

IDENTIFIKACIJA MODELA

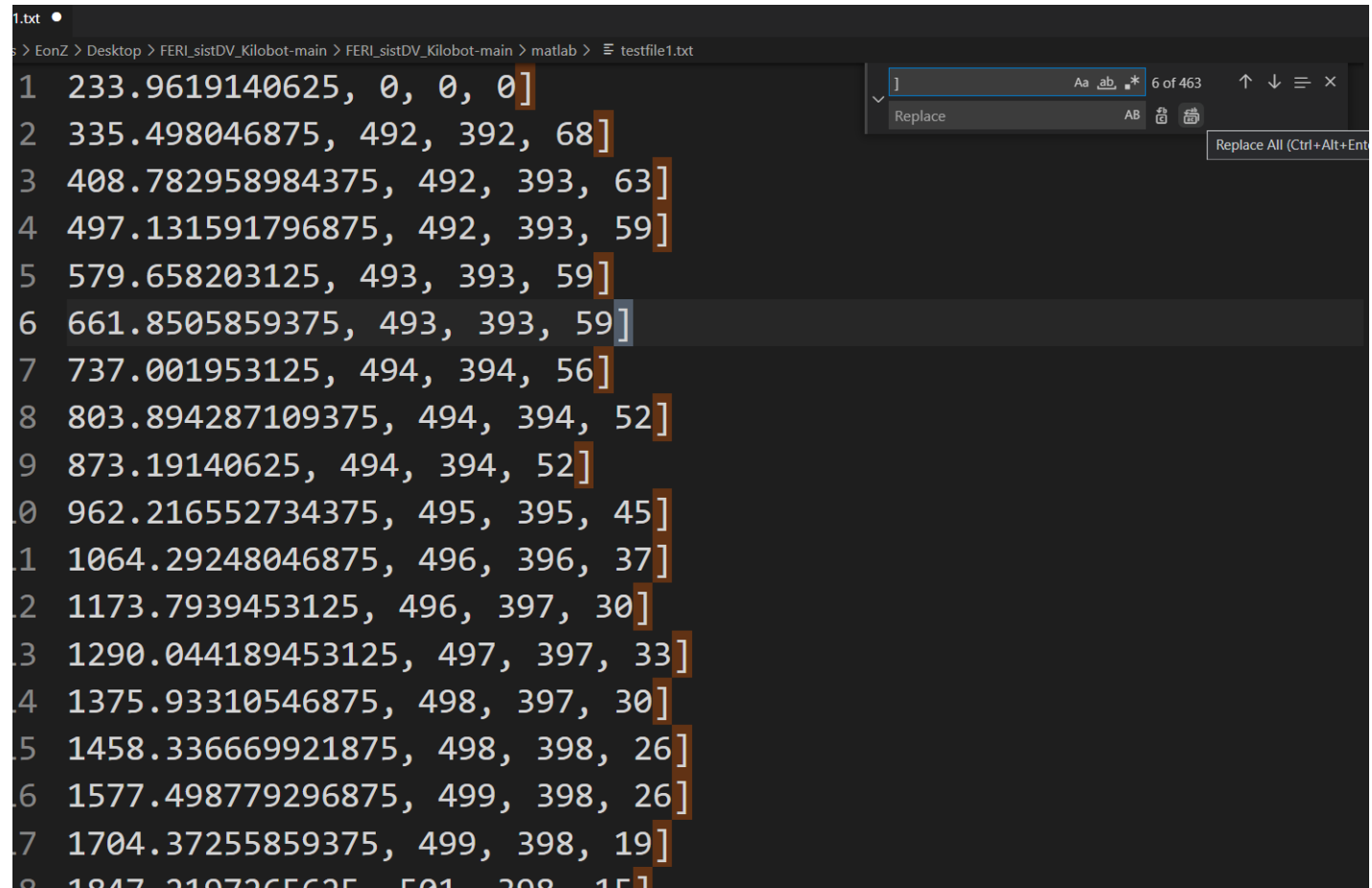
skupini 6 in 7



Posnetek
delovanja

Obdelava podatkov

```
1 [233.9619140625, 0, 0, 0]
2 [335.498046875, 492, 392, 68]
3 [408.782958984375, 492, 393, 63]
4 [497.131591796875, 492, 393, 59]
5 [579.658203125, 493, 393, 59]
6 [661.8505859375, 493, 393, 59]
7 [737.001953125, 494, 394, 56]
8 [803.894287109375, 494, 394, 52]
9 [873.19140625, 494, 394, 52]
10 [962.216552734375, 495, 395, 45]
11 [1064.29248046875, 496, 396, 37]
12 [1173.7939453125, 496, 397, 30]
13 [1290.044189453125, 497, 397, 33]
14 [1375.93310546875, 498, 397, 30]
15 [1458.336669921875, 498, 398, 26]
16 [1577.498779296875, 499, 398, 26]
17 [1704.37255859375, 499, 398, 19]
18 [1847.3107265625, 501, 398, 15]
```



The screenshot shows a text editor window with a dark theme. The file path in the title bar is "EonZ > Desktop > FERI_sistDV_Kilobot-main > FERI_sistDV_Kilobot-main > matlab > testfile1.txt". The editor contains the same list of data points as the left panel. A search and replace dialog is open in the top right corner. The search field contains the character "]", and the replace field is empty. The dialog shows "6 of 463" matches. The text in the editor has orange brackets highlighting the closing square brackets of each data point array, which correspond to the search term.

```
1 233.9619140625, 0, 0, 0]
2 335.498046875, 492, 392, 68]
3 408.782958984375, 492, 393, 63]
4 497.131591796875, 492, 393, 59]
5 579.658203125, 493, 393, 59]
6 661.8505859375, 493, 393, 59]
7 737.001953125, 494, 394, 56]
8 803.894287109375, 494, 394, 52]
9 873.19140625, 494, 394, 52]
10 962.216552734375, 495, 395, 45]
11 1064.29248046875, 496, 396, 37]
12 1173.7939453125, 496, 397, 30]
13 1290.044189453125, 497, 397, 33]
14 1375.93310546875, 498, 397, 30]
15 1458.336669921875, 498, 398, 26]
16 1577.498779296875, 499, 398, 26]
17 1704.37255859375, 499, 398, 19]
18 1847.3107265625, 501, 398, 15]
```

Uvoz podatkov v Matlab

Import - C:\Users\EonZ\Desktop\FERI_sistDV_Kilobot-main\FERI_sistDV_Kilobot-main\matlab\testfile1.txt

IMPORT | **VIEW**

☒ Delimited ☐ Fixed Width

Column delimiters: **Comma** (1.)

