



## EDITOR-IN-CHIEF'S WORD

Dear readers,

Within the scope of its task the Croatian Academy of Engineering strives to promote, explain and support the development of rapidly evolving technologies that are changing lives around the world, whatever that means.

Our distinguished member, Professor Emer. Nedjeljko Perić, Ph.D. is very involved scientifically and institutionally in projects that contribute to these changes, and we have tried to give him space in our bulletin to show us some of his achievements as well as of his associates that will surely interest you.

Editor

Vladimir Andročec, President of the Croatian Academy of Engineering



## EDITOR'S WORD

Dear readers,

As an academy of engineering sciences, Croatian Academy of Engineering is specially pleased to report on collaborative research efforts between academic institutions and the industrial sector. Along this vein, in this issue of Engineering Power we present the research activities of the Laboratory for Renewable Energy Systems, Faculty of Electrical Engineering and Computing, University of Zagreb, and Innovation Centre Nikola Tesla, Zagreb, in different fields of industrial applications.

Guest-Editor is Professor Emeritus Nedjeljko Perić, Innovation Centre Nikola Tesla, and University of Zagreb, Faculty of Electrical Engineering and Computing, and Full Member of the Academy.

Editor

Zdravko Terze, Vice-President of the Croatian Academy of Engineering



## FOREWORD

The Laboratory for Renewable Energy Systems (LARES) of University of Zagreb Faculty of Electrical Engineering and Computing (FER) conducts research and development of control systems based on advanced methods and digital technologies such as model predictive control and artificial intelligence methods. There is a wide range of applications that LARES deals with. To name just a few: renewable energy sources - predominantly wind and solar energy, energy storage - predominantly battery and hydrogen, complex automation in buildings, smart cities especially public lighting management, water supply management, optimization in railway transport systems. In the last two years, LARES has launched research and development projects aimed at digitization in the agri-food sector. More detailed information on ongoing and finished projects can be found at <https://www.lares.fer.hr>. In cooperation with the Innovation Centre Nikola Tesla (ICENT), LARES is very successful in building a network of cooperation with our and foreign companies. Construction of LARES began in 2007 based on a previously well-designed and long-term sustainable program. Today, LARES, as an integral part of the Department of Control and Computer Engineering of FER, consists of a research team of over 45 members, who are doctoral students, postdoctoral students, assistants and professors with international expertise and reputation. The author of this foreword has the honor to point out that the current head of LARES is Professor Mario Vašak who with his energy, enthusiasm, knowledge and dedication undoubtedly ensures the further very successful development of the laboratory to his satisfaction and the satisfaction of all members of the laboratory. In this issue of Engineering Power, six papers have been selected for publication. The first paper presents the original concept of the modular hierarchical model predictive control for coordinated and holistic energy management of buildings, which provides a significant reduction in the overall building operation cost. The second paper describes a case study of a real power distribution grid in Croatia focused on its dynamic reconfiguration, showing that the developed control algorithm can contribute to significant savings for the grid operator. The third paper presents the off-line and on-line optimization of the behavior of a battery system in a building for demand response provision, showing that the battery energy storage system can reduce the operating costs of a prosumer and that it can contribute to an overall electrical grid stability according to a demand response scheme. Optimal parameterization of a PV and a battery system add-on for a consumer is the fourth paper describing a procedure used for optimal sizing of the investment in a renewable electricity source and electricity storage. The fifth paper describes a case study for Croatian Railways based on coordinated energy management of the electric railway traction system. The developed algorithm is verified on a detailed real case study scenario with the presented results showing significant cost and energy consumption reductions. The sixth paper deals with the rapid plant development modelling system for predictive agriculture. Current and upcoming climate changes will evidently have the greatest impact on the cultivation of agricultural crops. Having it in mind, the paper focuses on a system concept to gather data for future models to be used publicly and interactively via a portal for predicting plant development under real and hypothetical climate conditions.

Guest-Editor

Nedjeljko Perić, Innovation Centre Nikola Tesla, and University of Zagreb, Faculty of Electrical Engineering and Computing