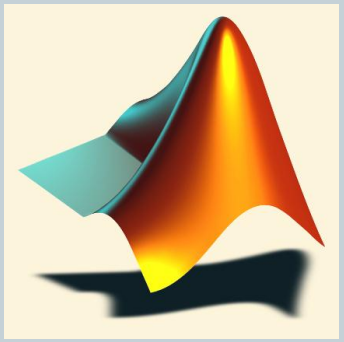
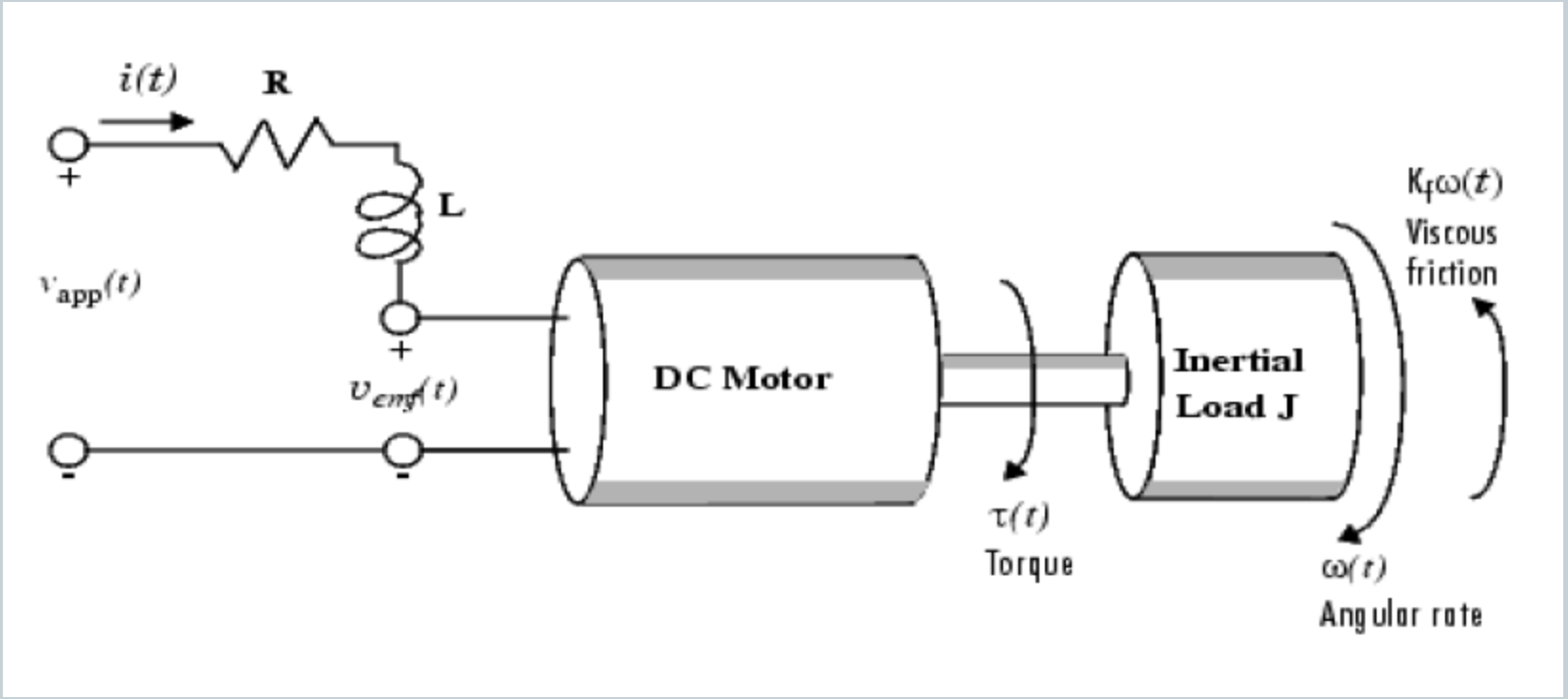
Lecture Series – 11

