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Design and CFD analysis of a high downforce rear wing in a Formula SAE racing car

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A design and analysis in CFD of a rear wing that generates high downforce is presented. Its dimensions are set up under the 2015 rules of the Formula SAE World Championship. Most circuits of this competition are characterized by sharp and accentuated curves demanding a vehicle with special ability for turning as fast as possible. In order to obtain high performance, is necessary a car with a special aerodynamic package that creates high downforce to generate sufficient grip between the tires and asphalt of the track. Until 2014 the aerodynamics dimensions was not strongly regulated, permitting to create aerodynamic devices with large frontal areas to obtain high downforce. Now, the 2015 regulations constrain the size of the wings, avoiding the implementation of wings with these characteristics. The main idea in our work is to show a way of recovering the downforce lost by decreasing of size, through optimization of the lift coefficient using different strategies, like creation of a special aerodynamic profile, optimization positioning, implementation of Gurney flap, vortex generators, beam wing and slats, among others. In addition, are described all of geometric and physical parameters used in a CFD simulation, and a general analysis with the overall results found.

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Effect of supercharging on the combustion characteristics of some selected fuels

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Spark ignition engines find wide applications as prime movers in light vehicles and domestic power generating units. The power output of these spark ignition engines could be improved by boosting the intake pressure and compression ratio; however the applications of these are limited by knock in engines. A reduction in cycle-to-cycle variation in engines have been noted by researchers as one of the methods of improving engine efficiency with a study showing that engine efficiency could be increased as much as 10% with a reduction in cycle-to-cycle variation. This study investigated the combustion performance characteristics of two fuels: E5 (95% gasoline and 5% ethanol) and ULG98 (unleaded gasoline) operating at varying inlet pressure conditions and ignition timing in a spark ignition engine. A two-stroke, 80 mm bore, spark ignition engine was operated at 1.6 and 2.0 bar inlet pressures using E5 and ULG98 fuels at 750 rpm and at spark-timings of 2 and 5 bTDC. A metal top cylinder head with a centralized spark plug was used for all the experiments. The Indicated Mean Effective Pressure (IMEP), IMEP Coefficient of Variance (COVIMEP), the Crank Angle of Cycle Peak Pressure (CApmax) Occurrence and the Crank Angle of Occurrence of 10, 50 and 90% Mass Fraction Burned (MFB) was determined. The results of the increase in engine intake pressure from 1.6 to 2.0 bars, showed an increase in engine IMEP for E5 of 20.7 and 21.5% and for ULG 98, 24.0 and 20.2% for 2 and 5 bTDC spark timings respectively. A reduction in the coefficient of variation of the IMEP (COVIMEP) (which is an indicator for cycle-to-cycle variability in engines) by 23.4% and 15.8% for E5 and 50% and 26.9% for ULG 98 at spark timings of 2 and 5bTDC respectively. For the crank angle of peak pressure occurrence (CApmax), an increase of 9.4 and 14.6 % for E5 was observed while a decrease of 1.7 and 11.4% was observed for spark timings of 2 and 5 bTDC respectively. The crank angle of occurrence of the 10, 50 and 90% of MFB for E5 increased with an increase in the inlet pressure by 5.7, 9.9 and 9.8% at 2bTDC and 30, 15.2 and 11.2% at 5bTDC while ULG 98 showed an increase in burning rate with an increase in inlet pressure as evident in the reduction of the crank angle of occurrence of 10, 50 and 90% MFB by 1.2, 1.7 and 1.9 % at 2bTDC and 22.8, 14.8 and 13.3 at 5bTDC. The study established that a reduction in the cycle-to-cycle variation in an engine can be achieved by supercharging or turbo-charging engines which improves the engine efficiency.

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