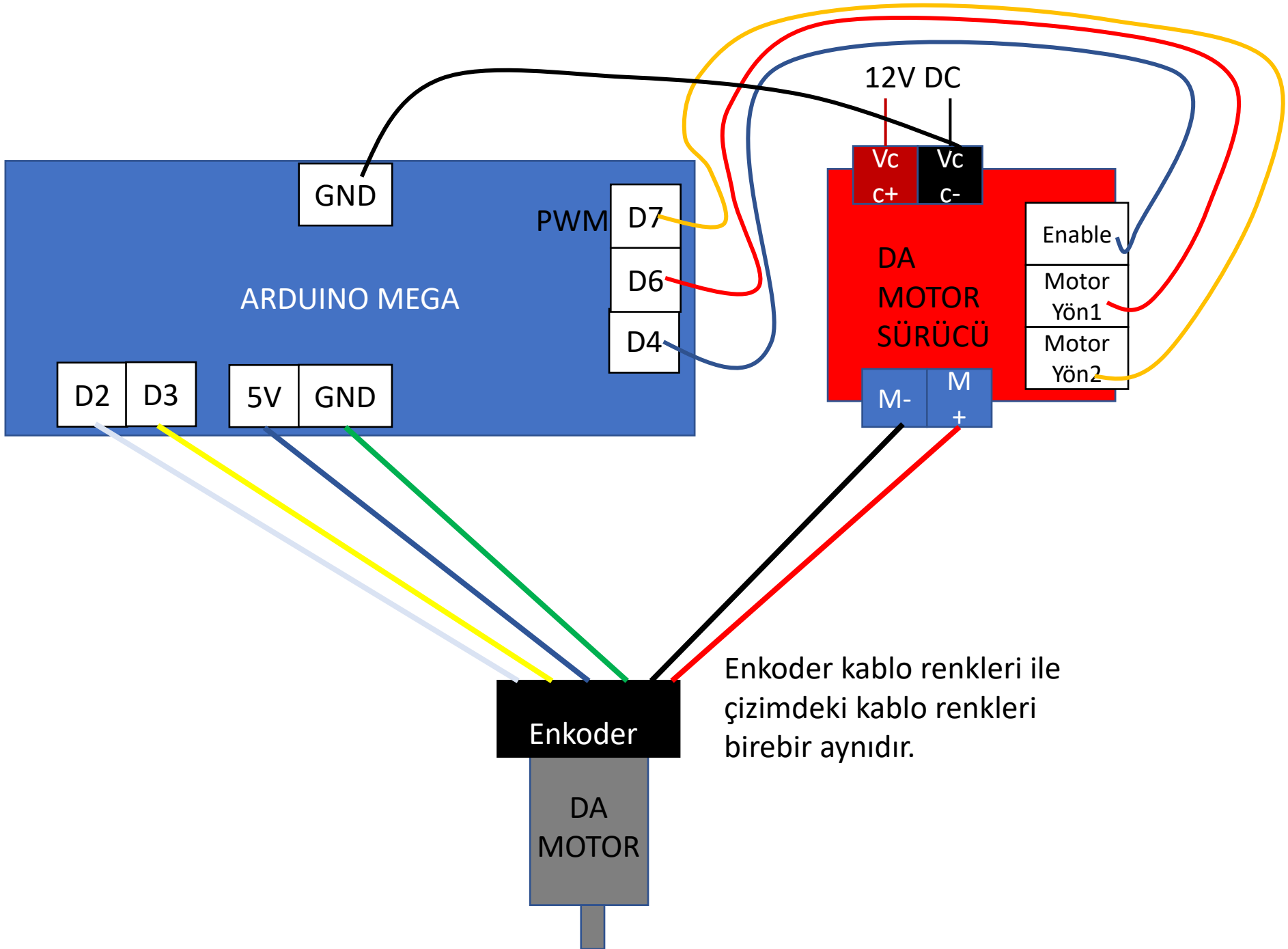
BİR DA MOTORUN TRANSFER FONKSİYONUNUN BULUNMASI

DEVRE KURULUMU



Enkoder kablo renkleri ile çizimdeki kablo renkleri birebir aynıdır.

KODLAR

```
clear;clc;
a = arduino('COM3','Mega2560','Libraries','rotaryEncoder');
encoder = rotaryEncoder(a,'D2','D3',48);
writeDigitalPin(a,'D6',1);
writeDigitalPin(a,'D7',0);
voltageX= [5*ones(1,50) 4.5*ones(1,50) 4*ones(1,50) 3.5*ones(1,50) 3*ones(1,50) 2.5*ones(1,50) 2*ones(1,50) 1.5*ones(1,50)];
voltageSaw=zeros(1,400);
d=5;
for i=1:length(voltageSaw)
    voltageSaw(i)=d-0.1;
    d=voltageSaw(i);
    if mod(i,50)==0
        d=5;
    end
end
```

```
d=5;
for i=1:50
    if i<25;
    voltageTrim(i)=d-0.25;
    else
    voltageTrim(i)=d+0.25;
    end
    d=voltageTrim(i);
end

for i=1:length(voltageX)
writePWMVoltage(a,'D4',voltageX(1,i));
pause(0.2);
rpm = readSpeed(encoder);
voltageX(2,i)=rpm;
subplot(1,2,1);
plot(voltageX(1,1:i));
subplot(1,2,2);
plot(voltageX(2,:));
fprintf('i=%d voltageX=%2.2f hiz=%2.2f\n',i, voltageX(1,i), rpm);
end
```

```
for i=1:length(voltageSaw)
writePWMVoltage(a,'D4',voltageSaw(1,i));
pause(0.2);
rpm2 = readSpeed(encoder);
voltageSaw(2,i)=rpm2;
subplot(1,2,1);
plot(voltageSaw(1,1:i));
subplot(1,2,2);
plot(voltageSaw(2,:));
fprintf('i=%d voltageSaw=%1.1f
hiz=%2.2f\n',i,voltageSaw(1,i), rpm2);
end

writeDigitalPin(a,'D6',0);
writeDigitalPin(a,'D7',0);
```

ELDE EDİLEN VERİLER

Variables - voltageX

voltageX

2x800 double

	1	2	3	4	5	6	7	8	9	10	11	12
1	5	5	5	5	5	5	5	5	5	5	5	5
2	1.1719e+03	1.4063e+03	1.4375e+03	1.4531e+03	1.4375e+03	1.4375e+03	1.4375e+03	1.4375e+03	1.4375e+03	1.4375e+03	1.4375e+03	1.4375e+03
3												
4												

Variables - voltageX

voltageX

2x800 double

	99	100	101	102	103	104	105	106	107	108	109	110
1	5	5	4.5000	4.5000	4.5000	4.5000	4.5000	4.5000	4.5000	4.5000	4.5000	4.5000
2	1.4531e+03	1.4531e+03	1.4063e+03	1.3906e+03	1.3906e+03	1.3906e+03	1.4063e+03	1.3906e+03	1.3906e+03	1.3906e+03	1.3906e+03	1.3906e+03
3												

Variables - voltageSaw

voltageSaw

2x800 double

	1	2	3	4	5	6	7	8	9	10	11	12
1	4.9500	4.9000	4.8500	4.8000	4.7500	4.7000	4.6500	4.6000	4.5500	4.5000	4.4500	4.4000
2	1.3594e+03	1.4219e+03	1.4375e+03	1.4219e+03	1.4219e+03	1.4219e+03	1.4219e+03	1.4219e+03	1.4219e+03	1.4219e+03	1.4063e+03	1.4219e+03
3												

