Process Engineering: Using AI for Industrial Processes

It is one of the great visions of the "Optimization" field: to make the next level of artificial intelligence (AI) usable for process engineering. In doing so, the researchers want to penetrate completely new regions.

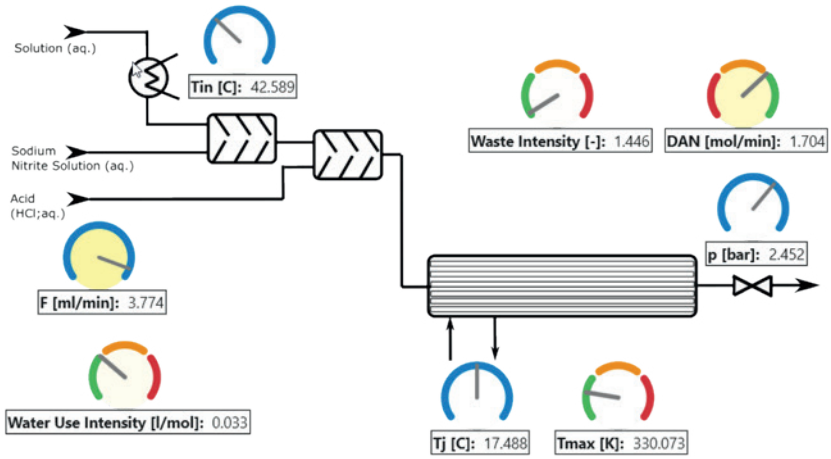
Whenever raw materials become a product, process engineering is used. Processes in this branch of industry are usually tried and tested over many years. The decision to intervene in work steps must be well thought out – wrong decisions can not only change the quality of a product, but also cause high costs.

AI Should Show Potential for Improvement Show

"AI is now very good at describing actual states," says Prof. Dr. Michael Bortz, head of the "Optimization – Technical Processes" department, and illustrates this with the example of speech recognition as used on cell phones: "It recognizes words that the user uses frequently and therefore suggests them as soon as he starts writing a certain sequence of letters. So the system is individually trained by the user and learns."

If AI is to be used to optimize production processes, there is more to it than that: optimization means finding combinations of degrees of freedom that lead to better results than those known to date. This requires rigorous physical models and optimization algorithms that come as close as possible to potential improvements. "The goal is for AI in process engineering to recognize where there is potential for improvement and thus provide the most concrete clues possible to take a closer look at specific processes," says Bortz. "Figuratively speaking: If I'm standing in the Alps and want to reach the highest point, AI should be able to tell me where to start from and how to reach the destination. Efforts to climb the second highest mountain only to see from there that there is an even higher one is not a satisfying result."

Schematic flow diagram of a chemical production process



Successful Projects Pave the Way

Bortz's team has gained experience in developing rigorous models for reliable, realistic predictions for the chemical company BASF SE, among others: In projects that have since been completed, a user-friendly interface to historical process data was created for a flowsheet simulator in order to calibrate the data for forecasts. In a current collaborative project, the aim is to use AI to numerically evaluate the processes calibrated in this way as

The main plant of BASF SE in Ludwigshafen is the largest contiguous industrial complex in Europe. Fraunhofer ITWM is currently working with BASF SE in a joint project to realize virtual "what-if scenarios" with the help of AI.

effectively as possible, enabling users to quickly and intuitively realize virtual "what-if" scenarios. In this way, the effects of changes can be simulated before they are actually implemented.

AI Projects Underway

Bortz's team is also exploring the possibilities of AI for process engineering in the KEEN project (AI incubator labs in the process industry) – an innovation platform for the chemical industry that brings together startups, corporations and research institutions. Fraunhofer ITWM provided the first software prototypes as part of the project last year. For one of these, a neural network was trained in such a way that the software enables engineers to reverse forward planning. That is, instead of changing certain factors and then checking their impact on the product, it answers the question, "Here's what I want the product to be, how do I need to run the plant to get it?"

Bortz rates the potential of AI for process engineering as definitely high because, "In numerically complex simulations, information about where to look can save a lot of time. The more precise this information is, the more concretely we can provide assistance and optimize processes."

More information at www.itwm.fraunhofer.de/projectkeen

Contact

Prof. Dr. Michael Bortz
Head of Department "Optimization – Technical Processes"
Phone +49 631 31600-4532
michael.bortz@itwm.fraunhofer.de