RLC série

1 RLC série

$u_L + u_R + u_C = e$ soit $L\frac{di}{dt} + Ri + u_C = e$ soit

$$LC\frac{d^2u_C}{dt^2} + RC\frac{du_C}{dt} + u_C = e$$

$\Delta = R^2C^2 - 4LC$ et la résistance critique est celle pour laquelle $\Delta = 0$ soit $R_c = 2\sqrt{\frac{L}{C}}$

[6]:
```
R,L,C,E=50,32e-3,100e-9,5
Rc=2*(L/C)**0.5
print(Rc)
```

```
1131.370849898476
```

$\frac{d^2u_C}{dt^2} = \frac{e-u_C-RC\frac{du_C}{dt}}{LC}$

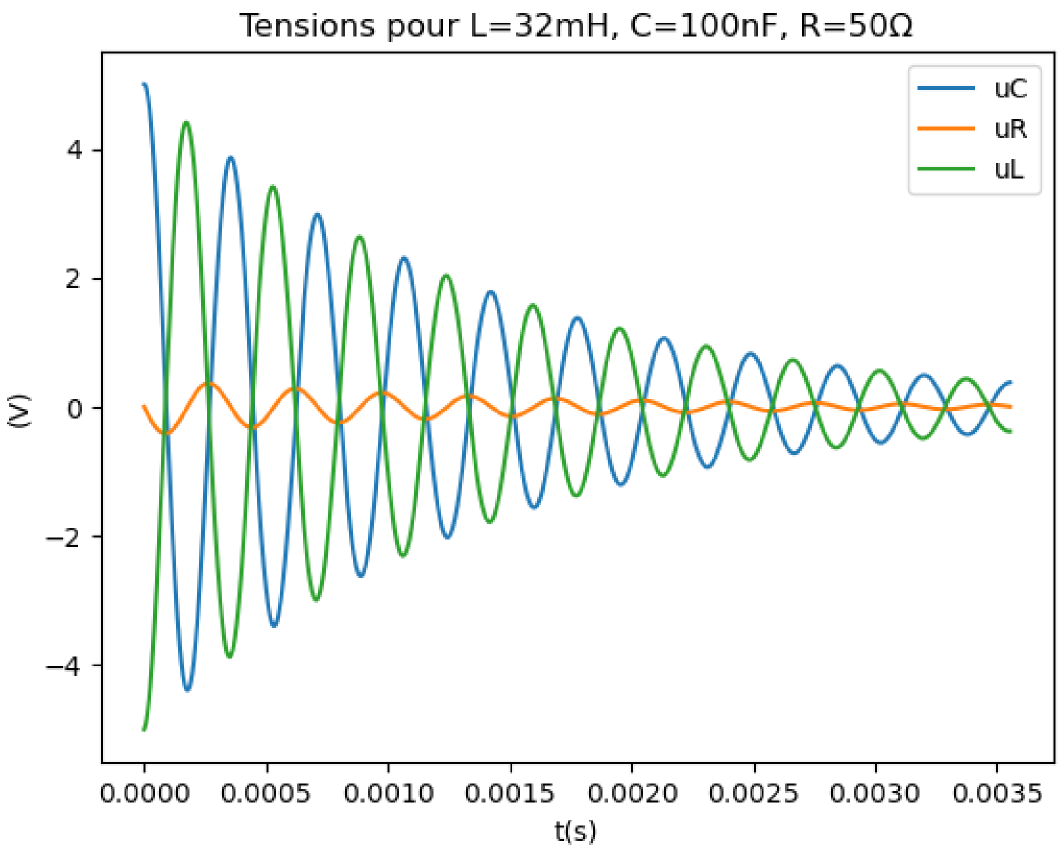
donc

$$\begin{cases} \frac{du_C}{dt} = v_C \\ \frac{dv_C}{dt} = \frac{e-u_C-RCv_C}{LC} \end{cases}$$

