

From AI-based Optimisation of Ion Thrusters to Machine Learning on the Roads and in Factories

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BY THE END OF 2021 the area of Infocommunications has really got dominated by the application of Artificial Intelligence-related methods. Even in this final issue of our journal, 3/4 of the articles are putting AI or machine learning into the focus as the approach for solving the otherwise very diverse problems.

Let us have a brief overview of the articles included in the current, last 2021-issue of the Infocommunications Journal.

In their paper, Árpád László Makara, András Reichardt and László Csurgai-Horváth present their first results of a system for controlling a small satellite's ion thruster's ion beam using merely the electric field. To summarize the application area, their work is aimed to optimize the electrostatic ion engine accelerator electrodes for orbit correction operations with minimum fuel usage. In order to solve the problem they used supervised machine learning techniques, along with the Least Mean Square method update steps. Since the satellite operates in space, a vacuum chamber can be a good modeling environment, but it is a very difficult to perform any measurement there, not to mention optimisation. Therefore, the authors choose to use a simulation-based approach. As they summarize their results, they found that thrusting material does not affect the ability to control. Their solution based on the optimisation of boundary conditions provides a result within an acceptable number of iteration steps. The process is fast and easy to parameterise. In addition, this procedure can be independent of the model and can be applied to a more complex physical ion thruster.

464XLAT is a prominent, standardised method to quickly deploy limited IPv4 access service to IPv6-only networks without encapsulation. The aim of Ameen Al-Azzawi and Gábor Lencse in their paper was to identify possible security issues related to 464XLAT transition. They applied the traditional STRIDE method and analysed vulnerabilities of data flows, data stores, processes and interactions in the dimensions of STRIDE. Besides, they built a test-bed and through that they analyzed how the provider-side translator behaves when it comes to DDoS attacks. The main finding is that the double translation mechanism of 464XLAT proved its effectiveness in terms of IPv4 literals communications over IPv6 infrastructure, although there are clear security vulnerabilities that have to be addressed as part of a complete system deployment.

Vehicular traffic has various peculiarities, one of them being the behaviour of the participants as individuals or as group members. Behaviour analysis is a currently hot topic in this domain. Gergely Hollósi, Csaba Lukovszki, Máté Bancsics, and Gábor Magyar are investigating traffic swarm behavior in their paper, especially by using machine learning methods and game theory in behaviour analysis. Their article outlines and compares

various methods for driver behaviour analysis, even in traffic situations with complex interactions. Although state-of-the-art machine learning models, latent space exploration techniques and game theory methods are successfully applied to image processing and various other problems, it is hard to find an approach that addresses traffic behaviour analysis as a whole. The authors suggest us to deeply consider the idea of traffic swarms, because this approach does not limit the interactions among drivers to the surrounding vehicles and the interactions are not bound to kinematic properties either. This allows us to analyse the actions as a result of complex behaviour instead of only trajectories or visible interactions of the vehicles.

The paper by Attila Frankó and Pál Varga surveys the machine learning based smart maintenance and quality control solutions. The authors aim to categorize the maintenance and quality control-related tasks at the various parts of the smart manufacturing ecosystem, and map machine learning solutions to these. The paper provides an overview of machine learning usage at various fields within diagnostics (especially fault detection and root cause analysis), prognostics, predictions, health management, and intelligent quality control – including non-visual and computer visual-aided types. Within smart maintenance, the hottest topic seems to be related to machine learning with unlabeled data, since in this early-mid phase of smart factory development the data is mostly unlabeled. In relation to non-visual quality control, the challenge is to enable high-data-rate and enhance flexibility in ever-changing smart factories, whereas for CV-based applications the main challenge is to improve the inference time and decrease the required computational capacity to enable image recognition- based quality inspection in production lines.

Infocommunications Journal finishes the year 2021 with these papers and wishes happy 2022 to all its readers, authors, and reviewers.



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