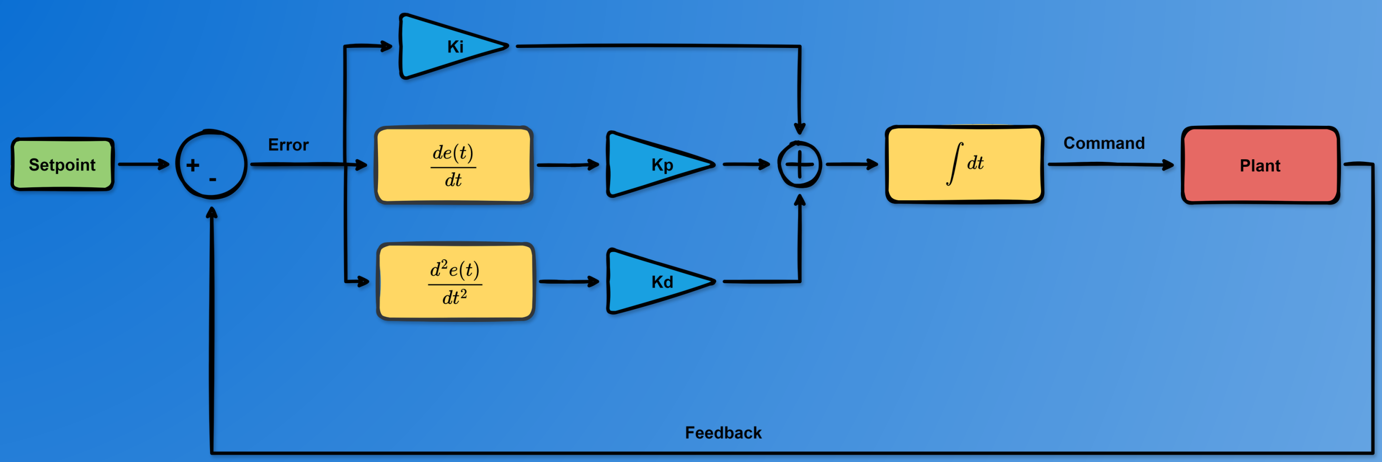
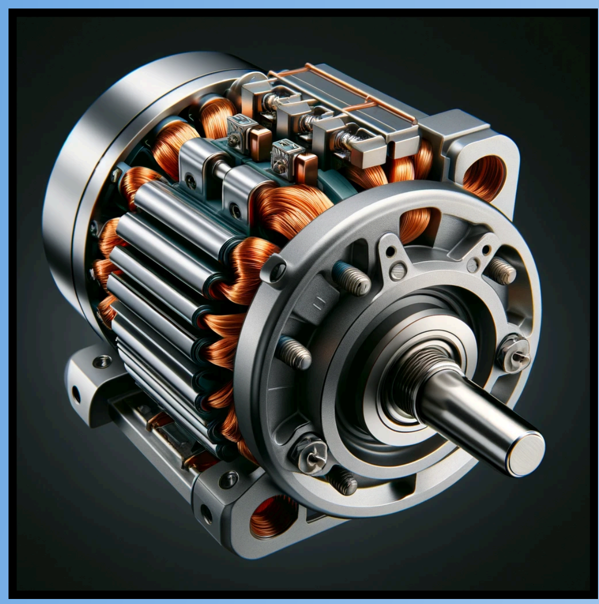
