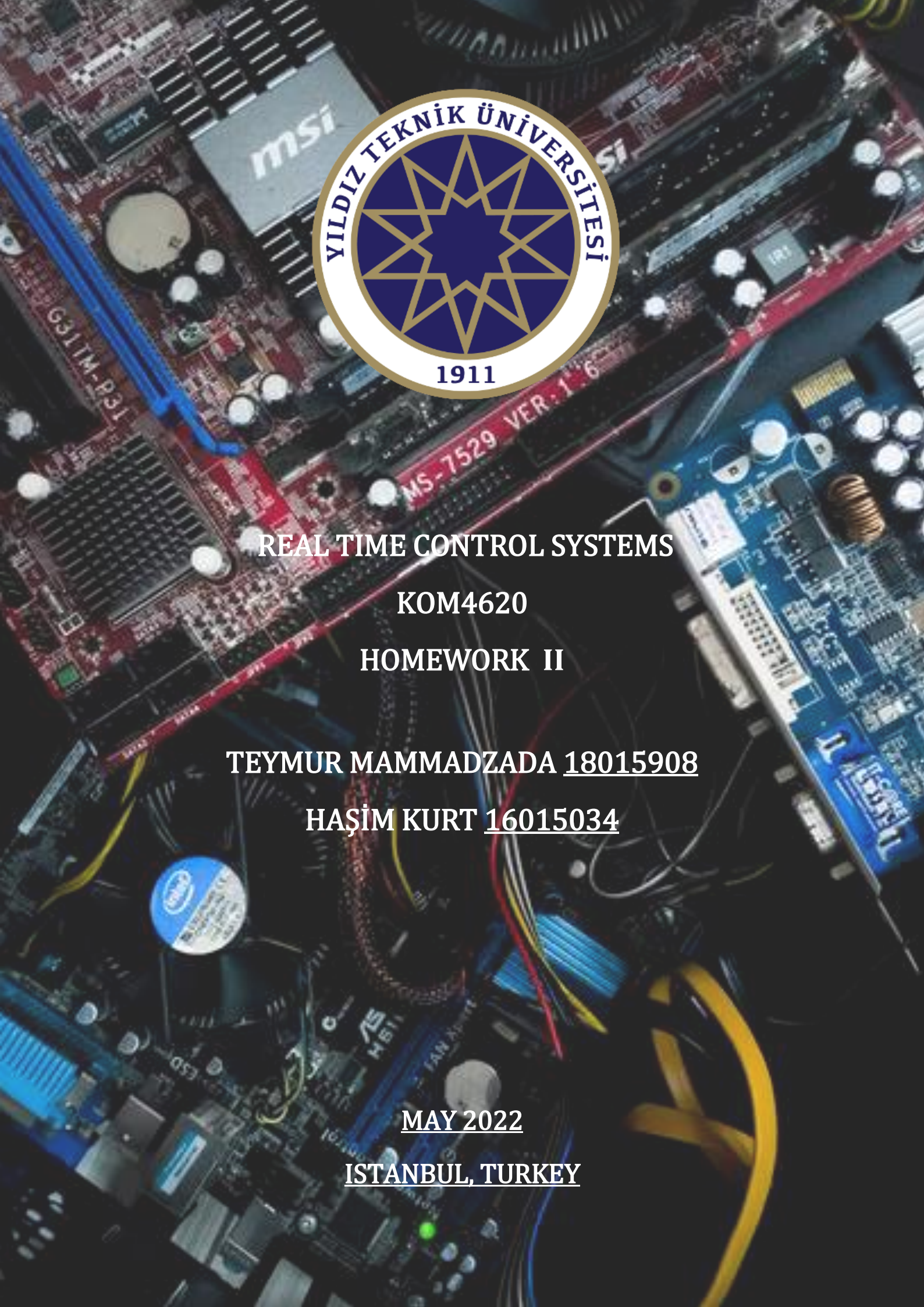

REAL TIME CONTROL SYSTEMS

KOM4620

HOMEWORK II

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INTRODUCTION

As the first option is chosen (building own experimental platform), the report covers DC Motor Control by Simulink/MATLAB with Arduino UNO R3 hardware implementation.

