ROADVIEW

Robust Automated Driving in Extreme Weather

Issue 2/February 2024

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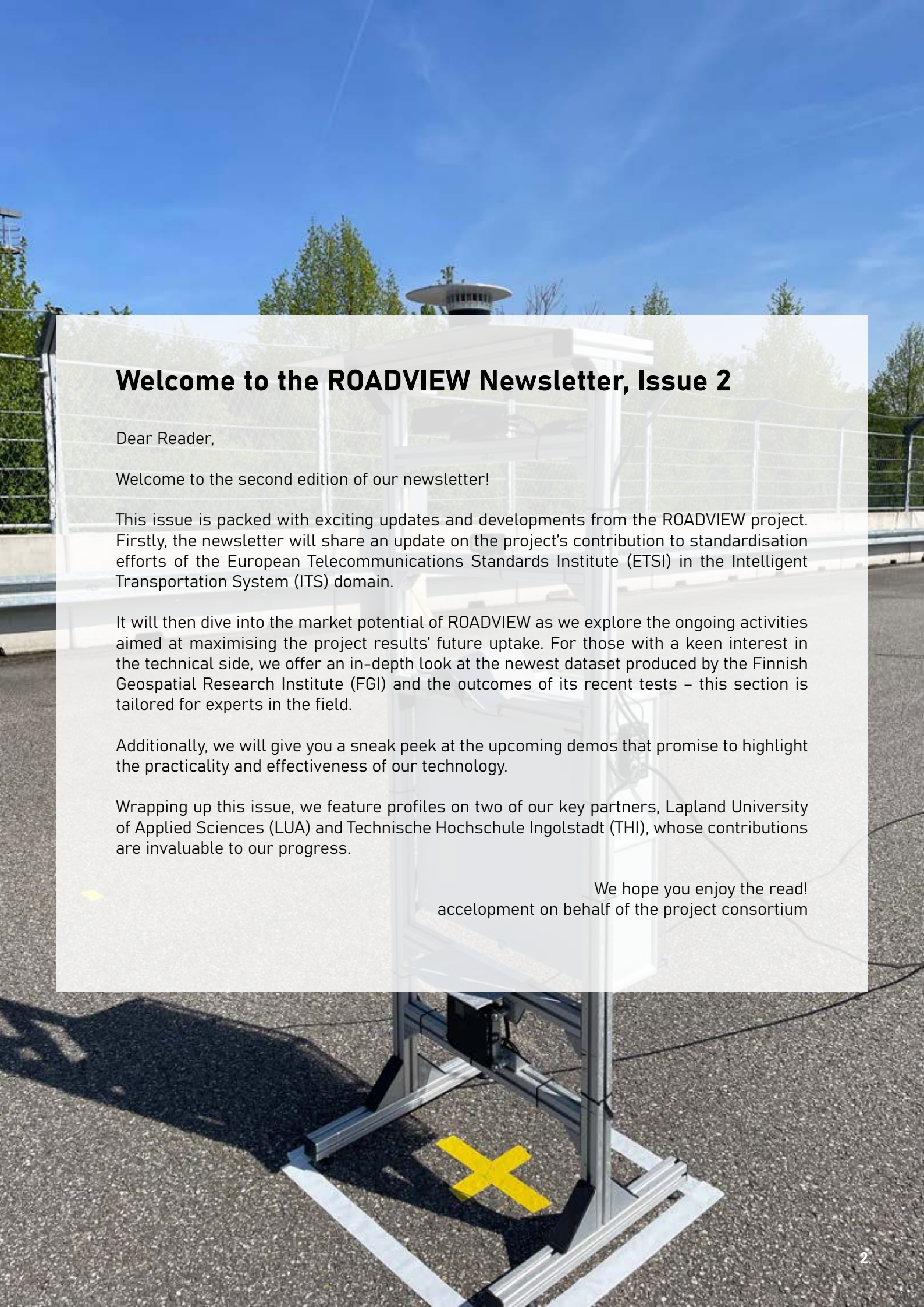


Welcome to the ROADVIEW Newsletter, Issue 2

Dear Reader,

Welcome to the second edition of our newsletter!

This issue is packed with exciting updates and developments from the ROADVIEW project. Firstly, the newsletter will share an update on the project's contribution to standardisation efforts of the European Telecommunications Standards Institute (ETSI) in the Intelligent Transportation System (ITS) domain.

