

# Impeller Machining Technology Research based on CAXA

Xinjian Xu

Shandong Xiehe University, China

## Abstract

The impeller is a kind of contain complex surface more difficult machining parts, often through the UG, Pro/E and CAM software production parts processing program. In this paper, ME2020 domestic CAXA software as a platform, the impeller machining method. In order to improve the machining efficiency of the impeller, and gives the VERICUT software optimization program method.

## Keywords

CAXA; Impeller; Processing.

## 1. Introduction

Many coordinate surface is mainly refers to application triaxial linkage CNC machine processing more complicated surface, including the shape of the impeller vane is the hardest of mechanical machining complex surface, is considered to be more shaft processing technology of a technical problem. With the development of CAD / CAM technology, such as UG, Pro / E software such as arises at the historic moment and a wide range of applications. Our CAD / CAM technology plan emerged like CAXA - ME such a good software. Five axis CNC processing because of its advanced technology, with effective avoid interference, side milling ruled surface, cutting good condition etc, becoming the improvement of the whole impeller machining efficiency and quality of first choice.

## 2. Impeller to Create

Blade of the original data is several cross section of discrete points or piecewise arc data, it is need to use surface fitting method generating smooth continuous surface. In the CAXA - ME with "splines" command to create cubic b-spline curve, and then in sequence to select each cross section profile generation NUBRS surface. Impeller create as shown in figure 1 shows.

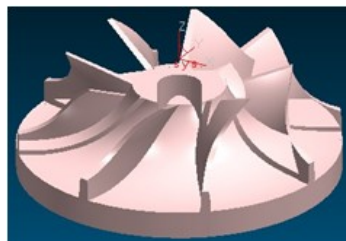
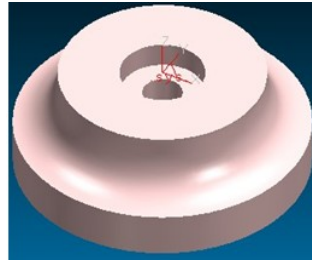


Figure 1. Impeller

## 3. The NC Machining Process Design

(1) determine the rough parts and materials

As a result of forging parts have excellent mechanical properties and reliability, considering the use of the impeller, the part blank selection of forging pieces, at the same time in order to save five axis machine tool processing time, first with CNC lathe turning into leaf transmigration twist of the basic shape, as shown in figure 2. In considering the use of the impeller and the process, choose brands of LD8 aluminum alloy.



**Figure 2.** The impeller blank

(2) for selectively positioning datum

Considering the integral impeller is a symmetrical parts, so the selection of the center hole as a circumferential positioning datum, the impeller of the bottom as the axial positioning reference. Machining integral impeller, the impeller blank is mounted on the clamp mandrel, is pressed at the same time.

(3) formulation of processing route

Analysis of integral impeller blade runner, geometric features, determine the blade surface, the characteristic parameters of flow channel, judging the leaf surface type, blade surface can be divided into the ruled surface and free surface, wherein the ruled surface can be divided into the surface of developable and undevelopable ruled surface. Integral impeller blade is the key element for the rational selection of cutting tools, and processing of trajectory planning, but also to determine the width of channel inlet, outlet width and other parameters. In order to prevent the deformation of the blade when processing, reduce the cutting temperature, cutting force, cutting speed is improved, the processing flow is as follows:

- ① blank clamping
- ② the impeller flow channel grooving
- ③ the impeller flow channel extending groove processing
- ④ the leaf blade abaxially semi finishing
- ⑤ the ventral surface of the semi-finishing machining of blade
- ⑥ the impeller flow channel semi finishing
- ⑦ the blade back surface finishing
- ⑧ leaves the ventral surface of the finish machining
- ⑨ impeller flow channel finishing

**Table 1.** Impeller machining process specific content

Processing way	Processing content	tool	Spindle speed (r/min)	Feed speed (mm/min)	Cutting Depth(mm)
unfinished	Blank open coarse	Flat bottom knife $\Phi 10$ r2 round nose knife	3000	1000	2
semi-finishing	Back, venter	Ball end cutter R5	4000	800	0.8
semi-finishing	Runner surface	Ball end cutter R5	4000	800	0.8
finishing	Back, venter	Ball end cutter R3	6000	400	0.2
finishing	Runner surface	Ball end cutter R3	6000	400	0.2

(4) the tool

The processing surface ball end milling cutter is mainly flat, annular cutter, cutter. Ball end milling cutter on a variety of surfaces of strong adaptability, tool path calculation is simple, therefore in the NC machining of free form surfaces has been greatly applied, but spherical

cutter obvious shortcoming, most notably the ball cutter endpoint and processing surface contact of the cutting speed is zero, cutting performance.