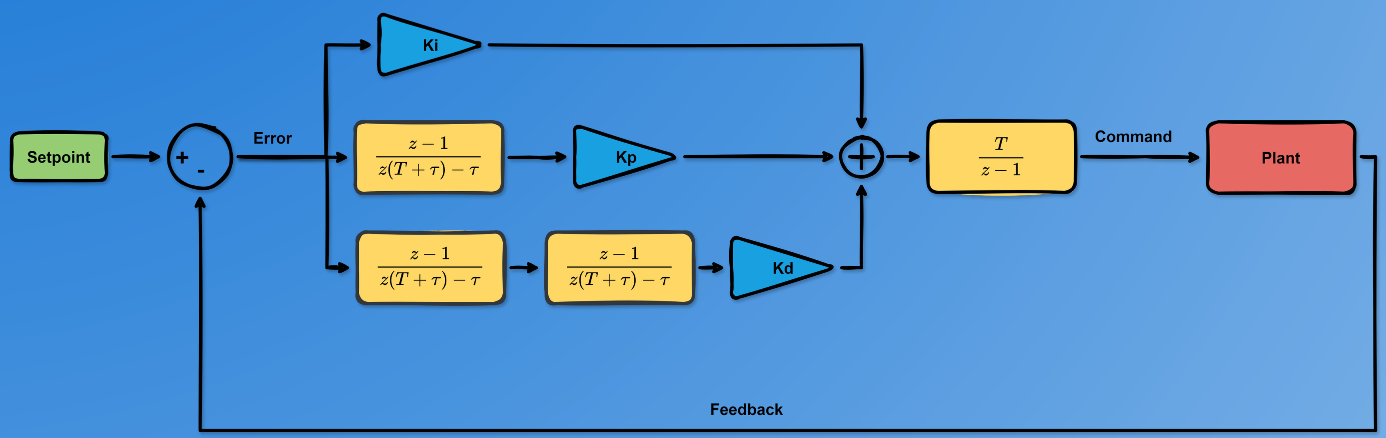
