

Predictive Control for Power Converters and Drives: Concept, Applications, and Trends

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Up to now the control of electrical power using power converters has been based on the principle of mean value, using pulse width modulation with linear controllers in a cascaded structure.

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.

The main advantages of predictive control are: Concepts are very intuitive and easy to understand; It can be applied to a great variety of systems; The multivariable case can be easily considered; Dead times can be compensated; Easy inclusion of non-linearities in the model; Simple treatment of constraints; The resulting controller is easy to implement; This methodology is open to include modifications and extensions depending on specific applications.

The participants of this tutorial will learn: The basic concepts and ideas; Different types of predictive controllers; detailed examples of predictive controllers; Several applications in different converter topologies.



Prof. Jose Rodriguez (M'81-SM'94-F'10) 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 is full professor at Universidad Andres Bello in Santiago, 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 2019 he has

been included in the list of Highly Cited Researchers published by Web of Science.



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 Technische Universitaet Muenchen (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 UK. Within IEEE he was Treasurer of the Germany Section as well as Region 8. Furthermore he has been Distinguished Lecturer of the Power Electronics Society. Dr. Kennel has received in 2013 the Harry Owen Distinguished Service Award from IEEE-PELS as well as the EPE Association Distinguished Service Award in 2015.

Dr. Kennel was appointed "Extraordinary Professor" by the University of Stellenbosch (South Africa) from 2016 to 2019 and as "Visiting Professor" at the Haixi Institute by the Chinese Academy of Sciences from 2016 to 2021. There he was appointed as "Jiayi Lu Overseas Guest Professor" in 2017. In 2018 Dr. Kennel was appointed Guest Professor at Harbin Institute of Technology (HIT), Harbin, China. In 2019 Dr. Kennel was appointed "Honorary chair Professor" ("distinguished visiting professor") at Shandong University in Jinan, China.