Transilvania University of Brașov
INTERDISCIPLINARY DOCTORAL SCHOOL

**ADMISSION TO DOCTORAL STUDIES** **Session September 2026**

**Field of doctoral studies: Automotive Engineering**
**Doctoral supervisor: Prof. Duguleana Mihai**

# TOPICS FOR THE ADMISSION TO DOCTORAL STUDIES

**TOPIC 1: Hybrid quantum-classical platform for mobility, perception, and digital trust in connected and autonomous vehicles**

**Contents / Main aspects to be considered** –

The development of connected and autonomous vehicles introduces highly complex optimization and decision problems: dynamic routing, fleet coordination, electric-vehicle charging scheduling, multi-sensor data fusion, and trust management for V2X data exchange. In parallel, recent results in quantum computing and quantum-inspired methods show that relevant classes of automotive problems can be reformulated as QUBO/Ising models and addressed through hybrid quantum-classical architectures suitable for NISQ platforms and for integration with AI algorithms, simulators, and automotive digital twins.

This research proposes the development of a hybrid quantum-classical platform, capable of:

- Formulating relevant automotive-engineering problems - routing, ride-pooling, EV charging scheduling, perception-resource allocation, and traffic-task prioritization - as QUBO/Ising models, while comparing QAOA, VQE, quantum annealing, and classical metaheuristic solutions;
- Integrating AI modules for environment perception and object detection, using video cameras, vehicular sensors, and real or simulated datasets to support decision-making in ADAS and CAV scenarios;
- Using traffic simulators, digital twins, and XR/VR environments for the safe validation of algorithms in smart intersections, vehicle-infrastructure cooperation, and fleet-management scenarios;
- Analyzing security and trust mechanisms for automotive data, including attack-resilient exchange, traceability, and compatibility with blockchain or post-quantum paradigms for connected ecosystems;
- Evaluating the proposed solutions rigorously in terms of computation time, solution quality, energy consumption, scalability, and industrial feasibility.

The innovation lies in connecting the doctoral supervisor's established directions - AI for automotive applications, smartphone-based ADAS, visual perception, XR/VR, and intelligent connected systems - with the emerging niche of quantum algorithms for mobility. The topic is inherently interdisciplinary and enables both theoretical and experimental results in decision optimization, assisted perception, and safe, efficient, and trustworthy mobility architectures.

**Recommended bibliography:**

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[Voinea, 2020] Voinea, G.-D., Postelnicu, C. C., Duguleana, M., Mogan, G.-L., & Socianu, R. (2020). Driving Performance and Technology Acceptance Evaluation in Real Traffic of a Smartphone-Based Driver Assistance System. International Journal of Environmental Research and Public Health, 17(19), 7098. https://doi.org/10.3390/ijerph17197098

[Girbacia, 2019] Girbacia, F., & Duguleana, M. (2019). Virtual and augmented reality in automotive design and maintenance: course notes. Editura Universitatii Transilvania din Brasov. ISBN 978-606-19-1124-0.

[Boboc, 2020] Boboc, R. G., Girbacia, F., & Butila, E. V. (2020). The Application of Augmented Reality in the Automotive Industry: A Systematic Literature Review. Applied Sciences, 10(12), 4259. https://doi.org/10.3390/app10124259

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[Stollenwerk, 2024] Stollenwerk, T., Bhattacharya, S., Cattelan, M., Ciani, A., Compostella, G., Headley, D., et al. (2024). Q(AI)^2: Quantum Artificial Intelligence for the Automotive Industry. KI - Kunstliche Intelligenz, 38, 351-359. https://doi.org/10.1007/s13218-024-00862-9

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[Khalid, 2025] Khalid, U., Paracha, U. I., Rizvi, S. M. A., & Shin, H. (2025). Quantum Computing for Intelligent Transportation Systems: VQE-Based Traffic Routing and EV Charging Scheduling. Mathematics, 13(17), 2761. https://doi.org/10.3390/math13172761

[Liu, 2025] Liu, P., Parkinson, S., & Best, K. (2025). Quantum and Quantum-Inspired Optimisation in Transport and Logistics: A Systematic Review. Smart Cities, 8(6), 206. https://doi.org/10.3390/smartcities8060206

**Prerequisites / Remarks:** *to be adapted/ completed/ deleted*

☒ **Scientific Doctorate**

☐ **Professional Doctorate**

☐ **without tuition fee (state budget funded)**

☐ **with tuition fee or with funding from other sources than the state budget**

**Doctoral supervisor,**
Prof. Dr. Duguleana Mihai
Signature

**Coordinator of the field of doctoral studies,**
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Signature