import numpy as np

import matplotlib.pyplot as plt

def main():

    J1 = 2.2

    J2 = 1

    B1 = 3

    Kt = 2

    M = 16

    b = 2

    k = 20

    R = 0.5

    r = 0.1

    m = r

    # define the system ODEs

    def equations(x, t):

        line\_1 = np.array([-B1/J1, 0, -Kt, 0])

        convt = (1 + M\*m\*\*2/J2)

        line\_2 = np.array([0, -m\*\*2\*b/J2/convt, Kt/convt, -m\*k/convt])

        line\_3 = np.array([1/J1, -1/J2, 0, 0])

        line\_4 = np.array([0, m/J2, 0, 0])

        A = np.array([line\_1, line\_2, line\_3, line\_4])

        B = np.array([1, 0, 0, 0])

        t\_in = 5 if t < 25 else 0

        return np.dot(A, x) + B \* t\_in

    x0 = np.array([0, 0, 0, 0])

    t = np.array([x\*0.01 for x in range(5000)])

    sol = rk4fixed(equations, x0, t)

    fig, (ax1, ax2) = plt.subplots(2)

    p3 = sol[:,0]

    p7 = sol[:,1]

    p10 = M\*m\*p7/J2

    q5 = sol[:,2]

    q11 = sol[:,3]

    twist = q5-q11

    dots = np.array([equations(sol[i],t[i]) for i in range(len(sol))])

    p7\_dot = dots[:,1]

    p10\_dot = M\*m\*p7\_dot/J2

    ax1.plot(t, twist, label = "Twist angle (rad)")

    ax1.plot(t, p10, label = "Mass displacement (m)")

    ax1.legend()

    ax1.set\_title("\_\_ vs Time")

    ax1.set\_xlabel("Time (s)")

    ax1.grid()

    ax2.plot(t,p10\_dot, label = "Mass velocity (m/s)")

    ax2.plot(t,dots[:,2] - dots[:,3], label = "Twist rate (rad/s)")

    ax2.grid()

    ax2.set\_title("\_\_ vs Time")

    ax2.set\_xlabel("Time (s)")

    ax2.legend()

    plt.show()

def rk4fixed(f, x0, t):

    import numpy

    n = len(t)

    x = numpy.zeros((n, len(x0)))

    x[0] = x0

    for i in range(n - 1):

        h = t[i+1] - t[i]

        k1 = f(x[i], t[i])

        k2 = f(x[i] + k1 \* h / 2., t[i] + h / 2.)

        k3 = f(x[i] + k2 \* h / 2., t[i] + h / 2.)

        k4 = f(x[i] + k3 \* h, t[i] + h)

        x[i+1] = x[i] + (h / 6.) \* (k1 + 2\*k2 + 2\*k3 + k4)

    return x

if \_\_name\_\_ == "\_\_main\_\_":

    main()

Chart, line chart

Description automatically generated