

Lab Report 7

State Space Modeling



Submitted by:

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Submitted To:

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“On my honor, as student of University of Engineering and Technology, I have neither given nor received unauthorized assistance on this academic work.”

Objective:

In this lab we learn about how to transfer

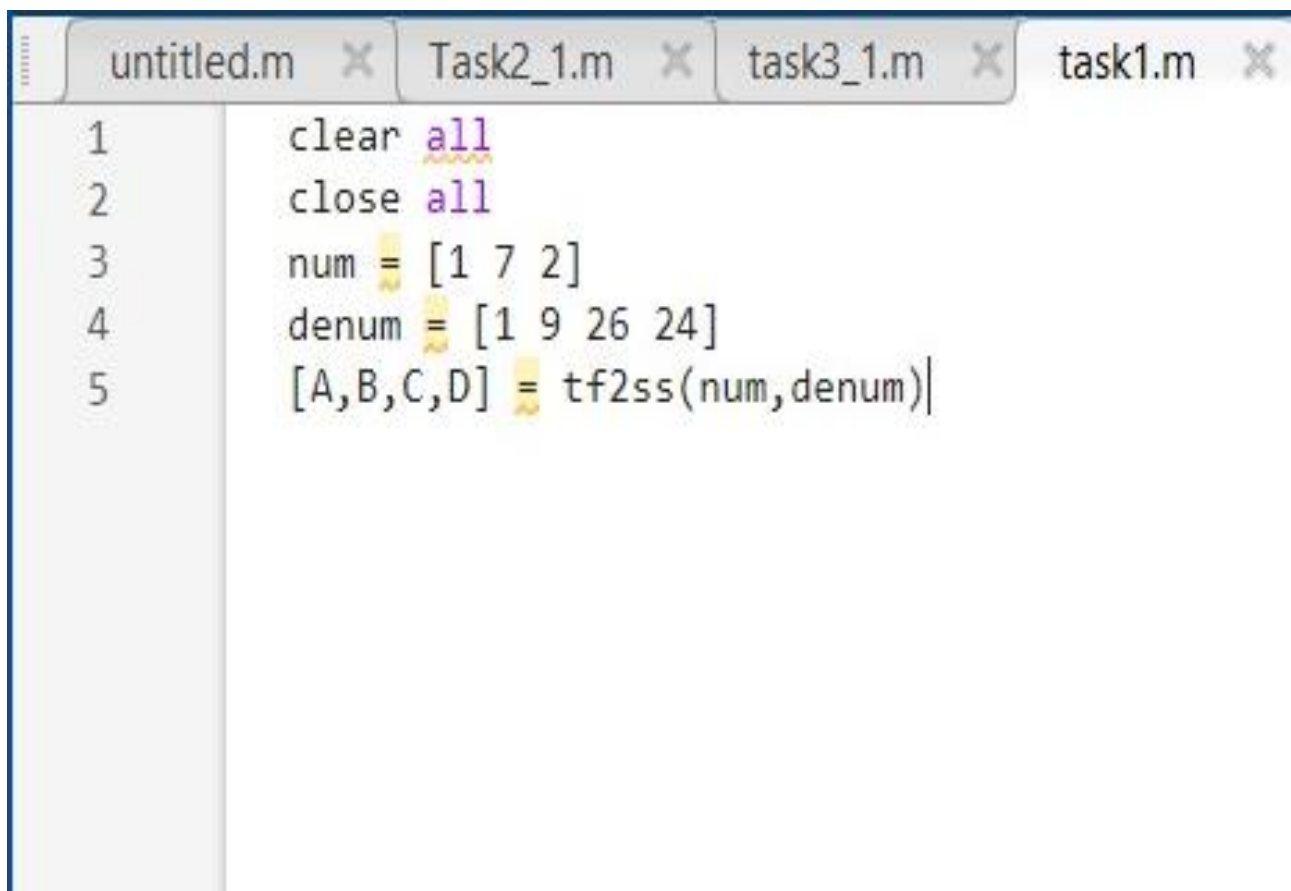
- State space to transfer function.
- Transfer function into state space.

