IEEE International Symposium on

Sensorless Control for Electrical Drives

and

Predictive Control of Electrical Drives & Power Electronics

SLED 2013
4th Symposium

PRECEDE 2013 2nd Symposium

17.-19. October 2013 - Munich, Germany

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IEEE International Symposium on Sensorless Control for Electrical Drives and Predictive Control of Electrical Drives and Power Electronics

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Program Overview

Thursday (17th October 2013)		
08:00	Registration Opening	
09:00 - 10:00	Welcome Reception	
10:00 – 10:30	Welcome Talks	
10:30 – 11:15	Honorary Keynote (Prof. Holtz)	
11:15 – 12:00	Predictive Keynote 1 (Prof. Rodriguez)	
12:00 – 12:45	Sensorless Keynote 1 (Prof. Lorenz)	
12:45 – 14:00	*-= Lunch Break =-*	
14:00 – 15:20	Sensorless Session 1 *Fundamental Model based SLC*	Predictive Session 1 *Analysis and Trajectory Planning*
15:20 – 15:40	*-= Coffee Break =-*	
15:40 – 17:00	Sensorless Session 2 *Analysis of Fundamental Models*	Predictive Session 2 *FPGA-based MPC*

Friday (18th October 2013)		
09:00 – 9:45	Sensorless Keynote 2 (Dr. De Belie)	
9:45 – 10:30	Predictive Keynote 2 (Dr. Geyer)	
10:30 – 10:50	*-= Coffee Break =-*	
10:50 – 12:10	Sensorless Session 3 *New Anisotropy based approaches*	Predictive Session 3 *Predictive Current Control schemes*
12:10 – 13:10	*-= Lunch Break =-*	
13:10 – 14:30	Sensorless Session 4 *Advanced Methods and Effect Study*	Predictive Session 4 *Multilevel Inverters*
14:40 – 16:00	Sensorless Session 5 *Extensions for Anisotropy Methods*	Predictive Session 5 *Special Inverter Topologies*
16:20 – 16:40	*-= Coffee Break =-*	
16:40 – 18:00	Sensorless Session 6 *Machine and Hardware Considerations*	Predictive Session 6 *MPC of Synchronous Machines*
20:00	**Gala Dinner**	

Saturday (19th October 2013)		
09:30 – 10:50	Sensorless Session 7 *Brushless DC Machines*	Predictive Session 7 *MPC with Online Identification*
11:00 – 12:00	Closing Ceremony	
12:00 – 13:00	*-= Lunch =-*	
13:30 – 16:30	**Tour Nymphenburg Palace**	

Keynote Sessions

*All keynote sessions will be held in **Room A**.*

Honorary Keynote:
History of predictive control

Prof. Joachim Holtz, Bergische Universitaet Wuppertal

The first ever publication of predictive inverter control dates 30 years back. Here, the stator current space vector of an induction motor was forced to follow a command value. Whenever a given maximum current deviation was exceeded, all possible future trajectories, both of the current vector and its reference were predicted. The next switching state was then determined such that the current error remained below its maximum value for a maximum time duration. Also the number of commutations required for any change of switching state was taken into account. The inverter switching frequency was thus minimized.

Sensorless Keynote 1:
What Limits the Broad Use of Self-Sensing, i.e. Using the Motor Itself as the Sensor?

Prof. Robert D. Lorenz, Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC)

The application of self-sensing has grown dramatically in the last twenty years. Both injection-based zero and low speed saliency image tracking methods as well as the back-EMF/flux linkage image tracking methods are in industrial and automotive products being sold successfully today. Despite these commercial successes, self-sensing methods are applied in only a small fraction of all motor drive and actuator applications. This presentation will explore the issues that appear to limit the wider use of both self-sensing methods and focus on what topics seem to still need significant research in order for self-sensing to become pervasive.