Range: **A2:D463** (2.)

Output Type: **Column vectors** (3.)

Variable Names Row: 1

☐ Replace unimportable cells with NaN

Import Selection (4.)

testfile1.txt

	A T Number	B X Number	C Y Number	D F Number
1	233.961914...	0	0	0
2	335.498046...	492	392	68
3	408.782958...	492	393	63
4	497.131591...	492	393	59
5	579.658203...	493	393	59
6	661.850585...	493	393	59

Import Selection

The following variables were imported:
[T \(462x1\)](#)
[X \(462x1\)](#)
[Y \(462x1\)](#)
[F \(462x1\)](#)

Workspace


Name	Value
F	462x1 double
T	462x1 double
X	462x1 double
Y	462x1 double

Priprava podatkov na izris

```
1 %clear
2 clc
3 close all
4 %https://ctms.engin.umich.edu/CTMS/index.php?example=Introduction&section=ControlStateSpace
5 load("matlab.mat")
6 generate = true;
7 N = 462;
8 T=T*1E-3;
9 if (generate)
10     t = 1:N;
11     d_X = zeros(1,N); %Rezercacija prostora v pomnilniku
12     d_Y = zeros(1,N);
13     d_F = zeros(1,N);
14
15     dd_X = zeros(1,N);
16     dd_Y = zeros(1,N);
17     dd_F = zeros(N);
18
19     x1= zeros(1,N);
20     x2 = zeros(1,N);
21
22     for i=1:N %Generiranje vhodnih funkcij
23         if(T(i)<=6.309)
24             x1(i) = 1500;
25         elseif ((T(i) > 7.363 && T(i)<=37.482))
26             x2(i) = 2000;
27         elseif (T(i) > 38.535)
28             x1(i) = 1400;
29             x2(i) = 1400;
30         end
31     end
```

```
32 sort = true; %Pretvorba merjenega položaja v "zvezno" verzijo
33 F2=F; %Vrednosti niso več 0-360
34 d_F2 = d_F;
35 dd_F2 = dd_F;
36 while (sort)
37     sort =false;
38     for i = 2:N
39         if((F2(i)-F2(i-1)) > 300)
40             F2(i) = F2(i)-360;
41             sort =true;
42         elseif ((F2(i)-F2(i-1)) < -300)
43             F2(i) = F2(i)+360;
44             sort =true;
45         end
46         d_F2(i) = (F2(i)-F2(i-1))/(T(i)-T(i-1));
47         dd_F2(i)= (d_F2(i)-d_F2(i-1))/(T(i)-T(i-1));
48     end
49 end
50
51 x1=x1';
52 x2=x2';
53 sum_dT=0;
54 for i=2:N %Računanje prvih odvodov položajev, povprečnega časa zajema
55     d_T=T(i)-T(i-1);
56     sum_dT=sum_dT+d_T;
57
58     d_X(i)=(X(i)-X(i-1))/d_T;
59     d_Y(i)=(Y(i)-Y(i-1))/d_T;
60     d_F(i)=(F(i)-F(i-1))/d_T;
61 end
62 avg_dT=sum_dT/N
63
64 d_X(1)=d_X(2);
65 d_Y(1)=d_Y(2);
66 d_F(1)=d_F(2);
```

Priprava podatkov na izris

```
67
68 
69
70
71
72
73
74
75
76
77
78
79
80
```

```
    for i=2:N      %Računanje drugih odvodov položajev
        dd_X(i-1)=(d_X(i)-d_X(i-1))/(T(i)-T(i-1));
        dd_Y(i-1)=(d_Y(i)-d_Y(i-1))/(T(i)-T(i-1));
        dd_F(i-1)=(d_F(i)-d_F(i-1))/(T(i)-T(i-1));
    end
    dd_X(1)=dd_X(2);
    dd_Y(1)=dd_Y(2);
    dd_F(1)=dd_F(2);

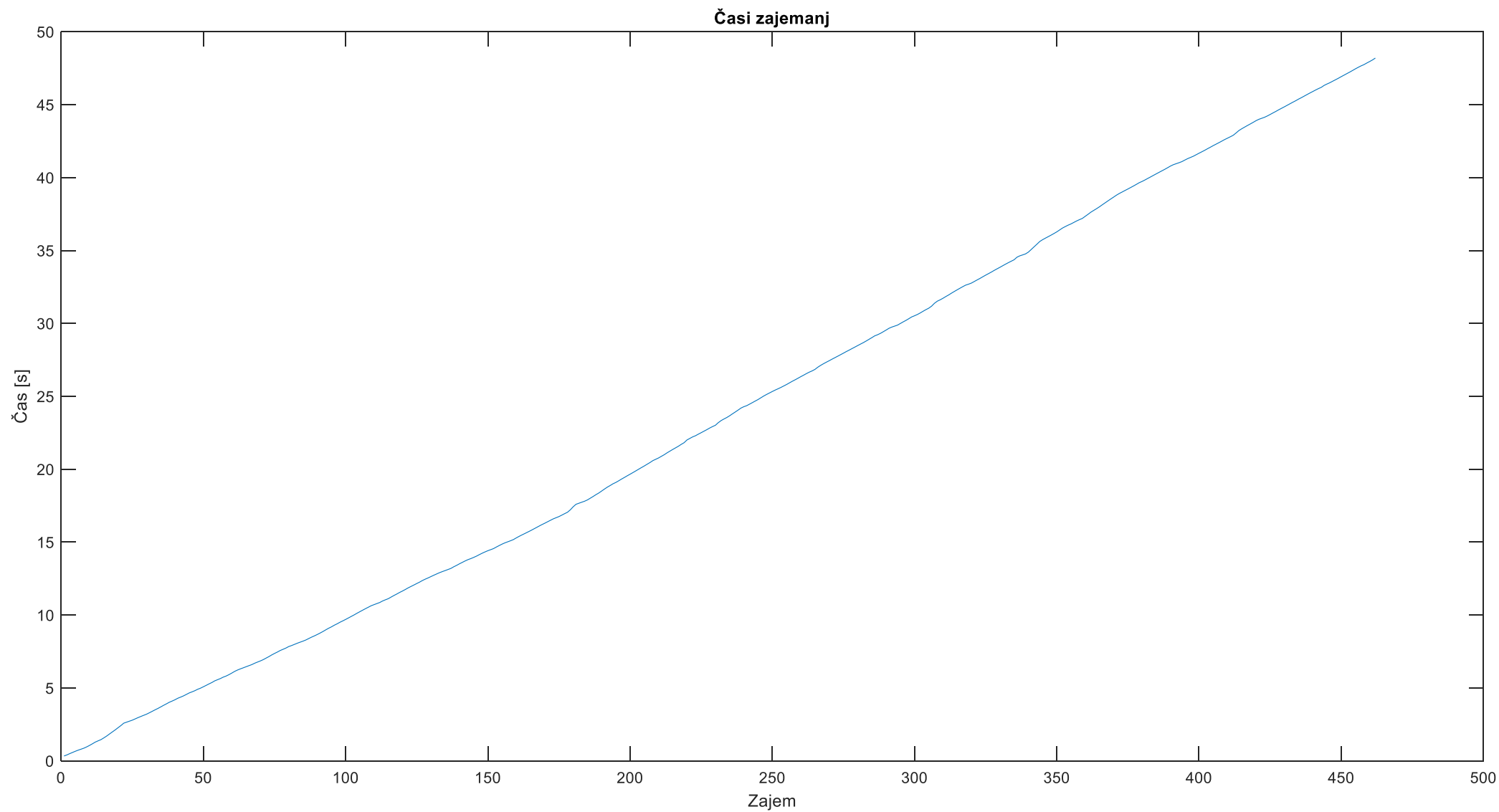
end
%Pakiranje vhodov in izhodov v skupne spremenljivke
X_in = [x1,x2];
Y_out=[X, Y, F2];
```

```
avg_dT =
0.1036
```