The main goal to preparing this environment is, to understand the working principle of the DC Motor with magnetic encoder sensor linked on it.

Using simulation platforms like Simulink and LabView do not give the specific information about the real-time control system applications. There are many uncertain disturbances which affect the system from outside and make the system to be non-linear, that aren't considered while doing simulations. The signals obtained from the encoder sensor provides to identify system behaviour and responses to the given input signals.

Generally, in this report, the parameters of motor will be taking into account and by using system identification methods, control system design applications will be applied properly.

PROBLEM APPROACH & OBJECTIVES

Using Arduino Uno R3

Arduino Uno R3 provides the data transmission between computer and DC motor. Moreover, it's common and suitable to use with L298N Motor Driver. Arduino Uno has PWM digital input pins on the board. Therefore, it is possible to give PWM Signals, read encoder and control the speed by doing all these procedures.

Convenient Hardware

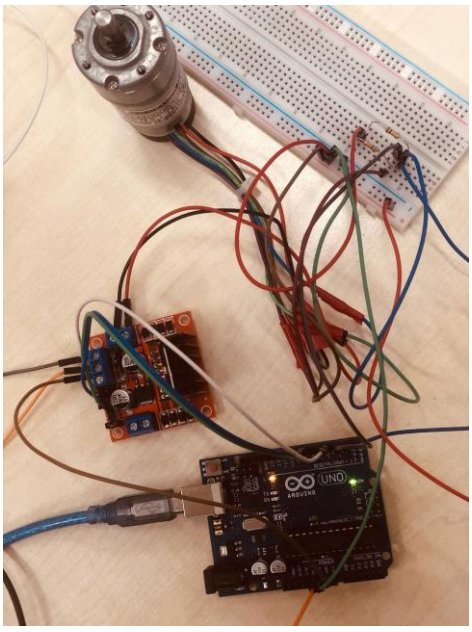
The requirements of the circuit's elements such as bread board, resistors and power supply will be chosen depending on the capability of the available DC Motor.

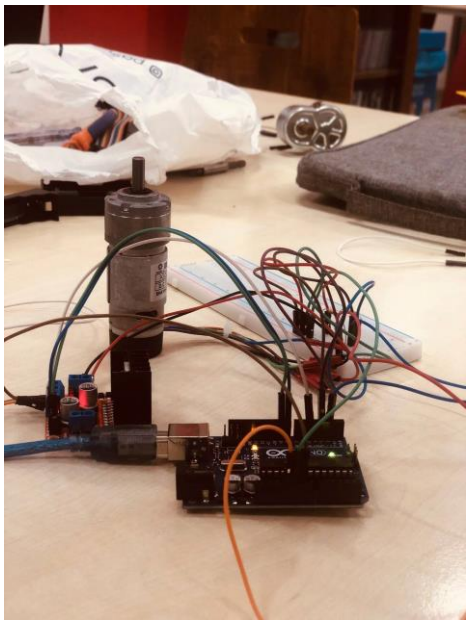
Role of MATLAB/Simulink in this project

In order to find the relevant parameters of the motor there will be used various toolboxes of MATLAB such as System Identification Toolbox, Parameter Estimation Toolbox. As the system's mathematical model will be derived, the controller designing process is going to begin. By using several tuning methods of PID controller, optimum values will be assigned to coefficients respectively.

Controller input/output.

Real-time / design implementation





The hardware of the configuration is shown above.