Predictive Keynote 1:
Model Predictive Control in Power Electronics

Prof. Jose Rodriguez, Universidad Tecnica Federico Santa Maria

This tutorial addresses to some of the latest contributions on the application of Finite Control Set Model Predictive Control (FCS-MPC) in Power Electronics. In FCS-MPC, the switching states are directly applied to the power converter, without the need of an additional modulation stage. The research shows how the use of FCS-MPC provides a simple and efficient computational realization for different control objectives in Power Electronics. Some applications of this technology in drives, active filters, power conditioning, distributed generation and renewable energy are covered. Finally, attention is paid to the discussion of new trends in this technology and to the identification of open questions and future research topics.

Sensorless Keynote 2:
Adaptive Test-Signal Injection to Support Low-Speed Self-Sensing Control

Dr. Frederik De Belie, Ghent University

The increasing demand of device reliability has been one of the main reasons to install electrical drives equipped with self-sensing control. To meet that demand in the future, the use of self-sensing controllers could be supported by an adaptive behaviour. For this, we'll discuss in this keynote the seamless integration of test signal injection which is often applied at low speed, shaping the self-sensing algorithm as a real add-on module. Using space-vector theory, we'll discuss the advantages of the high flexibility in composing such test signals and illustrate this with several control case studies.

Predictive Keynote 2:
Model Predictive Control of Industrial Drives

Dr. Tobias Geyer, ABB Corporate Research, Switzerland

High-performance model predictive control (MPC) schemes have been developed, implemented and tested for industrial megawatt drives during the past 10 years. These MPC schemes combine the very fast transient response times of deadbeat controllers with the superior steady-state performance of optimized pulse patterns. To achieve this, the control and modulation problem is addressed in one computational stage, and very long prediction horizons are used, often exceeding 100 time-steps. As a result, the current harmonic distortions and the switching losses can be reduced considerably, when compared to carrier-based PWM. For a five-level inverter, this reduction amounts to about 50%.

Technical Sessions

Session 1: Thursday 14:00–15:20

	Sensorless Control *Fundamental Model based SLC* Room A | Chair: Prof. J. Holtz	Predictive Control *Analysis and Trajectory Planning* Room B | Chair: Dr. H. Abu-Rub
14:00	MRAS Based Real-Time Speed-Sensorless Control of Induction Motor with Optimized Fuzzy-PI Controller E. Zerdali, M. Barut	Is multiple-objective model-predictive control "optimal"? C. M. Hackl, F. Larcher, A. Dötlinger, R. Kennel
14:20	Sensorless Torque Control of a DFIG connected to a DC Link G. Marques, D. Sousa, M. Iacchetti	Receding Horizon based Trajectory Planning and Two-Degree-of-Freedom Tracking Control for Fast Sampling Constrained Systems A. Dötlinger, J.-F. Stumper, R. Kennel
14:40	Sensorless Observation of a Very-High-Speed Permanent Magnet Synchronous Machine W. van Meijl, G. Muisers, A. Borisavljevic, M. Brands, E. Lomonova	Efficiency Analysis of Reduced-Order Observers Applied to the Predictive Current Control of Asymmetrical Dual Three-Phase Induction Machines J. Rodas, R. Gregor, M. Rivera, Y. Takase, M. Arzamendia
15:00	Sensorless Induction Motor Drive with Voltage Inverter and Sine-Wave Filter J. Guzinski, H. Abu-Rub	Effective Formulation of the DTC Strategy for Convergence and Stability Analysis - The IPM Motor Drive Case Study A. Faggion, S. Bolognani

Session 2: Thursday 15:40–17:00

	Sensorless Control *Analysis of Fundamental Models* Room A | Chair: Dr. L. Alberti	Predictive Control *FPGA-based MPC* Room B | Chair: Prof. T. Mouton
15:40	Comparison of a Linear and a Non-linear State Observer for Sensorless Control of PM Machines F. Demmelmayr; M. Troyer; M. Schroedl	Predictive Control vs. Linear Control for Current Control of a Single-leg Inverter T. Mouton; P. Stolze; T. Geyer; M. Tomlinson; R. Kennel
16:00	Investigating characteristics of a concentrated-winding interior permanent magnet synchronous machine for sensorless direct torque control D. Nguyen; R. Dutta; M. Fazlur Rahman	An FPGA Implementation of the Fast Gradient Method for Solving the Model Predictive Pulse Pattern Control Problem H. Peyrl; J. Liu; T. Geyer
16:20	Gain Scheduling of a Full-Order Observer for Sensorless Induction Motor Drives Z. Qu; M. Hinkkanen; L. Harnefors	Fully Digital FPGA-Based Current Controller for Switched Reluctance Machines J. Gottschlich; B. Burkhart; C. Coenen; R. De Doncker
16:40	Design of Signal-Injection-Based Sensorless Interior Permanent Magnet Synchronous Motor Drives for HEV Y. Kano; T. Kosaka; N. Matsui	

