

A white Siemens Simrod electric race car is shown on a gravel track. The car is a three-wheeled open-cockpit vehicle with black racing seats and a roll-over protection structure. It features the Siemens logo and 'Ingenuity for life' slogan on its side. The background shows a clear blue sky and some distant structures.

# SIEMENS

*Ingenuity for life*

## The shift of the automotive power towards the research and development cannot be done without state-of-the-art digitization tools

When the Slovak University of Technology (STU) received an electric roadster Simrod for rent at the end of last year, it was a relatively ordinary vehicle that required a driver for its operation. In about half a year, the same Simrod drove Andrej Doležal, a Minister of Transport and Construction of the Slovak Republic, at the Slovakia Ring completely autonomously, i.e. without any intervention from the driver or operator.

Simrod demo electric vehicle was provided to the Faculty of Mechanical Engineering by the Siemens' Digital Industries division that cooperates with selected partners from academic and private sector on research and development projects in various industries to demonstrate the important role that SimCenter software plays in design and development today. For Siemens, the project of integration of autonomous technologies into an electric vehicle submitted by STU also had the same goal.

The team led by Ľuboš Magdolen has extensive experience in research and development in the field of automotive industry, including electric vehicles. It has cooperated with partners from

automotive industry in Slovakia on various projects for a long time. "We started to focus on electromobility as the first in Central and Eastern Europe ten years ago when few people knew anything about this topic," Ľ. Magdolen explained one of the reasons why Slovaks gained the trust of the German concern.

Combining the company's portfolio of state-of-the-art software tools for digital design, simulation and product prototype testing with a team of automotive R&D academics seemed the perfect combination from the beginning. Not only in terms of the goals of Siemens and STU, which is constantly looking for opportunities to improve students' education, but also the entire Slovak economy which needs to shift towards activities with higher added value.

Today, Slovakia is a world power in the number of cars produced per thousand inhabitants. In recent years, however, there have been more intense voices drawing attention to the lack of research and development activities. The country's economy is too dependent on single industry which is currently

very notable when the demand for new cars has dropped significantly due to the pandemic.

### What does autonomy mean

Today, cars are an everyday part of our lives and, thus, few people are aware of their technical and constructional complexity. However, autonomy takes the complexity of cars to another level. A vehicle, that can drive on its own, needs a number of sensors, not only for localization but also for detection and determination of objects' position. It must also have technologies to identify the speed, acceleration and to orient the car to the cardinal points according to magnetic fields. All input data must be combined into one data stream and must be in a computer-processable format.

The second part of the technological equipment consists of so-called actuators, i.e. electronic control systems to control the engine, steering wheel or brakes and assistance services. The whole complex of technologies is controlled by the central brain – a computer with elements of artificial intelligence which determines how the car should behave and predicts what will happen.



Michal Dobrovič is Siemens Sales Executive dedicated for CEE region, representing portfolio Simcenter in direct sales business.

In order to promote Simcenter in highly developing markets of CEE in R&D area, he brought to light an idea together with Center of Excellence in Leuven, to make Siemens Simrod demonstrator with new and very wanted capability – Autonomous Driving.

The ideal case was to involve Technical University in Bratislava with the team of Ľuboš Magdolen, where besides delivering such co-developed capabilities with Siemens - project manager Matthieu Worm, they would also learn about newest state of the art processes and technology provided by Simcenter portfolio and therefore spread the knowledge between students as well.

The secondary and more strategic milestone was, successful demonstration of the R&D results on Autonomous Simrod, with higher visibility in national media and public.

This success gave us an opportunity to raise the hand and be trusted partner for smart mobility in Slovakia and internationally in the region.

Resulting in featured national project of Engineering Center powered by Siemens technology, where we transfer the know-how, our technology and hand to hand mentoring efforts with local private, public companies and universities in order to support national targets of R&D capabilities in Slovakia and raising new engineering talents locally.