It will then dive into the market potential of ROADVIEW as we explore the ongoing activities aimed at maximising the project results' future uptake. For those with a keen interest in the technical side, we offer an in-depth look at the newest dataset produced by the Finnish Geospatial Research Institute (FGI) and the outcomes of its recent tests – this section is tailored for experts in the field.

Additionally, we will give you a sneak peek at the upcoming demos that promise to highlight the practicality and effectiveness of our technology.

Wrapping up this issue, we feature profiles on two of our key partners, Lapland University of Applied Sciences (LUA) and Technische Hochschule Ingolstadt (THI), whose contributions are invaluable to our progress.

We hope you enjoy the read!
accelopment on behalf of the project consortium

ETSI ITS Standardisation: ROADVIEW's Contribution

The world of autonomous driving is evolving rapidly, and with it, the need for robust, standardised communication systems for automated vehicles has become more crucial than ever. The ROADVIEW project is contributing to the standardisation efforts of the European Telecommunications Standards Institute (ETSI) in the Intelligent Transportation System (ITS) domain, specifically focusing V2X communication between autonomous vehicles and infrastructure-based decision-making systems.

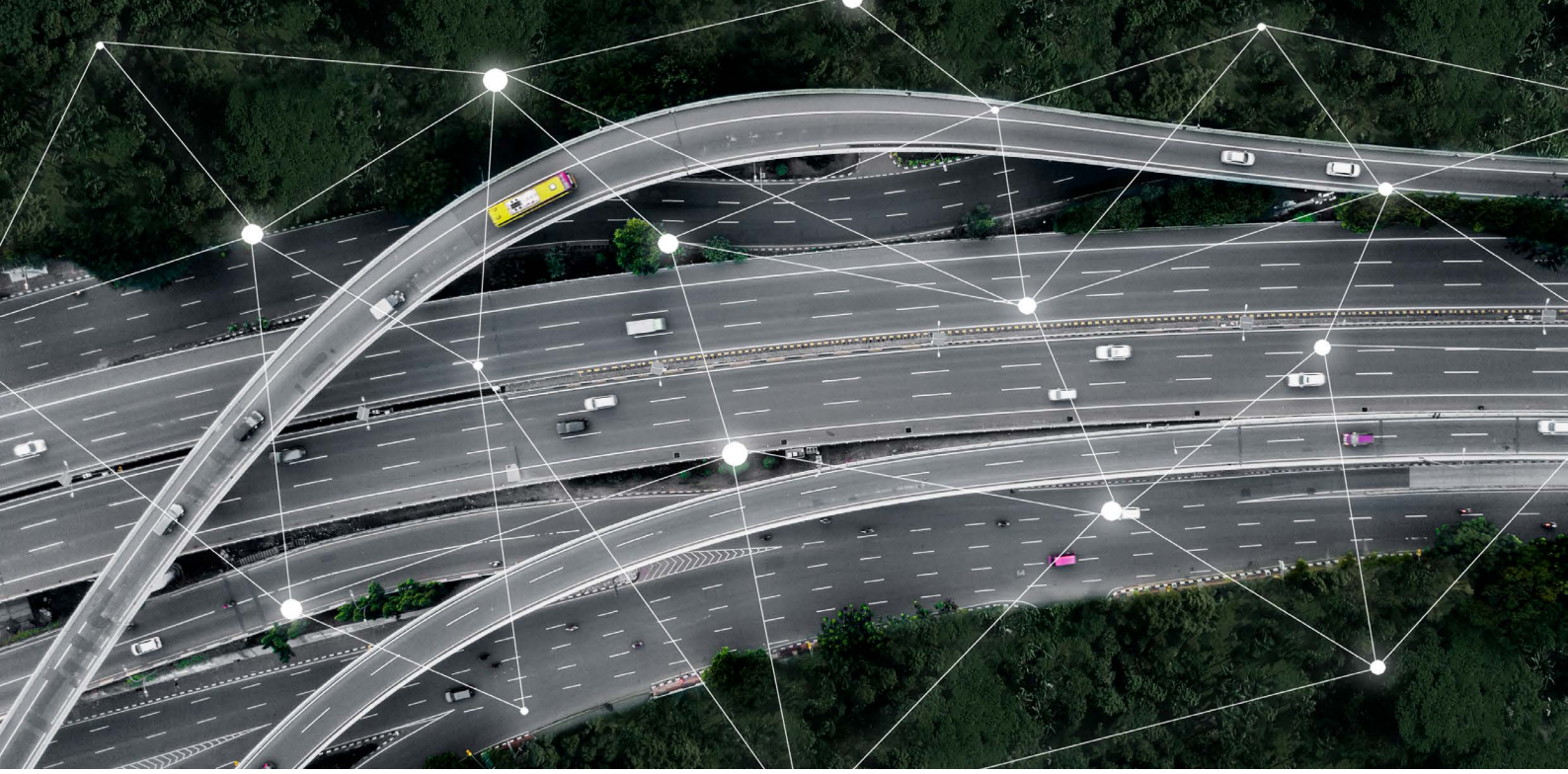
Figure 1. Example of V2X infrastructure.

