

Ulysses Research Group's thematic focus

Research Problem: **Intelligent Cognitive Manufacturing**

Research Topic: **Manufacturing Quality Control and Predictive Maintenance**

Vision holder – TUKE IH: Prof. Tibor Krenicky

Main area of research: Implementing AI and IIoT sensors to predict equipment failures before they occur, minimizing malfunctions that endanger workers and operations; reducing production quality, failure downtimes, and maintenance costs. Integration of advanced AI-enabled object and image recognition systems and sensors to monitor product quality in real-time/online, defects identification, and enhancing consistency of production processes.

Existence of living labs: SmartTechLab for Industry 4.0 (<http://smarttechlab.tuke.sk/>) with the support of the Centre for Testing and Monitoring of Technical Systems, Identification Technologies and Artificial Intelligence Lab; Electrical Engineering, Mechatronics and Cybernetics Lab.



Specific research problems & objectives:

- Predictive Maintenance using AI tools
- Visual monitoring and identification systems (RFID/IIoT)
- Modular monitoring systems
- Virtualization, VR/AR/MX reality
- AI-driven image recognition systems and sensors

Required expertise:

- Building on-demand hardware and/or software tools for data acquisition, processing and analysis
- Modeling Digital Twins of technical systems or processes
- Design and implementation of AI tools for technical systems predictive maintenance and/or product quality control
- and related ...

Feel free to contact us for any questions and 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, presentations and discussions aimed at the formation of specific research and innovation groups.

Contact:

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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
- SF ITMS 26220220103 Research and development of intelligent actuators based on artificial muscles
- HORIZON-MSCA-2021-SE-01 SME 5.0 - A Strategic Roadmap Towards the Next Level of Intelligent Sustainable and Human-Centred SMEs
- APVV-18-0316 Research and development of composite material configurations with advanced properties for applications in production machines
- Design and implementation of teaching stands in the educational process of technically oriented subjects in the context of current needs of industry
- KEGA 052TUKE-4/2024 Innovation of the subjects of mechanics of materials and design of structures by transfer from scientific and research activities in the field of non-standard structural materials, their mechanical properties and applications in mechanical systems

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

- Krenicky T, Nikitin Y, Božek P. Model-Based Design of Induction Motor Control System in MATLAB. *Applied Sciences*. 2022; 12(23):11957. <https://doi.org/10.3390/app122311957>
- Gulyaev P, Krenicky T, Shelkovnikov E, Korshunov A. Particle and Particle Agglomerate Size Monitoring by Scanning Probe Microscope. *Applied Sciences*, 2022; 12(4):2183. <https://doi.org/10.3390/app12042183>
- Krenicky T, Olejarova S, Servatka M. Assessment of the Influence of Selected Technological Parameters on the Morphology Parameters of the Cutting Surfaces of the Hardox 500 Material Cut by Abrasive Water Jet Technology. *Materials*. 2022; 15(4):1381. <https://doi.org/10.3390/ma15041381>
- Bozek P, Krenicky T, Prajova V. Digital Induction Motor Model Based on the Finite Element Method. *Applied Sciences*. 2023; 13(8):5124. <https://doi.org/10.3390/app13085124>
- Božek P., Nikitin Y, Krenicky T. *Diagnostics of Mechatronic Systems*. Cham: Springer Nature, 2021. 79 p. ISBN 978-3-030-67054-2. <https://www.springer.com/gp/book/9783030670542>.
- Trojanová M, Čakurda T, Hošovský A, Krenický T. Estimation of Grey-Box Dynamic Model of 2-DOF Pneumatic Actuator Robotic Arm Using Gravity Tests. *Applied Sciences*. 2021; 11(10):4490. <https://doi.org/10.3390/app11104490>