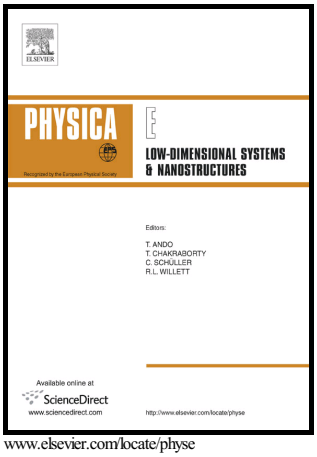
A comparison of performance of several artificial intelligence methods for predicting the dynamic viscosity of TiO2/SAE 50 nano-lubricant

Mohammad Hemmat Esfe, Afshin Tatar, Mohammad Reza Hassani Ahangar, Hossein Rostamian



www.elsevier.com/locate/physe

PII: S1386-9477(17)31003-2
DOI: http://dx.doi.org/10.1016/j.physe.2017.08.019
Reference: PHYSE12899

To appear in: *Physica E: Low-dimensional Systems and Nanostructures*

Received date: 10 July 2017
Revised date: 10 August 2017
Accepted date: 25 August 2017

Cite this article as: Mohammad Hemmat Esfe, Afshin Tatar, Mohammad Reza Hassani Ahangar and Hossein Rostamian, A comparison of performance of several artificial intelligence methods for predicting the dynamic viscosity of TiO2/SAE 50 nano-lubricant, *Physica E: Low-dimensional Systems and Nanostructures,* http://dx.doi.org/10.1016/j.physe.2017.08.019

A comparison of performance of several artificial intelligence methods for predicting the dynamic viscosity of TiO2/SAE 50 nano-lubricant

Mohammad Hemmat Esfe[1*], Afshin Tatar[2], Mohammad Reza Hassani Ahangar[3*], Hossein Rostamian[4]

[1]Department of Mechanical Engineering, Imam Hossein University, Tehran, Iran

[2]Young Researchers and Elite Club, North Tehran Branch, Islamic Azad University, Tehran, Iran

[3]Department of Computer Engineering, Imam Hossein University, Tehran, Iran

[4]Faculty of Chemical, Petroleum and Gas Engineering Semnan University, Semnan, Iran

[*]Email: m.hemmatesfe@semnan.ac.ir

Email: Afshin.Tatar@gmail.com

Abstract

Since the conventional thermal fluids such as water, oil, and ethylene glycol have poor thermal properties, the tiny solid particles are added to these fluids to increase their heat transfer improvement. As viscosity determines the rheological behavior of a fluid, studying the parameters affecting the viscosity is crucial. Since the experimental measurement of viscosity is expensive and time consuming, predicting this parameter is the apt method. In this work, three artificial intelligence methods containing Genetic Algorithm-Radial Basis Function Neural Networks (GA-RBF), Least Square Support Vector Machine (LS-SVM) and Gene Expression Programming (GEP) were applied to predict the viscosity of TiO2/SAE 50 nano-lubricant with Non-Newtonian power-law behavior using experimental data. The correlation factor (R^2), Average Absolute Relative Deviation (AARD), Root Mean Square Error (RMSE), and Margin of Deviation were employed to investigate the accuracy of the proposed models. RMSE values of 0.58, 1.28, and 6.59 and R2 values of 0.99998, 0.99991, and 0.99777 reveal the accuracy of the proposed models for respective GA-RBF, CSA-LSSVM, and GEP methods. Among the developed models, the GA-RBF shows the best accuracy.