UUM 500E: Homework #0

12591 - Tuesday

Due on Monday, Oct 8, 2018

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Contents

1 Examples

1.1 Equations

$$f(x) = \underbrace{(x+2)^3}_{\text{text 1}} + \Big(\overbrace{(c - 2d)}^{\text{text 2}} + \overbrace{(3e - 4f)}^{\text{text 4}}\Big) + \overbrace{(x-3)}^{\text{text 5}}$$

(with $\underbrace{2d) + (3e}_{\text{text 3}}$)

$$\begin{vmatrix} \lambda - 1 & 0 & 0 \\ 0 & \lambda - 2 & 0 \\ 0 & 0 & \lambda - 3 \end{vmatrix} = (\lambda - 1)(\lambda - 2)(\lambda - 3) = 0$$

$$\Big\| \sum_{i=1}^{n} a_i(e_i - v_i) \Big\|^2 = \Big\langle \sum_{i=1}^{n} a_i(e_i - v_i), \sum_{j=1}^{n} a_j(e_j - v_j) \Big\rangle$$

$$\begin{aligned} c_{11} &= a_{11}b_{11} + \cdots + a_{1n}b_{n1} \\ c_{22} &= a_{21}b_{12} + \cdots + a_{2n}b_{n2} \\ &\vdots \\ c_{nn} &= a_{n1}b_{1n} + \cdots + a_{nn}b_{nn} \end{aligned} \tag{1}$$

$$e_3 = \Big|\Big| x^2 - x + \frac{1}{6} \Big|\Big| = \sqrt{\int_0^1 \Big(x^2 - x + \frac{1}{6}\Big) dx} = \sqrt{\frac{1}{180}} = \frac{1}{6\sqrt{5}}$$

$$\lim_{x \to \infty} p(x) = \lim_{x \to -\infty} p(x) = \infty$$

$$f(x, y) = \begin{cases} \frac{x^4 - y^4}{(x^2 + y^2)^2} & (x, y) \neq 0 \\ b & (x, y) = 0 \end{cases}$$

$$\lim_{(x,y) \to (0,0)} \frac{x^4 - y^4}{(x^2 + y^2)^2}$$

$$D_F(x, y, z) = \begin{bmatrix} \frac{\partial f}{\partial x} & \frac{\partial f}{\partial y} & \frac{\partial f}{\partial z} \\ \frac{\partial g}{\partial x} & \frac{\partial g}{\partial y} & \frac{\partial g}{\partial z} \\ \frac{\partial (f+g)}{\partial x} & \frac{\partial (f+g)}{\partial y} & \frac{\partial (f+g)}{\partial z} \end{bmatrix}$$

$$
\begin{aligned}
f(x_1, x_2) &= x_1 e^{-x_2} + x_2 + 1, x_0 \\
f_{x_1}(x_1, x_2) &= e^{-x_2}, \\
f_{x_2}(x_1, x_2) &= -x_1 e^{-x_2} + 1 \\
f_{x_1 x_1}(x_1, x_2) &= 0 \\
f_{x_1 x_2}(x_1, x_2) &= -e^{-x_2} \\
f_{x_2 x_2}(x_1, x_2) &= x_1 e^{-x_2}
\end{aligned}
$$

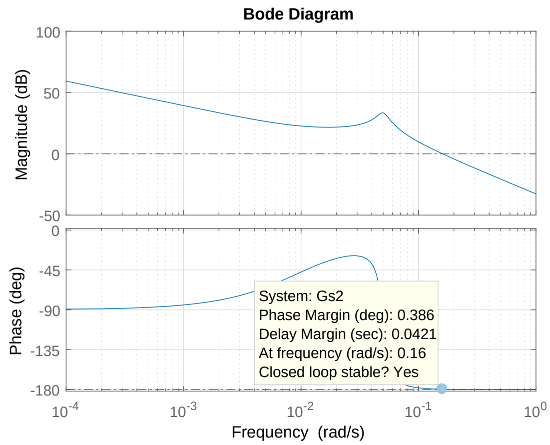
$$
\begin{bmatrix}
1 & 0 & \dots & 0 & 0 \\
-a & 1 & \ddots & \ddots & 0 \\
0 & -a & 1 & \ddots & 0 \\
\vdots & \vdots & \ddots & \ddots & \vdots \\
0 & 0 & 0 & -a & 1
\end{bmatrix}
\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_n \end{bmatrix}
= b \begin{bmatrix} u_1 \\ u_2 \\ \vdots \\ u_n \end{bmatrix}
+ \begin{bmatrix} v_1 \\ v_2 \\ \vdots \\ v_n \end{bmatrix}
$$

$$
\left.\frac{\partial^2 T}{\partial x^2}\right|_{m,n} = \frac{\partial T/\partial x|_{m+1/2,n} - \partial T/\partial x|_{m-1/2,n}}{\Delta x}
$$