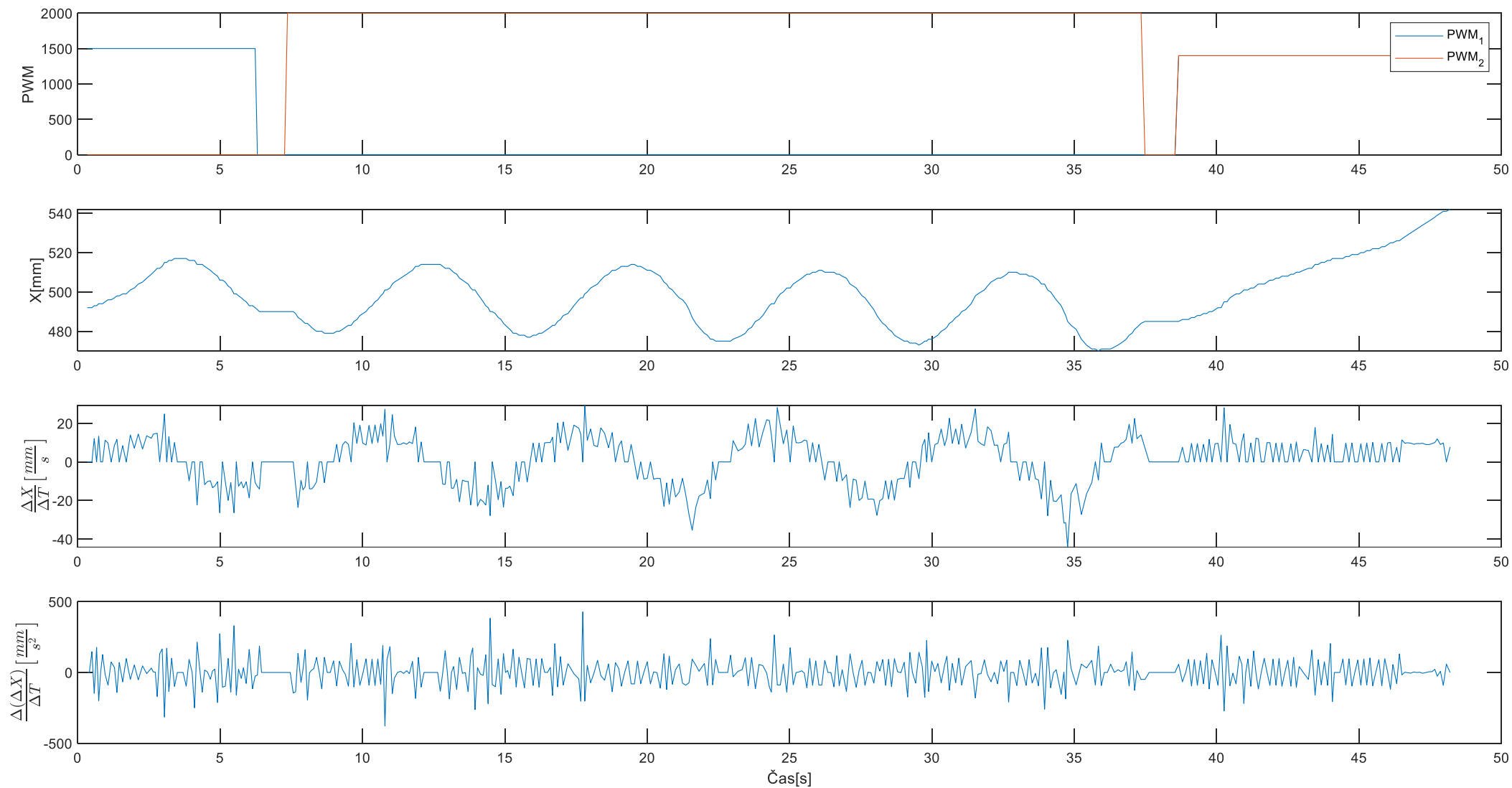
Izris grafov

```
84 plot(t,T) %T
85 title("Časi zajemanj")
86 xlabel("Zajem")
87 ylabel("Čas [s]")
88
89 figure(2)
90 subplot(4,1,1);
91 plot(T,x1,T,x2)
92 ylabel("PWM")
93 legend("PWM_1", "PWM_2");
94 subplot(4,1,2);
95 plot(T,X)
96 ylabel("X[mm]")
97 subplot(4,1,3);
98 plot(T,d_X)
99 ylabel("$\frac{\Delta X}{\Delta T}[\frac{mm}{s}]$", 'interpreter', 'latex', 'FontSize', 14)
100 subplot(4,1,4);
101 plot(T,dd_X)
102 ylabel('$\frac{\Delta (\Delta X)}{\Delta T}[\frac{mm}{s^2}]$', 'interpreter', 'latex', 'FontSize', 14)
103 xlabel("Čas[s]")
104
105 figure(3)
106 subplot(4,1,1);
107 plot(T,x1,T,x2)
108 ylabel("PWM")
109 legend("PWM_1", "PWM_2");
110 subplot(4,1,2);
111 plot(T,Y)
112 ylabel("Y[mm]")
113 subplot(4,1,3);
114 plot(T,d_Y)
115 ylabel("$\frac{\Delta Y}{\Delta T}[\frac{mm}{s}]$", 'interpreter', 'latex', 'FontSize', 14)
116 subplot(4,1,4);
117 plot(T,dd_Y)
118 ylabel("$\frac{\Delta (\Delta Y)}{\Delta T}[\frac{mm}{s^2}]$", 'interpreter', 'latex', 'FontSize', 14)
119 xlabel("Čas[s]")
```

