UNIVERSITY
OF PARDUBICE
FACULTY OF ELECTRICAL
ENGINEERING
AND INFORMATICS

Strategic Research and Development Plan

Faculty of Electrical Engineering and Informatics

University of Pardubice

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Preamble

The Faculty of Electrical Engineering and Informatics at the University of Pardubice (FEEI UPCE) has long been engaged in applied research and experimental development in key areas of electronic systems, cybernetics, and information and communication technologies. The faculty's strategic research focus is primarily defined by the domains of object detection, localization, classification, and identification, utilizing both radio-frequency systems and optical and acoustic sensors. This orientation reflects the needs of modern society in the fields of security, transportation, industrial automation, and digitalization. The faculty's research activities are particularly concentrated on radar, communication, and sensor technologies, with strong integration of artificial intelligence (AI) tools, advanced signal and data processing techniques, and the development of specialized materials.

The Strategic Research and Development Plan of the Faculty of Electrical Engineering and Informatics outlines the main research pillars of the faculty and its vision for the coming period. Emphasis is placed on cooperation with industry and active participation in international research networks, which are considered key factors for the sustainable development of research and innovation.

Research Pillars and Strategic Visions

Sensor and Radar Systems

Research in radar and radio-navigation systems focuses on object detection, tracking, localization, and identification. This area is primarily developed by the research team led by Tomáš Zálabský. The team has long been engaged in the design of modern radar and radio-navigation systems that leverage advanced signal processing methods and machine learning algorithms. In cooperation with industrial partners, new generations of radar systems and sensor algorithms are being developed to ensure reliable and robust object detection under demanding operational conditions. The research also includes the development of functional electromagnetic materials for specialized sensor applications, including nanostructured layers and composite solutions.

The strategic vision of the research team is to develop next-generation intelligent sensor systems that combine advanced AI algorithms with physically optimized sensing elements, thereby achieving greater accuracy, resilience, and system adaptability. These technologies are applicable both in the defence and security sectors and in civilian domains such as autonomous systems, traffic management, and critical infrastructure monitoring.

The long-term objective is to position FEEI as a centre of excellence in sensor technology research, integrating theoretical modelling, experimental development, and industrial deployment of advanced sensing technologies.

Artificial Intelligence and Industrial Automation

Applied research and experimental development in the field of artificial intelligence at FEEI are focused on solving tasks for industrial and autonomous systems. In this domain, the research team led by Petr Doležal is active, specializing in the application of machine learning and deep learning methods to address challenges in real-world industrial environments. Key research topics include feature extraction from visual and sensor data, object segmentation and classification, automation of production processes, and robotic control. FEEI is advancing research in machine vision, intelligent sensing, and robotic platforms with the aim of enabling advanced automation in line with ongoing innovations and transformations in control and manufacturing systems.

The vision of this research pillar is the development of intelligent manufacturing and cyber-physical systems that enhance the efficiency, flexibility, and autonomy of production while also contributing to the advancement of autonomous systems—such as those used in transportation and logistics. Strong emphasis is placed on the integration of theoretical research with practical applications. In the development of new systems in cooperation with industrial partners, the creation of AI algorithms for object detection, characterization, and localization plays a key role. The strategic objective is to reinforce the position of FEEI as a leader in applied artificial intelligence.

Data Analytics and Simulation of Complex Systems

The domain of data analytics, computationally intensive processing of large-scale datasets, and simulation of dynamic systems focuses on research into the operation of selected complex systems such as transport infrastructures. In this field, the research team led by Tomáš Brandejský is active. The team's activities are centred on the development and implementation of advanced methods for processing and analysing large datasets that describe the behaviour and operation of complex technical and infrastructural systems. The research employs modern approaches in Big Data processing, parallel computing architectures, and distributed database systems, which are complemented by advanced simulation models and algorithms capable of real-time data processing. FEEI is developing its own high-performance computing infrastructure and implementing parallel programming techniques that enable efficient modelling of complex processes and predictive system control.

