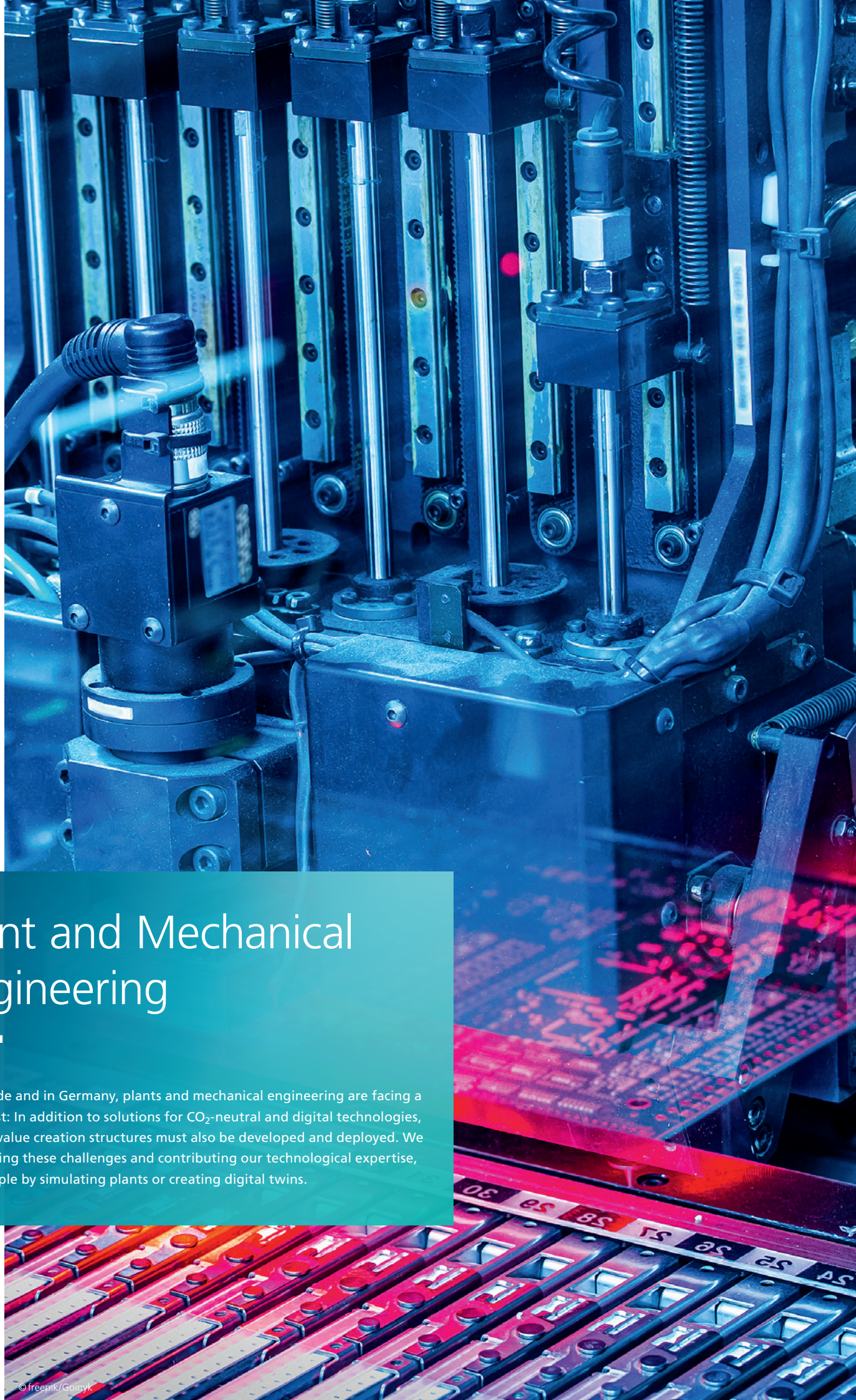
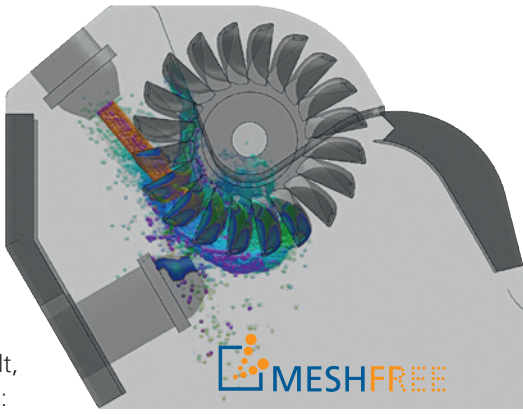


Plant and Mechanical Engineering

Worldwide and in Germany, plants and mechanical engineering are facing a major test: In addition to solutions for CO_2-neutral and digital technologies, resilient value creation structures must also be developed and deployed. We are meeting these challenges and contributing our technological expertise, for example by simulating plants or creating digital twins.

MESHFREE – Process Simulation to the Point



The simulation with MESHFREE shows the flow behavior and abrasion (wear) in a Pelton turbine.

How does water behave when a car drives through a puddle? How efficient is a water jet turbine? What happens during machining or during the filling of a beer glass? These are all complex questions to which there is an innovative ITWM answer in the field of simulations: MESHFREE.

The interdisciplinary team around Dr. Jörg Kuhnert and Dr. Isabel Michel now consists of seven members and is developing meshfree simulation as a key solution for a wide variety of application fields. Their MESHFREE software combines more than 15 years of expertise from the Fraunhofer Institutes ITWM and SCAI.

Simulating dynamic processes

"For a long time, a computational grid was first placed over every geometry in the simulation process. This is and was usually expensive, tedious and also not optimal for many processes in terms of results," says Kuhnert. "Our simulation method eliminates the need for such computational grids. Instead, we use the finite pointset method (FPM) approach. This uses point clouds in which each point can be freely positioned." This offers decisive advantages over traditional methods and more and more cooperation partners are now taking notice.

"In the automotive sector, we have been providing support with simulations for some time now. MESHFREE makes processes more understandable digitally," explains Michel. Specifying material properties is sufficient to predict behavior with MESHFREE. The user exports the geometry from common CAD tools. "As we continue to develop our methodology, we work hand-in-hand with the industry. Examples include multiphase simulations or 3D-2D transitions. In the same way, we are exploring the interaction of fluids and solids. As a result, the demands on simulations are growing: MESHFREE is becoming more efficient and more accurate, and at the same time we want to make it easier to use. Smaller companies should also benefit from the solution."

New boost for turbines

One of these practical examples is hydropower turbines, or more precisely Pelton turbines. "In a project that we are implementing with Voith Hydro, among others, different model approaches are intertwined," Kuhnert reports. "We are investigating the water flow in interaction with the air as well as the behavior of the complete flow. Wear, known as abrasion, is also mapped by MESHFREE."

The example of abrasion illustrates how important simulations are because, above all, they can save time and money, Kuhnert emphasizes. "The surface of a turbine runner is damaged over time by sand or stone particles contained in the water. This leads to changes in the flow and the turbine becomes weaker. The runner will eventually need to be replaced," the team leader explained. "If modernization does occur, the team assists in optimizing the turbine," he continued. "Simulation is a great tool for predicting flow, the formation of water layers and material wear – in plant design even long before a prototype is built.

Further information on the project page www.meshfree.eu

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