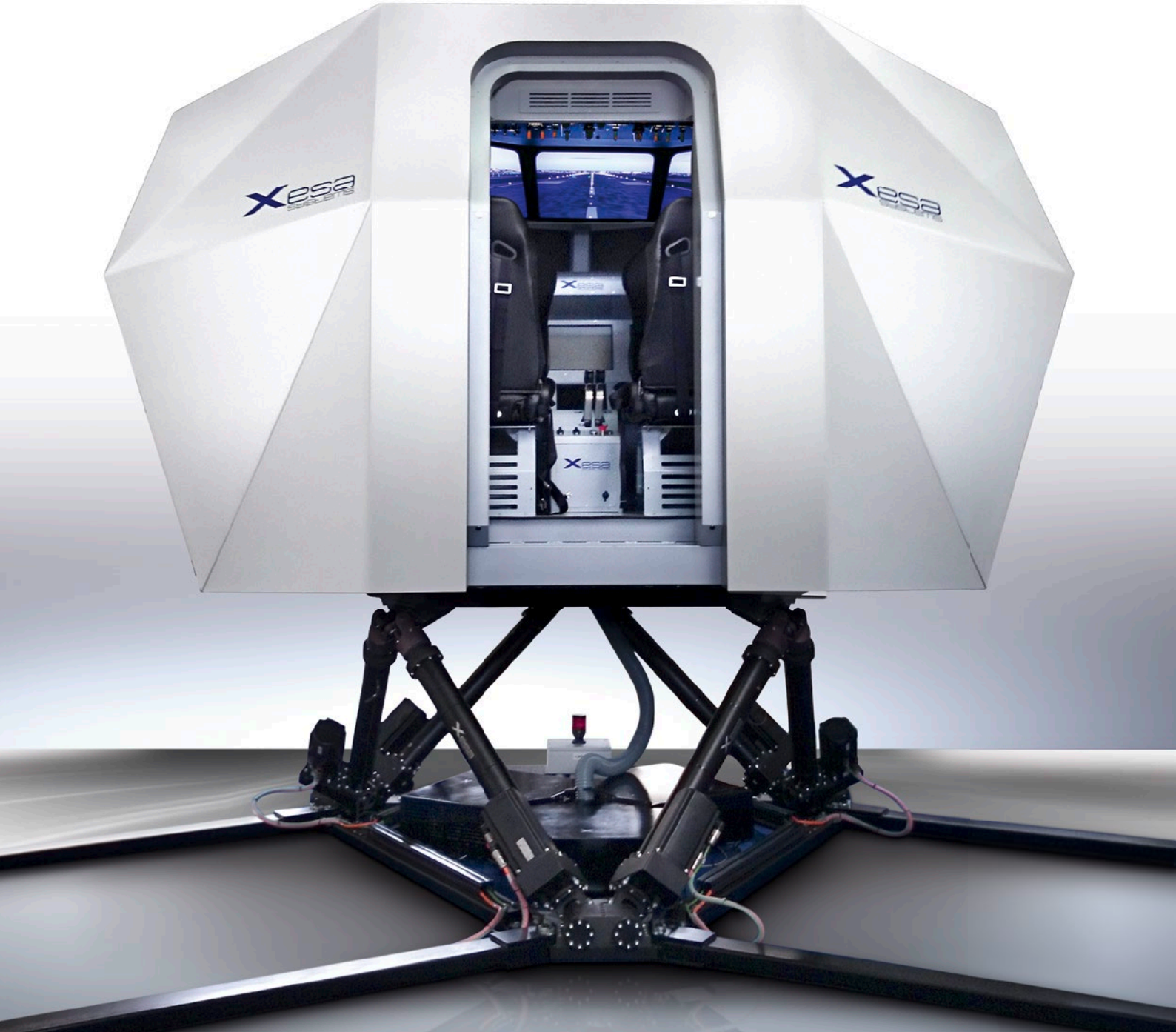
Full-motion simulator for ultra-realistic driving simulation

PC- and EtherCAT-based controller provides highly dynamic, precise axis control in advanced vehicle simulations

Modern driving simulators are capable of replicating the sensations of motion, such as in the cockpit of an aircraft, in a car, on a train or on the bridge of a ship. These simulations are so realistic that they are often indistinguishable from the actual driving or flying experience. Full-motion simulation systems are used, for example, in professional pilot training as well as in "edutainment" and entertainment applications. The Italian brand Xesa Systems owned by GIEI s.r.l. specializes in this market segment, leveraging automation products from Beckhoff to bring simulations to life.



The core of the Xesa motion simulator is a parallel kinematic machine built on a hexapod or Stewart platform. It has up to six degrees of freedom (three translatory and three rotary), enabling the generation of realistic motion sequences that are highly dynamic and accurately-positioned. The software produces a dynamically changing virtual environment that is in sync with real physical movements, completing the simulation. The physical drive of the motion platform is located at the lowest level of the system and uses linear or rotary actuators. Each axis is equipped with at least three sensors, and in some cases up to five. Feedback from these sensors – in conjunction with the feedback from an encoder mounted on the motor – enables absolutely precise movements to each of the individual positions. The axes are moved using Beckhoff AM8052 servomotors which are connected to AX5000 Servo Drives via One Cable Technology (OCT). A DIN rail mounted CX5020 Embedded PC serves as the central control platform.

