

Control systems and their safety

Control with a defined Safety Integrity Level (SIL), Cybersecurity, Cyber-Physical Systems (CPS)



Safe Process Control



Cybersecurity



Cyber-Physical Systems

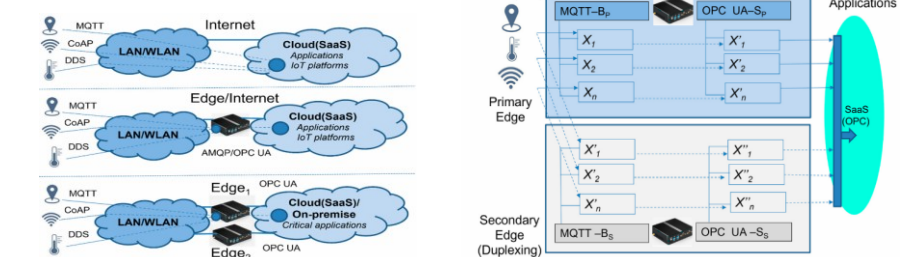
➤ Safe control of industrial and transportation processes (functional and technical safety)

➤ Cybersecurity, reliability, and availability of intelligent IoT/IloT systems

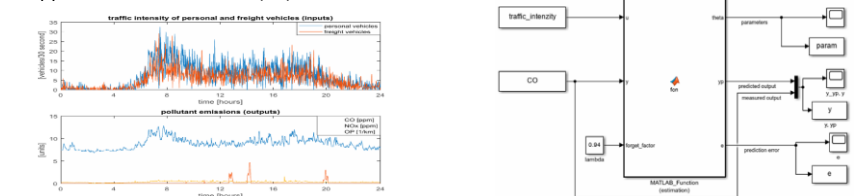
➤ Risk and vulnerability analysis, design, and implementation of safety measures (CPS systems, digital twins, simulations, and system integration)

➤ Design of fault-tolerant information systems resistant to failures and cyberattacks

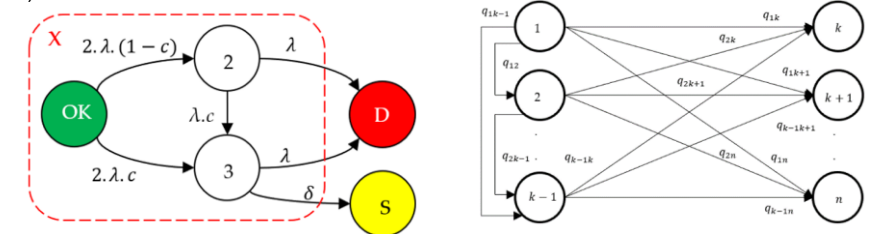
Peniak, P. et al. Validation of High-Availability Model for Edge Devices and IIoT. Sensors 2023, 23, 4871



Hrbček J. et al. The Online Identification of the Behaviour of Pollutants inside the Tunnel Tube. Applied Sciences. 2023; 13(20): 11251.



Medvedík, M. et al. Safety of Control Systems with Dual Architecture Based on PLCs. Appl. Sci. 2022, 12, 9799.

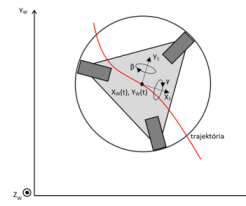
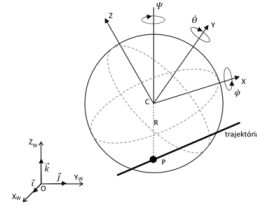
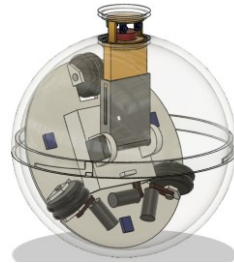


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Intelligent Transportation Systems

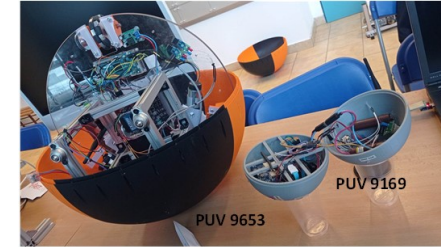
Applications of Artificial Intelligence in Transportation

Exploratory spherical robots



$$\vec{v}_0 = \vec{\omega} \times \vec{R}$$
$$\vec{v}_0 = ((-\psi \sin \theta + \phi) \vec{i} - \dot{\theta} \vec{j} - \psi \cos \theta \vec{k}) \times R(-\sin \theta \vec{i} + \cos \theta \vec{k})$$

