Escola Politécnica da
Universidade de São Paulo

PME 3380

Lista G

Professores: Décio Crisol e Agenor Fleury

Aluno: Maurício Chung Leiman - 10772571

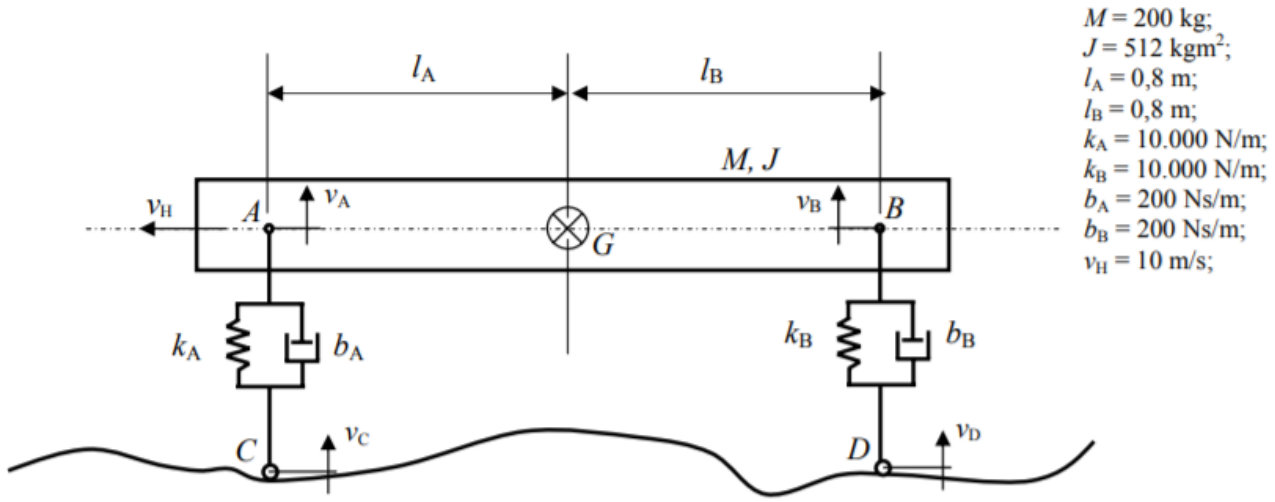
São Paulo

2020

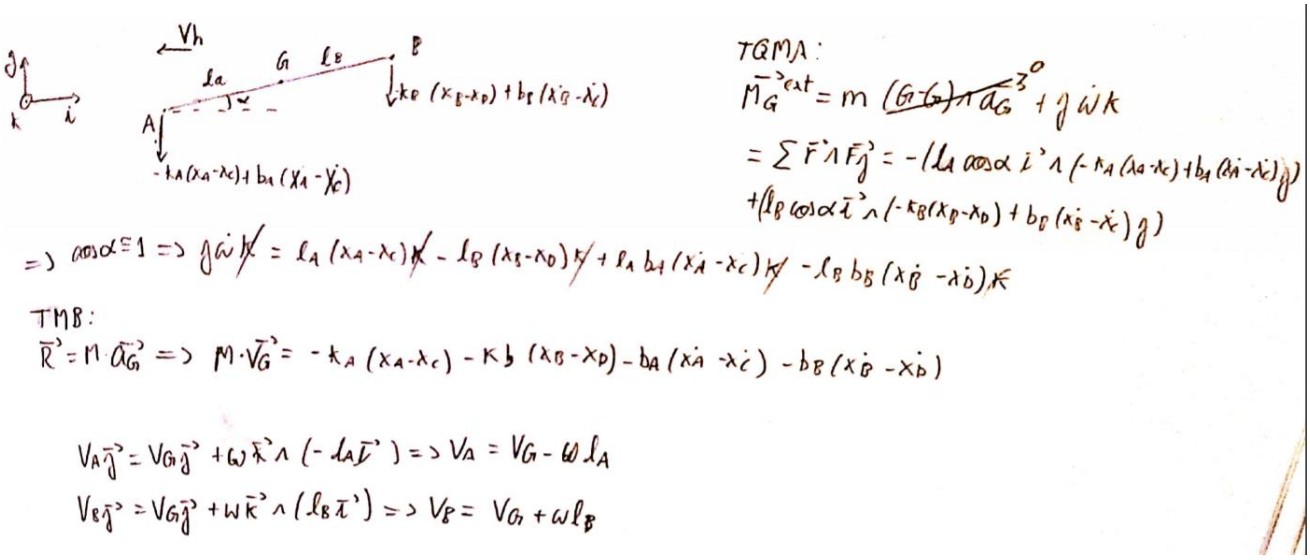
SUMÁRIO

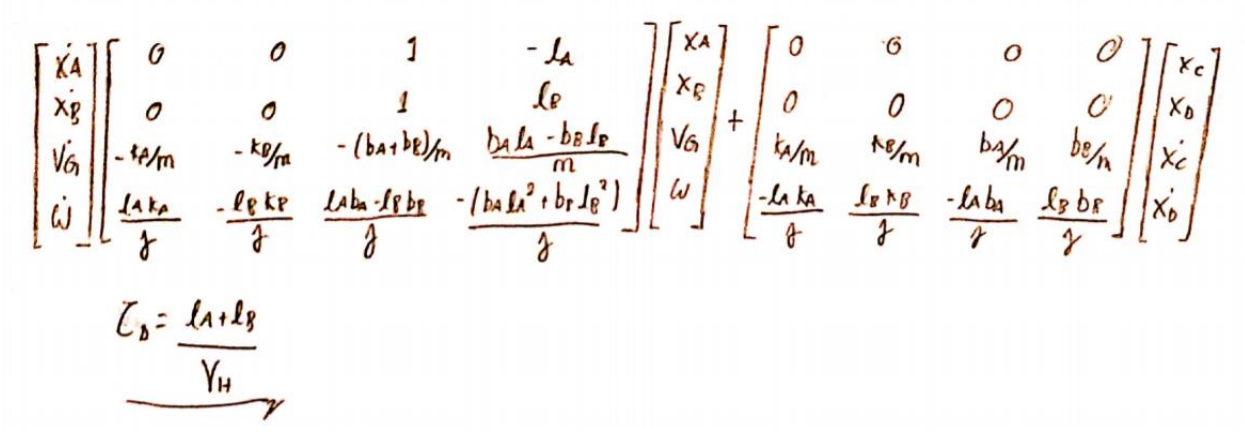
1 PRIMEIRO EXERCÍCIO

O primeiro exercício consiste na obtenção do modelo que descreve o problema do meio-carro, representado na imagem abaixo:



