START STOP SYSTEM

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PENGAKUAN

Saya menngisytiharkan kerja dan perkataan kenyataan yang diggunakan didalam laporan ini adalah hasil kerja saya dan setiap butir maklumat yang diggunakan telah diberi peningiktirafan kepada penulis asal dan telah dijelaskan sumbernya.

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PENGHARGAAN

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ABSTRACT

Most of the car in this world are using combustion engine. The combustion engine give a good power, handling, comfort and cheaper compare to the other type of car. Due to global warming, people starting to change into HEV and EV car for zero or less emission car in order to reduce the greenhouse effect. However, the HEV and EV technology are quite expensive and still under development stage and has lots of problems. In order to comply with strict emission standard produce and to support the reducing emission campaign, engineers developed a system call start stop system which can be apply in Internal Combustion Engine and also hybrid car. This system use the cylinder deactivation and activation method in order to produce less emission. The strategy that been used was adjusting the fuel injection timing and controlling the ignition system. This report shows how to model engine using Simulink and also 1D modelling using GT-POWER software. Using engine parameter equation, the engine were able to be model and can be validated. After that, the experiment of tuning and manage the ECU in order to achieve the start stop strategy. After doing some analysis by changing two parameter which was the size of the diameter or intake manifold and also the length of the intake manifold, the result shows that there are slight difference between the emission produced and fuel consumption. By having to use GT-Power software, lots of analysis and further research can be done to get a better performance of an engine.

ABSTRAK

Kebanyakan kereta di dunia ini menggunakan enjin pembakaran dalaman. Enjin pembakaran memberikan kuasa, pengendalian, keselesaan yang lebih baik dan lebih murah untik dibandingkan dengan jenis kereta lain. Disebabkan pemanasan global, orang mula untuk menukar ke kereta HEV dan EV untuk kereta kosong pelepasan gas merbahaya atau kurang pelepasan gas merbahaya dalam usaha untuk mengurangkan kesan rumah hijau. Walau bagaimanapun, kereta HEV dan EV masih belum siap sepenuhnya dan mempunyai banyak masalah. Dalam usaha untuk mencapai hasil piawaan pelepasan gas merbahaya dan untuk menyokong kempen mengurangkan pelepasan gas merbahaya, jurutera mencipta satu sistem "start and stop" yang di mana boleh digunakan di dalam Enjin Pembakaran Dalaman dan juga kereta hibrid. sistem ini di mana menggunakan penyahaktifan silinder dan kaedah pengaktifan dalam usaha untuk menghasilkan pelepasan gas merbahaya yang kurang. Strategi yang telah digunakan telah melaraskan masa suntikan bahan api dan mengawal sistem pencucuhan. Laporan ini menunjukkan bagaimana untuk model enjin menggunakan Simulink dan juga model 1D menggunakan perisian GT-POWER. Menggunakan persamaan parameter enjin, enjin mampu untuk menjadi model dan boleh disahkan. Selepas itu, eksperimen penyubahsuaian dan pengurusa ECU untuk mencapai strategi "start stop system". Dengan mengubahsuai ukur lilit dan panjang paip pancarongga pengambilan, analisis simulasi enjin pembakaran dalaman dapat dijalankan. Hasil analisis menunjukkan ada sedikit perubahan kadar pengeluaran emissi dan juga kadar penggunaan minyak keta. Dengan adanya perisian GT-Power ini, banyak analisa dan eksperimen dapat dijalankan untuk mendapat prestasi enjin yang terbaik

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CHAPTER 1

INTRODUCTION

1.0 INTRODUCTION

Internal combustion engine are widely use all over the world. Internal combustion engines is where the combustion takes place within the engine. (Ganesan, 2004). Internal combustion engines uses hydrocarbon compounds such as gasoline as a source of energy to move the vehicles. the internal combustion engines which convert chemical energy from gasoline into the mechanical energy to give energy for car to move. However, the products that been produced for example exhaust gas were not good for environmental.

Some of the products that been produced by vehicles such as CO_2, CO, and NOx were toxic and harmful to environment and our body. About 17.9 percent of the total hydrocarbon emission, 30.9 percent of total carbon monoxide emissions, and 11.1 percent of the oxides of nitrogen emission were produced by passenger car. Imagine what will happen in the world in the future if this gaseous were not controlled and regulated.

To prevent and reducing the emission, engineer all around the world begin their researching to reduce emission that been produce by the passenger car. It been known that catalytic converter is the most effective devices for controlling exhaust emissions. In the past, lots of ways that been use for example auxiliary air injection, exhaust gas recirculation and positive crankcase ventilation. But by using this way, it will effect the power produce and consume lots of fuel. Since the catalytic converter was been introduced, the fuel consumption can be reduce too.