What is V2X Communication?

V2X communication (See Fig. 1) is a cornerstone technology in cooperative, connected and automated mobility, as it enables the exchange of information between vehicles, infrastructure, and other road users. In case of harsh weather conditions, this communication is vital for enhancing road safety and traffic efficiency of automated vehicles, as it provides real-time information about road conditions, the surrounding environment and potential risks ahead of the vehicles.

ETSI ITS Standardisation

ETSI is an independent, non-profit organisation that develops globally applicable standards for Information and Communication Technologies (ICT), including fixed, mobile, radio, converged, broadcast, and internet technologies. Their role in ITS standardisation is pivotal, particularly in the context of autonomous driving. By standardising V2X message formats, ETSI aims to ensure interoperability among various manufacturers and systems, which is critical for its reliability and effectiveness.



ROADVIEW's Contribution to Standardisation

The Canon Research Centre France (CRF) and VTT Technical Research Centre of Finland (VTT) have recently presented the ROADVIEW use-case to ETSI ITS technical committee. This use-case focuses on autonomous driving in challenging weather conditions, with a particular focus on slippery roads. Such conditions pose significant risks, and the standardisation of communication protocols is vital for ensuring the safety and reliability of autonomous vehicles in these scenarios. The ambitious goal of ROADVIEW is to demonstrate its use-case within the ITS Manoeuvre Coordination Service, showcasing how standardised V2X communication between autonomous vehicles and infrastructure-based decision-making systems can significantly enhance safety and efficiency, especially in adverse weather conditions. This initiative is not just about technological advancement but also about setting a precedent in Europe for future developments in autonomous driving.

Meet the main contributors

Isabelle Morvan
Research Engineer at Canon Research Centre France

Mikko Tarkiainen
Senior Scientist at VTT Technical Research Centre of Finland

It is All About Impact: ROADVIEW Market Potential

In the rapidly evolving world of technology, the ROADVIEW project stands at the forefront of technological innovation, with the goal of creating long-lasting change in the field of autonomous driving. In the past couple of months, ROADVIEW has made progress in both commercial and non-commercial uses of its research. ROADVIEW partners FORD OTOSAN (FORD), Halmstad University (HH) and accelopment Schweiz AG (accelCH) have joined forces to bring the innovation potential of the project to a higher level. Let's delve together into what has been done so far.

Assessing Innovation Potential

A critical aspect of ROADVIEW's journey to market success is encapsulated in understanding the innovation potential of the proposed technologies. Under the lead of FORD and with the input of the whole project consortium, project partners have assessed the technologies and processes developed throughout the first 18 months of the project, focussing on various aspects of innovation, such as, amongst others, the level of innovation, technology and market maturity, and ownership as well as the societal impact and its alignment with the UN Sustainable Development goals. All the information gathered was compiled into the "Innovation Review Report", which was used as the foundational tool for understanding and maximising the project's innovation capacity.

Exploitation Stakeholders

Once potential innovations were identified and assessed, an ecosystem analysis was performed to identify key stakeholders who stand to benefit significantly from ROADVIEW's technological advancements. The target groups identified include the scientific community, to foster further research into AV technologies; the European automotive industry, to encourage the development and deployment of products and services based on the proposed innovations; and policymakers, to create a harmonised approach to automated driving policy and standards, as well as to raise public awareness and support about the project.

Scientific Community

The main interests of this group lay in the project's knowledge, follow-up projects and new publications.

Automotive Industry

The main interests of the industry lay in the project's IP and in the ambition of bringing new technology to the market.

Policymakers

The main interests of this group lay in the policy-oriented recommandations and guidelines for AVs.