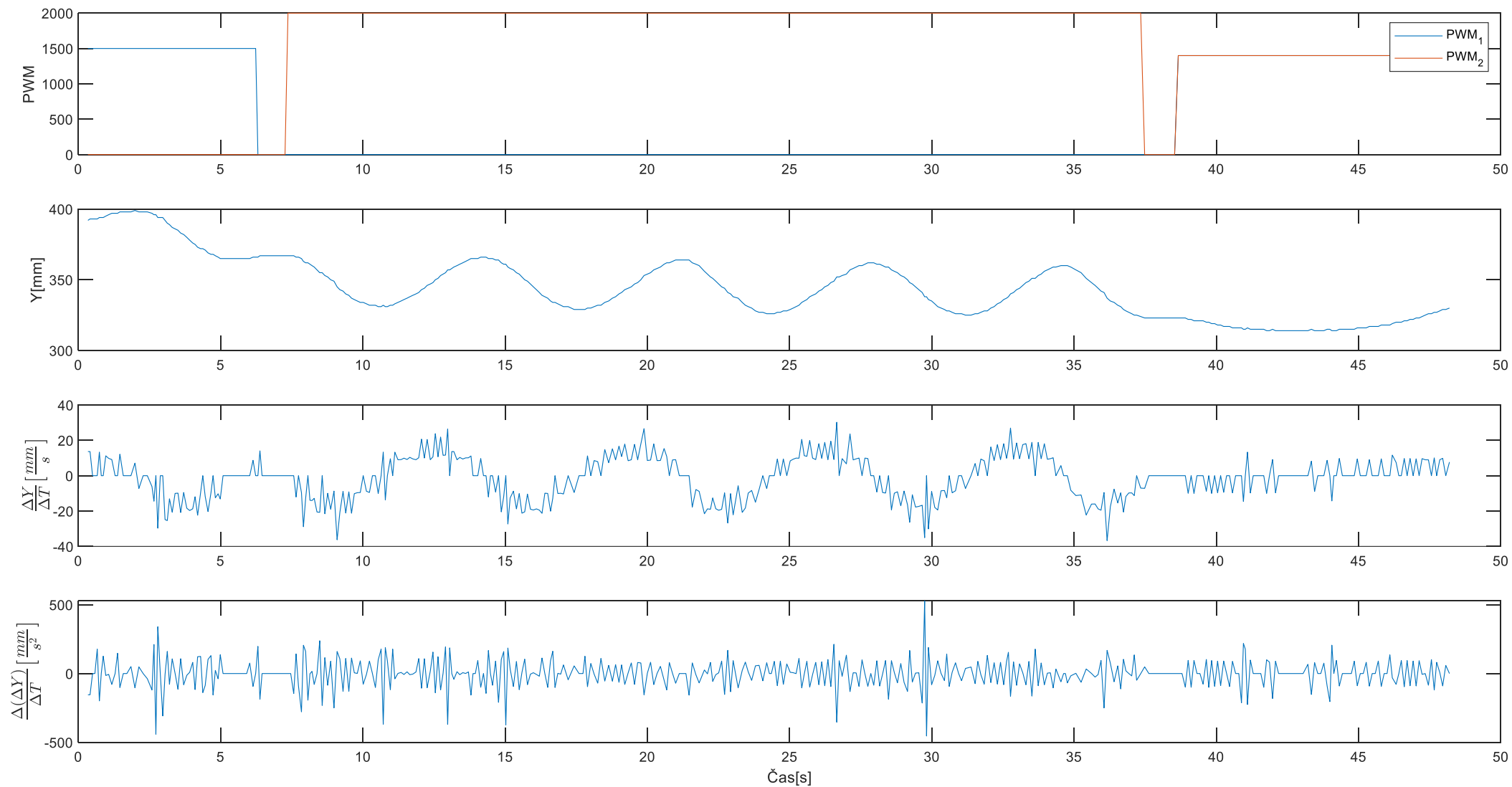
```
121 figure(4)
122 subplot(4,1,1);
123 plot(T,x1,T,x2)
124 ylabel("PWM")
125 legend("PWM_1", "PWM_2");
126 subplot(4,1,2);
127 plot(T,F)
128 ylabel("\theta_{kamera}[\circ]")
129 subplot(4,1,3);
130 plot(T,d_F)
131 ylabel("$\frac{\Delta \theta_{kamera}}{\Delta T}[\frac{\circ}{s}]$", 'interpreter', 'latex', 'FontSize', 14)
132 subplot(4,1,4);
133 plot(T,dd_F)
134 ylabel("$\frac{\Delta (\Delta \theta_{kamera})}{\Delta T}[\frac{\circ}{s^2}]$", 'interpreter', 'latex', 'FontSize', 14)
135 xlabel("Čas[s]")
136
137 figure(5)
138 subplot(4,1,1);
139 plot(T,x1,T,x2)
140 ylabel("PWM")
141 legend("PWM_1", "PWM_2");
142 subplot(4,1,2);
143 plot(T,F2)
144 ylabel("\theta_{zvezni}[\circ]")
145 subplot(4,1,3);
146 plot(T,d_F2)
147 ylabel("$\frac{\Delta \theta_{zvezni}}{\Delta T}[\frac{\circ}{s}]$", 'interpreter', 'latex', 'FontSize', 14)
148 subplot(4,1,4);
149 plot(T,dd_F2)
150 ylabel("$\frac{\Delta (\Delta \theta_{zvezni})}{\Delta T}[\frac{\circ}{s^2}]$", 'interpreter', 'latex', 'FontSize', 14)
151 xlabel("Čas[s]")
```



