Volume estimation via integrating on a curve fitted point cloud

HiPEDS 2018 Cohort: G. Bisbas, L. Castiglione, D. Grumberg, S. Karolčík, L. Keeble, D. Kulon, B. Kwan, C. McMeel, R. Miles, J. Ortiz, N. Perez-Nieves, V. Pham Ngoc, J. Vandebon, D. Vink

Imperial College London

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Overall structure

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The problem and the goal

The hardware

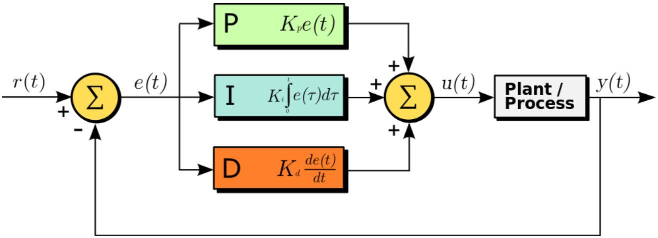

Figure: PID controller

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Extracting the point cloud

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PID tuning

Adjustment of its control parameters (gain/proportional band, integral gain/reset, derivative gain/rate) to optimum values for a target response. Tuning is part of loop design, usually required if the system oscillates too much, responds too slowly, has steady-state error, or is unstable.

Another is known as the Ziegler-Nichols method, introduced by John G. Ziegler and Nathaniel B. Nichols of Taylor Instruments in 1942. This technique also involves setting I and D gains to zero and then increasing P gain until the loop output starts to oscillate.

In fact, most industrial facilities no longer tune loops with manual calculation, but use tuning and loop optimization software. The only drawbacks: Software is somewhat costly and involves some training.

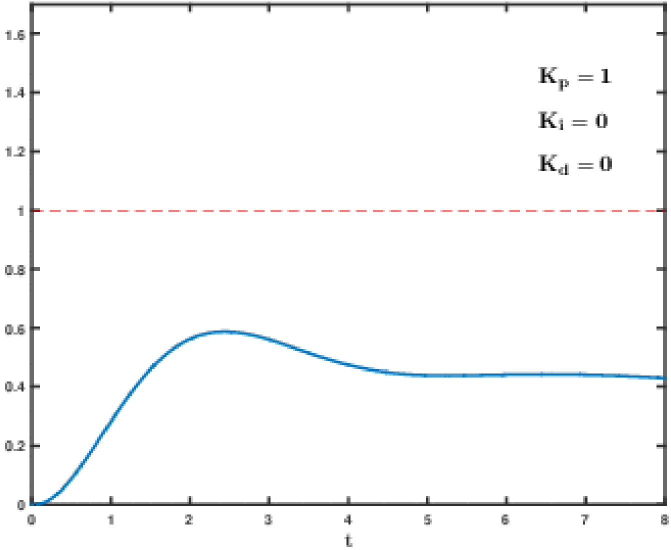
The analytical approach involves mathematics.

One can also tune by feel, which is an online method that doesn't require math. The main problem with this method is that it is erratic, not repeatable, and can be inefficient.

PID tuning

The final method of tuning is a quality process model called the Cohen-Coon, which is a modified version of the Ziegler-Nichols approach. This offline method involves some math, but is only good for the first-order process.
We can use this:
https://www.machinedesign.com/sensors/introduction-pid-control

Embedded PID Animation



Embedded PID Animation

Linear Quadratic Regulator - Introduction

Introduction

The Linear Quadratic Regulator (LQR) is a well-known method that provides optimally controlled feedback gains to enable the closed-loop stable and high performance design of systems.

The problem

LQR solution via Dynamic Programming

Solution

Extension I: for Non-Linear Systems

Extension II: Penalize for change in Control Inputs

Gradient Method Solution for the General Case

LQR Solution

Optimal Full-State Feedback

Properties and Use of the LQR

The End