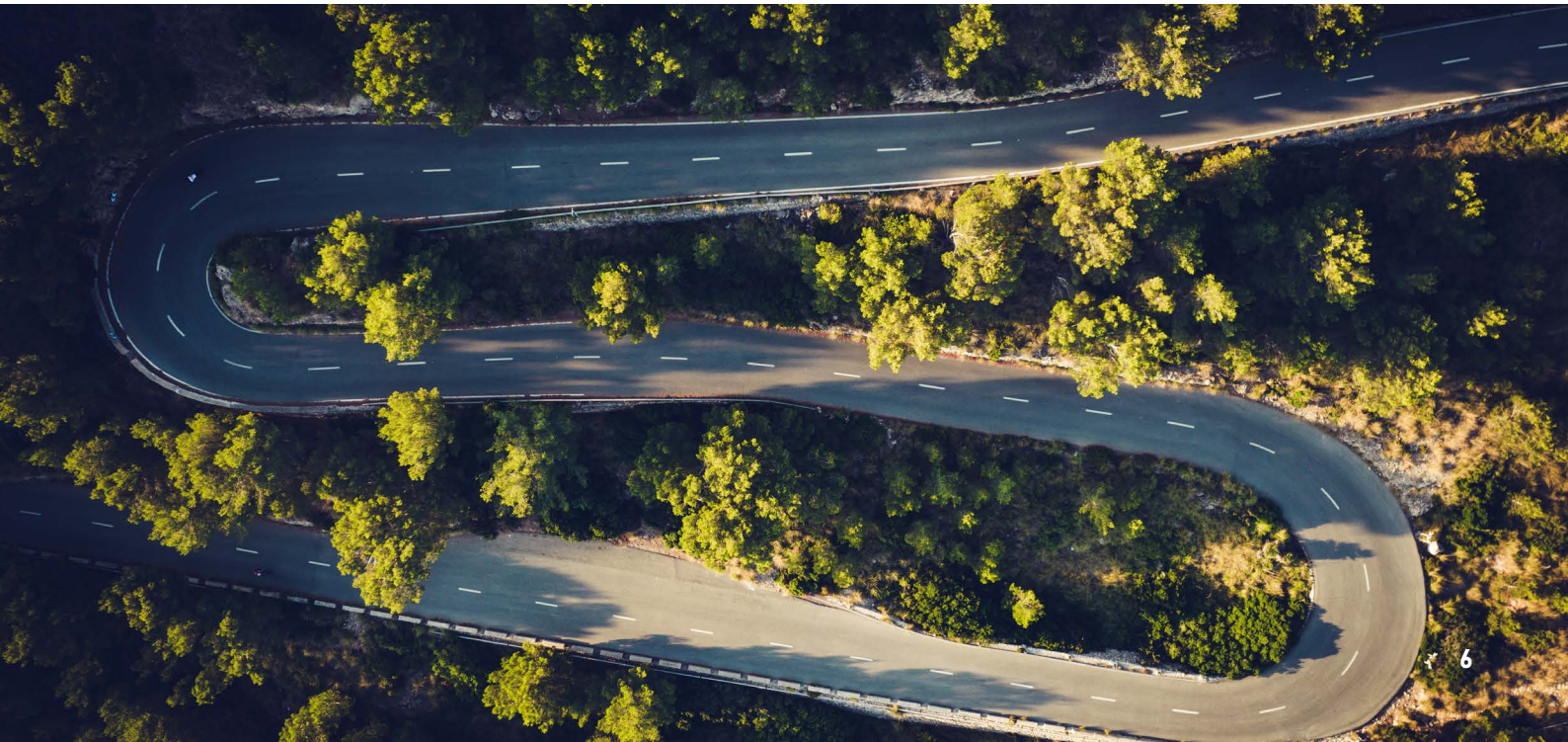
The Initial Roadmap for Exploitation

A critical document in the project's exploitation trajectory was the development of the Initial Roadmap for Exploitation. Led by HH and accelCH, this roadmap outlines state-of-the-art measures for both the commercial and non-commercial use of ROADVIEW's results. It provides a timeline and outlines key measures for exploiting the project's outputs during its 4-year lifespan and beyond. The roadmap is a living document, evolving with the project's findings and it is expected to be updated throughout the project's lifetime.

Figure 2. VTT's autonomous vehicle as part of the ROADVIEW project.

What are the Next Steps for Exploitation?

