

Ulysses Research Group's thematic focus

Research Problem: **Intelligent Cognitive Manufacturing**

Research Topic: **Smart Manufacturing Systems**

Vision holder – TUKE IH: Prof. Jan Pitel

Main area of research: Integrating interconnected systems and devices across the manufacturing floor to enable real-time data exchange, collaboration, and decision-making. Digital twins as a powerful tool in the realm of smart manufacturing, facilitating the integration of various technologies and processes within a manufacturing environment. Integrating digital twin technology with VR/AR/MX reality into a compelling platform for immersive visualization, interactive training, and real-time human-machine collaboration. Communication in smart manufacturing to ensure seamless integration of technologies, efficient data flow, real-time decision-making, and overall operational effectiveness.

Existence of living lab: SmartTechLab for Industry 4.0 (<http://smarttechlab.tuke.sk/>) - research and teaching laboratory based on an experimental SMART production system with installed technologies of advanced robotics, progressive production, digitalization (digital twin, clouds), visual systems and RFID/IIoT (product identification), VR/AR/MX reality, PLC control.



Specific research problems & objectives:

- Research on implementing a digital twin in the online control and monitoring of the production process with the support of mixed reality.
- Real-time human tracking in the collaborative assembly process.
- Real-time monitoring of 3D printing with the support of computational intelligence.
- M2M in 5G communication networks.

Expertise requested:

- Expertise in control and monitoring systems, industrial vision systems, sensors, IIoT, machine-to-machine communication, VR/AR/MX reality for joint research and scientific publishing.
- Exchange and preparation of project proposals for international and national funding.

Feel free to contact us for any questions or proposals. We are open to discussing and preparing the prospective cooperation by arranging an online meeting to speed up the effective exchange of experiences and ideas at the formation of specific R&I groups.

Contact:

Prof. Jan Pitel, PhD., Technical University of Kosice, Faculty of Manufacturing Technologies,
jan.pitel@tuke.sk

Selected research projects of the TUKE team related to the research topic:

- H2020-MSCA-RISE-2016 Industry 4.0 for SMEs - Smart Manufacturing and Logistics for SMEs in an X-to-order and Mass Customization Environment
- DESCA-2020 MIDIH - Manufacturing Industry Digital Innovation Hubs
- HORIZON-MSCA-2021-SE-01 SME 5.0 - A Strategic Roadmap Towards the Next Level of Intelligent Sustainable and Human-Centred SMEs
- CEF-DIG-2022-5GSMARTCOM TUKE 5G Infrastructure for Smart Communities
- APVV-19-0590 Modular Multifunctional Inspection Workplace using Computational Intelligence Technique

Selected recent scientific publications of the TUKE team related to the research topic:

- Ivanov, V., Andrusyshyn, V., Pavlenko, I., Piteľ, J., Bulej, V. New classification of industrial robotic gripping systems for sustainable production. *Scientific Reports*, Vol. 14, 2024, 295. ISSN 2045-2322. <https://doi.org/10.1038/s41598-023-50673-5>
- Andrusyshyn, V., Židek, K., Ivanov, V., Piteľ, J. Novel Gesture-Based Robot Programming Approach with the Ability of Code Reuse, *Machines*, Vol. 12, Issue 4, 2024, 217. ISSN 2075-1702. <https://doi.org/10.3390/machines12040217>
- Piteľ, J., Židek, K., Modrák, V., Hošovský, A., Lazorík, P. Learning based on SmartTechLab for I4.0. In: Managing and Implementing the Digital Transformation: Proceedings of the 1st International Symposium on Industrial Engineering and Automation ISIEA 2022. *Lecture Notes in Networks and Systems*, Cham: Springer, 2022, pp. 309-318. ISBN 978-3-031-14316-8. https://doi.org/10.1007/978-3-031-14317-5_26
- Lishchenko, N., Piteľ, J., Larshin, V. Online Monitoring of Surface Quality for Diagnostic Features in 3D Printing. *Machines*, Vol. 10, Issue 7, 2022, 541. ISSN 2075-1702. <https://doi.org/10.3390/machines10070541>
- Pavlenko, I., Piteľ, J., Ivanov, V., Berladir, K., Mižáková, J., Kolos, V., Trojanowska, J. Using Regression Analysis for Automated Material Selection in Smart Manufacturing. *Mathematics*, Vol. 10, Issue 11, 2022, 1888. ISSN 2227-7390. <https://doi.org/10.3390/math10111888>
- Židek, K., Piteľ, J., Adámek, M., Lazorík, P., Hošovský, A. Digital Twin of Experimental Smart Manufacturing Assembly System for Industry 4.0 Concept. *Sustainability*, Vol. 12, No. 9, 2020, 3658. ISSN 2071-1050. <https://doi.org/10.3390/su12093658>