

Exploring advanced process data visualization in the 4th industrial revolution: a CFD-ANN approach

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Several studies involving the implementation of artificial neural networks (ANN) technologies for process design, monitoring, and control are under active research. The capability of this new technology has shown great potential in advancing chemical processes through the development of digital Twins and smart factory. In joining this race, the current study explores the capability of physics-based modeling (CFD) and artificial neural networks for advanced process data visualization. Here 20 CFD simulations of a multitubular reactor equipped with a Zn-Fe-Cr catalyst for synthesizing butadiene was executed. The simulation result was extracted as 3-D data with XYZ coordinates and imported into a python-based ANN model for training and cross validation. An accuracy of 99.2% was obtained from the ANN surrogate model. The trained model was used to predict other sets of 3D data in terms of the process temperature. The 3D data was then imported into a Paraview® VTK for detailed virtualization. Cross-sectional, longitudinal, and radial distribution of the various process variables such as concentration profiles, and pressure contour were effectively visualized.