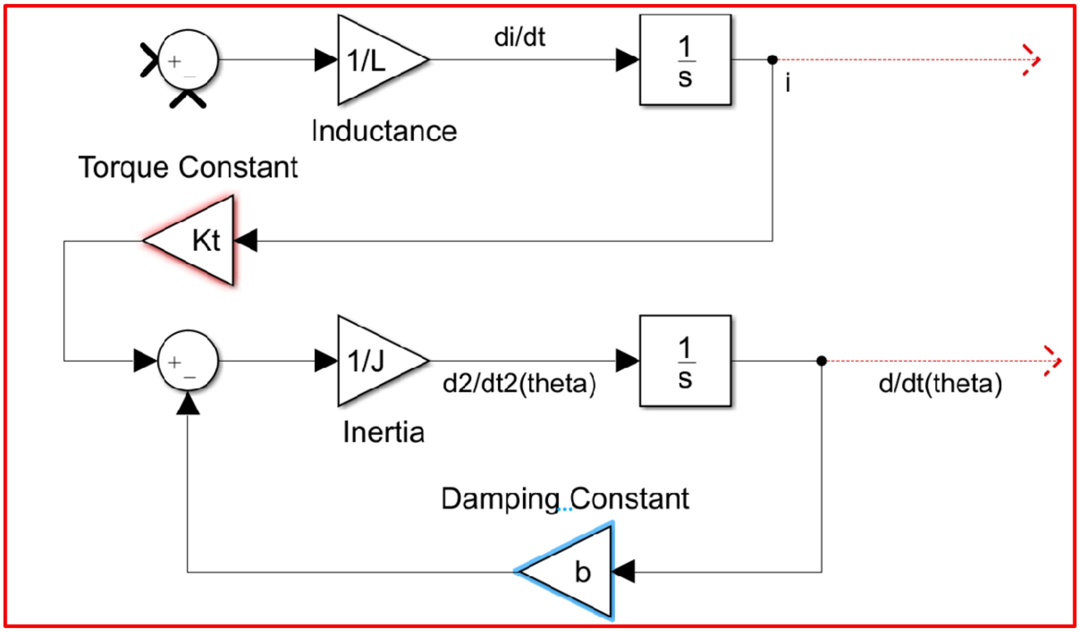
Proceed Stepwise to get the output

$$\frac{\mathrm{di}}{\mathrm{dt}} = \frac{1}{L}\left[v - R\,i - K_e\frac{d\theta}{\mathrm{dt}}\right]$$

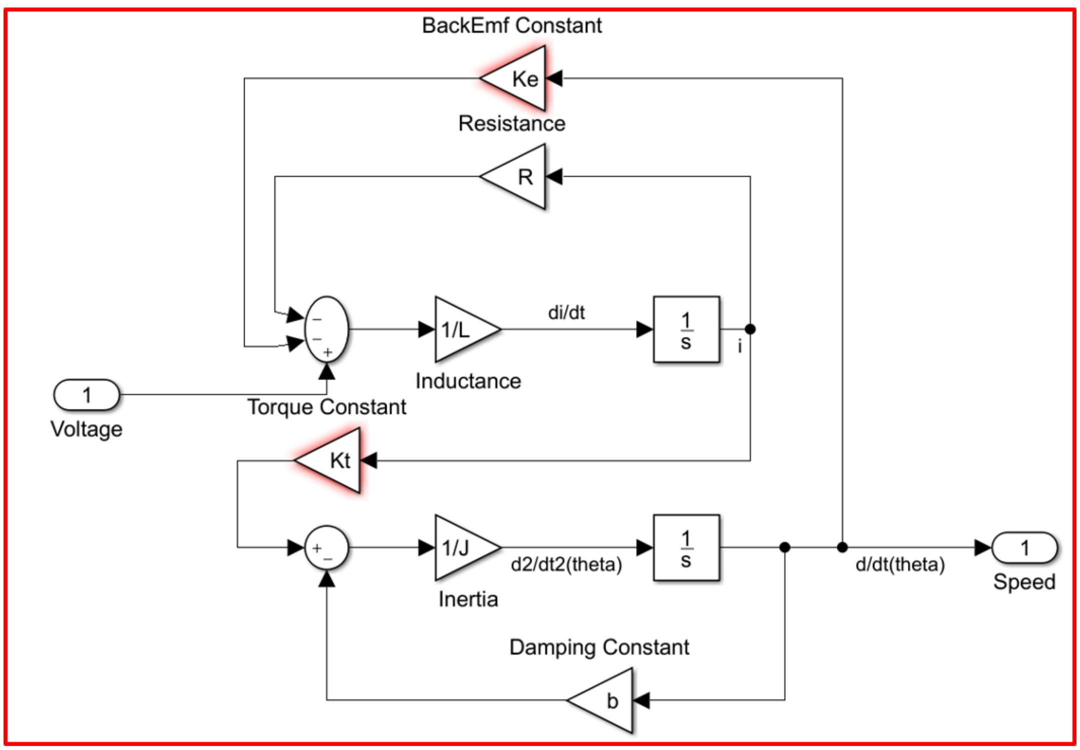
$$\frac{d^2\theta}{\mathrm{dt}^2} = \frac{1}{J}\left[K_t\,i - b\,\frac{d\theta}{\mathrm{dt}}\right]$$



