DC motor MPC Python

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LaTeX cheatsheet

1 Introduction

2 DC Motor Parameters

$$J\dot{\omega} = -b\omega + k_t i$$
$$L\dot{i} = -k_b\omega - Ri + V$$

J = 0.018256, b = 0.168599, kt = 1.595349, kb = 1.56749, R = 1.746171, L = 0.
Noticed L = 0.

3 Discretization

Using Euler's method (Slope), converting A and B to:

$$\frac{x(k+1) - x(k)}{T_s} = Ax(k) + Bu(k)$$
$$A_d = I + A \cdot T, \quad B_d = B \cdot T.$$

4 State-Space Equations

The state Vector is:

$$x = \begin{bmatrix} \omega \\ i \end{bmatrix}$$

The control input is:

$$u = V$$

State-space equations:

$$A = \begin{bmatrix} -\frac{b}{J} & \frac{k_t}{J} \\ -\frac{k_b}{R} & -\frac{1}{R} \end{bmatrix}, \quad B = \begin{bmatrix} 0 \\ \frac{1}{R} \end{bmatrix}$$

5 Cost Function

Cost Function:

$$\text{Cost} = \sum_{t=0}^{N-1} \|x_t - r_t\|_Q^2 + \|u_t\|_R^2 \,,$$

where x_t is the state, r_t is the reference, u_t is the control input, and Q and R are weight matrices.

6 Constraints

Constraints:

$$u_{\min} \leq u_t \leq u_{\max}, \quad x_0 = [0, 0]^T \text{,initial state.}$$

7 Simulation