# Tutorials at IEEE-IAS 2007Annual Meeting

Schedule and Titles

Tutorial #1 – Sunday, September 23, 2007, 8:00 AM - 5:00 PM
Modeling and High-Performance Control of Electric Machines.
Organizer: John Chiasson

Tutorial #2 – **Cancelled**
Power Converters for Utility Applications
Organizer: Subhashish Bhattacharya

Tutorial #3 - **Cancelled**
Multi-Level / Matrix Converters - Voltage Quality and Electrical Machine PWM Loss Evaluation.
Organizer: Alex Ruderman

Tutorial #4 – Sunday, September 23, 2007, 1:00 PM - 5:00 PM
SiC Power Devices and Their Applications.
Organizer: Dr. Burak Ozpineci

Tutorial #5 - Sunday, September 23, 2007, 1:00 PM - 5:00 PM
Theory and Design of Fractional-Slot PM Motors.
Organizer: Nicola Bianchi.

Tutorial #6 – **Cancelled**
More Than Arc Flash - Designing and Implementing a State of the Art Electrical Safety Program.

Tutorial #7 – Sunday, September 23, 2007, 8:00 AM - 5:00 PM
LED Electronics – LEDs, Drivers, Controls, Applications.
Organizer: Dr.-Ing. Joep Jacobs

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|---|---|
| Introduction | J. Jacobs, Philips |
| LED applications | B. Ackermann, Philips |
| Characteristics of LEDs | T. Jüstel, FH Münster |
| LED colour control | R. Helbing, Avago |
| LED drivers | W. Sowa, Osram |
| LED backlight technologies for LCDs | K. Kalantar, Nippon Leiz |

# Tutorials at IEEE-IAS 2007Annual Meeting

## Tutorial #1 - Modeling and High-Performance Control of Electric Machines

**Sunday, September 23, 2007, 8:00 AM - 5:00 PM**

**Organizer: John Chiasson**


**Abstract**

Although electric machines have been in existence for well over a hundred years, they continue to be of increasing importance to engineers. For example, the growth in hybrid electric vehicles (often using permanent magnet synchronous machines) and wind power generation (typically using induction machines) are just two emerging technologies. This workshop is intended to be an exposition of the modeling and control of alternating current (AC) electric machines. Specifically, the induction motor, the permanent magnet (PM) synchronous motor, and the trapezoidal back-emf (BLDC) motor are all presented. Traditionally, direct current (DC) motors were reserved for high-performance applications (positioning systems, rolling mills, traction drives, etc.) because of their relative ease of control compared to AC machines. However, the DC machines has several disadvantages. These include being more expensive compared AC machines and having a mechanical commutator which in turn requires regular maintenance and limits the speed of the machine. With the advances in control methods, computing capability, and power electronics, AC motors continue to replace DC motors in high-performance applications.


## Tutorial #2 – Power Converters for Utility Applications

## Cancelled

**Organizer: Subhashish Bhattacharya**

## Tutorial #3 - Multi-Level / Matrix Converters - Voltage Quality and Electrical Machine PWM Loss Evaluation

## Cancelled

**Organizer: Alex Ruderman**

# Tutorials at IEEE-IAS 2007Annual Meeting

## Tutorial #4 – SiC Power Devices and Their Applications

**Sunday, September 23, 2007, 1:00 PM - 5:00 PM**

**Dr. Burak Ozpineci**


## Abstract

There is a growing demand for more efficient, higher power density, and higher temperature operation of the power converters in power converters. In spite of the advanced technology, silicon (Si) power devices cannot meet some power electronics requirements. Silicon carbide (SiC) has been identified as a material with the potential to replace Si devices in the near term because of its superior material advantages such as wider bandgap, higher thermal conductivity, and higher critical breakdown field strength. SiC devices are capable of operating at high voltages, high frequencies, and at higher junction temperatures. Significant reduction in weight and size of SiC power converters with an increase in the efficiency is projected. SiC unipolar devices such as Schottky diodes, VJFETs, MOSFETs, etc. have much higher breakdown voltages compared to their Si counterparts which makes them suitable for use in medium-voltage applications replacing Si pn diodes and IGBTs. Presently, SiC Schottky diodes are the most mature and the only commercially marketed SiC devices available. These diodes are commercially available up to 1200V and 50A. SiC Schottky diodes have been experimentally proven to have better performance characteristics when compared to their equivalent Si pn diodes, especially with respect to the switching characteristics. SiC devices can also operate at higher temperatures and thereby resulting in reduced heat sink volume.

# Tutorials at IEEE-IAS 2007Annual Meeting

## Tutorial #5 - Theory and Design of Fractional-Slot PM Motors

**Sunday, September 23, 2007, 1:00 PM - 5:00 PM**

**Organizer: Nicola Bianchi**

## Abstract

The interest for the fractional-slot PM motors is increasing in the last years. In particular the solutions with non-overlapped coils, that is, with coils wound around a single tooth are mainly adopted.
There are several reasons for choosing a fractional-slot PM machine of this kind. Among the others, there are:
- reduction of cogging torque at no-load and ripple under load,
- reduction of copper volume and Joule losses for given torque,
- increase of fault-tolerant capability,
- increase of flux-weakening capability.

However, the fractional-slot PM motors have not only advantages. For instance, it has been shown that
- some solutions exhibit low winding factor,
- rotor losses can drastically increase,
- the armature MMF increases heavily,
- MMF sub-harmonics can cause additional rotor losses and torque ripple.

As a consequence, a correct choice of the number of slots and poles, together with the winding arrangement is imperative. Thus, effective design rules of fractional-slot motors are essential to satisfy the application requirements without increasing the parasitic effects.

This tutorial studies various performance of fractional-slot PM motors. Besides the common analysis, general rules are identified to determine rapidly if a solution (according to the combination of number of poles and slots) is or is not appropriate for a specific application. These simple but effective rules are essential for a correct choice of the motor geometry.

Both finite element simulations and experimental results will confirm the analytical predictions.

# Tutorials at IEEE-IAS 2007Annual Meeting

## Tutorial #6 – More Than Arc Flash - Designing and Implementing a State of the Art Electrical Safety Program

## Cancelled

## Tutorial #7 – LED Electronics – LEDs, Drivers, Controls, Applications

**Sunday, September 23, 2007, 8:00 AM - 5:00 PM**

**Organizer: Dr.-Ing. Joep Jacobs**

**Abstract**

The solid-state lighting technology is moving forward rapidly. Over the last three decades, the light emitting diode (LED) flux per package has doubled every 18-24 months, while the cost per lumen has decreased ten times per decade. Due to these developments, the high-brightness LED market is expected to grow from $2.7 billion in 2003 to $6 billion in 2008 with an average annual growth rate of approximately 20%. Although the LED performance is improving rapidly and LEDs are being used in more and more applications, still many problems have to be tackled, especially in the area of drivers, architectures, sensing, controls, etc.