



Left: Xylon's logiRECORDER
Below: How the simulator and the real ECU are connected

Higher dimension

How to seamlessly exchange a soft ECU with its physical counterpart and use a software simulator to control the real ECU through a configurable box interface

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An unwritten rule across the automotive and many similar engineering sectors is... if you can simulate, then you should simulate! Simulations offer better controllability and faster checking of numerous traffic scenarios and are simply more economical than real-world testing and validation.

Although software simulations are invaluable engineering tools, there are simulation cases that inevitably require work with real hardware. Exchange of a soft ECU model used in software-in-the-loop (SIL) simulations with a hardware ECU stimulated and monitored from the software simulator in hardware-in-the-loop (HIL) simulations brings a new, higher dimension of realism and confidence to simulation results.

Joint development

Xylon, an expert in embedded electronics, and rFpro, an expert in driving simulation software, have teamed up to jointly explore different methods of connecting hardware ECUs to

simulation software. The result of this cooperation is a proven concept of a flexible interface that both companies can quickly and independently adapt for third-party ECUs and software simulators.

This interface has been verified within the driving simulation rig that connects rFpro's simulator with Xylon's Surround View ECU. This parking assistance ADAS was selected based on its highly visual nature being convenient for testing, and more significantly, based on its ability to cope with the challenging transfer of large amounts of video data.

The key component of the interface is Xylon's logiRECORDER Automotive HIL Video Logger, which works in the Smart I/O mode and converts simulation data into real automotive data and vice versa.

The ECU displays full 360° surroundings of the car by stitching together video inputs received from cameras placed on the car's front grid, at the rear and within the side-view mirrors. The car model and its surroundings can be seen from

different perspectives via a mouse-controlled virtual flying camera.

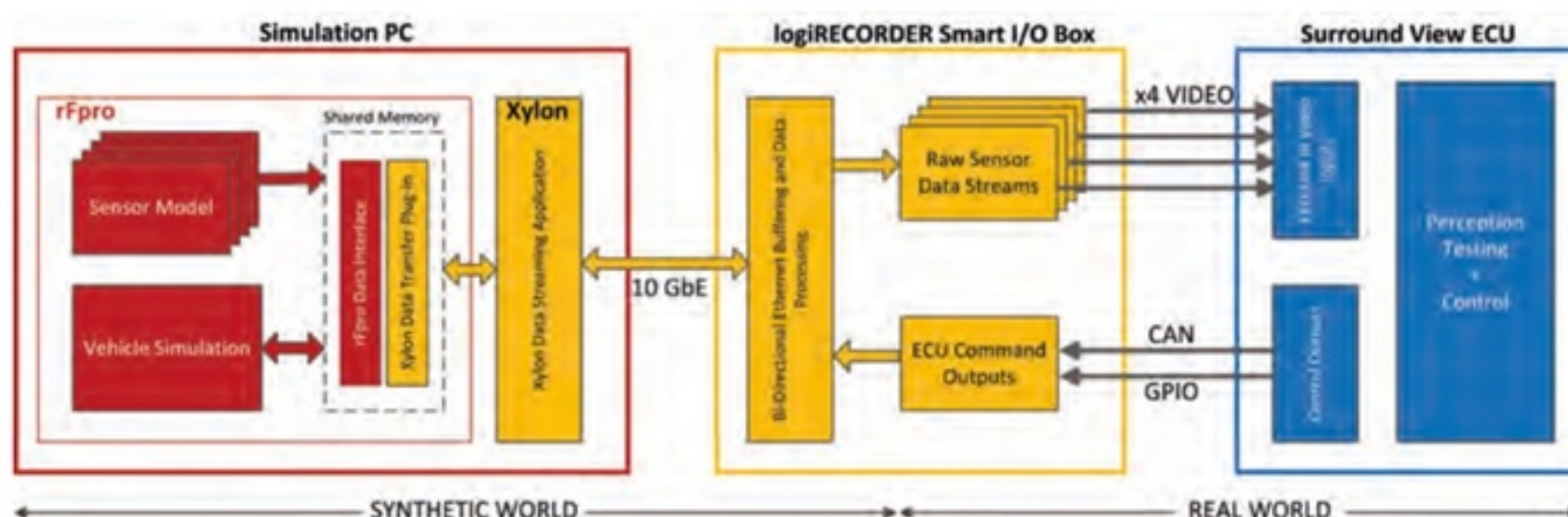
rFpro simulates the car model, its surroundings and four 1920x1080/30fps video cameras. Camera image generators convert native RGB888 pixels into common pixel formats, such as YUV420, and add a fish-eye lens distortion typical of optics in this type of ADAS application. The simulator uses GPU PC cards for pixel-level processing and can run across multiple stacked PCs to maximize performance.

rFpro's interface for externals is highly flexible, enabling easy interfacing with Xylon's adapted data transfer plug-in, which accepts simulated camera video streams and hands them over to the streaming application. This application reformats video into standard MIPI packets typically generated by real-world sensors. Each MIPI packet is time-stamped to ensure proper video data formatting and timings at the inputs of the physical ECU. Converted MIPI packets are transferred to the logiRECORDER via one of two available 10GbE HIL links.

The logiRECORDER de-encapsulates Ethernet packets, and based on encoded time stamps, converts synthetic videos to four native automotive interfaces. The box supports practically all serial interfaces for video and other high-bandwidth data transfers. The current demo integrates the FPD-Link III serial interface from Texas Instruments.

The surround view ECU receives raw sensory data through four video inputs regularly used for video camera connections, and fully unaware of the synthetic nature of its inputs, generates a surround view video of the simulated scene. Instead of working in a special diagnostics mode, the ECU runs production firmware. Full sensor fusion and perception testing can be achieved by using inputted raw data, together with a full checkup of all ECU functions. The surround view ECU can be changed for other ECU types.

The demo also integrates the loop-back feature. The ECU's responses connect back to the logiRECORDER through automotive interfaces, and it sends them back via Ethernet to the simulator. This turns the complete demo setup into a fully featured virtual test drive simulator, in that the simulator can adapt simulation scenarios based on the received responses from the ECU. ◀



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