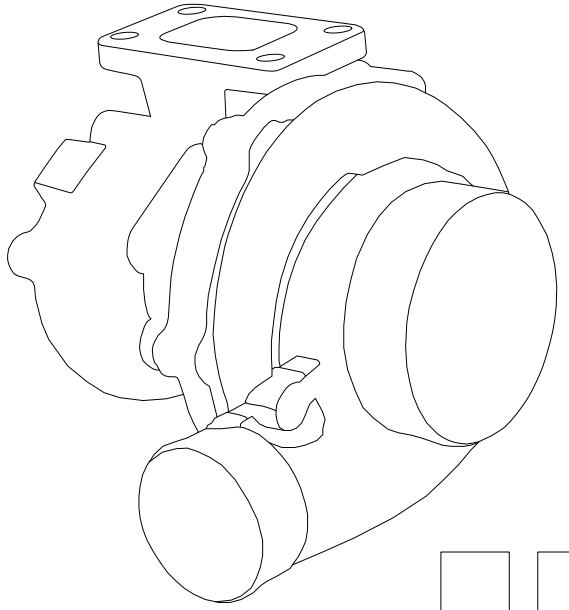
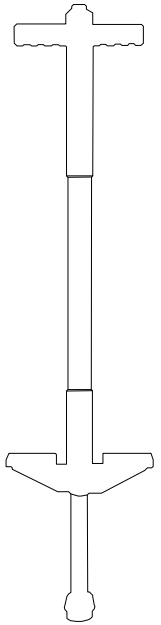
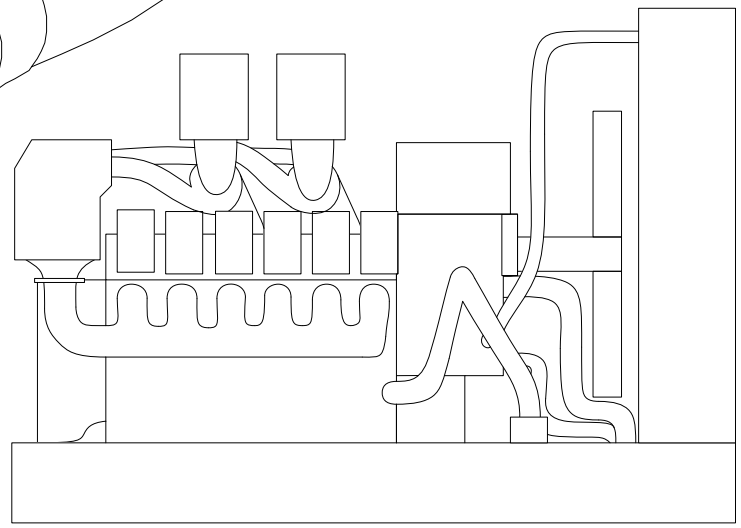
Paths to Control Viability

Factors adding to the challenge of controlling a system

- Device Complexity
  - Interrelation of control variables
  - Many, potentially conflicting, control actuators
  - Non-linear behavior
  - Complex equipment damage characteristics
  - Personal safety concerns
- Device Response Time
  - Quickly reacting controls
  - Quickly reacting system
  - System response time similar to control response time
  - Required time to reach damage thresholds
- Device Durability
  - Proximity to damage thresholds
  - Overload capability



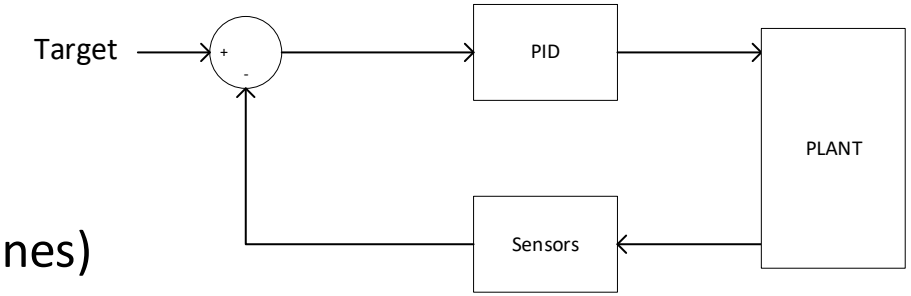


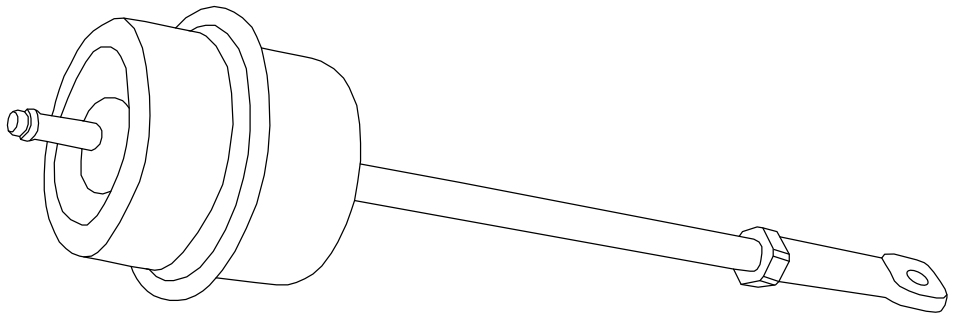


Paths to Control Viability

Available Control Tools

- Controller Topologies
  - Simple PID (feedback)
  - State-Space controllers
  - Prediction or feed-forward tables
  - Non-linear control systems (such as state machines)
  - Model Predictive Control
- Design Decisions
  - Integrated safety stops or features
  - Operating well below design capability
  - Self-regulation
  - Secondary control