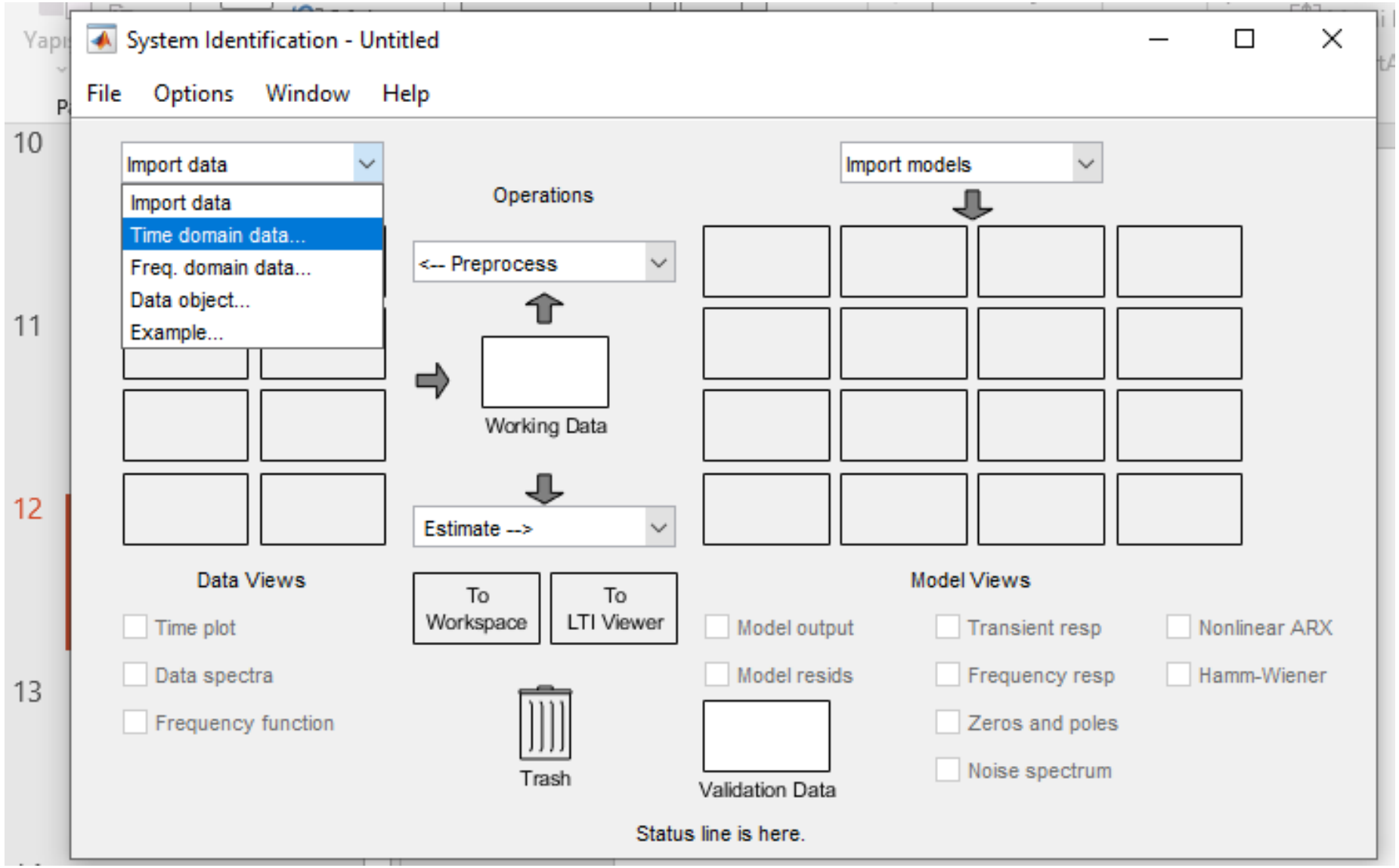
Variables - voltageSaw

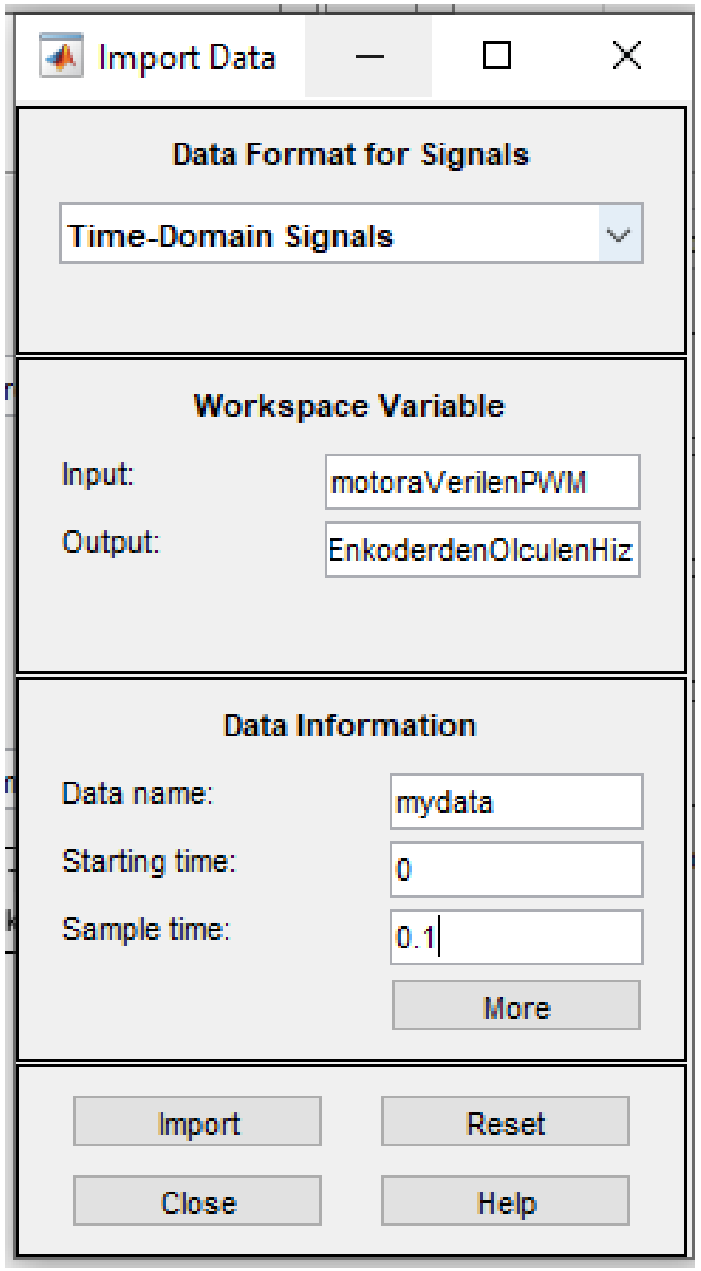
voltageSaw

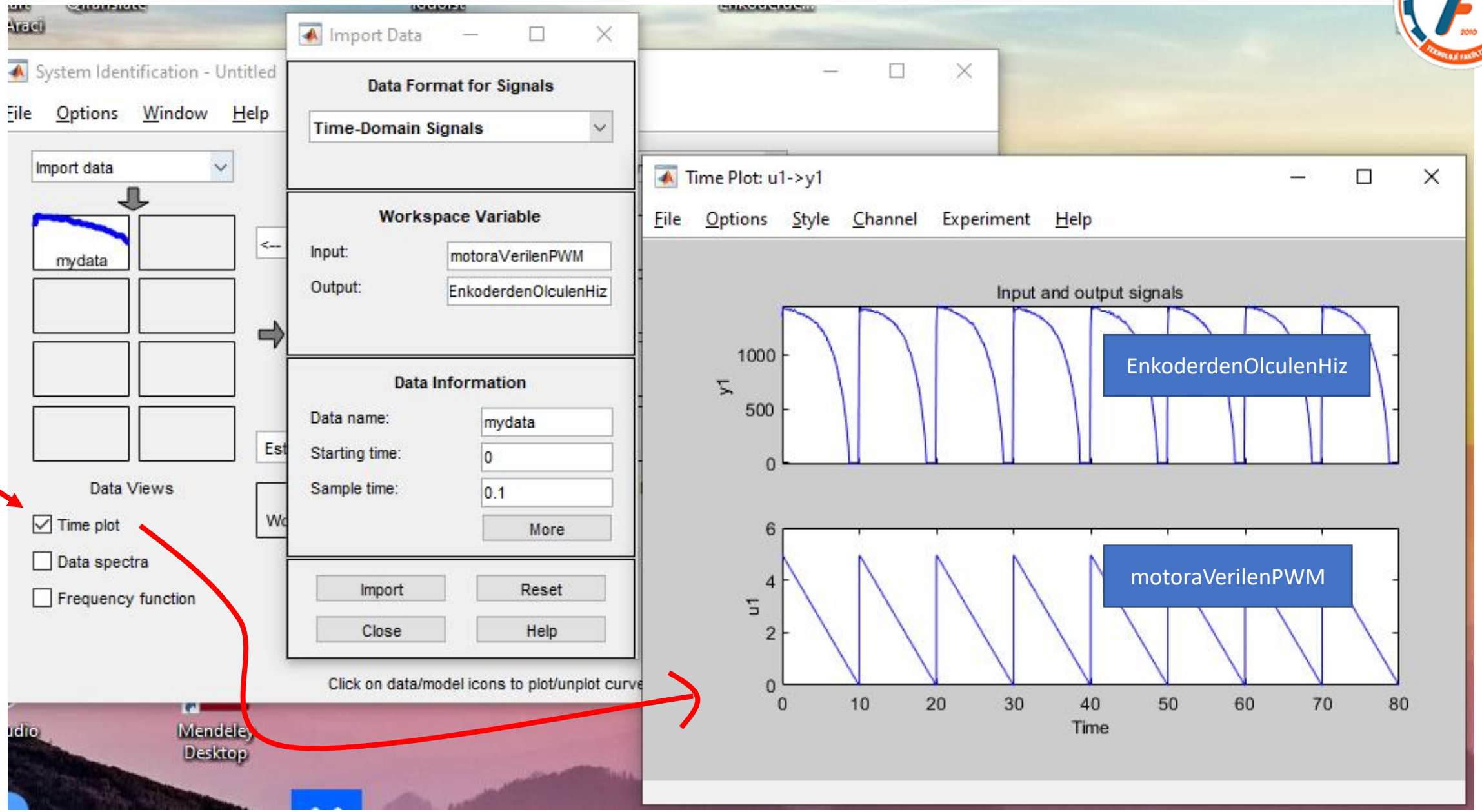
2x800 double

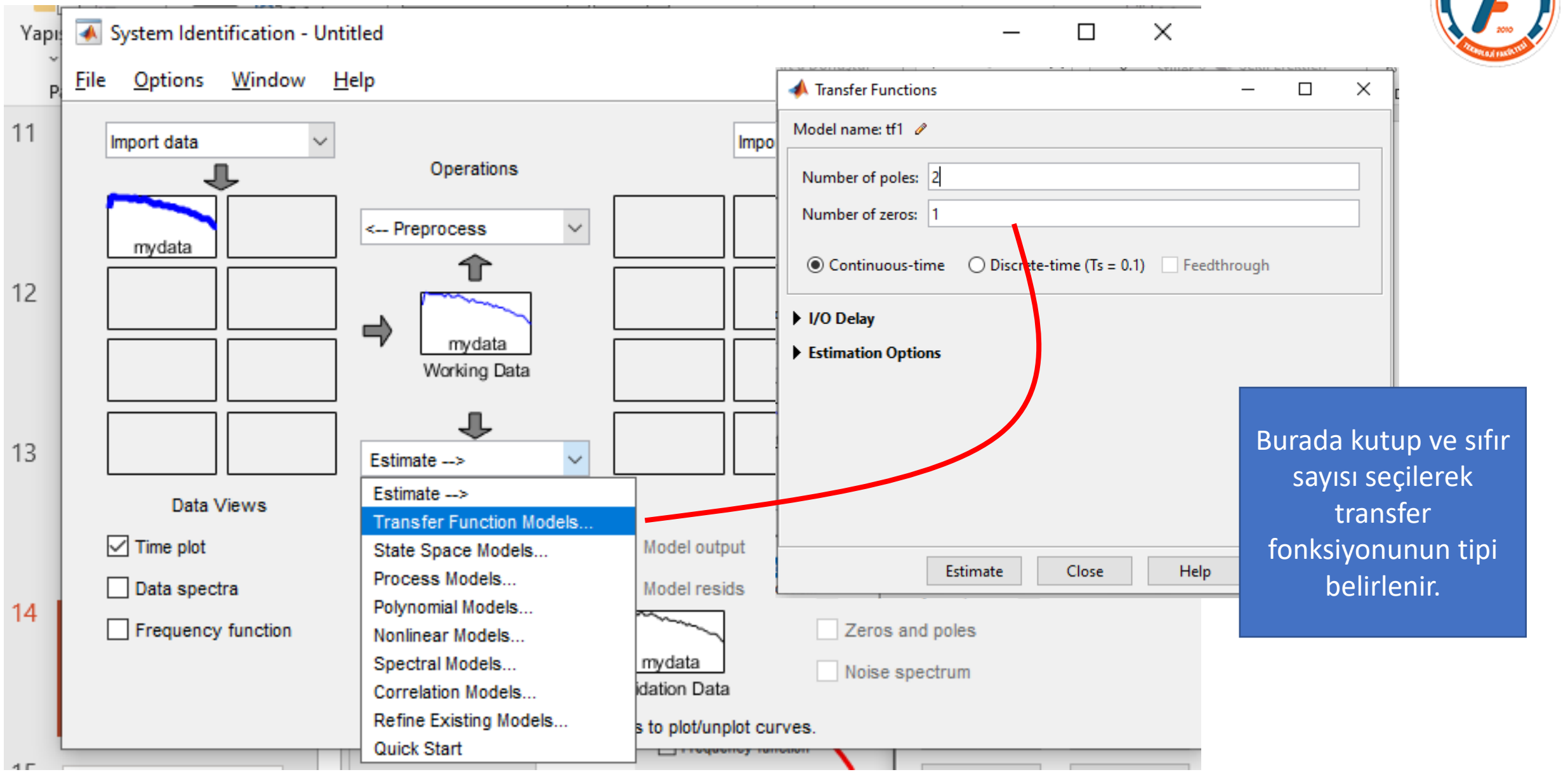
	89	90	91	92	93	94	95	96	97	98	99	100
1	0.5500	0.5000	0.4500	0.4000	0.3500	0.3000	0.2500	0.2000	0.1500	0.1000	0.0500	9.3953e-15
2	0	0	0	0	0	0	0	0	0	0	0	0
3												
4												