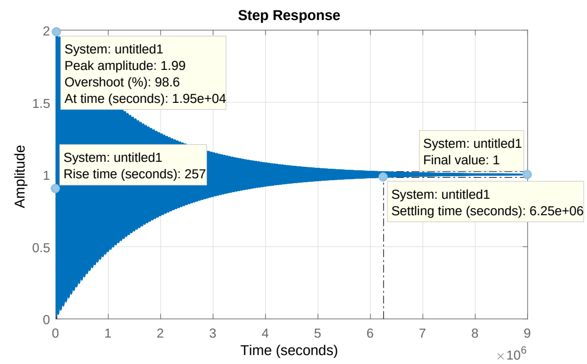
$$
\begin{aligned}
p(x) = 3x^6 &+ 14x^5y + 590x^4y^2 + 19x^3y^3 - 12x^2y^4 - 12xy^5 + 2y^6 - a^3b^3 - 12x^2y^4 - 12xy^5 + 2y^6 - a^3b^3 \\
&- 12x^2y^4 - 12xy^5 + 2y^6 - a^3b^3
\end{aligned}
$$

1.2 Figures

The following figures are just to show the positioning and sizing. They are not sized properly.



(a) Bode gain.



(b) Step response.

Figure 1: Control plots.

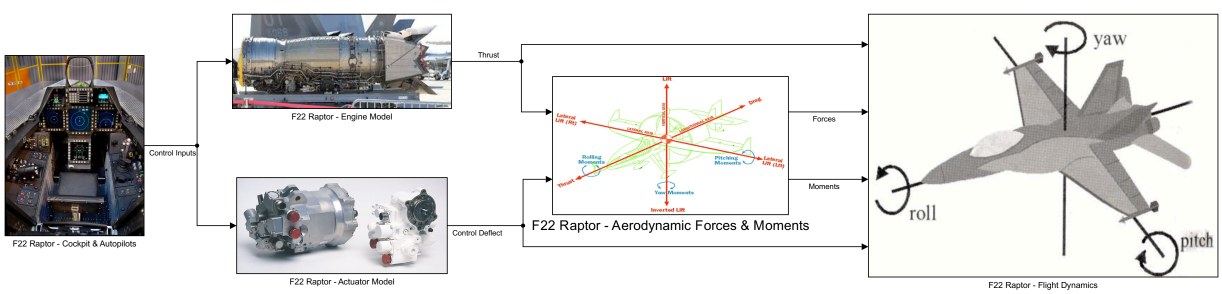


Figure 2: Simulink block that has the environment model

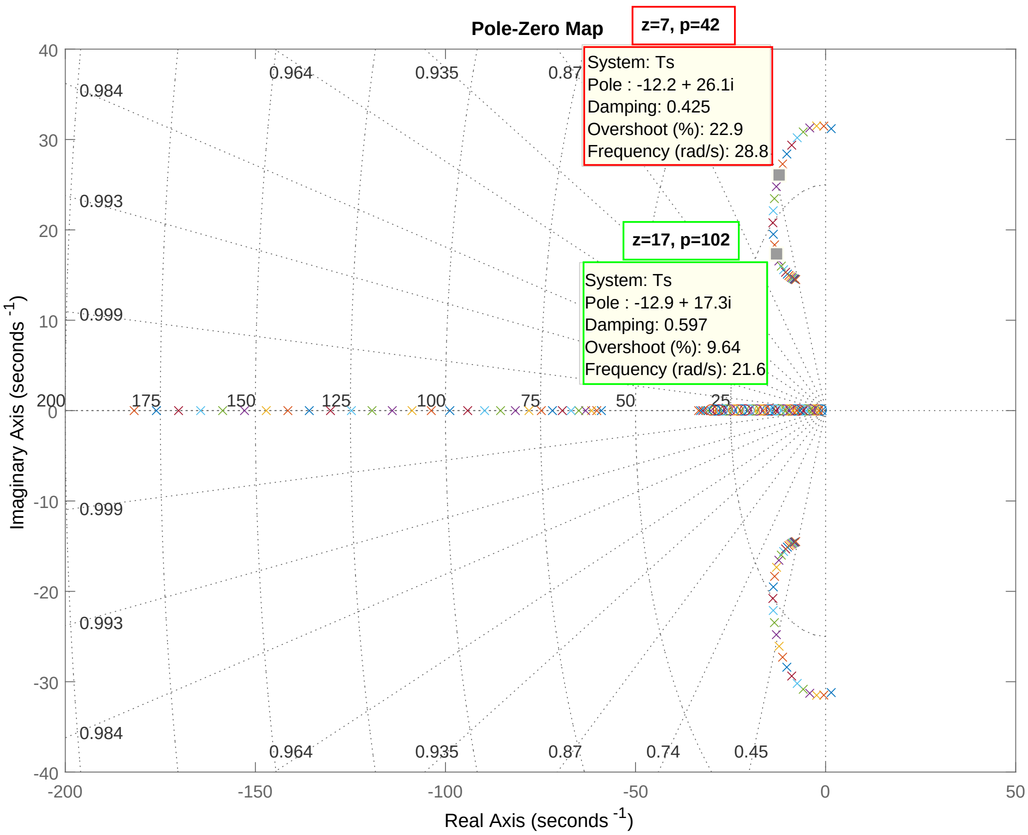


Figure 3: Pole-Zero map of the closed-loop transfer function for different z values

1.3 Tables

Create tables on Latex Table Generator Website. Or prepare in MS Office Excel and save as PDF file.

Table 1: Permutation results

System	K_p	ω_n
$G_1(s)$	0	1
	0	1
	0	1
	0	1

2 Additional Part

Each section should start at a new page.

3 Additional Part

To cite a reference, you need to include them in your bibliography file (.bib). You can find the BibTex information from the Google Scholar or from publishers' websites [1].

4 Additional Part

Codes should be given at Appendices, and Appendices should be located after the references. Check the main file for the sequence.

5 References

[1] G. Franklin, J. Powell, and A. Emami-Naeini, *Feedback Control of Dynamic Systems*. Pearson, 2015.

A MATLAB Codes

A.1 Initialization Code

Listing 1: Plot Code

```
% Graphics for Results Created 08.10.2018, ITU FAA, Istanbul, Turkey by;
% XX        ---> x@mail.com
% XX        ---> x@mail.com
% XX        ---> x@mail.com
% via use making use of the book xx
% For more question about models contact us
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
%-------------------------------------------------------------------------%
figure(1)
title('Velocity,AoA,Beta');
subplot(3,1,1);
plot(Time,States(:,1));
