Control of Permanent Magnet Synchronous Motor (PMSM) Using Texas Instrument’s InstaSPIN™-FOC motor control technology
Sept 12 – 14, 2016

CONTENT and AGENDA

C2000 32-bit microcontroller based 3-Day Hands-On Motor Control Workshops:

PM Drives, Sept 12 - 13, 2016
Induction Machine Drives, Sept 14, 2016 (optional)

Control of Permanent Magnet Synchronous Motor (PMSM) Using Texas Instrument’s InstaSPIN™-FOC motor control technology

Presented by: Prof. Dr. ir. Duco W. J. Pulle
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Workshop location:
Bildungszentrum der Erzdiözese München und Freising, Kardinal-Döpner-Haus, Domberg 27, 85354 Freising

Overview
Learn how to design and experimentally implement a sensorless speed and field-oriented controlled (FOC) electrical PMSM drive from the ground up using TI’s MotorWare™ project laboratories and Code Composer Studio.
During the workshop you will learn all aspects of drive operation for PMSM (salient and non-salient) ranging from speed/current control and space-vector modulation up to and including all aspects of sensorless control using TI’s InstaSPIN-FOC motor control technology.

The two/three day workshop is ‘hands-on’ and aimed at engineers who need to be able to design, develop and understand modern electrical PMSM or induction machine drives. As such the workshop is designed to significantly shorten the development time needed for industrial drive applications. A third day may be added (pending customer interest) which considers FOC encoderless control for induction machine drives.

The class takes advantage of MotorWare [1] and Code Composer Studio [2] for real-time control of the electric drive system. Simulation examples are carried out using PLECS™ [3], which also includes processor in the loop examples that are linked to workshop based Code Composer projects.
A step-by-step laboratory approach is used which is a mixture of theory followed by experimental analysis using TI's low voltage motor control kit (LAUNCH-XL-F28069M and BOOSTXL-DRV8301), with InstaSPIN-enabled Piccolo TMS320F28069M MCU. A significant period of time is set aside to fully understand all aspects of drive operation, including sensored and sensorless field oriented control, field weakening and motor parameter identification. In this context attention is given to explaining how parameters should be set for the speed/current controllers and InstaSPIN in particular. Participants should have some familiarity with C-code development, i.e. to be able to interpret code examples given.
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Outline

The first day is dedicated to sensed control of salient and non-salient PMSM drives. Initially the theory and principles are covered based on our books [4], [5], [6] together with scaling and practical discrete control issues. Most of the day is focused on using a set of project examples which takes the attendee from a simple open loop voltage controller to a fully operational sensed field-oriented controlled PM drive. For this purpose use is made of a workshop dedicated set of MotorWare laboratory projects with graphic capabilities. Control of salient-PM drives is also covered together with over-modulation and field-weakening, where use is made of PLECS for simulation mode and MotorWare based laboratories for hands-on real-time control.

The second day focusses on sensorless operation of PMSM drives. The same approach as mentioned above for day one is used; however, emphasis is on achieving sensorless control using the FAST™ Software Observer and motor parameter identification included with InstaSPIN-FOC. A combination of simulation using PLECS ‘processor in the loop’ (PIL) technology and real-time control using a set of MotorWare projects specifically designed for this workshop series will be presented. A third day on sensorless control of IM will be offered which is along the lines discussed for PM, hence FOC using FAST and motor identification will be covered. In addition the PLECS PIL approach is shown for three-phase AND single phase IM drives.

The aim is to empower the attendee with the ability and confidence to fast track development of his or her own drive application using the workshop specific MotorWare and PLECS examples given in this workshop.

If there is sufficient registration, a third day on sensorless control of IM will be given which is along the lines discussed for PM, hence FOC using FAST and motor identification will be covered. In addition the PLECS PIL approach is shown for three-phase AND single phase IM drives, together with energy efficient operation using PowerWarp.
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An overview of the course syllabus is given below:

Agenda

Monday, Sept 12

Registration starts at 8:30

Day 1: Introduction to real-time control of AC drives

09:00 – 10:30

- Control of electrical drives covering:
  - Speed control principles
  - Torque control of AC machines
  - Synchronous frame current control
  - Space vector modulation

10:30 – 10:45 Coffee break

- Drive development for real-time control
  - Use of scaling
  - Discrete integration
  - Simulation using PLECS
  - Real-time control using Code Composer Studio

12:00 – 13:00 LUNCH

- Hands-on real time AC motor control laboratory exercises, based on VisSim/PLECS tools:
  - Open loop voltage/frequency control
  - Open loop current/frequency control
  - Sensored field oriented (FOC) current control of a PM motor

14:30 – 14:45 Coffee break
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- Field-weakening for a non-salient sensored FOC PM drive
- Sensored field-oriented (FOC) current control of a salient PM motor
- Current reconstruction techniques to achieve high modulation values
- Achieving a drive quick-start using predefined ADC offsets