Michal Dobrovič, Sales Executive Simcenter – CEE

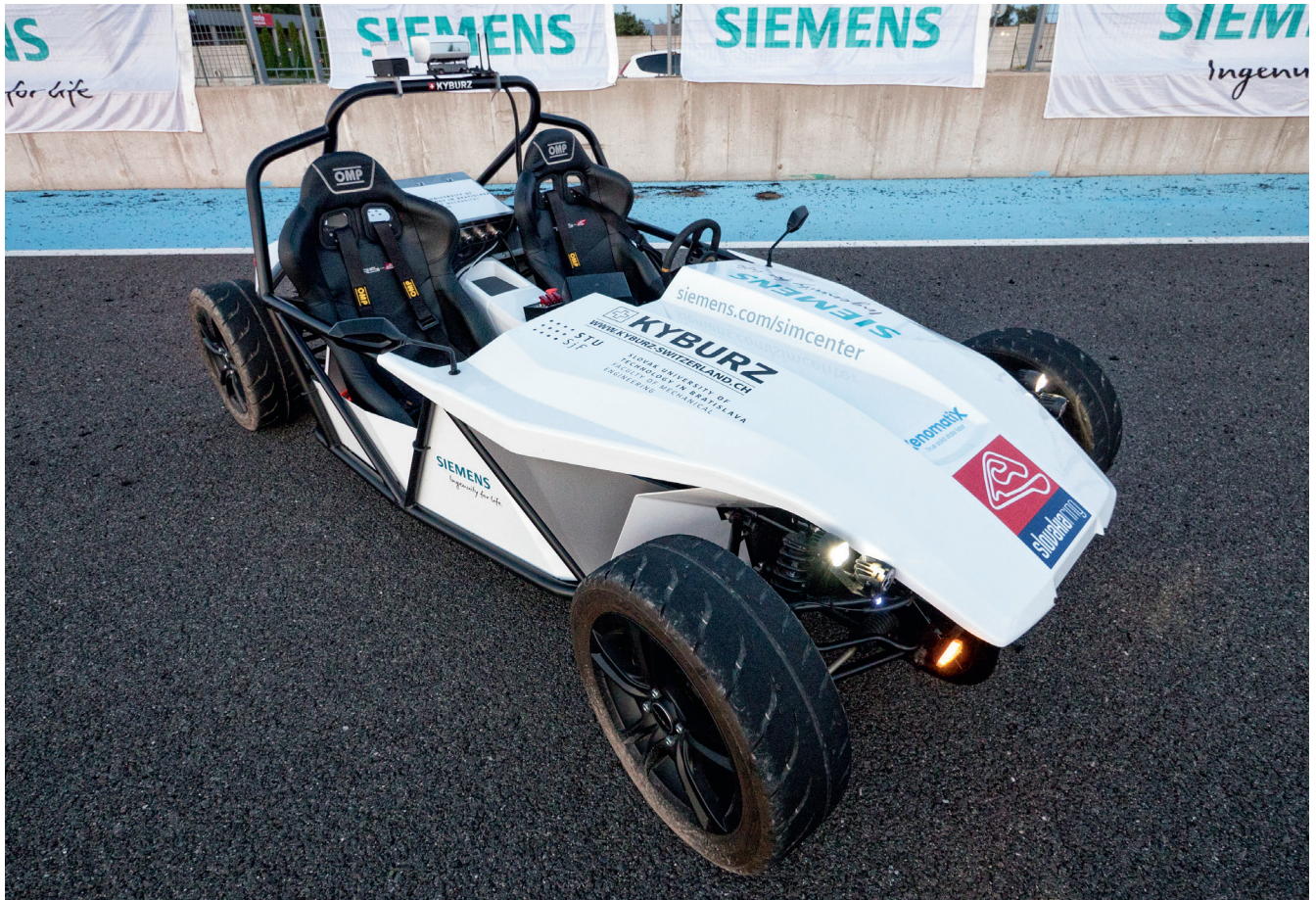
Therefore the STU team, although equipped with state-of-the-art software tools, did not have an easy task. Especially because they received the electric vehicle in last December and the original plan was to present the autonomous Simrod four months later at the big technology festival IXPO which was to take place in April in Bratislava.

#### No software

Before Christmas, the developers began to examine the individual components of the electric vehicle and get acquainted with the interfaces used, so that they could then create a concept and gradually integrate sensors







as well as autonomous technologies. SimCenter software tools have played a key role in the project from the beginning. Thanks to it, it is possible to simulate how the vehicle behaves in a virtual environment, for example, whether it has sufficient engine power and how effective the brakes are. The software also allows to simulate various forces acting on the vehicle, such as airflow, and to determine how vibrations, noise and other details develop while driving. Another SimCenter tool simulates the vehicle's behaviour in specific situations, such as skidding or cornering at higher speeds, in relation to tires.