[7]:
```
import numpy as np
import matplotlib.pyplot as plt
T0=2*np.pi*np.sqrt(L*C)
tsim=10*T0
pas=T0/1000
N=int(tsim/pas)
tab_t=np.zeros(N+1)
tab_uc=np.zeros(N+1)
tab_ducdt=np.zeros(N+1)
tab_t[0],tab_uc[0],tab_ducdt[0]=0,E,0
def derivee2(uc,ducdt,t):
    return (0-uc-R*C*ducdt)/(L*C)
for i in range(N):
    tab_t[i+1]=tab_t[i]+pas
    tab_uc[i+1]=tab_uc[i]+pas*tab_ducdt[i]
    tab_ducdt[i+1]=tab_ducdt[i]+pas*derivee2(tab_uc[i],tab_ducdt[i],tab_t[i])
```

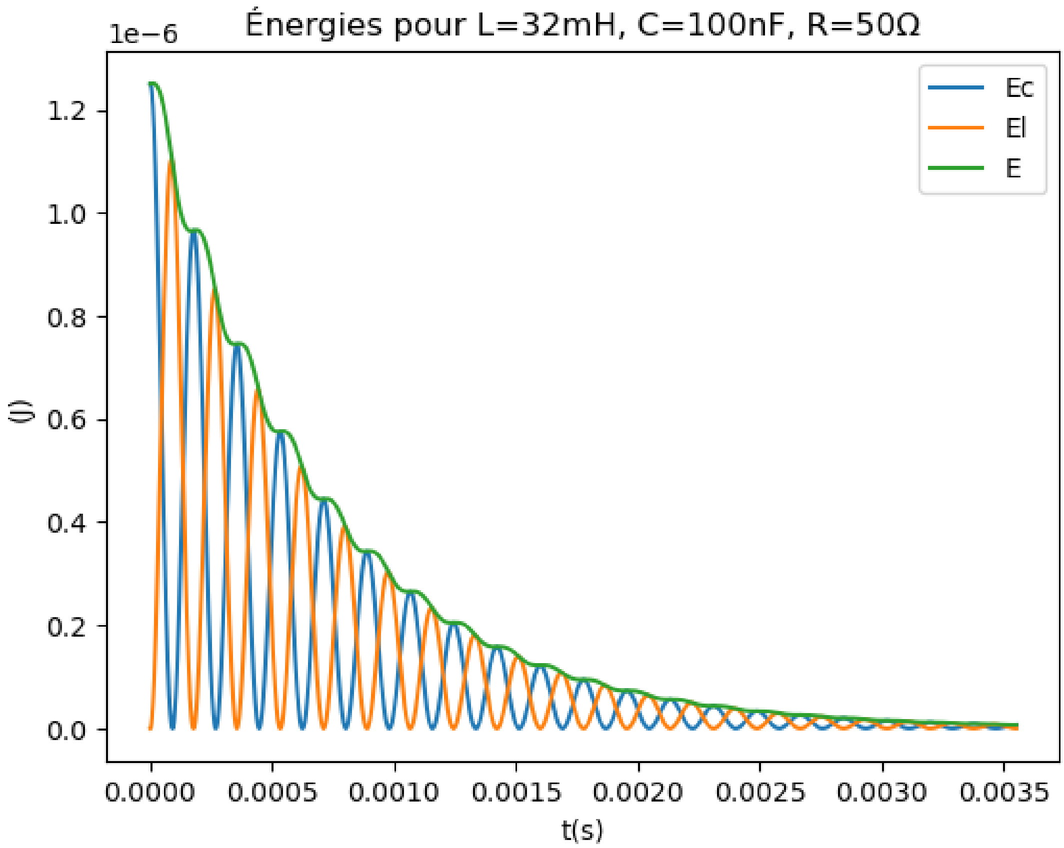
```
tab_i=C*tab_ducdt
tab_ur=R*tab_i
tab_ul=-tab_uc-tab_ur
```

