World Academy of Science, Engineering and Technology
International Journal of Energy and Power Engineering
Vol:19, No:05, 2025

Variable Refrigerant Flow (VRF) Zonal Load Prediction Using a Transfer Learning-Based Framework

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Abstract : In the context of global efforts to enhance building energy efficiency, accurate thermal load forecasting is crucial for both device sizing and predictive control. Variable Refrigerant Flow (VRF) systems are widely used in buildings around the world, yet VRF zonal load prediction has received limited attention. Due to differences between VRF zones in building-level prediction methods, zone-level load forecasting could significantly enhance accuracy. Given that modern VRF systems generate high-quality data, this paper introduces transfer learning to leverage this data and further improve prediction performance. This framework also addresses the challenge of predicting load for building zones with no historical data, offering greater accuracy and usability compared to pure white-box models. The study first establishes an initial variable set of VRF zonal building loads and generates a foundational white-box database using EnergyPlus. Key variables for VRF zonal loads are identified using methods including SRRC, PRCC, and Random Forest. XGBoost and LSTM are employed to generate pre-trained black-box models based on the white-box database. Finally, real-world data is incorporated into the pre-trained model using transfer learning to enhance its performance in operational buildings. In this paper, zone-level load prediction was integrated with transfer learning, and a framework was proposed to improve the accuracy and applicability of VRF zonal load prediction.

Keywords : zonal load prediction, variable refrigerant flow (VRF) system, transfer learning, energyplus
Conference Title : ICAE 2025 : International Conference on Applied Energy
Conference Location : Istanbul, Türkiye
Conference Dates : May 06-07, 2025