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Using adaptive neuro-fuzzy inference system for predicting thermal conductivity of silica -MWCNT-alumina/water hybrid nanofluid

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Abstract

In this study, the thermal conductivity (k_{nf}) of Silicon Oxide-MWCNT-Alumina/Water hybrid nanofluid (HNF) is predicted versus solid volume fraction (SVF) and temperature. For this reason, various combinations of SVF and temperature are considered from SVF=0.1–0.5% and 20–60 (°C) respectively. Then, an adaptive neuro-fuzzy inference system (ANFIS) has been effectively used to model the k_{nf} of HNF as one of the effective machine learning techniques. Various shapes of membership functions are considered and the generalized bell shape membership function showed to have acceptable accuracy for k_{nf} prediction using an ANFIS-based model. Moreover, the outcomes reveal that the effect of SVF is higher than temperature influence on the knf of HNF. Specifically, when the SVF is increased from 0.1% to 0.5%, there is an approximate 25% increase in k_{nf}. Conversely, an increase in temperature leads to a smaller ratio of k_{nf} increment. When the temperature rises from 20° to 60°C, k_{nf} only increases by less than 10%. The highest error value is found at φ=0.2% and T=60°C, amounting to 0.01128W/mK.