$$\frac{d^2\theta}{\mathrm{dt}^2} = \frac{1}{J}\left[K_t\,i - b\,\frac{d\theta}{\mathrm{dt}}\right]$$



$$\frac{di}{dt} = \frac{1}{L}\left[v - R\,i - K_e\frac{d\theta}{dt}\right]$$



<u>Select all the intermediate element and make subsystem</u>

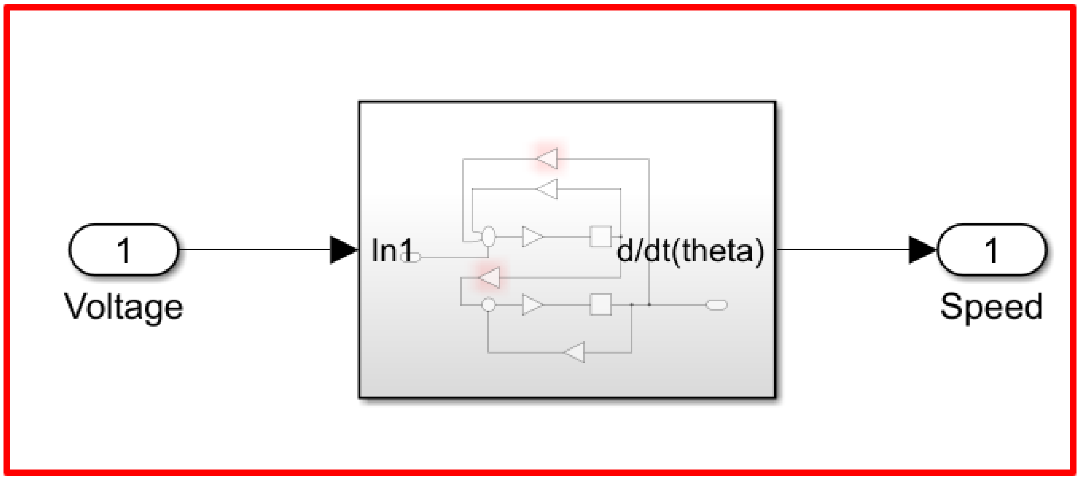


Fig: Model of Speed Control of DC Motor in Simulink

3.3 Modelling of Armature Controlled DC Motor By Simulink Transfer System Block

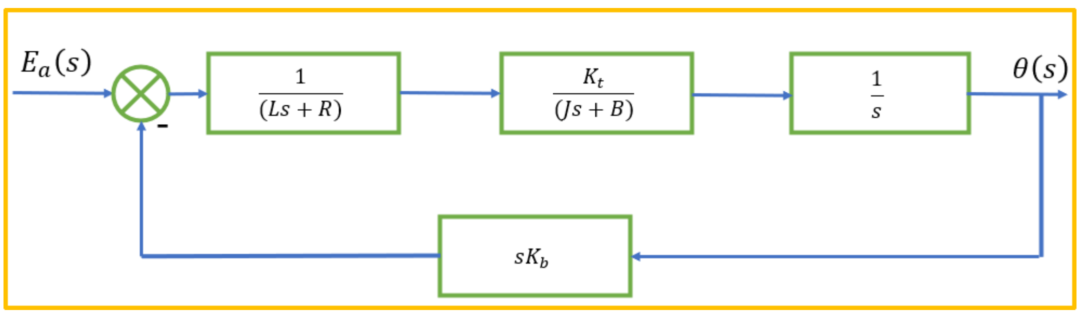


Fig: Mathematical Model of Armature Control of DC Motor [Position Control]