SYSTEM IDENTIFICATION TOOLBOX TRANSFER FONKSİYONU ÇIKARTMA

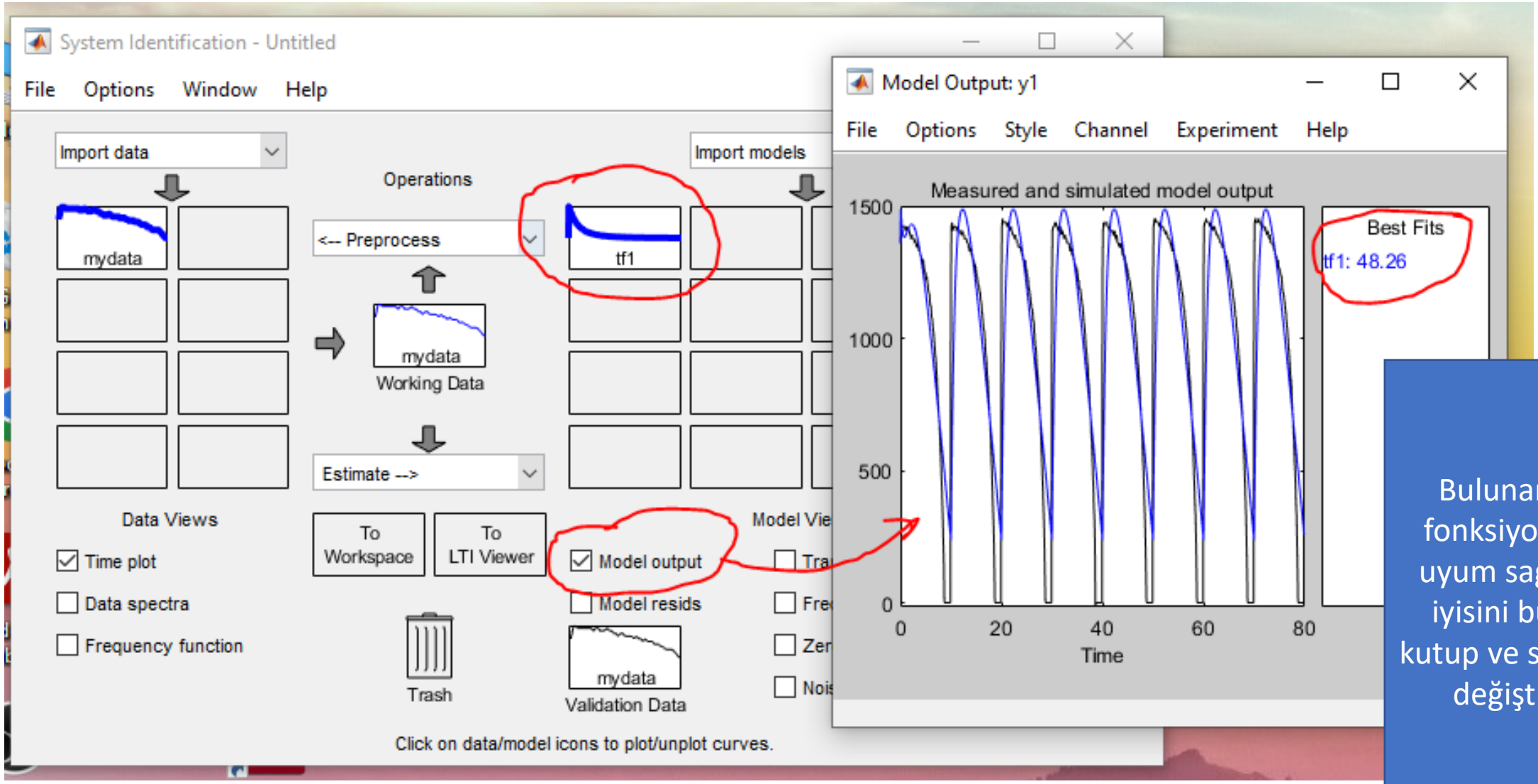

System Identification - Untitled
File
Options
Window
Help
Import data
Import data
Time domain data...
Freq. domain data...
Data object...
Example...
Operations
<-- Preprocess
Working Data
Estimate -->
Import models
Data Views
Time plot
Data spectra
Frequency function
To Workspace
To LTI Viewer
Trash
Model Views
Model output
Model resids
Validation Data
Transient resp
Frequency resp
Zeros and poles
Noise spectrum
Nonlinear ARX
Hamm-Wiener
Status line is here.


Import Data
Data Format for Signals
Time-Domain Signals
Workspace Variable
Input:
motoraVerilenPWM
Output:
EnkoderdenOlculenHiz
Data Information
Data name:
mydata
Starting time:
0
Sample time:
0.1
More
Import
Reset
Close
Help

