ANALYSIS OF INTERNAL COMBUSTION ENGINE BEHAVIOR THRU KNOCKING AND FIRING CONDITION

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ABSTRACT

Engine knock and firing are well-recognized phenomenon in an internal combustion engine. These phenomenon contribute to less fuel efficient system and causing damage to engine components and affect the engine behaviour. In this paper, the study of CPS signal is carried out from an engine to initiate the spark ignition timing and fuel injection timing. The study uses a single cylinder four stroke engine equipped with fuel injection system. Arduino controller is design to initiate spark plug ignition timing, fuel injection timing and control the fuel intake for the system. The signals are recorded by Instrustar DAQ, and to analyse and compare with previous research.

Keywords: fuel injection, fuel injection timing, performance, signal, spark plug ignition timing

1.0 INTRODUCTION

The growing number of vehicle on the road around the world arose the possibility of high pollution environment. This issue is a major concern for the future generation. (Mansha, Shahid, & Qureshi, 2012) mentioned about the pollution from exhaust emission is dangerous to human health and can produce more hazardous pollution. Spark ignition combustion engine is well known in automobile industry and widely be implemented for every vehicle. Spark plus is used to ignite the flame inside the combustion chamber.

(Xu et al., 2015) stated that fuel injection system is another device that can be used in the automobile engine. Fuel injection system fits into two category which are multipoint port injection and single point throttle body injection. These systems functioned in the same manner where the fuel is injected into the intake port for each engine cylinder and required one injector per cylinder. These systems both utilize mechanical injection systems and electronically controlled injection systems.

In the combustion engine system, spark plug play a vital role to ignite the flame inside the combustion chamber. (Reyes, Tinaut, Melgar, & Pérez, 2016) suggested spark plugs can be manipulated to overcome the imbalance combustion. Improper combustion inside the combustion chamber will lead to knocking phenomenon and also contribute to exhaust emissions (Pauzi, Bakar,
This matter can be solved by developing the multiple variable controller to actuate the right timing to the spark plugs by (Beccari, Pipitone, & Genchi, 2016). This paper is to propose acquire signal of CPS from an engine to initiate the spark plug and injection timing.

2.0 METHODOLOGY

Charging coil is identified and reviewed as the part is used to actuate the spark plug. The study of signal of crank position sensor (CPS) is carried out based on the frequency emitted by the CPS and fuel injection timing will be reviewed alongside this signal. An engine controller will be designed to initiate the spark plug timing and injection timing based on these parameters and the data will be recorded and analyze for further analysis. The overall project flowchart is shown below in Figure 1.

2.1 Experiment Setup

A Modenas GT128 single cylinder engine at ISI Laboratory, School of Aerospace Engineering, Universiti Sains Malaysia cylinder is mounted on an engine bench. Signals of CPS are recorded to identify frequency to spark plug timing and injection timing activation. The data will be used to design the engine controller. Figure 2 shows the equipment for the experiment.
A switch will be controlling the artificial knocking and misfire conditions. The Arduino controller will be controlling the spark timing and fuel injection timing. Therefore the switch for artificial misfire condition is located with the same controller. The accelerometer mounted on the engine will record the signal during the knocking and misfire condition are activated.

Figure 3 show the accelerometer is mounted to the engine block, red and black wire is attached to the oscilloscope to record signals. There are few wire wrapped with a black tape. It contains charging circuit and CPS wire circuit. CPS wire circuit is attached to oscilloscope to identify the signals. The signals are identified to design the Arduino controller for the engine.

![Accelerometer Attached To The Engine And Cps Wire For Signals Identification](image)

3.0 RESULT AND DISCUSSION

Figure 4 show signals from CPS at channel 1 and spark at channel 2 are recorded. The signals indicate an acceleration at idling speed of 1000RPM. The fluctuations show it produced alternate current, constantly within 5V. Different signals recorded for high speed condition. Furthermore, figure 6 shows signal at high speed, about 2000RPM. CPS signals show constant signals voltage but different width of peak to peak. These figures show the speed of the engine, whether it is on idling condition at low speed, acceleration from low speed to high speed or constantly in high speed condition.
Figure 4: CPS Signals Range At 1000rpm

Figure 5: CPS Signals At 1000rpm For One Cycle
3.1 Discussion.

From the signals recorded, it is possible to design spark plus timing controller based on the signals from the CPS. The CPS produced a constant voltage of 5 V but different fluctuation between peak to peak conditions. The signals show the speed of the engine, where it is possible to actuate the spark plug timing based on the peak to peak distance and actuate the artificial pulse of the fuel injection between the each cycle.
4.0 CONCLUSION

Based on the analyzed CPS signals, the peak to peak signal is the main trigger to spark plug timing using Arduino controller. The 5V of CPS signal is able to initiate spark timing constantly. Furthermore, the peak to peak initiate good timing based on the air fuel ratio and engine speed. In future analysis, knocking condition and the timing of the fuel injection can be initiated through the control unit.

REFERENCES


