



## Tutorial Title

**Model Predictive Control of Power Electronics – An Intuitive and Simple Concept for the Future**

## Instructor Team

Team Chair: Ralph Kennel, Technische Universitaet Muenchen

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## Abstract

Recent research works have demonstrated that it is possible to use Predictive Control to control electrical energy with the use of power converters, without using modulators and linear controllers. This is a new approach that will have a strong impact on control in power electronics in coming decades. Since around two decades predictive control is investigated in many important Research institutes. Most applications have been dealing with power electronics and electrical drives. This tutorial is going to show the main differences between conventional control and model predictive control. There will be a statement, under which circumstances model predictive control has significant advantages. There will be some examples to emphasize that. Furthermore, the application of predictive control in sensorless operations of AC drives will be explained. As Model Predictive Control is a tool to improve the use of so-called Renewable Energy Sources, this will be discussed in the tutorial as well.

## Instructor Team Biographies

Ralph M. Kennel was born in 1955 at Kaiserslautern (Germany). In 1979 he got his diploma degree and in 1984 his Dr.-Ing. (Ph.D.) degree from the University of Kaiserslautern.

From 1983 to 1999 he worked on several positions with Robert BOSCH GmbH (Germany). Until 1997 he was responsible for the development of servo drives. Dr. Kennel was one of the main supporters of VECON and SERCOS interface, two multi-company development projects for a microcontroller and a digital interface especially dedicated to servo drives. Furthermore he took actively part in the definition and release of new standards with respect to CE marking for servo drives.

Between 1997 and 1999 Dr. Kennel was responsible for "Advanced and Product Development of Fractional Horsepower Motors" in automotive applications. His main activity was preparing the introduction of brushless drive concepts to the automotive market.

From 1994 to 1999 Dr. Kennel was appointed Visiting Professor at the University of Newcastle-upon-Tyne (England, UK). From 1999 - 2008 he was Professor for Electrical Machines and Drives at Wuppertal University (Germany). Since 2008 he is Professor for Electrical Drive systems and Power Electronics at the Technical University of Munich (Germany). His main interests today are: sensorless control of AC drives, predictive control of power electronics and Hardware-in-the-Loop systems.

Dr. Kennel is a Senior Member of IEEE, a Fellow of IET (former IEE) and a Chartered Engineer in the



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UK. Within IEEE he is Treasurer of the Germany Section as well as Distinguished Lecturer and Region 8 Liaison as well as ECCE Past Global Partnership Chair of the Power Electronics Society (IEEE-PELS). Dr. Kennel has received in 2013 the Harry Owen Distinguished Service Award from IEEE-PELS.

Jose Rodriguez (M'81-SM'94-F'10-LF'20) received the Engineer degree in electrical engineering from the Universidad Tecnica Federico Santa Maria, in Valparaiso, Chile, in 1977 and the Dr.-Ing. degree in electrical engineering from the University of Erlangen, Erlangen, Germany, in 1985. He has been with the Department of Electronics Engineering, Universidad Tecnica Federico Santa Maria, since 1977, where he was full Professor and President. Since 2015 he was the President and since 2019 he was full professor at Universidad Andres Bello in Santiago, Chile. Now José Rodriguez is Director of the Center for Energy Transition at the University of San Sebastian in Santiago de Chile. He has coauthored two books, several book chapters and more than 400 journal and conference papers. His main research interests include multilevel inverters, new converter topologies, control of power converters, and adjustable-speed drives. He has received a number of best paper awards from journals of the IEEE. Dr. Rodriguez is member of the Chilean Academy of Engineering. In 2014 he received the National Award of Applied Sciences and Technology from the government of Chile. In 2015 he received the Eugene Mittelmann Award from the Industrial Electronics Society of the IEEE. In years 2014 to 2020 he has been included in the list of Highly Cited Researchers published by Web of Science.

Zhenbin Zhang (S'13–M'16) received the Ph.D. degree at the Institute for Electrical Drive Systems and Power Electronics (EAL), Technical University of Munich (TUM), Germany, with “summa cum laude”. From 2016 to 2017, he worked as a Research Fellow and the group-leader for “Modern Control Strategies for Electrical Drives” group in EAL. Since 2017, he has held the position of full professor and International Collaboration Ambassador of Shandong University, China. Since 2018, he has been a guest professor in TUM with the “August-Wilhelm Scheer Professorship Award.” In 2018, he was also elected as IEEE Senior Member and TUM-IAS Fellow. In 2019, he was selected as a recipient of China's “1000-Talent-Plan”. Dr. Zhang is a recipient of the VDE-Award, Germany and has received best paper awards from IEEE international conferences three times. He has authored one book and more than 70 papers. Dr. Zhang has also made several invited presentations at international conferences and seminars. In addition, he has facilitated tutorials in IEEE conferences four times. He was elected chairman of IEEE-PECED-2019 programming committee, chairman of IEEE-PECED-2021 conference, and Associate Editor of IEEE TRANS. IND. ELECTRON. Dr. Zhang is the founder and director of the Lab for More Power Electronics Energy Systems in Shandong University. His research interests include power electronics, renewable energy and smart grids