Re: queries regarding ALTIVAR 58

Source: http://sci.tech−archive.net/Archive/sci.electronics.design/2005−03/3022.html

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From: Terry Given (*my_name_at_ieee.org*)
Date: 03/17/05

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Date: Thu, 17 Mar 2005 20:09:35 +1300
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dhananjay wrote:
> *Hello,*
> *Our chemical plant is having a crane (40/5 Te) with MH, CT, LT motion*
> *and was operated by slip ring motor (for two speeds 100% & 10%) with*
> *rotor resistance control (may be and mechanical gear boxes) by our*
> *electrical and mechanical operators etc, i am an electronic engineer*
> *and been called to take the job 'now', as the installation is changed*
> *to an induction motor with ALTIVAR 58 drive (flux vector control*
> *sensorless)for MH and ALTIVAR 28 drive for CT, LT.*
>
> *The queries are as following regarding this*
> *1) the literature says that the 58 drive is a sensorless flux vector*
> *control but has an encoder card option for speed control? also it says*
> *that there is a series called ALTIVAR 58F which is flux vector control*
> *with or without sensor and is recomendaded for material handling*
> *operations, vertical and horizontal where high dynamics and precision*
> *etc is required, i have learnt while searching the postings that, for*
> *crane applications it is good to have a FVC drive in close loop etc,*
> *so now i dont understand that after puting the encoder card to altivar*
> *58, will it become a close loop FVC? ALso the term "sensor" in the*
> *literature i guess, does not refer to the speed sensor, is it so ?(the*
> *58F drive which is titled as flux vector control with sensor is also*
> *having an option card for speed feedback), so what is this sensor and*
> *how the drive can function with or without this sensor?*

The sensor referred to is a (quadrature) encoder for measuring shaft speed.

To be honest, google the damned thing.

An altivar 58F is an IP55 Altivar 58.

I cant be bothered researching the Altivar 58 sensorless algorithm, but invariably sensorless operation is not as good as that obtained with a speed sensor. Sensorless Flux Vector Control (SFVC) algorithms have some method of estimating rotor speed. A common technique is to estimate flux by integrating the output voltage (less the IR drop). SFVC algorithms invariably have problems at very low speed, as the output voltage is is no longer large compared with the voltage drop across the IGBTs, so obtaining an accurate measure (often its an estimate) becomes tricky. Accurate values of stator resistance are required, and this can be quite a challenge, especially since its all over the show with temperature.

Not to mention the fact that an integrator becomes a right PITA at very low speeds (slow response, runs away with small errors, stuff like that). Ultimately if you need really good dynamic performance, a speed sensor is required.

A sensorless FOC set to zero speed (ie hold shaft still) will be a lot "softer" than one with a sensor − IOW if you do this, then load the shaft with a torque (eg a 1m lever with 3 fat people standing on it) the shaft will turn far more without the sensor. some sensorless drives I have played with are so bad (using little 1kW setups) that you can spin the shaft by hand (albeit with some effort). OTOH with a sensor the shaft wont budge at all.

Its not that surprising really − if you dont look at the shaft, it is rather hard to tell if it *really* moves. Whereas if you do look, its rather trivial. Problem is, encoders are expensive and fragile, and if not correctly aligned they will flog themselves to bits.

As to how the controller can use (or not use) the speed sensor, its easy. If the speed sensor input is not doing anything, the SFVCA just uses its estimated speed. OTOH if it can see the speed sensor is doing something (or perhaps you tell it the sensor is connected) then it uses that for an actual shaft speed measurement.

>
> 2)i am also not sure which type of control this drive uses in its
> algorithms, how can i understand is it indirect or direct torque
> control?
>

there isnt really any such thing as "indirect torque control"

DTC is an algorithm that runs at the IGBT switching frequency, and uses measured voltages and currents to estimate torque error, then chooses the most appropriate set of switch states to force the torque error to zero. In theory its really good, in practice very few companies use it (ABB does, and they sank many tens of millions of dollars into making it work right)

Direct and Indirect refer to the type of Field−Oriented Control implemented.

Direct FOC either measures or estimates (from I,V) flux and torque, and controls them (usually with synchonous PI controllers)

Indirect FOC regulates torque by controlling Iq and slip speed, and regulates machine flux by controlling Id (note there are 2 definitions of Id and Iq, which are exactly opposite, just for fun)

IMO stator flux oriented DFOC is far better than IFOC, because there are a hell of a lot less parameters involved − meaning fewer calculations (ie higher torque bandwidth for a given processor speed) and greatly reduced sensitivity (if it doesnt use, say, rotor resistance at all in the algorithm, then who gives a shit how bad the estimate is)

> 3)also the literature of ALTIVAR 58F suggests that DC injection
> braking is not compatible with FVC close loop and sugests dynamic
> braking, since we have ALTIVAR58 and there is no such incompatibility
> shown for DC injection braking i have a doubt regarding this as
> follows: for crane application which is good combination "DC
> injection braking, dynamic braking resistor and openloop FVC drive
> (our installation)" OR "FVC close loop drive (like altivar 58f) AND no
> DC injection braking (dynamic resistor braking in its place)"
> considering the safety?
> also why is it incompatible, please explain?

you *can* do DC injection braking with FOC, providing the software supports it. But DC injection braking, by definition, dumps all of the braking energy into the stator of the machine. If you dont have much energy to throw away, DC injection braking is nice and cheap. If you have a lot of energy to throw away it gets expensive, as the machine will cook and need replacing. A big machine has a very low surface−area−to−volume ratio, so is terrible at getting rid of heat. This thermal time constraint further hampers the dynamic response available from DCIB. DB resistors are designed to have massive SA/V ratios, and get really, really hot − many hundreds of degrees C. On a cold day, standing next to a 400kW DB running full tit is nice.

In the case of a crane, when you are lowering a load then you must dump the change in gravitational potential energy of the load, i.e. m*g*(start_height − finish_height). This is usually a LOT. If you try to use DC injection braking you will likely cook the machine and drop the load, quite possibly killing people. This is bad.

>
> D'jay
> 16 mar 2005

Cheers
Terry