Introduction

# Open Loop Control

## Stable Plant

### Linear Dissipation

Velocity control for mass + damper

### Power Law Dissipation

Velocity control for mass + air drag

## Uncertainty

### External Disturbance

Wind or gravity on variable slope

### Plant Variation

Variable mass, room temperature or humidity with variable number of people

## Unstable Plant (Force to Position)

### Marginally Stable Plant (Non-Oscillating)

Position control for mass + damper

### Marginally Stable Plant (Oscillating)

Position control for mass + spring

### Runaway Plant

Position control for mass in space

Inverted pendulum, mass on a hill

Thermal runaway

# Output Feedback

## Proportional (P)

### Integrating System

Force to velocity

### Non-Integrating System: Steady State Error

Force to acceleration

### Double-Integrating System: Oscillation

Force to position

## Proportional + Derivative (PD)

### Lowpass and Anti Kick

## Proportional + Integral (PI)

### Anti Windup

## PID

### Gain Scheduling

### Feedforward and Input Shaping

### Disturbance and Noise

## Zeros

### Minimum Phase

### Non-Minimum Phase

### Time Delay

## Unstable Poles

### Strongly Stabilizable

### Weakly Stabilizable

## Lead and Lag Compensators

### Stability Margins

### Sensitivity Reduction

# State Feedback

## Pole Placement

## Reference Tracking

## MIMO Zeros

## MIMO Decoupling

# State and Model Estimation

## Predictor

## Observer

## Kalman Filter

# Non-linear Systems

## Feedback Linearization

## Aiming for Limit Cycles (?)