Design and Development of Lean Burn Fuel Efficient Engine Management System for a Single Cylinder LPG Engine

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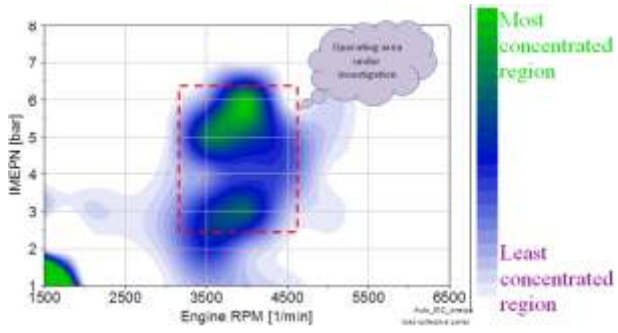
Abstract:

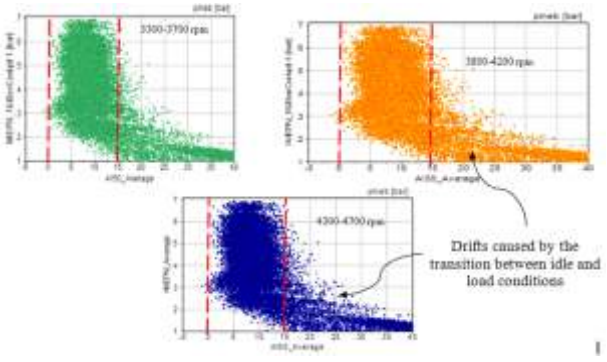
A clean and economic fuel injection system for Three Wheelers is very much needed for emission control and fuel consumption reduction point of view. An Electronic Fuel Injection (EFI) system coupled with the lean-burn capability of LPG fuel has the potential for fuel economy improvements and reduction in exhaust gas emissions. Currently there are no EFI systems for single cylinder LPG engines.

This project deals with the design and development of a lean burn, fuel efficient EFI system for a single cylinder, spark ignited LPG engine. The scope of this thesis work is limited to the investigation carried over the small single cylinder auto rickshaw LPG engine. The base carburetor engine system is analyzed and used as a benchmark for its conversion to EFI system via LPG lean burn approach using appropriate engine management system components. A comparative analysis of the carburetor and electronic fuel injection system including the potential fuel economy improvement scope has been investigated in detail. Experimental evaluation has been carried out with suitable testing facility and measuring tool sets.

In a carburetor system, driven for 1000km, emission results were meeting the BS-III limits marginally and also lean operations resulted in a drop of torque and power, which is mainly due to the improper combustion phasing. Constant NOx emission is observed in the carburetor system due to lean operation. With Electronic Fuel Injection system at = 1 operation, vehicle emissions were within ~ 50% of the BS-III legal limit. It is found that with EFI under LPG lean burn operation there is an improvement up to 14% in the fuel efficiency while still being within BS-III exhaust emission limits. The engine roughness, COV, is less than 5% for the entire engine operation map with ≈ 1.2. It can be concluded that LPG lean operation does not influence on the engine vibration unlike in gasoline fuel.



Engine operating points in IDC



Combustion phasing in IDC at λ =1