

Method for Switching a Combustion Mode from Compression Ignition to Homogeneous Charge Compression Ignition Mode

1. Technology:

Vellore Institute of Technology researchers at Automotive Research Centre have patented a method of combustion mode switch over between conventional compression ignition (CI) to homogeneous charge compression ignition (HCCI) mode. This switching method helps to change the mode of combustion by using existing injection system for any commercial automobile vehicle with help of an open electronic control unit (ECU) by maintaining engine parameters at best points. Moreover, this combustion mode swift can also be applicable for multi-cylinder engine or more than one cylinder. This method eliminates the motoring arrangement, dependency on multi-cylinder and ISG to initiate and sustain the HCCI combustion mode thereby power consumption for the above sophisticated system for initiating the HCCI combustion can also be neglected. The process of combustion mode switch over is depicted in Fig.1. Moreover, the proposed combustion mode switch over process is adopted and validated in a twin cylinder common rail direct injection diesel engine.

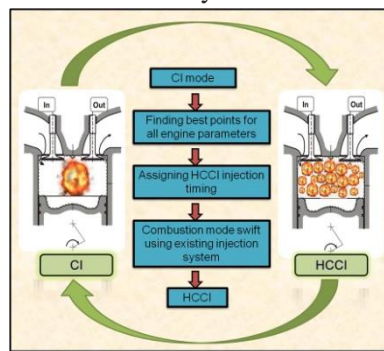


Fig.1 Combustion mode switch over

2. Problem Addressed:

The patented method addresses the prime limitations of HCCI commercialization. (1) The motoring arrangement is essential to initiate and sustain the HCCI mode and which contains an electric motor, electromagnetic clutch for disengaging and engaging with engine shaft and variable frequency transformer (VFT). (2). In some cases, more than one neighbouring cylinder in multi-cylinder engine must run in conventional combustion mode to push HCCI combustion in the respective cylinder. This method leads to imbalance in the crankshaft because of different combustion modes in the same bank of cylinder. (3) Integrated starter generator (ISG) motor is used for CI-HCCI combustion switching control to do dynamic torque compensation while doing combustion mode change. These challenges are overcome through the novel method of combustion mode switchover using existing injection system without doing major modifications on engine.

3. Industrial Applications:

- Passenger Vehicles (Fuel Economy Improvement): In urban driving, where vehicles frequently operate at low loads and speeds, HCCI can improve fuel efficiency by offering leaner combustion and lower peak combustion temperatures.
- Hybrid Electric Vehicles (HEVs): For HEVs, the engine does not always need to run at full load and can be optimized for low and medium load conditions, where HCCI is most efficient.
- Commercial and Fleet Vehicles (Emission Reduction Goals): Fleet vehicles operating in urban areas, like delivery vans or city buses, could use HCCI in low-load driving conditions and CI at higher loads.
- Light-Duty Trucks (Emission Compliance): Light-duty trucks that operate at variable loads can switch between CI and HCCI to manage emissions and fuel efficiency. This would be especially beneficial for meeting standards in regions with strict emission regulations.

4. Patent Application Number: 202041044589