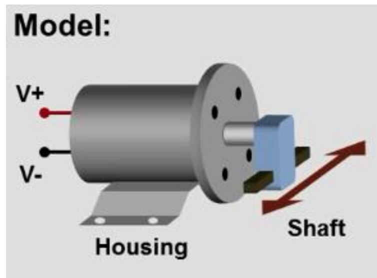
Lab # 08

Designing DC Motor in Simulink

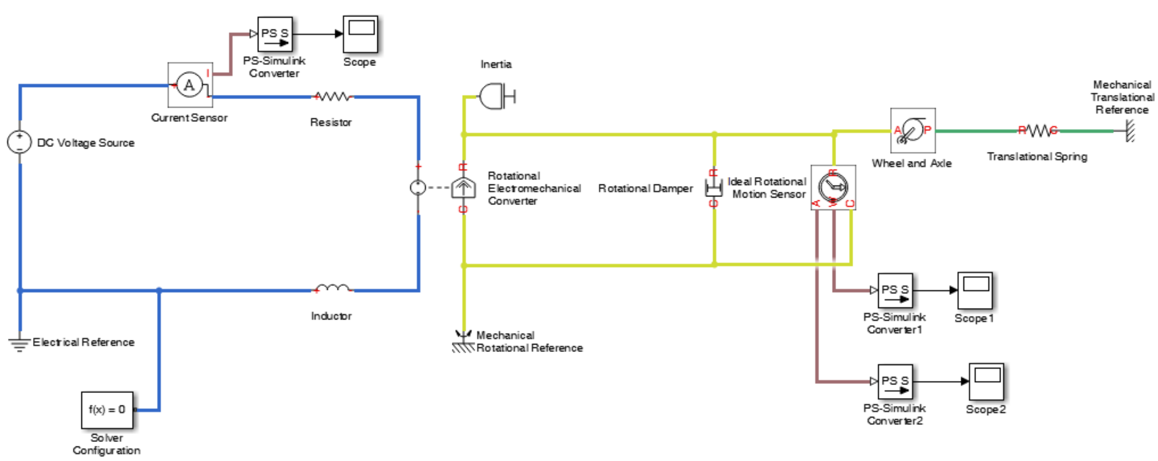
Aim:

In this lab we will see how to model a DC motor using a physical modeling method. The system which we want to model looks like that



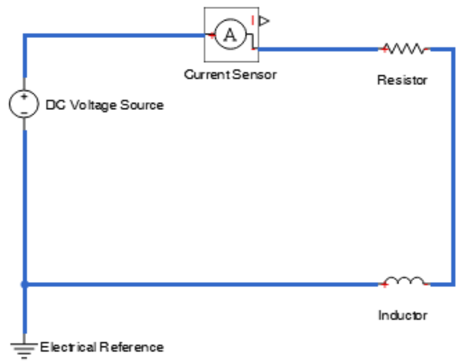
Procedure:

We have a DC motor with electrical inputs that is connected to a companion to produce translational motion. We want to model this with a physical modeling approach. To do this we use simscape. The model which we will build look like this

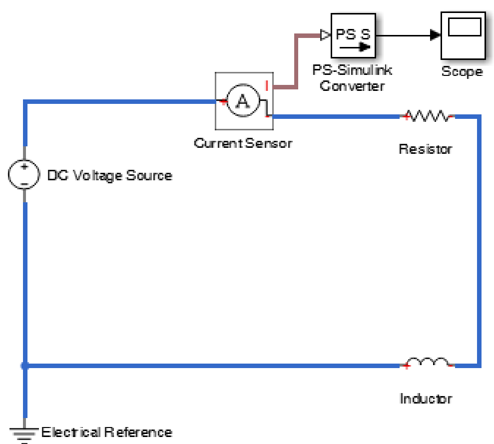


We see that electrical and mechanical components are connected using physical connections. And we will see when we run the simulation the results of mechanical and electrical portion of our systems. Now to see how it is done.