The ROADVIEW project, through its meticulous planning and innovative approaches, is poised to make a significant impact in the field of autonomous driving. Its commitment to understanding and maximising market potential ensures that the project results can benefit a wide array of stakeholders, paving the way for technological advancements in the European automated vehicle industry. As next steps, guided by FORD, HH, and accelCH, ROADVIEW will consistently assess and monitor new innovations. This process will be detailed in both interim and final Innovation Review Reports and the Roadmaps for Exploitation. The Innovation Review Reports will capture all ROADVIEW innovations as the project evolves, while the Roadmaps will ensure ongoing updates and adaptations to meet the evolving needs of exploitation.



A New Multimodal Dataset for Road Slipperiness Prediction

Technical read!

Most datasets from sensors used for perceiving the environment on public roads, such as cameras, LiDAR, and RADAR, come with labelled object data. However, they often miss detailed information on weather conditions like fog, rain, snow, or slush. This information is vital for understanding how adverse weather conditions can affect the accuracy of onboard sensors in detecting objects and obstacles. For this reason, the Finnish Geospatial Research Institute (FGI), as part of its activity within the ROADVIEW project, has been working on the collection of data and the development of a new dataset, taking into consideration all weather conditions.

Figure 3. Autonomous driving research platform ARVO.

The proposed dataset consists of 32 hours (1314 kilometres) of RGB camera images (Basler ace), thermal images (Flir ADK), LiDAR range and reflectance data (Velodyne VLS-128), and road weather sensor data (Vaisala MD30). All data from different sensor modalities were overlaid pixel-wise on the RGB camera images, allowing for experiments on multimodal computer vision methods. The dataset was collected and processed by Researcher Jyri Maanpää with the help of the Autonomous Mapping and Driving group (AMAD) at FGI, utilising the autonomous research vehicle observatory (ARVO, see Fig. 3). The dataset includes several adverse road and weather conditions, such as rain, snowfall, snow-covered roads.

From Data Collection to Real-world Experiments

Once the dataset was collected, the Research Assistant Julius Pesonen from FGI performed initial experiments on dense road slipperiness prediction as part of his Master's thesis, titled "Pixelwise Road Surface Slipperiness Estimation for Autonomous Driving with Weakly Supervised Learning" In Julius's experiments, the road weather sensor measurements were projected on the corresponding road points in the RGB camera images with 3D projection and accurate GNSS trajectory. This allowed for the creation of a weakly labelled training dataset for road slipperiness prediction (Fig. 4).

Figure 4. An example frame from the collected dataset. On top, there is an RGB camera image with the overlaid road weather sensor data, where darker colour means a higher grip, at the centre there is a fused thermal camera image, and at the bottom, the LiDAR reflectance data is overlaid on the RGB camera image.

A U-Net model, an advanced tool to accurately identify and map out road elements and obstacles by analysing images, and enhancing the vehicle's navigation capabilities, was also fitted to forecast road grip measurements based on RGB camera images, allowing for the prediction of grip values on the entire road area by generating a dense 'slipperiness map'. However, the dense grip predictions could only be examined

qualitatively as dense reference data from the road is difficult to collect. Initial experiments using thermal camera data for grip prediction were also conducted, but no significant accuracy improvements were observed as the models are still under development.

The U-Net model based on RGB images accurately predicted the conditions of dry asphalt roads with a grip value of approximately 0.8, and roads covered with snow with a grip value of approximately 0.4 in the road weather sensor measurements. These were the main road conditions included in the dataset, accounting for roughly 75% of the data. As there were fewer grip measurements on other road conditions in the training dataset, the accuracy of other grip value predictions was relatively inaccurate. The overall accuracy of the model on the test dataset is 0.083 as the standard deviation of the grip is 0.197 in the complete test dataset.

Some example slipperiness outputs generated by the model are shown below. The road grip values are accurately predicted in dry asphalt conditions and snowy conditions, the most prevalent conditions in the dataset. The grip predictions mostly follow the snowy areas of the road. Future work will concentrate on improving the slipperiness prediction accuracy within other conditions and improving the validation of dense grip predictions (Fig. 5).

