ABDULLAH GÜL
UNIVERSITY

Electrical & Electronics Engineering Department

Control & Embedded Systems

Laboratory Report

Mucahit Demirci

110110177

OBJECTIVE & BACKGROUND

In this assignment, as a main goal, we are expected to analyze and learn the implementation of the first order transfer functions, learning model validation which is the task of investigation of the data-generating process in control systems. Moreover, we are also expected to understand the fundamentals of the bump test which is essential to observe the cause-and-effect relationship in a control system loop through designed DC Motor model.

PROCEDURE

Bump Test

It is a test-based method to analyze the step response of a stable system. In this experiment, system is given to a step input. Next, the response is plotted on a graph shown below.
Figure 1 is generated by using transfer function with $K = 24$ rad/V.s and $\tau = 0.22$ s.

Model Validation

In this part, main goal, we learned model validation explained in the background through analyzing actual open-loop process. Model validation and measured response are shown on the same scope. The match percentage is higher than +90%. In the signal generation part, to obtain these graph responses, Amplitude (V) is set to 2.0, Frequency (Hz) is set to 0.40, and Offset value set to 3V.

RESULTS

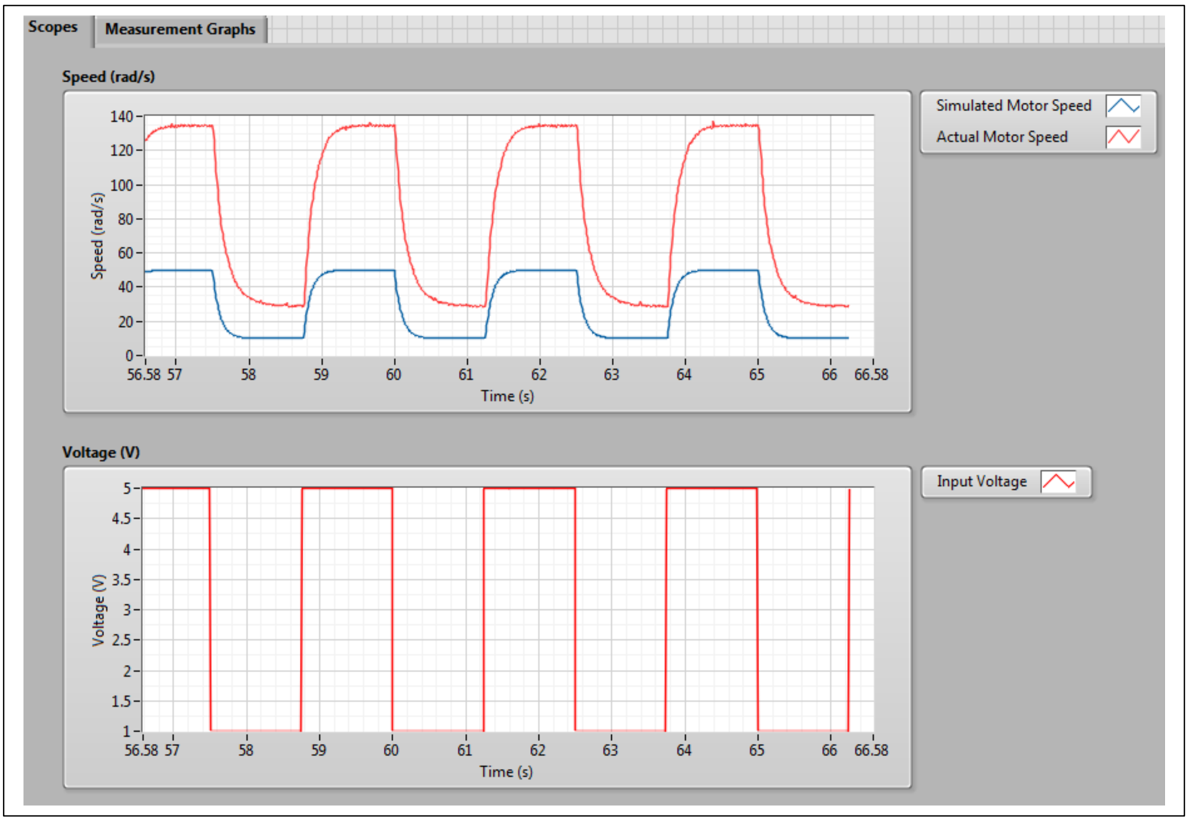


Figure 1 Responses in the Speed (rad/s) and Voltage (V) graphs

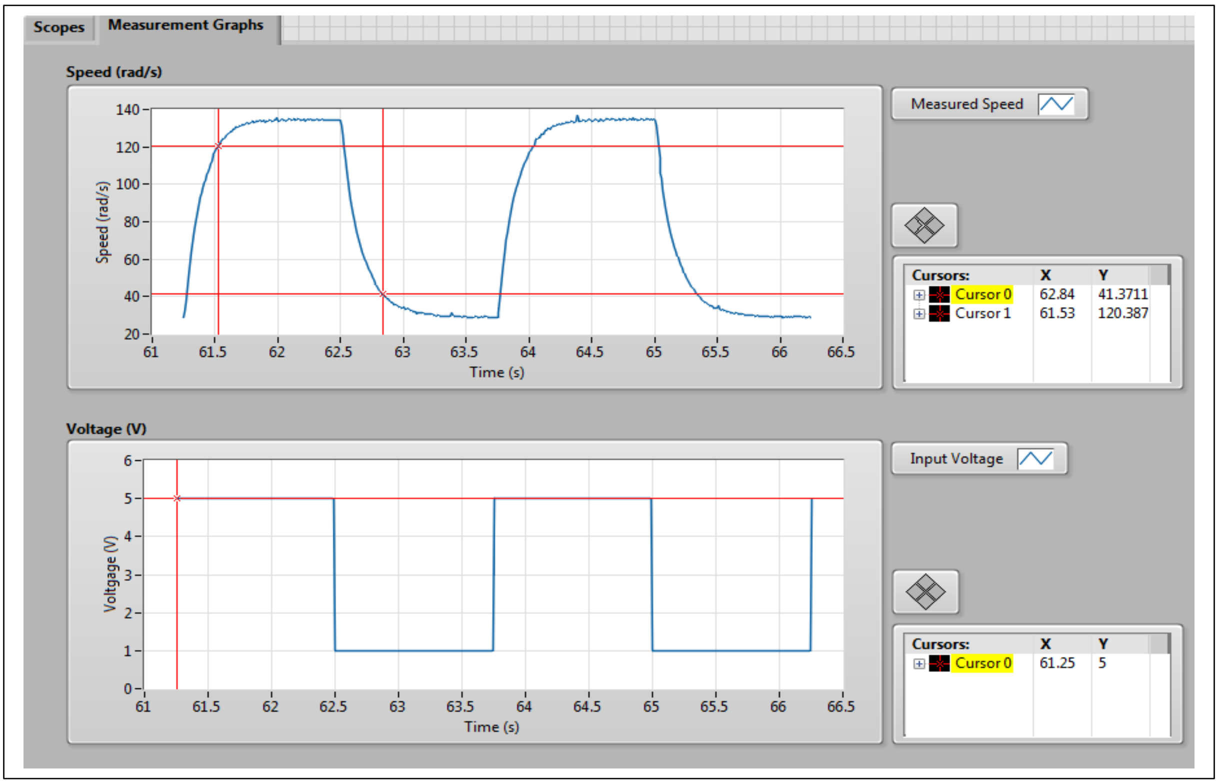


Figure 2 DC Motor Modeling. Sample response in Measurement Graphs

Description	Symbol	Value	Unit
Section2.1 Bumptest Modeling			
Motor Steady-state gain	$K_{e,b}$	24	Rad/s
Motor Time Constant	τ	0.22	s
Section 2.2 Motor Validation			
Motor Steady-state Gain	$K_{e,b}$	27	Rad/s
Motor time constant	τ	0.25	s

