A Segue to Segways

PID controllers

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Motivation

- Control theory is relevant for all engineering majors
  - Process control for ChemE
  - Robotics for everything else
- PID controllers are ubiquitous in control theory
- Self-balancing stuff are cool

Introduction

- What is control theory?

What is a PID?

- A history lesson

- An algorithm

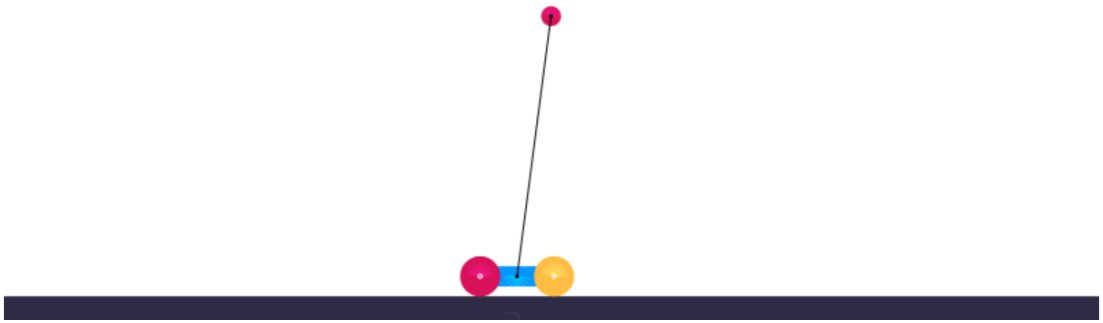
$$u(t) = K_p e(t) + K_i \int_0^t e(t')dt' + K_d \frac{de(t)}{dt}$$

(that's actually not that scary)

Let's get tuning!

Go to: https://SASE-Labs-2021.github.io/inverted-pendulum

Simulation Sensor Code



K_p

K_i

K_d

Restart Engine

Cheat Sheet

See this gif

What happens what we increase ...?

Parameter	Rise time	Overshoot	Settling time	Steady-state error	Stability
K_p	Decrease	Increase	Little change	Decrease	Decrease
K_i	Decrease	Increase	Increase	Eliminate	Decrease
K_d	Little change	Decrease	Decrease	Little change	Increase

Next steps

- Build something self-balancing with Arduino or MicroPython
- An excuse to learn reinforcement learning or genetic algorithms
  Can you teach a computer to do this?
- Appreciate steering wheels and thermostats a little more
- Share your very own PID!