Oscillateur conservatif lineaire a un degre de liberte

Table of Contents

Question1

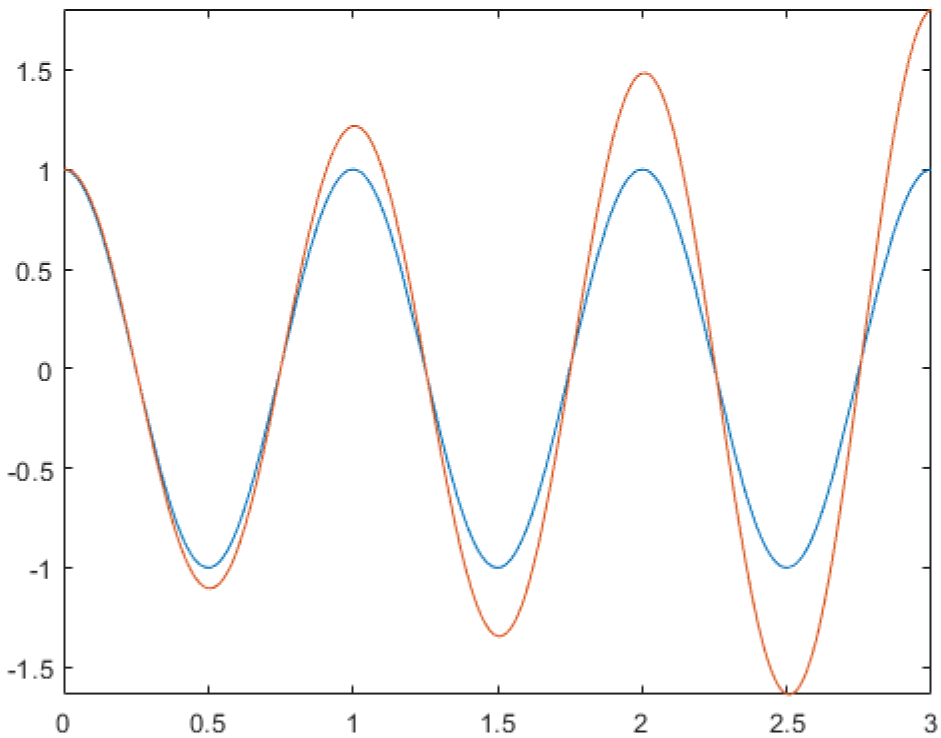
```
%1.1
w0 = 2*pi;
q = dsolve('D2q+(2*pi)^2*q=0','q(0)=1','Dq(0)=0');

%1.2
E = 0.5*((diff(q))^2+(2*pi*q)^2);
E = simplify(E)
```

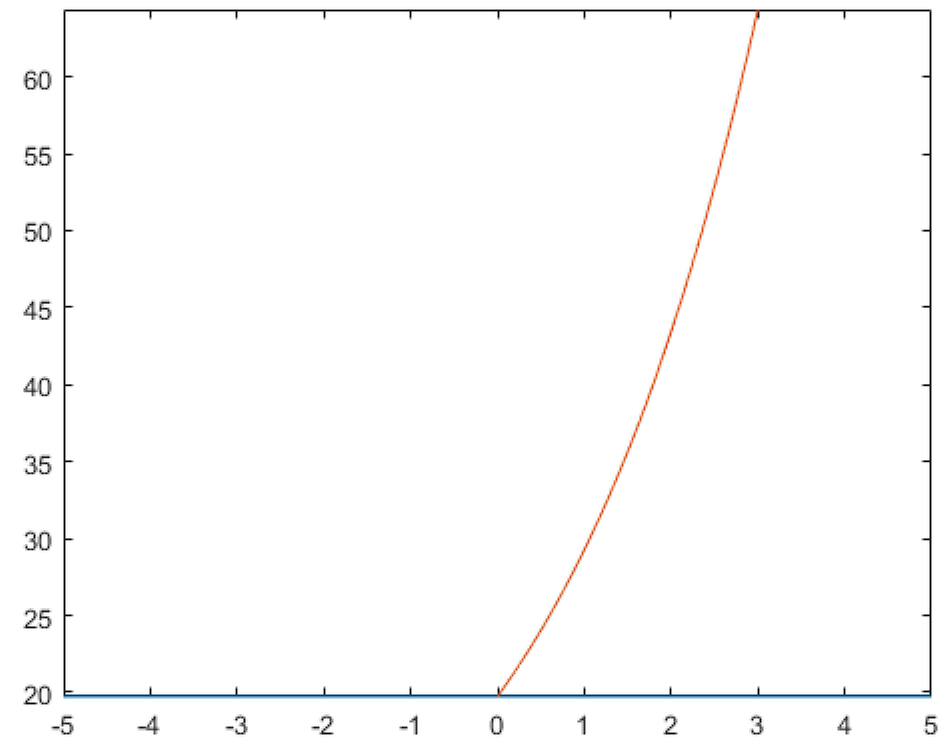
```
##: Support of character vectors and strings will be removed in a
 future
release. Use sym objects to define differential equations instead.

E =

2*pi^2
```