Task 1:

TF to SS using TF2SS function in MATLAB:

$$\text{sys} = s^2 + 7s + 2 / s^3 + 9s^2 + 26s + 24$$

Code:

A screenshot of a MATLAB script editor window. The window has four tabs at the top: 'untitled.m', 'Task2_1.m', 'task3_1.m', and 'task1.m'. The 'task1.m' tab is active. The script contains five lines of code:

```
1 clear all
2 close all
3 num = [1 7 2]
4 denum = [1 9 26 24]
5 [A,B,C,D] = tf2ss(num,denum)
```

Output:

```
Command Window
New to MATLAB? See resources for Getting Started.

>> task1

num =

    1     7     2

denum =

    1     9    26    24

A =

   -9   -26   -24
    1     0     0
    0     1     0

B =

     1
     0
     0

C =

    1     7     2

D =

     0

fx >> |
```

Task 2:

SS to TF

Code:

```
untitled.m x Task2_1.m x task3_1.m x task1.m x task2.m x
1 clear all
2 close all
3 A=[-4 -1.5;4 0];
4 B=[2;0];
5 C=[1.5 0.625];
6 D=0;
7 T = ss(A,B,C,D);
8 T = tf(T)
```

Output:

```
>> task2
```

```
T =
```

$$\frac{3s + 5}{s^2 + 4s + 6}$$

```
Continuous-time transfer function.
```

```
fx >>
```

Task 3:

TF to SS using TF2SS function in MATLAB:

$$\text{Sys} = 8s + 10 / s^4 + 5s^3 + s^2 + 5s + 13$$

Code:

```
untitled.m x Task2_1.m x task3_1.m x task1.m x task2.m x task3.m x
1 clear all
2 close all
3 num = [8 10]
4 denum = [1 5 5 5 13]
5 [A,B,C,D] = tf2ss(num,denum)
```

Output:

```
>> task3

num =

     8     10

denum =

     1     5     5     5    13

A =

    -5    -5    -5   -13
     1     0     0     0
     0     1     0     0
     0     0     1     0

B =

     1
     0
     0
     0

C =

     0     0     8    10

D =

     0
```

fx >>

Task 4:

TF to SS using TF2SS function in MATLAB:

$$\text{Sys} = s^4 + 2s^3 + 12s^2 + 7s + 6 / s^5 + 9s^4 + 13s^3 + 8s^2$$

Code:

```
1 clear all
2 close all
3 num = [1 2 12 7 6]
4 denum = [1 9 13 8 0 0]
5 [A,B,C,D] = tf2ss(num,denum)
```

Output:

```
>> task4
```

```
num =
```

```
1 2 12 7 6
```

```
denum =
```

```
1 9 13 8 0 0
```

```
A =
```

```
-9 -13 -8 0 0  
1 0 0 0 0  
0 1 0 0 0  
0 0 1 0 0  
0 0 0 1 0
```

```
B =
```

```
1  
0  
0  
0  
0
```

```
C =
```

```
1 2 12 7 6
```

```
D =
```

```
0
```

```
fx >>
```

Task 5:

SS to TF

Code:

```
untitled.m x Task2_1.m x task3_1.m x task1.m x task2.m x task3.m x task4.m x task5.m x
1 clear all
2 close all
3 A=[0 1 5 0;0 0 1 0;0 0 0 1;-7 -9 -2 -3];
4 B=[0;5;8;2];
5 C=[1 3 6 6];
6 D=0;
7 T = ss(A,B,C,D);
8 T = tf(T)
```

Output:

```
>> task5

T =

    75 s^3 - 96 s^2 - 2331 s - 210
-----
    s^4 + 3 s^3 + 2 s^2 + 44 s + 7

Continuous-time transfer function.

fx >>
```

Task 6:

SS to TF

Code:

```
untitled.m x Task2_1.m x task3_1.m x task1.m x task2.m x task3.m x task4.m x task5.m x task6.m x
1 clear all
2 close all
3 A=[3 1 0 4 -2;-3 5 -5 2 -1;0 1 -1 2 8;-7 6 -3 -4 0;-6 0 4 -3 1];
4 B=[2;7;8;5;4];
5 C=[1 -2 -9 7 6];
6 D=0;
7 T = ss(A,B,C,D);
8 T = tf(T)
```

Output:

```
>> task6

T =

-25 s^4 - 292 s^3 + 1680 s^2 + 1.628e04 s + 3.188e04
-----
s^5 - 4 s^4 - 32 s^3 + 148 s^2 - 1153 s - 4480

Continuous-time transfer function.

fx >>
```