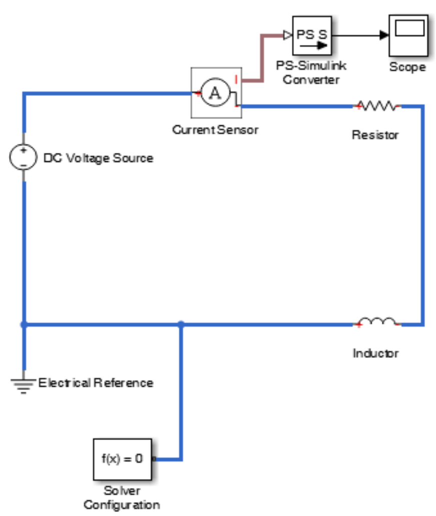
We want to build a DC motor. First we need DC voltage source. We will get it from Electrical source library. Next we need some more electrical components. That is to take resistor, an inductor and an electrical reference and connect them using physical connections. These physical connections represent ideal electrical connections between the electrical components. We want to measure current from our circuit during our simulation so we use a current sensor.



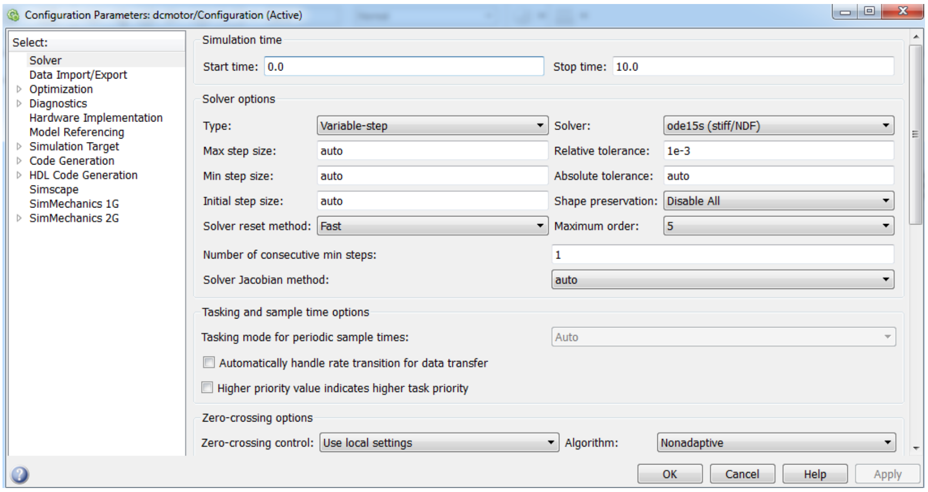
Scope is used to view our simulation results. The output of the current sensor is a physical signal. The physical signal is the unit associated with it. We use the converter block in order to assign the unit of Ampere to the signal that we want to view. We connect this to the sensor block and then to the scope.



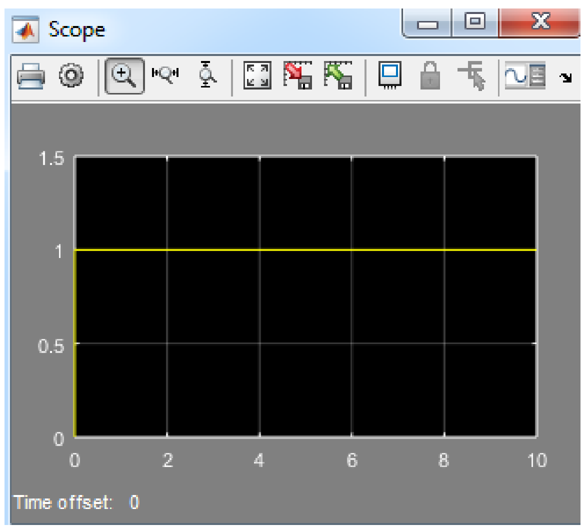
Simscape use solver technology above and beyond and available in normal Simulink to have an access to important settings we use the solver configuration block.