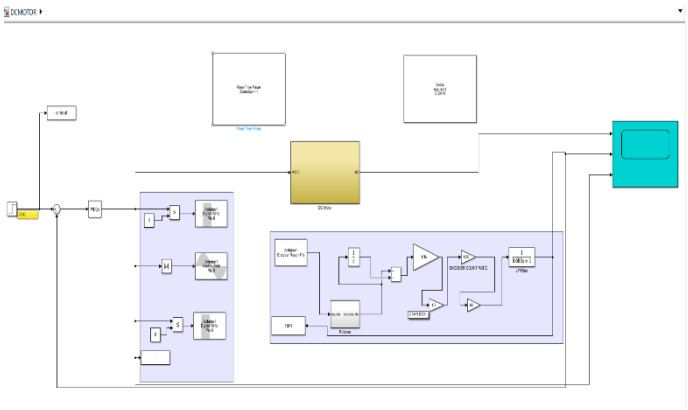
Motor model: Shayang YE Industrial IG320005X00111R D.C **12V**

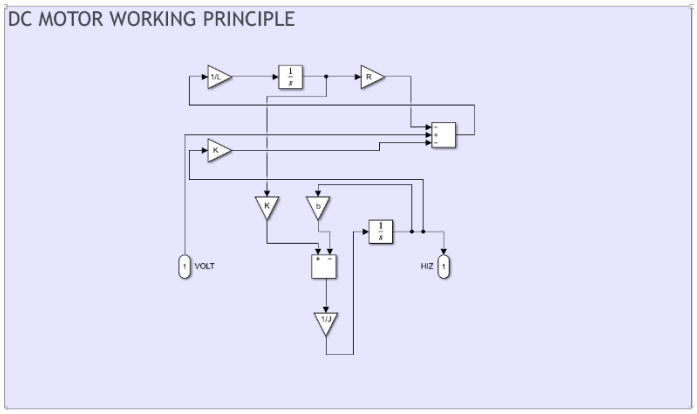
Motor driver: L298N module

Resistors: 10k Ω (2)

Power Supply: Fully Output DC 12V-1A

The Simulink/Arduino configuration:





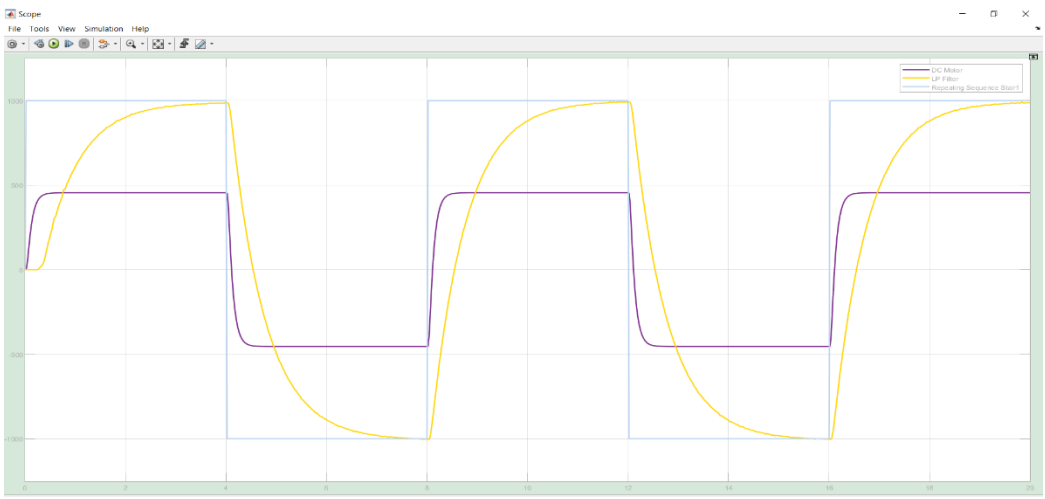
The DC motor mathematical model is simulated as block diagram in Simulink. The coefficients of damper, internal inertia, torque constant, resistance and inductance described via gain blocks respectively.

Firstly, these values selected randomly for parameter estimation. Due to number of iterations, the real value of these coefficients will occur.

