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Fuzzy-based simulation of thermohydraulic behavior in solar air heater with attached inclined broken roughness

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Inclined broken roughness was designated as the (optimized) roughness to experimentally investigate the enhancement of thermohydraulic performance. This research concentrates on the Fuzzy Inference System (FIS) as an alternative and novel methodology to previse the Nusselt number, friction factor and thermohydraulic performance in solar air heaters. Separated FIS for each smooth and roughened plate (method 1) beside the integrated FIS for both (method 2) was prescribed as the strategy of modeling. Also utilizing the temperature and velocity features were suggested as a cutting-edge (convenient) solution to dominate the restrictions of complexity in geometry parameters of roughnesses based on their generality in all solar air heaters. Triangular membership functions obtained the smaller MSE and MRE compared to gaussian function in both methods except for the friction factor of the roughened plate in method 1. Sugeno inference system achieves a better performance over the Mamdani in estimating the mentioned parameters. Also, higher consistency of Nusselt number rather than friction factor between the predicted values of FIS with experimented data was observed. For the sake of generality, designed FIS for a smooth plate with gaussian membership function achieved the better accuracy in predicting the parameters of the roughened plate. Least MSE for the friction factor/Nusselt number in smooth and roughened plate was 2.5477E-04/8.1115E-04 and 2.0218E-04/7.5150E-04, respectively based on method 1. Also for the thermohydraulic performance, best agreement was gained with the magnitude of 8.6255E-04 for MSE in method 1. Taken together, findings suggest the fuzzy logic as a robust method to tackle the prediction of the considered parameters in solar air heaters.

Biography

Ali M Nikbakht is Associate Professor in Mechanical Engineering of Biosystems at Urmia University, Iran. He completed his Ph.D. at Tarbiat Modares University, Tehran, Iran. His research interests lie in the area of energy and exergy analysis of biosystems ranging from poultry and dairy farms to food machinery and industry. He has collaborated actively with researchers in several other disciplines of energy management and engineering. Recognized as a national distinguished researcher in 2017, Ali has conducted numerous projects for industry as a prospect of energy reduction and zero energy buildings. He also serves as the director of Technology Transfer Office (TTO) at Urmia University and organizes techno-fairs. He has patents in the field of thermal engineering in food industry and commercialized a modern sugar dryer. Dr Ali is now leading a lab entitled “Bioenergy Lab” in which several engineering and post graduates experience applied on-demand researches.

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