

Open Loop vs Closed Loop Motor Control Demonstration

Touch each wheel to feel the difference. They are both being run at half speed. One has Open Loop Control, and is not as strong. The other has Closed Loop control and increases the voltage when you interfere to try and keep the speed constant.

At full speed, we can just run the motors with maximum voltage and do not need any control.

But, we usually want to run at lower speeds so we can turn slowly, or drive slowly up to the target location. Also, two of the same motors rarely run at exactly the same speed, so we need to send different speed commands to each motor to have the robot drive straight.

With Open Loop control, we can simply lower voltage to make the motor spin slower, but that results in less power, so the motors will drive slower on hills and turns.

To solve this problem, we use Closed Loop motor control. We add Encoders to the motor - they report how far the wheel has turned so we can calculate the speed in Rotations per Minute, or RPM.

A Closed Loop control system will monitor the RPM, and increase the motor voltage if it is running slower than desired, and vice versa.

This example is for Velocity Control, and you can also use Encoders and Closed Loop control for Position Control - having a motor rotate to a specific heading, stop, and hold there.

The most common Closed Loop control algorithm is called PID (Proportional, Integral, Derivative). There are tons of great YouTube videos on how PID control works.