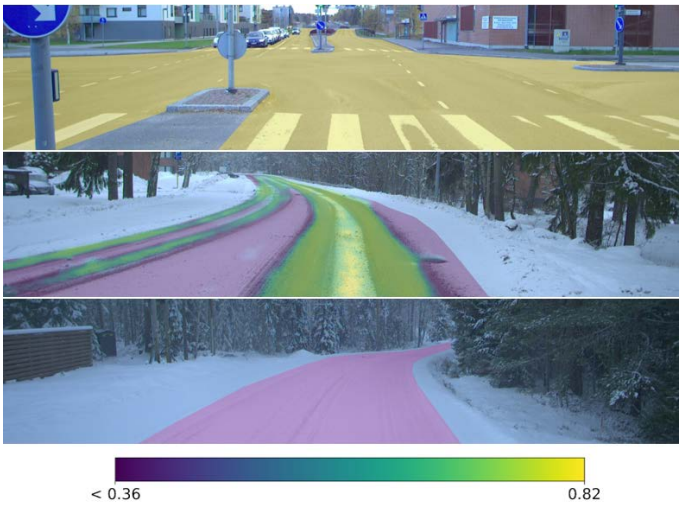


Figure 5. Examples of road grip prediction. The colour indicates the grip values overlaid on camera images. We observe that the model detects well-dry asphalt and snowy conditions, and the prediction mostly follows the boundaries between clean and snowy areas.

ROADVIEW Demos: The Pathway Towards Technological Success

After 18 months of hard work and commitment, the ROADVIEW team is on the verge of an exciting milestone: integrating the project's software and technology into actual components and vehicles. This step has the ambition to showcase the effectiveness of ROADVIEW's solutions for autonomous driving, especially under harsh weather conditions. Starting in August 2024, a total of five demos will take place across various locations in Europe, proving ROADVIEW's innovative contributions to autonomous driving. The demos are especially crucial as they test and demonstrate the viability of the decision-making systems and infrastructure-based functionalities, the core of ROADVIEW technology.

The first demo is expected to take place in August 2024 in Turkey. Led by FORD OTOSAN (FORD) and utilising vehicles from Finnish Geospatial Research Institute (FGI), VTT Technical Research Centre of Finland (VTT), and FORD itself, the demo will demonstrate early versions of components designed to enhance data logging and filtering, quality assessment, system perception, and its control and decision-making ability in harsh weather conditions.

A second demo will occur between June 2025 and February 2026 in Lapland. Led by VTT and using its autonomous car, the demo will validate the ROADVIEW system and how it works together to understand its surroundings, accurately recognise the weather conditions, and share its location using detailed maps, while making decisions based on the weather conditions.

In October 2025, two more demos will be launched. Demo 3, led by the Technische Hochschule Ingolstadt (THI) in its facilities in Germany, will demonstrate the integrated perception system together with the noise models for challenging weather conditions in the X-in-the-loop environment, a controlled setup that simulates real-world conditions. In this demo, THI's BMW 8 (See Fig. 6) vehicle will navigate freely on an empty test track while the surroundings are simulated, meticulously evaluating the system's performance under diverse weather conditions.

Figure 6. THI's vehicle for Demo 3.

Demo 4, led by FORD in Turkey, will showcase the automated driving of an SAE Level 4 trailer-mounted truck, a highly automated vehicle that can perform all driving tasks without human intervention, in extreme weather conditions on a Turkish highway. This demonstration will highlight the system's adaptability in handling various scenarios such as lane keeping, following, overtaking, merging, and exiting, incorporating innovative technology from the ROADVIEW project.

Demo 5, under AVL Software and Functions GmbH (AVL)'s leadership, marks the culmination of the ROADVIEW project. Scheduled for August 2026, this final demonstration will integrate all ROADVIEW components, showcasing a highly automated passenger car navigating a defined urban driving scenario on a test track in Germany. The vehicle will adeptly handle urban traffic scenarios with the inclusion of pedestrian and cyclist dummies, emphasising its advanced capabilities. The demonstration, conducted in real or artificially emulated severe weather conditions, will spotlight the integration of weather-aware decision-making and advanced perception modules into the AVL AD Platform.

As ROADVIEW propels into its next phase, the project marks a significant stride towards shaping the future of autonomous driving. Each DEMO will underscore ROADVIEW's commitment to advancing the field of automated driving across Europe while providing a platform to promote the project's technology and its further uptake.

