The Analysis of the Combined Territorial Machining and Contour Line Machining Based on the CAXA Manufacturing Engineer 2004

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Abstract: *This paper introduces the rough machining of territorial machining and contour line machining based on the CAXA manufacturing engineer* 2004, *and gives an analysis of the combined machining of territorial machining and contour line machining. Finally, it proves the superiority of the combined machining by the example of high speed machining of an aluminium alloy lamina part.*

Key words: CAXA; territorial machining; contour line machining

1 Introduction

CAXA manufacturing engineers 2004 software is domestic CAD/CAM software. It can be used for the design of the 3D graphics parts, and it also can be used for the 2D parts and 3D parts machining, it is efficient and easy to learn, with outstanding 3D design software of excellent technical performance. It can be used to facing the NC machining provide entity, surface mixed 3D model, mold design, 2 ~ 5 axis, milling NC programming method and powerful functions such as data binding. It already widely used in modeling, forging die, automobile covering stretching mode, die casting molds for complex mold and weapons, the 3D model of aerospace and other industry precision components and NC machining, providing for the NC machining industry from modeling to processing code generation and check the integration of comprehensive solution. This paper focuses on the new 7 different methods of rough machining in the CAXA manufacturing engineer 2004, which include territorial rough machining and contour line rough machining and analyed their combination using the example of high speed machining of aluminium alloy lamina part.

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2 Territorial rough machining

2.1 Introduction of territorial rough machining method

Territorial rough machining method is generating territorial rough machining´s track. The processing method are two axis machining, its advantage is that it desn´t need 3D model, just given the outer contour and islands of the parts, it can generate a machining track, and also can automatically increase the arc trajectory in sharp corners, and ensure a smooth of the track to meet the requirements in high speed machining. In essence, the processing method is a special contour line machining method. In the modelling, it will need to sculpt the surface modeling in the shape it can complete the machining, with high processing efficiency, as shown in Figure 1 and Figure 2.

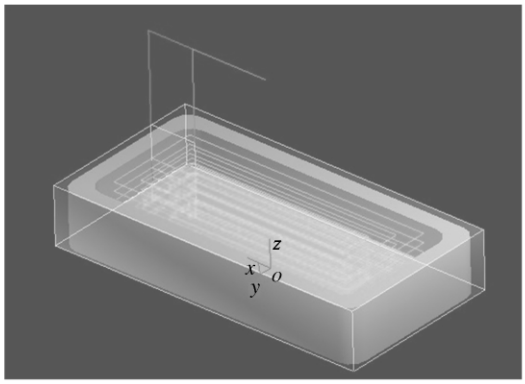

Figure 1 Schematic diagram of territorialrough machining´s track

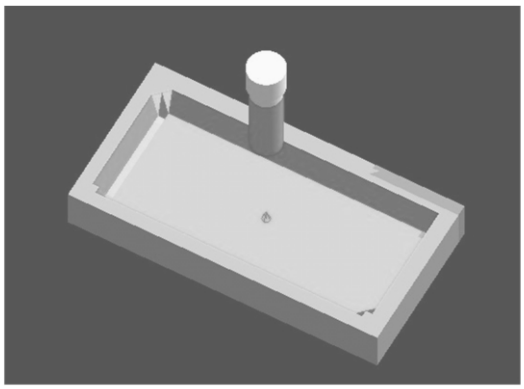

Figure 2 Schematic diagram of territorial rough machining´s result

2.2 The reference technique of the territorial rough machining

The territorial rough machining method aims at the 2D contour milling, whether within or outside profile outlines, we need to arrange the tool from the tangential entry profile machining; When the contour machining is completed, we need to arrange a section along the tangent direction continued movement´s distance to retract, in order to avoid the tool leaving a knife scar on the workpiece entry and exit point. To select a reasonable feed and recede cutter location, we should choose a less important position as far as possible.

In fact, the the territorial rough machining method is a provision of tool track on the two-dimensional area to be machined, and for those 3D surface bottom cavity areas, the tool track is generally chosen in a 2D area planning, and then it can be obtained by projecting it into the the tool offset surface of cavity bottom. Certainly, it can be seen that it is an important problem to planning the 2D area tool track for territorial machining method.

