

Development of a predictive model for estimating the specific heat capacity of metallic oxides/ethylene glycol-based nanofluids using support vector regression

ABSTRACT

The specific heat capacity of nanofluids (CPnf) is a fundamental thermophysical property that measures the heat storage capacity of the nanofluids. CPnf is usually determined through experimental measurement. As it is known, experimental procedures are characterised with some complexities, which include, the challenge of preparing stable nanofluids and relatively long periods to conduct experiments. So far, two correlations have been developed to estimate the CPnf. The accuracies of these models are still subject to further improvement for many nanofluid compositions. This study presents a four-input support vector regression (SVR) model hybridized with a Bayesian algorithm to predict the specific heat capacity of metallic oxides/ethylene glycol-based nanofluids. The bayesian algorithm was used to obtain the optimum SVR hyperparameters. 189 experimental data collected from published literature was used for the model development. The proposed model exhibits low average absolute relative deviation (AARD) and a high correlation coefficient (r) of 0.40 and 99.53 %, respectively. In addition, we analysed the accuracies of the existing analytical models on the considered nanofluid compositions. The model based on the thermal equilibrium between the nanoparticles and base fluid (model II) show good agreement with experimental results while the model based on simple mixing rule (model I) overestimated the specific heat capacity of the nanofluids. To further validate the superiority of the proposed technique over the existing analytical models, we compared various statistical errors for the three models. The AARD for the BSVR, model II, and model I are 0.40, 0.82 and 4.97, respectively. This clearly shows that the model developed has much better prediction accuracy than existing models in predicting the specific heat capacity of metallic oxides/ethylene glycol-based nanofluids. We believe the presented model will be important in the design of nanofluid-based applications due to its improved accuracy.

Keyword: Materials science; Nanotechnology; Thermodynamics