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SPECIAL SECTION

On IIoT and AI-based optimization

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1. INTRODUCTION

The aim of the *Special Section on IIoT and AI-based optimization* is to present the latest developments and applications of the following topics:

- Methods and systems in the Industrial Internet of Things;
- Modelling, simulation, and structural optimization;
- IoT infrastructure, protocols, and algorithms;
- Connecting new and legacy devices supporting multiple protocols and standards;
- Advanced industrial, automotive, and green IoT applications;
- Ways to improve performance;
- Identification and validation of data;
- Applications of artificial intelligence (AI) and computational intelligence in IoT;
- Device and data protection;
- Security, attacks, and counter-measurement of the Industrial Internet of Things;

The topics of the Special Section are in line with current research trends in the disciplines of computer science, telecommunications, and mechanical engineering. They combine the experiences of researchers and participants at the International Conference "*Intelligent Solutions for Industry – ISI 2022*" with the latest trends in the discipline, in particular research in the field of IIoT, Industry 4.0, and the emerging Industry 5.0.

The rapid proliferation of Internet of Things devices is enabling its effective use in a wide range of fields: from industry to agriculture to healthcare and education, or – more generally – in all kinds of smart environments in the above fields and beyond. Operating at all layers: things, network, and cloud, it facilitates faster data acquisition, computational modelling, inference based on artificial intelligence methods, and coordinated

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control of sensor and effector assemblies. It also provides an opportunity to integrate legacy network and production assets into the Industrial Internet of Things (IIoT), thus making them more digitized, automated, and data secure, resulting in greater reliability and better performance optimization and technical control at every stage of production. Importantly, the current implementation of IIoT security standards allows for better protection of stored and transmitted data, the use of the most advanced access control mechanisms, and monitoring of the network for potentially harmful activities, reducing the risk of attack. The use of computational models based on AI is the basis for using real data sets to make decisions in the maintenance area, including so-called virtual twins. This helps to reduce costs, improve product quality, document lessons learned from past system performance, and formulate data-driven plans for future development. AI offers methods for solving problems that cannot be effectively solved by algorithmic means. This includes not only analysing the past and present performance of complex systems but also predicting future behaviour, including that resulting from natural wear and tear.

The collective concept of integrating intelligent machines and systems and making changes to production processes to increase production efficiency and the ability to flexibly change parameters and assortments (including personalization of mass production) are just some of the areas presented during the conference. Industry 4.0 and Industry 5.0 create not only a novel approach to technology but also new ways of working and roles for humans and the environment in industry, integrating humans and digitally controlled machines with the internet and information technologies. Energy efficiency and sustainability are becoming important, and materials used in production are subject to life-cycle analysis and recycling. The flow of information therefore plays a greater role than in previous applications, being multi-directional and multi-level, impossible to understand without artificially intelligent data analysis, inference, and prediction. Artificial intelligence methods and techniques are increasingly being used to solve problems that are difficult to algorithmize and require a heuristic approach.

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2. PAPERS IN THIS SPECIAL SECTION

The articles included in this Special Section are authored by renowned researchers and focus on various aspects and developments in the field of IIoT and AI-based optimization. The current state of knowledge on IIoT and AI-based optimization is included in a review article by D. Mikołajewski, J. Czerniak, M. Piechowiak, K. Węgrzyn-Wolska, and J. Kacprzyk (The Internet of Things and AI-based optimization within the Industry 4.0 paradigm). The paper by P. Szywalski and A. Waindok (A decentralized radio network for small groups of unmanned aerial vehicles) presents a study of the capacity of a decentralized radio network dedicated to unmanned aerial systems for different algorithms, frequencies, Gaussian keying configurations, and for static as well as dynamically moved UAVs. The article by B. Kwiatkowski, T. Kwater, D. Mazur, and J. Bartman (An off-line application that determines the maximum accuracy of the realization of reference points from G-code for given parameters of CNC machine dynamics) is dedicated to an off-line application that determines the maximum accuracy of the reference points for the given CNC machine dynamic parameters (maximum velocity, acceleration and rate of change of acceleration (JERK) for each working axis of the machine). The article by A. Czajkowska, T. Rydzkowski, and D. Laskowska (Wood-based composite materials in the aspect of structural new generation materials. Recognition research) concerns the selection of composite materials produced by gravity casting in silicone moulds for use in the production of new-generation wood-based composites. The article by A. Paszkiewicz, C. Ćwikła, M. Bolanowski, M. Ganzha, M. Paprzycki, and M. Hodoň (Multifunctional clustering based on the LEACH algorithm for edge-cloud continuum ecosystem) describes a new simulation approach for building multifunctional network cluster structures, based on a modified LEACH algorithm. The article by P. Kiedrowski (Three methods of selecting a smart meter for data concentration in the automatic meter reading last mile network) focuses on three methods for the optimal selection of a smart meter as a data hub in a last mile automatic meter reading network taking into account the reliability of communication and the speed of the automatic meter reading process. Ł. Kowalski, M. Bembenek, A. Uhryński, and S. Bajda (Comparative study of experimental thermographic data and finite element analysis on temperature evolution of PET-G layer deposition during additive manufacturing process) use finite element analysis to determine the thermal evolution during the 3D printing process and create a layered numerical model of the transient heat transfer for comparison with thermal camera images. The paper by J. Kochańska, A. Burduk, D. Łapczyńska, and K. Musiał (The solution of MRSLP with the use of heuristic algorithms) is dedicated to improving the delivery of components to the production area using trains and appropriately placed wagons, the so-called MRSLP (milk run stop locations problem) based on heuristic algorithms: tabu search, genetic algorithm and simulated annealing. The article by P. Czyżewski, D. Marciniak, and D. Sykutera (Mechanical properties of ABS samples manufactured under different process conditions) is concerned with determining the influence of manufacturing conditions on the mechanical properties and structure of ABS parts produced by fused deposition modelling (FDM) and injection moulding (IM).

3. CONCLUSIONS

Intelligent solutions are gaining popularity in industry because of the possible benefits they offer, in particular the ability to automatically or semi-automatically find the optimal solution quickly and accurately and to avoid or predict errors, including human errors, under conditions as close to real life as possible.

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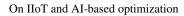


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