

Research and Application of Rapid Transplant Method of NC Program Based on Vericut

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Abstract: Small changes in the production plan will cause frequent changes in machine tools, which brings the NC program quickly transplant needs, this paper integrates simulation, post processing and cutting parameters optimization technology, based on a typical example, successfully proposed and validated a fast transplantation method of NC program based on Vericut, to meet the needs of project business process rapid transplantation.

Introduction

With the further development of "Made in China 2025", the number, specification and structure of CNC cutting machine entering manufacturing industry will develop flourishing, and the goal of the NC rate of machine tool industry in international manufacturing power reaches 60% is getting closer and closer.

In manufacturing enterprises, with the diversification of NC machine tools and control systems, NC program processing programs are changing more and more frequently, and these changes usually take much time, which is a great impact on the accuracy of production plan, the delivery cycle and the manufacturing cost. According to the statistics, the abnormal change of production planning due to abnormal machine tools and uneven production load is more than 10% of the normal production plan. How to respond to the demand of NC program transplant caused by equipment abnormality and production load nonuniform effectively and quickly has become a key problem to the internal technology management of an enterprise.

Current requirements and problems of the program transplant

It is because of those above reasons, more and more attention has been paid to the rapid and reliable transplant requirements of NC programs. However, most enterprises lack special processing tools. Some enterprises have developed specialized program transplant programs, but there are still many problems. To sum up, there are some typical problems in the current program transplant caused by the change of production plan:

- 1) Most enterprises lack the tools of NC program transplantation, the NC programs often need to re-program, post process and simulate, which also requires the approval of process and publication of data, time-consuming.
- 2) Some enterprises have no original 3D model. If planning changes lead to procedure changes, it can only reverse calculation based on the NC program to obtain the mathematical model, and then programming, postpone and emulation, which is more uncertain and time-consuming.
- 3) Small enterprises have already exploit a program that transfers directly from the NC

program of the original machine to the target machine, which is quick but take a large amount of workload and in the transplant progress the different movement modes of two programs will lead to problems that can't be corrected effectively like nonlinear error and abnormality of cutting parameters. there is a potential risk of quality.

This paper presents a new NC program transplant method based on Vericut. You don't need to reverse calculation to obtained the 3D model according to this method. At the same time of a significant reduction in the software development of the amount of work, it can also transplanting data with existing post-processing tools. what's more, by using the optimization function of Vericut, the problem that the traditional program transplanting method can not modify the cutting adaptive parameters is improved significantly.

Fast transplant method of the NC program based on Vericut

The main contents of the method proposed in this paper are as follows:

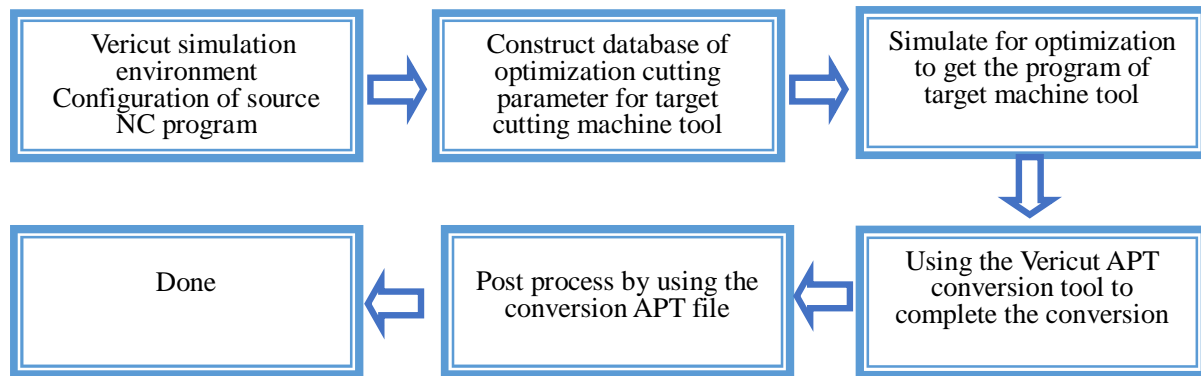


Figure 1 Processing Work flow based on the proposed method

The verification of typical examples and the results

Without losing the generality, this paper chooses an impeller machining program with VERICUT Software to verify the method proposed in this paper. The example doesn't have product model, only a processing program. Here's a list of the main different points of the source machine / system and the target machine / system. It can be seen that the structure and control system of the two machine tools are different. The spindle's maximum speed is also different. All the cutting parameters of the corresponding tools should be adjusted according to the cutting ability of the cutting tool, which is difficult to be solved comprehensively and effectively by the traditional program transplant method.

	<i>Source machine /Control</i>	<i>Target machine /Control</i>
<i>Name</i>	DMG Mori NMV1500	StarRag 1250
<i>Type</i>	Dual Table, BC	Head and Table , AB
<i>Max Speed</i>	35000 RPM	8000 RPM
<i>Control system</i>	MAPPS iv	Siemens 840D

Figure 2 the main information of the source machine tool and the target machine

Step 1:Source program Vericut simulation environment creation

This article borrows the configured simulation project file that comes with Vericut ,and no longer carries on the detailed simulation software configuration operation explanation.when the disposition is good, the cutting simulation result is shown in Figure 3.

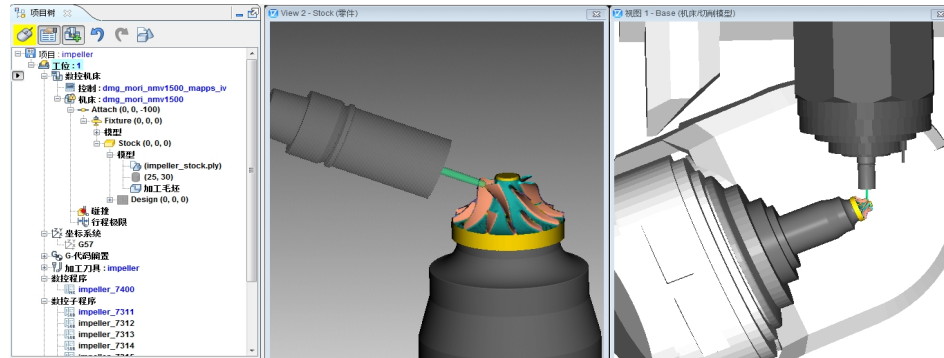


Figure 3 Simulation effect Diagram of example parts

Step 2: Construction database of optimization cutting parameter Library for Target Machine tool

Based on the maximum speed of target machine, Setting optimal cutting parameters for each tool(The specific parameters are related to the cutting performance of the material and the actual tool,which is beyond the scope of this paper). This can be set according to the actual situation of the unit, the typical parameter settings as shown in Figure 4.

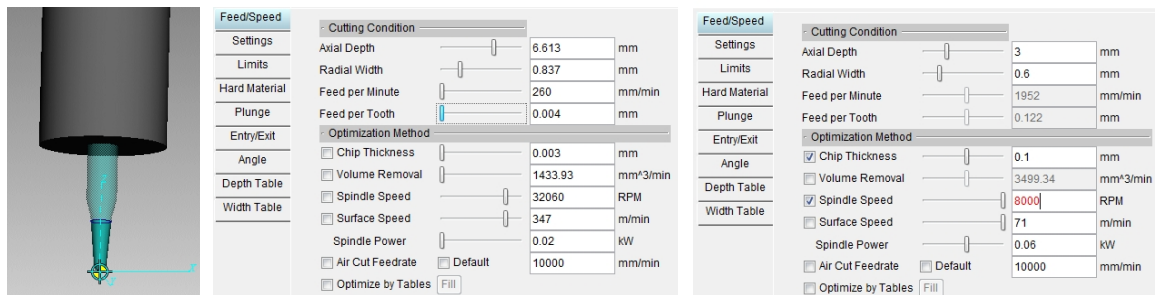


Figure 4 Optimization parameter information of a tool for a target machine tool

Step 3:Simulate for optimization realizes the adjustment of cutting parameters

After setting the cutting parameters of the target machine, we can optimize the NC programs to get the available cutting parameters for the target machine tools, and at the same time can greatly reduce the defects of traditional program transplant process such as poor matching of cutting parameters caused by direct program transplantation.