[2]:
```
plt.figure()
plt.plot(tab_t,tab_uc,label="uC")
plt.plot(tab_t,tab_ur,label="uR")
plt.plot(tab_t,tab_ul,label="uL")
plt.legend()
plt.ylabel("(V)")
plt.xlabel("t(s)")
plt.title("Tensions pour L=32mH, C=100nF, R=50Ω")
plt.show()
```



[3]:
```
tab_Ec=0.5*C*tab_uc**2
tab_El=0.5*L*tab_i**2
tab_E=tab_Ec+tab_El
plt.figure()
plt.plot(tab_t,tab_Ec,label="Ec")
plt.plot(tab_t,tab_El,label="El")
```

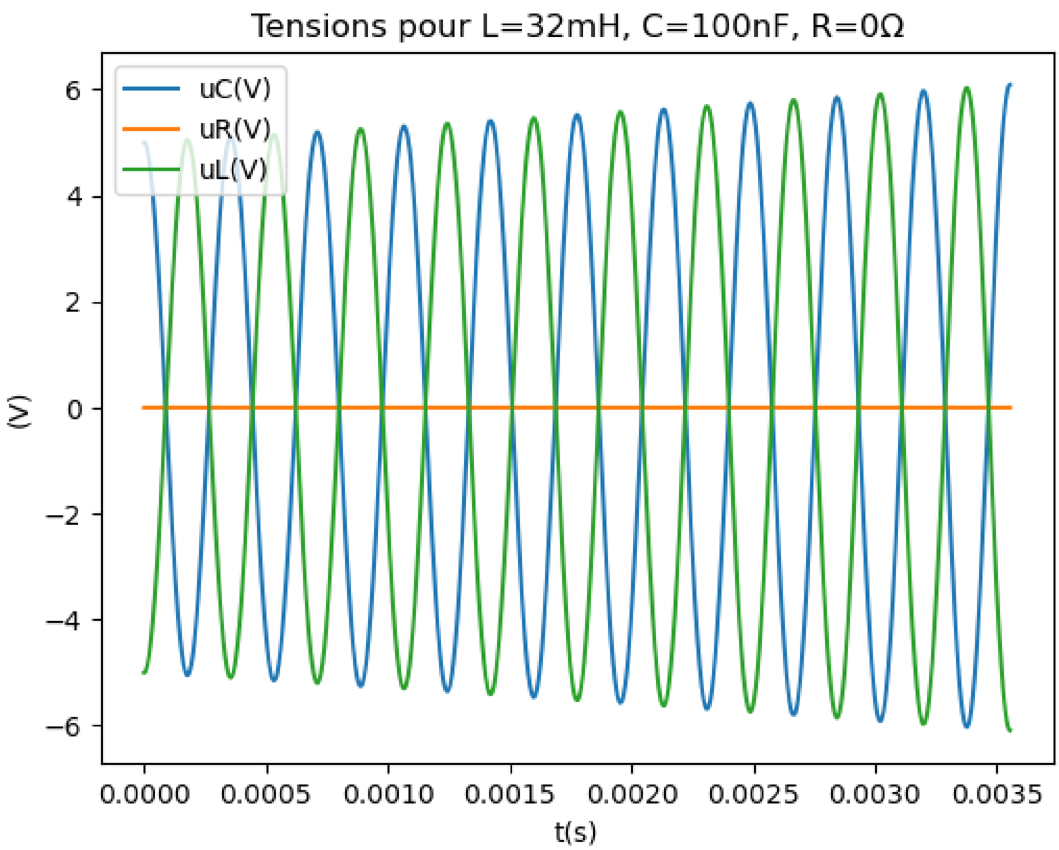
```
plt.plot(tab_t,tab_E,label="E")
plt.legend()
plt.ylabel("(J)")
plt.xlabel("t(s)")
plt.title("Énergies pour L=32mH, C=100nF, R=50Ω")
plt.show()
```