DC Motor Modeling Using SIMULINK



Shameer Koya

DC Motor Dynamic Model



Dynamic Equations

- The motor torque, T, is related to the armature current, i, by:

$$T = Ki$$

- The back emf, Eb, is related to the angular velocity by:

$$V_b = K\omega$$

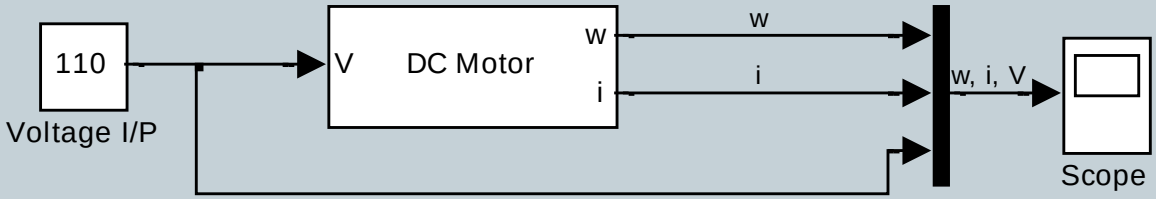
- The dynamic equations for electrical and mechanical balance from Kirchhoff's law and Newton's law are

$$\frac{di}{dt} = \frac{V_{app}}{L} - \frac{R}{L}i - \frac{K_\Phi}{L}\omega$$

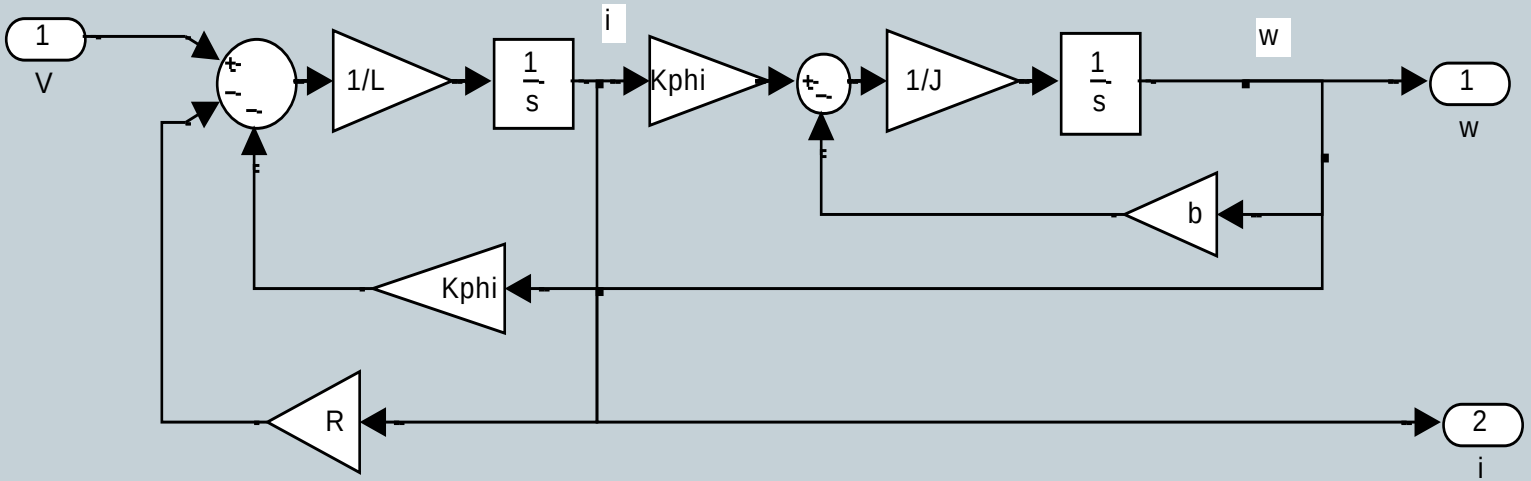
$$\frac{d\omega}{dt} = \frac{K_\Phi}{J}i - \frac{b}{J}\omega$$