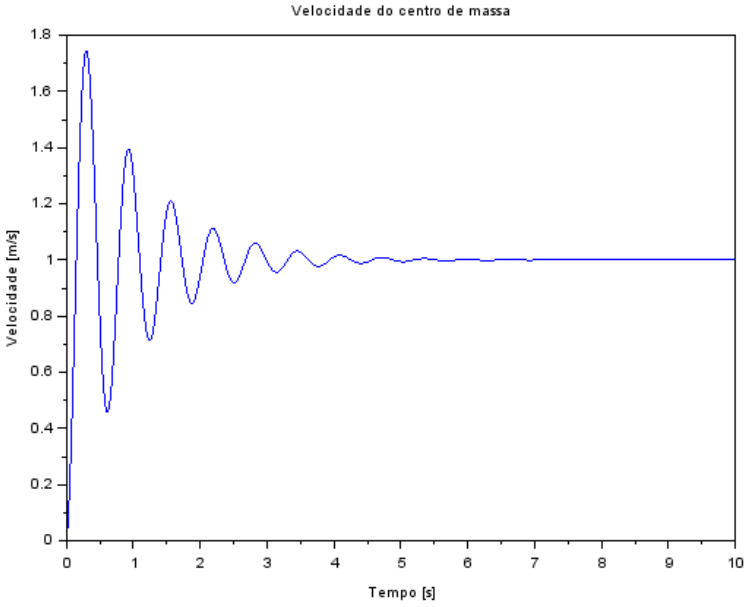
Os desenvolvimentos feitos podem ser observados a seguir:

