

# Real-time **health tool** ensures **development projects** are under budget and on time

By: James Hilton

**Up to 100 critical event chains for driver assistance systems are contained in today's cars, and this number will increase by at least a factor of 10 as vehicles move towards autonomous driving.**

One of the biggest challenges for system developers and engineers is to assess the real-time behavior of their systems and networks in the face of increasing complexity. In response German company INCHRON has developed a set of methods and tools that help reduce the costs and ensure that deadlines are met in the development of the increasingly complex systems. The tools help developers to get rid of load limits and performance, deadline and response time violations. As an example they are used to optimize the coordination of sensor input (radar, camera, ultrasonic), the processing, and the actuator output (brake, steering, gear box) that forms the "brain" of a driver assistance system.

INCHRON supports system architects and engineers from the earliest stages of a design project. Using INCHRON tools it is possible to optimize individual subsystems, as well as manage an end to end event chain from the

INCHRON's tool suite includes the real time Simulator chronSIM as a design tool, the validator chronVAL as a worst case analysis tool for systems with an ASIL A to D classification as well as a visualization and analyzation tool for measuring trace, chronVIEW.

"In order to give engineers even better support," says Dr. Ralf Münzenberger, CEO and Co-Founder of INCHRON, "we have extended our tool suite to include an optimization tool. chronOPT."

As a partner in AUTOSAR, the INCHRON tool suite is designed to allow users to work efficiently with the AUTOSAR system model. "The huge benefit of working on one database for OEM, supplier and tool provider is the data consistency throughout the project and the fast turnaround times. Seemingly small changes of an

AUTOSAR configuration parameter often have dramatic consequences on the dynamic system behavior. This is a major disadvantage of abstract modelling the system architecture," says Ingo Houben, Business Development Manager at INCHRON.

"Without doubt an important driver of AUTOSAR is the integration of application software from different suppliers into a single ECU. Such collaboration project has very high technological and organizational risk to fail or at least a high risk exceeding the budget. Our tools and timing methodology help you to handle the integration with the necessary care and technical depth".

**Automotive Industries (AI) asked Münzenberger what particular challenges he sees in the autonomous driving area.**

**Münzenberger:** I would firstly like to mention a rise in technical complexity of ECUs in the last decade, which is exponentially increasing in the area of autonomous driving. Concepts such as multiple core CPUs, Ethernet, GPUs, hypervisors, and a growing array of sensors are not just technical buzz words, but are components which are being intensively deployed.

We are also seeing a very strong growth in organizational complexity. More and more third-party software from different suppliers must be integrated into one ECU. It is not unusual that the project partners have never worked together before. The increasing technical and organizational complexity generally leads to a high risk in the

**Dr. Ralf Münzenberger, CEO and Co-Founder of INCHRON. Real-time health is the key factor for success. Find out the health of your system with our Real-Time Health-Check.**



sensor to the actuator. Managing the flow of data (event chain) of the sensors via the different ECUs and busses (FlexRay, CAN, Ethernet, LIN) through to the actuators plays a central role in the functionality and safety of the driver assistance system. A wrong course of action within the event chain, a break of the data flow or a too long latency can lead to malfunctions. In other words, it leads to a bad real-time health.

What is needed, according to INCHRON, is to constantly monitor the real-time health of the embedded system. Companies such as Audi, BOSCH, Continental Automotive, Hella, Lear and TTTech have are using INCHRON tools for a number of years, both for the event chain analysis of individual ECUs and at the vehicle level. "Up to now we identified timing and performance problems only during series development. Next time we will do this systematically right from the start - already in the concept phase," said Bernhard Augustin, AUDI AG Driver Assistance Systems.

# THINK REAL-TIME



## CHRONOPT CHRONVAL CHRONSIM CHRONVIEW

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development phase, as we have seen in many customer projects. This often means that development costs rise well above the planned budget or can even lead to the cancelation of the project. We developed a Real-Time Health-Check guide to prepare our customers before the start of the development project to reduce this risk significantly.

**AI: What is the thinking behind the Real-Time Health-Checks?**

**Münzenberger:** The Real-Time Health-Check came out of our analysis of a large number of research and development projects. We have seen too many fail or run significantly over budget and deadline. Based on this experience we have developed the Real-Time Health-Check. With the help of 12 questions, I can find out whether my current development process will result in a real-time healthy embedded system. The check assigns a real-time health grading of high risk; medium risk; or excellent real-time health. Our real-time health check is online. Everyone is invited to make their own evaluation of their real time health ([real-time-doctors.com](http://real-time-doctors.com)).

**AI: What findings have you gained from the Real-Time Health-Checks?**

**Münzenberger:** The evaluation of the test clearly shows that without a systematic approach, 65% of the projects have major problems (high real-time health risk) and none fall in the green area of excellent real-time health. It looks different if our methods and tools are used systematically. A third of these projects is in the green area and therefore have excellent real-time health. The rest are in the acceptable range. Based on the results of Real-Time Health-Checks we define the necessary process steps together with customers to get into the green zone. It's amazing how much can be achieved with small steps. For example in autonomous driving the focus on event chains is a key for success.

**AI: In what other areas are event chains playing an important role?**

**Münzenberger:** Event chains play a central role in all automotive domains. You will find them in the central access system, engine control, the chassis area as well as in infotainment systems. Because of increasingly strong networking of the car with the environment (car2x) event chain analysis will increase significantly in importance. Our solutions are already used in all domains with resounding success. In other sectors such as automation, mobile or aerospace, our solutions are also being

successfully used. As different domains come together more and more industry boundaries are blurred the demand will increase sharply. With car2x we already see collaboration of automotive, mobile and big data in the IoT (internet of things). **AI: Can the tools from INCHRON only be used for an event chain analysis?**

**Münzenberger:** No, the application is significantly greater. The use of our methodology and tools leads to a robust system and software architecture, so that there will be no breakdowns in late stages of development. The tools avoid costly timing and performance errors and time-consuming redesigns. The verification of change request is done very quickly and efficiently, and identifies whether new functionality still can be integrated or not. If this is not possible out of the box, an architecture optimization with chronOPT can be performed automatically to fit in the new functionality.

**AI: At what development stage should a user start with the use of INCHRON tools?**

**Münzenberger:** As a rule of thumb, the sooner the better to save costs and time. However, there are also big benefits in the later stages of development, as we have demonstrated in numerous projects where we were called just before SOP to solve integration problems. It is best to start in the Requirement-Phase and to define the timing, performance and event-chain requirements. This is an important key to success, especially in complex systems and collaboration projects. Inexact requirements often cause wrong design decisions. A robust and extensible system and software architecture will be designed in the design phase. In the test phase deviations identified by our tools are often not found through traditional testing. Designing such complex architectures in a trial and error manner does not work anymore. **AI**

**Charting the "health" of an embedded system.**

