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MULTISENSOR SOFTWARE SOLUTIONS

A dSPACE COMPANY

AUTONOMOUS

Strengthening the AD Portfolio

Software tools from Intempora complement dSPACE solutions for data-driven development

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In July, dSPACE acquired Intempora, a pioneer in the area of real-time development software. The two companies already had a long-standing strategic partnership. Through the acquisition, dSPACE now offers a unique and reliable end-to-end solution as well as optimized support for innovative development projects. In this interview, Nicolas du Lac, CEO of Intempora, explains the history of the company and how this closer cooperation will bring a unique value.

Nicolas, 20 years ago Intempora was one of the first companies to develop software for sensor signal processing. I am sure that in the early days, no one talked about autonomous driving. How did your first developments come about? And how did your software evolve to meet the requirements of the automotive market?

The reason for founding Intempora in 2000 was the success of our core technology RTMaps, which was developed at the Center of Robotics of Mines ParisTech in 1998. At the time, a team under former Director Claude Laugeau was working on robotics and intelligent transport systems (ITS). The team participated in the Eureka Prometheus project, one of the very first EU-funded R&D projects focusing on automated driving. At the outset of the project, autonomous vehicles were considered robots. The project therefore focused on overcoming the challenges associated with mobile robotics: perception, positioning, control, capability to move fast,

safety requirements, interaction with humans, etc. Back then, Bruno Steux and Pierre Coulombeau, PhD students in Claude's team, aimed to develop computer vision algorithms and Bayesian-network-based data fusion for vehicle perception and accurate positioning. Their objective was to execute these algorithms in real time in a prototype vehicle equipped with a front camera, a front radar, and the very first models of lidar scanners. The pair soon realized they spent 90% of their time working on their software architecture rather than on the algorithms at the heart of their thesis. They needed a modular (component-based) environment to manage the different parts of their complex software, such as data acquisition from multiple vehicle sensors and data processing as well as visualization, recording, and playback features for offline work. Additionally, they decided to incorporate a time-stamping and data synchronization process to ensure smooth and coherent

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“The majority of our customers use RTMaps to develop algorithms for assisted and automated driving.”

sensor data fusion across the different streams and asynchronous data sources. Since no development tools on the market met their requirements, they developed their own software solution: RTMaps (Real-Time Multi-sensor applications). A few months later, another European project consortium, called CarSense, was actively looking for a data logging solution for numerous camera, radar, and lidar sensors on a vehicle. They tested RTMaps and found it worked great, inspiring Claude and Bruno to create a company based on the idea that such software could be useful for the automotive industry in the future.

What were some of Intempora's first milestones?

At the IEEE Intelligent Vehicle Symposium in Versailles in 2002, Ecole des Mines de Paris demonstrated an autonomous vehicle prototype, called LaRA, which used RTMaps as the on-board data processing software. The vehicle was driven on a track at more than 100 km/h with no hands on the wheel, using a single camera for lateral control and a Pentium II computer in the trunk. In 2004, one of Intempora's first customers, the LIVIC Laboratory presented a fully autonomous vehicle with similar capabilities, but with both lateral and longitudinal

control. A few years later, the Grand DARPA challenge in the US launched a worldwide race towards autonomous driving. RTMaps participated in the challenge alongside the DotMobil Team. RTMaps was also showcased on the SwRI vehicle at the ITS 2008 exhibition in New York. Today, we have customers around the world, some of which have been using our solutions for more than 15 years. Needless to say, our software has evolved and greatly improved since then.

You have observed developments in autonomous driving for quite some time now. What are the major challenges we have to overcome to get a self-driving car on the road?

When talking about self-driving cars, we have to distinguish between robotaxis and personal vehicles. The former are heavily equipped with sensors and computing resources, and evolve at quite a slow speed. Personal vehicles have to be affordable and follow a different maintenance schedule. We still have many challenges to overcome on the path to Level 5 autonomous (personal) vehicles for public roads that can be further developed at high speed. The main challenge is ensuring safety in all driving conditions and situations. Safety is a prerequisite to gain acceptance and for authorities to allow mass deployment. Achieving safety involves several technical challenges, including:

Sensor accuracy and efficiency in all conditions:

Sensors are continuously improving in resolution and range. We have to combine sensor technologies for an autonomous vehicle to properly handle diverse situations, including driving at night, in the fog, rain, snow, dirt, etc.

