Modelling the viscosity of nanofluids using artificial neural network and Bayesian support vector regression

ABSTRACT

This study demonstrates the application of artificial neural networks (ANNs) and Bayesian support vector regression (BSVR) models for predicting the relative viscosity of nanofluids. The study examined 19 nanofluids comprising 1425 experimental datasets that were randomly split in a ratio of 70:30 as a training dataset and a testing dataset, respectively. To establish the inputs that will yield the best model prediction, we conducted a systematic analysis of the influence of volume fraction of nanoparticles, the density of nanoparticles, fluid temperature, size of nanoparticles, and viscosity of base fluids on the relative viscosity of the nanofluids. Also, we analyzed the results of all possible input combinations by developing 31 support vector regression models based on all possible input combinations. The results revealed that the exclusion of the viscosity of the base fluids (as a model input) leads to a significant improvement in the model result. To further validate our findings, we used the four inputs—volume fraction of nanoparticles, the density of nanoparticles, fluid temperature, and size of nanoparticles to build an ANN model. Based on the 428 testing datasets, the BSVR and ANN predicted the relative viscosity of nanofluids with an average absolute relative deviation of 3.22 and 6.64, respectively. This indicates that the BSVR model exhibits superior prediction results compared to the ANN model and existing empirical models. This study shows that the BSVR model is a reliable approach for the estimation of the viscosity of nanofluids. It also offers a generalization ability that is much better than ANN for predicting the relative viscosity of nanofluids.