1.1 PROBLEM STATEMENT

A mixture of fuel and air that ready to be burn are waiting for the spark plug to plug some fire and ignite the mixture to produce power in the engine. Spark plug is one of the essential parts in the engine cylinder to make sure the combustion process occur smoothly. The challenge was to control the spark plug whether to turn it on or off so the combustion doesn't occur in order to reduce the fuel consumption.

For gasoline engine, the fuel injection that been use was indirect injection which is low pressured time injection. The fuel injection function to inject the fuel before the valve and to maintain 14.7 : 1 ratio in the combustion chamber. By adjusting the timing of the injection, rich or lean mixture can be produced to vary the performance of the engine.

1.2 OBJECTIVE

The objective of the research was to develop ECU control strategy for the optimization of the internal combustion engine. Another objective was to use the engine management system to activate and deactivate the engine cylinders,

1.3 SCOPE

The scope of the research was :

1. To improve the fuel consumption of the vehicles.
2. To reduce the emission produce by the vehicles.
3. To use the GT-Power software to model and simulate the engine.
4. To study the cylinder deactivation system.

CHAP 2

LITERATURE REVIEW

2.1 HISTORY OF THE INTERNAL COMBUSTION ENGINE

The first Internal Combustion engine was developed by a French guy name J.J.E. Lenoir (1822 – 1900) in the year 1860. Back then coal gas and air mixture were drawn into the engine cylinder during 1st half of the stroke then being ignited by a spark. Pressure rises and the product of the combustion delivered the power to piston in the second half of the stroke. Then on the return stroke, the cylinder discharged the gases from it. It was possible to do return stroke by using a large flywheel which stored energy during the power stroke and dissipated energy during the return stroke.

In German, Nicolaus A. Otto (1832 – 1891) and Eungen Langen (1833 - 1895) developed a free piston engine. After that, in 1862, Alphonse Beau de Rochas (1815 – 1893), a Frenchman, explain the principal of four stroke cycle and the condition to obtain maximum efficiency in Internal Combustion engines. However, de Rochas could not build the engine himself based on his principal, then Nicolaus August Otto built an engine based on these principal. The engine basically work on four stroke principal which are intake, compression, expansion or power and exhaust strokes. Otto had achieved great achievement by reducing the weight of the engines and volume and also give higher thermal efficiency.

By the 1880s, Dugald Clerk and James Robson of the UK and Karl Benz of Germany developed the two stroke internal combustion engine. In 1885, James Atkinson of England developed and engine with an expansion stroke larger then compression stroke. In 1882, Rudolf Diesel (1858 – 1913) build a different type of engine which a high compression ratio was used to ignite a fuel. (H.N. Gupta, 2006)

2.2 THE WORKING PRINCIPAL OF ENGINES

Using small spark to ignite the combustion in combustion chamber which give power to the engine. Using this principle, lots of type engine produced such four stroke cycle, and many more.

2.2.1 FOUR STROKE SPARK IGNITION ENGINE

In figure below, there are four main steps in operating cycle of engines. The first one is the induction/intake stroke. This part where the mixture of air and fuel entering the cylinder with the ratio 14.7 : 1. Then the compression stroke where the pressure increased because of the compressed air inside the cylinder. Third step is the power stroke where the combustion will occur. Lastly the exhaust stroke where the burn gas or exhaust gas is forced out of cylinder.

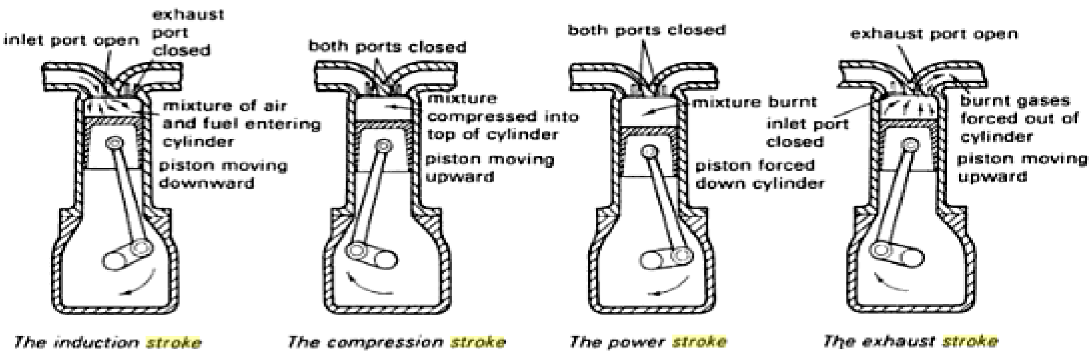

Figure 2.2.1.1 Operation of the engine on four stroke cycle

Sources : (V.A.W Hillier, 2004)

a) **Intake** – the process where the piston are moving from TDC (top dead centre) to BDC (bottom dead centre) of the cylinder making some space for the air fuel mixture to enter the chamber. In this process the inlet valve will open and then the exhaust will closed so no air fuel mixture escape from the chamber.