title('Velocity');
xlabel('Time [sec]')
ylabel('Velocity [m/sec]');
grid on
hold on
subplot(3,1,2);
plot(Time,States(:,2)*180/pi);
title('Angle of Attack');
xlabel('Time [sec]')
ylabel('AoA [deg]');
grid on
hold on
subplot(3,1,3);
plot(Time,States(:,3)*180/pi);
title('Beta');
xlabel('Time [sec]')
ylabel('Sideslip Angle [deg]');
grid on
%-------------------------------------------------------------------------%
figure(2)
title('Roll,Pitch,Yaw');
subplot(3,1,1);
plot(Time,States(:,4)*180/pi);
title('Roll');
```

```
xlabel('Time [sec]')
ylabel('Phi [deg]');
grid on
hold on
subplot(3,1,2);
plot(Time,States(:,5)*180/pi);
title('Pitch');
xlabel('Time [sec]')
ylabel('Theta [deg]');
grid on
hold on
subplot(3,1,3);
plot(Time,States(:,6)*180/pi);
title('Yaw');
xlabel('Time [sec]')
ylabel('Psi [deg]');
grid on
hold on
%-----------------------------------------------------------------------%
figure(3)
title('P,Q,R');
subplot(3,1,1);
plot(Time,States(:,7)*180/pi);
title('Roll Rate');
xlabel('Time [sec]')
ylabel('P [deg]');
grid on
hold on
subplot(3,1,2);
plot(Time,States(:,8)*180/pi);
title('Pitch Rate');
xlabel('Time [sec]')
ylabel('Q [deg]');
grid on
hold on
subplot(3,1,3);
plot(Time,States(:,9)*180/pi);
title('Yaw Rate');
xlabel('Time [sec]')
ylabel('R [deg]');
grid on
hold on
%-----------------------------------------------------------------------%
```

```
figure(4)
title('Position');
plot3(States(:,10),States(:,11),(States(:,12)*(-1)));
xlabel('North [m]');
ylabel('East [m]');
zlabel('Altitude [m]');
grid on
hold on
%------------------------------------------------------------------------%
figure(5)
ss = size(States,1);
trajectory3(States(:,10),States(:,11),(States(:,12)*(-1)),...
            States(:,5),States(:,4),States(:,6),0.005,3000,'mig');
%------------------------------------------------------------------------%
```