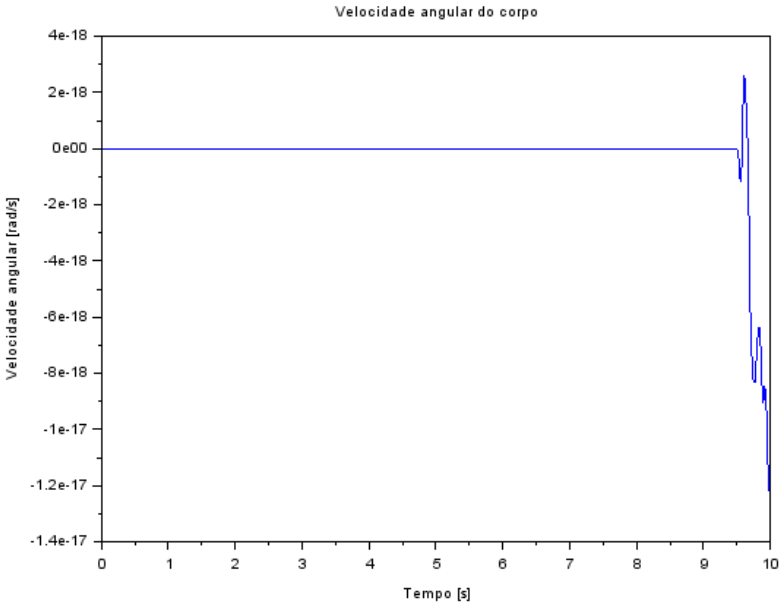




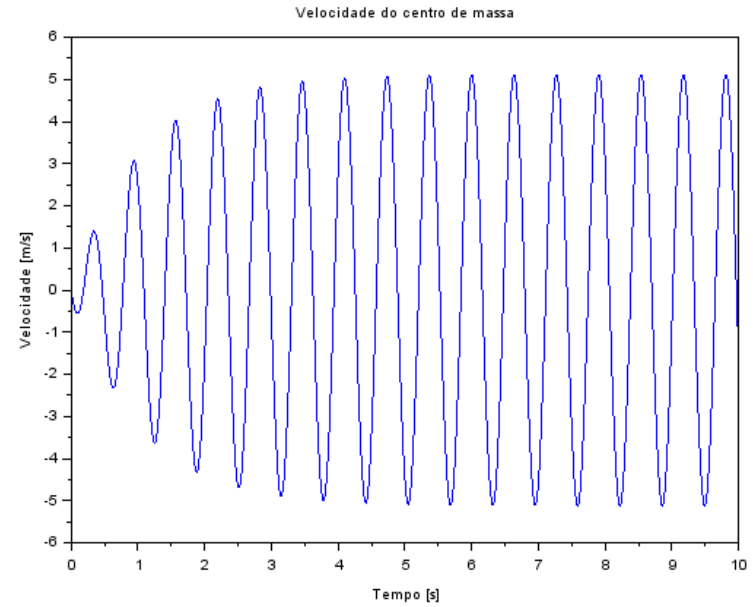
2 SIMULAÇÃO DO MEIO-CARRO

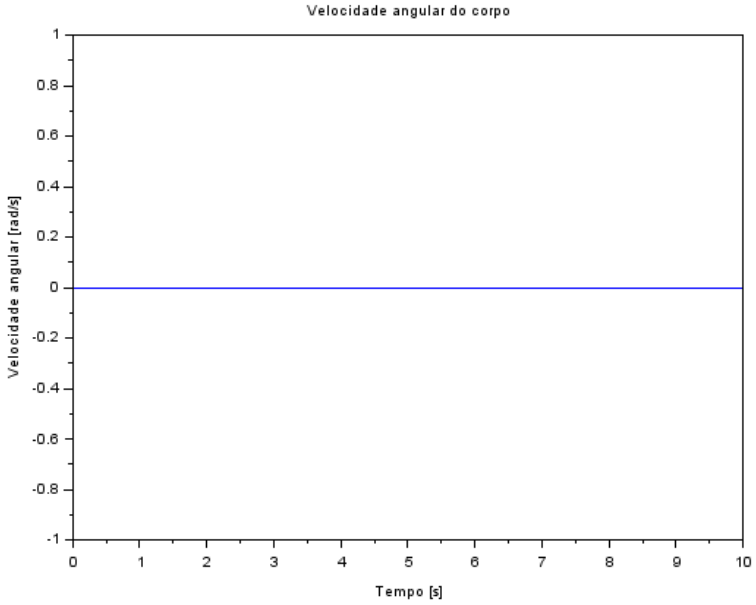
2.1 SIMULAÇÃO 1



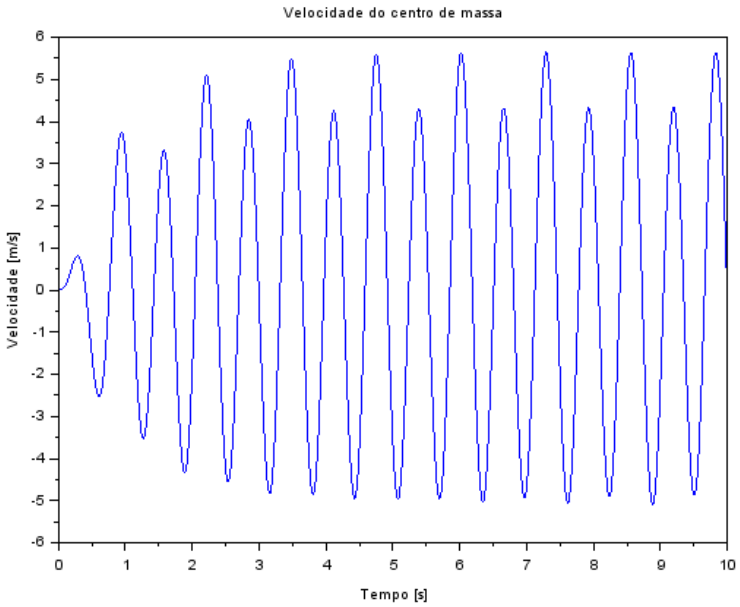


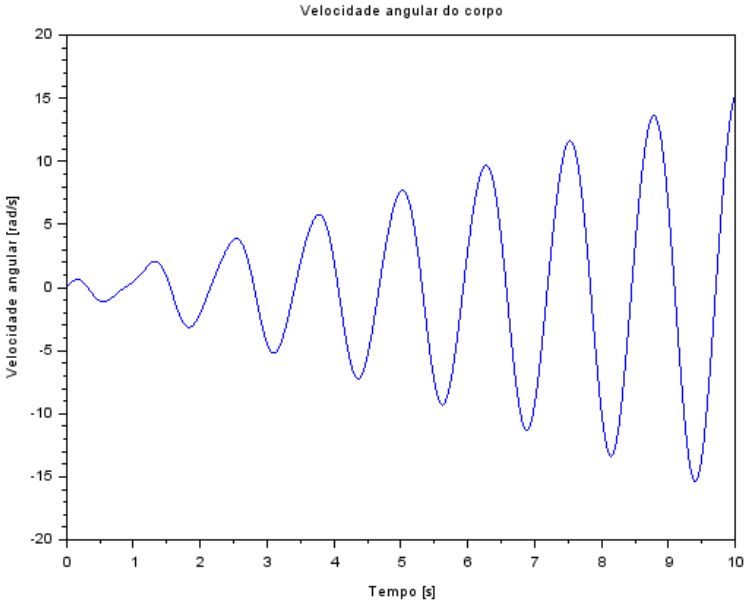
2.2 SIMULAÇÃO 2



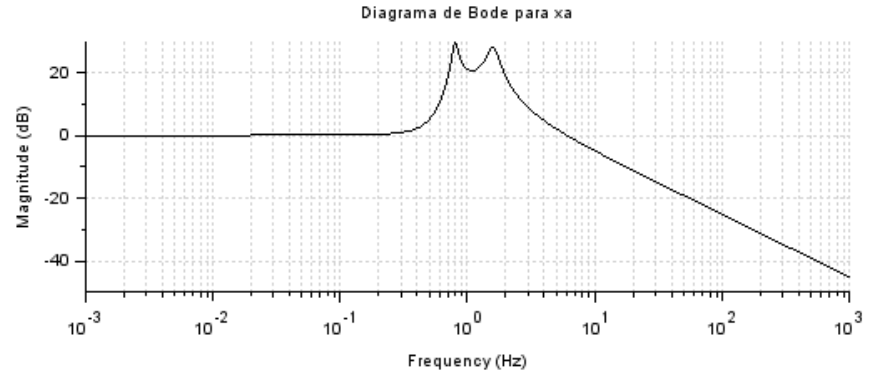


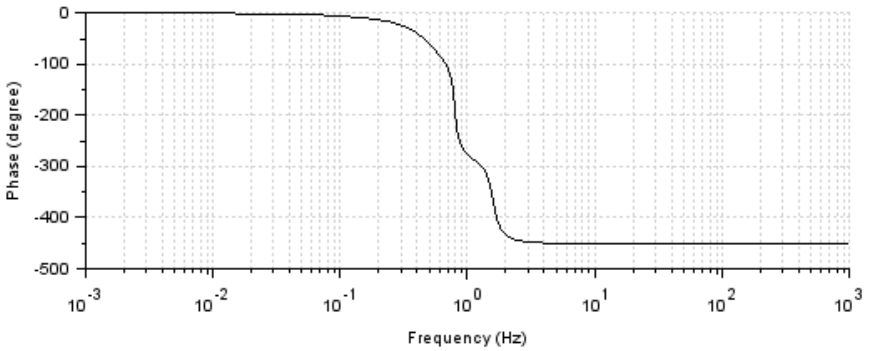
2.3 SIMULAÇÃO 3

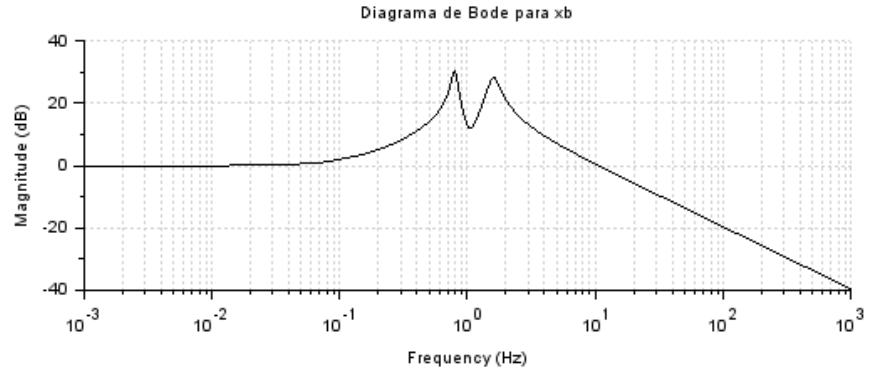