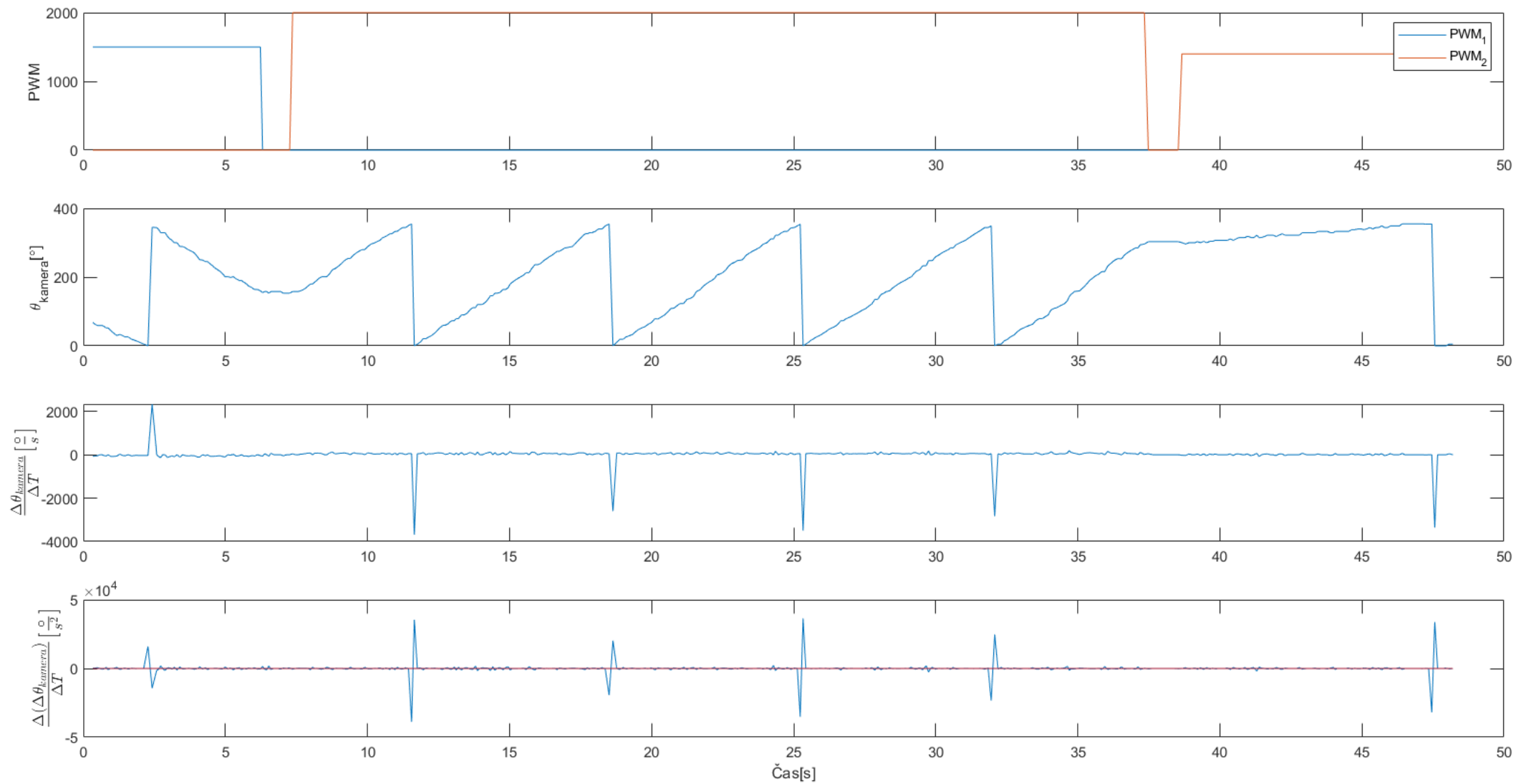
Časi zajemanj



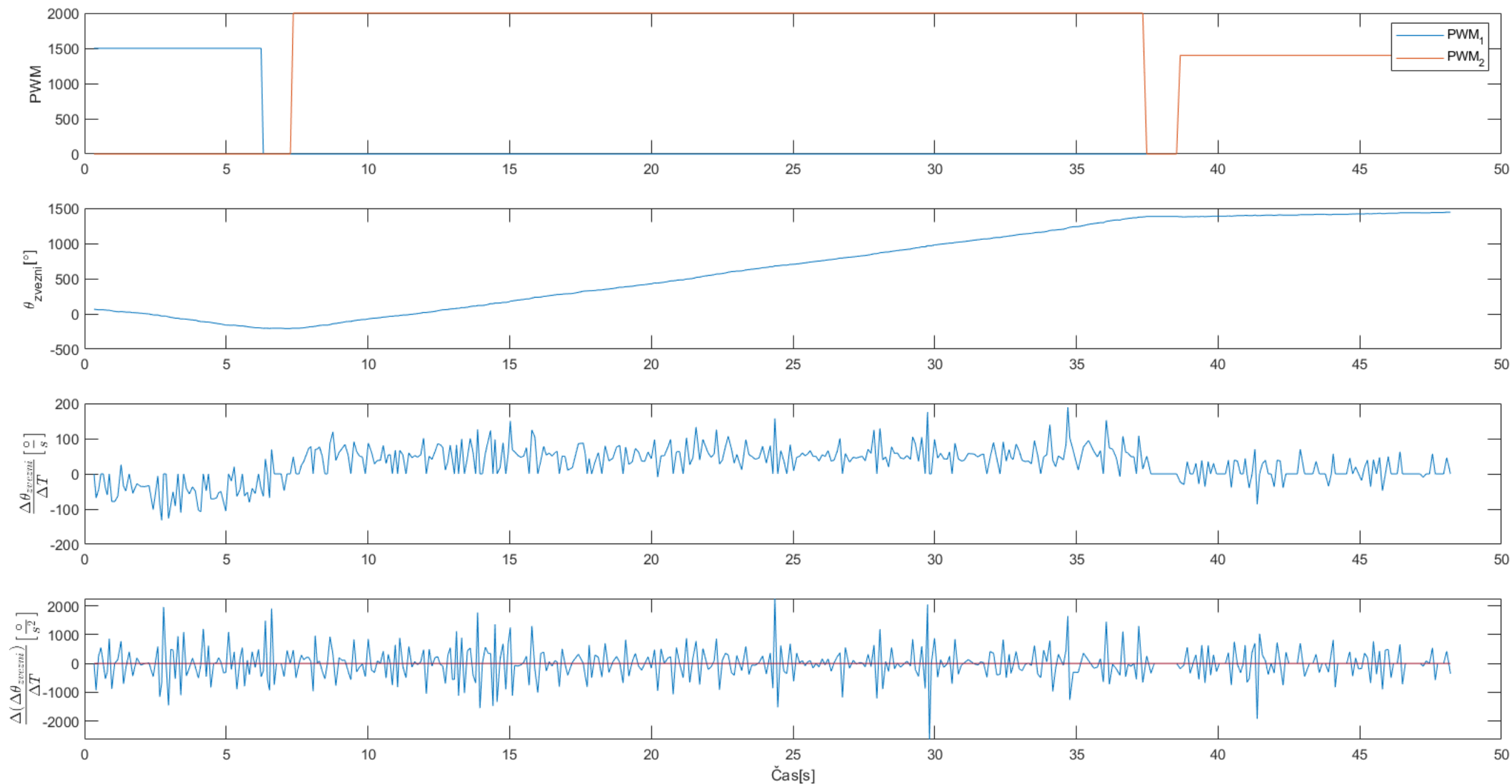