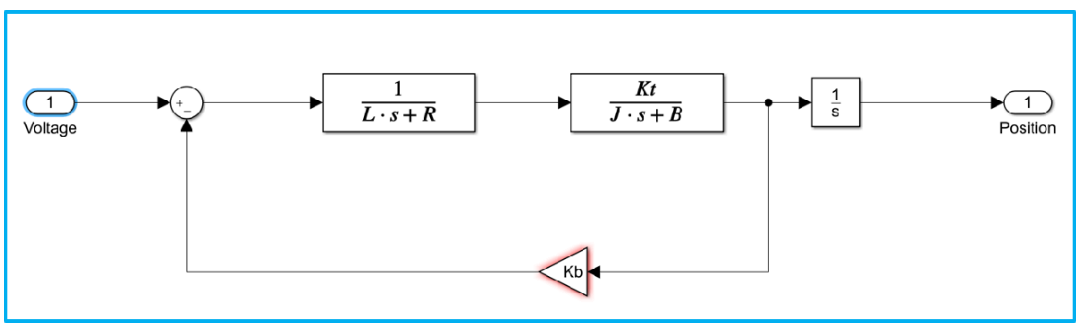


Fig: Simulink Model of Position Control of DC Motor

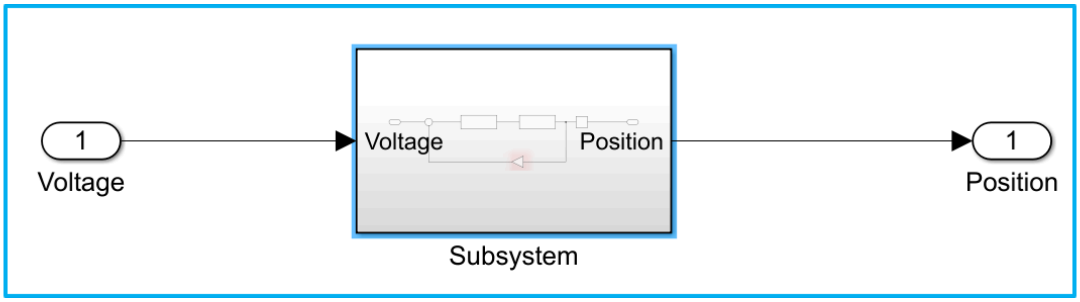


Fig: Subsystem of Simulink Model of Position Control of DC Motor

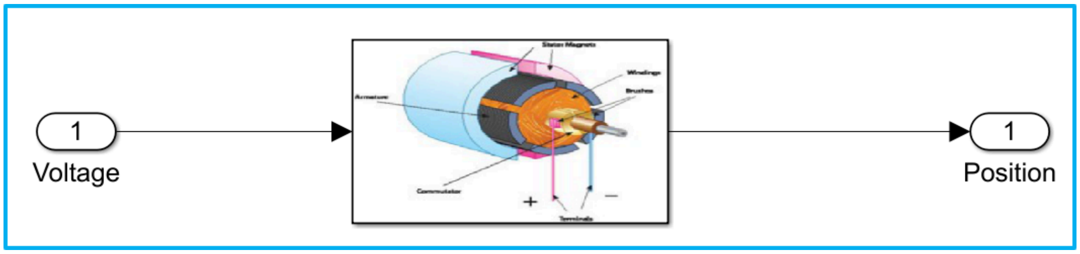


Fig: Adding an Icon to the Subsystem

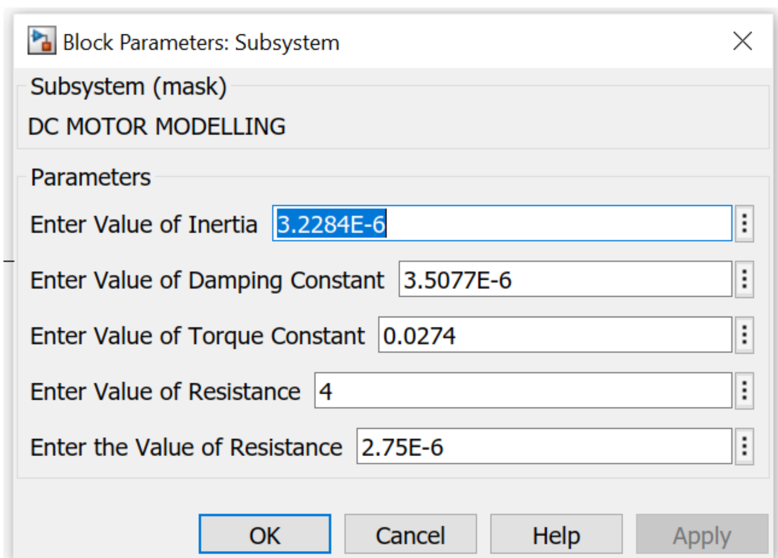


Fig: Parameters Input to the system by Masking

References

1. Mathworks.inc
2. https://ctms.engin.umich.edu/CTMS/index.php?aux=Home
3. Bakshi, Uday A., and Varsha U. Bakshi. *Control system engineering*. Technical Publications, 2020.
4. Nise, Norman S. "Control system engineering, John Wiley & Sons." *Inc, New York*(2011).