ECE 3510 Lecture 1 notes Introduction to Feedback Systems

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1/10/10
1/6/13

Syllabus.

Supplemental example and problem sessions will make this class much easier.

But it's still a 4-hour engineering class. How can you survive??

1. Easiest way to get through school is to actually learn and try to retain what you are asked to learn.

   Even if you're too busy, don't lose your good study practices.
   What you "just get by" on today will cost you later.

   Don't fall for the "I'll never need to know this" trap. Sure, much of what you learn you may not use, but some you will need, either in the current class, or future classes, or maybe sometime in your career. Don't waste time second-guessing the curriculum, It'll still be easier to just do your best to learn and retain.

2. Don't fall for the "traps".

   Homework answers, Problem session solutions, Posted solutions, Lecture notes.

3. KEEP UP! Use calendar.

4. Make "permanent notes" after you've finished a subject or section and feel that you know it.

Signals (INFORMATION !!)

For us: A time-varying voltage or current that carriers information.

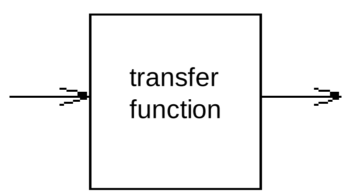
| Audio, video, position, temperature, digital data, etc...

In some unpredictable fashion
DC is not a signal, Neither is a pure sine wave. If you can predict it, what information is it providing??
Neither DC nor pure sine wave have any "bandwidth".

Recall Fourier series: Any periodic waveform can be represented by a series of sinewaves of different frequencies.

Blocks and block diagrams (acting on signals (information))

input information



output information

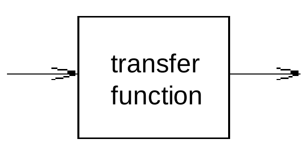
Not cold air, but desired temperature — Not hot air, but temperature of a room

Not fuel, but desired speed — Not movement, but position or speed

These blocks DO NOT show the flow of materials, power, or energy needed to act upon the information. For example, the input to a block might be the postion of the gas pedal in your car and the output might be the car's speed. The energy input required is not shown and niether are the fuel and air moving through the engine. Although they are very important engineering concerns, we will not be considering those things in this class.

If possible we'd like to work with the blocks in a very simple mathmatical way:

input

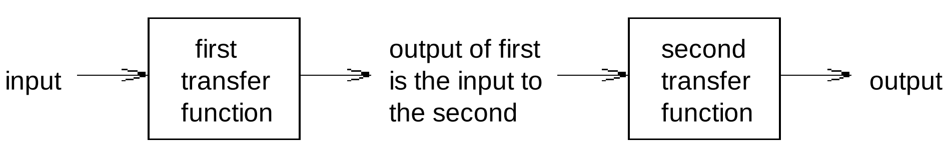


output = input x transfer function

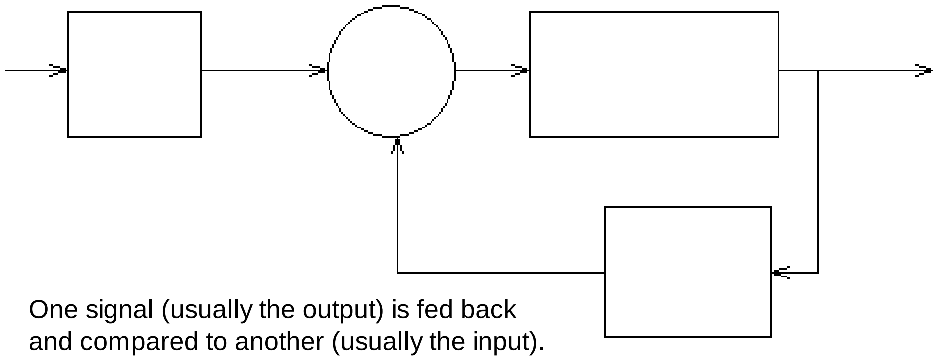
In this case, the transfer function = $\frac{\text{output}}{\text{input}}$

This is NOT always possible

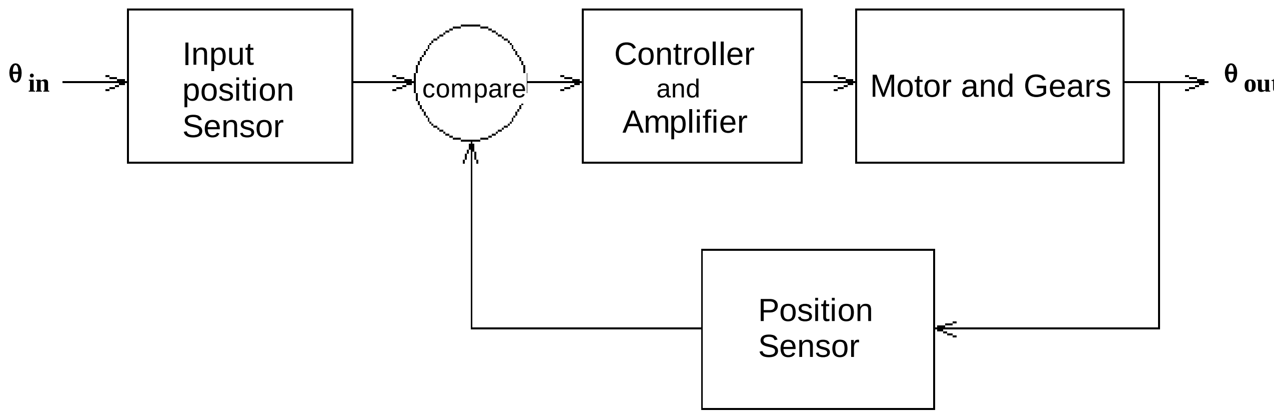
Blocks can be "hooked" together, that is, the output of one block could be the input to another



Blocks can be hooked together in more complex ways like this loop. This is an example "feedback".



Example of a System (A Position Servo with Feedback)



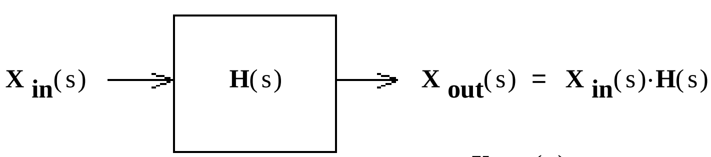
Again, the lines represent signals. Yes, there may also be considerable power moving from one block to another or out the end, but that's not what we'll care about here. All we really care about here is the basic information.

Blocks represent subsystems, devices or components which act upon an input or inputs to produce an output.

We will want a **mathmatical** way to represent the signals and the action of the blocks so that we can get a better handle on what's happening, and, hopefully, make the whole sytem work as we want.

We'll assume that each of the blocks is linear and time invariant. Anything else gets too hard too fast, and this is a good place to start. Many real devices can be modeled as linear and time invariant, at least over some region of operation.

For linear systems, where the signals and systems can be represented by Laplace transforms:



Transfer function: $\mathbf{H}(s) = \dfrac{\mathbf{X}_{out}(s)}{\mathbf{X}_{in}(s)}$

$\mathbf{X}_{in}$ and $\mathbf{X}_{out}$ could be anything from small electrical signals to powerful mechanical motions or forces.

The variable "s" comes from Laplace transformations.

We will come back to this and spend a LOT more time on Laplace transforms and transfer functions