Literature Review on Performance of Single Cylinder Four Stroke Petrol Engine with use of Compressed Cylinder Air

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Abstract— Supercharging of intake air can improve the engine power and combustion characteristics by boosting the intake pressure above atmospheric pressure. So this is a one type of supercharger. On my basic research, the supercharging performance of a single cylinder gasoline engine on the basic theoretical investigation. Then testing physical models for different rotors and vane rotors are generated and numerical simulations are conducted to determine the desired parameters. Furthermore, sensitivity studies have been performed, to determine the effects of a different number of vanes, inner and outer radius and various angles of vanes.

Key words: supercharging of single cylinder engine; testing performance

I. INTRODUCTION

To increase the output efficiency of any engine we have to burn more fuel and make bigger explosion in every cycle. We have two options for this. One way to add power is to build a bigger engine. But bigger engines, which weight more and cost more to build and maintain, are not always better. Another way to add power is to make a normal-sized engine more efficient. We can accomplish this by forcing more air into added, and more fuel means a bigger explosion and greater horsepower. This can be done with the help of supercharger.

II. WORKING PRINCIPAL

All IC engine, work and power are generated through the transformation of the chemical energy stored in fuel via combustion or oxidation next conversion of heat energy into mechanical energy. The oxygen necessary for the combustion is extracted from the air introduced into working chamber. There for power output of IC engine is depends quantity of air and combustion partner of fuel. It is quite evident that to get more output from any engine we need to burn more fuel. More fuel will result in a bigger explosion in every cycle, which will then push the piston with more thrust, and consequently this thrust will be transmitted to the wheels with the help of crank and shaft. Wheels will rotate faster and with more power and that is how it works. But, to burn more fuel in an engine, we need more air in it (The chemically correct mixture ± (14: 1:: air : fuel) ± is essential for an engine to operate perfectly). Thus a supercharger compresses the air being delivered to the engine so as to supply more air in the same, limited volume of the cylinder. This ensures complete combustion of the fuel and no unburnt fuel comes out of the exhaust. Thus the supercharger increases the power output of any engine.

III. LITERATURE REVIEW

A. Research Paper On Air:

Fuel ratio control.

Yildiray Yildiz et. al. (2010) [1], have researched the control of spark ignition (SI) internal combustion (IC) engine fuel-to-air ratio (FAR) using an adaptive control method of time-delay systems. The objective is to maintain the in-cylinder FAR at a prescribed set point, determined primarily by the state of the three-way catalytic converter (TWC), so that the pollutants in the exhaust are removed with the highest efficiency. Two controllers, an Adaptive Feed Forward Controller (AFFC) and an Adaptive Posicast Controller (APC), have been developed and implemented in a test vehicle. The AFFC is a simple controller based on feed forward adaptation, while the APC is a more elaborate controller that uses adaptation in both feed forward and feedback paths and is based on a recently developed adaptive control method for time-delay systems.

Hyun Kyu Suh et. al. (2011) [2], has investigated multiple injection strategies for the improvement of combustion and exhaust emissions characteristics in a low compression ratio (CR) engine. His experimental analysis was conducted for a better understanding of the combustion stability and reduction of exhaust emission in low compression ratio (CR) engine. The combustion stability was analysed in terms of combustion pressure, the rate of heat release (ROHR), the indicated mean effective pressure (IMEP), and coefficient of variation of indicated mean effective pressure (COVIMEP), and formation of exhaust emissions such as CO, HC, NOX, and soot was measured and compared in the low compression ratio single cylinder CI engine. The IMEP of two pilot injection increased about 2.1% compared to single injection. The COVIMEP decreased to 33.5% in one pilot injection and 5.7% in two pilot injections. From this result, it can be said that two pilot injections improves combustion efficiency of low compression ratio engine, and the low compression ratio engine operates more stably in multiple injection conditions.

Marcus Klein et.al. (2007) [3], has analysing compression ratio estimation based pressure data. He used four methods. First three methods rely upon a model of polytrophic compression for the cylinder pressure. It is shown that they give a good estimate of the compression ratio at low compression ratios, although the estimates are biased. The fourth method includes heat transfer, crevice effects, and a commonly used heat release model for firing cycles. This method is able to estimate the compression ratio more accurately in terms of bias and variance.

Behrouz Ebrahimi et. al. (2014) [4], has researched the Air-Fuel Ratio Control of Lean-Burn SI Engines. In this paper, the engine dynamics are rendered into a non-minimum phase system using Pad approximation. A novel systematic approach is presented to design a parameter varying dynamic sliding manifold to compensate for the instability of the internal dynamics while achieving desired output tracking performance. A second-order sliding mode strategy is developed to control the AFR to remove the effects of time varying delay, canister purge disturbance,
and measurement noise. The chattering-free response of the proposed controller is compared with conventional dynamic sliding mode control. The results of applying the proposed method to the experimental data demonstrate improved closed-loop system responses for various operating conditions.

Tomoya su Konno et.al. (2008) [5], has testing AFR control for MOTOR Cycle Engine Smith Predictor and H\textsubscript{\textinfty} Control. He has focuses on feedback control of the Air Fuel Ratio (AFR) for a motor cycle engine. A feature of this paper is to identify a simple model from the fuel injection time to AFR, which captures the dynamics in various operating conditions. The model is composed of a single transfer function and a lookup table storing the gain and delay relative to the nominal model as function the engine speed, throttle position and water temperature. And then a compensator for changes of the delay is constructed using smith predictor. The effectiveness of the proposed method has been investigated by experiments.