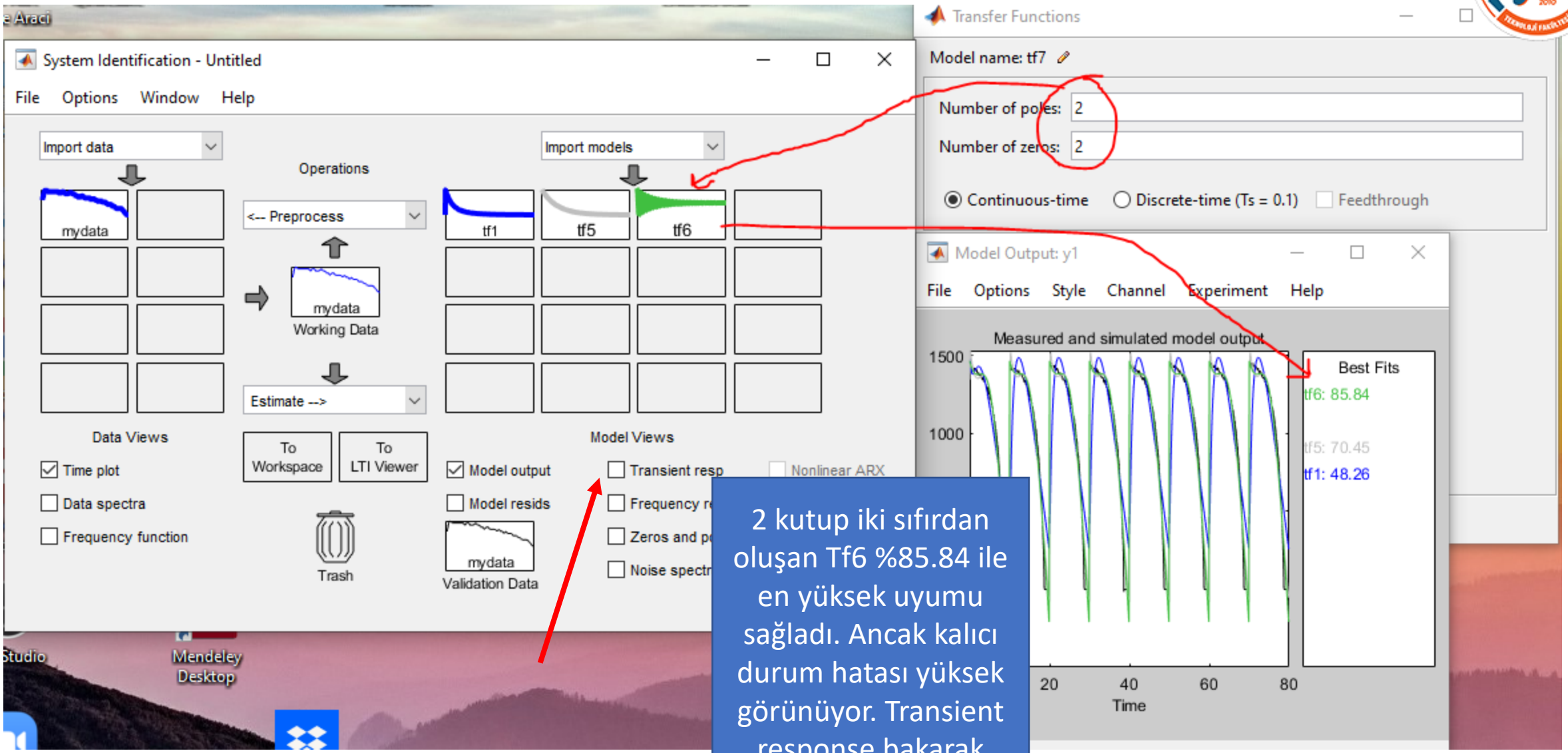

Import Data
Data Format for Signals
Time-Domain Signals
Workspace Variable
Input:
motoraVerilenPWM
Output:
EnkoderdenOlculenHiz
Data Information
Data name:
mydata
Starting time:
0
Sample time:
0.1
More
Import
Reset
Close
Help
System Identification - Untitled
File
Options
Window
Help
Import data
mydata
Data Views
Time plot
Data spectra
Frequency function
Click on data/model icons to plot/unplot curve
Time Plot: u1->y1
File
Options
Style
Channel
Experiment
Help
Input and output signals
EnkoderdenOlculenHiz
motoraVerilenPWM
y1
u1
Time
Mendeley Desktop



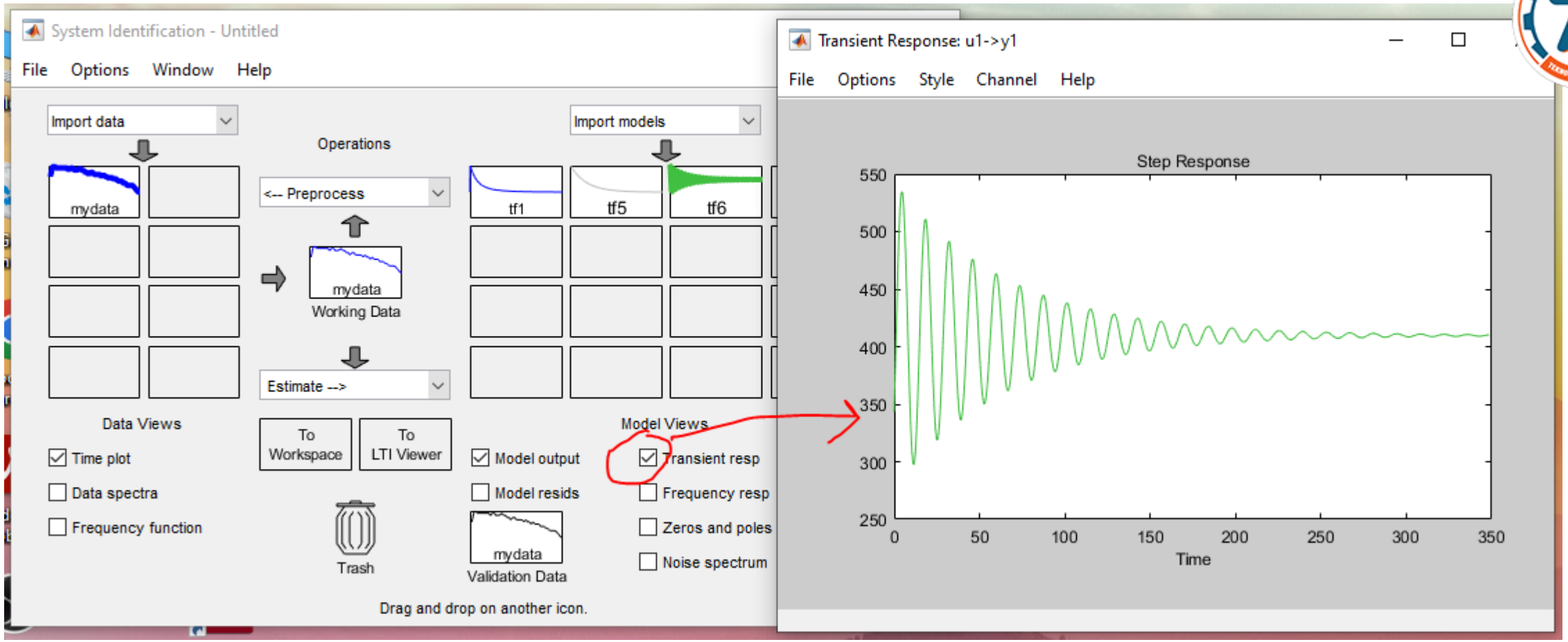
Burada kutup ve sıfır sayısı seçilerek transfer fonksiyonunun tipi belirlenir.



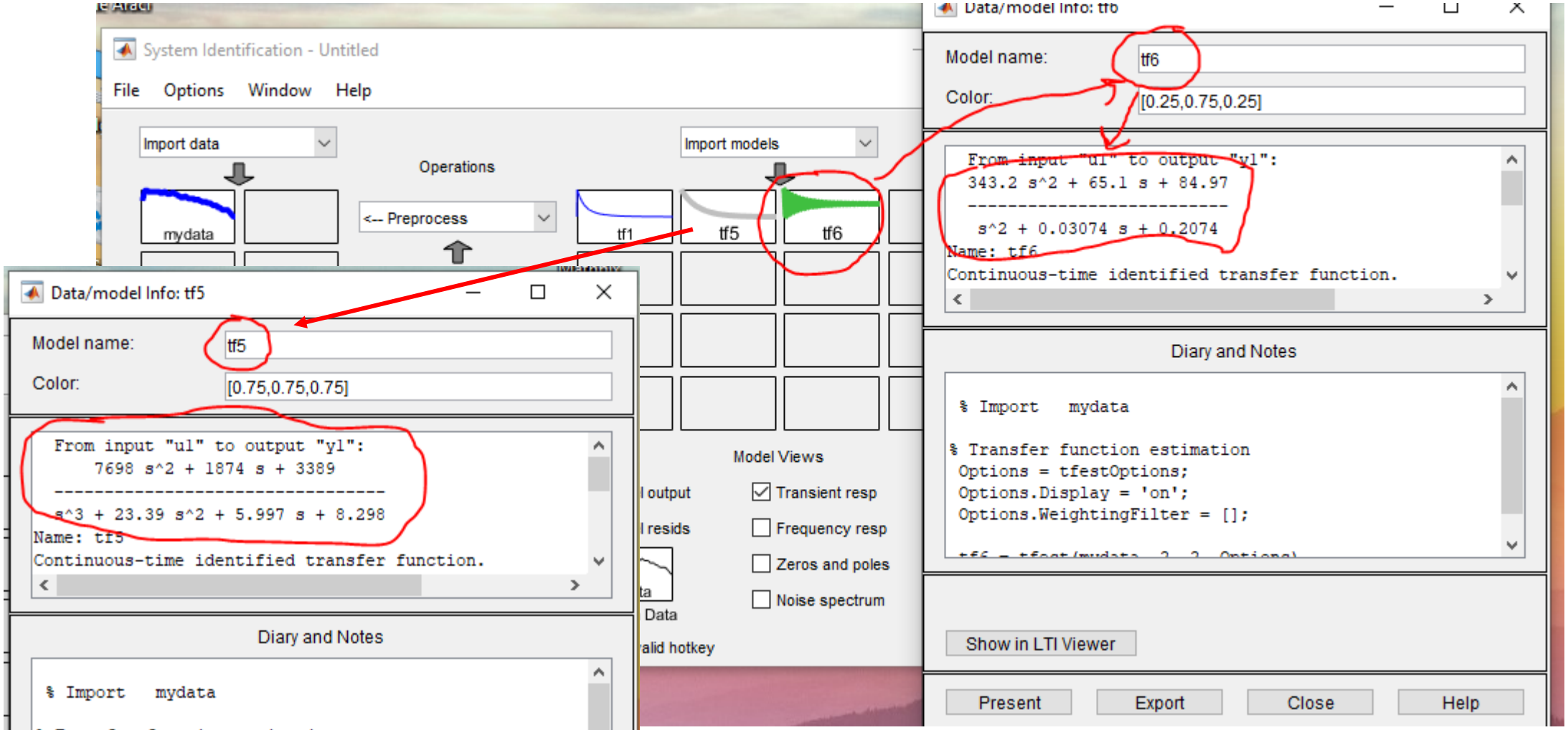
Bulunan transfer fonksiyonu %48.26 uyum sağladı. Daha iyisini bulmak için kutup ve sıfır sayılarını değiştirebiliriz.



