

Re: Do you think NI can fix my PLL?

Source: <http://sci.tech-archive.net/Archive/sci.electronics.design/2006-06/msg00498.html>

- *From:* Tim Wescott <tim@xxxxxxxxxxxxxxxxxxxx>
 - *Date:* Fri, 02 Jun 2006 17:58:10 -0700
-

Chris Carlen wrote:

Hi:

I'm attempting to build another motor PLL system and running into some difficulties stabilizing the loop. Since there is a lot of work to do, I have considered contracting out the PLL design to a well known control expert outside of my company, so I can focus on building other subsystems of the project.

Basically, the PLL is to lock a 136mmx2.54mm Al wheel to a 400Hz reference (24kRPM, 1 pulse/rev position sensor). Must be 2nd order PLL yielding zero phase error with constant frequency input. Wheel to be driven directly by a Maxon 200W brushless DC motor with an Advanced Motion Controls B15A8 PWM servo driver running in open loop mode. I have found that the open-loop mode of the motor drive results in not very linear DC transfer of ref. voltage in to motor phase voltage out, as well as not yielding a very linear dynamic response as well (rise time != fall time, but only by about 10-20%).

I have suspected that this may be the root of why the PLL behaves quite a bit less stable than my modeling predicts.

-- snarping snipped --

Thanks for input.

I think the root of your problem lies in the amplifier.

Your brushed DC motor system has magnets attached to the case, a thingy wound with coils attached to the shaft, an amplifier that delivers current to a switch, and a switch that directs that current to the appropriate coils depending on the angle of the shaft with relation to the case (and hence the magnets with relation to the coils).

Your brushless "DC" motor system has magnets attached to the shaft, a thingy wound with coils attached to the case, sensors that tell you where the shaft is in relation to the case, and what sounds like this gawdaful

Re: Do you think NI can fix my PLL?

mess of electronics interposed between your torque command and your coils.

You say you're driving the brushed motor with a power op-amp that's being driven by your torque command — why not do the same thing with your brushless motor? Get three power op amps that are big enough to handle the current, take the signals from your motor's position sensors and commutate your drive current (or drive voltage) command with an appropriate complement of 405x switches, and do the whole thing linearly. You won't have any concerns about the internal PWM of the drive doing weird things because there won't be any. You won't have to worry about internal sampling in the controller, or weirdo loops, or any of that, either.

I suspect that if you do this you will find out two things: one, the room will be warmer when the system is running, and two, the brushless motor/amplifier system will act a whole lot more like the brushed motor/amplifier system did.

--

Tim Wescott
Wescott Design Services
<http://www.wescottdesign.com>

Posting from Google? See <http://cfaj.freeshell.org/google/>

"Applied Control Theory for Embedded Systems" came out in April.
See details at <http://www.wescottdesign.com/actfes/actfes.html>

.