



CDS 110: Lecture 1.2 Applications of Control



Richard M. Murray
29 September 2004

Goals:

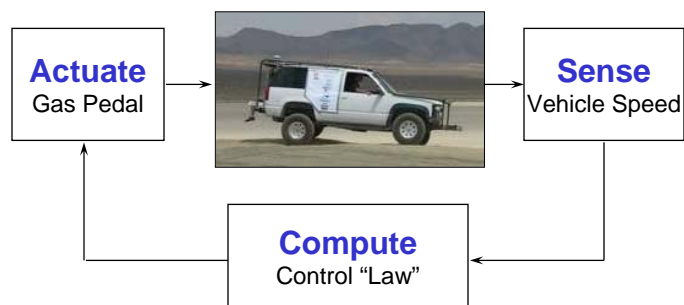
- Describe modern engineering environment for control
- Survey engineering applications of control and key features
- Provide information on CDS 110 sections; explain schedule process
- Honor System discussion

Reading (available on course web page):

- Optional: R. Murray (ed), *Control in an Information Rich World*, 2003.

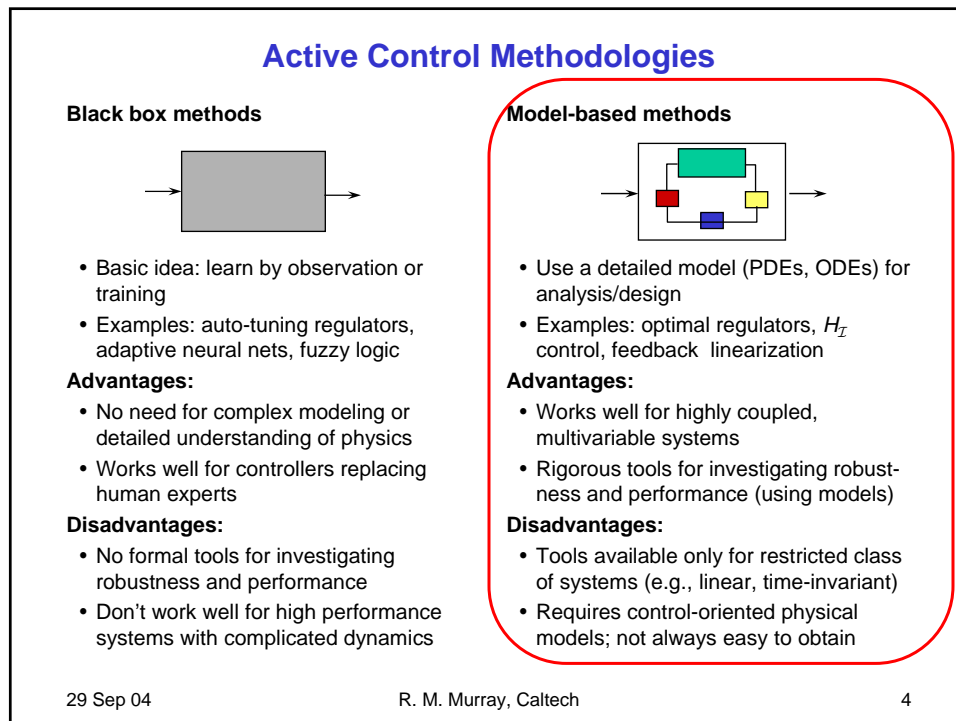
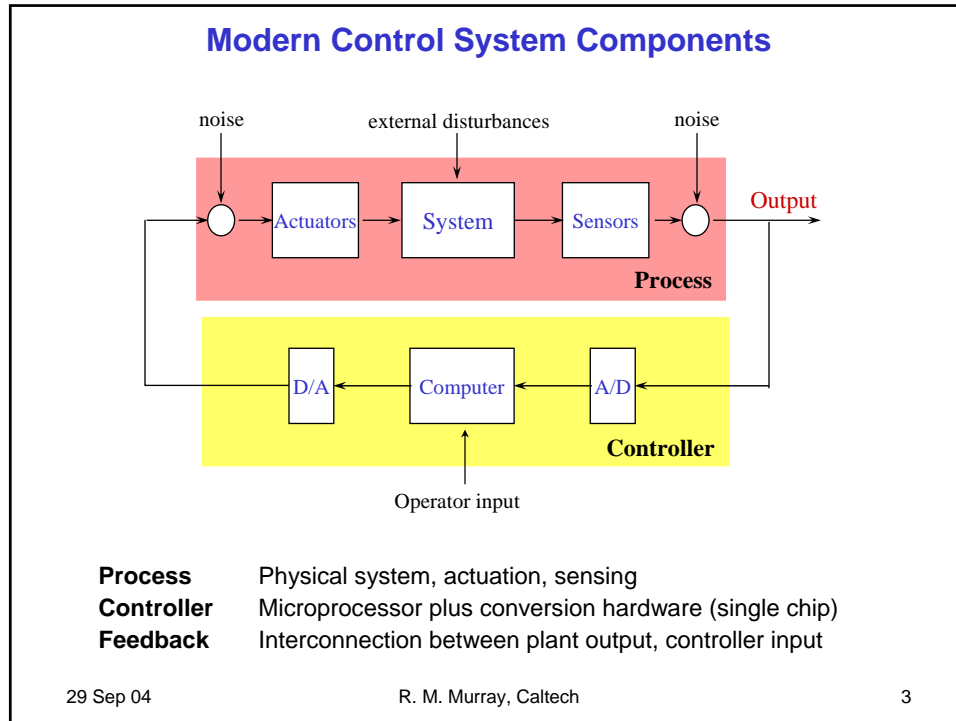
Control = Sensing + Computation + Actuation

