PRESS RELEASE

The Fraunhofer ITWM at E-world Energy and Water 2025

Using AI, Digital Twins and Smart Algorithms to Achieve a Resource-Efficient Energy Industry

Saving energy and using it sensibly – this goal runs through many projects at the Fraunhofer Institute for Industrial Mathematics ITWM. In its projects, the institute is committed to making the generation, procurement and distribution of energy calculable. At E-world Energy and Water 2025 from February 11 to 13 in Essen, the institute will therefore be represented by three departments presenting their latest developments in the context of »energy«.

The teams from our »System Analysis, Prognosis and Control« and »Financial Mathematics« as well as the »Green by IT« team from the division »High Performance Computing« are on site with these topics:

Artificial Intelligence for Resource-Efficient Plant Operation

At E-World, our team from the »System Analysis, Prognosis and Control« department will be presenting its latest developments for resource-efficient plant operation. Their monitoring systems with non-contact torque detection have been used in power plants for many years to detect critical torsional vibrations in the shaft trains resulting from interactions with the electrical grid. The team has now expanded the measuring system so that it can also determine the speed and angle of rotation.

At the trade fair, they will be presenting their demonstrator, which the researchers will use to simulate typical faults in drives and then show how they detect and analyze the faults using artificial intelligence. »Beyond the power plant sector, our systems are suitable in principle for torsion detection and analysis on drives with ferromagnetic shaft surfaces. In particular, our systems are an ideal extension of condition monitoring systems for many applications,« explains Dr. Andreas Wirsen, Head of the »System Analysis, Prognosis and Control« department.

Imaging Methods for Process and Product Monitoring

The demonstrator also illustrates how modern imaging processes can be used in the areas of condition monitoring, predictive maintenance and quality control. »Our imaging methods continuously monitor the processes during operation. They detect changes in product quality at an early stage, even before the fault tolerance is exceeded and the product is rejected,« says Wirsen.

By using innovative algorithms, the causes of deviations can be identified, which enables targeted measures to be taken. This not only leads to a reduction in rejects, but also minimizes downtime in the production process. In addition, the recording of energy consumption and the associated costs is included in the analysis. »This allows us to develop sustainable and resource-saving working methods that optimize production targets as well as the condition of the systems and energy use,« Wirsen continues.

Digital Twin Optimizes Processes in Combined Heat and Power Plants

Real-time condition monitoring, predictive maintenance and digitally optimized energy use: AI-supported technologies for plant operation help to plan energy requirements in advance and control them optimally. This is important for the Cologne-based energy supplier »RheinEnergie« in order to be able to offer customers an efficient, low-emission and cost-saving energy supply.

In joint projects, our researchers have optimized heat generation by heating plants for local heating networks for RheinEnergie with the help of a digital twin and intelligent control. This significantly saves primary energy without jeopardizing the security of supply. »Our team provided RheinEnergie with comprehensive support, from the development of the methods to the integration of hardware and software in the control cabinet,« explains Dr. Christian Salzig, Team Leader »Digital Twins and Predictive Control« at Fraunhofer ITWM. Our researchers will be presenting the project at E-world Energy and Water.

Intelligent Management System for Energy Communities

The »High Performance Computing« department's »Green by IT« team is working on the management of the energy transition. Among other things, the researchers will be demonstrating at the trade fair how they are flexibly integrating the Dutch energy community »Schoonschip«, consisting of 30 floating houses north of Amsterdam, into the energy markets with their PV systems, heat pumps and battery storage systems. Using innovative technologies, they predict electricity consumption and production, implement efficiency and price optimizations and enable trading transactions on various energy markets: the day-ahead market and the imbalance market. The Fraunhofer ITWM has succeeded in positioning the energy community as a flexible virtual power plant that is capable of both supplying and receiving energy. Our researchers will be demonstrating the activities of the energy community live at the stand.

Mathematical Algorithms for the Energy Market

The »Financial Mathematics« department will be presenting innovative projects with a focus on »Energy Markets«. In view of the changes in electricity pricing and the energy market environment as a whole, the researchers are demonstrating how the electricity procurement strategy can be dynamically optimized using specially developed stochastic electricity price models.

The »FlexEuro« project focuses on the optimization of bids for a virtual battery across various short-term markets. Of course, the associated schedule is also calculated and its restrictions included in the optimization. The researchers also provide insights into the »EnerQuant« project, which aims to solve large energy industry models. As part of this project, the researchers developed advanced algorithms for qubit-based quantum computers and quantum simulators in order to efficiently analyze and solve a fundamental energy industry model with stochastic influencing variables.

Visit Us Here:

»High Performance Computing«: Hall 4, Booth 4J112
»Financial Mathematics«: Hall 4, Booth 4H113
»System Analysis, Prognosis and Control«: Hall 4, Booth 4H115
You find us on the E-World Innovation Floor area 44 B-E in Hall 4.

We look forward to working with you to develop sustainable solutions for the energy transition!

The researchers from the »System Analysis, Prognosis and Control« department are using the demonstrator to simulate typical faults in drives. At their booth at E-world Energy and Water, they will show how they detect and analyze faults using Artificial Intelligence. © Fraunhofer ITWM

RheinEnergie AG combined heat and power plant in Cologne Merheim. © RheinEnergie AG

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The Dutch energy community »Schoonschip« with 30 floating houses north of Amsterdam, which is integrated into the energy markets by an intelligent management system of the Fraunhofer ITWM. Innovative technologies optimize electricity consumption and the production of PV systems, battery storage and heat pumps, enabling the community to function as a flexible virtual power plant. © Isabel Nabuurs

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Further information can be found here:

https://www.itwm.fraunhofer.de/eworld-2025-en

About the Fraunhofer Institute for Industrial Mathematics ITWM

The Fraunhofer Institute for Industrial Mathematics ITWM in Kaiserslautern is one of the largest research institutes for applied mathematics in the world. We see it as our task to further develop mathematics as a key technology and to provide innovative impulses. Our focus is on the implementation of mathematical methods and technology in application projects and their further development in research projects. The close cooperation with partners from industry guarantees the high practical relevance of our work.

Their integral building blocks are consulting, implementation and support in the application of high-performance computing technology and the provision of customized software solutions. Our various areas of expertise address a wide range of customers: the automotive industry, mechanical engineering, the chemical industry, energy and the financial sector. This also benefits from our excellent networking, for example in the Simulation and Software-based Innovation Center.

About the Fraunhofer-Gesellschaft

The Fraunhofer-Gesellschaft, based in Germany, is the world's leading organization for application-oriented research. With its focus on future-oriented key technologies and the utilization of results in business and industry, it plays a central role in the innovation process. As a guide and driving force for innovative developments and scientific excellence, it helps to shape our society and our future. Founded in 1949, the organization currently operates 76 institutes and research facilities in Germany. More than 30,000 employees, most of whom are trained in the natural sciences or engineering, work on the annual research volume of 2.9 billion euros. Contract research accounts for 2.5 billion euros of this total.