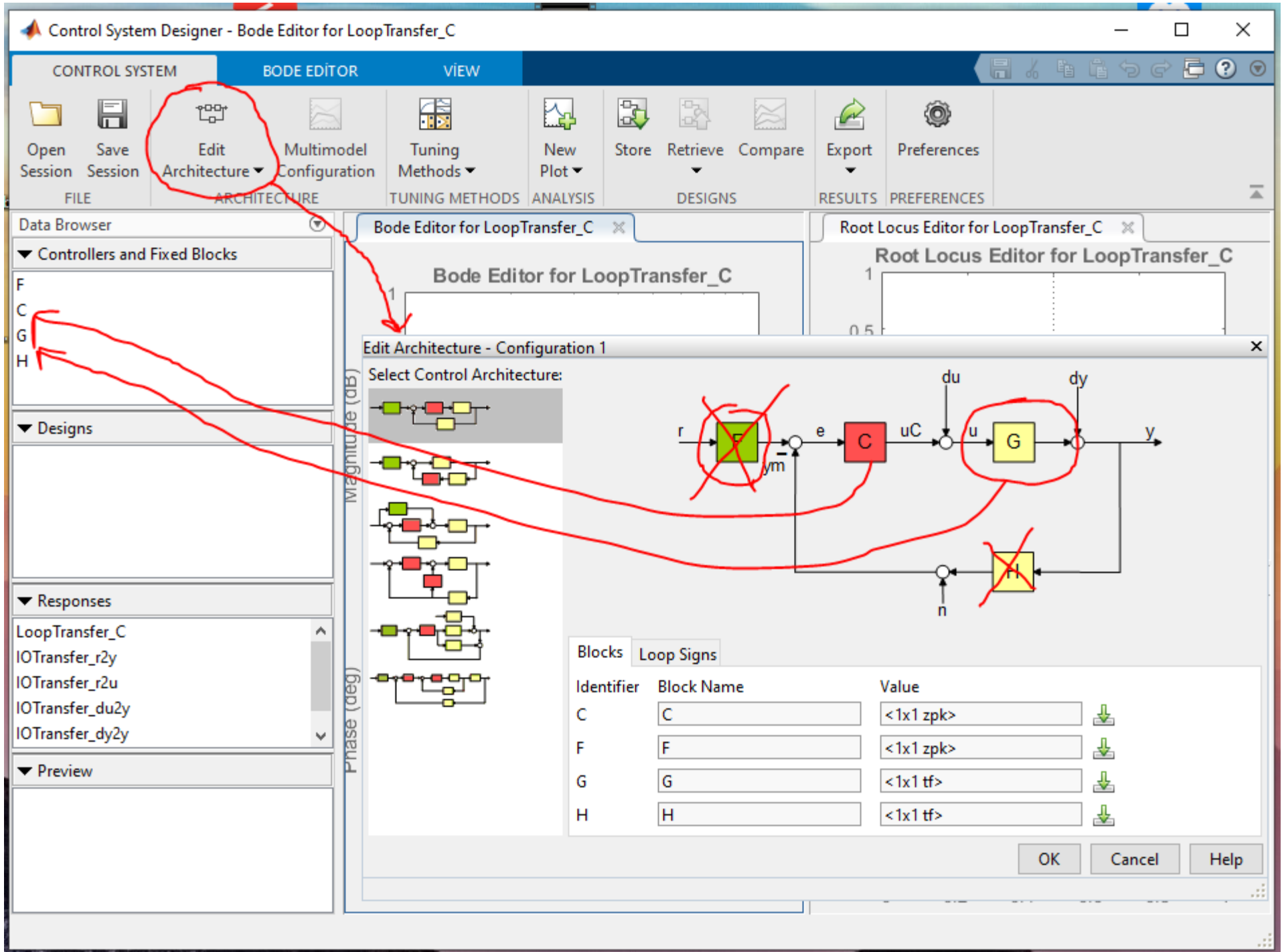
2 kutup iki sıfırdan oluşan Tf6 %85.84 ile en yüksek uyumu sağladı. Ancak kalıcı durum hatası yüksek görünüyor. Transient response bakarak bunu görebiliriz.



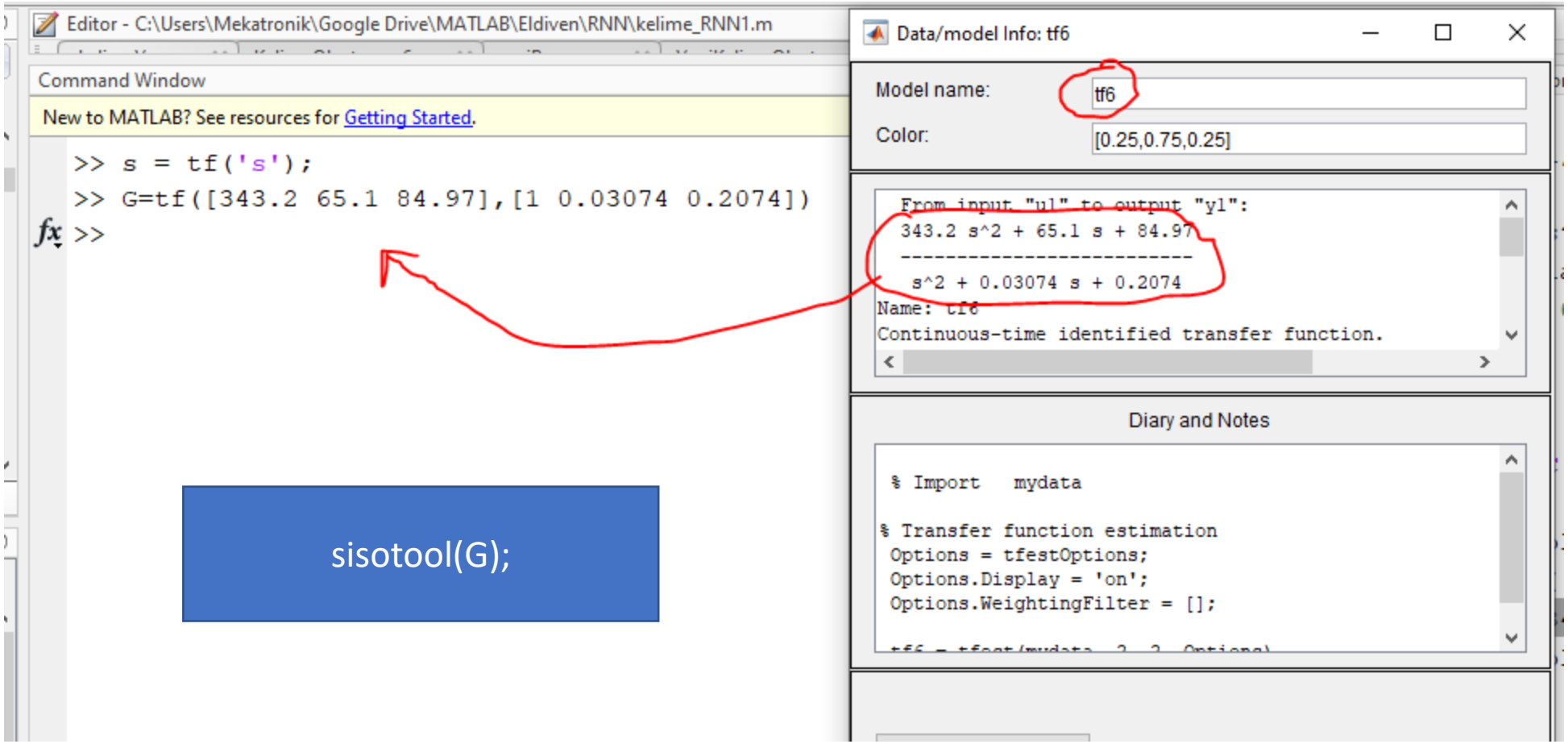
Tf6 ve tf5'in transfer fonksiyonlarını görelim. Modellerin üstüne çift tıklamak yeterli.