In Feedback "Loop"



Goals

- Stability: system maintains desired operating point (hold steady speed)
- Performance: system responds rapidly to changes (accelerate to 6 m/sec)
- Robustness: system tolerates perturbations in dynamics (mass, drag, etc)



CDS 101/110 Course Sequence

<p>CDS 101 – Introduction to the <i>principles</i> and <i>tools</i> of control and feedback</p> <ul style="list-style-type: none"> • Summarize key concepts, w/ examples of fundamental principles at work • Introduce MATLAB-based tools for modeling, simulation, and analysis 	}	Fall
<p>CDS 110a – Analytical understanding of key concepts in control</p> <ul style="list-style-type: none"> • Detailed description of classical control and state space concepts • Provide knowledge to work with control engineers in a team setting 	}	Fall
<p>CDS 110b – Detailed design tools for control systems</p> <ul style="list-style-type: none"> • Estimation and robust control tools for <i>synthesis</i> of control laws 	}	Winter
<p>CDS 111 – Implementation of control systems for engineering applications</p>	}	Spring
<p>CDS Minor: CDS 110, CDS 140, senior thesis/project or Ae/CDS 125</p>		

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CDS 110 Recitation Sections

<p>Goals</p> <ul style="list-style-type: none"> • Respond to 2003 feedback: more worked out examples • Provide more discipline-specific examples and discussion <p>Approach</p> <ul style="list-style-type: none"> • Weekly 1 hour meeting led by TA • Held after Wed lecture => reinforce concepts from class, answer questions • Each recitation will provide additional details on lectures + worked examples 	<p>Available sections</p> <ul style="list-style-type: none"> • Biomolecular and chemical processes • Information systems • Mechanical and aerospace systems • Electrical and electronic systems • Robotics and autonomous systems <p>How to sign up</p> <ul style="list-style-type: none"> • Fill out scheduling sheet <ul style="list-style-type: none"> ▫ List top 3 section choices ▫ List available times for section • Sections assignments will be announced on Monday • OK to attend a different section than you are assigned, if you prefer
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Scheduling forms due by Friday (10/1) @ 5 pm

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Biomolecular and Chemical Processes

