Course > Week 1 > Python programming for beginners > Problem (7-8)

Problem (7-8)

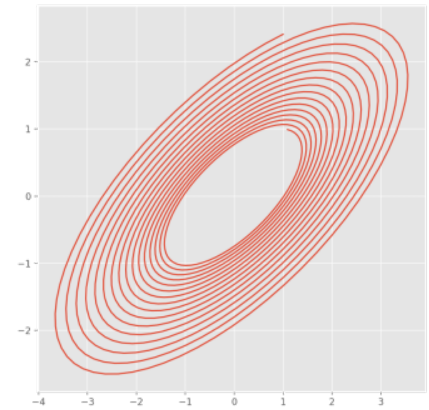
Problem 7

0.0/1.0 point (graded)

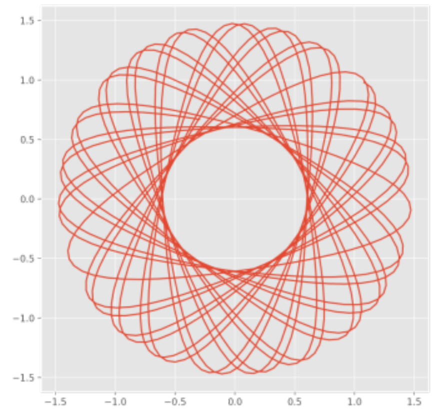
Modify the original code example used in Part 4, Which used the Euler method to integrate the equations of motion for a damped harmonic oscillator, with the Leap-Frog method [Eps.(B17) and (B18)]. This can be achieved by replacing the original "animate" function with the following code fragment. Set the friction constant to 0.1 ($\zeta = 0.1$), perform a simulation and plot $R_x(t)$ vs $R_y(t)$. Which of the following graphs (G11, G12, G13, G14) is the closest to your results?

```
R1 = np.zeros(dim)
def animate(i): # define amination
    global R,V,F,Rs,Vs,time,Et
    R1=R
    V = (V*(1-zeta/2/m*dt)-k/m*dt*R)/(1+zeta*dt/2/m) # Leap-Frog Eq.(B17)
    R = R + V*dt # Leap-Frog Eq.(B18)
    Rs[0:dim,i]=R
    Vs[0:dim,i]=V
    time[i]=i*dt
    Et[i]=0.5*m*np.linalg.norm(V)**2+0.5*k*np.linalg.norm((R+R1)/2)**2 # Et i
    particles.set_data(R[0], R[1]) # current position
    line.set_data(Rs[0,0:i], Rs[1,0:i]) # add latest position Rs
    title.set_text(r"$t = {0:.2f},E_T = {1:.3f}$".format(i*dt,Et[i]))
    return particles,line,title
```

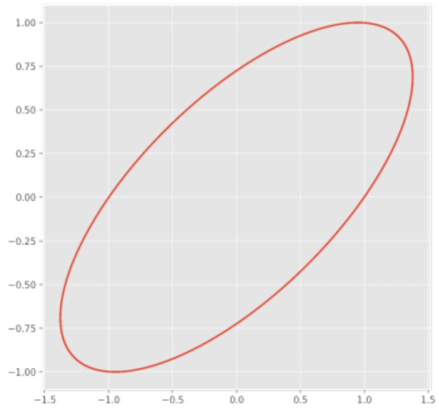
G11



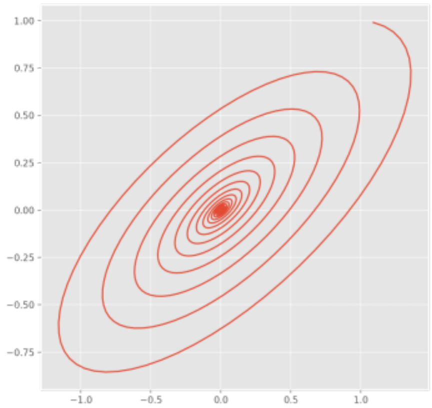
G12



G13



G14



- G11
- G12
- G13
- G14

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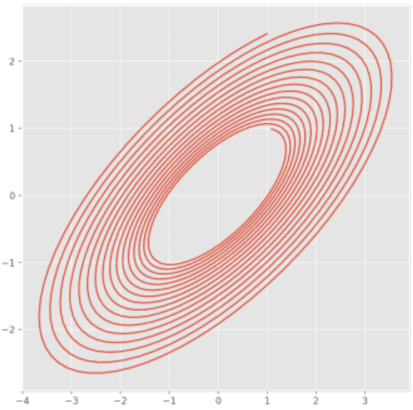
Problem 8

0.0/1.0 point (graded)

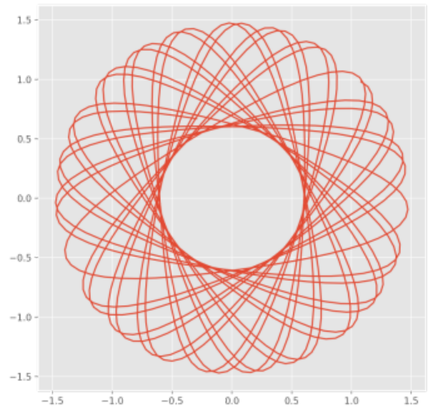
Modify the code used to solve Problem 7 to replace the harmonic spring ($\vec{F}_{sprint} = -k\vec{R}$ and $E_t = \frac{1}{2}mV^2 + \frac{1}{2}kR^2$ with an anharmonic spring ($\vec{F}_{spring} = -kR^2\vec{R}$ and $E_t = \frac{1}{2}mV^2 + \frac{1}{4}kR^4$). Set the friction constant to $\zeta = 0.0$ and run the simulation. Plot $R_x(t)$ as a function of $R_y(t)$. Which of the previous graphs (G11, G12, G13) is the closest to what you have obtained? Note that the changes in the code will take place in the following two lines.

```
V = (V*(1-zeta/2/m*dt)-k/m*dt*R)/(1+zeta*dt/2/m)
Et[i]=0.5*m*np.linalg.norm(V)**2+0.5*k*np.linalg.norm((R+R1)/2)**2
```

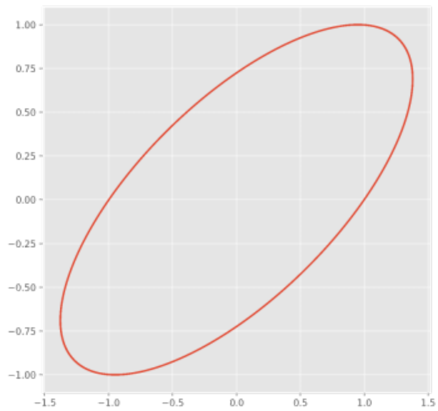
G11



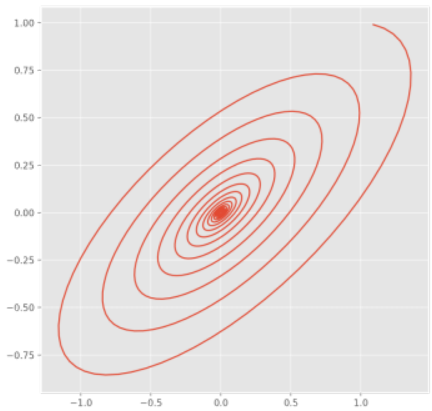
G12



G13



G14



- G11
- G12
- G13
- G14

Submit

You have used 0 of 2 attempts