Položaj X



Položaj Y

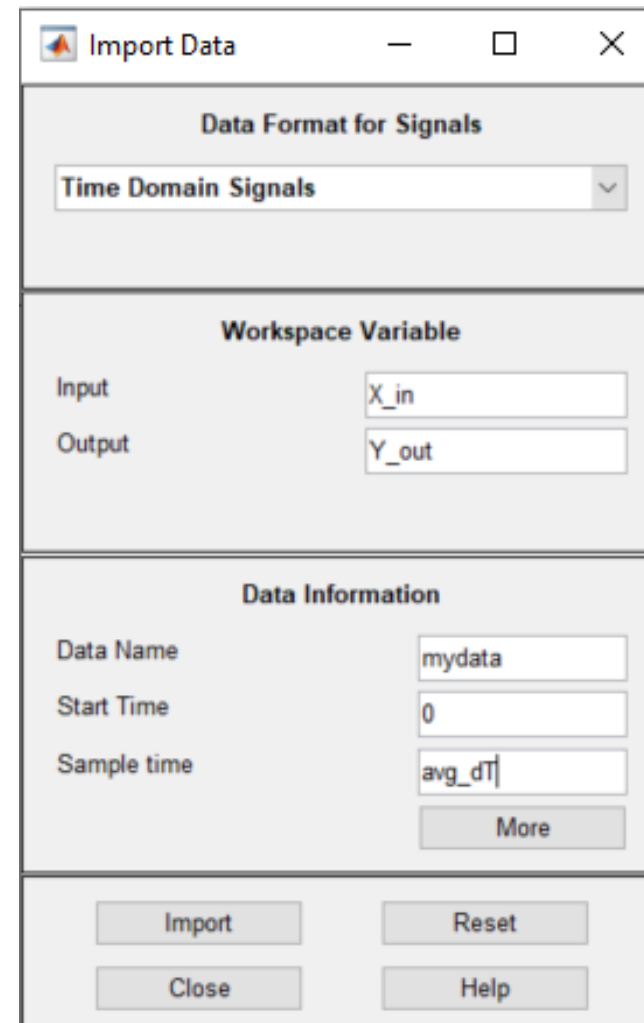
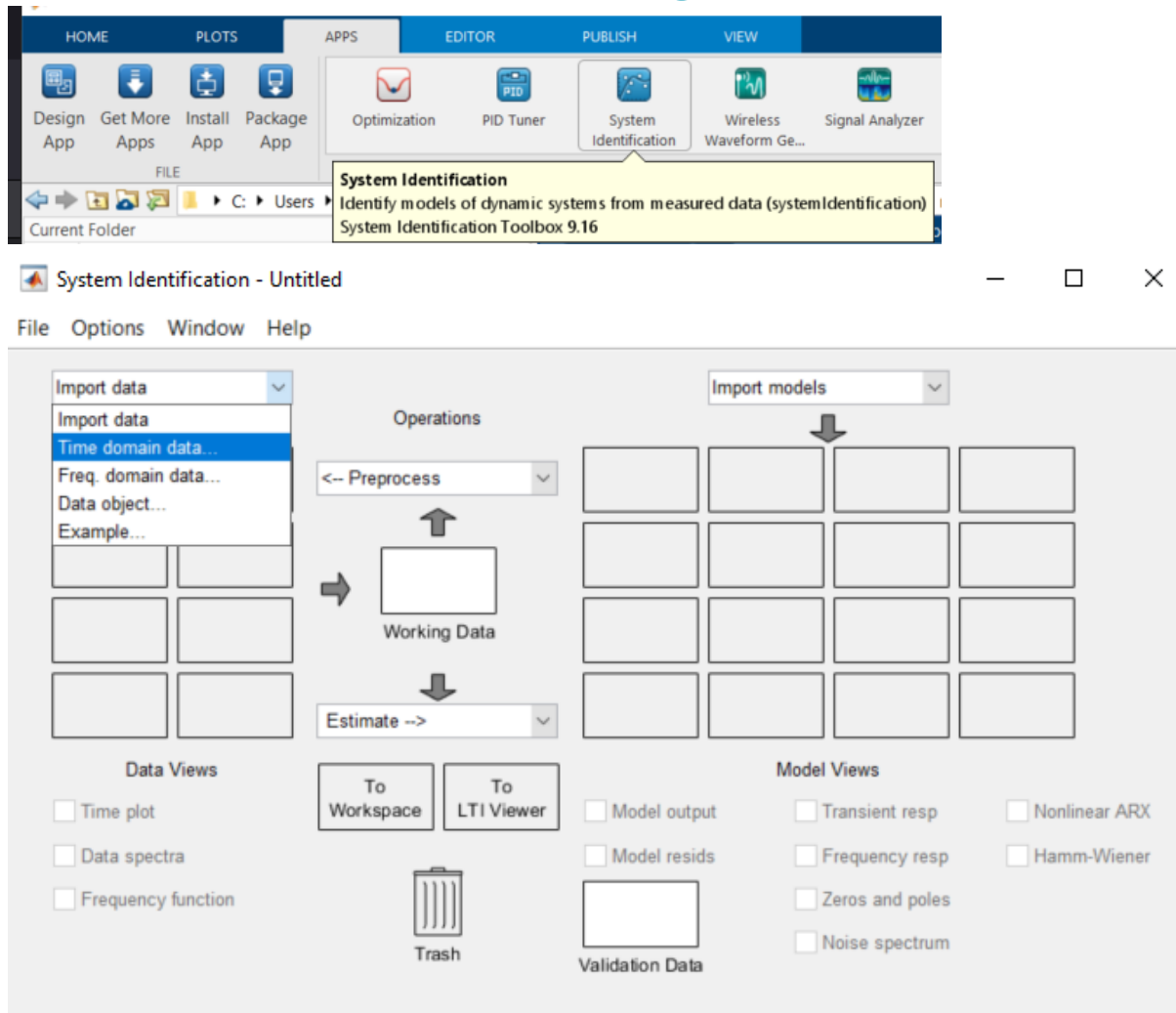


