



TNCHE Asia 2024 Conference
" Decarbonization, AI and Digital Transformation
for Sustainability in Process Industries "
Presenter's Biodata & Abstract



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Title of Presentation : **Identify, Analyze, Optimize: Overcoming Energy Challenges in Chemical Engineering with Artificial Intelligence**



Presentation Abstract :

In the face of pressing demands for increased energy efficiency and reduced environmental impact, artificial intelligence (AI) has emerged as a revolutionary tool for chemical engineering. This presentation explores the transformative role of AI in identifying, analyzing, and optimizing energy management, emphasizing how various AI techniques can have a significant impact on energy usage in the chemical industry. The framework begins with a multi-task learning model that identifies critical energy consumption hotspots within the large-scale process. By investigating specific consumption hotspots, this approach enables targeted operational adjustments that drastically decrease energy consumption, leading to significant reductions in carbon emissions and operating costs. Following this, a multi-channel convolutional deep model addresses the challenge of inconsistent sampling intervals, a common issue in the industry, and conducts an energy gap analysis. The energy gap is performed by analyzing clusters of specific energy consumption residuals of process-model mismatch and weighting the significant part of input features. However, the optimization performance of these models is inherently dependent on the volume and quality of available data. Insufficient data can lead to unreliable energy efficiency monitoring, complicating the adjustment of operational conditions and ultimately hindering effective energy management. The simulation-to-real transfer learning concept was introduced to improve model performance in a limited data domain by leveraging parameters learned from the simulated source domain. Surplus energy demand and supply are optimized for opportunities to save energy and reduce fuel consumption. Advancing from optimizing energy demand and supply, external disturbance can also affect operating decisions. In the final part, reinforcement learning for renewable energy management under the influence of climatic variability is presented for maintaining energy efficiency and sustainability.

Keywords: Artificial Intelligence, Energy Efficiency, Energy Management, Hotspot Identification, Limited Data, Sim to Real Transfer Learning. Energy Demand Analysis.



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