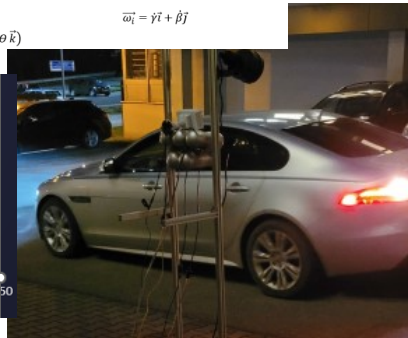
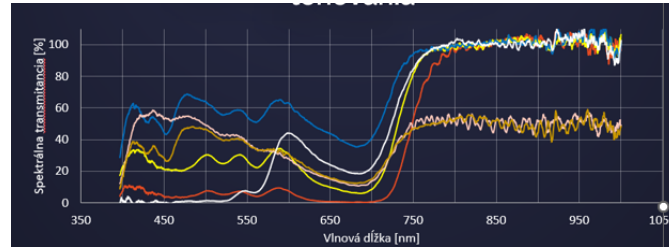
$$\vec{\omega}_1 = \dot{\gamma} \vec{i} + \dot{\beta} \vec{j}$$



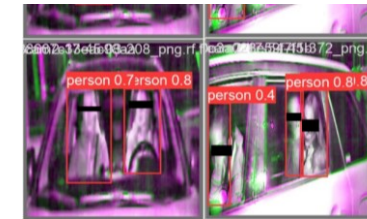
Marek Bujňák, Rastislav Pirník, Dušan Nemec, and the team: SpheriDrive: A spherical robot with an innovative 3-wheeled platform and omnidirectional wheels, Results in Engineering, Q1



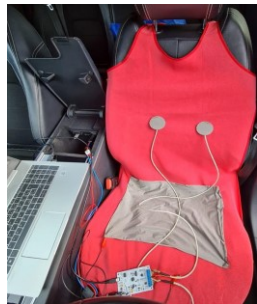
Passenger Detection



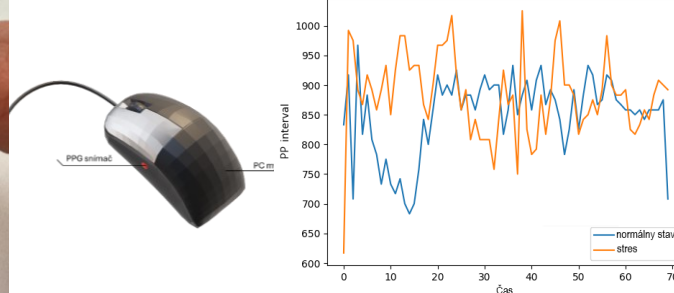
P. Kuchár, R. Pirník, J. Kafková, et al. "SCAN: Surveillance Camera Array Network for Enhanced Passenger Detection," in *IEEE Access*, Q2



HORIZON-WIDERA-2021-ACCESS-05: Trailblazing Inclusive, Sustainable and Resilient Cities (INCITIES)

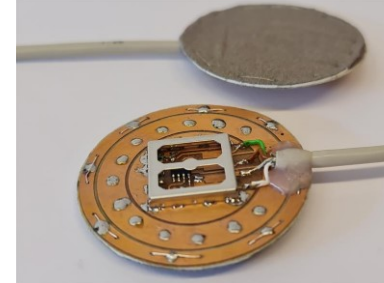


Pioneering Capacitive ECG

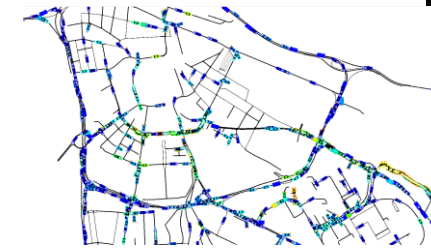


Stress profile of a driver and a traffic dispatcher

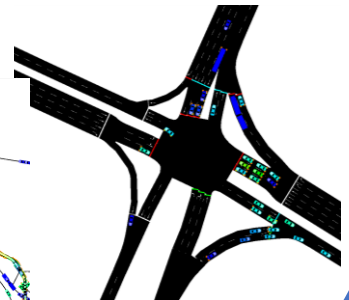
Kafková, J., Pirník, R., and the team., "Seat to Beat: Pioneering Capacitive ECG Integration for In-Car Cardiovascular Monitoring" Measurement (Q1)



