

Road User Assistance

1 Introduction to the Work Package

The Work Package 'Road User Assistance' focuses on advancing the application of Artificial Intelligence (AI) to improve road safety. Within the framework of the Marie Skłodowska-Curie Industrial Doctoral Network, five doctoral candidates (DCs) are conducting complementary research that spans behavioural modelling, sensor-based detection, and data-driven assistance systems. Their work collectively aims to understand, predict, and mitigate risky driving behaviours through AI-based analytics, supporting the development of safer, adaptive, and human-centered driver assistance systems.

2 Literature Insights: State of the Art and Research Gaps

The collective literature review activities across the five doctoral projects reveal a dynamic research landscape in the application of AI for road safety. The state of the art includes data-driven behavioural modelling, telematics-based risk profiling, video-based behaviour detection, and physiological signal analysis for monitoring driver states. Traditional research has often focused on reactive safety—detecting errors, violations, or crash precursors—while largely overlooking adaptive and undisturbed driving behaviour. The doctoral work redefines safety through a continuous spectrum perspective (Safety-II), emphasizing the importance of learning from successful, safe performance as well as from failures.

In smartphone-based telematics, existing studies rely heavily on labelled data and fixed device orientations, limiting scalability. Recent advances by the DCs have introduced self-supervised and orientation-invariant frameworks, addressing real-world deployment challenges. In computer vision, lane-change detection from dashcam videos has evolved from manual annotation-based methods toward automated, explainable algorithms capable of identifying rare cut-in and cut-out events automatically. In the domain of physiological sensing, current gaps include privacy-preserving data collection and robust multimodal fusion of signals such as ECG and PPG for drowsiness detection. Moreover, research on distraction and fatigue in automated driving contexts has identified a need for proactive, fairness-aware AI models that can detect early precursors of risky behaviour. Together, these findings highlight a paradigm shift from reactive detection to proactive prevention, where AI supports anticipatory safety interventions.

3 Scientific Outputs and Publications

During the first reporting period, the doctoral candidates have actively contributed to the dissemination of their research through conference presentations and journal submissions. Key outputs include papers under review or accepted in leading international venues, demonstrating strong engagement with both academic and industrial communities.

Doctoral Candidate	Publication
DC4 – Shi Qiu	TRANSCODE conference 2025: 'Lane Change Detection of Surrounding Vehicles in Dashcam Videos: A Synthesis of Methods and Challenges for Future Research' (accepted, to appear in Transportation Research Procedia).
	Draft paper on novel algorithm under preparation for submission to a top-tier journal.
DC5 – Ajay Iyer	Transport Research Arena (TRA) 2026, Budapest: 'Drowsiness Dynamics: AI-Driven Approach Unveiling Drowsiness Patterns and Risks Across Automation' (under review).
	Transportation Research Symposium (TRS) 2025, Rotterdam: 'Driver Distraction Analysis: A Big-Data Analytics Approach Using Naturalistic Driving Data'.
DC6 – Mohammad Pashaee	Transport Research Arena (TRA) 2026, Budapest: 'Speed Adaptation Patterns: A Safety-II Perspective on Naturalistic Driving Data' (abstract accepted; final paper submitted).
	Transportation Research Symposium (TRS) 2025, Rotterdam: Co-author presentation on 'Driver Distraction Detection: An AI-Powered Approach Using Naturalistic Driving Data'.
DC7 – Aristotelis Tsoutsanis	hEART 2025 Symposium, Munich: 'Classifying Vehicle Cornering Behavior Using Mobile Sensor Data'.
	ICTR 2025, Thessaloniki: 'Identifying Dangerous Street Segments Using Telematics and Crash Data'.
	AI for Road Safety Workshop (NTUA, 2025): 'Data Fusion of Traffic Behaviour and Infrastructure for Holistic Driver Assistance'.
DC14 – Aristotelis Styaniadis	IEEE International Conference on Intelligent Transportation Systems (ITSC) 2025: 'Impact of Missing Inter-Beat Intervals on Heart Rate Variability Features and Driver Drowsiness Detection' (accepted).
	Presentations: BMW Summer School 2025, Saint-Raphaël, and NRSO Workshop 2025, Athens.

4 Next Steps and Ongoing Research

In the next project phase, the doctoral candidates will focus on scaling their methods and validating them across diverse datasets, platforms, and real-world environments. Key objectives include:

- Expanding the continuous safety model to incorporate multimodal behavioural indicators and contextual variables.
- Enhancing smartphone-based frameworks with broader sensing capabilities and testing in industrial pilot studies.
- Refining video-based lane change detection algorithms and benchmarking across datasets.
- Developing multimodal deep learning architectures that integrate physiological, behavioural, and contextual data for robust drowsiness detection.
- Advancing fairness-aware and privacy-preserving AI frameworks that ensure equitable performance across driver demographics.

Through these efforts, the Work Package will contribute to the creation of intelligent driver assistance systems capable of proactively reducing crash risks and improving road safety outcomes. The interdisciplinary collaboration among academic and industrial partners will continue to strengthen the integration of AI-driven innovation into practical mobility solutions.