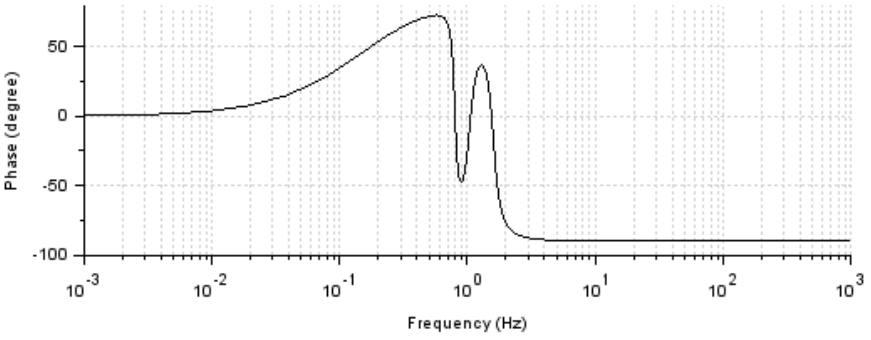


2.4 DIAGRAMAS DE BODE









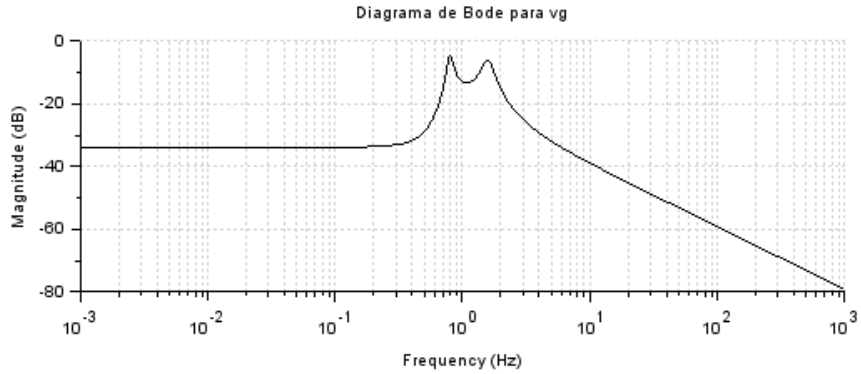
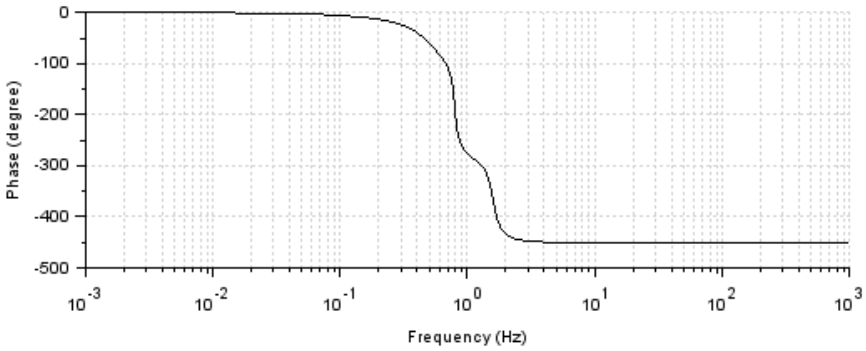


Diagrama de Bode para vg
Magnitude (dB)
0
-20
-40
-60
-80
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
0
-100
-200
-300
-400
-500
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

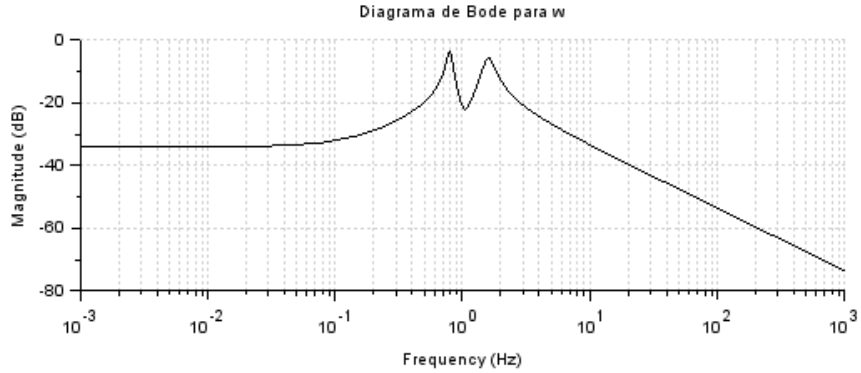
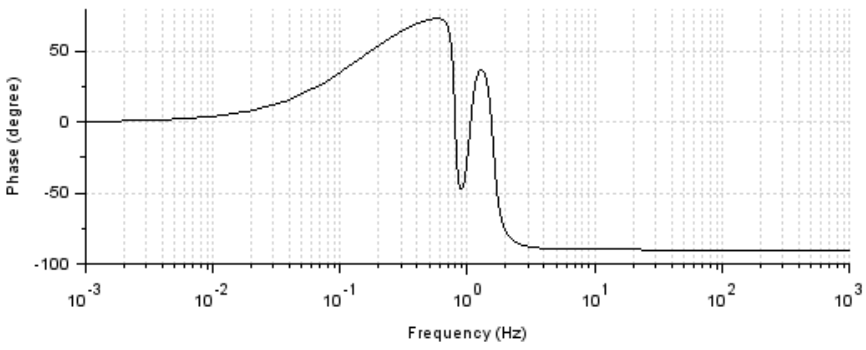