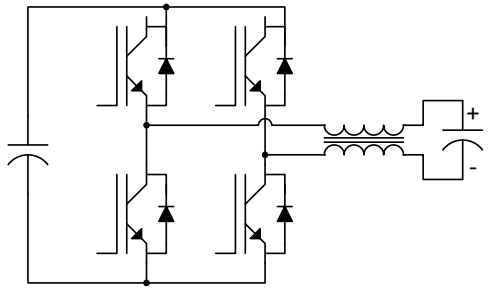


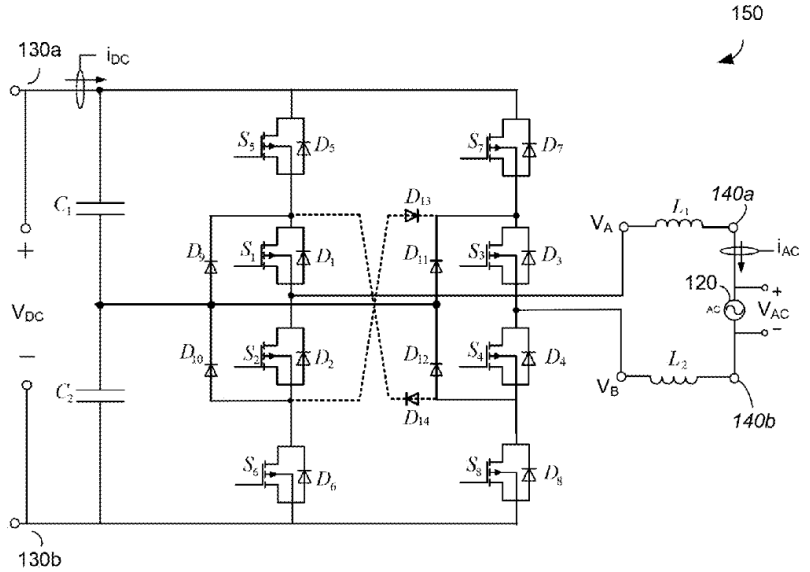
Paths to Control Viability

Examples

- Controlling internal combustion engine speed
  - Lawn Mower
    - Simple engine; loose requirements
  - Generator
    - Simple Engine
    - Spark Ignited
    - Turbocharged

- Controlling power electronics
  - Simple H-bridge inverter
  - 3-level converter
  - Multi-level resonant converter

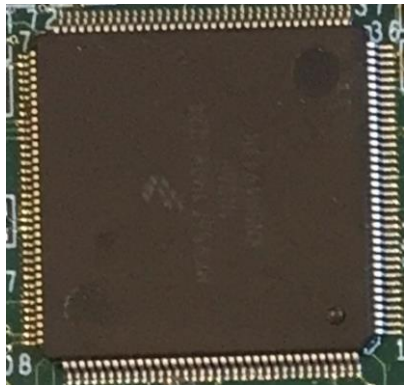




Paths to Control Viability

Practical considerations

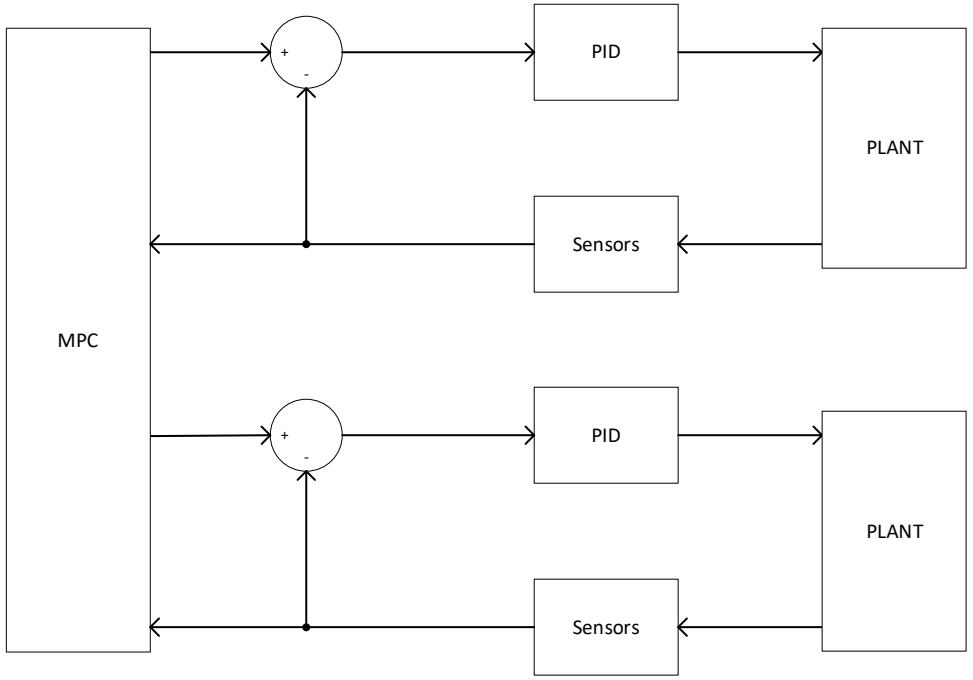
- Hardware
  - Processor
  - Operating system
  - Connections to system
- Cycle Time
  - Control system update rate
  - Feedback update rate
- Delay in feedback
  - Sampling delay
  - Measurement delay
- Actuator
  - Available effort
  - Wear and tear
  - Response time



Paths to Control Viability

Summary

- MPC
  - Greatly expands control capability
  - Often reduces actuator effort
  - Requires large computing resources
  - Is seldom able to react quickly
- Simple controllers
  - Control limited to simple, linear systems
  - Can operate on low-end hardware
  - Very quick



Combining both strategies can provide excellent control for complex systems.

Paths to Control Viability

QUESTIONS?