3 Contour line rough machining

3.1 Introduction of contour line rough machining method

The contour line rough machining method is generated a contour line rough machining track. The processing efficiency depends on the speed of the rough machining remove surplus to a large extent. A rough machining method is provided in the CAXA engineer 2004 software, that is, contour line rough machining. The programmer given parameters are automaticly divided into multi-layers, and each layer is equivalent to a planar region. It is suitable for flat blade, spherical cutter and lat blade with R (circle angle), therefore, it can be effective and reliable remove the surplus within the cavity. And according to the requirements of final machining set aside surplus, it makes a good foundation for final machining. The processing method is a more universal roughing approach, with a broad application scope and it can be specified for the machining area, optimization air cutting track. The track-in of the corner can be set arc or S shape transition, generating a smooth tracking, thus it provides support for high-speed processing equipment. As shown in Figure 3 and Figure 4.

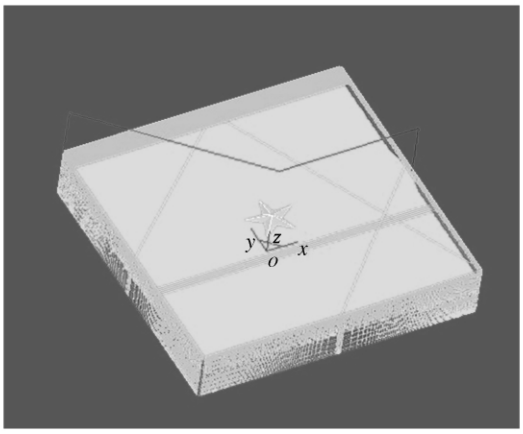

Figure 3 Schematic diagram of contour line rough machining tracking

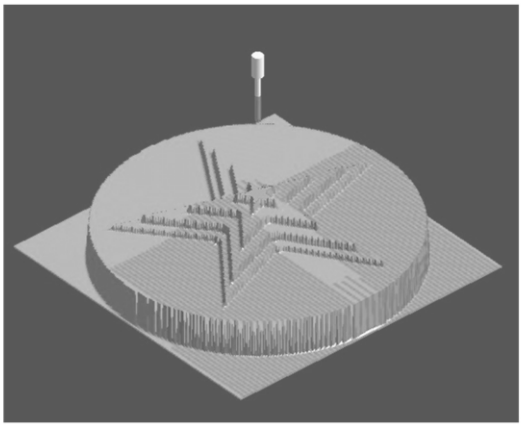

Figure 4 Schematic diagram of contour line rough machining result

3.2 The reference processing of the contour line rough machining

In high-speed machining, it is required to use rows connection mode of arc or *S* shape, and if the rows distance is large. In order to avoid interference it is recommended to use the *S* shape mobile tool, the method of the contour line rough machining is the most widely used one in rough machining method in the NC processing. It uses a series of imaginary horizontal plane and part's surface and blank boundary intersection to get a series of 2D cutting layer, and then the processing is conducted layer by layer. For the cavity boundary constrained condition, are also need to consider the problems of vertical feed and the adjacent layer of the cutting tool path's transition problem, according to the specific processing conditions to be considered.

4 Combined use of territorial rough machining and contour line rough machining

Shown in Figure 5 is the schematic diagram of territorial rough machining track of a high-speed processing process for an aluminum alloy thin-walled part. Shown in Figure 6 is the schematic diagram of contour line rough machining track of high-speed processing process for an aluminum alloy thin-walled part. Shown in Figure 7 is the schematic diagram of the processing track of the combined use of the two kinds of processing method.