Diagrama de Bode para w
Magnitude (dB)
0
-20
-40
-60
-80
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
50
0
-50
-100
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

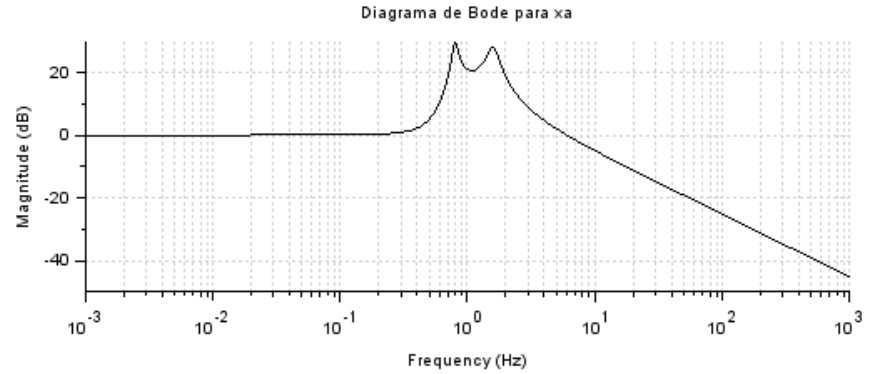
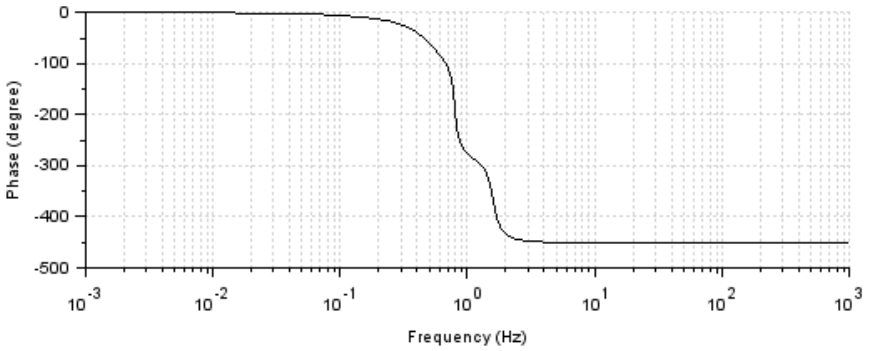


Diagrama de Bode para xa
Magnitude (dB)
20
0
-20
-40
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
0
-100
-200
-300
-400
-500
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

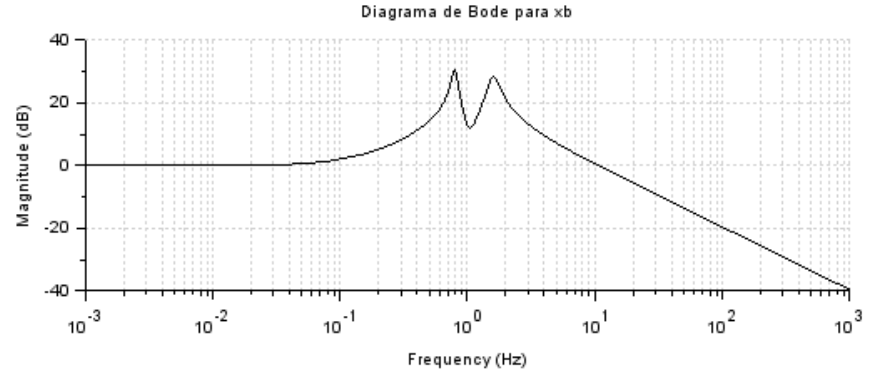
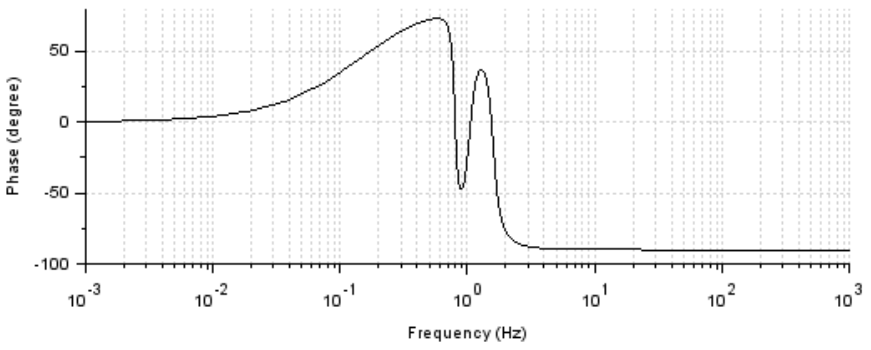


Diagrama de Bode para xb
Magnitude (dB)
40
20
0
-20
-40
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
50
0
-50
-100
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

