CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Machining process is a widely used method of production method to remove excess material to get the desired dimension. Machining processes can be classified into traditional machining process or nontraditional machining process. Traditional machining processes are milling, turning, and etc. while the nontraditional machining processes are electrical discharge cutting, chemical milling, and etc.

Milling process is one of the most adaptable traditional machining process where a rotating cutter removes the material while traveling along different axes with respect of the workpiece. Milling is able to produce a part with very compact shape but still very close to the tolerance and with a very fine finishing surface.

Due to the ability of milling process to produce workpiece with intricate profiles or complicated shape, it has been classified as commonly used machining process. An end mill is used in the machining process to remove the material on the workpiece. This cutter can be either having a straight shank for a small size cutter or a tapered shank for an end mill with bigger diameter. The cutter has different kinds of geometry such as cylindrical end mill, ball end mill, bull nose end mill, and other geometries [1]. The end
mill is installed on a tool holder and mounted on the spindle of the milling machine. Generally, the cutter is made from high speed steel (HSS) but it may be made from carbide or cobalt and come with a protective coating to increase its surface hardness [2].

The quality of the end milling is related to the milling parameters such as cutting speed, feed, cutting time, material removal rate, and etc. Other than these parameters, the quality of the surface is also depending on the condition of the cutting tools. The quality and wear of the end mill will affect directly the result of the end milling process. Normally the wear pattern found in the ends mill are flank wear on the cutting edge and center wear on the tool tip [2]. A worn end mill will give a damaged surface to the workpiece, thus it is very important for us to understand the wear mechanism of the end mill and remaining useful life of it.

This research paper is focus on estimating the amount of wear and predicting the remaining useful life of an end mill. A few different prediction methods have been established to know the remaining tool life of the cutter. The approaches available are Artificial Neural Network [3], Fuzzy Neural Network [4], Support Vector Regression [5], and etc. Different prediction methods were investigated in this research paper to determine the best approach for remaining useful life prediction. The data driven approach is selected to be investigated in this research paper.

1.2 PROBLEM STATEMENT

In the manufacturing sectors nowadays, end milling process is a machining process that is widely adopted. The condition of the tool cutter is very important as it represents the remaining useful tool life of the cutter. The failure of a cutting tool occurs when it has come to the end of its service life. A worn tool will cause the workpiece to
have inferior quality and increased surface roughness. In some cases, if the wear of the tool was not detected, it may cause damage to the milling machine or may even cause accidents. This has negatively impact the usefulness of milling process [5].

Therefore, it is important to conduct this research to determine the best approach to estimate the wear of an end mill and predict its remaining useful life. The main focus of this research will be on the data driven type of prediction method with the help of MATLAB software in the analysis of data. This research will investigate different prediction methods using MATLAB to increase the reliability of the tool life prediction model. This allows us to reduce the manufacturing costs by reducing the scrap produced due to the broken tools and the service life of the end mill cutter can be fully utilized before it is disposed away.

1.3 OBJECTIVES

The objectives of this project are:

1. To predict the remaining useful life of an end mill cutter.
2. To investigate and compare different prediction methods available using MATLAB software.
3. To propose the best approach to predict the remaining tool life end mill cutter.

1.4 PROJECT SCOPE

The scope of this project is to investigate the methods available to estimate the wear of the end mill and predict its remaining useful life. The prognostics prediction approaches for remaining tool life can be classified into three types which are model based