Cutting orientations for non-complex parts in 4th axis machining

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Abstract. The application of Computer Numerically Controlled (CNC) machining for Rapid Manufacturing processes (CNC-RM) exploits the innate potential of 4th axis machining. The use of an indexer allows the workpiece to be rotated to various orientations which directly increased the region accessible to the cutting tool. However, in order to avoid thin webs and preserve tool life, cutting must be executed with a minimum of three orientations even for geometrically simple parts. Recent findings have suggested the separation of cutting orientations into roughing and finishing operations. Thus, the selection of orientations in finishing processes becomes more flexible and independent. This study was conducted to identify the effects of using a minimum of two cutting orientations in finishing operations for CNC-RM applications. This method is only applicable for non-complex parts where all the features can be machined from two directions. The results of the study illustrate the positive effects of minimizing the number of orientations. Despite improvement in machining operations, the complexity in defining the cutting orientations was also reduced.

1. Introduction

Computer Numerically Controlled (CNC) machines are one of the most important elements in current manufacturing industries. This technology has been used in many areas of production such as moulds and tooling, biomedical parts and customized products. Accordingly, the way of this technology being implemented has evolved and is not only restricted to conventional machining operations. Over the past decade, a distinct machining method has been introduced by integrating 3-axis CNC milling machines with indexable rotating devices [1]. The integration allows cutting processes to take place in 4 axes which expands the workpiece cutting area. Additionally, machining can be executed continuously without the need for any re-fixturing. This realizes the implementation of CNC machines in rapid manufacturing processes (CNC-RM). Figure 1 illustrates the mechanism of clamping the workpiece in an indexable rotational device. This process allows cutting operations to be performed in various rotations of one axis and is capable of producing complex shapes and features [2].

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