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
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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
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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
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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
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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.
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QUESTIONS?