Plans for the future



Digital twin of the road network in Žilina



Advanced and Mobile Robotics

R&D in perception, localization, navigation, and control of mobile wheeled and aerial robots

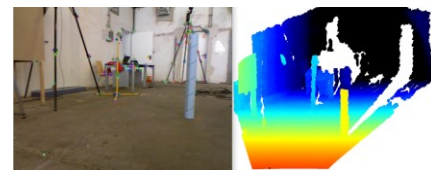
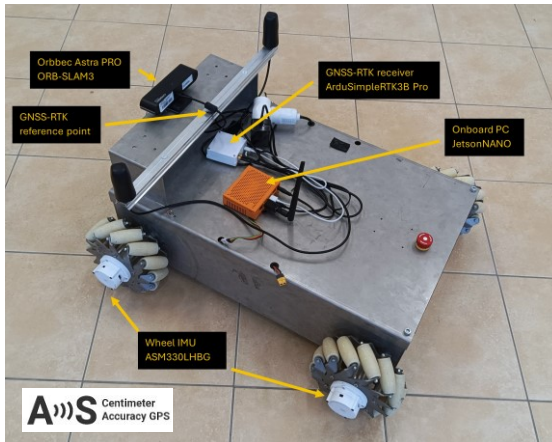
Experimental robotic platforms



Wheeled robots



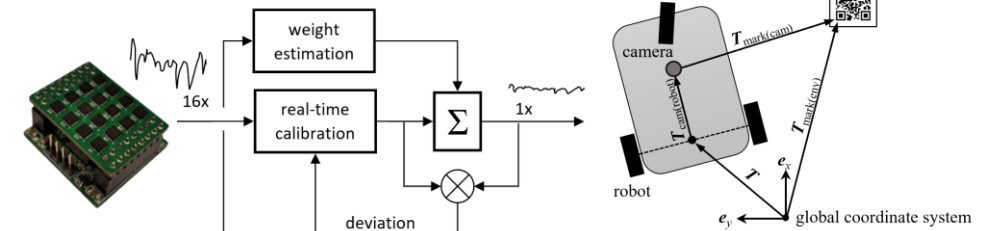
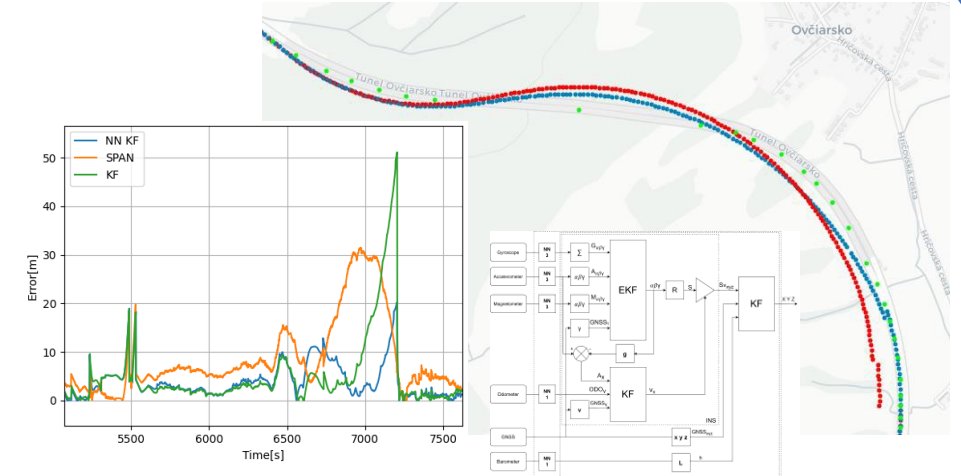
Aerial robots



Robot perception



Simak, V. et.al, [Online Calibration of Inertial Sensors Based on Error Backpropagation](#), Sensors, 2024, 24(23), 7525



Nemec, D. et.al, [Homogeneous Sensor Fusion Optimization for Low-Cost Inertial Sensors](#), Sensors, 2023, 23(14), 6431

Nemec, D. et.al, [Precise localization of the mobile wheeled robot using sensor fusion of odometry, visual artificial landmarks and inertial sensors](#), Robotics and Autonomous Systems, 2019, 112, pp. 168–177

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