

Press release

SEMIKRON Foundation and ECPE honour Dr. Tobias Geyer with the Innovation Award 2021 while this year's Young Engineer Award goes to Dr. Jakub Kucka.

March 23rd, 2020

This year the jury has decided to give the SEMIKRON Innovation Award to **Dr. Tobias Geyer from ABB Medium-Voltage Drives, Switzerland** to acknowledge his pioneering work in the field of Model Predictive Control awarding his innovation regarding '**Model Predictive Pulse Pattern Control**'.

Optimized pulse patterns (OPPs) minimize the current distortions per switching frequency during steady-state operation, but achieving high dynamic performance is generally considered impossible. Model predictive pulse pattern control (MP³C) solves this problem by formulating and solving a model predictive control problem. The stator flux vector is controlled along its optimal trajectory by modifying the switching instants of the OPP's switching transitions. MP³C combines the benefits of hysteresis control methods, such as direct torque control, with the optimal steady-state performance of OPPs, by resolving the antagonism between the two. MP³C has been successfully demonstrated and proven in an ABB medium-voltage drive. The control innovation increases the drive's power by up to 50% at high fundamental frequencies.

This year's SEMIKRON Young Engineer Award is given to **Dr. Jakub Kucka** (now EPFL École Polytechnique Fédérale de Lausanne) for his work on '**Quasi-Two-Level PWM Operation for Modular Multilevel Converters**' he has conducted at the Institute for Drive Systems and Power Electronics of **Leibniz University Hannover, Germany**.

The novel quasi-two-level PWM operation mode revolutionizes the way how the modular multilevel converters are operated in low-frequency medium-voltage drive applications. Thanks to the quasi-two-level PWM operation, the amount of installed modules' capacitance in the modular multilevel converters can be reduced by more than one order of magnitude. This is a great advantage, considering that the large module capacitors of the conventionally operated modular multilevel converters generally represent the main drawback of this topology. Hence, the quasi-two-level PWM operation has the potential to significantly reduce the size of the modules, the footprint of the converter, and the production costs. Most of the advantages of modular multilevel converters, like modularity, voltage scalability, possible redundancy and commutation loops confined to within the modules, are preserved. Without a necessity to utilize costly high-voltage semiconductor switches or output filters, the innovation opens a path for cost-sensitive applications e.g. in medium-voltage drives.



In his work Jakub Kucka has developed the main principles of the operation, studied the design trade-offs and operation properties, and derived and implemented a novel control. He has implemented the proposed control in a downscaled converter prototype with very low module capacitance, to prove the concept and to experimentally validate the advantages of the quasi-two-level PWM operation

About the SEMIKRON Foundation:

The SEMIKRON Foundation was founded on December 4, 2010, by owners of the SEMIKRON Group. Equal founders are the daughters of Peter Martin, the SEMIKRON owner and managing director of many years, who passed away in 2008. With the founding act, the founders intended to live up to their responsibility being the owners of a family-owned medium industry business and to contribute to their company's "Corporate Social Responsibility".

The purpose of the SEMIKRON Foundation is to bundle and extend the charitable activities operated by the owners of the SEMIKRON Group. In particular, the humanitarian projects initiated by Mr. Peter Martin, and supported by the Mali Martin Care e.V. charity are to be continued. These projects support children and people in need all over the world. Over the past 10 years, Mali Martin Care e.V. has donated more than one million Euro to humanitarian projects for children and young adults, mostly in Brazil (projects "Centro Social" and "Lar do Menor"). In addition, the foundation supports research projects and innovations in the field of power electronics. For more information, please visit: www.semikron-stiftung.com.

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