Mastering software complexity:

Autonomous vehicles are highly complex real-time systems and require complex software to process numerous high-bandwidth data streams. Multiple robust and efficient algo-



A Success Story: Navya Shuttles

To develop complex functions for autonomous driving, NAVYA, one of the leading suppliers of autonomous shuttles, relies on the multi-sensor development environment RTMaps. “We have accompanied the company since its foundation. The Navya team already consists of 250 employees, is still growing rapidly and already operates more than 150 vehicles worldwide,” says Nicolas du Lac. RTMaps is a tool that many developers use on a daily basis. “We are proud that we were able to make our contribution to this success story,” explains du Lac.

Nicolas du Lac is the CEO of Intempora.



gorithms and software tasks have to be executed in parallel, with safety constraints on execution timing, latency and error management.

Data management and algorithm validation:

Data is the virtual fuel of autonomous vehicles. To train, test, and validate perception and deep learning algorithms, engineers have to collect various large sensor data sets in different driving conditions. Data annotation, labeling, and management tools for data selection and postprocessing, as well as simulation tools, are critical for the development and validation of robust and safe systems.

Since the recent acquisition by dSPACE, our software engineers and consulting experts have been collaborating closely to bring reliable and efficient solutions to the market. We are definitely thinking about the next steps – we aim to deliver a unique software tool chain, from prototyping to production, to address all stages of the development process for autonomous driving, and we are bursting with ideas.

RTMaps is the core solution of Intempora. What makes this software so special and who is working with it? Can you briefly present an example project?

The majority of our customers use RTMaps to develop algorithms for assisted and automated driving, but some also use RTMaps in other applications and domains, including autonomous trains, robotics, offshore wind turbines, smart rearview mirrors, inspection robots, simulated driver and pilot behavior, mobile mapping systems, cognitive applications, and system and video monitoring for race sailing ships. The high versatility and performance of our solution is appreciated by many of our customers, with some of them considering RTMaps the real enabler for drastically speeding up their development pro-

cesses. Valeo uses RTMaps in R&D in different countries. We recently established a technology partnership with them to publish the Valeo Drive4U Locate algorithm in the RTMaps AI Store. Valeo Drive4U Locate is an affordable, precise, and robust localization and mapping solution developed by Valeo for automated driving. This proprietary SLAM enables centimeter-accuracy positioning in situations with limited or no GPS signal. This algorithm was developed with RTMaps and demonstrated in the streets of Paris with a Level 4 autonomous vehicle.

Complementary solutions to RTMaps include your new data annotation software, RTag, and the Intempora Validation Suite (IVS). What is the functionality of these two solutions?

RTag is an annotation software application for mobile devices. With RTag, it is easy to manually monitor in-vehicle data recorders and manually annotate recording sessions while driving to identify relevant scenarios. The Intempora Validation Suite (IVS) is a cloud-based software tool chain for training, testing, benchmarking, and validating ADAS and AD software functions, including perception and deep learning algorithms (designed with RTMaps, for instance) against large driving sensor data recordings stored in big data architectures (cloud or on-premise).

How does the cooperation with dSPACE influence your relationship with international customers?

The acquisition was very well received by our customers and partners around the world. It is definitely a new chapter in the history of our company. We will continue to work as we always did – delivering best-in-class software solutions to all of our users. Our Cooperation with dSPACE is going well, as we are already involved in

many strategic discussions. The acquisition boosts our ability to provide optimized support in customer projects.

How does the cooperation with dSPACE influence your relationship in terms of technology development?

Technologies are evolving fast, and we are continuously refining and developing our solutions to bring cutting-edge software to the market. We are working with dSPACE to offer a seamless and complete end-to-end tool chain. We are also working on new enhancements for IVS by integrating tools from understand.ai, another company in the dSPACE family. We continue to establish technology partnerships with semi-conductor companies such as NVIDIA, NXP, and Renesas, to better meet customer expectations. We are also working on our product roadmap with dSPACE consulting experts, which will define our strategic approach to future challenges.

Who can customers contact about your products?

The best way is to contact your regional dSPACE company and account manager. dSPACE has offices around the world, offering personal and optimized support in your native language.

Thank you for the interview.