Session 3: Friday 10:50–12:10

	Sensorless Control *New Anisotropy based approaches* Room B | Chair: Prof. R. Lorenz	**Predictive Control** *Predictive Current Control schemes* Room A | Chair: Dr. T. Geyer
10:50	Current slope calculation in FPGA for sensorless control technique and associated slope based predictive precise current control J. Wang; A. Binder	Simulation of a Single DC Voltage Source Multilevel Active Power Filter with a Predictive Current Control Scheme A. Cano-Farrera; I. Araujo-Vargas; S. Salas-Duarte; K. Cano-Pulido; J.-E. Medina-Jurado; A. Forsyth
11:10	General Arbitrary Injection Approach for Synchronous Maschines D. Paulus; P. Landsmann; R. Kennel	Predictive Frequency Spectrum Shaping of Currents in a Three Phase Inverter M. Perez; J. Rodriguez
11:30	Flatness Based Sensorless Control of PMSM Using Test Current Signal Injection and Compensation for Differential Cross-Coupling Inductances at Standstill and Low Speed Range S. Ebersberger; M. Seilmeier; B. Piepenbreier	Predictive Current Control of Asynchronous Machines by Optimizing the Switching Moments P. Goedertier; T. Vyncke; F. De Belie; J. Melkebeek
11:50	Sensorless control of wound rotor synchronous machines using the switching of the rotor chopper as a carrier signal A. Rambetius; B. Piepenbreier	

Session 4: Friday 13:10–14:30

	Sensorless Control *Advanced Methods and Effect* Study Room B | Chair: Dr. F. De Belie	**Predictive Control** *Multilevel* Inverters Room A | Chair: Prof. J. Rodriguez
13:10	High Efficiency Universal Position Sensorless Control for Various Motors S. Sato; K. Ide	Heuristic Variable Switching Point Predictive Current Control for the Three-Level Neutral Point Clamped Inverter P. Stolze; P. Karamanakos; M.Tomlinson; R. Kennel; T. Mouton; S. N. Manias
13:30	Silent and parameter independent Hybrid Sensorless Control for SPMSM based on Current Oversampling P. Landsmann; D. Paulus; R. Kennel	An Improved Predictive Control Approach for Multilevel Inverters M. Trabelsi; L. Ben-Brahim; A. Gastli; K. A. Ghazi
13:50	Ring Losses Evaluation in Ringed Pole PM motors D. Mingardi; E. Fornasiero; N. Bianchi; S. Bolognani; A. Faggion	Predictive control with efficiency optimization and normalization for a multilevel converter J. –Y. Gauthier; X. Lin-Shi; A. Avramoae
14:10	Identification of high frequency resistances and inductances for sensorless control of PMSM M. Seilmeier; S. Ebersberger; B. Piepenbreier	Control of a Multi-level Inverter with EMF prediction and Single Carrier-based Space Vector Modulation J.-E. Medina-Jurado; I. Araujo-Vargas; A.. Cano-Farrera; K. Cano-Pulido; S. Salas-Duarte; J. Ramirez

