Московский авиационный институт

(национальный исследовательский университет)

Институт № 8 «Информационные технологии и прикладная математика»

**Лабораторная работа №2**

**по курсу «Теоретическая механика»**

**Анимация системы**

Выполнил студент группы М8О-207Б-21

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Оценка:

Дата:

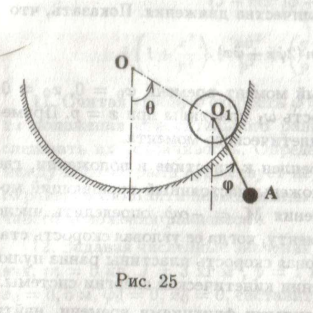
Москва, 2022

**Вариант № 25**

**Задание:**

Реализовать анимацию движения механической системы в среде Python

**Механическая система:**



**Текст программы**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | |  |  |  |  | **import numpy as np**  **import matplotlib.pyplot as plt**  **from matplotlib.animation import FuncAnimation**  **import sympy as sp**  **def sector(x, y, r):**  **cx = [x + r \* np.cos(i / 100) for i in range(314, 628)]**  **cy = [y + r \* np.sin(i / 100) for i in range(314, 628)]**  **return (cx, cy)**  **def circle(x, y, r):**  **cx = [x + r \* np.cos(i / 100) for i in range(0, 628)]**  **cy = [y + r \* np.sin(i / 100) for i in range(0, 628)]**  **return (cx, cy)**  **t = sp.Symbol('t')**  **R = 1**  **r = 0.2**  **m1 = 5**  **m2 = 3.5**  **l = 0.65**  **g = 9.80665**  **phi = sp.sin(np.pi / 6 \* t)**  **dphi = sp.diff(phi, t)**  **ddphi = sp.diff(dphi, t)**  **theta = sp.sin(np.pi / 4 \* t)**  **dtheta = sp.diff(theta, t)**  **ddtheta = sp.diff(dtheta, t)**  **x2 = (R - r) \* sp.sin(ddtheta)**  **y2 = (-1) \* (R - r) \* sp.cos(ddtheta)**  **vx2 = sp.diff(x2, t)**  **vy2 = sp.diff(y2, t)**  **ax2 = sp.diff(vx2, t)**  **ay2 = sp.diff(vy2, t)**  **x3 = x2 + l \* sp.sin(ddphi \* sp.cos(phi-theta) + dphi \*\* 2 \* sp.sin(phi-theta))**  **y3 = y2 - l \* sp.cos(ddphi \* sp.cos(phi-theta) + dphi \*\* 2 \* sp.sin(phi-theta))**  **vx3 = sp.diff(x3, t)**  **vy3 = sp.diff(y3, t)**  **T = np.linspace(0, 50, 1000)**  **X1 = np.zeros\_like(T)**  **Y1 = np.zeros\_like(T)**  **X2 = np.zeros\_like(T)**  **Y2 = np.zeros\_like(T)**  **X3 = np.zeros\_like(T)**  **Y3 = np.zeros\_like(T)**  **V = np.zeros\_like(T)**  **x = np.linspace(0, 0, 1000)**  **y = np.linspace(-1.05, 0, 1000)**  **for i in np.arange(len(T)):**  **X2[i] = sp.Subs(x2, t, T[i])**  **Y2[i] = sp.Subs(y2, t, T[i])**  **X3[i] = sp.Subs(x3, t, T[i])**  **Y3[i] = sp.Subs(y3, t, T[i])**  **fig = plt.figure(figsize=[16, 9])**  **ax = fig.add\_subplot(1, 2, 2)**  **ax.axis('equal')**  **ax.set(xlim=[-1.5, 1.5], ylim=[-3, 1.5])**  **ax.plot(x, y, linestyle = '--', linewidth = 1, color = 'black')**  **line1, = ax.plot([X2[0], X2[0] + l \* sp.sin(np.pi)], [Y2[0], Y2[0] + l \* sp.cos(np.pi)], 'black')**  **line2, = ax.plot([X1[0], X2[0]], [Y1[0], Y2[0]], linestyle = '--', linewidth = 1, color = 'black')**  **line3, = ax.plot([X2[0], X2[0]], [Y2[0], y[0]], linestyle = '--', linewidth = 1, color = 'black')**  **sector1, = ax.plot(sector(X1[0], Y1[0], R)[0], sector(X1[0], Y1[0], R)[1], 'red')**  **circle1, = ax.plot(circle(X2[0], Y2[0], r)[0], circle(X2[0], Y2[0], r)[1], 'blue')**  **circle2, = ax.plot(circle(X3[0], Y3[0], 0.1)[0], circle(X3[0], Y3[0], 0.1)[1], 'green')**  **point, = ax.plot(0, 0, marker='o', color='black')**  **point1, = ax.plot(X2[0], Y2[0], marker='o', color='black')**  **point2, = ax.plot(X3[0], Y3[0], marker='o', color='black')**  **def kadr(i):**  **point.set\_data(0, 0)**  **point1.set\_data(X2[i], Y2[i])**  **point2.set\_data(X3[i], Y3[i])**  **line1.set\_data([X2[i], X3[i]], [Y2[i], Y3[i]])**  **line2.set\_data([X1[i], X2[i]], [Y1[i], Y2[i]])**  **line3.set\_data([X2[i], X2[i]], [Y2[i], 0 - R])**  **sector1.set\_data(sector(X1[i], Y1[i], R)[0], sector(X1[i], Y1[i], R)[1])**  **circle1.set\_data(circle(X2[i], Y2[i], r)[0], circle(X2[i], Y2[i], r)[1])**  **circle2.set\_data(circle(X3[i], Y3[i], 0.1)[0], circle(X3[i], Y3[i], 0.1)[1])**  **return sector1, circle1, circle2, point, point1, point2, line1, line2, line3**  **ax2 = fig.add\_subplot(4, 2, 1)**  **ax2.plot(T, X2)**  **plt.title('Vx[O1]')**  **plt.xlabel('t')**  **plt.ylabel('Vx')**  **ax3 = fig.add\_subplot(4, 2, 3)**  **ax3.plot(T, Y2)**  **plt.title('Vy[01]')**  **plt.xlabel('t')**  **plt.ylabel('Vy')**  **ax4 = fig.add\_subplot(4, 2, 5)**  **ax4.plot(T, X3)**  **plt.title('Vx[A]')**  **plt.xlabel('t')**  **plt.ylabel('Vx')**  **ax5 = fig.add\_subplot(4, 2, 7)**  **ax5.plot(T, Y3)**  **plt.title('Vy[A]')**  **plt.xlabel('t')**  **plt.ylabel('Vy')**  **model = FuncAnimation(fig,**  **kadr,**  **interval=(T[1] - T[0]) \* 1000,**  **frames=len(T))**  **plt.show()** | |

**Результат работы:**

