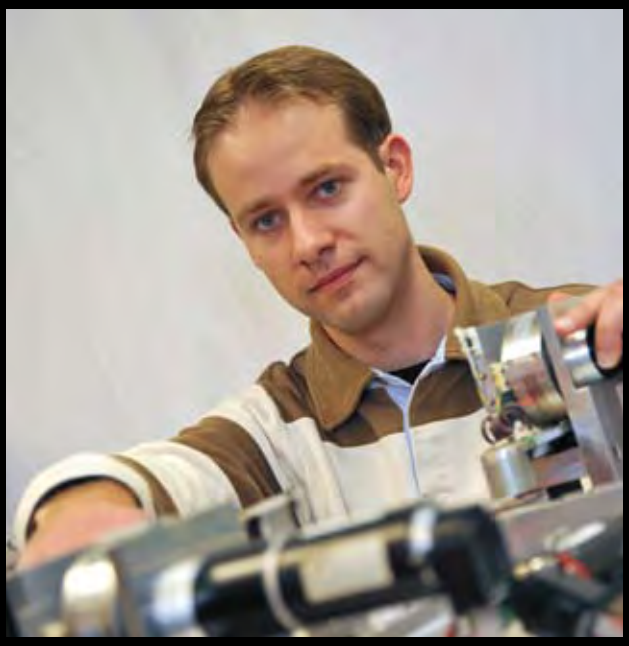
MAKING THE RIGHT CONNECTION FOR DEPENDABLE SYSTEMS



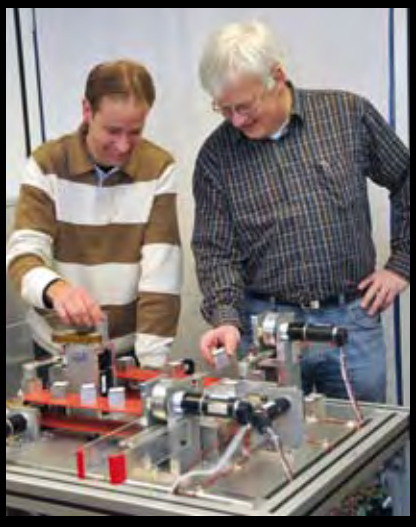
MARCEL GROOTHUIS

By definition, several disciplines are involved in the design, testing and construction of mechatronic devices and apparatus. In his PhD thesis project, Marcel Groothuis, MSc shows that model-driven design can shorten the time-to-market of new products. Conditions include adequate interconnection between software tools and the intensification of a suitable multidisciplinary approach.

Four disciplines are always involved in mechatronic design and testing processes: electronics, mechanics, software engineering and control engineering. "In most projects, the experts meet one another at the very beginning", Marcel Groothuis observes. "Too often, however, the collaboration stops and the experts go back into their own familiar routines until very late in the project."

INTEGRATION TESTS

Groothuis strongly believes that this situation causes many opportunities to be missed, deepens misunderstandings and causes unnecessary time-to-market delays. Especially for complex mechatronics, he advocates early "integration tests", supported by multidisciplinary computer simulation techniques that use a clever combination of existing software tools. "Software developers usually examine the potential success of their products by testing them on simple, standardized test benches", Groothuis explains. "We are exploring the advantages of using a combination of tools (for example AutoCad or SolidWorks interconnected with specialized dynamics-modelling and simulation tools, like 20-Sim) as a test bench for the software. These tools are used in the process of designing real complex systems, like robot arms."
The combination of tools should favour the co-simulation process, in which researchers are challenged to collaborate and show one another manifold simulation tests. Previous research at Océ Venlo showed that the usage of simulation tests and the interconnection of software tools could eliminate an entire step in the design of a new type of printer. This result is the reason that research is continuing within the Dependable Systems and Networks (DSN) research orientation in Twente, together with the renowned Embedded Systems Institute, situated at Eindhoven University of Technology.



EDUCATIONAL PROGRAMME

Groothuis continues, "Of course, the interconnection and adaptation of software tools require a considerable investment of time. On the other hand, it is possible to demonstrate the advantages of waiting longer before building prototypes in the process of designing complex products. In our educational programmes, we teach our students to act in this way. The results in the experiments we constructed have already shown very clear results."

SAFETY

Collaborating with colleagues from other technical backgrounds pays off, especially when complex safety issues are involved, according to DSN coordinator Dr Jan Broenink. "For example, a robot arm moves very quickly and, under some circumstances, in an abrupt, uncontrolled manner." Even in low-scale experimental set-ups, this can lead to dangerous situations for the people involved, as well as for the costly experimental set-up and its surroundings. The clever combination of software tools with mathematical techniques (derived from a specialized UT group on formal mathematics) can be beneficial in this situation as well. Broenink explains, "Mathematics adds to the development process, sometimes in a decisive manner. The introduction of disturbances into simulations can prevent damage to the actual set-up. In some cases, predicted disturbances are very unlikely to occur, in which case a calculated risk can be taken in building a prototype set-up."
According to Broenink, the complexity of control systems in everyday products, like cars, makes design approaches that use co-simulation even more attractive. "Control systems grow not only in numbers, as the systems themselves become interconnected in new ways. They should respond to each other flawlessly, all the time. Otherwise, the manufacturer is in big trouble."

RECYCLING SOFTWARE MODELS

The use of co-simulation is not limited to the design process of a single product, according to Marcel Groothuis. In many cases, parts of larger units are used – almost identically – in new series or in new variations of the same product. Groothuis elaborates, "Océ hopes to recycle models, experiments and their previous simulation outcomes in the production cycles of types that are yet to come. This would help to create a more manageable process, using only a limited number of prototypes. It also represents a learning curve for the company. At some point, however, it is better to go ahead and build a prototype scanner, for example, and use it to test new paper-handling mechanisms."