MODEL PREDICTIVE CONTROL · POSITION · PYTHON CLI · CARIMO DCMK KIT

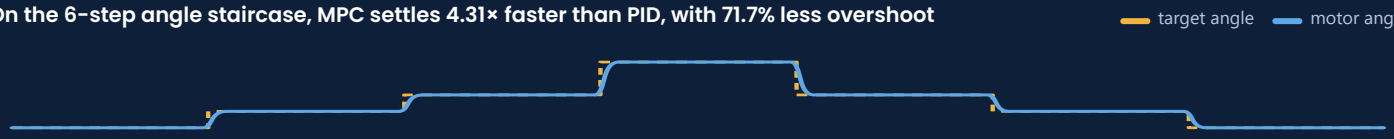
MPC POSITION CONTROL

PYTHON EDITION · NO MATLAB

Real constrained-QP MPC for precise angle control, as a pure-Python pipeline. Live plots, saved data, no MATLAB, on the same motor.

12 TEXTBOOK CHAPTERS

On the 6-step angle staircase, MPC settles 4.31× faster than PID, with 71.7% less overshoot



Tracking the kit's 0° → 90° → 180° → 360° → 180° → 90° → 0° staircase on a live DCMK motor: the locked MPC tuning settles inside ±1°, well ahead of a hand-tuned PID.

IN ONE BREATH

MPC Position Control runs entirely in Python. A real constrained quadratic program (OSQP) plans every move to hit a target angle inside hard limits, and cracks the stiction wall that breaks textbook linear MPC. On the 6-step staircase it settles 4.31× faster than a hand-tuned PID with 71.7% less overshoot. One terminal command per experiment, a live plot, auto-saved CSV and PNG. No MATLAB, no toolbox licence.

No MATLAB — no toolbox licence to buy

4.31× — faster settling than PID

±1° — max steady-state error

A scriptable pipeline, four steps per run

1 RUN
One terminal command per experiment, presets in the args.

2 SOLVE
A real QP plans the move, honouring hard limits.

3 WATCH
A live plot draws angle, setpoint and PWM per tick.

4 SAVE
Auto-saved CSV + PNG, with canonical metrics.

Twelve textbook chapters, every MPC knob a dial

1. Locked MPC vs PID (the headline)
2. Prediction horizon (N)
3. Control horizon (M)
4. Speed vs gentleness (Q, Q_e)
5. Cracking stiction (Q_e)
6. Input weight (R), why R > 0
7. Hard input bounds (u-box)
8. Hard input-rate bounds (du-box)
9. Move-suppression cost (R_du)
10. Eddy-disk damping (0 / 4 / 8 magnets)
11. Load-step recovery
12. Software-injected disturbance

Why students win

No MATLAB
Real MPC with zero MathWorks licence cost.

Beats PID
4.31× faster on the staircase, 71.7% less overshoot.

Real nonlinearity
Stiction breaks textbook MPC; students see why.

Reproducible
Scriptable runs, CSV + PNG, variance bands published.

Open Python
Every driver script editable, a ~213-line MPC class.

What you need

Software
MPC Position Python · Python 3.x · cvxpy + OSQP + pyserial
No MATLAB, no toolbox.

System
Windows 10 or 11 · one free USB port · a terminal. Runs on your own PC.

Hardware
CARIMO DC Motor Kit in position mode, with magnetic load disk · **sold separately**

Real predictive position control, no MATLAB required. Also available as Simulink editions.

Part of the CARIMO DCMK control family, built on a 15-year teaching heritage at IIT Bombay

Request a demo or quote | www.carimotech.com | contact@carimo.tech | +91 90823 97027