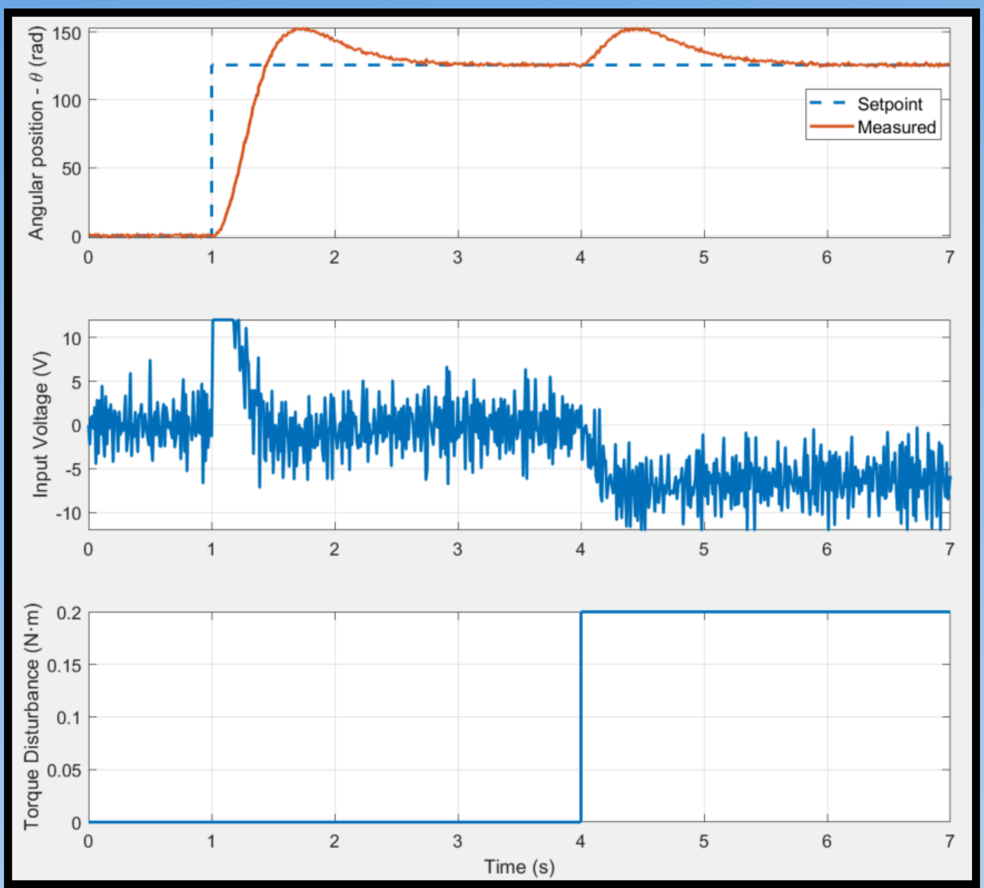
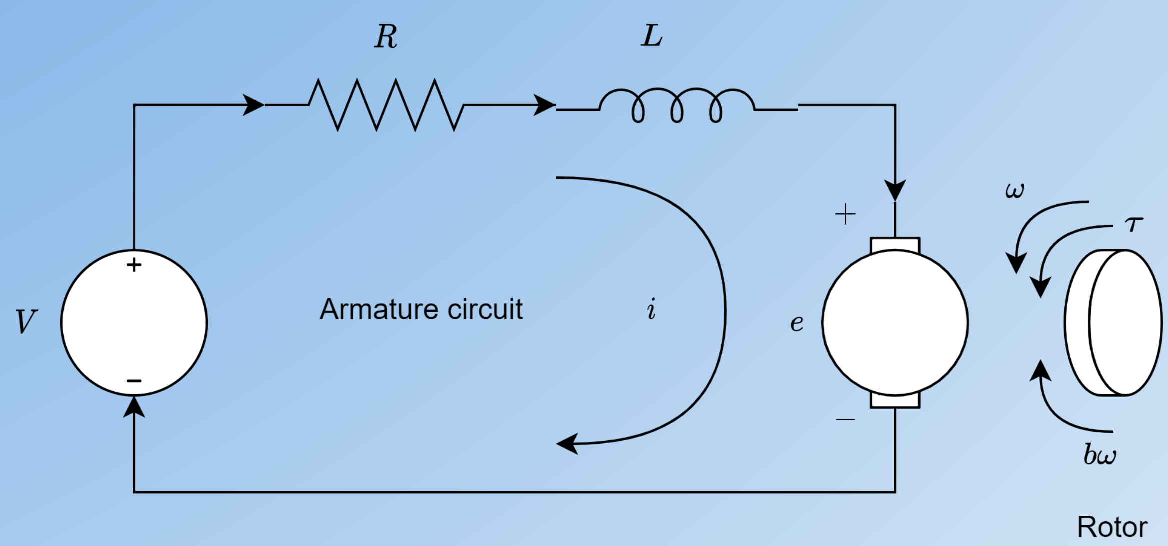






