

CE 8


Robot Automation

Intelligence by Feedback Control

Prof. Bill Dunbar

TA: Brett Gyarfas (Gar-Fus)

Syllabus

- Who (Bill) and where I am
 - From a small farm in Virginia ... not really
 - Who are you?  no really.
- Web: course, webforum
- Grading

Form Teams of Three

- Name your team (A-team minus BA)



- Assign team Roles

- Leader/Presenter: Coordinates team meetings to work on HW/projects, presents group results in class

- Secretary: Does writing, assembles group HW/project reports

- Programmer: Most familiar with robot, responsible for code in HW and onboard robot.



Also on the Syllabus

- Homework Policy
- Text
- Exams and quizzes
- Lab sections (www.scribblerrobot.com)

So, what are "dynamics"?

- Branch of physics. More detail:
- How things move. Still weak ... how about:
- Study of motion of objects (rigid or flexible) or the evolution of a system (economical, biological, peopleinamall), usually through mathematical equations (called **dynamic models**). A good model closely predicts how dynamics evolve in real life.

- Examples:

$$m \frac{dv}{dt} = F$$



... and "Feedback Control"?

- When an INPUT to a system is directly affected by a measured OUTPUT of the system, in order for the OUTPUT to achieve a desired value.

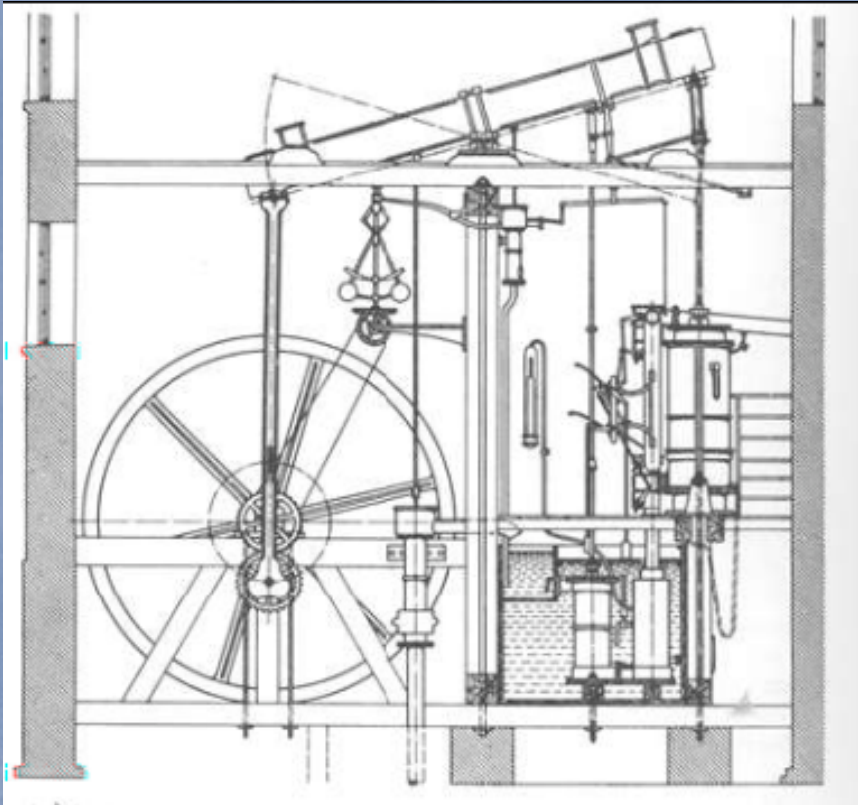


- Examples ...

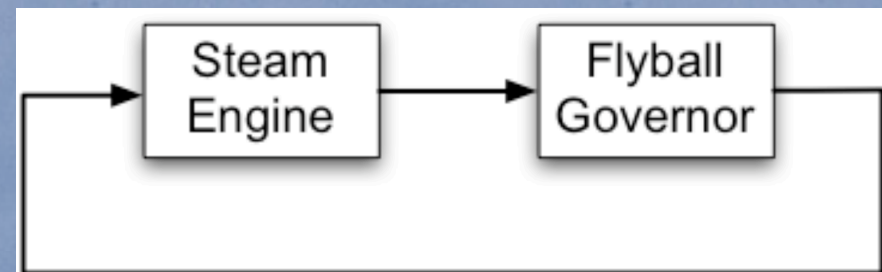
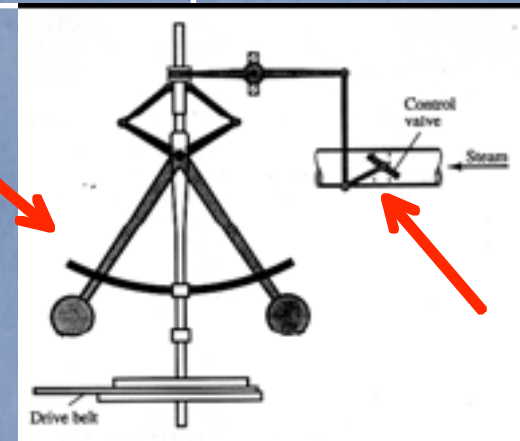
THE classic example no snoring

“Flyball” Governor (1788)

- Regulate speed of steam engine
- Reduce effects of variations in load (disturbance rejection)
- Major advance of industrial revolution



Balls fly out
as speed
increases



Result: *settles to desired speed*

Equally classic (and more fun): Inverted pendulum

QuickTime™ and a
decompressor
are needed to see this picture.

- Pardon the Dharma Initiative Voiceover

even cooler...

QuickTime™ and a
decompressor
are needed to see this picture.

a.k.a. Balancing a Broomstick in your hand

- The INPUT (what you have direct control over) is hand motion
- The OUTPUT (what you measure or observe) is the top of the stick (your eyes are the "sensor")
- The OBJECTIVE is to use feedback control (output used to directly affect the input) so the output stays at or near the desired upright position.



Other Examples

- Cruise Control
- Thermostat
- Gene Regulatory Networks
- Supply Chains

Our Scribbler Robots



light tracking



line tracking

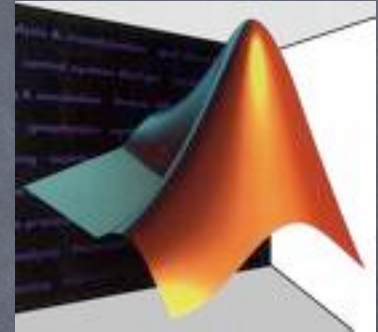
Because multi-robot coordination is cool

Experiment



What about Matlab?

- Learn it in this class, because:
 - you'll very likely need it later
 - we use it to **simulate models of dynamic systems!** (predator-prey, robot model)
 - Given a model, we'll eventually TUNE a feedback controller for a wall-following robot, entirely in Matlab simulations.



questions?