CHAPTER 1

INTRODUCTION

1.1 Introduction

Chapter 1 will discuss about the background of the project, problem statement, objectives to be achieved in this project, as well as the project scopes.

1.2 Project Background

Incremental sheet forming (ISF) is a versatile sheet metal forming process where a sheet metal is formed into its final shape by a series of localized deformation. Generally, the process can be carried out on a CNC machine, where the perimeter of the sheet metal is clamped in a special blank holder. While the forming tool is attached to the CNC machine, it is usually round-ended with a diameter of 5 to 20mm, moving along a designed tool path and continuously indent the sheet following the contour until the final part is formed.

The ISF process has been introduced to the manufacturing industry since the last decades, although patents showed that ISF existed before the year 1993, but it did not contribute to the development of the modern ISF. Major growth of the modern ISF began in the 1990’s, where the works were initiated by Iseki and his partners in Japan. The process started to vary from single point incremental forming (SPIF) to two point incremental forming (TPIF). Researches on ISF begins to expand to the western countries in this century (Emmens et al, 2010).
SPIF and TPIF are the most widely used methods of incremental sheet forming. SPIF uses a single indenter to form the sheet metal which was clamped around its edges, whereas in TPIF a male or female die is involved, together with a second indenter (Jackson & Allwood, 2009). However, SPIF is more favourable in batch production due to the elimination of die which leads to low production costs and reduced production time. SPIF also found increasing of demands in rapid prototyping. Although ISF is considered a promising and feasible technology in forming sheet metal products, many researches are still undergoing to improvise the process such as improving the formability, improving the accuracy, eliminating springback, optimizing surface roughness etc. Figure 1.1 and Figure 1.2 shows the example of SPIF and TPIF.

**Figure 1.1:** Example of Single Point Incremental Forming (SPIF)

**Figure 1.2:** Example of Two Point Incremental Forming (TPIF)
1.3 Problem Statement

In the recent manufacturing industries, the demands for sheet metal forming is increasing rapidly. Although mass production remained dominated in the industry, batch production also facing strong competitions in terms of production cost and time. For high volume production, traditional sheet metal forming methods such as drawing and stamping are still the most effective ways to produce a large number of parts in a short period of time, it is because the high cost of initial capital investment can be shared among a large amount of products. However, for batch production, which usually involved customized products, traditional forming methods are not suitable as the highly specialized tools and dies are expensive and time consuming to produce, which will cause higher costs of products. Therefore, ISF is gaining its important role in the sheet metal forming industry, which is to reduce the set-up cost and production time.

Even though ISF is considered as a capable and promising technology in forming sheet metal parts, the process still has many shortcomings that need to be overcome. Among the drawbacks include geometric accuracy, surface roughness, formability, and forming speed. Many studies have been done in order to optimize the process by varying the process parameters, such as tool diameter, wall angle, tool path, step size, sheet thickness, spindle speed, and feed rate, but the mechanism is still not fully understood. Hence, better understanding of the mechanism of ISF is required to improve the part precision in order to achieve higher quality of products.