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## EDITORIAL

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## Foreword

We are delighted to introduce this special issue of the Proceedings of the Estonian Academy of Sciences. This issue is a follow-up to the 19th Biennial Conference on Electronics and Embedded Systems 2024 (BEC2024) that took place on October 2–4, 2024, in Tallinn, Estonia.

Since its inception in 1996, the BEC conference has played a significant role in promoting the results of research and development in the field of electronics and embedded systems, with a particular focus on the Baltic Sea region, while also welcoming contributions from the global research community. Following the conference, authors of selected papers were invited to prepare extended versions of their work.

This special issue features six extended papers that illustrate the breadth and depth of the research presented at the conference.

“Enhancement of residential PV energy storage system by supercapacitor battery – high spatial resolution data analysis” by Szymon Rogowski, Sayeed Hasan, Andrii Chub, and Maciej Sibiński addresses frequent instability problems in residential photovoltaic microinstallations through a novel hybrid energy storage system design that combines a supercapacitor bank with traditional batteries. Using data from a real-life installation and a Z-score-based peak detection method, the paper shows how this mixed approach compensates for both short-term and long-term power fluctuations, and potentially extends battery lifespan.

“Design and development of solid state circuit breaker with residual current protection for residential prosumer DC microgrids” by Tanel Jalakas, Andrii Chub, Indrek Roasto, Dmitri Vinnikov, and Jarek Kurnitski presents the design, implementation, and laboratory testing of a novel hybrid protection device that integrates a solid-state circuit breaker and residual current detection for residential microgrids. The developed prototype can be used to improve DC microgrid protection systems thanks to its compliance with safety requirements and its ability to protect against short circuits, electric shock hazards, and equipment overloads.

“Environmental performance analysis of innovative mechanical separation for recycling of waste printed circuit boards” by Pooya Hosseini, Artur Klauson, Dmitri Goljandin, Brent Hendrickx, and Joost R. Duflo evaluates the environmental performance of a mechanical separation process for printed circuit boards. The paper focuses on enriched material. The results show the potential mitigation impact of the proposed method, but also highlight the energy required by the process. Size reduction was identified as the most energy-intensive step, due to the high energy demand of millimeter-scale material reduction needed for the inertial and electrostatic separations. The paper further discusses other aspects of advanced mechanical separation to address e-waste concerns and identify areas for improvement toward a more sustainable recycling framework.

“Lightweight CNN-based microfluidic droplet classification for portable imaging flow cytometry” by Fariha Afrin, Yannick Le Moullec, Tamas Pardy, and Toomas Rang introduces a customized YoloV4-tiny model deployed on resource-constrained devices for classifying microfluidic droplets into three categories (no cell, one cell, multiple cells) in portable imaging flow cytometry applications. The paper compares several machine learning models across different hardware platforms and highlights the trade-offs between processing speed and classification accuracy. The results show that carefully designed systems can enable robust performance even on resource-constrained devices for deployment in the field.

“Detection of surface defects of metals: a case study” by Olev Märtens, Raul Land, Margus Metshein, Anar Abdullayev, Henri Vennikas, Yannick Le Moullec, and Marek Rist reviews and contributes to eddy-current testing methods for metal surface defect detection, with a focus on cracked saw blade specimens using planar coils. The paper shows that higher frequencies enhance crack detection capabilities and proposes recommendations for future work to concentrate on high-speed detection technologies and machine vision-based solutions.

“Impact of multipath on anchor selection strategies for UAV localization in mobile networks” by Luca Reggiani and Alberto Facheris investigates several strategies for selecting appropriate base stations (anchors) for UAV positioning in mobile networks to address the trade-off between signal reception from multiple sources at higher altitudes and computational complexity and latency. The use of a standard least-squares positioning technique reveals salient properties that help design a new solution to the anchor selection problem. Results obtained using realistic propagation scenarios, including multipath effects, show that sub-meter 3D positioning accuracy can be achieved while maintaining system efficiency.

Compiling this special issue would not have been possible without the dedicated efforts of the authors who accepted our invitation and prepared extended versions of their papers, the BEC2024 Technical Program Committee members who assisted in paper selection and the review process by providing constructive feedback, as well as the assistance of Ms. Hedi Tõnso and her colleagues at Estonian Academy Publishers who provided their editorial expertise.

We hope you find this BEC2024 special issue both informative and inspiring, and that the papers stimulate further research and innovation.

We look forward to welcoming you to the next edition of the BEC conference, where we can continue sharing and exchanging ideas on topics of electronics and embedded systems.

Yannick Le Moullec and Peeter Ellervee  
Guest editors