Θ na kameri

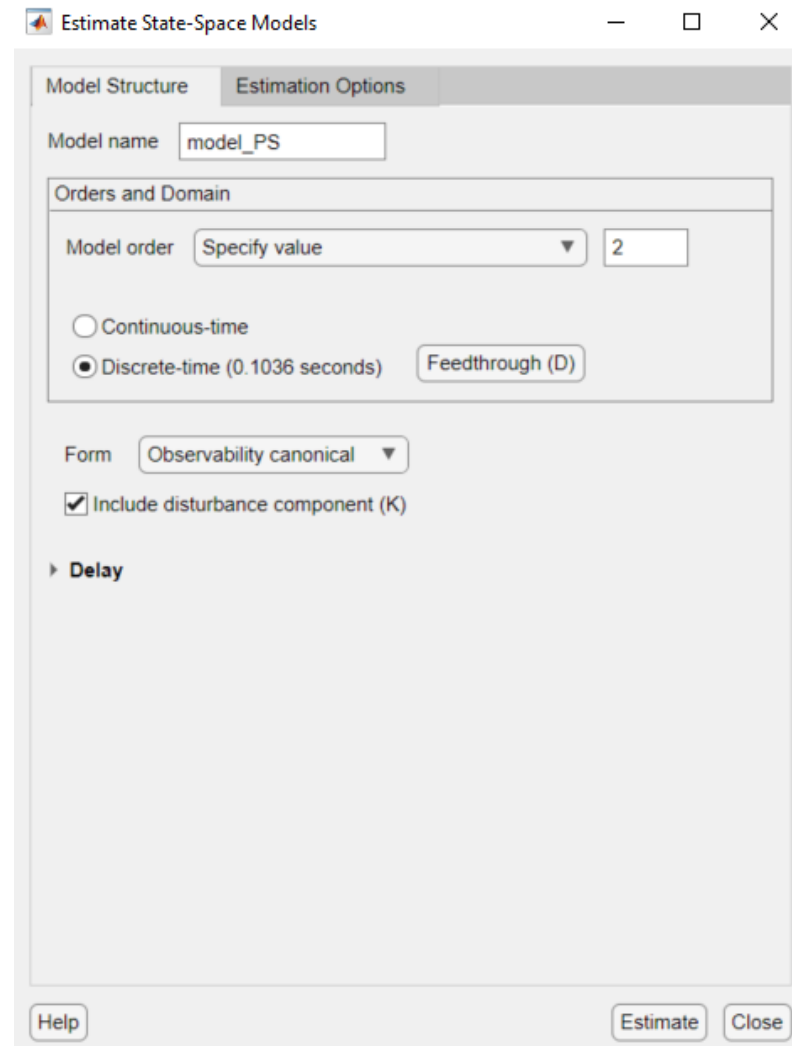
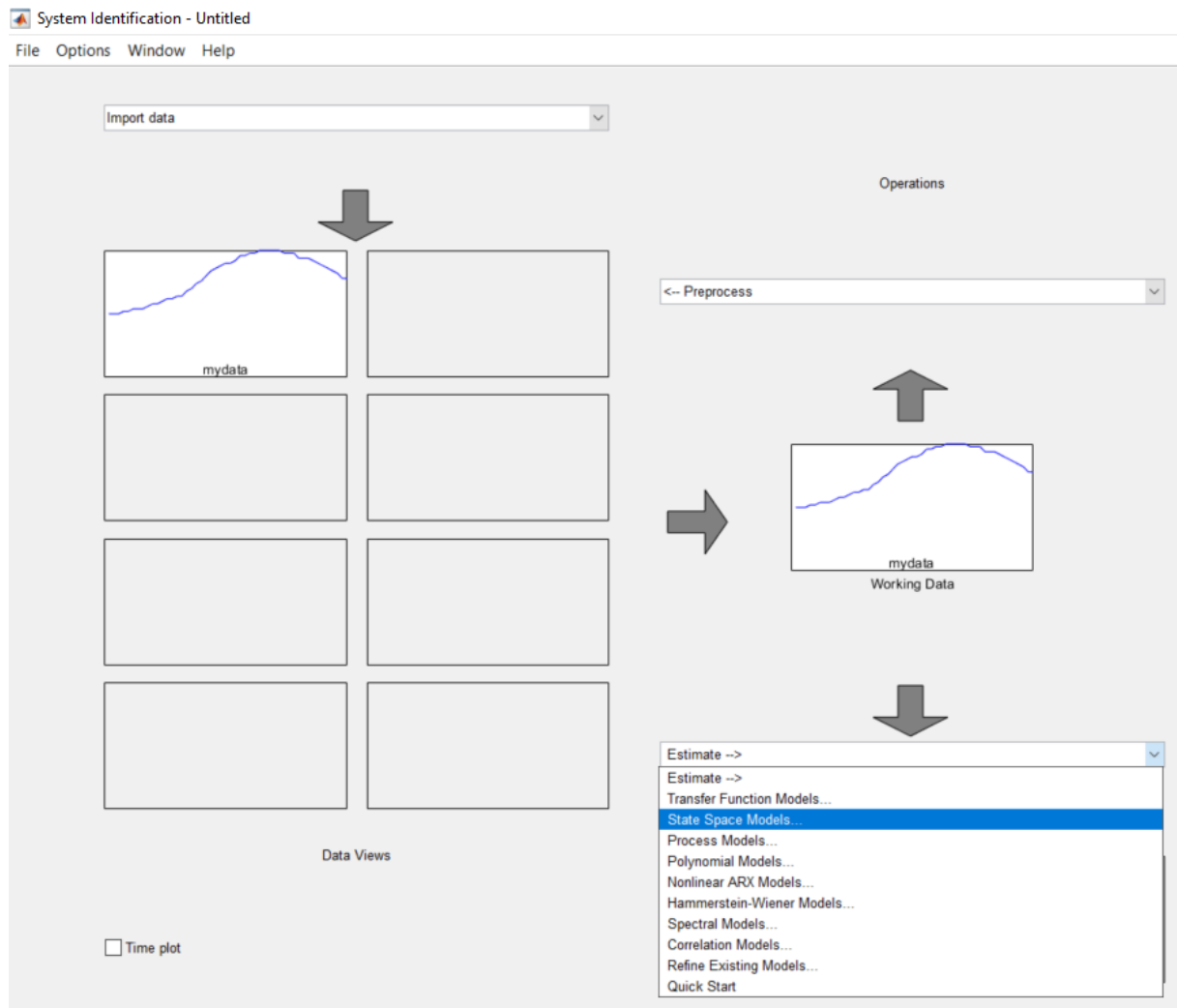