Question2 EULER implicite

```
% 2.1 on peut trouver que D2q=-w0^2*q. Donc, si l'on simplifier
 l'equation
%5, on obtient les equations 6

%2.2
%methode 1
q2 = [1];
dq2 = [0];
deltat=0.01;
for i=1:300
    q2=[q2,q2(i)+deltat*dq2(i)];
    dq2=[dq2,dq2(i)+deltat*(-w0^2*q2(i))];
end
```

```
%2.3
figure(1);
fplot(q,[0,3]);
hold on;
plot([0:0.01:3],q2);
hold off;

%2.4
E2 = 0.5.*((dq2).^2+(2*pi.*q2).^2);
figure(2);
fplot(E);
hold on;
plot([0:0.01:3],E2);
hold off;
%plus le deltat est petit, plus le resultat est proche avec la
 solution
%exacte

%2.5
syms deltat1;
Ma_Amplifica=[1,deltat1;-w0^2*deltat1,1];
[x,y]=eig(Ma_Amplifica)


x =

[ (70368744177664*((2778046668940015^(1/2)*deltat1*1i)/8388608
 - 1))/(2778046668940015*deltat1) + 70368744177664/
(2778046668940015*deltat1), 70368744177664/(2778046668940015*deltat1)
 - (70368744177664*((2778046668940015^(1/2)*deltat1*1i)/8388608 + 1))/
(2778046668940015*deltat1)]
[
                                                                    1,
                                                                   1]


y =

[ 1 - (2778046668940015^(1/2)*deltat1*1i)/8388608,
                           0]
[                                                 0,
 (2778046668940015^(1/2)*deltat1*1i)/8388608 + 1]
```