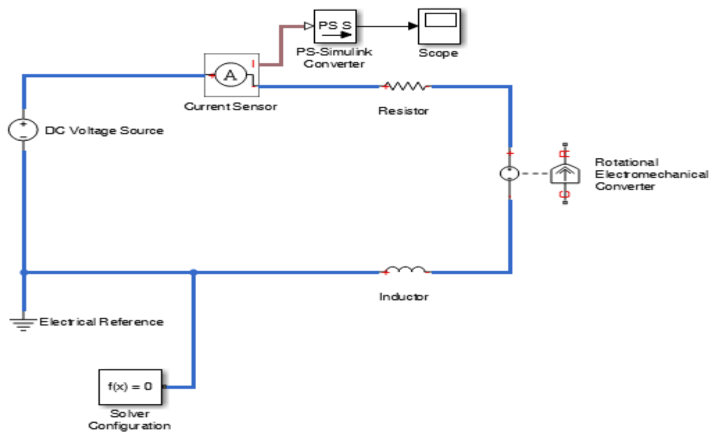
Finally we use a Simulink solver that is recommended for the physical system. We use ode 15s.



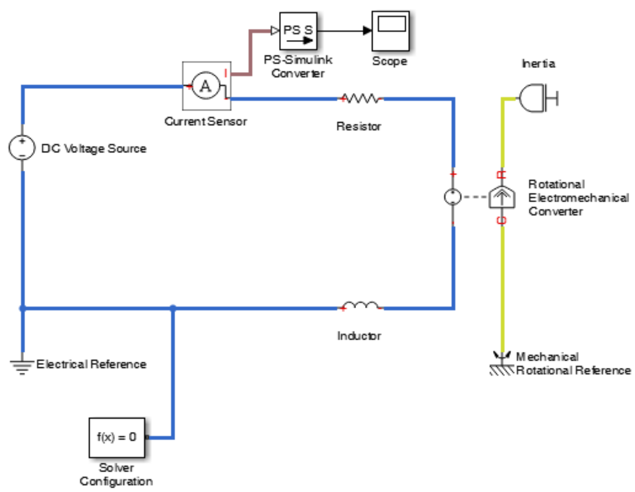
At this point run the simulation and see the current produced. We notice that the current remains 1 Amps.



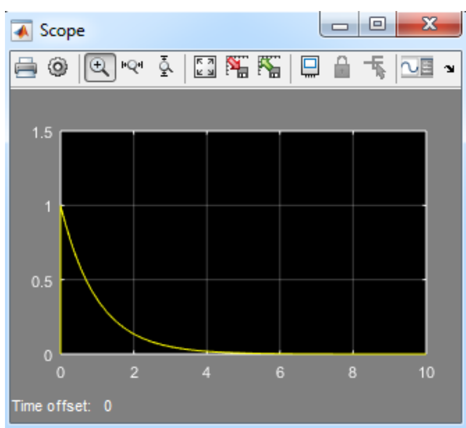
Next we model the mechanical portion of the system. To convert power to mechanical power we need the rotational electromechanical converter. This block allows exchanging power between electrical and mechanical portion of our system. It has two electrical ports and two mechanical ports.



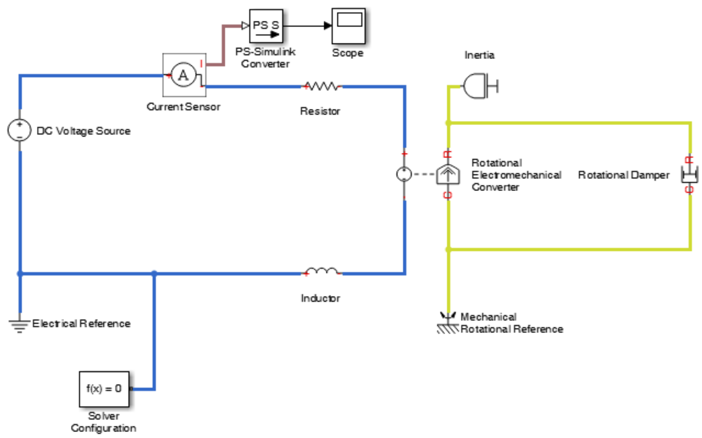
The mechanical portion represents the shaft of the motor. We go to the mechanical rotational elements and pick the inertia block. Rotate it and connect it. The lower part represents the housing of the motor and we know the housing does not move so we connect it to the mechanical rotational reference block.