Workspace

Name	Value
b	0.5000
J	0.0500
K	0.2000
L	0.0200
R	0.8000
Ts	0.0200

Real time performance of system for given 1000rpm speed command (before estimation):



Parameter estimation is done by selecting proper parameters and experiments.

The closest values acquired:

```
Estimation result(s):
  J = 0.60297
  K = 0.55847
  L = 0.049977
  R = 0.66843
  b = 0.38018
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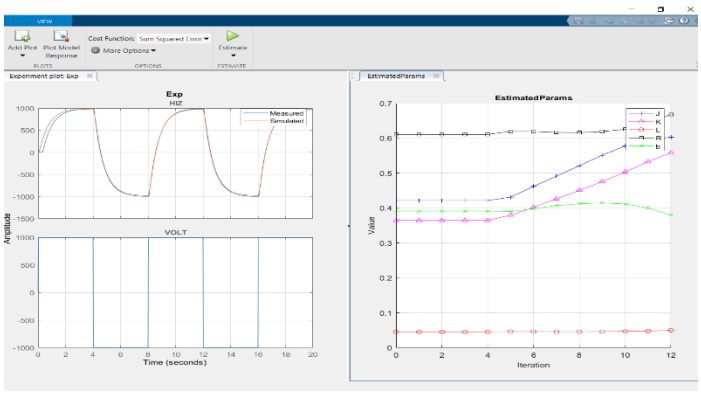
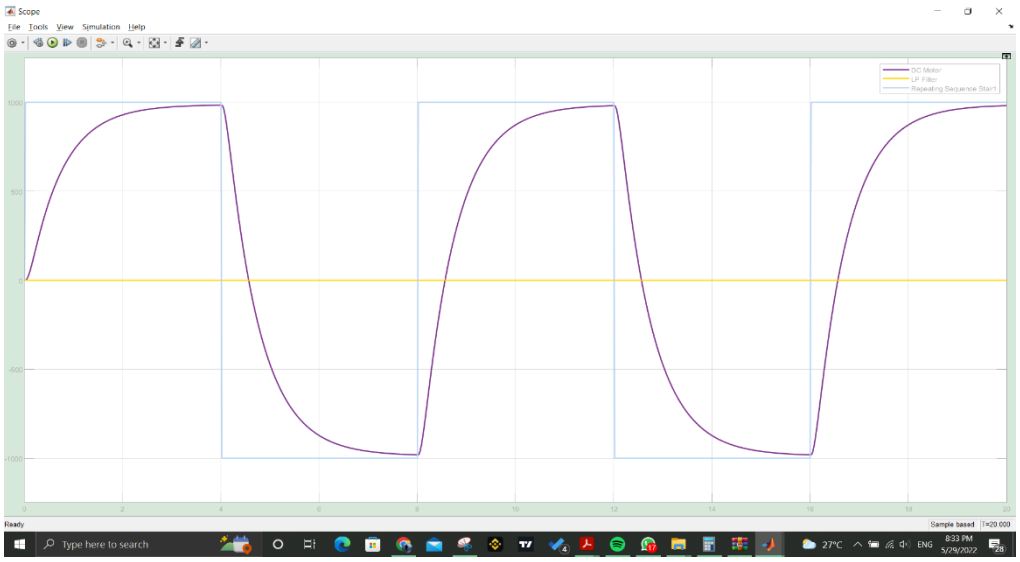
