PRESS RELEASE

Increasing Efficiency Through Machine Learning in Plastics Processing

Fraunhofer ITWM's Digital Twin Optimizes Extrusion Processes

Digital twins are considered a key technology in many industrial processes. Researchers at the Fraunhofer Institute for Industrial Mathematics ITWM in Kaiserslautern have developed a machine learning tool for the plastics industry that uses a digital twin to determine the optimum process settings. The digital twin calculates the required extruder settings based on the desired product properties. This enables companies to save time and resources while increasing the quality of their products.

Extrusion is a key process in the plastics industry. In this process, plastic is pressed through a shaping opening as a viscous mass under high pressure and temperature. The aim is to create the highest quality product with the lowest possible energy and material input. Such products can be, for example, cable sheathing, pipes for construction, films or thermal insulation panels. In order to achieve the desired product quality, various process settings on the extruder play a role, such as speed, throughput and temperature of the heating elements. The quality of the product is determined, for example, by the melting temperature, the pressure or the residence time.

In order to find the optimum values for the process settings, companies usually rely on empirical knowledge. Making subsequent adjustments according to the »trial & error« principle is time-consuming and leads to material waste and high energy costs. Based on methods of machine learning, artificial intelligence and statistical data analysis, researchers at Fraunhofer ITWM have developed a software solution that determines the optimum settings for an extruder on the basis of test data from project partner Fraunhofer ICT.

Data Clouds Augment Real Test Data

A great deal of data is required for machine learning processes. »Generating this data through experiments alone is far too time-consuming,« explains Julia Burr, an expert in data-driven modeling at the Fraunhofer ITWM, describing the challenge she initially

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had to tackle. »We then developed a way to generate a sufficiently large data cloud of measurement and simulation data from a small amount of measurement data using simulation software.« At the beginning of the project, real test data was therefore initially generated at the Fraunhofer ICT. Burr then created a digital twin using the data cloud enhanced by simulations.

Production Linked to the Price of Electricity

As part of the »ENERDIG – Energy Management 2.0, Digitalization, AI and Optimized Processes« project, the researchers have further developed their software solution. With the help of the digital twin, precise settings can be specified that lead to grid-friendly electricity consumption. If a lot of energy is available or the electricity price is low, the throughput is increased. The appropriate speed and temperature of the heating elements are specified to ensure the quality of the product. If electricity is expensive, settings can be suggested that ensure low energy consumption with the same product quality. »This not only strengthens the company's market position through cheaper production, but also makes an important contribution to grid stability and to increasing the proportion of renewable energy,« explains Julia Burr.

Tailor-Made Solutions for Companies

In practice, the team reviews existing data together with a partner company and develops a data collection system to supplement the existing database at minimal cost and with the least possible effort. If necessary, the researchers adapt a simulation tool individually to the plant in question in order to generate additional data. They then create a digital twin and use it to calculate the required settings.

Based on this, they develop a control strategy. The results are poured into an assistance system so that the proposed optimized control variables can be used directly on site at the machine. This does not replace the machine operator, but provides them with a basis for decision-making.

»It is also possible to involve the extruder manufacturers in the process and equip the machine with artificial intelligence functions from the outset. This means that our tool can prevent avoidable costs right from the start by saving time and materials,« says Julia Burr about the potential applications of her development.

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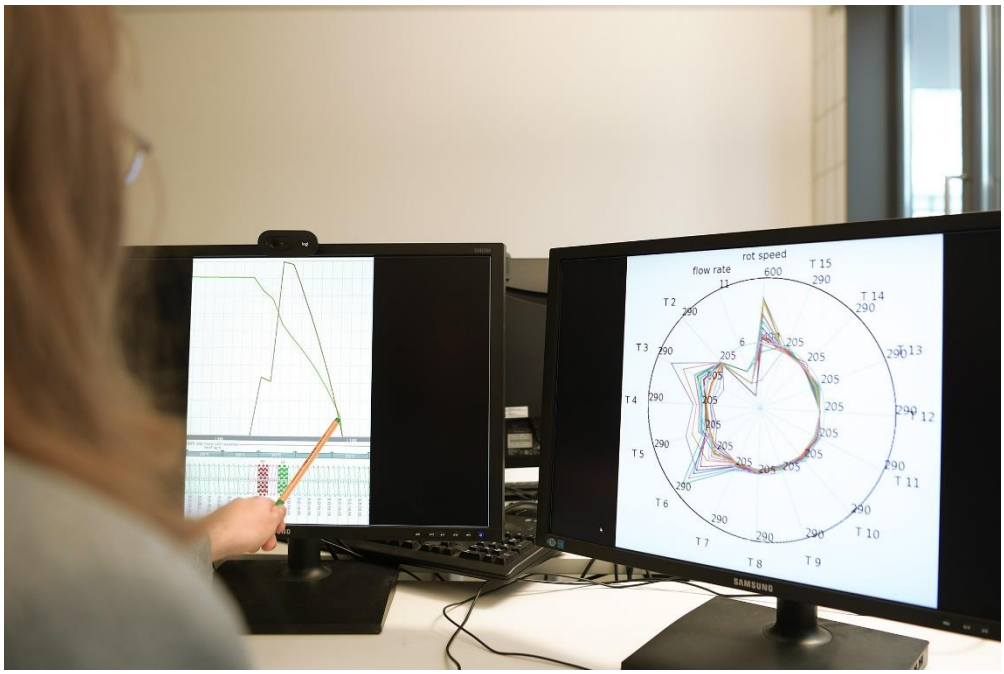

Julia Burr checks the results of the algorithm that suggests the settings for the extrusion machine. The left-hand screen shows the pressure and temperature curve of the melt in the extruder. The right-hand screen shows a Spyder plot with various suggested settings. © Fraunhofer ITWM

More Information Online: https://www.itwm.fraunhofer.de/pm-HyTwin-en

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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 industrial mathematics worldwide. We see our task in further developing mathematics as a key technology and providing innovative impetus. 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 components are consulting, implementation and support in the application of high-performance computer technology and the provision of tailor-made software solutions. Our various competencies address a wide range of customers: automotive industry, mechanical engineering, textile industry, energy and finance. This also benefits from our good networking, for example in the High performance center »Simulation- and Software-Based Innovation«.

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-relevant key technologies and on the exploitation of the results in business and industry, it plays a central role in the innovation process. As a guide and stimulus for innovative developments and scientific excellence, it helps shape our society and our future. Founded in 1949, the organization currently operates 76 institutes and research facilities in Germany. Around 30,800 employees, most of them trained in the natural sciences or engineering, generate an annual research volume of around €3.0 billion. Of this, €2.6 billion is spent on contract research.

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