Simulink Model Code:

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FurutaConstants.m | FurutaVisualization.m

```
%Aaron Dizon, Michael Korhummel, Efrain Cobian - Group Project 3

%Starting view
view(135,20)
%Define Graph Axis
AL = 5;

grid on

%Rotatary arm length
LArm1=4.5;
%Pendulum length
LArm2=3.5;

Xh=[0 ; LArm1]';
Yh=[0 ; 0]';
Zh=[0 ; 0]';

Xv=[Xh(2) ; LArm1]';
Yv=[Yh(2) ; 0]';
Zv=[Zh(2) ; -LArm2]';

hold on
Harm  = fill3(Xh,Yh,Zh,'b');
Varm  = fill3(Xv,Yv,Zv,'g');

s=8;
M=scatter3(Xv(2),Yv(2),Zv(2),s,'filled','MarkerFaceColor','b','MarkerEdgeColor','k')

```

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```
31 -    axis([-AL AL -AL AL -AL AL]);
32
33 -    thet=0;
34 -    phi=0;
35 -    c = [0 0 0];
36
37 -    TXT=title('Time: ')
38
39 -  for t=1:20:size(simTheta,1)
40 -        TXT2=sprintf('Time:%.2f',simt(t));
41 -        set(TXT,'String',TXT2);
42
43 -        phi=simPhi(t);
44 -        thet =-simTheta(t);
45
46 -        Xh(2)= L1*cos(phi);
47 -        Yh(2)=L1*sin(phi);
48
49 -        Xva = 0;
50 -        Yva = L2*sin(thet);
51 -        Zva = -L2*cos(thet);
52
53 -        Xvb = Xva*cos(phi)-Yva*sin(phi)+L1*cos(phi);
54 -        Yvb = Xva*sin(phi)+Yva*cos(phi) + L1*sin(phi);
55 -        Zvb = Zva;
56
```

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```
57
58 -        Xv=[Xh(2);Xvb]';
59 -        Yv=[Yh(2);Yvb]';
60 -        Zv=[ 0    ;Zvb]';
61
62 -        set(Harm,'XData',Xh);
63 -        set(Harm,'YData',Yh);
64 -        set(Harm,'ZData',Zh);
65          %set(Harm,'FaceVertexCData',C);
66
67 -        set(Varm,'XData',Xv);
68 -        set(Varm,'YData',Yv);
69 -        set(Varm,'ZData',Zv);
70          %set(Varm,'FaceVertexCData',C);
71 -        rem(t,30)
72
73
```

```
78
79
80
81 -         set(M,'XData',Xv(2));
82 -         set(M,'YData',Yv(2));
83 -         set(M,'ZData',Zv(2));
84
85 -         drawnow;
86
87      %       pause(0.0010);
88 -     end
```

Constants Code:

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FurutaConstants.m | FurutaVisualization.m

```
1
2
3     % 1 - Arm
4     % 2 - Pendulum
5
6 -   g = 9.81;
7 -   m1 = 0.380;
8 -   m2 = 0.054;
9 -   L1 = 0.066;
10 -  L2 = 0.146;
11 -  M = 0.044;
12
13    %System
14    %3.5256e-04
15 -  J = 3.5256e-4;
16 -  kb_p = 4.7940e-04 ;
17
18 -  kb_m = 6.75e-4 ;
19 -  ke = 0.5;
20 -  Re = 14.5;
21
22 -  a = J + (M+m1/3+m2)*L1^2;
23 -  b = (M + m2/3)*L2^2;
24 -  gamma = (M + m2/2)*L2*L1;
25 -  sig = (M + m2/2)*g*L2;
26
```

```
27      %% Simulation parameters
28
29 -    initial_state = pi;
30 -    Ts = 0.001;
31 -    dtDisc = 0.01;
32 -    Reference = [0 0 0 0];
33      %Dead Zone
34 -    Zn = 3;
35
36 -    StepX = 10;
37 -    distrub = 12;
38 -    disturb = distrub*pi/180;
39
```

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```
40      %% Linearization
41
42      % A matrix
43 -    A = zeros(4,4);
44 -    A(1,2) = 1;
45 -    A(2,3) = -(sigma*gamma)/(alpha*beta-gamma^2);
46 -    A(3,4) = 1;
47 -    A(4,3) = (alpha*sigma)/(alpha*beta-gamma^2);
48
49      % B matrix
50 -    B = zeros(4,2);
51 -    B(2,1) = beta/(alpha*beta-gamma^2);
52 -    B(2,2) = -gamma/(alpha*beta-gamma^2);
53 -    B(4,1) = -gamma/(alpha*beta-gamma^2);
54 -    B(4,2) = alpha/(alpha*beta-gamma^2);
55
56      % C matrix
57 -    C = [0 0 1 0;
58           0 0 0 1];
59
```