Derong Liu et. al. (2008) [6], has researched Adaptive Critic Learning Techniques for Engine Torque and Air–Fuel Ratio Control. A new approach for engine calibration and control is proposed. In this paper, he presents our research results on the implementation of adaptive critic designs for self-learning control of automotive engines. A class of adaptive critic designs that can be classified as (model-free) action-dependent heuristic dynamic programming is used in this research project. Using the data from a test vehicle with a V8 engine, he developed a neural network model of the engine and neural network controllers based on the idea of approximate dynamic programming to achieve optimal control. He has developed and simulated self-learning neural network controllers for both engine torque (TRQ) and exhaust air–fuel ratio (AFR) control. Rodrigo C. Costa et. al. (2011)

B. Research Paper On The Effect Of Air Flow:

J. Galindo et. al. (2009) [7], has done experiment on the effect of a pulsating flow on the surge margin of small centrifugal compressor for automotive engines.

Fig. 1: measured surge line at 1000 rpm rotating valve speed with different manual valve v1 position [7]

In this experiment tests have demonstrated that compressor in terms of surge stable operation range is effectively increased when pulsating conditions in the 40–67 Hz range are present at compressor outlet. For the tested compressor the improvement in surge margin was up to 15% (equivalent to a shift of the surge line about 4 g/s) and no important effect of the pressure pulsation frequency was detected in the tested range, while pulsation amplitude linearly affected the surge margin improvement. This result is of relevance in internal combustion engine boosting applications: larger surge margin exists when compared with compressor flowcharts obtained in steady gas stands. Thus, compression ratio can be increased without experiencing surge.

J. Galindo et. al. (2008) [8], has done Experiments and modelling of surge in small centrifugal compressor for automotive engines. In this paper The experimental work was first focused on the measurement of a steady compressor map extended to the zones of flow rates under the surge limit and negative values. To do this different facility setups have been proposed. Some tests have been also carried out in deep and mild surge operation. An experimental parametric study has been conducted with different length values of the duct downstream the compressor. The results show how the surge operation may change from low-frequency deep surge to a less destructive high-frequency mild surge.

Fig. 2: Comparison of the compound and measured compressor inlet and outlet pressure under deep surge [8]

J.R. Serrano et. al. (2007) [9], has research Potential of flow pre-whirl at the compressor inlet of automotive engine turbochargers to enlarge surge margin and overcome packaging limitations. This paper presents an interesting solution based on a specifically designed inlet swirl- generator device (SGD) that palliates these negative effects. In addition, the SGD can be used to extend the surge margin of the compressor if the position of the SGD blades is modified in function of the reciprocating engine operation conditions. The results obtained show the influence of the SGD blades position on the compressor performance.
In order to better understand the influence of the SGD on the turbocharger behaviour, the flow velocity triangles near the inducer have been reconstructed using an approach based on CFD calculations.

Chehat Abdelmajid et. al. (2013) [10], has research CFD Analysis of the Volute Geometry Effect on the Turbulent Air Flow through the Turbocharger Compressor. In this study, three volutes (circular cross section with tangential inlet location, circular cross section with symmetrical inlet location, and semi-circular cross section with tangential inlet location) with the same impeller were investigated using the computational fluid dynamics. The high complexity of the flow in the centrifugal compressor volute makes the CFD modelling very difficult, only steady state flow is investigated, the choose of the volute geometry is made on the base that two geometrical parameters, which affect the overall performance and operating range, are studied at the same time. which are:

1) The shape of cross section of the volute
2) The location of the volute inlet

C. Research Paper On Fuel Economy:
Toshihiko Noguchi et. al. (2007) [11] has research Development of 150000 r/min, 1.5 kW Permanent-Magnet Motor for Automotive Supercharger. This paper discusses an optimum design of an ultra-high-speed permanent-magnet synchronous motor (PMSM), which is applied to a supercharger of an automotive engine. Although the motor is driven by an inverter with a 12-V DC bus voltage due to an automotive power source, it achieves the maximum rotating speed of 150000 r/min and the rated output of 1.5 kW. Since the power source strictly restricts the motor terminal voltages and the fundamental operating frequency is as high as 2500Hz, it is significant to pursue further reduction of the synchronous impedance in the motor, paying attention to its per menance coefficient. In the paper, a FEM-based electromagnetic field analysis is conducted, followed by a theoretical discussion on the optimum machine design. Li Wei et. al. (2007) [12], has study on improvement of fuel economy and reduction in emissions for stoichiometric gasoline engines. This paper presents the experimental study results carried out on an electronically controlled fuel injection ‘stoichiometric gasoline engine’ by using cold EGR and increasing ‘compression ratio’ to improve fuel economy and reduce emissions. When the compression ratio is increased from 8 to 11.8 and EGR ratio as well as air swirl ratio of the engine are optimized, the fuel economy is improved by 5.3% and the NOx and (NOx + HC) emission is decreased by 54.8% and 43.2%, respectively at (wide operating throttle) WOT speed characteristics. Based on the measured indicator diagrams, the rate of heat release is calculated and the combustion process is analysed. The results is that the combustion process is remarkably improved.

IV. Conclusions
There are so many researches on engine efficiency, but SI engine has low efficiency compare to DI engine. Because of SI engine has low compression ratio than DI engine. In wide operating throttle condition in SI engine has poor efficiency due to the low A:F ratio, so Supercharging of intake air can improve the engine power and combustion characteristics by boosting the intake pressure above atmospheric pressure, by using of supercharger it can increase compression ratio in engine. It can be increase torque also.

REFERENCES
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