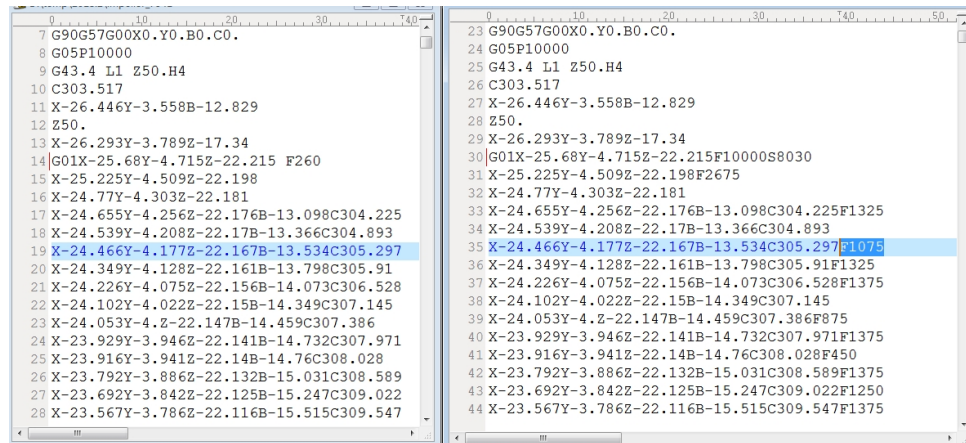


Figure 5 Comparison of NC programs before and after optimization

From Figure 5 we can see that there are significant differences of the cutting parameters before and after the optimization. The feed speed before optimization is a single F260 while the optimized cutting parameters show a variable state, which is a typical optimization effect based on Vericut that can effectively improve the load balancing state corresponding to the tool machine of the target.

Step 4: Convert and output the APT files of the optimized program

Transform the optimized NC Program into APT to obtain the APT files in Vericut format based on the APT output function of Vericut, as shown in figure 6.

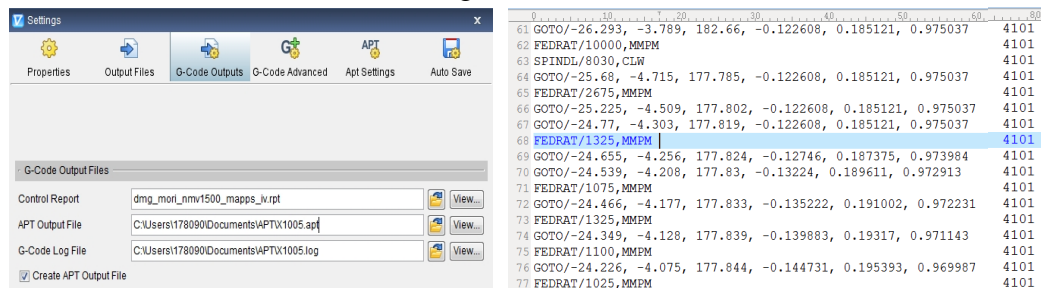


Figure 6 APT translation based on Vericut

Step 5: APT files translation and target machine tool post processing

Because the format of the APT tool source file converted from Vericut is different from format of tool bit source files output by CATIA/UGNX, there is needed to develop special APT tool file format transformation tool for processing. Considering about the versatility, this paper treats the APT format of the Vericut Output as a separate tool source file format, and merge with existing post-processing processes in the enterprise to simplify the operation process. Based on the author's own post processing software, We have developed the conversion module of APT tool bit source files from Vericut output and integrated it into existing post-processing software. The developed post processing software and the results after the post processing are shown in Figure 7 and figure 8.