Session 5: Friday 14:40–16:00

	Sensorless Control	Predictive Control
	Extensions for Anisotropy Methods	*Special Inverter Topologies*
	Room B | Chair: Prof. R. Leidhold	Room A | Chair: Dr. M. Fadel
14:40	Adaptive signal amplitude for high frequency signal injection based sensor less PMSM drives R. A; S. Wekhande; K. Chatterjee	Variable Switching Point Predictive Torque Control for the Four-Switch Three-Phase Inverter G. Patsakis; P. Karamanakos; P. Stolze; S. N. Manias; R. Kennel; T. Mouton
15:00	Q-axis pulse based identification of the anisotroy displacement over load for surface mounted PMSM P. Landsmann; R. Kennel	Predictive Control of Two Parallel Induction Machines fed by a Six-Leg Indirect Matrix Converter under an Unbalanced AC-Supply M. Lopez; M. Rivera; C. Garcia; J. Rodriguez; R. Pena; J. Espinoza; P. Wheeler
15:20	Compensation of rotor position estimation error due to stator winding resistance in signal injection based sensor less PMSM drives R. A; K. Chatterjee; S. Wekhande	Predictive Control of MultiCell Converters E. Solano; A. M Llor; M. Fadel; M. Rivera
15:40	PMSM Model for Sensorless Control Considering Saturation Induced Secondary Saliencies M. Seilmeier; S. Ebersberger; B. Piepenbreier	Model Predictive Controller for Grid-Connected Photovoltaic based on Quasi-Z-Source Inverter A. F. Ayad; R. Kennel

Session 6: Friday 16:40–18:00

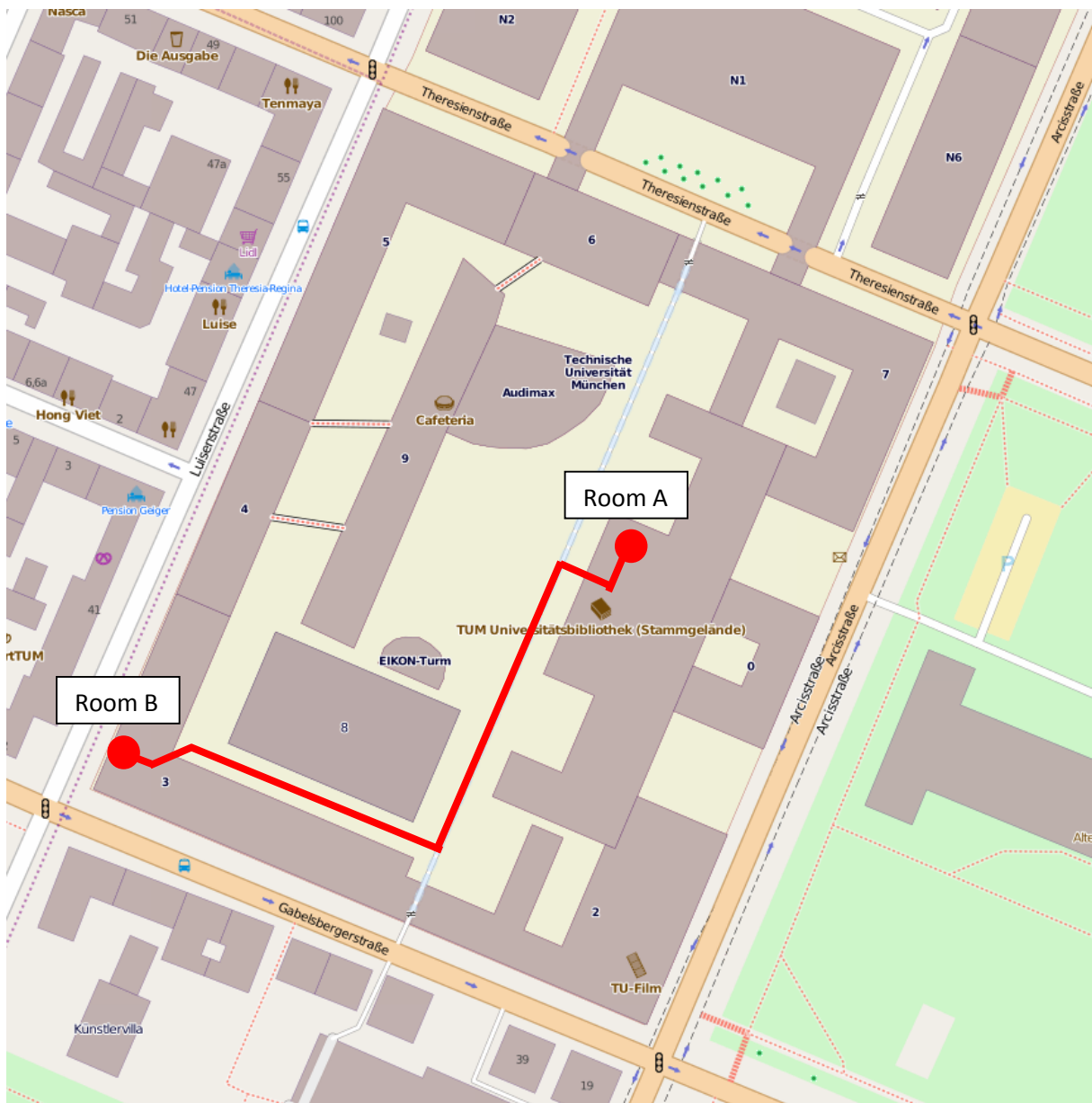|	Sensorless Control	Predictive Control
	Machine and Hardware Considerations	*MPC of Synchronous Machines*
	Room B | Chair: Prof. R. Kennel	Room A | Chair: Dr. M. A. Trabelsi
16:40	Saliency performance investigation of Synchronous Machines for Position Sensorless Controlled EV drives W. Villet; A. MH Prins; C. Vorster; M. Kamper	A Finite-Set Model Predictive Position Controller for the Permanent Magnet Synchronous Motor E. Fuentes; R. Kennel
17:00	Investigation on the self-sensing capability of a fractional-slot inset PM motor L. Alberti; N. Bianchi; S. Bolognani	Different solutions of predictive control for two synchronous machines in parallel M. Fadel; A. M Llor; N. Linh Nguyen
17:20	Analysis of Losses in a Novel IPMSM Resulting From High-frequency Injection for Sensorless control X. Wang; W. Xie; R. Kennel; D. Gerling	Predictive functional control of PMSM based on a composite prediction model S. Li
17:40	Issues and Improvements of Hardware/Software Co-Design Sensorless Implementation in a Permanent Magnet Synchronous Motor using Veristand V. Miñambres-Marcos; M. Ángel Guerrero-Martínez; E. Romero-Cadaval; J. Gutiérrez	

