Efficient Gaussian Sugeno fuzzy vector with bidirectional lucidity network for gas turbine

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In the realm of power generation, the integration of gas turbine technology with complementary components in a combined gas turbine (CGT) plant demands meticulous examination of exergy destruction and NO_x reduction to ascertain its pivotal performance metrics. Hence, a novel Gaussian Sugeno vector network with a bidirectional lucidity network has been introduced. In the condenser, azeotropic mixtures in the working fluid reveal different heat-transfer characteristics which affect condenser effectiveness and contribute to higher exergy destruction. Thus, a novel Gaussian–Sugeno–Swarm vector network has been implemented, which mitigates the complexities introduced by azeotropic mixtures, reducing exergy destruction and significantly improving the overall effectiveness of the condenser. Furthermore, selective catalytic reduction (SCR) systems exhibit non-linear behaviour due to catalyst deactivation, causing incomplete NO_x reduction due to difficulty in predicting and controlling temperature changes. So, a novel bidirectional niching fuzzy lucidity network has been introduced, which provides a comprehensive solution to address the limitations of current control algorithms, ensuring a complete reduction in NO_x emissions in SCR systems. The proposed method demonstrates excellence in condenser and SCR systems by achieving a high prediction accuracy of 0.94, precision of 0.96, NO_x reduction of 0.97 and low heat loss of 0.02.

Keywords: Azeotropic mixtures, catalyst deactivation, combined gas turbine plant, condenser system, exergy destruction, selective catalytic reduction systems.

and hybrid models combining multiple techniques. Time-series analysis leverages historical load data to identify patterns and trends, while machine learning models, such as artificial neural networks and support vector machines, use historical and real-time data for predictions. However, these methods face challenges such as data uncertainty, nonlinearity in load patterns and the dynamic nature of gas turbine plants. Additionally, the lack of accurate weather predictions, unexpected plant component failures and the need for continuous model adaptation pose significant hurdles. Integrating these forecasting methods effectively requires addressing these challenges to enhance the accuracy and reliability of load predictions in gas turbine plants[1–4].

Furthermore, in combined gas turbine (CGT) plants, exergy destruction in the condenser occurs due to several factors, and various methods are employed to mitigate these losses. One common approach is using advanced heat exchanger designs, such as compact and enhanced surface condensers, to improve heat-transfer efficiency and minimise exergy destruction. Additionally, incorporating advanced materials with better thermal conductivity can enhance overall condenser performance. Optimising operating parameters, such as maintaining proper temperature and pressure levels, is another strategy to reduce exergy destruction. However, challenges persist in implementing these methods, including the high cost associated with advanced materials and design, as well as the need for stringent control and maintenance practices. Balancing the trade-offs between cost and performance remains a significant challenge in achieving optimal condenser effi-