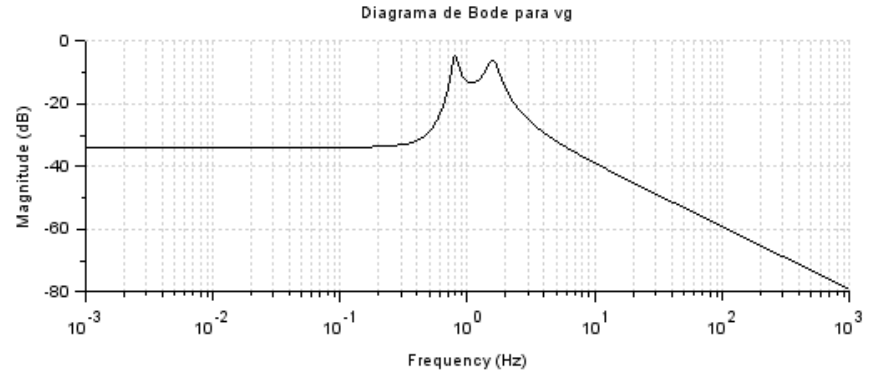
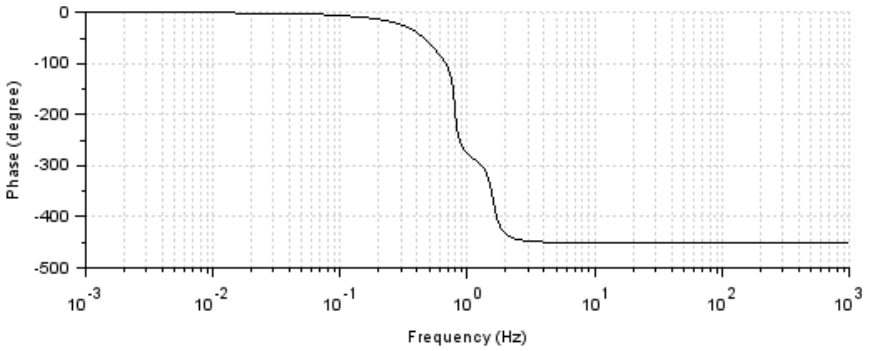


Diagrama de Bode para vg
Magnitude (dB)
0
-20
-40
-60
-80
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
0
-100
-200
-300
-400
-500
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

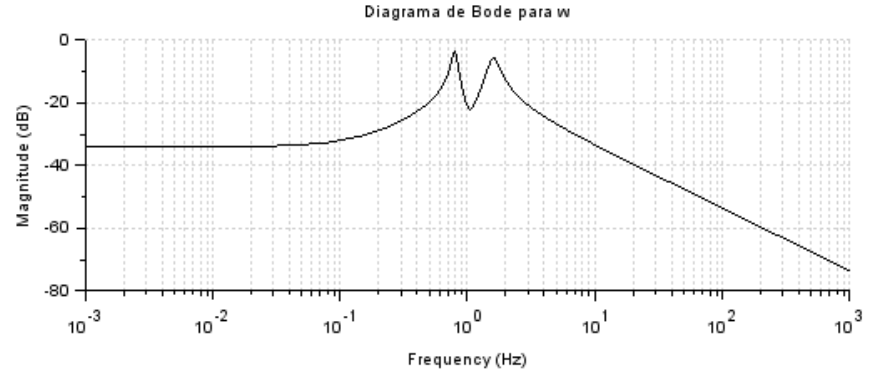
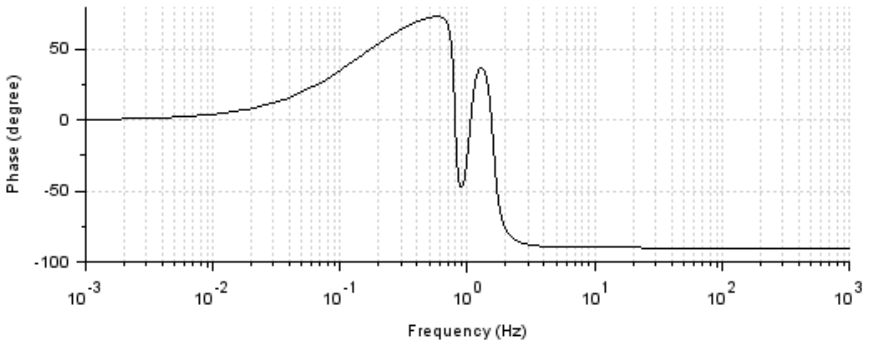


Diagrama de Bode para w
Magnitude (dB)
0
-20
-40
-60
-80
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
50
0
-50
-100
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

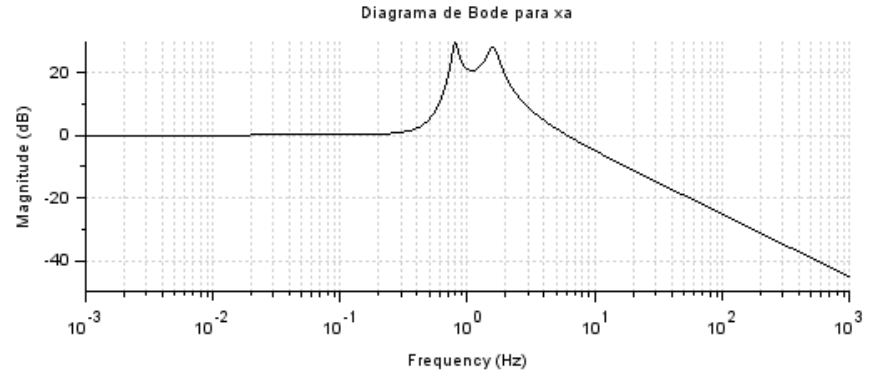
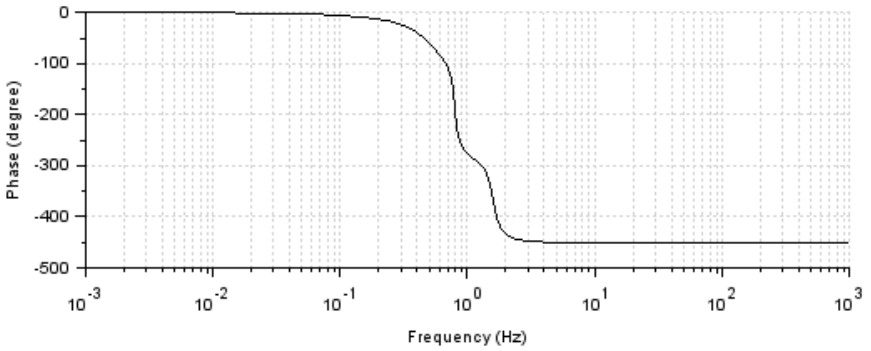


Diagrama de Bode para xa
Magnitude (dB)
20
0
-20
-40
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
0
-100
-200
-300
-400
-500
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