How to Use a PID Velocity Algorithm to Control the Position of a DC Motor





Code

https://github.com/simorxb/PID-Velocity-Algorithm

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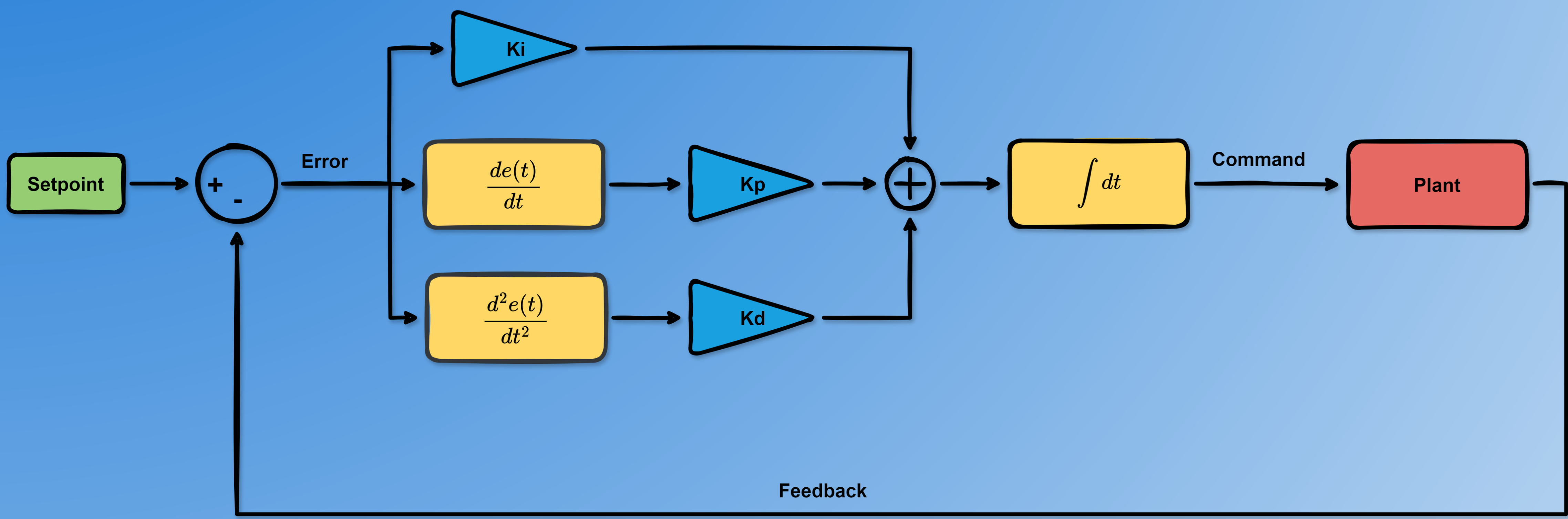
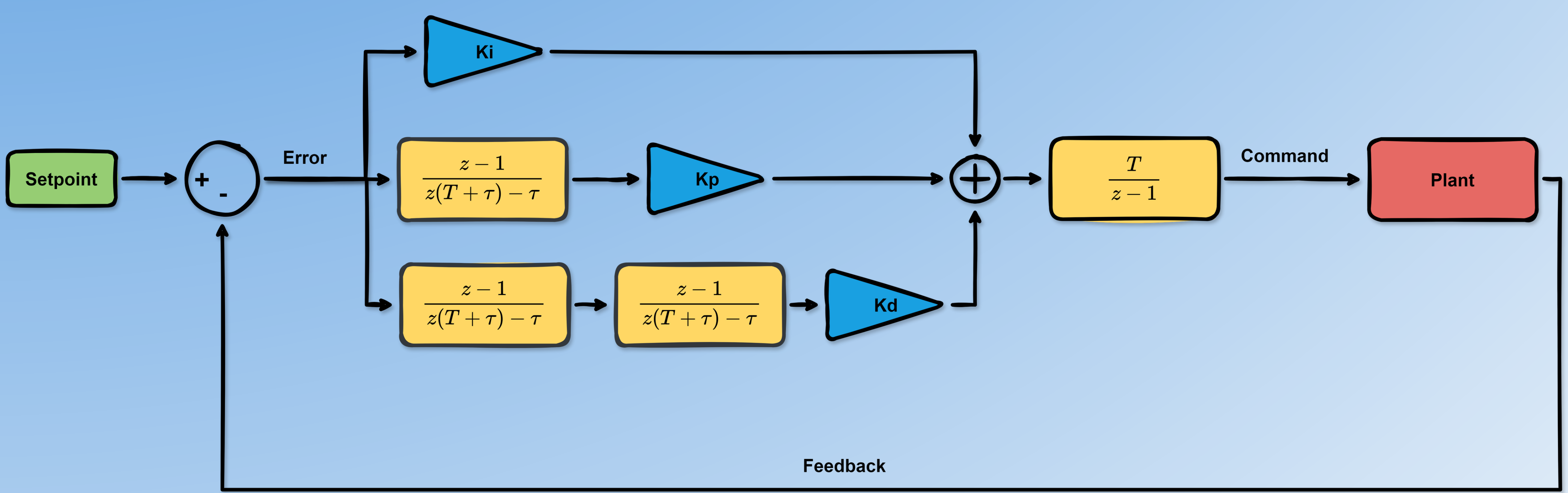
SIMONE BERTONI CONTROL LAB

PID Velocity Algorithm
What is it?

