Home_Work

计算物理作业

研究在势函数中添加微扰项对二维偕振子运动轨迹的影响

1. 理论分析

势函数：

$$V(x,y)=a(x^2+y^2)+e_1x^3+e_2x^3+e_3x^3y^3 \tag{1}$$

在本次讨论中 a 固定为 0.5.

x,y 方向上的受力分别为:

$$F_x=-\frac{\partial V}{\partial x}=-(2ax+3e_1x^2+3e_3x^2y^3) \tag{2}$$

$$F_y=-\frac{\partial V}{\partial y}=-(2ay+3e_2y^2+3e_3x^3y^2) \tag{3}$$

于是x,y 方向的加速度(设质点质量 $m=1$):

$$\frac{d^2x}{dt^2}=\frac{F_x}{m}=-(2ax+3e_1x^2+3e_3x^2y^3) \tag{4}$$

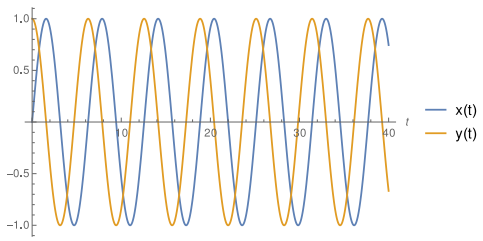
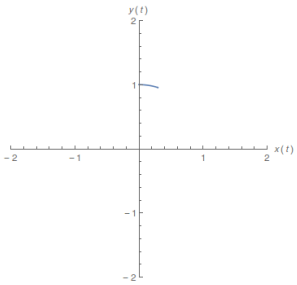
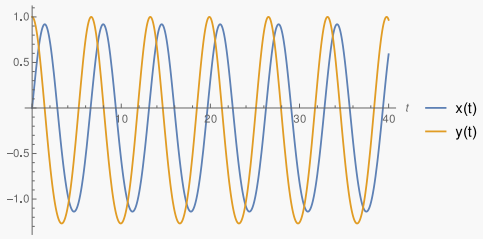
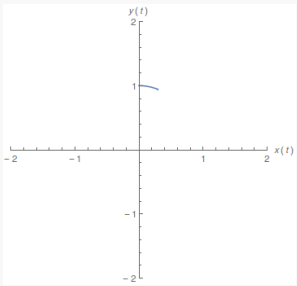
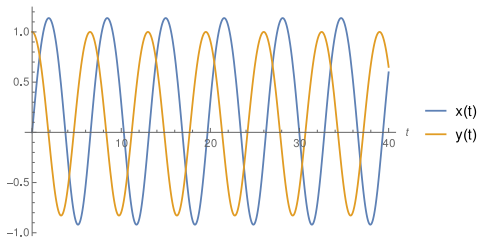
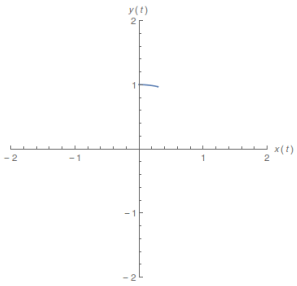
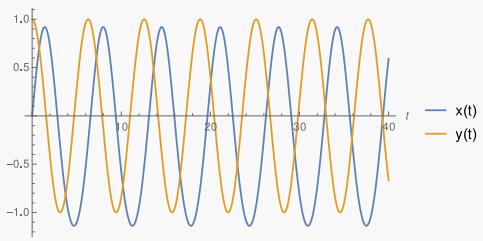
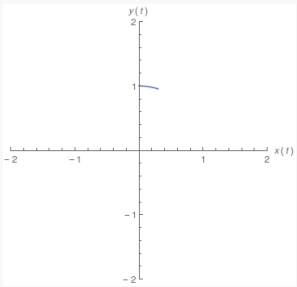
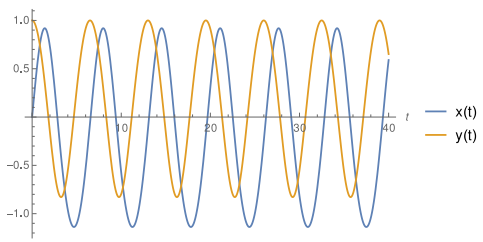
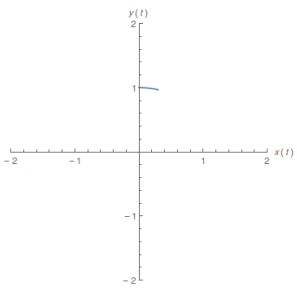
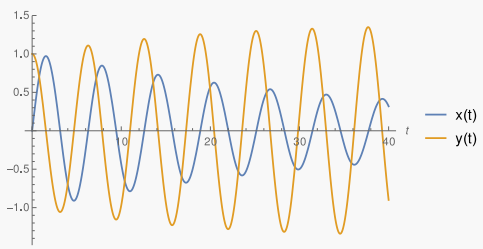
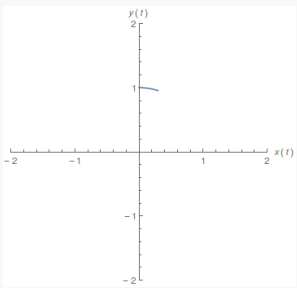
$$\frac{d^2y}{dt^2}=\frac{F_y}{m}=-(2ay+3e_2y^2+3e_3x^3y^2) \tag{5}$$