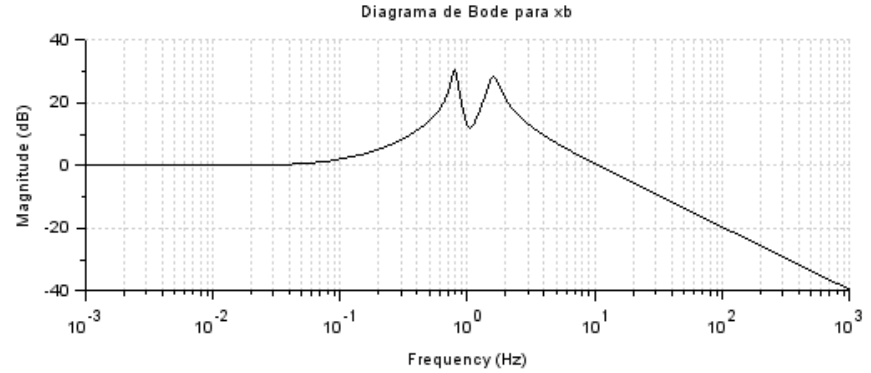
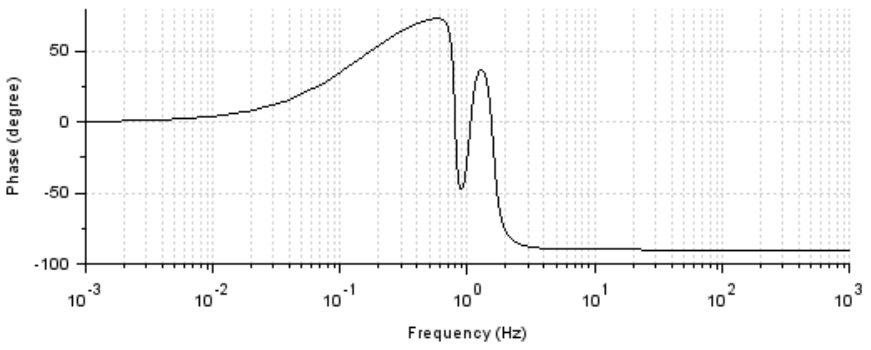


Diagrama de Bode para xb
Magnitude (dB)
40
20
0
-20
-40
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
50
0
-50
-100
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

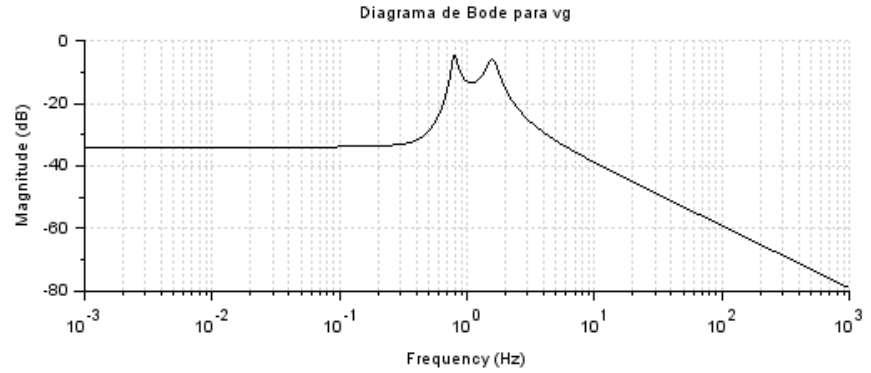
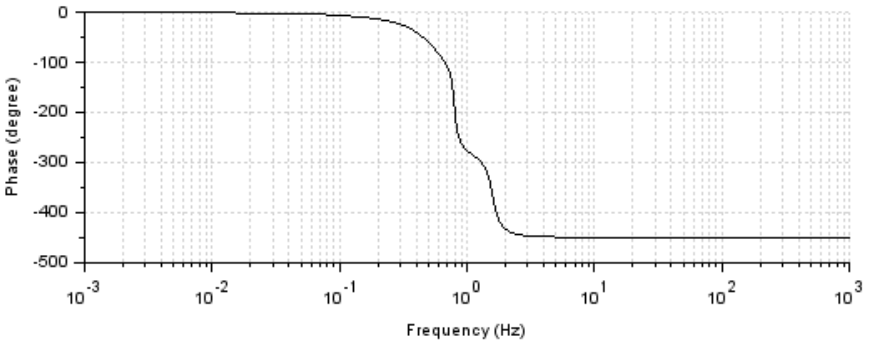


Diagrama de Bode para vg
Magnitude (dB)
0
-20
-40
-60
-80
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
0
-100
-200
-300
-400
-500
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