Session 7: Saturday 09:30–10:50

	Sensorless Control *Brushless DC Machines* Room A | Chair: Dr. G. Marques	Predictive Control *MPC with Online Identification* Room B | Chair: Prof. R. Kennel
9:30	FPGA-Based Implementation of the Back-EMF Symmetric-Threshold-Tracking Sensorless Commutation Method for Brushless DC-Machines A. Darba; F. De Belie; A. Salem; J. Melkebeek	Real-time estimation and tracking of parameters in permanent magnet synchronous motor using a modified two-stage particle swarm optimization algorithm E. M. Tofighi; A. Mahdizadeh; M. R. Feyzi
9:50	A Fault-Adaptive and Observer-based Sensorless strategy for a Fault-Tolerant Five-phase BLDC motor C. Olivieri	System Identification and MPC Based on the Volterra-Laguerre Model for Improvement of the Laminator Systems Performance C. Medina-Ramos
10:10	A New Sensorless Control Method for Brushless Permanent Magnet DC Motors W. Chen	Adding inverter fault detection to model-based predictive control for flying-capacitor inverters J. Druant; T. Vyncke; J. Melkebeek
10:30		Combining Model Predictive and Adaptive Control for an Atomic Force Microscope Piezo-Scanner-Cantilever System C. Fuhrhop; P. Mercorelli; A. Georgiadis

Room Descriptions

Room A (official number 0140) is located at ground floor in the main building. After entering the building from the central square, you find Room A directly on your right hand side behind the glass doors.

Room B (official number 2350) is located at the second floor in the south-western corner of the central campus building complex. You can reach it by a 2 minutes' walk following the path below. After entering the building from the inner corner, you take the elevator (or stairs) to the second floor, where you find the room labeled 2350 on your right hand side.

Map

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