FAULT DETECTION AND DIAGNOSIS OF AN AUTOMOBILE ENGINE USING INSTANTANEOUS ANGULAR SPEED FLUCTUATION

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Early fault detection and diagnosis for automobile engines are very important to ensure reliable operation of the engine. Most of the faults in an automobile engine cannot be detected externally. Detecting faults and their location, without dismantling the engine is very difficult. On-board diagnostic (OBD) systems in modern vehicles can be used to detect engine faults up to some extent. However, OBD systems are not accurate enough in certain conditions and technicians have difficulties when interpreting information. OBD method cannot be used for old vehicles because those vehicles do not have OBD systems. Hence, these factors necessitate the development of intelligent and accurate diagnosis method for troubleshooting automobile engine faults. Therefore, in this research, a mathematical model was developed to identify engine faults through the simulation of Instantaneous Angular Speed Fluctuation (IASF) of crank shaft. Three force components created by gas pressure, inertia of the moving parts and friction of the moving parts were used to generate the mathematical model. The parameters of the mathematical model were modified according to the potential faulty condition and IASF waveform was recorded and compared in different fault scenarios. Type of the fault and the severity of the fault were identified through comparison.

An experiment was conducted using a healthy automobile engine to validate the simulation results. IASF waveform of the crank shaft was recorded using a rotary encoder circuit. A potential fault was manually induced into the engine and the IASF waveform was recorded. The practical recordings were compared with the simulated results to measure the accuracy of the mathematical model.

Finally, a Graphical User Interface (GUI) was developed to simulate instantaneous angular speed in both healthy and faulty condition as well as to simulate both model data and experimental data. With the use of mathematical model, experimental data and GUI analysis, the relationship between IASF waveform and cylinder misfiring was identified for a multi-cylinder engine. This interrelationship can be used to develop a real time engine condition monitoring for diagnosing faults in an automobile engine.

Keywords: Automobile, Fault detection, IC engine, Instantaneous Angular Speed, On-board diagnostic