SVM and ANFIS for Prediction of Performance and Exhaust Emissions of a SI Engine with Gasoline–Ethanol Blended Fuels

G. Najafi[a], B. Ghobadian[a], A. Moosavian[a], T. Yusaf[b], R. Mamat[c], M. Kettner[d], W.H. Azmi[c]

[a] Mechanics of Biosystem Engineering, Tarbiat Modares University, Tehran, Iran

[b] Faculty of Engineering and Surveying, USQ University, Toowoomba, Australia

[c] Faculty of Mechanical Engineering, Universiti Malaysia Pahang, Malaysia

[d] Karlsruhe University of Applied Sciences, 76131 Karlsruhe, Germany

ABSTRACT

This paper studies the use of support vector machine (SVM) and adaptive neuro-fuzzy inference system (ANFIS) to predict the performance parameters and the exhaust emissions of a spark ignition (SI) engine, which operates on ethanol–gasoline blends of 0%, 5%, 10%, 15% and 20% called E0, E5, E10, E15 and E20, respectively. In the experiments, the engine was run at various speeds for each test fuel, and 45 different test conditions were created. In comparison with gasoline fuel, the brake power, the engine torque, the brake thermal efficiency, and the volumetric efficiency increased using ethanol blends, while the brake specific fuel consumption (bsfc) decreased. Moreover, the concentration of CO and HC in the exhaust pipe decreased after ethanol blends were introduced, but CO_2 and NO_X emissions increased. In order to predict the engine parameters, all the experimental data were randomly divided into training and testing data. For SVM modelling, different values for the radial basis function (RBF) kernel width and the penalty parameters (C) were considered, and the optimum values were then found. For ANFIS modelling, the Gaussian curve membership function (gaussmf) and 200 training epochs were found to be the optimum choices for the training process. The results showed that the SVM predicted the engine performance and the exhaust emissions with the correlation coefficient (R) and the accuracy in the ranges of 0.660–1 and 65.310–99.330%, respectively, while these same parameters were in the ranges of 0.760–1 and 79.270–98.810%, respectively, for the ANFIS. The results demonstrate that the SVM and ANFIS are capable of predicting the SI engine performance and emissions. However, the performance of the ANFIS is significantly higher than that of the SVM.

KEYWORDS: SVM; ANFIS; Engine performance; Exhaust emissions; Ethanol–gasoline blends

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