Development of machining simulation application using visual basic programming in NX CAM system environment

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ABSTRACT – This paper presents the integration of visual basic programming in NX Computer-Aided Manufacturing (CAM) system with 4th axis milling simulations as machining routines. A customized graphical user interface (GUI) was developed to simplify the simulation process planning and reduce the dependency on user's experience while developing the machining program in NX CAM system. The simulation operation construction code was recorded by using journaling tool that available in NX CAM. Then the code is modified in visual basic program to build custom machining simulation applications. The results indicate that the developed programs are capable to optimize 4th axis machining simulation by reducing the processing steps and time with minimum process planning tasks.

1. INTRODUCTION

Simulation in manufacturing is defined as the imitation routines of the selected operation in real processes for pre-evaluation purposes. The behavior of machining processes and response parameter is studied by developing a simulation model for cutting operation before proceed into real machining. The simulation is carried out to identify the issue or problem at early stage of machining [1]. It is important to investigate the machining processes by simulating the operation to ensure the result is similar as expected. Simulation can be carried out in CAM software or direct on the machine control panel. Besides that, simulation analysis also permits the user to identify the effect of changes and act as a design tool to develop a new system [2]. A part of that, it is also can be used to analyze different machining scenarios, not only rapidly but also without any risk, damage and waste of workpiece. In Computer-Aided Manufacturing (CAM), the efficiency of planning task and process execution are crucial factors to develop machining routines for simulation purpose. Process planning in CNC machining is directly influence the processing time, procedure, operator skill and operation cost [3].

2. METHODOLOGY

In this study, a visual basic programming language was used as a basis for graphical user interfaces (GUI) development and machine code customization. The developed GUI was embedded with journaling code generated from NX CAM system. Journaling is a tool that available inside NX CAM where it allows user to record, edit and replay back all the interaction during NX sessions [7]. The instruction tasks during machining program developments are recorded separately with different parameter setup for each operation. The recorded codes are translated into visual basic script files. Then it was modified to remove the code stickiness. The modification allows user to input certain parameters such as, cutting orientation, cutting parameter (spindle speed, feed rate, and depth-of-cut), tool diameter and workpiece diameter. Two different GUI programs were developed to handles different simulations and operation analysis. Roughing operation GUI used to build roughing machining operation and aims to remove large amounts of material rapidly from the workpiece to produce part geometry close to the desired shape. Finishing operation GUI construct finishing machining operation and the purpose is to achieve final geometry of the machined parts with a good surface finish. In order to illustrate the overview of simulation operation, the differences in process planning between conventional and proposed approaches can be seen as shown in Figure 1. Manual approach is conventional methods that are typically used to build machining programs and requires a significant user intervention and efforts to execute the repetitive processes [8]. Some parameters and settings for each operation need to be changes in order to run simulations with a few constant parameters. In this study, certain level of automation is expected to be embedded in the operation build-up routines. The proposed approach is an improvised method by developing a custom application to build a NX CAM program with the addition of several automation elements.

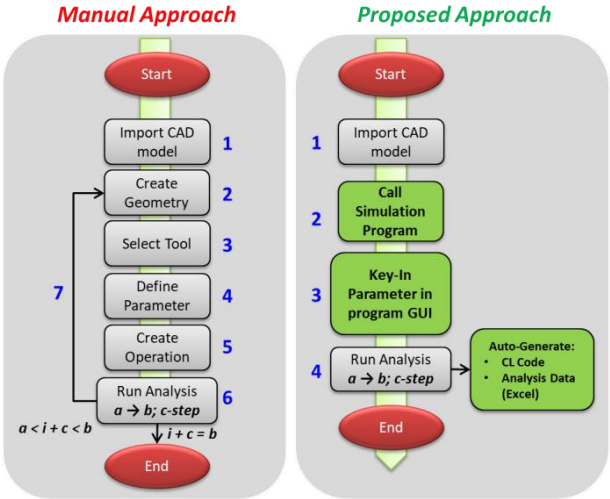

Figure 1 Comparison of simulation approaches.

The simulation will run continuously without requiring user intervention between the geometry in 4th axis machining operation. Consequently, if there has much geometry in one operation, the program will automatically loop the simulation to the next operation efficiently. Journaling program codes are recorded through the tool in NX CAM starts from "Create Geometry" (level-2) to "Create Operation" (level-5). Some parameters values that need to be set in each level have been simplified and grouped in GUI program window. Through this method, the proposed approach has managed to reduce the processing step from 7 steps to just 4 steps.

3. RESULTS AND DISCUSSION

The proposed simulation application was validated by machining several 3D CAD models as shown in Figure 2. Table 1 reveals the results of the proposed approach in assisting the process planning of machining program developments in NX CAM systems.

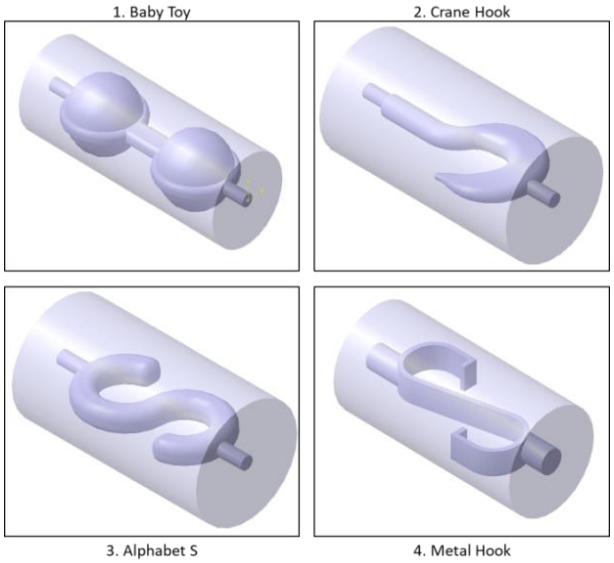

Figure 2 3D CAD simulation models.

Table 1 Results of processing time required to construct a machining operation programs using conventional and proposed approach.

No.	Total operations	Processing time (min)		Improvement rate (%)
		Conventional approach (min)	Proposed approach (min)	
1	4 Roughing 2 Finishing	16.78	2.98	82.2%
2	4 Roughing 2 Finishing	14.48	2.38	83.5%
3	4 Roughing 2 Finishing	16.27	2.45	84.9%
4	4 Roughing 2 Finishing	15.82	2.80	82.3%

4. CONCLUSION

This paper has discussed the integration of visual basic programming in NX Computer-Aided Manufacturing (CAM) system for the application of 4th axis machining. From the study, the developed applications managed to execute, control and develop machining simulation programs efficiently with minimum processing steps. The results show that proposed approach successfully reduces processing time up to 84.9% of improvement rate.

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