With the development of CNC machine tool technology, flat-end milling cutter, circular knives and other cutting tool in machining of free surface in superiority is shown ceaselessly, greatly improves the efficiency of free-form surfaces machining and cutting performance.

(5) determine the processing process the specific content

Based on the elaboration of the processing line, for each process to choose the appropriate processing tool, spindle speed, feed rate, depth and machining allowance, specific content is as shown in table 1.

(6) the jig design

Because of the complexity of the processing, jig design takes into account of integral impeller structure and processing strategy, interference factors such as collision. Therefore, design jig need to leave enough space, in case the rotation of the workbench and tool produce interference. Jig structure as shown in figure 3 shows.

Jig base part has three countersunk hole, through 3 M5 bolt to tighten it in the table of T slot inside. Clamp the part is a  $\Phi 8$  mm spindle, deviation is 0.01, the deviation was 0.05, and impeller blank in the middle of the hole with close, and impeller blank positioning hole depth slightly than jig spindle part slightly a little higher, clamp the upper portion is a bolt connection part, through the nut the impeller blank fastening.

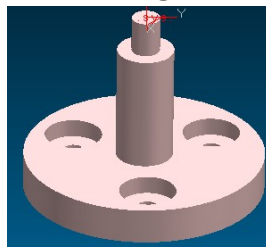


Figure 3. Jig structure

#### 4. Impeller Machining

The process using MIKRON UCP800 vertical five axis machining center, movement by using CAXA - ME surface processing module Settings blank open coarse, back venter semi-finishing, runner surface semi-finishing, back venter finishing, runner surface finishing processing parameters, the production of tool path as shown in figure 4 to figure 8 shows.

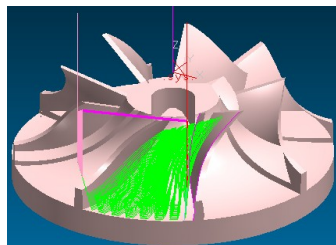


Figure 4. blank open coarse

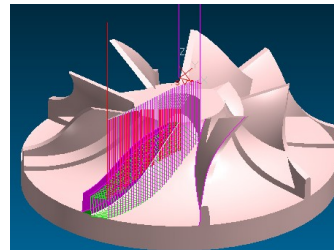


Figure 5. back, venter semi-finishing

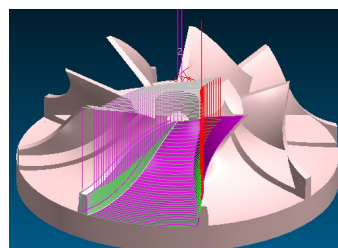


Figure 6. runner surface semi-finishing

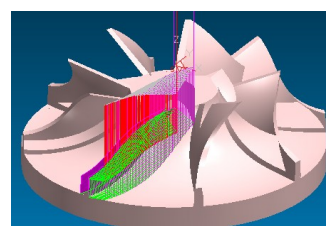
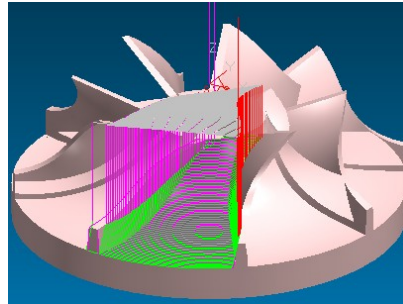


Figure 7. back, venter finishing



**Figure 8.** flow surface finishing trajectory

## 5. Impeller Cutting Tool Path Optimization

VERICUT software of the world's leading nc machining simulation system, VERICUT optimization and actual production is completely unified. Through the calculation of cutting quantity each step program, the numerical and cutting parameters experience value or tool manufacturers recommended cutting parameters are compared. When allowance is very large, VERICUT lower speed, when allowance is lesser, speed, and then modify the program, insert the new feed speed, and eventually optimize get safer, more efficient nc program. VERICUT optimization is according to cutting output to optimize nc program feed speed, do not change the trajectory of program.

According to the optimization results, adjust and optimize library parameter Settings, and then optimized, finally to achieve the desired results.

## Acknowledgments

(Shandong Province University Science and Technology Plan Project, No. J18KB043).

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