1.5
1
0.5
0
-0.5
-1
-1.5
0
0.5
1
1.5
2
2.5
3

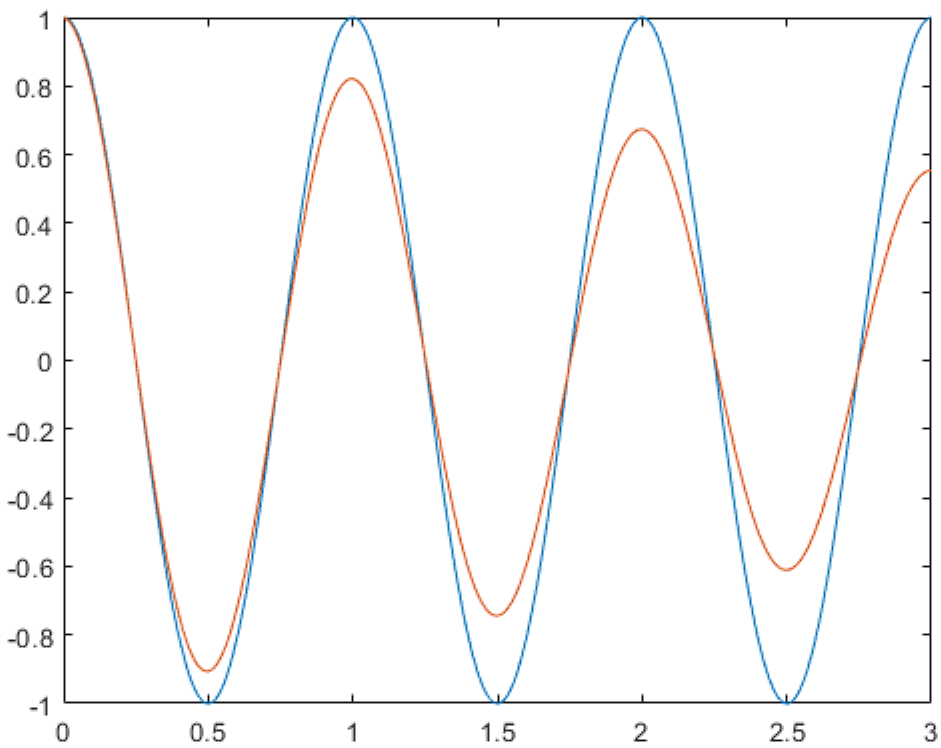

60
55
50
45
40
35
30
25
20
-5
-4
-3
-2
-1
0
1
2
3
4
5

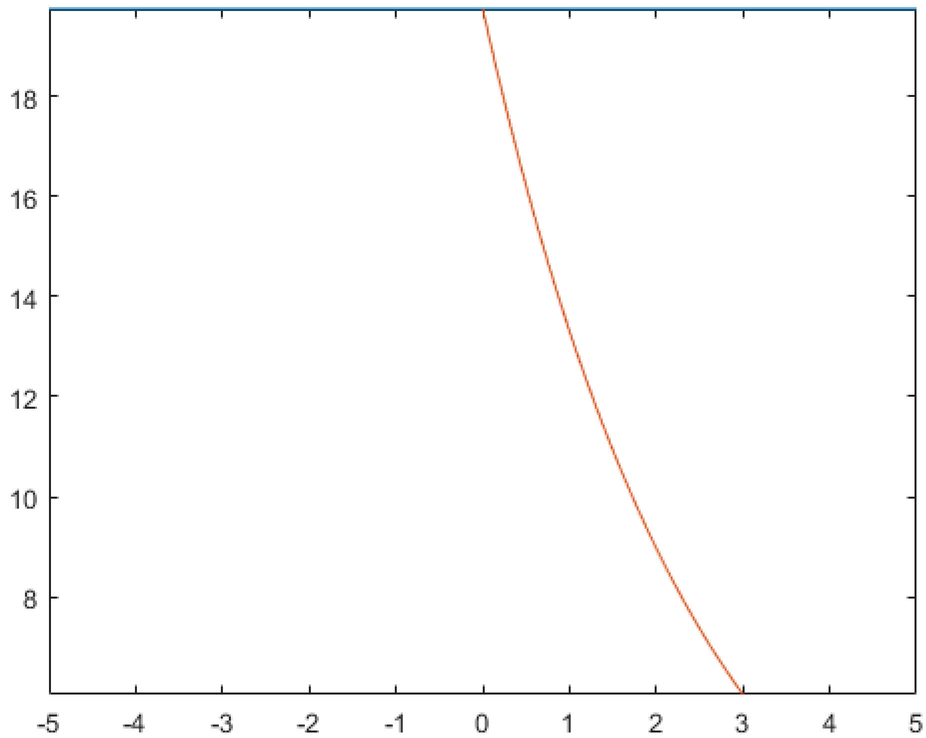
question3 EULER explicite

```
%3.1
q3 = [1];
dq3 = [0];
deltat=0.01;
for i=1:300
    q3=[q3,(q3(i)+deltat*dq3(i))/(1+deltat^2*w0^2)];
    dq3=[dq3,dq3(i)+deltat*(-w0^2*q3(i+1))];
end

%3.2
figure(3);
fplot(q,[0,3])
hold on;
plot([0:0.01:3],q3)
hold off;

%3.3 on change deltat

%3.4
E3 = 0.5.*((dq3).^2+(2*pi.*q3).^2);
figure(4);
fplot(E);
hold on;
plot([0:0.01:3],E3);
hold off;
%plus le deltat est petit, plus le resultat est loin avec la solution
%exacte

% 3.5
syms deltat2;
Ma_Amplifica2=inv([1,-deltat2;w0^2*deltat2,1]);
[x,y]=eig(Ma_Amplifica2)
```

```
x =

[ 70368744177664/(2778046668940015*deltat2)
 + (8388608*(2778046668940015*deltat2^2 +
 70368744177664)*(2778046668940015^(1/2)*deltat2 - 8388608i))/
(2778046668940015*deltat2*(deltat2^2*2778046668940015i +
 70368744177664i)), 70368744177664/(2778046668940015*deltat2)
 - (8388608*(2778046668940015*deltat2^2 +
 70368744177664)*(2778046668940015^(1/2)*deltat2 + 8388608i))/
(2778046668940015*deltat2*(deltat2^2*2778046668940015i +
 70368744177664i))]
[


         1,
```

```
                    1]


y =

[ -(8388608*(2778046668940015^(1/2)*deltat2 - 8388608i))/
(deltat2^2*2778046668940015i + 70368744177664i),

         0]
[
                                                    0,
 (8388608*(2778046668940015^(1/2)*deltat2 + 8388608i))/
(deltat2^2*2778046668940015i + 70368744177664i)]
```