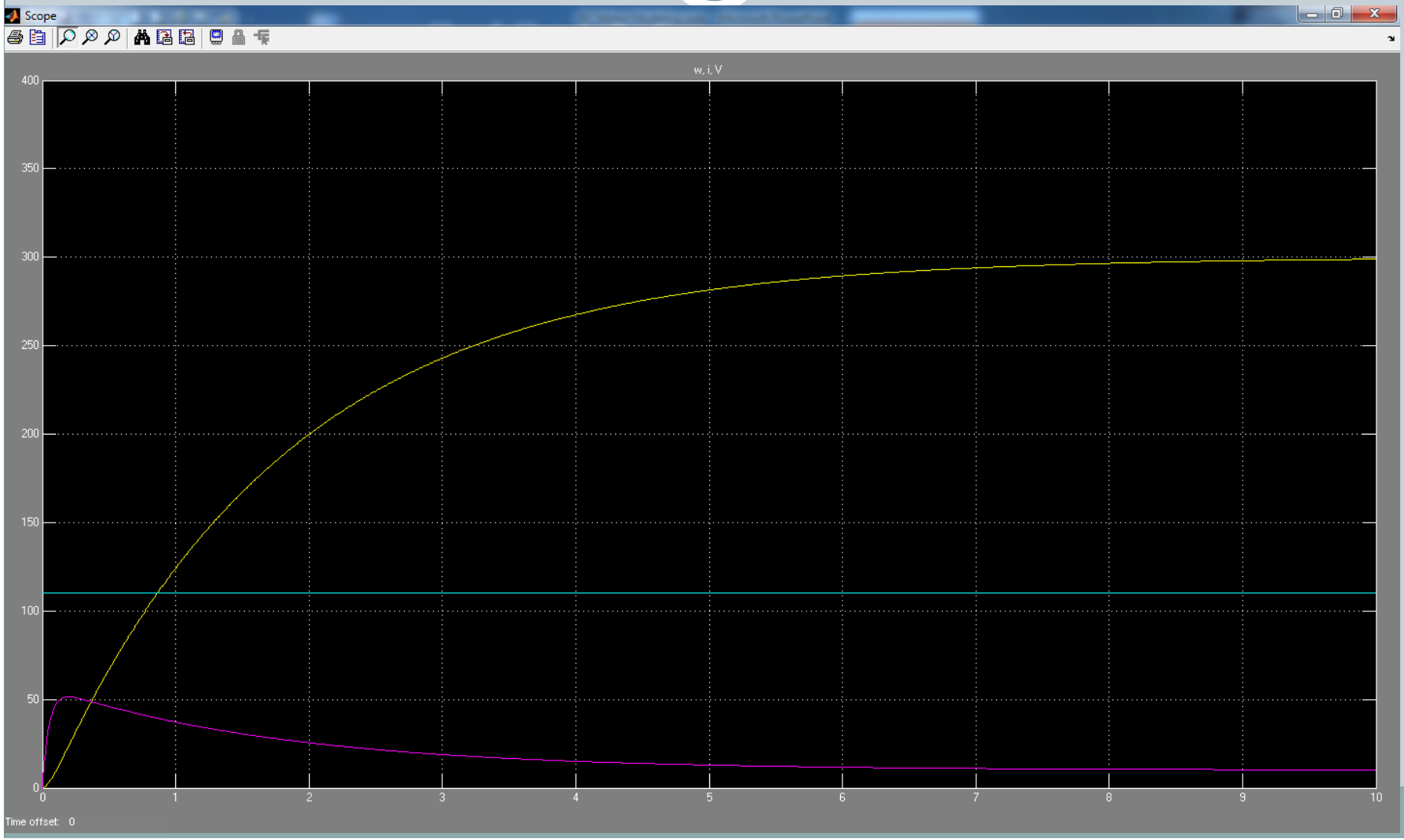
Where:

b	➔viscous friction
J	➔moment of inertia for the motor load
Kφ	➔armature or emf constant



DC Motor model




Scope
w, i, V
400
350
300
250
200
150
100
50
0
0
1
2
3
4
5
6
7
8
9
10
Time offset: 0

