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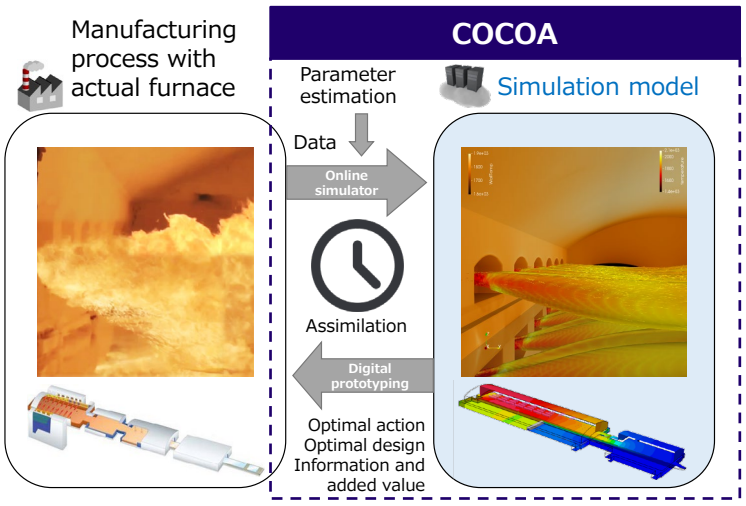
News Release

AGC Develops Digital Twin Technology for Glass Melting Process and Begins Operational Verification in Float Furnaces

Tokyo, January 23, 2023 – AGC Inc. (AGC; Headquarters: Tokyo; President: Yoshinori Hirai), a world-leading manufacturer of glass, chemicals and high-tech materials, has developed the CADTANK Online Computation and Optimization Assistant (COCOA: provisional name) as a digital twin technology[*1] for the glass melting process that integrates an online simulator[*2] with a digital prototyping tool[*3]. Full-scale operational verification at AGC's float furnaces is scheduled to begin in February 2023. This technology provides detailed insights into the states of the glass melting process and enables rapid yet comprehensive study of furnace operations, which have been difficult to achieve timely in the past.



Operation flow of COCOA

① **Obtain operation data (gas consumption, electric boosting power, etc.) and actual furnace condition data (temperature, quality, etc.).**

② **Automatically generate simulation models of the "current furnace status" using an online simulator.**

③ **Run case study simulations of furnace operation with the simulation model shown in (2) as a reference.**

④ **Reflect the optimum operating conditions derived in (3) on the actual furnace and return to (1).**

The temperature inside a float furnace and the flow of molten glass change daily depending on various factors such as the condition of raw materials and ageing of refractories, which greatly impacts the quality of the glass produced. One of the important tasks of the process engineers is to adjust the operation settings to avoid production loss in such situations. In fact, these adjustments are not straight forward and requires some time.

The inside of a float furnace is searing at approximately 1,600°C, so it is difficult to obtain detailed information of the internal conditions directly. Therefore AGC have been developing CADTANK, an in-house furnace simulation technology, since the 1970s. However, it was difficult to run simulations in a timely manner due to major effort required to collect the necessary data.

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To solve these issues, AGC developed the simulation tool COCOA. It can automatically collect the furnace operation data and then launch simulations to "sync" the simulation model to the actual state, to provide detailed information of the temperature distribution and the flow of molten glass. COCOA also provide an easy-to-use interface to launch simulations on-demand.

This allows process engineers to conduct detailed operation assessments and perform case study simulations to find optimal conditions. Previously, such studies required the specialized skills and knowledges of the simulation experts, but now they can be carried out on site. In the future, AGC will build an efficient production system based on simulation forecasts and utilize this system for sustainability to reduce GHG emissions[*4].

As the next step in the development of digital twin technology, AGC is working on implementation of “data assimilation” technology. A major expectation towards data assimilation is to make a good estimation of the states of the entire furnace, including those locations that are difficult to measure directly. Once this is achieved, the real-time forecasting accuracy of digital twin technology will be significantly improved, and further application of the digital twin technology can be expected. By enabling anyone to use and benefit from simulation technology through the digital twin, AGC will further expand its accumulated strengths in simulation technology and develop it into a differentiation technology.

[*1] Digital twin: Reproduction of the environment of a real space within a virtual space based on information from the real space.
[*2] Online simulator: A system that automatically updates simulation models in real time
[*3] Digital prototyping tool: Simulation execution tool for sensitivity analysis and preliminary study
[*4] An abbreviation of greenhouse gas

