OMICS Group Conferences
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International Conference and Exhibition on
Mechanical & Aerospace Engineering
September 30-October 02, 2013 Hilton San Antonio Airport, TX, USA

Experimental study of the combustion characteristics of a controlled auto-ignition two-stroke cycle engine using hot burned gas

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A new kind of alternative combustion concept that has attracted attention intensively in recent years is controlled auto-ignition (CAI) combustion. CAI combustion has been proposed and partially implemented with the aim of both improving the thermal efficiency of internal combustion engines and achieving cleaner exhaust emissions. Similar to a conventional SI engine, in a CAI engine the fuel and air are mixed together either in the intake system or in the cylinder with direct injection. The premixed fuel and air mixture is then compressed. Towards the end of the compression stroke, combustion is initiated by auto-ignition in a similar way to the conventional CI engine. Due to its significantly low temperature combustion, NOx will be dramatically reduced while the mixture will be under ultra-lean fuel-air condition, thus able to achieve high efficiency and low emission. Two-stroke cycle engines are well known owing to their light weight, simple construction, less components, cheap to manufacturing and the potential to pack almost twice the power-density than that of a four-stroke engine having similar capacity. One problem with conventional two-stroke engines is that they emit high levels of unburned hydrocarbons (HCs) because of their unstable operation at low loads .However, depending on the engine speed, equivalence ratio and quantity of combustion product either via exhaust gas recirculation (EGR) or trapped residual gases applied, it is possible to introduce auto-ignition combustion in a two-stroke engine. This combustion processes can reduce emissions of unburned HCs and allow stable engine operation by lowering the cyclic variation. Experimental study has been based on consideration of one single cylinder liquid cooled two-stroke engine. Specific accessories and parts have been designed in order to build one experimental research engine that will be operated on the CAI combustion mode. One single butterfly valve, which is mounted right after the exhaust pipe connection, will be able to throttle the exhaust gas (internal-EGR) as well as, one bypass pipeline will be connected between the exhaust and intake pipe in order to supply some portion of hot burned gas into the intake fresh charge (external-EGR). Both internal and external-EGR rate (In/Ex-EGR%), air-fuel ratio (AFR), engine rotation (rpm) and engine load (IMEP) will be varied in order to achieve the CAI combustion mode. The main purpose of this paper is to examine the effect of operating parameters (In/Ex-EGR rate, engine speed and equivalent ratio) upon combustion characteristics, performance and output emissions of the two-stroke engine converted into CAI mode. Besides, the rate of utilized hot burned gas in order to expanded CAI Combustion mode operation is estimated.

Biography

Amin Mahmoudzadeh Andwari is Ph.D. candidate in Automotive Development Centre (ADC), Faculty of Mechanical Engineering, UniversitiTeknologi Malaysia (UTM). He is a research assistant of the Automotive Development Centre as one of the Centre of Excellent (COE) in UTM with the aim to lead the research and development of automotive engineering technology in Malaysia.

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