Knocking Index

Determine Knocking Index using MATLAB

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Agenda

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Introduction

- Diesel engines began to be used in automobiles in the 1930s (Source: Wikipedia)
- Diesel Engines are becoming extremely popular due to its good fuel economy
- In Europe, majority of new vehicle registrations have been Diesel powered vehicles
- The ability to maximize power and fuel economy by optimizing spark timing for a given air/fuel ratio is limited by engine knock
- Tuning vehicle NVH Parameter is a key aspect of the powertrain development process
Knocking Index

Knocking?

Diesel knock is the clanking, rattling sound emitted from a running diesel engine.

This noise is caused by the compression of air in the cylinders and the ignition of the fuel as it is injected into the cylinder.

Knocking index: impulsive noise analysis parameter for engine sound quality.

Knock is an undesirable combustion mode occurring in SI engines. It results in an abnormal auto-ignition of the end gas ahead of the propagating flame front.
Knocking Effects?

01 Effect on the perceived quality of vehicles

02 Misinterpreted by customers as defects

03 Adherence to Legal Requirements

04 Customer Preference of Vehicles with little Diesel Knocking

05 Influence on vehicle interior Sound Quality
Knocking Index

Problem Definition

Knocking is a common term that conveys that there is something wrong in the engine, based on uncontrolled combustion process.

Impulsive noise analysis parameter plays an important role for measuring the engine sound quality.

It's necessary to find efficient ways of detecting engine knocking index with the help of various data analytics techniques.

Pain Areas

Cost Effective Solutions??

Engineering Solutions??

Customizations??
Impulsive Noise

**Impulse noise** is a category of (acoustic) noise which includes unwanted, almost instantaneous (thus impulse-like) sharp sounds.

Knocking Index is an impulsive noise analysis parameter for engine sound quality.

Noise consisting of random occurrences of energy spikes having random amplitude and spectral content.
Knocking Index

Approach

Noise Types:
1. Knocking
2. Rattling
3. Ticking
4. Tonal Noise

Noise Characteristics:
1. Impulsivness
Knocking Index

Results

Knocking

Crank Angle

Cylinder Pressure

Intense Knocking
Knocking Index Infrastructure

- MATLAB R2015b
- Signal Processing Toolbox
- MATLAB Compiler
- Statistics & Machine Learning Toolbox
- Database Toolbox
Knocking Index

Benefits

- The characteristic features of Diesel sounds can be identified and quantified.
- Easy to analyze results for arriving at better decisions.
- Performance improvement in the validation of the components.
- Separation of Noise types & its characteristics.
Knocking Index

Future Scope of Work

- Influence of knocking Index parameter for Sound quality evaluation
- Implementation of Stability index along with Knocking index
- Interfacing with database & managing data
- Use of advanced visualization techniques for better representation of data & results
Knocking Index