b) **Compression** – process where the piston move from BDC to TDC to compress the mixture. Both inlet and exhaust valve were close. The mixture were placed at the clearance volume where the combustion will take part later.

c) **Power –** during the power stroke, both valve also closed. The spark plug will ignite the mixture, and then the mixture will burn and give power to force the piston move towards BDC. Great change in pressure and temperature occur during this process.

d) **Exhaust –** exhaust stroke is the process where the exhaust valve will open to let out the burn gas out of cylinder. The piston move from BDC to TDC to clear up the gas inside the cylinder but still some trapped gas inside clearance space trapped call residual gas. Then this residual gas with combine with fresh gas and compressed again to do the cycle again.

2.2.2 ENGINE CYLINDER GEOMETRY

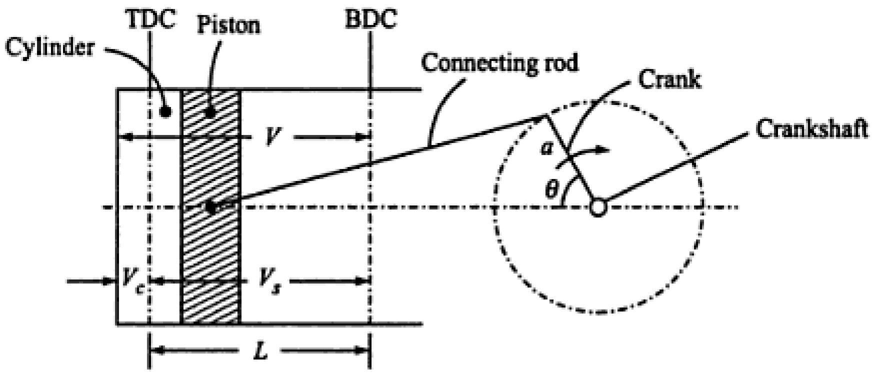

Figure 2.2.2.1 Basic terminology

a) **Bore (d)** – the inside diameter of the engine cylinder. Bore name come from the process of manufacturing using the boring process

b) **Stroke (L)** – during the travel of the piston, there is an upper as well as lower limiting position at which the direction of the motion is reversed. The linear distance through which the piston travels between the extreme upper and lower position of the piston is called the stroke. Stroke is equal two time crank radius.

$$L = 2a \quad (\text{ equation } 2.1)$$

Where a = crank length

L = stroke length

c) **Top Dead Centre** – the position where the piston will travel to the topmost position. This is where the piston is at the farthest from the crankshaft.

d) **Bottom Dead Centre** – the position of piston when they are at the bottom part of the cylinder. The nearest position against crankshaft.

e) **Clearance Volume, V_c –** the position when the piston at the TDC, the trapped air is contained at the top part of the cylinder called clearance volume. The piston cannot reach this place. This place always clear.

f) **Piston Displacement, V_s –** the volume displaced from the position of TDC to BDC,

$$V_s = \frac{\pi}{4} d^2 L \text{ (equation 2.2)}$$

Where,

d = bore

L = stroke

e) **Cylinder volume, V –** includes both the clearance volume and swept volume

$$V = V_c + V_s \text{ (equation 2.3)}$$

f) **Compression Ratio, r –** ratio of the total cylinder volume to clearance volume

$$R = \frac{V_c + V_s}{V_c} \text{ (equation 2.4)}$$

g) **Mean piston speed –** the speed of the piston is zero at the TDC and BDC. It achieved maximum speed in the middle of the position between TDC and BDC. The crank angle θ is zero at TDC, it is 90° when the piston speed is maximum and 180° at BDC. Thus in a half rotation of the crank, the piston moves a distance equal to the length of the stroke, L. in full rotation, the distance travelled by piston will be 2L. If N is the engine speed in revolution per minute (rpm) and L is in metres, the mean piston speed will be 2LN/60 m/s. (H.N. Gupta, 2006)

2.2.3 OTTO CYCLE

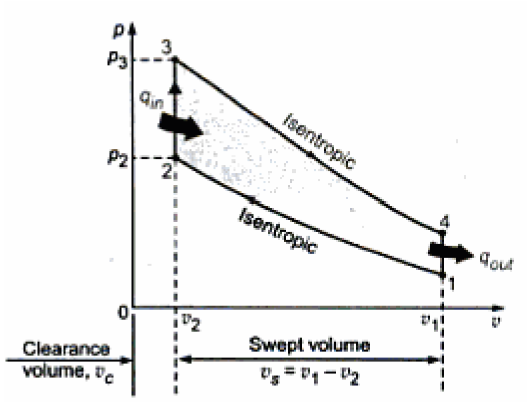

Figure 2.2.3.1 shows the P-V diagram of Otto cycle (source : M. Ratore, 2010)