The strategic vision is to establish the faculty as a key player in the digital transformation of complex systems through the development of digital twins, advanced simulation tools, and data-driven analytical platforms for use in industry, transportation systems, and the public

sector. FEEI aims to further strengthen its capacities in data modelling and computationally intensive simulations to effectively meet the growing demands for processing large volumes of data and increasing requirements for the precision and reliability of simulation outputs.

Synergies and Future Strategic Orientation

The individual research pillars of FEEI complement each other synergistically and together create an interdisciplinary ecosystem that enables the faculty to address complex challenges. By combining expertise in sensor technologies, artificial intelligence, and data analytics, unique solutions are emerging—for example, intelligent sensor networks using AI for predictive maintenance or the integration of radar data with big data analytics to improve traffic management. FEEI actively promotes internal collaboration among research teams, facilitating knowledge transfer across disciplines ranging from electronics and computer science to materials research.

A key component of the faculty's future direction is close cooperation with industry. The key pillar of interaction with the application sector lies in joint research and development projects, where FEEI applies its expertise in electrical engineering, automation, and information technology, with a strong focus on results protected by intellectual property. The faculty supports the implementation of contract research utilizing state-of-the-art laboratories. Industry experts are involved in the educational process through guest lectures and student thesis supervision. This bidirectional flow of knowledge ensures that research responds to current industrial needs while industry partners help guide education and innovation in a relevant direction. FEEI also systematically supports student internships and placements in companies, contributing to talent development at all levels of education and to the employability of graduates in technology-oriented enterprises. Looking ahead, the faculty aims to strengthen technology transfer further and establish joint innovation platforms to ensure that research results are rapidly translated into practice.

An integral part of achieving objectives across all research pillars at FEEI is international cooperation and active involvement in research networks. The faculty places a strong emphasis on building long-term strategic partnerships with foreign institutions and actively participating in joint projects and exchange programs for researchers and students. FEEI also supports staff membership in international professional organizations and research consortia, which enhances the faculty's visibility and facilitates the transfer of cutting-edge knowledge. A long-term goal is to further expand engagement in international alliances and funding programmes such as Horizon Europe, the European Defence Fund (EDF), the European Space Agency (ESA), Erasmus+, Interreg, and others. FEEI is also committed to deepening its participation in global research initiatives in the fields of electrical engineering and informatics.

The future strategic development of FEEI UPCE builds on its research pillars and their synergies, with the aim of strengthening scientific excellence and the societal impact of research. The faculty continuously updates its strategic priorities in line with technological applicability and societal needs, supports the growth of early-career researchers, and invests in research infrastructure at a level comparable with leading international institutions. By bridging academic research with industry and the international landscape, FEEI UPCE contributes dynamically to innovation at both regional and global scales and fulfils its vision of becoming a modern, open, and respected research institution for the 21st century.

Monitoring Indicators and Long-Term Objectives of FEEI

Code	Strategic Monitoring Indicator	Strategic Target
P2.2/U1	Average involvement in R&D projects	> 33 %
P2.3/U2	Number of project proposals submitted to international funding agencies	1 submitted, 1 awarded per year
P2.3/U3a	Number of publications in D1 journals (according to WoS)	1x per year
P2.4/U4a	Number of publications in Q1 and Q2 journals (according to WoS)	> ∑FTE AP/4 ≈ 11, share >50 %
P2.4/U4b	Number of Module 1 (M17+) results with evaluation grades H1 to H3	1 per year
P2.4/U6	Participation in editorial boards of Q1 or Q2 international scientific journals (WoS), and elected memberships in international professional societies	>=3
P2.4/U8	Number of Q1 and Q2 journal publications (WoS) in collaboration with other research organizations	> 15%
P2.4/U9	Number of Q1 and Q2 journal publications (WoS) in collaboration with foreign research organizations	>10%
P2.6/U2	Number of applied research results with economic impact on society: Czech licensed patents, international patents, sold licenses, prototypes, spin-offs, etc.	1 per year