The controller communicates with the drives after receiving data from the so-called washout filters (high-pass and low-pass software modules). This comes from the application software, where the simulation system and the inverse kinematics are located. After the physical model in the upper software layer has calculated the behavior of the system, and the inverse kinematics has performed the respective conversions, the information is transmitted to the automation system in the form of points where the simulator must drive to. This simulates a highly realistic driving experience for the driver.

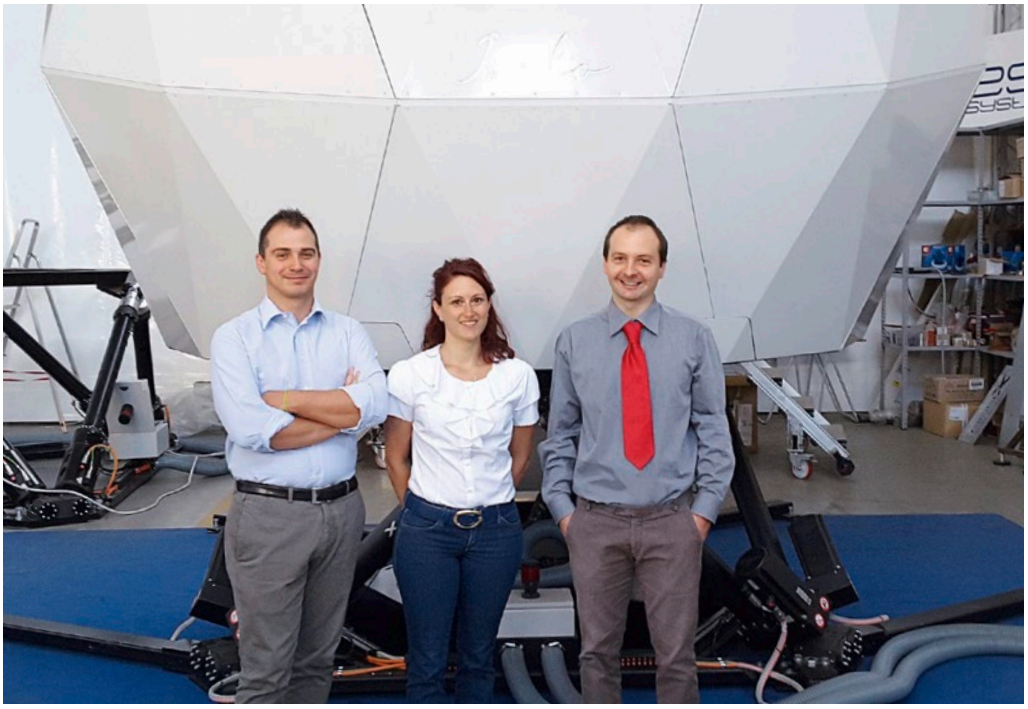
PC- and EtherCAT-based controller as a universal platform

"Xesa Systems and Beckhoff have collaborated closely for many years," explains Lorenzo Vicini, who is the engineering manager responsible for automation at Xesa Systems. "Our engineering successes certainly rely on the high degree of innovation offered by automation solutions from Beckhoff. One of the most substantial reasons why we chose a PC-based controller was that it enabled us to streamline our systems. We now only need a single CPU, TwinCAT as a universal software platform, and EtherCAT as the high-performance communication system for the entire application. Our software developers are far more flexible and gain a familiar, universal development environment with Visual Studio® embedded into TwinCAT 3. Additional benefits include the ability to link MATLAB®/Simulink® projects and the option to use C++ as a programming language. Further, the scalability of the Beckhoff components – from the PCs and drive components to the software – offers us a system with which we can create very precise controller designs that ideally fit the respective application."

"EtherCAT also plays an important role for us," continues Lorenzo Vicini. "On the basis of this fieldbus, we can achieve a controller accuracy that is higher than what is possible with any other system. A further advantage is the possibility of remote control as enabled by TwinCAT. We can fully access all devices: even if our simulator is located on the other side of the world, we can easily access it anytime via smartphone or tablet."

Controller-integrated safety solution

Xesa has also solved the issue of safety controllers in a simple manner with the integrated Beckhoff control architecture. The safety functions are implemented easily by adding safety option cards to the AX5000 drives. Even if safety requirements are not critical in the testing industry, extremely high precision is required. In order to connect the velocity and current controller to the AX5206 drive via the built-in encoder on the AM8052 servomotor, Xesa Systems uses a second external encoder to control the outer controller. "The performance that we achieve is impressive in this case, too," says Lorenzo Vicini. He emphasizes that: "With the integrated system from Beckhoff, we can achieve an individual axis precision of 10-5 m. Further advantages include the availability of a dual-axis drive and the OCT technology. This has made our machine designs and cabling much leaner. Connecting through OCT also allows us to start up one axis quickly and validate the system with the help of the TwinCAT NC PTP software library," concludes Lorenzo Vicini.



From right to left: Lorenzo Vicini, Engineering Manager for automation at Xesa Systems, Elena Briganti, Marketing Communications from Beckhoff Italy and Gabriele Vercesi, Area Sales Engineer from Beckhoff Italy.

Further information:

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