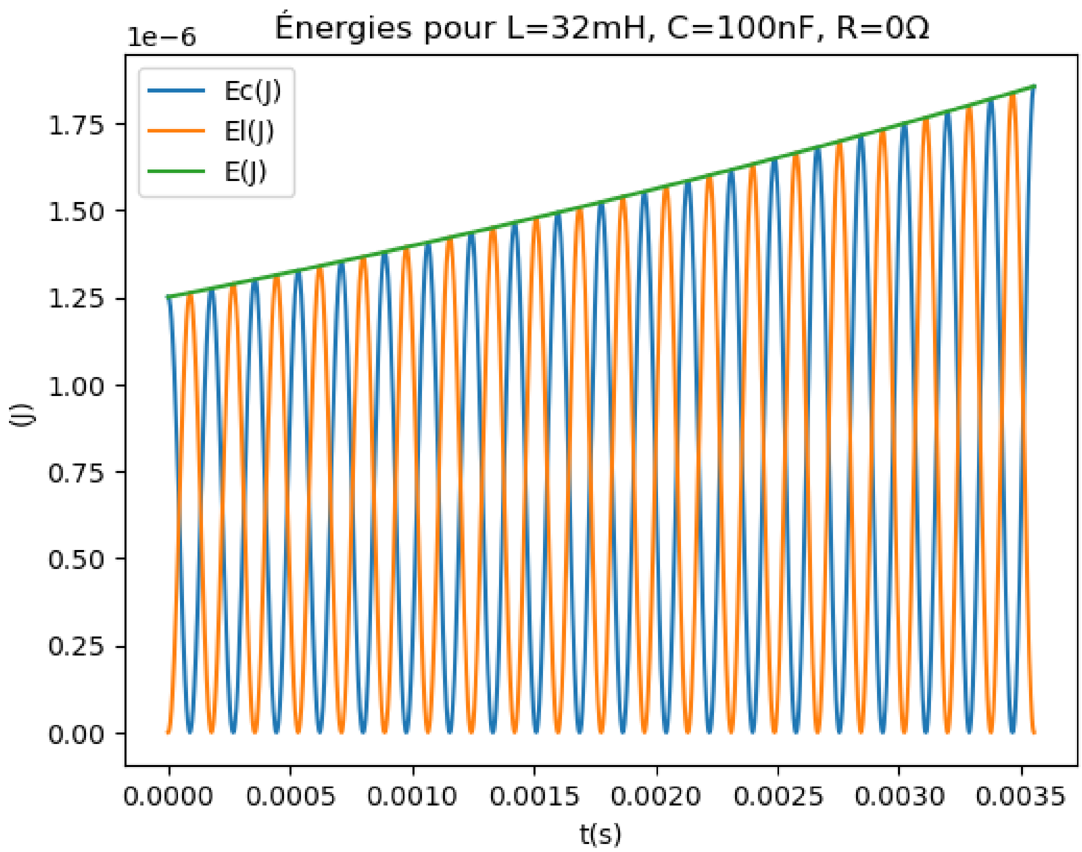


[4]:

```
R=0
for i in range(N):
    tab_t[i+1]=tab_t[i]+pas
    tab_uc[i+1]=tab_uc[i]+pas*tab_ducdt[i]
    tab_ducdt[i+1]=tab_ducdt[i]+pas*derivee2(tab_uc[i],tab_ducdt[i],tab_t[i])
tab_i=C*tab_ducdt
tab_ur=R*tab_i
tab_ul=-tab_uc-tab_ur
plt.figure()
plt.plot(tab_t,tab_uc,label="uC(V)")
plt.plot(tab_t,tab_ur,label="uR(V)")
plt.plot(tab_t,tab_ul,label="uL(V)")
```

```python
plt.legend()
plt.xlabel("t(s)")
plt.ylabel("(V)")
plt.title("Tensions pour L=32mH, C=100nF, R=0Ω")
tab_Ec=0.5*C*tab_uc**2
tab_El=0.5*L*tab_i**2
tab_E=tab_Ec+tab_El
plt.figure()
plt.plot(tab_t,tab_Ec,label="Ec(J)")
plt.plot(tab_t,tab_El,label="El(J)")
plt.plot(tab_t,tab_E,label="E(J)")
plt.legend()
plt.xlabel("t(s)")
plt.ylabel("(J)")
plt.title("Énergies pour L=32mH, C=100nF, R=0Ω")
plt.show()
```