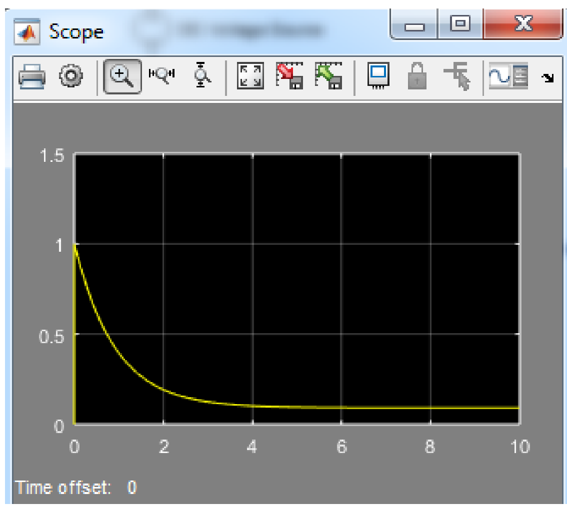
Now we run the simulation and see what effect will produce by these components. We see that the current slowly drops as the motor comes up to speed.



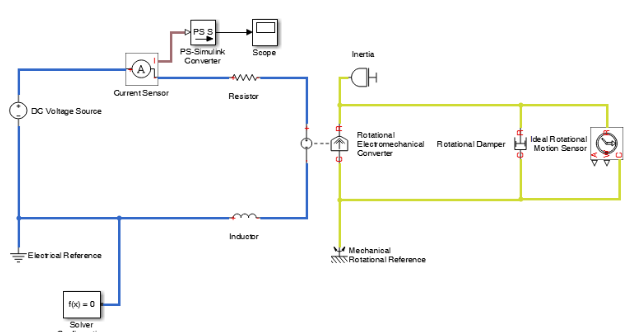
Now we want to add some damper to our motor so we add rotational damper block and connect it here as shown.



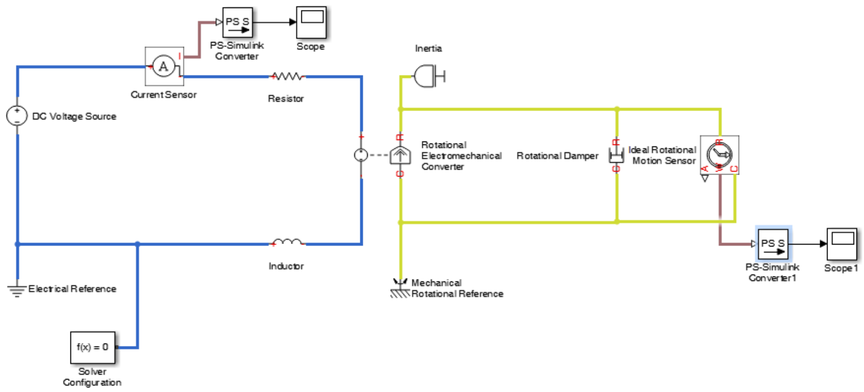
Now we re-run the simulation and see what effect will produce by it? We notice that the motor reaches to a different final speed.

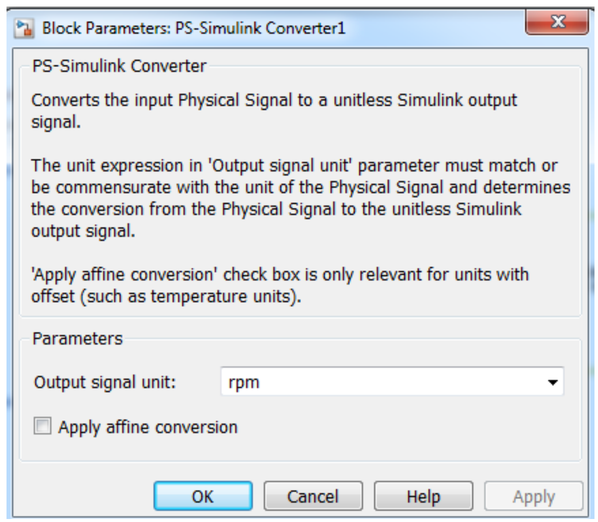


Now to measure the speed of the motor we go to the mechanical sensor and then pick up the rotational motion sensor and connect one end to the shaft and we measure the speed of the shaft with respect to the housing of the shaft as shown.