Table 1: DC Motor Modelling Results

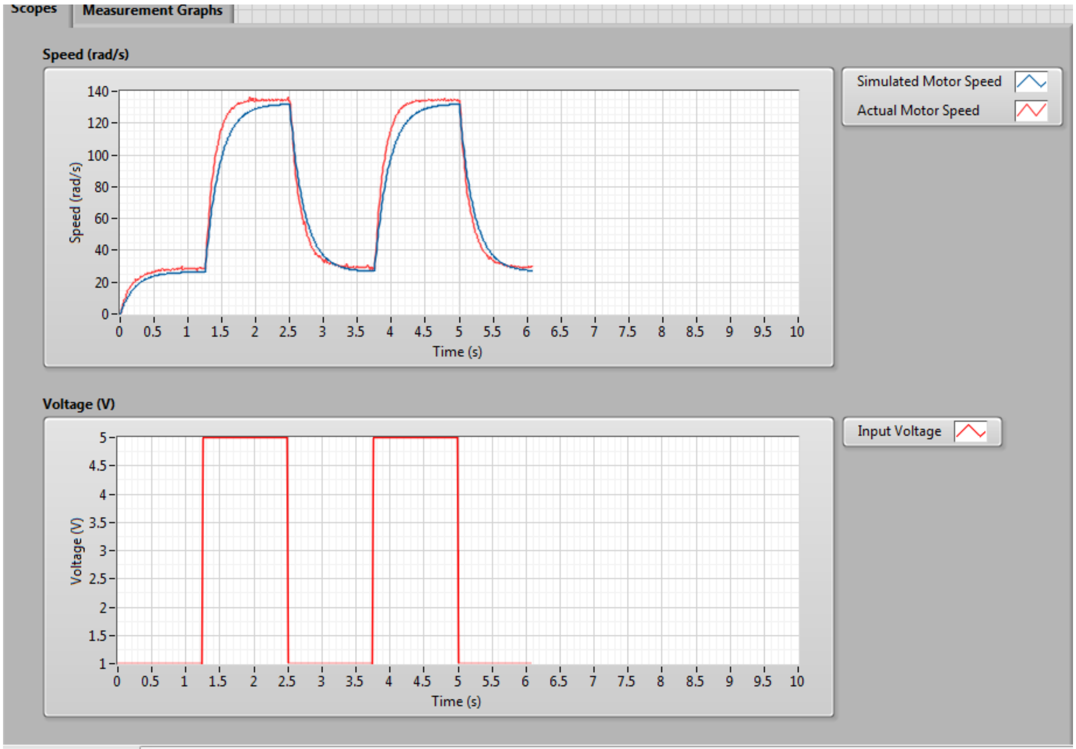
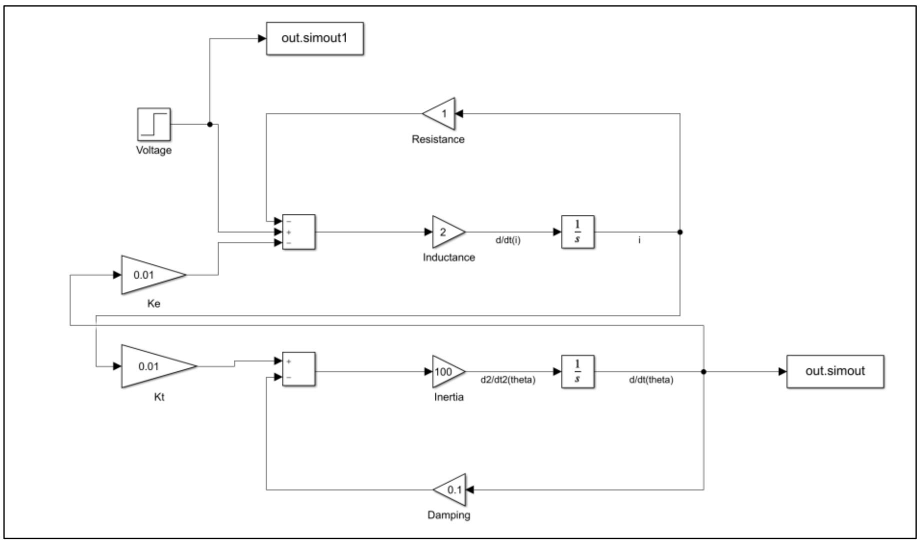
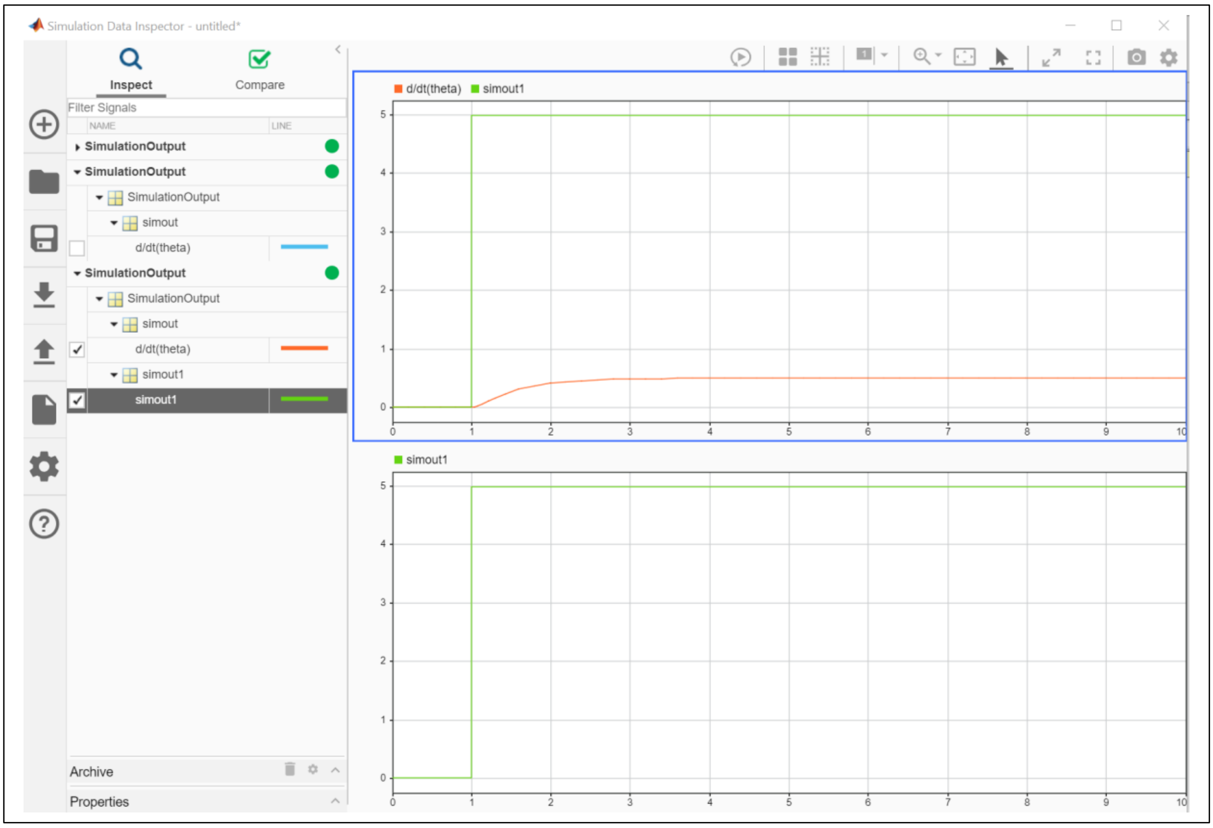