Meet the Partners:
Lapland LUA

LAPIN AMK
Lapland University of Applied Sciences

Lapland University of Applied Sciences (LUA) is a multidisciplinary higher education institution, with campuses in three different locations across Northern Finland: Rovaniemi, Kemi, and Tornio. Enjoying an annual turnover of approximately 43 million Euros, the institution excels in research, development and innovation, dedicating around 10 million Euros yearly to these ventures. With a dedicated staff of 400 in teaching and research, Lapland UAS is a thriving academic community.

Click on the image to hear from Tuomas Herranen talking about the LUAS and its role within the project.

Offering both bachelor's and master's degrees, Lapland UAS is home to a vibrant student body of 5,200, spanning diverse educational fields. Its pivotal role in regional development is marked by significant contributions to education, research, and innovation. This excellence has been recognised with a quality award from the Finnish Higher Education Evaluation Council (FINHEEC), as well as the prestigious Best Regional Universities award from the Europe Business Assembly (EBA) in 2014.

At the forefront of Finnish universities of applied sciences, Lapland UAS's strategic focus areas include Global Arctic Responsibility, Sustainable Tourism, and Future Services and Reachability. Annually, it counts approximately 160 projects, with a notable 25% being international projects. With over 25 years of experience in coordinating international EU projects, Lapland UAS has been a key player in numerous international funding programmes and networks, including Horizon Europe, Horizon 2020, Interreg, Erasmus and others.

Notably, the FrostBit Software Lab is one of the main RDI units of Lapland UAS. Established in 1999 as the first Finnish virtual reality programming laboratory, the major R&D focus of the FrostBit lab is on entertaining & educational games, simulations, extended reality, web and mobile computing and complex data systems. FrostBit's team consists of software engineers, and visual artists specialised in 3D modelling, graphic design, UI and UX design, web developers and communications.

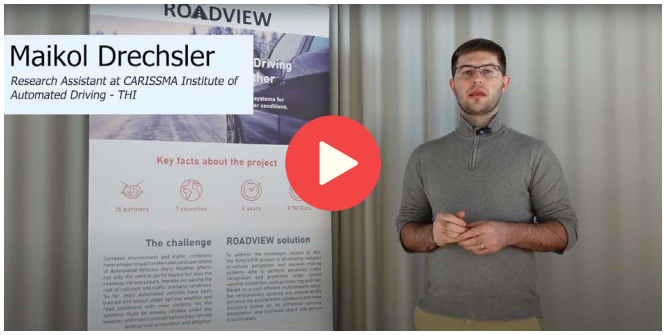
Meet the team

Tuomas Herranen
Specialist at the FrostBit Software Lab

Jarkko Piippo
Specialist at the FrostBit Software Lab

Meet the Partners:
THI

Technische Hochschule Ingolstadt



Click on the image to hear from Maikol Drechsler talking about THI and its role within the project.

The Technische Hochschule Ingolstadt (THI), located in the heart of Bavaria, Germany, is a dynamic and innovative institution that specialises in technical and business education. Established in 1994, THI has rapidly developed a reputation for excellence in applied sciences and technology. In 2022, the University counted 7,500 students, and 880 employees, with a turnover of €71 million, of which €29 million was dedicated to R&D activities. With a strong emphasis on practical and industry-oriented learning, the university offers a wide range of undergraduate and postgraduate programmes in fields such as engineering, computer science, and business administration. The university's close ties with more than 330 leading companies and industries in the region not only enhance the practical relevance of its academic programs but also offer valuable networking and career opportunities for its students. THI prides itself on its modern facilities, including state-of-the-art laboratories and research centres, which provide students with hands-on experience and opportunities to engage in cutting-edge research.

Amongst these, the CARISSMA Institute of Automated Driving (C-IAD) focuses its research on the development, testing and validation of automated driving functions. Under the 'Vision Zero' initiative, the goal is to enhance road safety. This strategy aims to eliminate all traffic fatalities and severe injuries. It also focuses on promoting safe, healthy, and equitable mobility for all road users. CARISSMA's role in this context is centred on preventing accidents. This involves a focus on active vehicle safety and its key influencing factors: human, vehicle, and environment. For this very reason, the institute is intensively involved in virtual and real driving tests as well as research into human factors such as trust, acceptance, ethics and the evaluation of the user experience (usability) surrounding automated driving. C-IAD is closely networked with the THI-based research centre for artificial intelligence and machine learning (AININ - Artificial Intelligence Network Ingolstadt).

Meet the team

Maikol Drechsler
Research Fellow at the CARISSMA Institute

Yuri Poledna
Research Assistant at the CARISSMA Institute

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