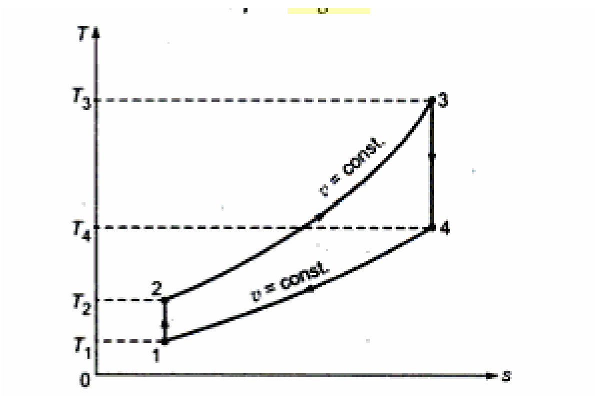

Figure 2.2.3.2 shows the T-S diagram of Otto cycle (source : M. Ratore, 2010)

From figure 2.2.3.1, the otto cycle in terms of pressure and volume. The process of 1 to 2 shows isentropic compression of the air when the piston moves from BDC to TDC. Process 2 to 3, heat is supplied at constant volume. This is the process where the spark ignition and combustion take place in engine. Process 3 to 4 and 4 to 1 shows isentropic expansion and also heat removal.

The thermal efficiencies is important to show how good the engine can perform. The thermal efficiencies for the Otto cycle is

$$\eta_{Otto} = \frac{Q_S + Q_R}{Q_S} \quad \text{(equation 2.5)}$$

Where ;

Q_S = m C_V $(T_3 - T_2)$ (equation 2.6)

Q_R = m C_V $(T_4 - T_1)$ (equation 2.7)

2.3. IGNITION SYSTEM

Ignition is very important in order to have a combustion to started. For spark ignition engines, using electrical discharge to produce the spark between two electrode.

2.3.1 Function Of The Ignition System

In the diesel engine, the gas were compressed till it can burn automatically due to high pressure and temperature. But in the Otto engine which is spark ignition engine, to start the combustion, assist from spark plug is needed to ignite the air fuel mixture inside the cylinder. The ignition system has three mains jobs:

1. Spark production – the ignition system must be able to quickly build enough high voltage sufficient to satisfy the requirements to ignite the air fuel mixture and maintain the adequate burn time for complete combustion.
2. Spark timing control – the ignition system must be able to alter the delivery time of the spark to account for rpm, varying load, and demand conditions.

3. Spark distribution – the ignition system must be able to deliver spark to the correct cylinder at the right time during the compression stroke in order to begin the combustion process.

4. After the combustion take place, strong pressure force the piston to do power stroke so the piston move from TDC towards BDC. In order to achieve the maximum pressure for the combustion, the piston position should be 10 degrees or 20 degrees after top dead center (ATDC) (source : Ken Pickeril, 2010). This is because the combustion of air fuel mixture take some time and the combustion must occur before the piston is on power stroke. Then the spark should ignite before the piston reach the TDC so the combustion can occur. As increasing in speed, the ignition occur need to ignite earlier. Figure 2.3.1.1 shows differ in angle in differ speed.

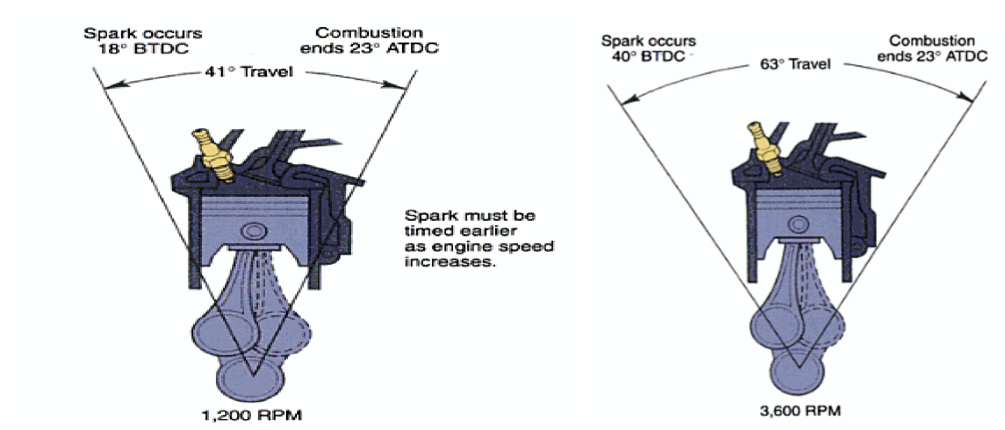

Figure 2.3.1.1 shows with increasing speed, ignition must start earlier. (source : Jack Erjavev, 2005)