A key advantage is the ability to test millions of different situations in a virtual environment, including slight differences in a seemingly identical scenario, for example with different speeds or different weather conditions. "You can play with endless variations of different situations which would not be possible without SimCenter software. This is especially important when developing autonomous systems that must be safe and cannot rely on an external operator or backup driver," Matthieu Worm, a director of Autonomous Vehicles, Simulation and Testing at Siemens' Digital Industries division, explained.

The STU team also created the entire track of the Slovakia Ring in the SimCenter software, and the team was able to drive on it virtually with Simrod, check the vehicle's reactions to obstacles, test various scenarios and fine-tune the settings of sensors and autonomous technologies. "Since we were adding new systems to the existing vehicle which had to work with the existing ones as a whole, we had to carry out many tests as well as virtual simulations. Digital tools allowed us to shorten and speed up a number of steps, since any technical change made in the virtual folder is much faster and cheaper than if it had to be done directly in the car," Ľ. Magdolen added.

The advantage of the SimCenter toolkit is that it covers the needs of development teams comprehensively, so there is no need to move from one development environment to another, or to interconnect applications from different vendors.

#### Successful debut

Naturally, the integration of autonomous technologies faced technical challenges. For example, developers struggled with the steering wheel control when they had to uninstall the electronic control from the vehicle in

order to find a way to communicate through a specific interface in the laboratory. During development, they had to solve vehicle stability problems in dynamic modes, for example, the car skidded in autonomous mode during testing and went off-track (into the run-out area) due to a deviation in the setting of performance parameters after a 180-degree turn on the track. Fortunately, everything went well without any material damage or personal injuries.

The whole development process was also complicated by the spring coronavirus pandemic which delayed some phases and due to which the IXPO technology festival, where the autonomous Simrod was to be premiered, did not finally take place.

It was finally demonstrated on the Slovak racing ring Slovakia Ring at the beginning of July where, with the participation of the media, it safely transported the Minister of Transport and Construction of the Slovak Republic and several personalities of Slovak industry and academic community.

In cooperation with Siemens, the team of the Faculty of Mechanical Engineering, STU (also employees of the Faculty of Civil Engineering, STU, and the Faculty of Informatics and Infor-





Development team, Slovak University of Technology

mation Technologies, STU, participated in the project), demonstrated that Slovakia has all the prerequisites for cutting-edge research and development, including skilled people able to use the latest software technologies for digitization and creating so-called digital twins.

Therefore, the successful project of integration of autonomous technologies resulted in a joint initiative of the Faculty of Mechanical Engineering, STU, Siemens, Mobility & Innovation and Slovakia Ring Agency; these companies want to cooperate on research and development of intelligent autonomous vehicles, alternative drives and progressive vehicle designs in Slovakia. They confirmed their intention during the demonstration of the autonomous Simrod with the ceremonial signing of a Memorandum of Cooperation in which they declare the goal to build a joint modern research and development workplace for smart mobility with transnational importance.

Vladimír Slezák, a CEO of Siemens Slovakia, reminded that the cooperation in the development of an autonomous vehicle and the effort to create a development centre for intelligent autonomous technologies respond to

the more urgent needs of Slovakia. "We need to move from industrial production to economic activities with higher added value and, at the same time, be able to not only provide quality education to young people but also ensure that they do not go abroad," he said.

Siemens representatives believe that the initiative also inspires the creation of new companies or more intensive activities of existing companies which can use state-of-the-art tools for simulation and creation of digital twins in the field of research and development to significantly accelerate and streamline R&D activities.

#### BRIEF SUMMARY

##### Background and challenges

Siemens is constantly looking for partners for joint R&D activities to support its research and development in various industries and to demonstrate the capabilities of its SimCenter software tools. On the other hand, the Faculty of Mechanical Engineering, STU, constantly strives to improve the quality of students' education and enable them to gain practical experience.

##### Solution

A joint project of Siemens and the Faculty of Mechanical Engineering, STU, for the integration of autonomous technologies into the Simrod demo electric vehicle using a state-of-the-art software solution for simulations and creation of SimCenter digital twins.

##### Benefits

Siemens has demonstrated the benefits of SimCenter software tools for the speed and efficiency of research and development activities in an attractive and up-to-date project. The Faculty of Mechanical Engineering, STU, enabled its students to work with advanced tools on a real project and to gain know-how useful for their future practice as well as for possible future cooperation of the university with industrial enterprises.

The successful cooperation resulted in an initiative to create a joint modern research and development workplace for smart mobility with transnational importance, to which other commercial entities also joined.