初始条件:

$$x(0)=0;\ x'(0)=1;\ y(0)=1;\ y'(0)=0 \tag{6}$$

2. 结果展示

由$(4)(5)(6)$可得:

Case	Solution	Visualization
$e_1 = e_2 = e_3 = 0$		
$e_1 = e_2 = 0.1, e_3 = 0$		
$e_1 = e_2 = -0.1, e_3 = 0$		
$e_1 = 0.1, e_2 = 0, e_3 = 0$		
$e_1 = 0.1, e_2 = -0.1, e_3 = 0$		
$e_1 = 0, e_2 = 0, e_3 = 0.1$		

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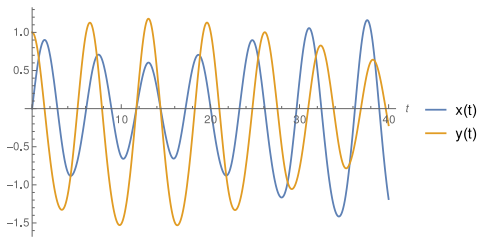
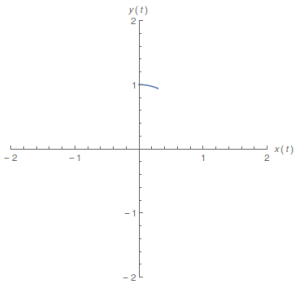
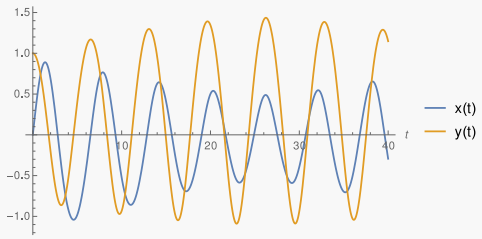
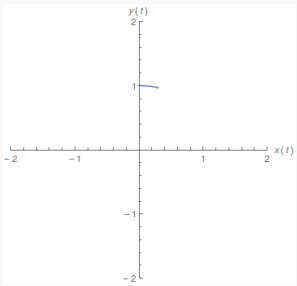
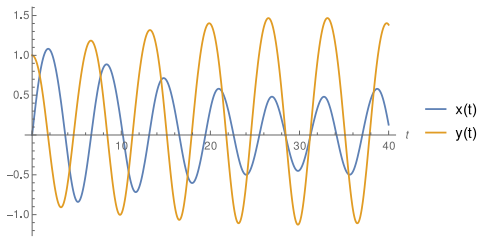
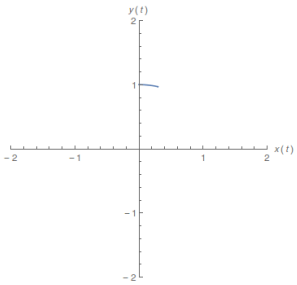
$e_1 = 0.1, e_2 = 0.1, e_3 = 0.1$		
$e_1 = 0.1, e_2 = -0.1, e_3 = 0.1$		
$e_1 = -0.1, e_2 = -0.1, e_3 = 0.1$		

3. 源代码

见`programs`文件夹。