5elen018w_tutorial7_2025_code

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import matplotlib.pyplot as plt

# Initialisation
v = 0  # current speed initialised to 0
previous_v = 0  # the speed at the previous time step
dt = 0.001  # time step for the simulation


''' Implementnts the dynamic system (plant) - system input is action u
    and the method returns the output of the plant '''
def plant(action_u):
    # m \dot{v} + b v  = u
    # m=1000, b=50, u = 500
    m = 1000.0
    b = 50

    v_dot = (action_u - b*v)/m

    new_speed = v + v_dot*dt
    return new_speed


# open a file for writing
pw = open('myfile.txt', 'w')

start_time = 0
end_time = 10.0

current_time = start_time

v_ref = 10  # the desired speed

K_p = 800  # proportional gain
K_i = 40    # integral gain
K_d = 40   # derivative gain

previous_error = 0
```

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integral = 0

# list containing time for the simulation
time = []

# list containing speed for the simulation
speed = []

#   simulate the system operation from the beginning till
#   the end of the simulation
while current_time <= end_time:
    error = v_ref - v

    # I(ntegral) component of the PID controller
    integral = integral + error*dt

    # D(erivative) component of the PID controller
    deriv = (error - previous_error)/dt

    # the output (action) of the PID controller
    action = K_p*error + K_i*integral + K_d*deriv

    # remember the last error when the previous action
    # was applied to the plant
    previous_error = error

    # apply the new action to the plant to calculate
    # the new (current) speed
    v = plant(action)

    print(f"Time: {current_time} Action: {action}, Speed={v}")
    pw.write(f'{v} {current_time}\n')

    # save v and current_time in the corresponding lists
    time.append(current_time)
    speed.append(v)

    # advance the time
    current_time += dt


pw.close()

# plot speed vs time
plt.plot(time, speed)
plt.ylim(0, 10)  # set the limits of the range for the y-axis
plt.show()  # display the plot
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