Analytical Instrumentation, Methods & Materials

Non-Intrusive Monitoring of Combustion Chambers

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WARF: P08225US

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The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing an improved system for monitoring cylinder pressure in an engine.

Overview

Exhaust emission and fuel economy standards have put increased pressure on the auto industry to improve the efficiency of internal combustion engines. While higher standards help protect the environment and alleviate energy dependence, engine modifications can be expensive to develop and manufacture. One modification that can improve engine efficiency, fuel economy and exhaust emissions is to control specific engine operations, including the air-to-fuel ratio, exhaust gas recirculation, spark plug timing, injection timing and valve train timing.

Monitoring systems and sensors are required to control engine management operations. These sensors provide active feedback that informs the control system of the conditions within the engine. For example, a control system must know the pressure in the combustion chamber, known as the cylinder pressure, to improve the efficiency of engine combustion. However, the combustion chamber of an engine is an extreme environment. Sensors placed within the combustion chamber must be able to endure high temperature and pressure, in addition to occupying a very limited space. Accommodating such restrictions makes cylinder pressure monitoring systems extremely expensive.

The Invention

A UW–Madison researcher has developed an improved monitoring system for engine combustion chambers that is less expensive and requires fewer components than currently available systems. Rather than using sensors located within the combustion chambers, this monitoring system makes use of a valve that allows air and fuel to enter and exit the chamber. When the piston compresses the air/gas mixture, the valve seals the chamber to contain it for the combustion process. The high pressure exerted by the piston compression causes the valve head to bend slightly, displacing the valve stem. Because the stem extends out of the chamber, displacements as small as 1/1000 of an inch can be measured by a sensor located on the outside of the chamber. To calculate pressure, the displacement is compared to a plot of valve movement versus cylinder pressure. Then a control system uses that information to adjust engine operation.

Applications

- Monitoring cylinder pressure in an internal combustion engine

Key Benefits

- Improves efficiency and fuel economy and reduces emissions of internal combustion engines
- Measures valve bending precisely and repeatedly
- Encases monitoring system away from extreme temperatures or pressures
- Requires few components, thus reducing costs

- Monitors pressure in multiple combustion chambers of a single engine
- May be used in two- or four-cycle engines
- Reduces particulate, carbon dioxide and nitrogen oxide emissions

Stage of Development

The concept was first demonstrated statistically, which showed a repeatable, nearly linear relationship between bending and cylinder pressure. Dynamic testing then was successfully performed on an engine.

Tech Fields

- Analytical Instrumentation, Methods & Materials : General analytical instrumentation
- Engineering : Engine technologies

For current licensing status, please contact Emily Bauer at emily@warf.org or 608-960-9842