Re: Best Book on PID ??

Source: http://sci.tech−archive.net/Archive/sci.electronics.misc/2004−11/0595.html

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From: Phil Hobbs (*pcdhSpamMeSenseless_at_us.ibm.com*)
Date: 11/25/04

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Date: Thu, 25 Nov 2004 12:28:37 −0500
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John Popelish wrote:
> Phil Hobbs wrote:
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>>John Popelish wrote:
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>
>>>You could probably write a good one. A PID controller is just a
>>>follower amplifier (that forces a process measurement to follow a
>>>setpoint). The PID controller tuning is just a lead lag network that
>>>stabilizes that unity gain amplifier.
>>>
>>
>>I'd agree if we were talking about PI controllers, but PID are somewhat
>>different−−the D term is there to compensate for slow transducers such as
>>motors and heaters.
>>
>>The slow transducers put a few wrinkles in practical control systems that are
>>different from ordinary amplifers: windup in motors and asymmetrical slewing
>>in heaters. The D term will turn the 2−pole response of a motor into 1−pole
>>so that it can be stabilized, but the settling behaviour won't be anything
>>pretty unless some sort of (nonlinear) windup control is in there somewhere.
>
>
> But follower amplifiers that drive big, slow, nonlinear devices have
> all those same problems. Slow is just not as slow. When I first got
> into process control, it seemed very strange, because I was unfamiliar
> with the jargon. Then I realized that I have been using oscilloscopes
> to study amplifiers doing all the things process control was doing,
> except that now, I could have a cup of coffee while the dynamics
> settled instead of it all happening in microseconds. but the
> principles are just the same. Gain bandwidth product, phase shift,
> slew rate limits, output nonlinearity, recovery from output overdrive,
> etc. all there.
>
> When I saw the Star Trek episode about the people who moved so fast
> that they were invisible, I realized that they was how I felt while
> tuning a control loop.
>

I don't disagree that there are lots of similarities, or that there's a lot of jargon in control system design that seems intended to preserve job security rather than make concepts clear. (There's a lot of that in some optics disciplines too−−it isn't just an EE problem. Not to mention all of anthropology.) If I'm designing e.g. a laser temperature controller, I use Bode plots: one for each of several representative choices of ambient temperature and thermal forcing. PLL design with nonlinear tuning is similar. Not everything is that simple, however.

Lots of control systems have to work in situations where an ugly settling transient will cause destruction−−from burned cookies and broken drive belts to loss of life and property. There are very few purely electronic situations (i.e. other than driving mechanical devices or large magnets) where a poor transient response is that serious.

Ordinarily, with an amplifier driving a speaker, say, you can have a few pops and bangs, but no great harm is done, and they can be tuned out during debugging. The nonlinearity is of a simple and intuitive sort, and there is no complex coupling. There is also usually no external forcing, unlike e.g. a motor controller which may have very different loads at different times. It isn't possible to test every situation, and it's the ones we haven't thought about that will turn round and bite us in the backside. Systems that are uncoupled during normal operation, but become coupled due to faults and transients, are a common source of this.

Cheers,

Phil Hobbs