Figure 3 Bump test and measured motor speed (red) correspondence.





Simulink DC Motor Modelling & Simulation

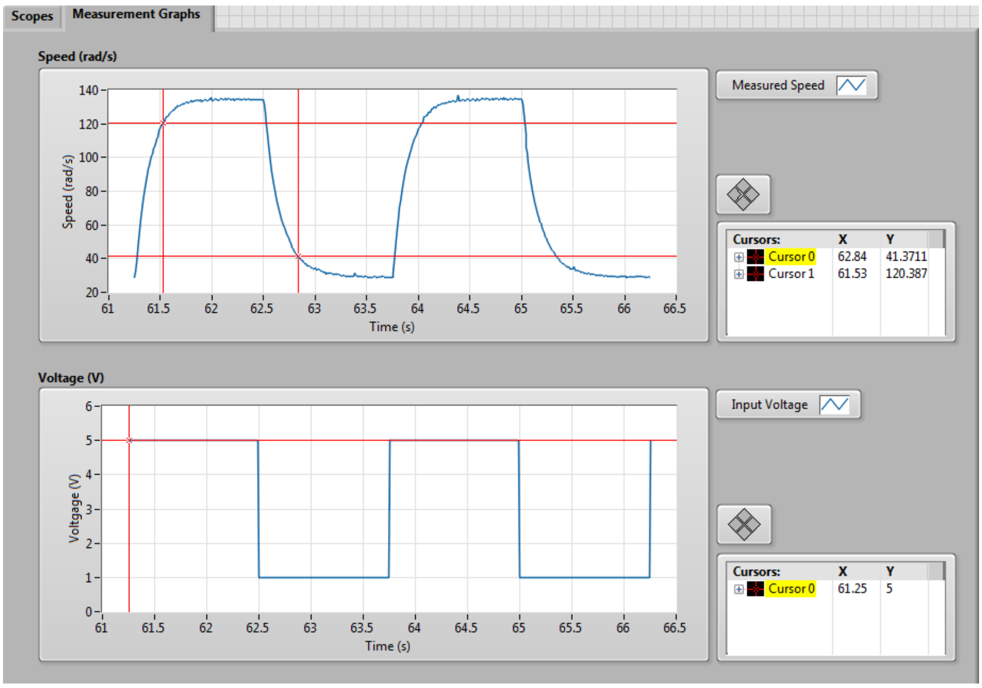


Figure 4 Attached Speed and Voltage scopes.

ANALYSIS

Steady-State Gain of the DC Motor

Steady-state gain is calculated by using the responses of Speed and Voltage graphs shown above by using the equations in the background part.

$K = \frac{\Delta y}{\Delta u}$, where Δy is equal to $y_{ss}-y_0$, and Δu is produced from $\Delta u = u_{max} - u_{min}$, $y_{ss}=134.607$, $y_0=28.846$. $u_{max}=5V$, $u_{min}=1V$, $y(t)=100.525$

Model Time Constant

After that, to calculate the model time constant τ, I firstly found the output t_1 and t_0 values by the help of cursor palette on the graphs. Thus, the time constant for this model can be obtained from this equation. $\tau = t_1 - t_0 = 0.22$ s.

CONCLUSION

It can be concluded that the desired simulation output and actual motor speed graphs are close to each other. (Bump test model parameters K and τ are used) Moreover, DC Motor simulation is conducted in control systems by Simulink.