Digital Twins in practice with FERAL

How Digital Twins are transforming the automotive industry

Interview with Dr. Pablo Oliveira Antonino, Department Head Virtual Engineering at Fraunhofer IESE

The two IESE technologies, Eclipse BaSyx and FERAL, complement each other in the creation and application of Digital Twins: BaSyx provides a standardized description of physical objects that can be used for simulations with FERAL. Both solutions illustrate Fraunhofer IESE's expertise in the field of Digital Twins. In this interview, Dr. Pablo Oliveira Antonino explains the special features of FERAL and the benefits that customers gain from using the simulation framework.

What makes FERAL special?

FERAL is a versatile toolbox designed to create highly complex Digital Twins for a wide range of components, particularly within the automotive sector-covering both on-road and off-road applications. It supports the modeling of embedded electronics, ECUs, and in-vehicle communication systems like CAN, CAN XL, Lean, and FlexRay. Beyond Digital Twin creation, FERAL enables comprehensive simulation capabilities, allowing users to explore "what-if" scenarios. This helps predict the impact of various decisions and verify whether the system behaves as expected, ensuring informed decision-making and enhanced system reliability.

Can you give us an example of what can be simulated with FERAL?

Recently, we completed a project examining the impact of security vulnerabilities on vehicle safety. With modern vehicles connected to the internet, the risk of a hacker accessing a car's systems raises serious concerns. Imagine driving on the highway at 200 km/h when an attack suddenly compromises control systems, preventing you from stopping the vehicle – an extremely dangerous scenario. Using FERAL, we create Digital Twins of critical vehicle components, enabling us to test potential attack scenarios in a virtual environment to enhance vehicle safety.

Just last week, a company manager highlighted the value of FERAL, saying, "You've already saved us thousands of physical tests. FERAL not only brings thousands of scenarios into the virtual world with Digital Twins but also simulates and analyzes their potential outcomes for us." This capability underscores FERAL's role in advancing secure and resilient automotive systems.

What unique advantages does FERAL offer over other solutions?

The key lies in its customizability and vendor independence. Unlike commercial providers, we're not tied to specific tools or brands, which allows us a unique advantage: we can integrate solutions from various vendors. For instance, through a strategic partnership with the U.S. company ANSYS and its European partner CADFEM, we've developed a demonstrator that combines CARLA for 3D modeling, Matlab/Simulink for functional modeling, and several other technologies. Ultimately, FERAL enables high-precision simulations of various vehicle controllers and communication systems by integrating features from multiple tools, each precisely suited to the specific goals of each analysis.

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Dr. Pablo Oliveira Antonino
Department Head Virtual Engineering

Equally important, as scientists, we incorporate the latest research advancements into FERAL. This keeps our software adaptable to the evolving needs of our industrial clients and enables us to deliver precise, cutting-edge analyses that directly address today's complex challenges, like integrating such complex analysis into CI/CD pipelines.

What collaboration options are available for companies?

Here's how the process typically works: A customer approaches us with a specific requirement, such as assessing the impact of security on vehicle safety. We then tailor FERAL internally to meet these requirements, creating Digital Twin models and identifying the key elements to analyze. Following this, we deliver a comprehensive diagnosis and strategic recommendations to the customer. In this approach, the customer receives the final results but does not directly access FERAL.

Alternatively, customers can choose to use FERAL within their own infrastructure. Through a license model, FERAL becomes available for internal use, with the added benefit of development support included as part of the license.

We're also introducing a new option: "Digital Twin or Simulation as a Service." In this model, FERAL remains fully integrated into our IESE infrastructure, providing customers with remote access to FERAL without the need for installation within their own systems. This solution offers an efficient and convenient way for companies to leverage FERAL's capabilities.

In which companies is FERAL used?

FERAL is used, for example, in our long-standing collaboration with Robert Bosch. Since 2016, we have assisted Bosch in developing Digital Twins and simulating vehicle communication systems, including those for autonomous driving functions. Bosch integrated the FERAL Virtual Bus into their SiL Framework, which significantly improved their network verification process. This integration not only streamlined the simulation of network scenarios but also accelerated their time to market.

PODCAST TIP

Digital Twins – utilizing potential

Find out more about how the FERAL solution is used. (German version)