

CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Combustion is the most important process taking place in spark-ignition (SI) engine, in which chemical energy of fuel is transformed into internal energy of the cylinder charge. During this process, a turbulent flame propagates across the combustion chamber and burns the premixed fuel-air mixture. The turbulent flame generally can be assumed in spherical shape (Bayraktar, 2006). The turbulence enhances the mixing process, and hence increases the combustion rate. Thus, combustion can be considered as turbulent flame propagation process.

Theoretically, as the flame propagation become faster, more efficient engine operation can be obtained. Faster burning is essential as it can reduce engine knock means higher compression ratios results to higher efficiency, higher power output and engine can operate in stable condition (Bayraktar, 2006). Moreover, better combustion together with leaner mixtures may also reduce hydrocarbon emissions from the engine. A commonly suggested method to analyses flame propagation is using computer simulation. Computer simulation of the combustion process in spark ignition began several decades ago.

The combustion process in spark ignition engine has been studied very extensively in the past. These studies have come up with, initially the flame is relatively smooth and as it grows, the flame front becomes increasingly influenced by the turbulent flow through it spreading and eventually develops a highly wrinkled and possibly multiply connected structure. The control of these variations could lead to improve engine operations in terms of economy, drivability and exhaust emissions.

1.2 PROBLEM STATEMENT

The purpose of this project is to analyze the flame propagation process and to propose a method to measure the flame radius inside combustion chamber. Flame propagation is useful in internal combustion engine as one can determine the engine efficiency, emission and many more. Therefore, a correct method to study the flame propagation and analyze the flame radius is needed to give better understanding on how flame propagates within combustion chamber.

1.3 OBJECTIVES OF THE PROJECT

The objectives of this research are:

1. To analyze the flame propagation process.
2. To propose a measurement method of flame radius within combustion chamber.

1.4 SCOPES OF THE PROJECT

The scopes of study covered the study of analysis the flame propagation process and to come up with method to measure the flame radius within the combustion chamber. First of all, in order to model the problem, the engine was modeled using based on the carbureted gasoline engine, Mitsubishi Magma 4G15, 12 valve, 1.5 litre engine with pent-roof combustion chamber. The type and the specification of this engine are shown in Chapter 3. The model was created as it can be compared to the reality engine design and it helps to improve understanding of how flame propagates inside the combustion chamber. Next, the model has to undergo meshing process.

The purpose of doing meshing is to analyze the fluid flow inside the combustion chamber. Before running the simulation, points are created inside the combustion chamber for the measurement of flame radius. For this study, the simulation has been carried out at constant engine speed of 2000 rpm. The main interest parameter is cylinder pressure as is used for validation between the simulated

and experiment. Other parameters that are discussed are flame propagation in terms of progress variable and lastly flame radius.

1.5 FLOW CHART

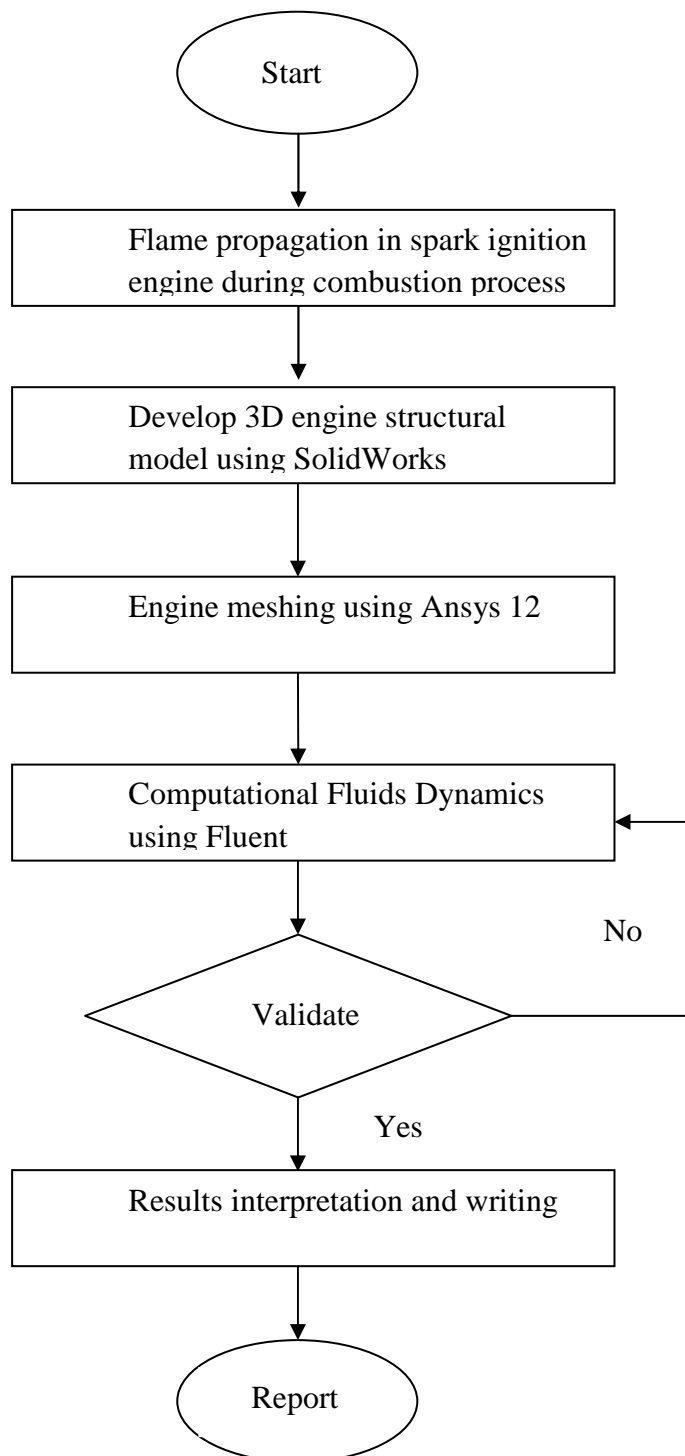


Figure 1.1: Project flow chart