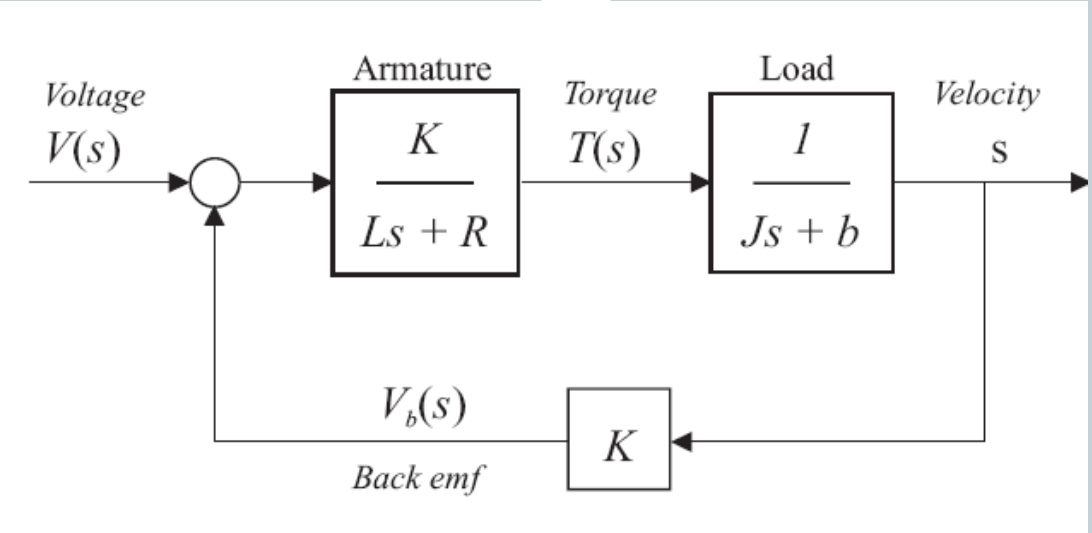
Transfer Function Model

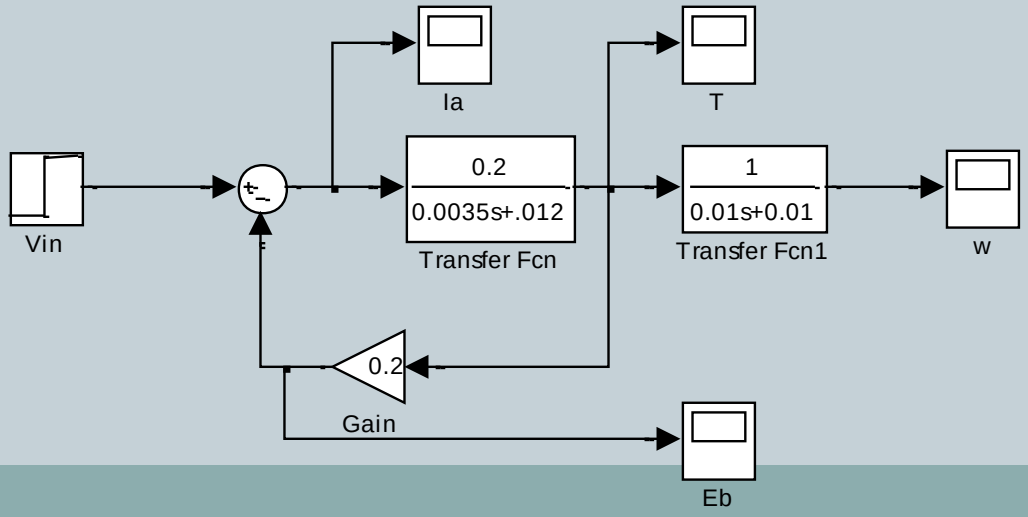
$$\begin{aligned} J\frac{d^2\theta}{dt^2} + b\frac{d\theta}{dt} &= Ki, \\ L\frac{di}{dt} + Ri &= V - K\frac{d\theta}{dt}. \end{aligned}$$

$$\begin{aligned} Js^2\theta(s) + bs\theta(s) &= KI(s), \\ LsI(s) + RI(s) &= V(s) - Ks\theta(s), \end{aligned}$$

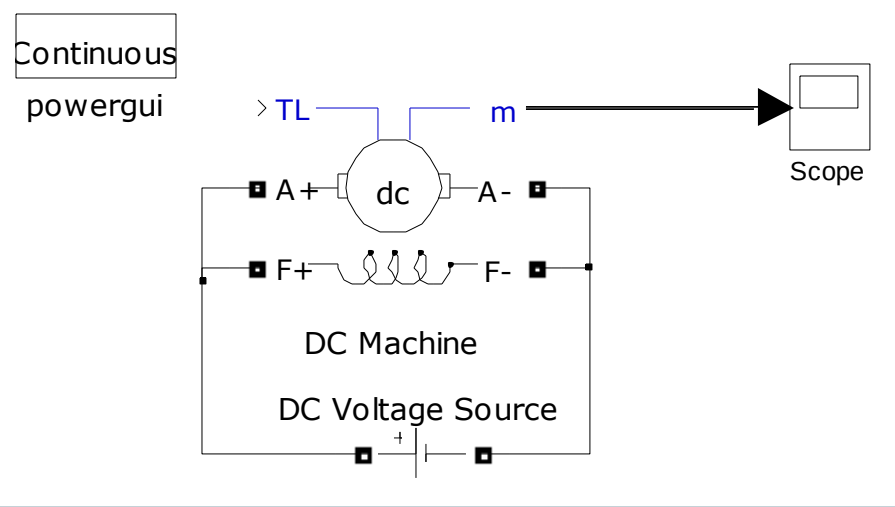
$$I(s) = \frac{V(s) - Ks\theta(s)}{R + Ls},$$

$$Js^2\theta(s) + bs\theta(s) = K\frac{V(s) - Ks\theta(s)}{R + Ls}.$$


Armature
Load
Voltage
V(s)
K
Ls + R
Torque
T(s)
1
Js + b
Velocity
s
$V_b(s)$
Back emf
K


Ia
T
Vin
0.2
0.0035s+.012
Transfer Fcn
1
0.01s+0.01
Transfer Fcn1
w
0.2
Gain
Eb

Simpowersystem model



- http://www.youtube.com/watch?v=5eC3kf8-k10

Thanks

Questions ??