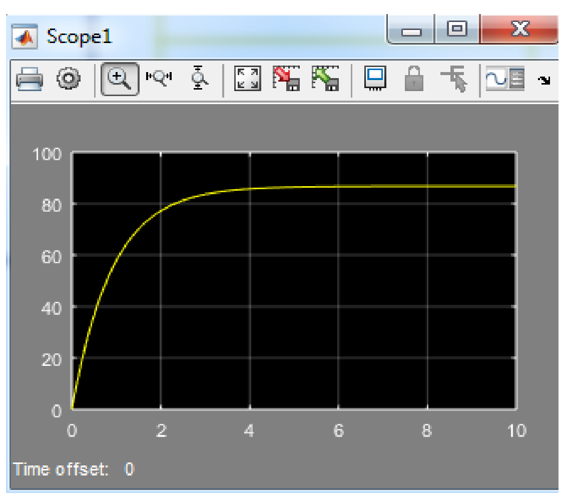


Copy the converter block to view the result on the Simulink scope. We connect it to the speed port and assign the output signal unit to the rpm.

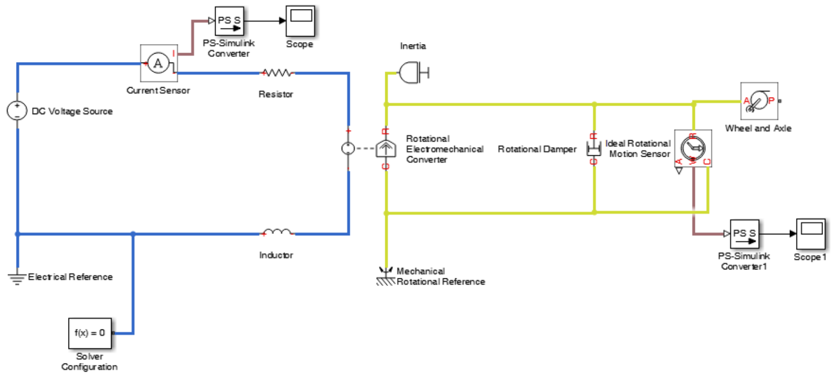




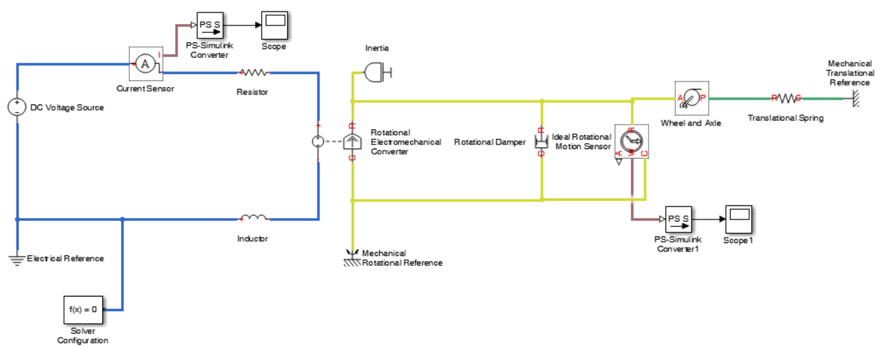
Now run the simulation. We see that the speed of the motor reaches to the final speed after about 6 seconds.