Continuous Time



Discrete Time - with Derivative Filter



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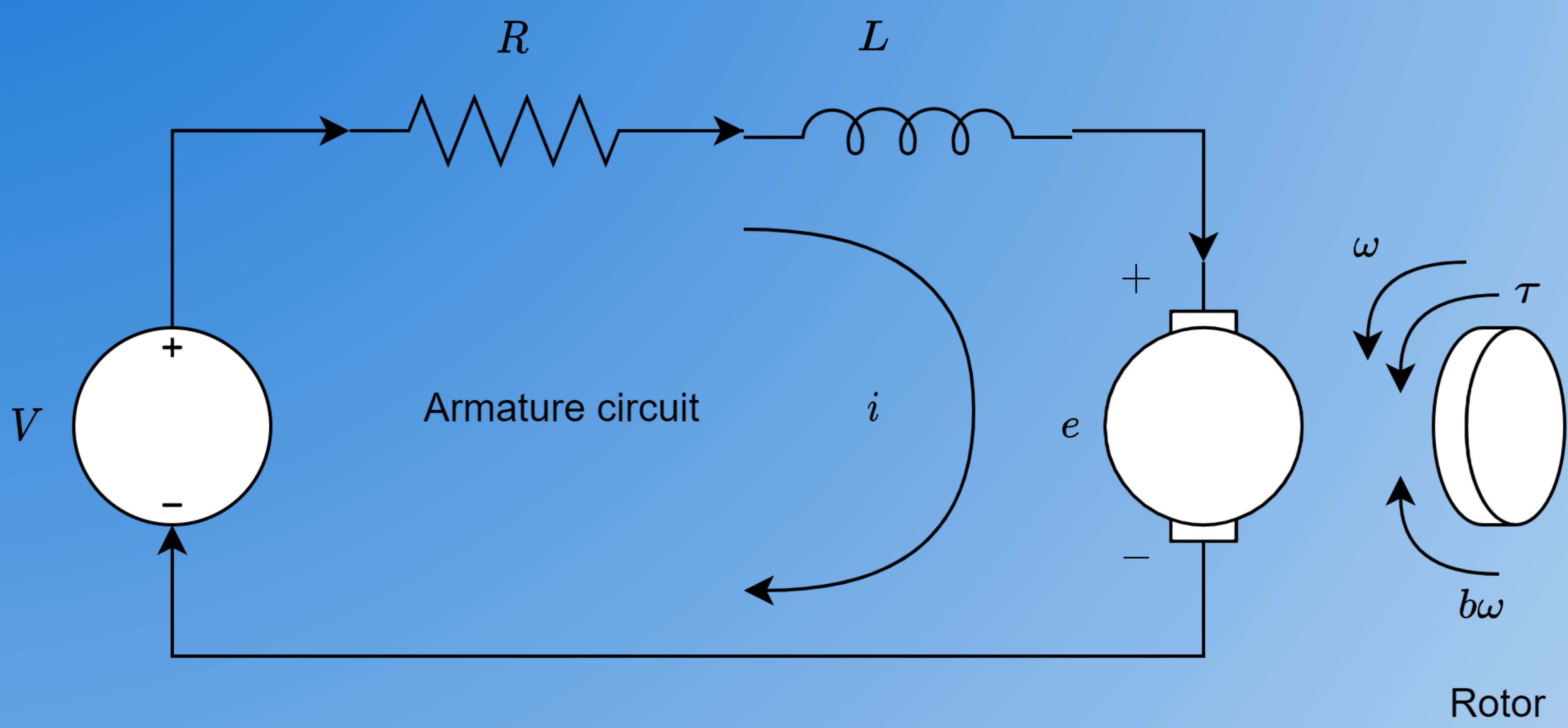
DC Motor



Mechanical - Newton's second law for rotational motion:

$$J\dot{\omega} + b\omega = \tau, \ \tau = k_t i$$

Electrical:

$$L\frac{di}{dt} + Ri = V - k_e\omega$$

Isolate the highest level derivatives to facilitate modelling:

$$\dot{\omega} = \frac{k_t i - b\omega}{J}$$

$$\frac{di}{dt} = \frac{V - k_e\omega - Ri}{L}$$

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DC Motor Parameters

Referring to the datasheet of a real DC motor (C23-L33-W10) from Moog (https://www.moog.com/content/dam/moog/literature/MCG/moc23series.pdf) we can derive our parameters:

Torque sensitivity (k_t) = 0.0187 Nm/A

Back EMF (k_e) = 0.0191 V/(rad/s)

Terminal resistance (R) = 0.6 Ohm

Terminal inductance (L) = 0.35 mH

Damping factor (b) = 0.001 Nm/KRPM = 0.0000095 Nm/(rad/s)