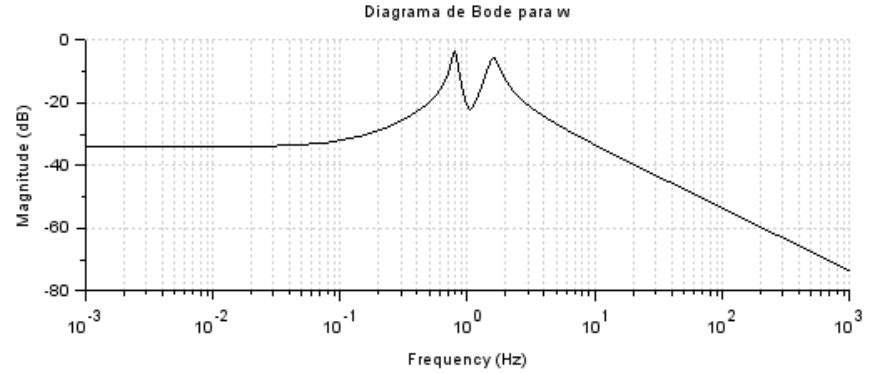
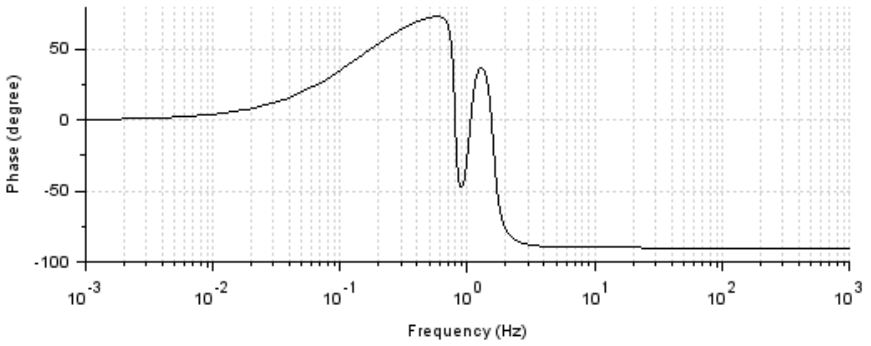
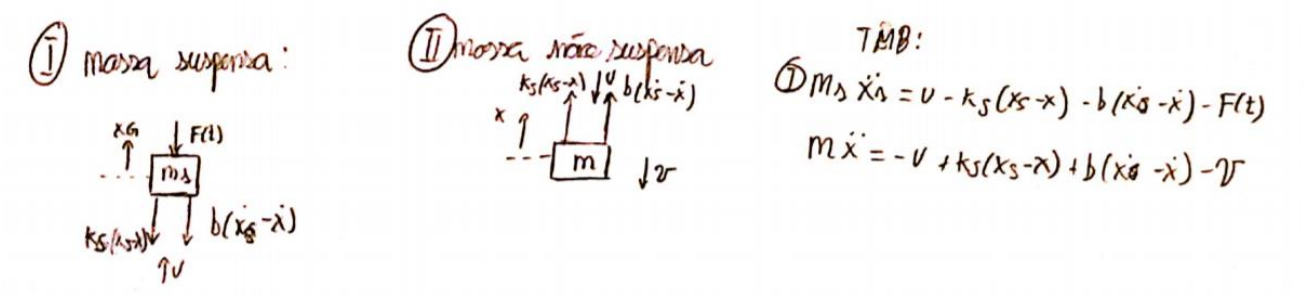


Diagrama de Bode para w
Magnitude (dB)
0
-20
-40
-60
-80
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)


Phase (degree)
50
0
-50
-100
10^{-3}
10^{-2}
10^{-1}
10^{0}
10^{1}
10^{2}
10^{3}
Frequency (Hz)

3 EXERCÍCIO 2



4 APÊNDICE

```
//PME 3380-Lista G
//Mauricio Chung Leiman - 10772571

//parametros do problema
m=200;
j = 512;
la = 0.8;
lb = 0.8;
ka = 10000;
kb = 10000;
ba = 200;
bb = 200;
vh = 10;

//vetor tempo
t = linspace(0, 10, 1000);

//condicoes iniciais
xa0 = 0;
xb0 = 0;
vg0 = 0;
w0 = 0;
simulacao = 1

//possibilidades de simulacao
if simulacao == 1 then
 function fun=u1(t), fun = t, endfunction
 if t < td then
 function fun=u2(t), fun = 0, endfunction
 else
 function fun=u2(t), fun = t, endfunction
 end

 function fun=u3(t), fun = 1, endfunction
 if t < td then
 function fun=u4(t), fun = 0, endfunction
 else
 function fun=u4(t), fun = 1, endfunction
end

elseif simulacao == 2 then
 function fun=u1(t), fun = -cos(9.8995*t)/9.8995, endfunction
 function fun=u2(t), fun = -cos(9.8995*t)/9.8995, endfunction
 function fun=u3(t), fun = sin(9.8995*t), endfunction
 function fun=u4(t), fun = sin(9.8995*t), endfunction

elseif simulacao == 3 then
 function fun=u1(t), fun = -cos(9.8995*t)/4.9875, endfunction
 function fun=u2(t), fun = cos(4.9875*t)/4.9875, endfunction
 function fun=u3(t), fun = sin(4.9875*t), endfunction
 function fun=u4(t), fun = -sin(4.9875*t), endfunction
end

//espaco de estados
function dy=meiocarro(t, y)
   dy(1)=y(3)-la*y(4);
   dy(2)=y(3)+lb*y(4);
   dy(3)=-(ka/m)*y(1) - (kb/m)*y(2) - ((ba+bb)/m)*y(3) + ((ba*la - bb*lb)/m)*y(4) + (ka/M)*u1(t) + (kb/M)*u2(t) + (ba/M)
*u3(t) + (bb/M)*u4(t);
   dy(4)=(la*ka/j)*y(1) - (lb*kb/j)*y(2) + ((la*ba - lb*bb)/j)*y(3) -((ba*la^2 - ba*la^2)/M)*y(4) - (la*ka/j)*u1(t) +
(la*ka/j)*u2(t) - (la*ba/j)*u3( t )+(lb*bb/j)*u4(t);
endfunction

//integracao
```

```
resultado = ode([xa0; xb0; vg0; w0], 0, t, meiocarro);
xa = resultado(1,:);
xb = resultado(2,:);
vg = resultado(3,:);
w = resultado(3,:);

//plots
scf(1)
xtitle("Velocidade do centro de massa");
xlabel("Tempo [s]");
ylabel("Velocidade [m/s]");
plot(t,vg);

scf(2)
xtitle("Velocidade angular do corpo");
xlabel("Tempo [s]");
ylabel("Velocidade angular [rad/s]");
plot(t,w);

//parte 2
a = [0,0,1,-la;0,0,1,la;-ka/m,-kb/m,-(ba+bb)/m,(ba*la - bb*lb)/m;la*ka/j,-lb*kb/j,(la*ba-lb*bb)/j,-(ba*la^2 + bb*lb^2)/j];
b = [0,0,0,0;0,0,0,0;ka/m,kb/m,ba/m,bb/m;-la*ka/j,lb*kb/j,-la*ba/j,lb*bb/j];
solucao = syslin('c',a,b,[1,1,1,1]);
X = ss2tf(solucao);
scf(3);
bode(X(1,1));
xtitle("Diagrama de Bode para xa");
scf(4);
bode(X(1,2));
xtitle("Diagrama de Bode para xb");
scf(5);
bode(X(1,3));
xtitle("Diagrama de Bode para vg");
scf(6);
bode(X(1,4));
xtitle("Diagrama de Bode para w");
```