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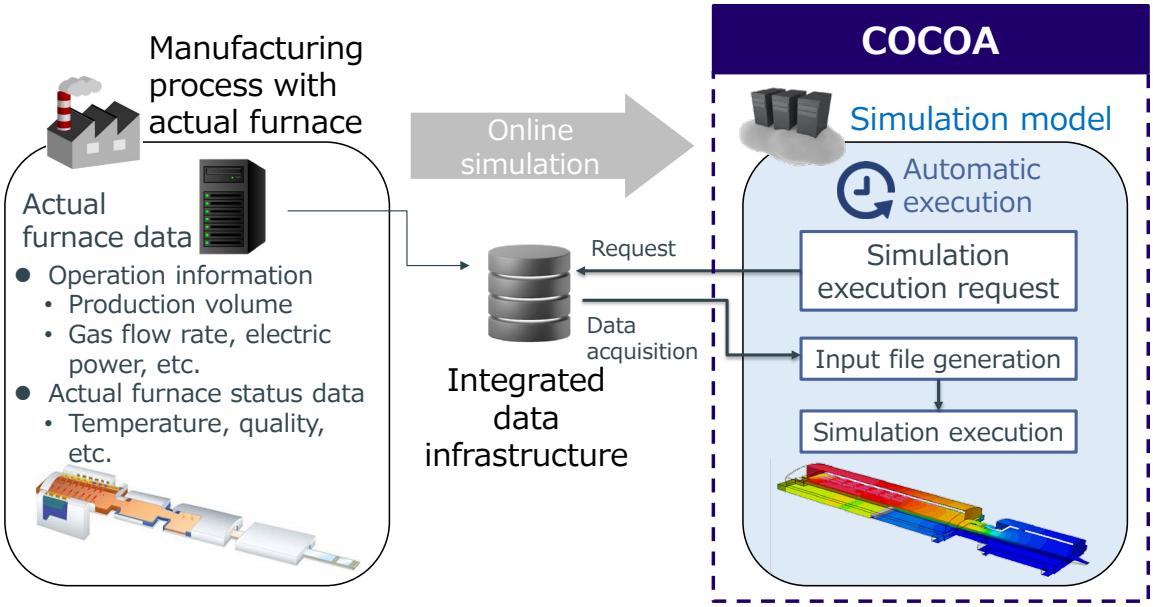
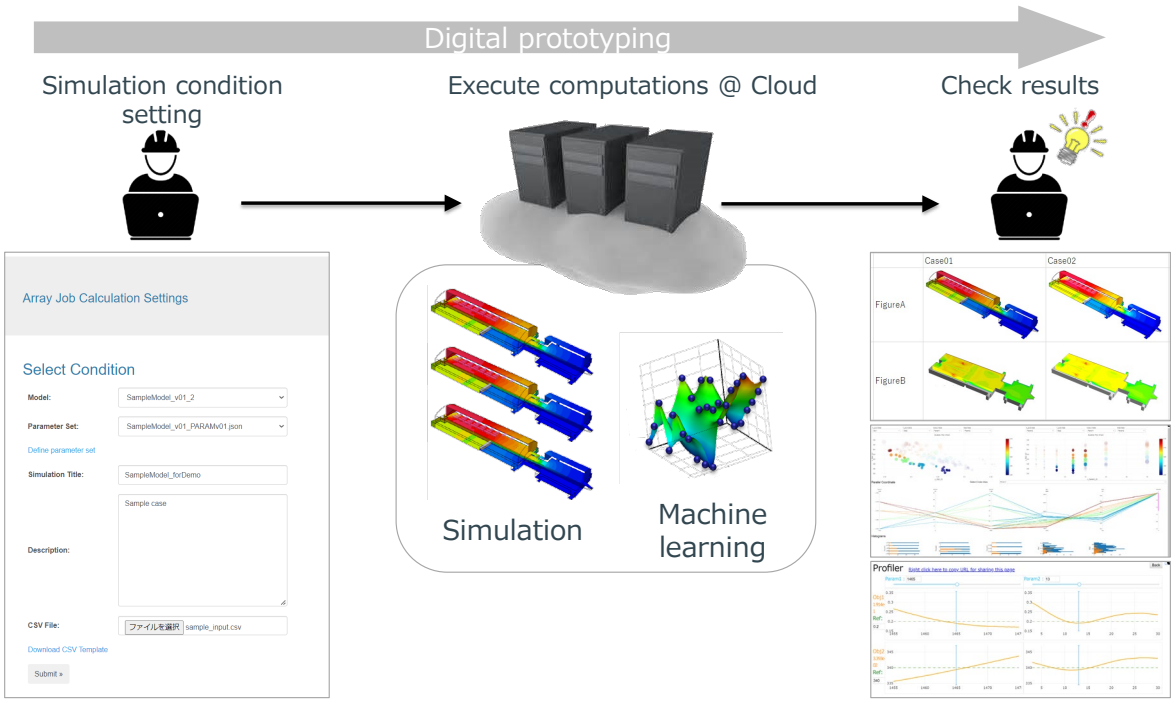
■Image of online simulation



■Image of digital prototyping



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■**Data assimilation**

Data assimilation is a methodology to combine simulations and observations to make a good state estimation of a dynamic system. This technology has developed especially in the field of meteorology, and it is expected to expand its application to industrial fields. The application of data assimilation to the simulation of glass melting processes is expected to improve the forecast accuracy of simulations by accurately estimating conditions inside float furnaces, which are difficult to measure.

AGC conduct open innovation to develop this technology, collaborating with Dr. Takemasa Miyoshi of the Data Assimilation Research Team at the RIKEN Center for Computational Science. Dr. Miyoshi is a leader in data assimilation research and made numerous achievements through cutting-edge initiatives, such as real-time forecasting of guerrilla rainstorms using the “Fugaku” supercomputer and big data from weather radar observations. AGC will promote the advancement of digital twin technology by fusing AGC’s simulation technology with Dr. Miyoshi’s deep knowledge of data assimilation.

URL: https://data-assimilation.riken.jp/~miyoshi/

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