System Identification - Untitled
File Options Window Help
Import data
mydata
Operations
<-- Preprocess
Import models
tf1
tf5
tf6
Model Views
Transient resp
Frequency resp
Zeros and poles
Noise spectrum
Data/model Info: tf5
Model name:
tf5
Color:
[0.75,0.75,0.75]
From input "u1" to output "y1":
7698 s^2 + 1874 s + 3389
s^3 + 23.39 s^2 + 5.997 s + 8.298
Name: tf5
Continuous-time identified transfer function.
Diary and Notes
% Import mydata
% Transfer function estimation
Options = tfestOptions;
Options.Display = 'on';
Options.WeightingFilter = [];
Show in LTI Viewer
Present
Export
Close
Help
Data/model Info: tf6
Model name:
tf6
Color:
[0.25,0.75,0.25]
From input "u1" to output "y1":
343.2 s^2 + 65.1 s + 84.97
s^2 + 0.03074 s + 0.2074
Name: tf6
Continuous-time identified transfer function.
Diary and Notes
% Import mydata
% Transfer function estimation
Options = tfestOptions;
Options.Display = 'on';
Options.WeightingFilter = [];
Show in LTI Viewer
Present
Export
Close
Help

SISOTOOLBOX PID KATSAYILARI BELİRLEME



Sisotoolbox'da 1. mimariyi seçiyoruz. Buradaki C: kontrolörümüzün trf fonksiyonu, G ise sistemimizin transfer fonksiyonu. Şimdi az önce bulduğumuz trf fonksiyonunu buraya aktaralım.


Editor - C:\Users\Mekatronik\Google Drive\MATLAB\EIdiven\RNN\kelime_RNN1.m
Command Window
New to MATLAB? See resources for Getting Started.
>> s = tf('s');
>> G=tf([343.2 65.1 84.97],[1 0.03074 0.2074])
>>
sisotool(G);
Data/model Info: tf6
Model name:
tf6
Color:
[0.25,0.75,0.25]
From input "u1" to output "y1":
343.2 s^2 + 65.1 s + 84.97
s^2 + 0.03074 s + 0.2074
Name: tf6
Continuous-time identified transfer function.
Diary and Notes
% Import mydata
% Transfer function estimation
Options = tfestOptions;
Options.Display = 'on';
Options.WeightingFilter = [];

Control System Designer - Bode Editor for LoopTransfer_C

CONTROL SYSTEM | BODE EDITOR | VIEW

Open Session | Save Session | Edit Architecture | Multimodel Configuration | Tuning Methods | New Plot | Store | Retrieve | Compare | Export | Preferences

FILE | ARCHITECTURE | RESULTS | PREFERENCES

Data Browser

Controllers and Fixed Blocks

F
C
G
H

Designs

Responses

LoopTransfer_C
IOTransfer_r2y
IOTransfer_r2u
IOTransfer_du2y
IOTransfer_dy2y

Preview

GRAPHICAL TUNING

Bode Editor
Edit feedback loop using Bode plot

Closed-Loop Bode Editor
Edit closed loop using Bode plot

Root Locus Editor
Edit compensators using root locus plot

Nichols Editor
Edit feedback loop using Nichols plot

AUTOMATED TUNING

PID Tuning
Tune PID compensator using robust response time or classical methods

Optimization Based Tuning
Optimize compensator parameters to satisfy design requirements

LQG Design
Obtain feedback compensator using Linear-Quadratic-Gaussian design

Loop Shaping
Find feedback compensator to match specified open-loop shape

Internal Model Control (IMC) Tuning

r LoopTransfer_C

10^0 10^1

ncy (rad/s)