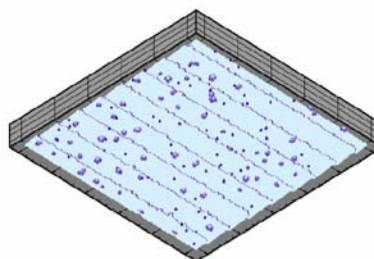
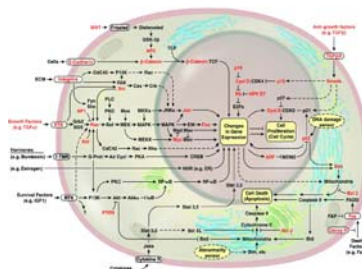
TAs: Domitilla Del Vecchio, Steve Chapman

Instructor: Anand Asthagiri

Application areas

- Chemical process control
- Biological feedback systems

Primary options: BE, Bio, ChE, MS



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Information Systems

TAs: Morr Mehyar, Kevin Tang

Instructor: Steven Low

Application areas

- Communications networks
- Software systems
- Economic systems

Primary options: CS, Ec, EE, SS



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Robotics and Autonomy

TAs: Haomiao Huang, Demetri Spanos

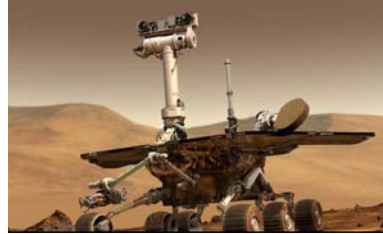
Instructor: Richard Murray

Application areas

- Autonomous robot systems
- Sensor-based navigation
- DARPA grand challenge

Primary options: CS, EE, ME

- Opportunities for hardware implementation on "Bob" or "Homer"



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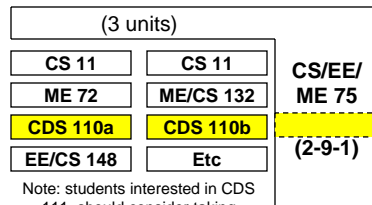
CS/EE/ME 75 – Multi-Disciplinary Systems Engineering

Course Goals

- Provide an introduction to team-based *multi-disciplinary* engineering
- Introduce tools for coordinating work across a large group
- Design, build and document a complex engineering system

Approach

- Select a major project each year (ideally with some prize money)
- Link work in individual classes to CS/EE/ME 75 project
- First two terms focused on design (through individual classes)
- Bring entire team together third term (and summer) to complete the project



Note: students interested in CDS 111, should consider taking CS/EE/ME 75abc



See <http://www.cds.caltech.edu/~murray/dgc75> for more info and signup

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Honor System

What is it?

No member of the Caltech community shall take unfair advantage of any other member of the Caltech community

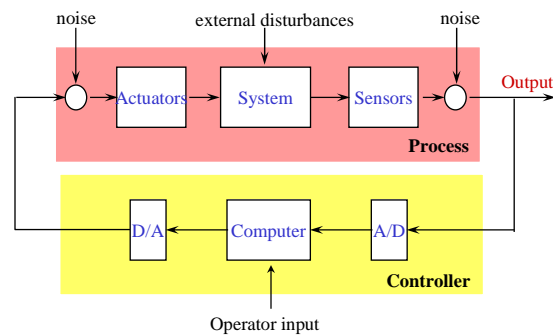
Why is it important?

- Provides a framework for ethical conduct in an academic setting
- Supports a *community* of scholars, working together to learn and educate
- Allows greater academic freedom through mutual trust and respect

How does it apply to this class?

- Homework: full collaboration allowed, but write up your own results
- Tests: take home, open book, limited time, non-proctored
- Violations: student centered – investigated by the BoC or GRB

Summary: Applications of Control



Modern applications of control

- Control = sensing, actuation and computation
- Digital control systems are increasingly common
- Applications across engineering and science



Molecular and chemical processes



Information Systems



Mechanical and Aero Systems



Electrical and Electronic Systems



Robotics and Autonomy