Fault Detection and Diagnosis of Internal Combustion Engines

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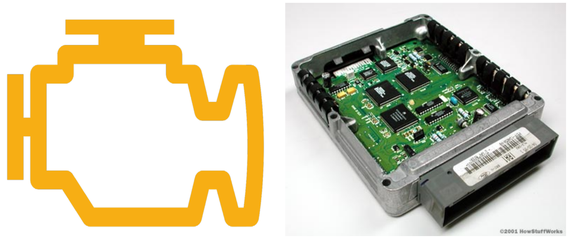
EECOMOBILITY (ORF) & HEVPD&D CREATE

Noise & Vibration Vs. Engine Light

Mechanical Faults

Noise or vibration indicate mechanical faults related to worn or loosen components that may effect the health of the engine. And the fault detector that is set in place to detect unusual noise and vibration is the driver of the vehicle.

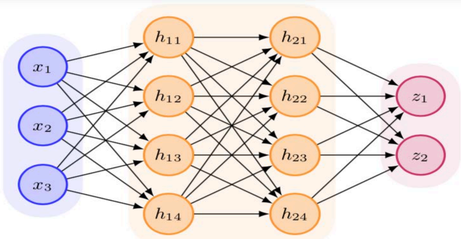
Emission Faults



Engine light doesn't always indicate the health of the engine. It indicates the when the engine is not operating within the emissions standards. In this case, the fault detector is the ECU that analyzes the measurement data from the sensors.

A sensory system is to be used to enhance the fault detection capabilities using sensors such as accelerometer and microphones. Accelerometer will capture the vibration and the microphone will capture the noise that may or may not be noticed by the driver. With the sensory system installed on the engine, numerous tests will be performed to obtain noise and vibration signals that represent healthy or faulty engine.

Classification



Deep learning algorithms have been shown to acquire the ability to effectively relate inputs data to their desired output values both in classification and regression problems. In this project, deep learning algorithms are to be utilized as a classification tool that will classify a signal as a specific type of fault.

Project Statement

To design and conduct a comparison study of two different fault detection & diagnosis technologies that can be applied to detecting faults in internal combustion engines.

Two fault detection & diagnosis technologies that are to be studied in this project include:

- a strategy that is developed in Centre for Mechatronics and Hybrid Technologies, and
- a strategy that is currently being used in Ford.

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Industrial-Extended Multi-Scale Principle Components Analysis (IEMSPCA) technology: a vibration and sound signal-based technology, has been developed through the merging of the PCA with the wavelet packets transformation

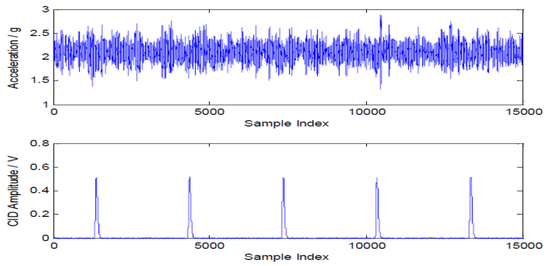
Ford

Technology is currently unknown

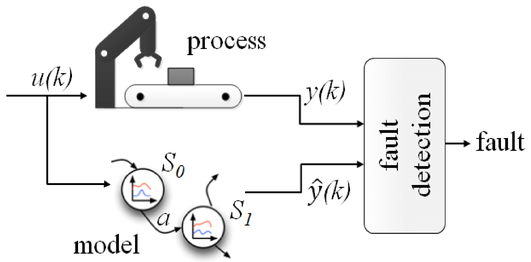
Fault Detection & Diagnosis

Fault detection and diagnosis technology's ability to detect and isolate fault conditions is valuable in providing a safe, reliable, and cost effective operation of mechanical systems. Fault detection & diagnosis technology can be achieved using model based or signal based techniques. The complexity of a system determines which fault detection and diagnosis technique will be used as more complex systems are harder to model accurately.

Since internal combustion engine, the mechanical system that is to be studied in this project, is a very complex system with numerous moving components the signal based fault detection diagnosis technique will be used. The signals that will be utilized are noise and vibration signals from the engine.



Signal-based techniques use measurements from sensors that are installed in mechanical systems.



Model-based techniques use a well-defined model of the mechanical system.

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Ontario Research Fund
We acknowledge the support of the Ontario Research Fund: Research Excellence Program.

NSERC CRSNG
We acknowledge the support of the Natural Sciences and Engineering Council of Canada (NSERC), which invests annually over $1 billion in people, discovery and innovation.