A computationally efficient digital twin approach for optimizing module-based CO_2 capture system

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Building a reliable virtual representation and synchronizing it with its corresponding real plant are the key issues in smart chemical and manufacturing processes. This concept is known as the digital twin (DT) and one of the main technologies in Industry 4.0. Through virtual experiments with rare digital resources, the optimal operating condition can be found in the virtual domain. This solution is applied to the real plant, and its response is reflected to the DT as a step of model update. The reliability and computational efficiency of the DT are the key factors for the success of the virtual experiments. Module-based CO_2 capture system modeled using gRPOMS model builder provides good functions of analysis and prediction to the real plant. However, it needs too many digital resources and takes 2-10 minutes for a single simulation run because of the cyclic steady state constraints and its high dimensionality. In order to execute the virtual experiments more efficiently, a computationally efficient DT is built using machine learning techniques. This approach makes the simulation faster, and as a result, the process is optimized in more computationally efficient way.