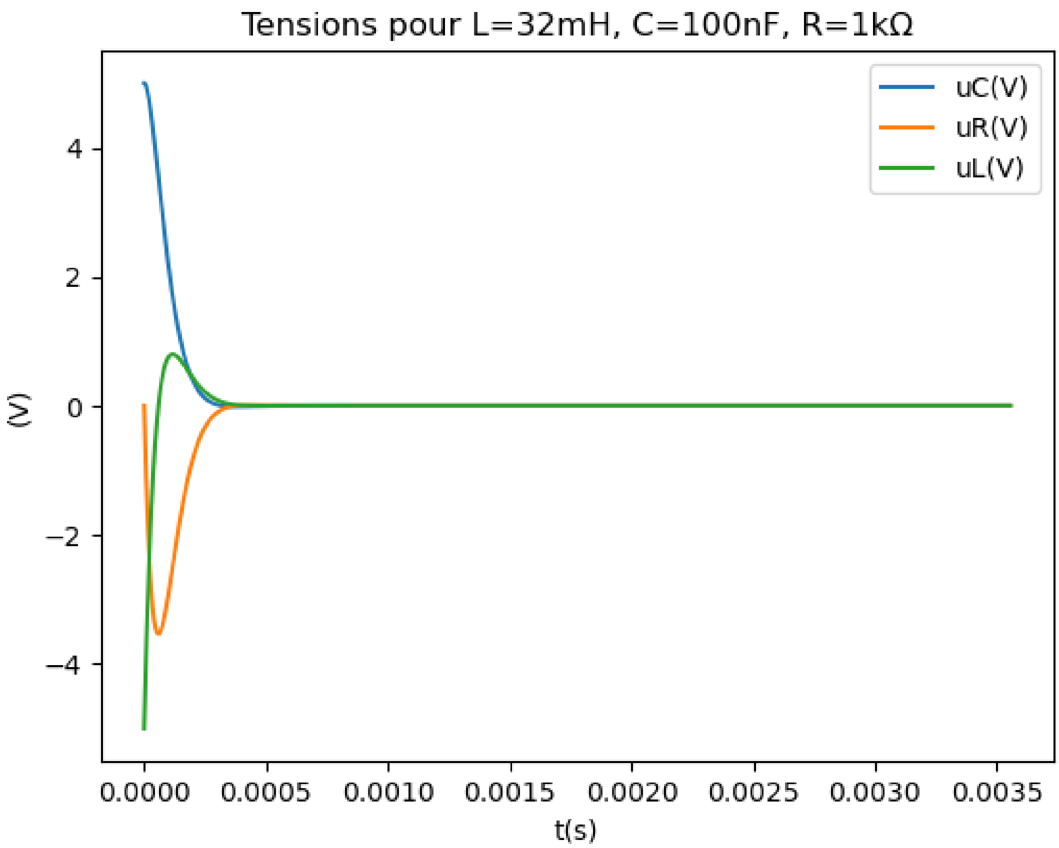


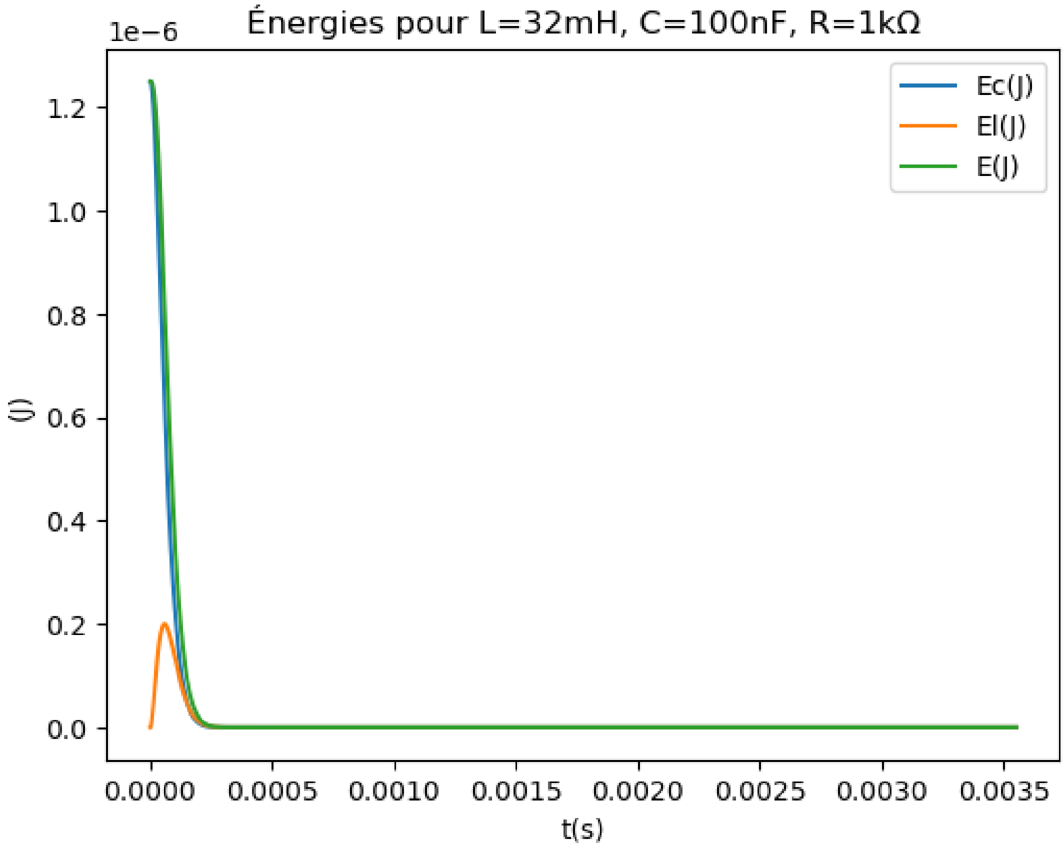
L'énergie augmente! C'est un effet de bord de la méthode d'Euler.

Régime apériodique:

[5]:
```
R=1000
for i in range(N):
    tab_t[i+1]=tab_t[i]+pas
    tab_uc[i+1]=tab_uc[i]+pas*tab_ducdt[i]
    tab_ducdt[i+1]=tab_ducdt[i]+pas*derivee2(tab_uc[i],tab_ducdt[i],tab_t[i])
tab_i=C*tab_ducdt
tab_ur=R*tab_i
tab_ul=-tab_uc-tab_ur
plt.figure()
plt.plot(tab_t,tab_uc,label="uC(V)")
plt.plot(tab_t,tab_ur,label="uR(V)")
plt.plot(tab_t,tab_ul,label="uL(V)")
plt.legend()
plt.xlabel("t(s)")
plt.ylabel("(V)")
plt.title("Tensions pour L=32mH, C=100nF, R=1kΩ")
```

```
tab_Ec=0.5*C*tab_uc**2
tab_El=0.5*L*tab_i**2
tab_E=tab_Ec+tab_El
plt.figure()
plt.plot(tab_t,tab_Ec,label="Ec(J)")
plt.plot(tab_t,tab_El,label="El(J)")
plt.plot(tab_t,tab_E,label="E(J)")
plt.legend()
plt.xlabel("t(s)")
plt.ylabel("(J)")
plt.title("Énergies pour L=32mH, C=100nF, R=1kΩ")
plt.show()
```




Énergies pour L=32mH, C=100nF, R=1kΩ
1e−6
Ec(J)
El(J)
E(J)
(J)
t(s)
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.0000
0.0005
0.0010
0.0015
0.0020
0.0025
0.0030
0.0035

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