Θ “zvezni”

Uvoz v orodje za identifikacijo



Identifikacija modela



Izvoz podatkov

Data/model Info: model_PS

Model name:

Color:

Discrete-time identified state-space model:

$$\begin{aligned} \mathbf{x}(t+T_s) &= \mathbf{A} \mathbf{x}(t) + \mathbf{B} \mathbf{u}(t) + \mathbf{K} \mathbf{e}(t) \\ \mathbf{y}(t) &= \mathbf{C} \mathbf{x}(t) + \mathbf{D} \mathbf{u}(t) + \mathbf{e}(t) \end{aligned}$$

A =

	x1	x2
x1	1.005	-0.007936
x2	0.003463	0.9947

B =

	u1	u2
x1	-0.0004141	-0.0004305
x2	0.0003763	0.0003664

Diary and Notes

```
% Details about Estimation Data
% Import mydata

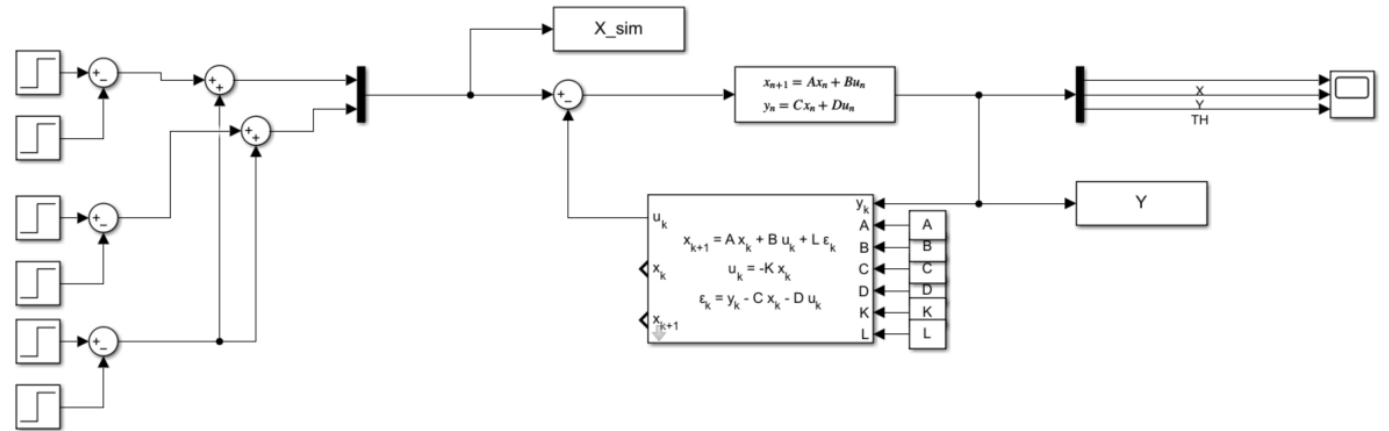
% State space model estimation

model_PS = n4sid(mydata, 2, 'Form', 'canonical')
```

model_PS	
3x2 idss	
Property ^	Value
A	[1.0053,-0.0079;0...
B	[-4.1414e-04,-4.3...
C	[1,0;0,1;40.8255,-...
D	[0,0;0,0;0,0]
K	[0.4470,0.2891,0....
StateName	2x1 cell
StateUnit	2x1 cell
Structure	1x1 ss
NoiseVariance	[382.3091,-490.5...
InputDelay	[0;0]
OutputDelay	[0;0;0]
Ts	0.1036
TimeUnit	'seconds'
InputName	2x1 cell
InputUnit	2x1 cell
InputGroup	1x1 struct
OutputName	3x1 cell
OutputUnit	3x1 cell
OutputGroup	1x1 struct
Notes	8x1 cell
UserData	[]
Name	'model_PS'
SamplingGrid	1x1 struct
Report	1x1 n4sid

Priprava modela za simulacijo

```
152 %%  
153  
154 %Model v prostoru stanj in observer  
155 %model_ps  
  
156  
157 A=model_PS.A;  
158 B=model_PS.B;  
159 C=model_PS.C;  
160 D=model_PS.D;  
161 K=model_PS.K;  
162  
163  
164 L_T=place(A',C',[-12 -11]);  
165 L=L_T';  
166 X_in=[T x1 x2]  
167
```



Izris simulacije modela

```
figure(6)
subplot(4,1,1);
plot(X_sim.time,X_sim.signals.values(:,1),X_sim.time,X_sim.signals.values(:,2))
ylabel("PWM")
legend("PWM_1", "PWM_2");
subplot(4,1,2);
plot(Y.time,Y.signals.values(:,1))
ylabel("X [mm]")
subplot(4,1,3);
plot(Y.time,Y.signals.values(:,2))
ylabel("Y [mm]")
subplot(4,1,4);
plot(Y.time,Y.signals.values(:,3))
ylabel("\theta [\circ]")
xlabel("Čas[s]")
```

Izris simulacije modela