Figure 7 post processing

Before Transplantation	After Transplantation
G01X-25.68Y-4.715Z-22.215F10000	G01 X-25.680 Y-4.715 Z-22.215 F10000
X-25.225Y-4.509Z-22.198F2675	X-25.225 Y-4.509 Z-22.198 F2675
X-24.77Y-4.303Z-22.181	X-24.770 Y-4.303 Z-22.181
X-24.655Y-4.256Z-22.176B-13.098C304.225F1325	X-24.655 Y-4.256 Z-22.176 A-10.800 B352.544 F1325
X-24.539Y-4.208Z-22.17B-13.366C304.893	X-24.539 Y-4.208 Z-22.170 A-10.930 B352.260
X-24.466Y-4.177Z-22.167B-13.534C305.297F1075	X-24.466 Y-4.177 Z-22.167 A-11.011 B352.082 F1075
X-24.349Y-4.128Z-22.161B-13.798C305.91F1325	X-24.349 Y-4.128 Z-22.161 A-11.138 B351.804 F1325
X-24.226Y-4.075Z-22.156B-14.073C306.528F1100	X-24.226 Y-4.075 Z-22.156 A-11.268 B351.514 F1100
X-24.102Y-4.022Z-22.15B-14.349C307.145F1025	X-24.102 Y-4.022 Z-22.150 A-11.393 B351.219 F1025
X-24.053Y-4.2-22.147B-14.459C307.386F875	X-24.053 Y-4.000 Z-22.147 A-11.443 B351.102 F875
X-23.929Y-3.946Z-22.141B-14.732C307.971	X-23.929 Y-3.946 Z-22.141 A-11.564 B350.810
X-23.916Y-3.941Z-22.14B-14.76C308.028F450	X-23.916 Y-3.941 Z-22.140 A-11.577 B350.781 F450
X-23.792Y-3.886Z-22.132B-15.031C308.589F925	X-23.792 Y-3.886 Z-22.132 A-11.696 B350.492 F925
X-23.692Y-3.842Z-22.125B-15.247C309.022F875	X-23.692 Y-3.842 Z-22.125 A-11.789 B350.262 F875

Figure 8 Comparison of programs before and after transplantation

As we can see from the contrast of the files on the left and right sides of figure 8, there are only differences in the angle of the pendulum axis between the NC programs before and after transplantation, the former is BC axis and the rear is AB axis respectively corresponding to the source machine and the target machine.

Conclusion

Import the transformed tool bit source file post-processed target file into the original Vericut simulation environment, replacing the previous source program. The simulation contrast verification has been passed through, and the simulation results of source NC program are consistent with those before conversion, which indicates that the method we proposed in this paper is feasible.

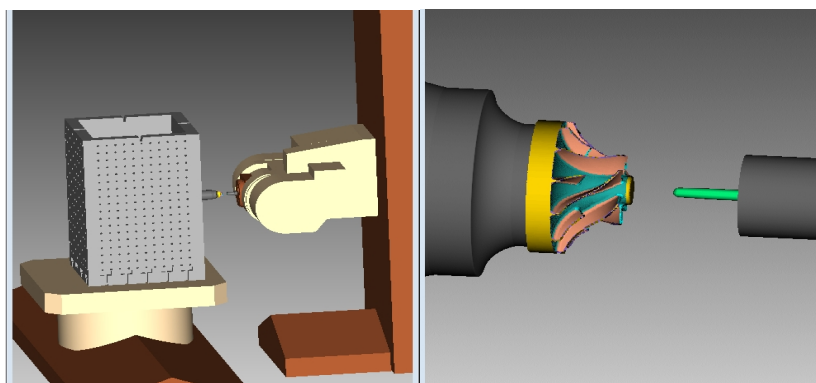


Figure 9 Simulate Based on target machine tool StarBag

To sum up, we can see that the NC program transplantation method proposed in this paper can both satisfy the enterprise programs demand and carry out the optimization of program and the adaptive matching of cutting parameters of Target Machine tool in the process of transplantation, and there is also no need for an enterprise to do a lot of technological development, which has a positive

significance for responding to the changing demand of production plan quickly, improving manufacturing efficiency and reducing manufacturing cost.

Acknowledgement

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