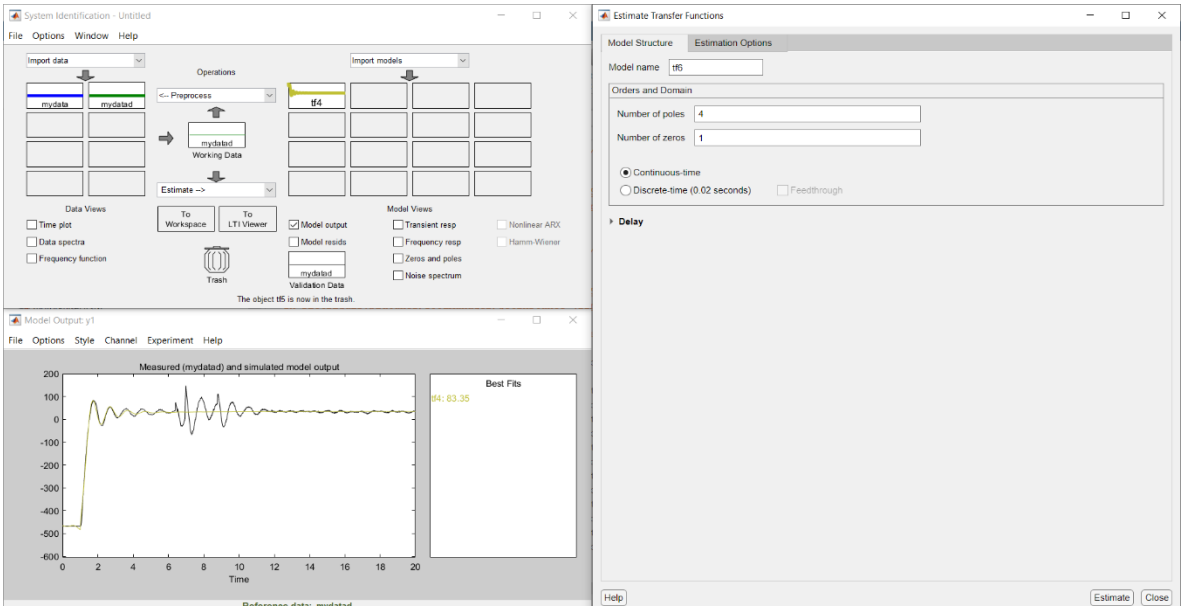


After estimation:

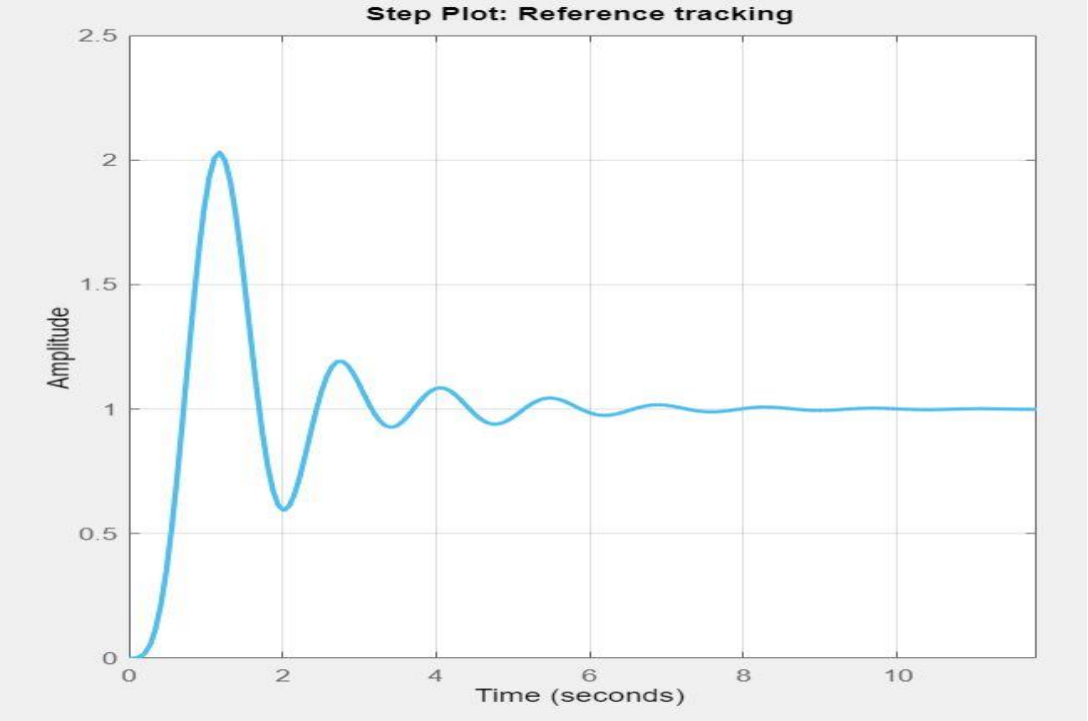


System transfer function identification by giving 500 RPM to system (means removed, thus, it settles to the 0 instead of 500)

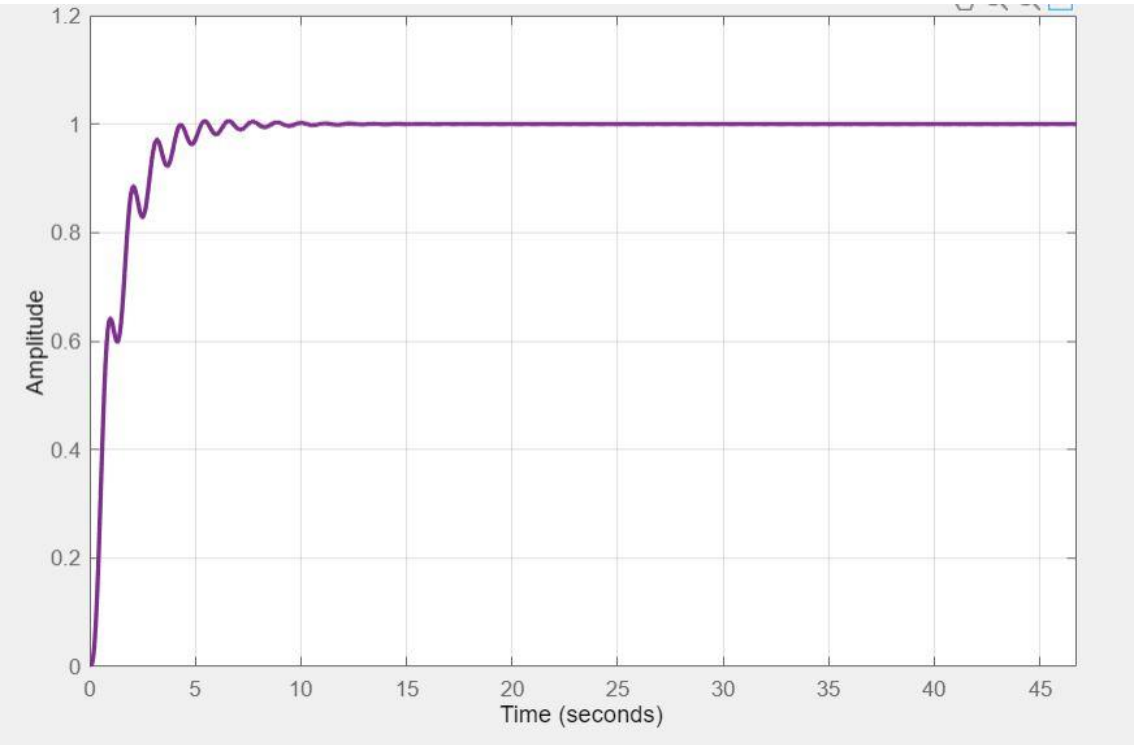


Controller outputs (MATLAB PID Tuner toolbox was used):

PD SPEED CONTROL:



PID SPEED CONTROL:



Conclusion

At the final point, it is concluded that identification and model a real time DC motor system is substantial issue in order to control an environment. Parameter estimation and system identification methodologies on Simulink achieves useful estimations for real time DC motor control operations. After obtaining system dynamics PID tuning tool followed through the mission. By using controller tuning, it has been easier to have better result because of better controller which is tuned.

References

- *https://ctms.engin.umich.edu/CTMS/index.php?aux=Activities_DCmotorA*
- *Modern Control Engineering Fifth Edition Katsuhiko Ogata*
- *KOM4620 Lecture Slides*