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Tutorial Title

Integrated Motor Drives, State of the Art, Challenges, and Emerging Technologies.

Instructor Team

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Abstract

The energy savings that can be achieved by driving electrical motors at the desired speed rather than maximum speed using variable frequency converter technologies is clear and accepted within industry. There can be however a general reluctance to retrofit VFD's due to increased infrastructure and installation costs. The integration of power electronic converters into electrical motors to create variable speed integrated motor drives offer many benefits over traditional separated VSD's in terms of installation costs, environmental requirements and raw material costs. There is also a cross sector move towards integration of motors and converters in order to reduce weight and raw material usage, for example in the automotive sector. This tutorial will introduce the concept of the integrated motor drive and summarize the challenges involved with their design and manufacture. Specific contributions will be provided by several world leading experts in areas of integrated drive topologies and distributed control, wide bandgap semiconductors and implications for their use in IMD's, systems based thermal management solutions and emerging technologies. Integrated motor drives from an industrial point of view will be highlighted together with a discussion of the constraints and commercial factors that are involved in addition to real-world examples of industrial deployment.

Instructor Biography

Professor Lee Empringham – Professor of Power Conversion Technologies works within the Department of Electrical and Electronic Engineering, Faculty of Engineering and the University of Nottingham, UK. Gaining his PhD in 2000 on Advanced Matrix Converter commutation techniques, has worked as a both a Senior and Principal Research fellow for 17 years working on advanced power converter topologies and motor control before becoming a tenured professor in 2017. He has presented at many international conferences and delivered tutorials at ECCE, EPE, SPECT conferences in addition to several taught courses at collaborating international institutions.



Dr Liliana de Lillo – Associate Professor in Power Electronics works in the Power Electronics Machines and Control Research Group within the Faculty of Engineering at the University of Nottingham, UK. She gained her PhD in Electrical and Electronics Engineering in 2004 on work related to the integrated drives for aerospace applications, Since then she worked as both Senior and Principal Research Fellows on direct AC-AC converter based power converter topologies and now holds a Royal Academy of Engineering Senior Fellowship in Advanced Embedded Motor Drive Technologies to reduce Global Energy Consumption. She has presented at many international conferences including ECCE, EPE and has delivered tutorials at previous ECCE and EPE conferences and various global academic institutions.

Dr. Xu Deng, is a NUAcT (Newcastle University Academic Track) Fellow in Electrical Power. Her research on Integrated Motor Drives (IMDs) has received the Best Paper Award from the IEEE Transactions on Energy Conversion in the period 2019-2020 in recognition of excellence in the field of electric machines and drives. She has led the production of an IET book on IMDs, which involved coordinating and leading more than 10 university and industrial partners from the UK and overseas.

Professor Thomas M. Jahns (Life Fellow, IEEE), received the B.S., M.S., and Ph.D. degrees in electrical engineering from the Massachusetts Institute of Technology (MIT), Cambridge, MA, USA, in 1974, and 1978, respectively. In 1998, he joined the Department of Electrical and Computer Engineering, University of Wisconsin–Madison (UW), Madison, WI, USA, as a Grainger Professor of Power Electronics and Electric Machines, where he was the Co-Director/Director of the Wisconsin Electric Machines and Power Electronics Consortium (WEMPEC) for 13 years from 2007 to 2020. Prior to joining UW, he worked at GE Corporate Research and Development (now GE Global Research Center), Niskayuna, NY, USA, for 15 years. From 1996 to 1998, he conducted a research sabbatical at MIT, where he directed research activities in the area of advanced automotive electrical systems as the Co-Director of an industry- sponsored consortium. Following his retirement from the active faculty in 2020, he is continuing to pursue research as an Emeritus Grainger Professor in the areas of high-performance permanent magnet synchronous machines using wide bandgap power switches and integrated motor drives using modular topologies to achieve high fault tolerance.

Mr. Daniel Kernan - Vice President & General Manager - ITT Inc. where he is responsible for launching, growing, and managing a new venture that takes early-stage technology through commercialization. Responsibilities include partnering with Academia to generate game changing ideas, team building, forging partnerships, developing supply chains, and launching new products. Key focus areas are products and services that make rotating equipment safer and more energy efficient by leveraging innovative technologies in power electronics, motors, drives. Previously, Daniel worked for 21 years in ITT Goulds pumps, as the Executive Director for Global Product Management & Strategy before moving to ITT Inc.

Barrie Mecrow - Barrie is Professor of Electrical Power at Newcastle University in the UK. He commenced his career as a turbogenerator designer, but left industry to become an academic at Newcastle in 1987. His current research work spans permanent magnet and reluctance machines and drives, fault tolerant drives and integrated drives. He has ties with both the automotive and aerospace sectors within Europe and leads a partnership with Dyson, who have a research centre based within the university.