17:00 End of Day 1

Tuesday, Sept 13

Day 2: Sensorless control of a FOC PMSM drive using InstaSPIN technology

09:00 – 10:30
- Importance of encoderless (sensorless) control:
  - Why use encoderless control
  - Critical issues for achieving good performance
- Introduction to InstaSPIN-FOC
  - FAST software observer
  - Motor Identification routine

10:30 – 10:45 Coffee break

- Hands-on Composer Studio™ /PLECS™ tools examples:
  - Use of FAST for sensorless operation with external FOC and known motor parameters including use of VisSim ‘processor in the loop’ technology
  - Motor Parameter Identification using InstaSPIN-FOC

12:00 – 13:00 LUNCH

- Use of FAST for sensorless operation with external FOC and known motor parameters of a salient PM motor, where PLECS processor in the loop technology is used
- Use of FAST for sensorless operation with external FOC and known motor parameters of a two-phase hybrid stepping motor, where PLECS processor in the loop technology is used
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14:30 – 14:45 Coffee break
  o On-line stator resistance measurement and MCU usage monitoring
  o Initial Position Detection (IPD) using PLECS, which shows the steps needed to identify
    the PM angle so that maximum torque at startup can be achieved.

17:00 End of Day 2

Wednesday, Sept 14

Day 3: Sensorless control of a FOC IM drive using InstaSPIN technology

09:00 – 10:30
  • Importance of encoderless (sensorless) control:
    o Why use encoderless control
    o Critical issues for achieving good performance
    o FOC control of induction machine drives

10:30 – 10:45 Coffee break
  • Introduction to InstaSPIN-FOC
    o FAST software observer
    o Motor Identification routine
  • Hands-on Composer Studio™ /PLECS™ tools examples:
    o Use of FAST for sensorless operation with external FOC and known motor parameters
      including use of VisSim ‘processor in the loop’ technology
    o Motor Parameter Identification using InstaSPIN-FOC

12:00 – 13:00 LUNCH
  • Hands-on Composer Studio™ /PLECS™ tools examples:
    o Use of FAST for sensorless operation with external FOC and known motor parameters
      of a IM motor
    o Motor Parameter Identification using InstaSPIN-FOC
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13:00 – 17:00, with coffee break at 14:30

- Energy Efficient operation using PowerWarp
- Use of FAST for sensorless operation with external FOC and known motor parameters of a single phase induction machine, where PLECS processor in the loop technology is used

17:00 End of Day 3

The participants will typically work in pairs at a workstation using a provided LAUNCHXL-F28069M and BOOSTXL-DRV8301 low voltage motor control kit set-up with a provided non-salient PM motor and their own laptop with Code Composer Studio and PLECS installed (see comment below). For those attending the third day (pending customer interest) the LVACIMTR (Induction machine) will be used for real-time control.

A copy of the specific MotorWare project labs used in the workshop (which include the graphic interface) and PLECS examples will be made available to the participants. It is recommended that attendees install (via a trial license) PLECS with ‘processor in the loop’ ability so that they can view the demonstration examples shown by the instructor on their own laptop. In addition, Composer Studio™ should be installed.

A printed version of the PowerPoint presentation will be given to the attendees. A free LAUNCHXL-F28069M module as used in the workshop will be sent to the participants upon completion of the workshop.

Audience
These workshops are designed for practicing engineers who:
- Want to significantly shorten the development time needed to get their drive application to market.
- Need to be able to apply sensorless control techniques to their drives quickly by making use of a unique (to this workshop) set of MotorWare laboratory examples provided.
- Need to understand how to use the C-code based project files for PM drive development starting at a basic level and then moving to encoderless FOC operation and parameter identification.
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- Want to familiarize themselves with PLECS modeling and processor in the loop technology which enable optimization/in depth analysis of an InstaSPIN based drive
- Need to fully understand all the parameters of InstaSPIN in order to optimize sensorless FOC control of their PM/IM drive application.
- Want to learn how to use a unique set of Code Composer Studio based project laboratories that will empower the user with the ability to confidently develop their own complete PM/IM drive application.

More information

Pricing
European pricing: 585 Euro/day, lunch and refreshments included.

Workshop language
The workshop language will be English.

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Terms and Conditions

Cancellation Policy
Classes are subject to cancellation if the minimum number of attendees is not met ten days before the date of the workshop. Minimum is 6 and maximum is 20 attendees.
In the event of short notice cancellation TI and EMsynergy’s liability is solely limited to the refund of the course fees.
No refund will be given if registrants cancel within 10 working days of the workshop date.

Payment Terms
Full payment is required within 7 days before the workshop start date. We reserve the right to refuse admission if full payment is not received in accordance with these terms.