From Shallow to Deep Hybrid Modeling: Application to supercritical CO2 extraction.

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Abstract

Deep learning, in conjunction with big data analytics, is being deployed across various industries to enhance production efficiency. However, the biomanufacturing sector lags in the development of big data infrastructure compared to other sectors. To address this limitation, a promising strategy involves integrating deep neural networks (DNN) with prior knowledge in hybrid neural networks (HNN). HNNs are less dependent on the quality and quantity of data. A review spanning the last 30 years in the field of HNN applications to bioprocesses was performed revealing research gaps in the application to the Chemical Process Industries (CPI). Moreover, recent deep learning frameworks such as deep HNNs based on deep feedforward neural networks (FFNNs), convolutional neural networks (CNN), long short-term memory (LSTM) networks, and physics-informed neural networks (PINNs) are key AI methodologies for future applications in the CPIs. A case study is presented of a supercritical carbon dioxide (SCCO2) extraction process to determine the optimal extraction rate by considering factors like temperature, pressure, and gas flow rate.

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