



Topic of dissertation thesis

Academic year 2026/2027

Title	Intelligent fiber-optic measurement systems for Industry 5.0		
Institute	Faculty of Electrical Engineering and Information Technology University of Žilina		
Place	Žilina, Slovakia		
PhD. programme	telecommunications		
Supervisor	Ing. Daniel Benedikovic, PhD. Department of multimedia and information-communication technology		
Co-supervisor	Ing. Jozef Dubovan, PhD. Department of multimedia and information-communication technology		
Study form	Internal		
Study duration	3 years (internal form)		
Study language	Slovak, English		
Start date	1.9.2026		
Research domain	Fiber-optics, Measurements, Metrology, Automation, Communications		
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Dissertation topic abstract

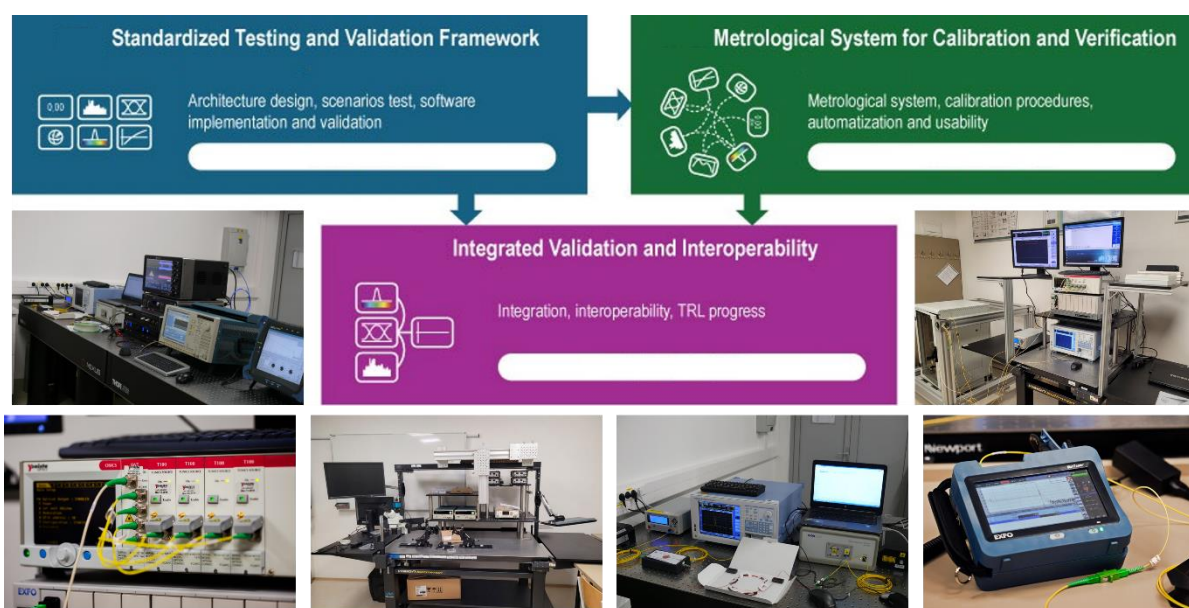
The dissertation topic focuses on the design and implementation of intelligent fiber-optic measurement systems supporting the concept of Industry 5.0, with emphasis on automation, adaptability, and the integration of artificial intelligence. The objective is to establish an advanced laboratory environment enabling automated testing of optical devices, analysis of degradation mechanisms and reliability of optical components, and performance evaluation of optical communication systems. The research concentrates on the development of measurement methodologies, calibration procedures, and data-driven algorithms for predictive diagnostics and parameter optimization. The expected outcome is the establishment of standardized, industry-oriented testing processes for next-generation optical communication systems.

Extended information, research responsibilities and tasks of PhD. candidate

The dissertation topic addresses a fundamental technological challenge of contemporary high-speed optical systems: the increasing complexity of devices and the inefficiency of traditional measurement procedures. With the deployment of networks operating at data rates of 400 Gbit/s, 800 Gbit/s, and prospectively 1.6 Tbit/s, the requirements for accuracy, repeatability, and speed of optical component characterization are rising dramatically. Modern transceivers, coherent modules, optical amplifiers, and photonic integrated circuits rely on advanced technologies, which significantly increase measurement sensitivity to errors and environmental influences. Conventional manual testing procedures are time-consuming, operator-dependent, and difficult to scale for both research and industrial applications. Moreover, they do not enable efficient monitoring of degradation mechanisms and long-term device reliability. A transition toward intelligent fiber-optic measurement systems integrating automated test sequences, adaptive offline/online control, and advanced data analytics supported by artificial intelligence is essential. Addressing this challenge will create a standardized and digitally controlled testing environment for next-generation communication systems in line with the Industry 5.0 concept.

The research objective is to establish an advanced laboratory environment enabling automated testing of optical devices, analysis of degradation effects, and comprehensive performance evaluation of high-speed optical communication systems. The work will focus on developing measurement methodologies for parameters such as insertion loss, dispersion, polarization, to name a few, as well as calibration procedures ensuring metrological traceability and

reproducibility of results. Data-driven algorithms for predictive diagnostics, anomaly detection, and optimization of testing sequences are foreseen to be implemented.



The PhD candidate will be responsible for the design and realization of experimental setups, manual validation of reference measurements, and their subsequent transformation into automated testing scenarios using scripting and control platforms. Key tasks include optimization of measurement processes in terms of efficiency, accuracy, and robustness; development of software tools for measurement control and large-scale data processing; and execution of long-term reliability testing under laboratory conditions. Close collaboration with industrial partners is expected in defining test scenarios, validating procedures, and transferring developed methodologies into practical applications.

Candidate profile

Required qualifications:

Education and professional background

- Master's degree (Ing./MSc.) in Telecommunications, Optics, Applied Physics, or a related technical field
- Knowledge of optical fibers and optical communication systems
- Familiarity with measurement methods and laboratory procedures is an advantage

Technical and practical skills

- Experience with experimental laboratory work and the development of testing setups
- Programming skills (Python, MATLAB, LabVIEW, or other environments) for automation and processing
- Ability to operate measurement and laboratory equipment
- Experience with data analytics, AI tools, and large-scale data processing is an advantage

Research and personal attributes

- Analytical and systematic thinking, with the ability to work independently as well as in a team environment
- Interest in applied research with relevance to industrial practice
- Ability to communicate scientific results effectively (publications, conferences, patents)
- Willingness to collaborate with industrial partners to develop laboratory infrastructure
- Proficiency in English (written and spoken)

This topic is suitable for highly motivated candidates interested in integrating optical technologies, metrology, automation, and intelligent data processing within the context of modern optical communication systems.

The intended PhD. topic is supported by the project KEGA 008ŽU-4/2025, and by dedicated contract research and industry-funded activities.

The PhD. topic is open only for internal form of study realized in Slovak or English language.