Root Locus Editor for LoopTransfer_C

Root Locus Editor for LoopTransfer_C

Imag Axis: 1, 0.5, 0, -0.5, -1

Real Axis: -1, -0.5, 0, 0.5, 1

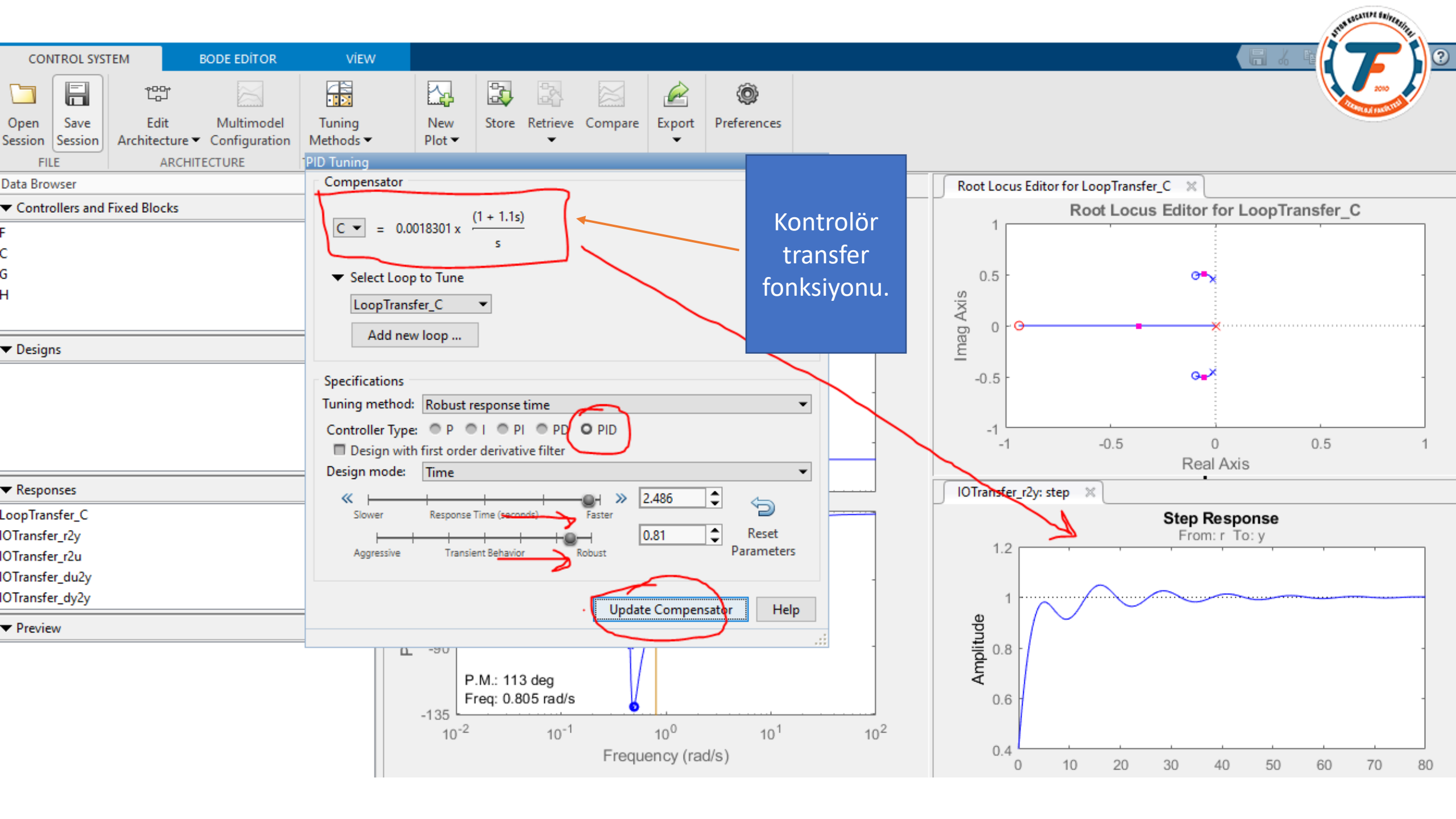
IOTransfer_r2y: step

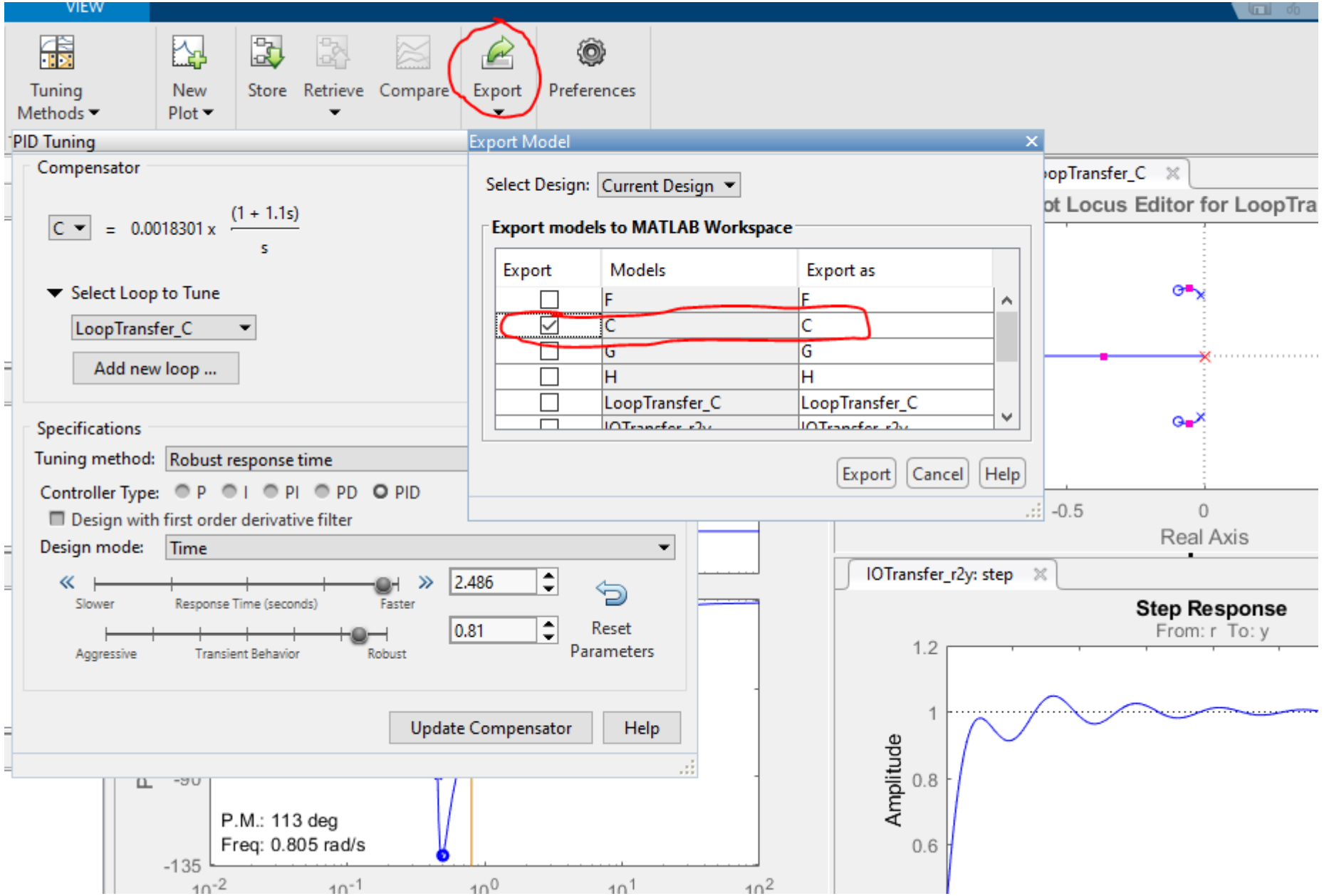
Step Response
From: r To: y

Amplitude: 0.9982, 0.998, 0.9978, 0.9976, 0.9974, 0.9972, 0.997

0 10 20 30 40 50 60 70

21°C 23:17 2.06.2022


CONTROL SYSTEM
BODE EDİTOR
VİEW
Open Session
Save Session
Edit Architecture
Multimodel Configuration
Tuning Methods
New Plot
Store
Retrieve
Compare
Export
Preferences
FILE
ARCHITECTURE
PID Tuning
Data Browser
Controllers and Fixed Blocks
F
C
G
H
Designs
Responses
LoopTransfer_C
IOTransfer_r2y
IOTransfer_r2u
IOTransfer_du2y
IOTransfer_dy2y
Preview
Compensator
C = 0.0018301 x (1 + 1.1s) / s
Select Loop to Tune
LoopTransfer_C
Add new loop ...
Specifications
Tuning method: Robust response time
Controller Type: P I PI PD PID
Design with first order derivative filter
Design mode: Time
Slower
Response Time (seconds)
Faster
2.486
Aggressive
Transient Behavior
Robust
0.81
Reset Parameters
Update Compensator
Help
Kontrolör transfer fonksiyonu.
Root Locus Editor for LoopTransfer_C
Imag Axis
Real Axis
IOTransfer_r2y: step
Step Response
From: r To: y
Amplitude
P.M.: 113 deg
Freq: 0.805 rad/s
Frequency (rad/s)



Elde ettiğimiz kontrolör transfer fonksiyonunu dışarıya export ederek PID katsayılarını bulacağız.

Command Window

New to MATLAB? See resources for Getting Started.

```
>> [kp, ki, kd]=piddata(C)

kp =

    0.0020


ki =

    0.0018


kd =

     0

>>
```