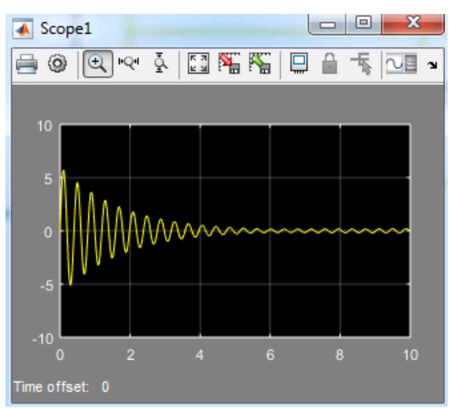
Our motor needs to produce translation motion to do this go to the mechanism library and pick wheel and axel block. This will take the rotational motion of the block and convert it to the translation motion.



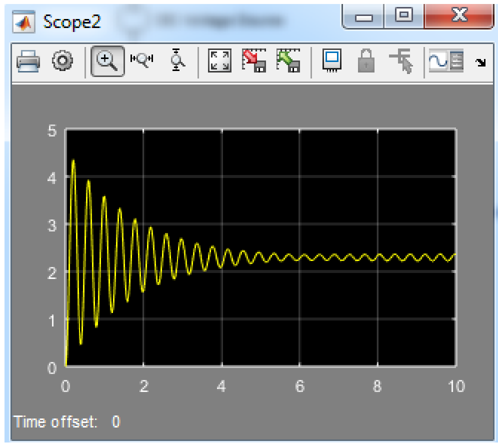
For load we will take the translation spring. This spring need to attach to the ground. Go to the translational element and pick the translational mechanical reference and connect to the other end of the spring.



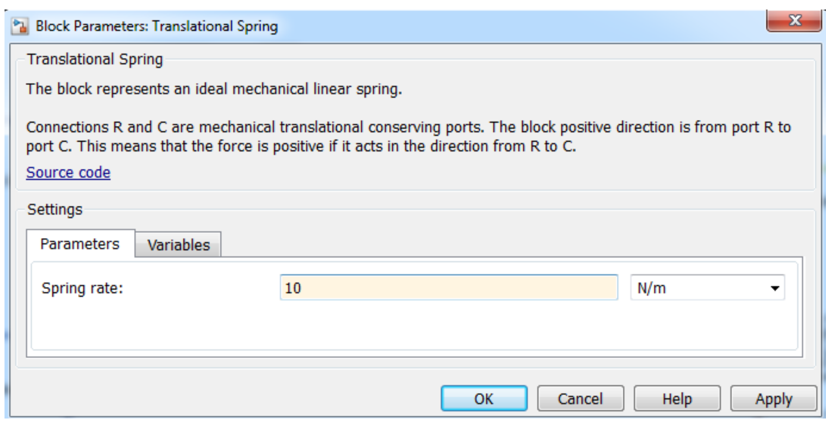
Run the simulation we will notice that the speed of the motor oscillates as the motor tempts to acts against the spring.

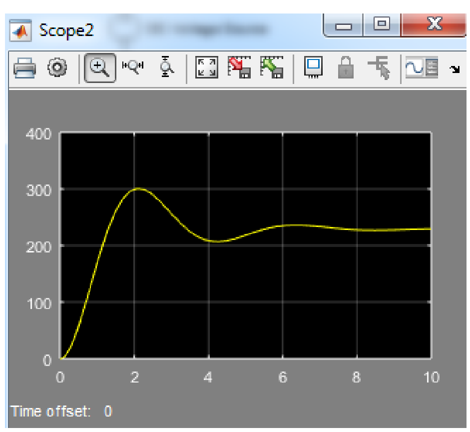


Now to see the angle the converter pin is change to the A port and change the output signal to deg. It will display it in degrees. Now run the simulation. Again the motor acts against the spring and we see the oscillation.



If we weakens the spring by double clicking on the spring and change the spring rate to 10 N/m and run the simulation we see that it will very quickly reaches to its final value which is somewhat less then rotation and less than 360^0.





Lab Task:

a) Why we are using PS-Simulink Converter?

b) Briefly explain the need of solver configuration.

c) Why we are using rotational electromechanical converter in our system?

d) Explain the function of wheel and axle block.

e) How we can measure the speed of the motor?

Marks Obtained: ……………………….

Remarks: ……………………