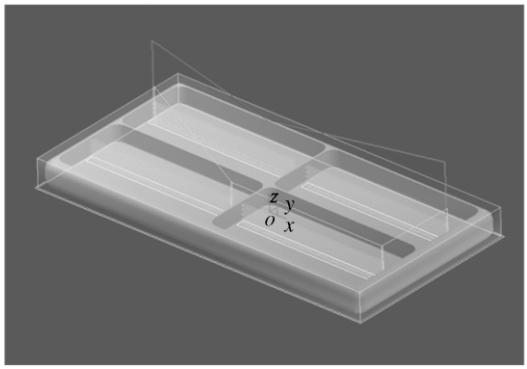

Figure 5 Schematic diagram of territorial rough machining track

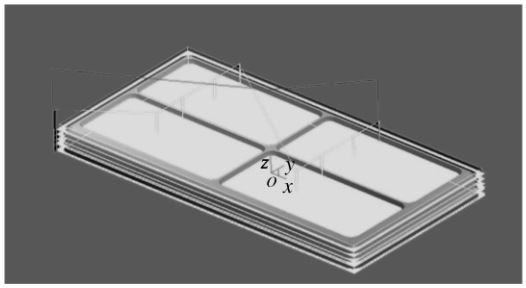

Figure 6 Schematic diagram of contour line rough machining track

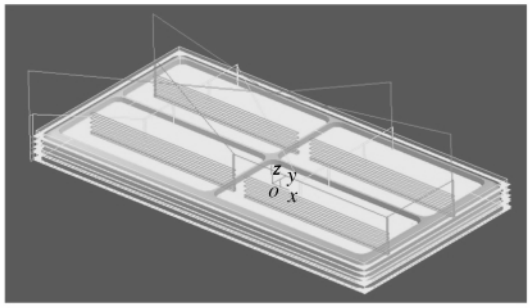

Figure 7 Schematic diagram of the machining track of and the combined machining method

In the processing of the blank, at the beginning of each processing the tool begins to cut blanks from a vertical direction; the first knife is full knife processing, then according to the cutting parameters to provide the cutting width processing. However, cutting speed and feed rate are in accordance with the given constant value processing, that is, in the first processing of the full knife and later according to a given the processing of the width of the cutting, it is using the same cutting speed and feed rate. In the beginning of processing vertical cuts and full knife processing, cutting force is particularly large, so in high speed machining is never allowed; If at the beginning of the full knife use of the high-speed machining, the tool will be severe worn, even the phenomenon of tipping, breaking will occur. Even if in the conventional processing, such processing also needs to avoid this as far as possible.

Therefore, in such a machining process, the first knife and a subsequent processing should be separated. In this example, it has used the tools of larger diameter with territorial rough machining method to make one knife, as here is the use of conventional cutting speed and feed rate to complete the groove processing, in order to facilitate the subsequent expansion of milling. Then it has used the tools of smaller diameter with contour line rough machining method, from the groove outside to begin to expansion of the milling process, it makes each process to ensure the same cutting width, and proceed to high-speed milling to complete the machining.

5 Conclusions

Through the above examples and analysis it can be concluded that in the milling process, the phenomenon of severe wearing and collapse cutting knife blade can be well avoided by the use of combination machining method of the territorial rough machining and the contour line rough machining in the process of the high speed machining, so as to increase the service life of cutting tools. It is a relatively economical processing method and is also a protective method of the cutting tool in processing.

References

[1] Chen M, Liu G, Zhong J W, *CAXA manufacturing engineer* 2004-*NC Machining*. Beijing: Beijing Aerospace University Press, 2006 (In Chinese)

[2] Yan G Q, Sun H Y, Li D, *The complex graphic NC milling machine based on CAXA manufacturing Engineer* 2004. Mechanical Engineer, 10, 2009 (In Chinese)

[3] Peng Z Q, Du W J, Gao X Y, *CAXA manufacturing engineers* 2004 *practical tutorial*. Beijing: Chemical Industry Press, 2005 (In Chinese)

[4] Song W K, *CAXA manufacturing engineer xp*. Beijing: Beijing Aerospace University Press, 2003 (In Chinese)

[5] Lu J S, Li X, Xie X X, 3*D modeling and NC programming*. Beijing: Tsinghua University Press, 2004 (In Chinese)

[6] Ai X, *High-speed machining technology*. Beijing: National Defense Industry Press, 2003 (In Chinese)

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