Assuming that we are spinning a disc of radius 5 cm and mass 0.1 kg, we have:

$$J = 0.5mr^2 = 0.000125\ kgm^2$$

```matlab
%% Parameters

m = 0.1;              % Mass of the disc (kg)
r = 0.05;             % Radius of the disc (m)
J = 0.5*m*r^2;        % Moment of inertia of the disc (kg*m^2)
b = 0.0000095;        % Viscous friction coefficient (N*m*s)
kt = 0.0187;          % Torque constant (N*m/A)
R = 0.6;              % Armature resistance (Ohm)
L = 0.35/1000;        % Armature inductance (H)
ke = 0.0191;          % Back EMF constant (V*s/rad)
```

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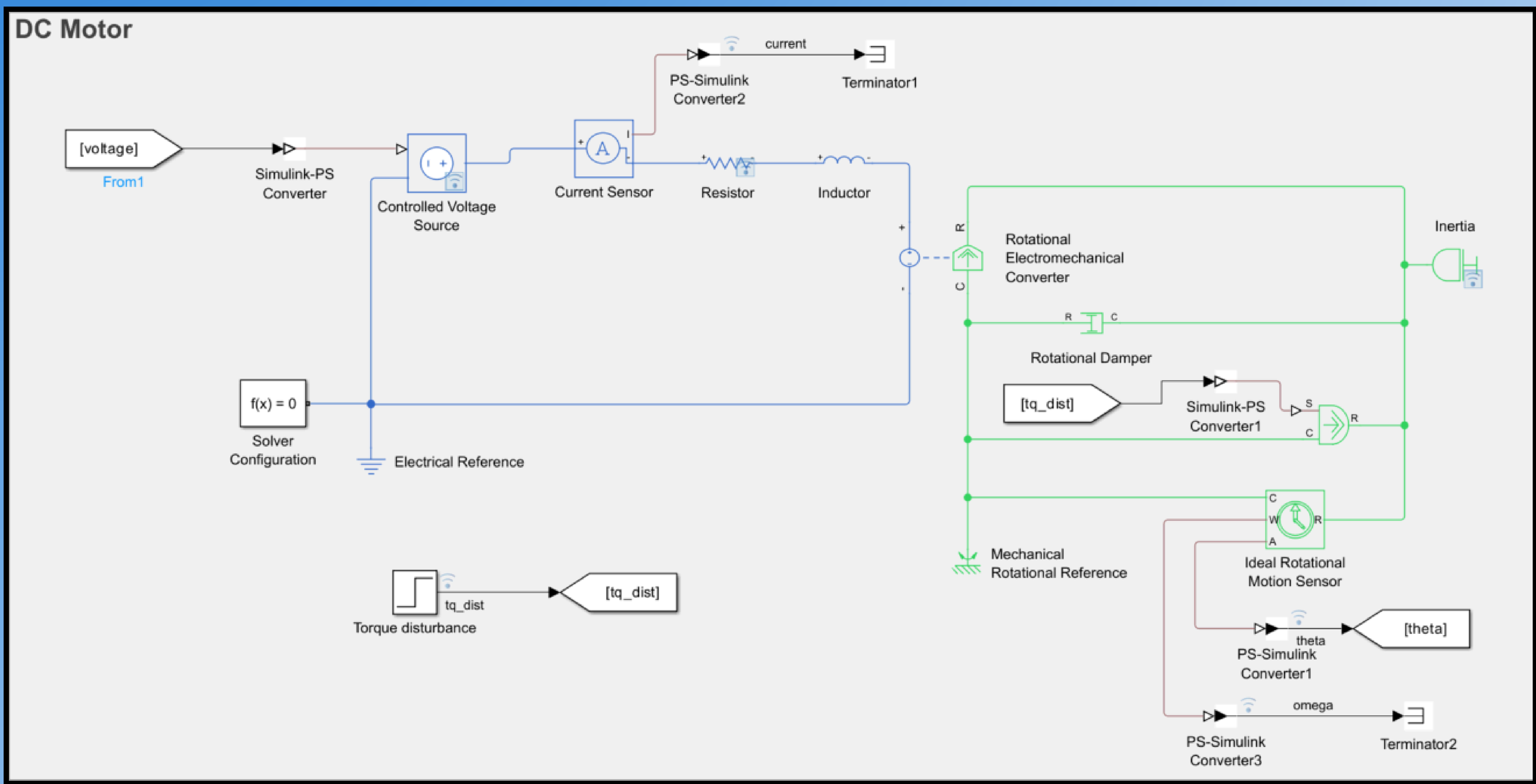
Simscape
DC Motor Model



