CHAPTER 1

INTRODUCTION

1.1 PROJECT BACKGROUND

Gas turbines became increasingly used as power plants for a wide variety of applications around the world. Originally they were developed solely for aircraft propulsion where their inherent low specific weight (i.e. mass/unit power) made them essential for high speed flight. For this particular purpose they have been developed to a high degree of efficiency both thermodynamically and mechanically. Due partly to the impetus from the aircraft engine field and to other significant operational advantages, industrial gas turbines have been and are being developed for such diverse applications such as electrical power peak lopping stations, fire fighting pump sets, natural gas pumping and compressor units, factory power and process heating plants, heavy lorry propulsion, rail and ship propulsion [6].

The theory and design of artificial neural networks have advanced significantly during the past 20 years. Much of that progress has a direct bearing on signal processing. In particular, the nonlinear nature of neural networks, the ability of neural networks to learn from their environments in supervised as well as unsupervised ways, as well as the universal approximation property of neural networks make them highly suited for solving difficult signal processing problems. From a signal processing perspective, it is imperative to develop a proper understanding of basic neural network structures and how they impact signal processing algorithms and applications. Neural networks are being trained to predict the output thrust produce of gas turbine and other industrial processes. They then replace complex and costly equipment used for this purpose in the past [1]. Research on uncertainty analysis of this

project will be utilising the proposed methods involving Artificial Neural Network (ANN) approximated function together with sequential perturbation numerical method.

1.2 PROBLEM STATEMENT

Uncertainty analysis can be divided into two case studies which are known function or specific function and unknown function. As for the known or specific function, either a simple function or a complex function were frequently encountered and due to this function existence, the proposed methods can always be use to solve them. The type of method that can be utilise in order to solve a simple function is by analytical method or more specifically Newton approximation method. However, for the complex function, it is more convenient to use numerical method or to be exact, sequential perturbation method though there is nothing wrong in using Newton approximation method except that the function itself is not appropriate for applying partial derivation as it might end up by consuming a lot of time.

Major setback here is for the unknown function. Differ from known function or specific function, unknown function cannot be solve by any of those proposed methods, neither Newton approximation method nor sequential perturbation method as the exact function is unknown and data obtain from experiment were the only source available right now, therefore any partial derivation or sequential perturbation cannot be done to obtain the overall uncertainty. Till now, there were two types of approaches that were recorded which are the structure approximation approach and the black box approximation approach in order to analyse the data but yet not finding the function. Hence for this project, as if having a case where a single known function is yet to be found, the propose method which is Artificial Neural Network approximation function will be use in order to find the function approximation of data obtained from experiment and only then sequential perturbation numerical method can be utilise to obtain the overall uncertainty. For further understanding and clarity on what uncertainty analysis is all about, a flow chart of uncertainty analysis is provided below.

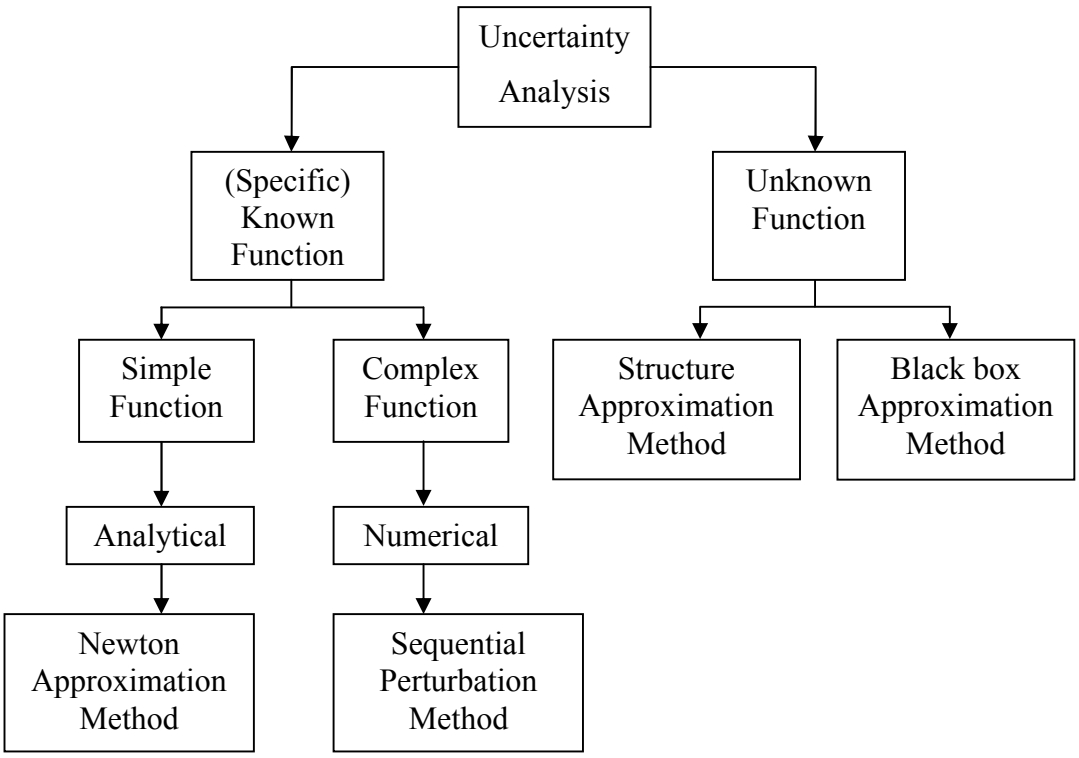

Figure 1.1: Flow chart of uncertainty analysis

1.3 OBJECTIVES

Crucial purpose of this project is to study about the propagation of uncertainty for two-shaft gas turbine's parameter using sequential perturbation method in application where the function was approximated using Artificial Neural Network (ANN).

Additional intention of this study is to attest that uncertainty analysis is possible through sequential perturbation method in application where the unknown function is complex or multivariable and is approximated via Artificial Neural Network (ANN).