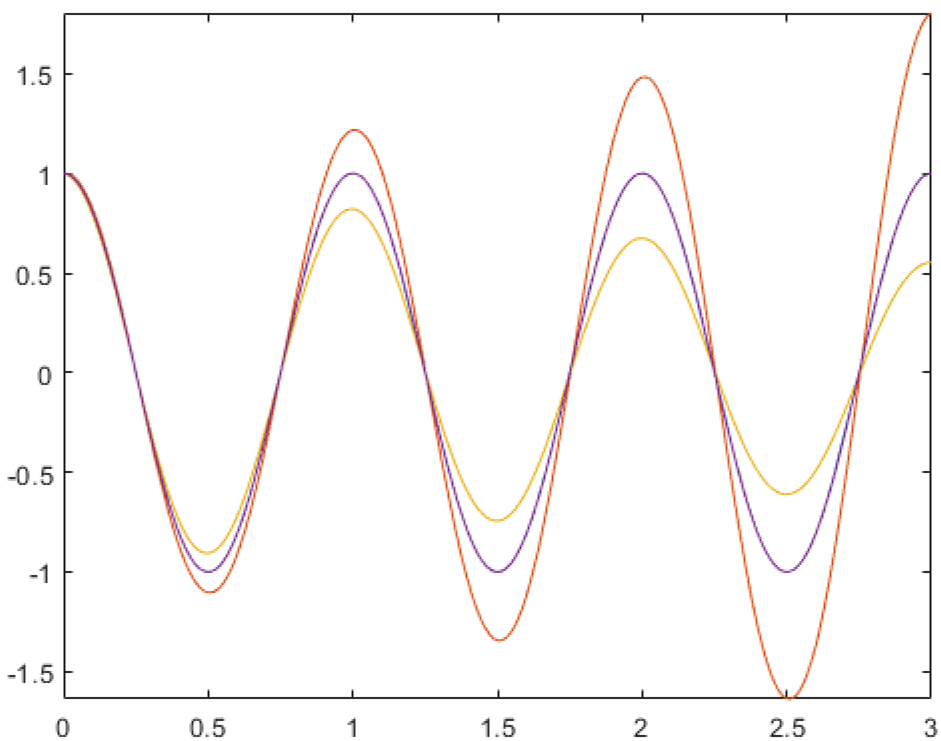


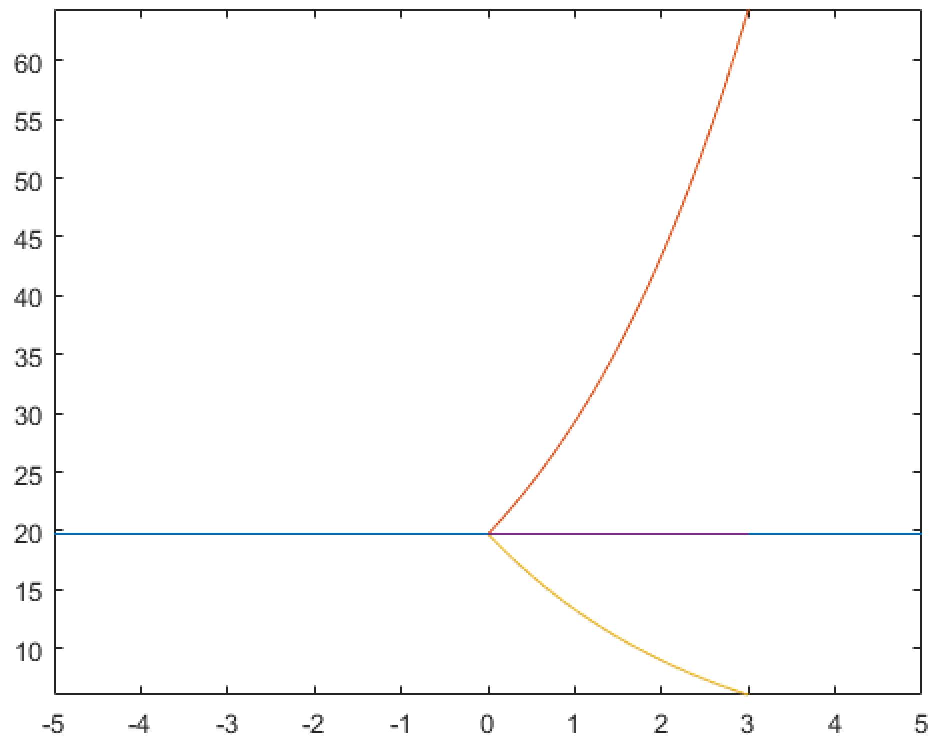


question4 RUNGE KUTTA

```
%4.1 selon l"equation 1, [Dq;D2q]=[0,1;-w0^2,0][q;Dq]

%4.2

q4 = [1];
dq4 = [0];
deltat = 0.01;
A = [0,1;-w0^2,0];
for i=1:300
    k1 = A*[q4(i);dq4(i)];
    k2 = A*([q4(i);dq4(i)]+deltat/2.*k1);
    k3 = A*([q4(i);dq4(i)]+deltat/2.*k2);
    k4 = A*([q4(i);dq4(i)]+deltat.*k3);
    K = (k1+2*k2+2*k3+k4)./6;
    q4 = [q4,q4(i)+deltat*K(1)];
    dq4 = [dq4,dq4(i)+deltat*K(2)];
end

%4.3
figure(5);
fplot(q,[0,3])
hold on;
plot([0:0.01:3],q2)
```

```
plot([0:0.01:3],q3)
plot([0:0.01:3],q4)
hold off;

%on peut trouver que le result de RUNGE KUTTA est meme avec la
 solution
%exacte. C"est-a-dire, le result de RUNGE KUTTA est precis.

%4.4
E4 = 0.5.*((dq4).^2+(2*pi.*q4).^2);
figure(6);
fplot(E);
hold on;
plot([0:0.01:3],E2);
plot([0:0.01:3],E3);
plot([0:0.01:3],E4);
hold off;
% Pour calculer E, le schema de RUNGE KUTTA est plus precis.
```





Published with MATLAB® R2019b