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Matlab – Velocity PID Initialisation

```matlab
%% PID

T = 0.01;            % Sampling time (s)
kp = 0.2;            % Proportional gain
ki = 0.3;            % Integral gain
kb = 1;              % Anti-windup gain
kd = 0.025;          % Derivative gain
tau = 0;             % Time constant for derivative filter
```

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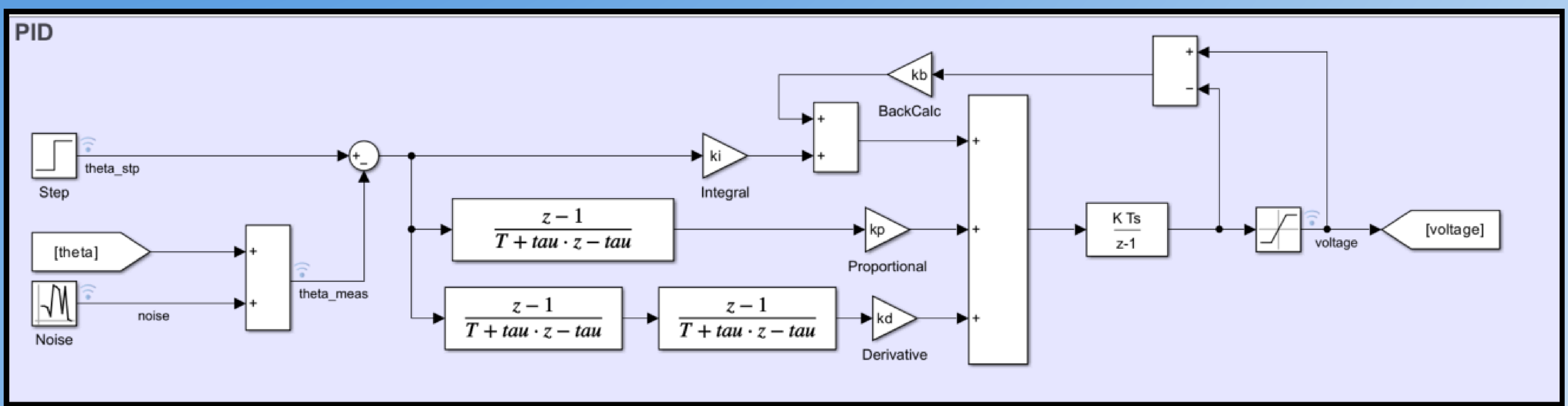
Simulink – Velocity PID Implementation

This implementation includes a back-calculation anti-windup technique.



