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Internal Combustion Engine Fuel Composition Detection by Analysing Vibration Signals Using ANFIS Network

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Abstract : Alcohol fuels are renewable, have low pollution and have high octane number; therefore, they are important as fuel in internal combustion engines. Percentage detection of these alcoholic fuels with gasoline is a complicated, time consuming, and expensive process. Nowadays, these processes are done in equipped laboratories, based on international standards. The aim of this research is to determine percentage detection of different fuels based on vibration analysis of engine block signals. By doing, so considerable saving in time and cost can be achieved. Five different fuels consisted of pure gasoline (G) as base fuel and combination of this fuel with different percent of ethanol and methanol are prepared. For example, volumetric combination of pure gasoline with 10 percent ethanol is called E10. By this convention, we made M10 (10% methanol plus 90% pure gasoline), E30 (30% ethanol plus 70% pure gasoline), and M30 (30% Methanol plus 70% pure gasoline) were prepared. To simulate real working condition for this experiment, the vehicle was mounted on a chassis dynamometer and run under 1900 rpm and 30 KW load. To measure the engine block vibration, a three axis accelerometer was mounted between cylinder 2 and 3. After acquisition of vibration signal, eight time feature of these signals were used as inputs to an Adaptive Neuro Fuzzy Inference System (ANFIS). The designed ANFIS was trained for classifying these five different fuels. The results show suitable classification ability of the designed ANFIS network with 96.3 percent of correct classification.

Keywords : internal combustion engine, vibration signal, fuel composition, classification, ANFIS
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