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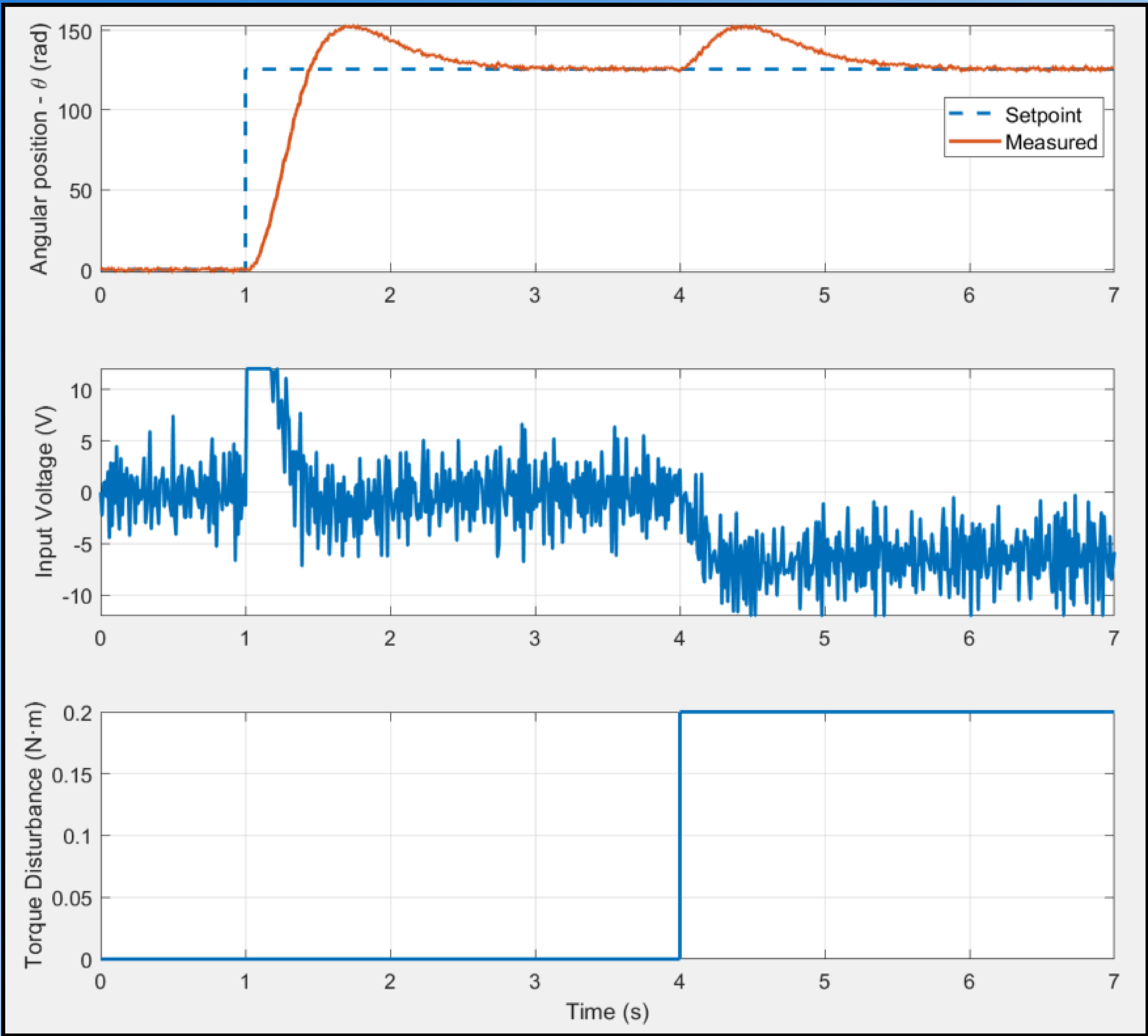
Position Control



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PID Controller Course

https://simonebertonilab.com

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Overall, a great course. worth recommending.

★★★★★ *May 7, 2024*

The course is exciting and engaging, covers most of the concepts and all the explanations are clear and easy to understand. it would be great if there was more explanation on the calculations and recommendations for additional resources. Overall excellent course, and I got to learn a lot.

Vikram Kolupula ✔ Verified

★★★★★

Very helpful and practical

Yoav Golan

I enjoyed this course very much. I learned a lot of practical knowledge in a short time. Simone is very clear and teaches well, thank you! In the future, I would be very interested if Simone added a course with more subjects, such as cascading controllers, rate limiting, and how the controllers look in actual code. Thanks again!

★★★★★

Intuitive and Practical

Ranya Badawi

Simone's explanation of PID control was very intuitive. This is a great starter course to gain a fundamental understanding and some practical knowledge of PID controllers. I highly recommend it. For future topics, I'd be interested in frequency response, transfer functions, Bode plots (including phase/gain margin), Nyquist plots, and stability.

Understand the control theory

★★★★★ *April 28, 2024*

I think the most important thing is to understand the meaning behind the mathematical formula. I guess this is the mission of Simone in this course and from my point of view he fully achivied this target. I hope to see in the future other courses (e.g advanced controls) structered in the same way with the same passion and examples.

Thank you Simone. Show less

Emidio ✔ Verified

★★★★★

Very good sharing of experience

Romy Domingo Bompart Ballache

I have background in control system for power electronics, I see every lesson very useful.

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