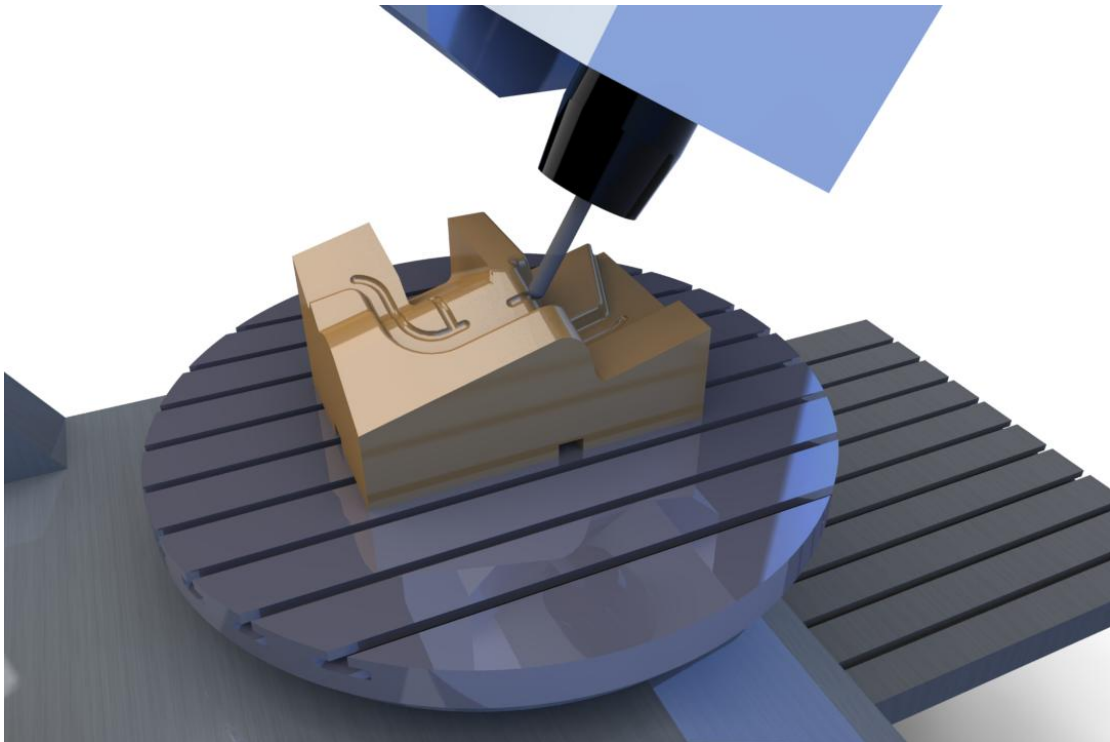




## **Manufacturing Better Product Smartly with ZW3D CAM**

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### ***ZW3D CAD/CAM White Paper***



January, 2014



## Overview

Looking at the products around you, such as phones, mice and laptops, have you ever thought about how they are manufactured?

Essentially, machining refers to the understanding of geometry, in which the geometry is divided into pieces. Although there are millions of products in the world, we don't have to apply millions of ways to machine them. Usually, Nurbs and STL are used to define the geometry and machine parts.

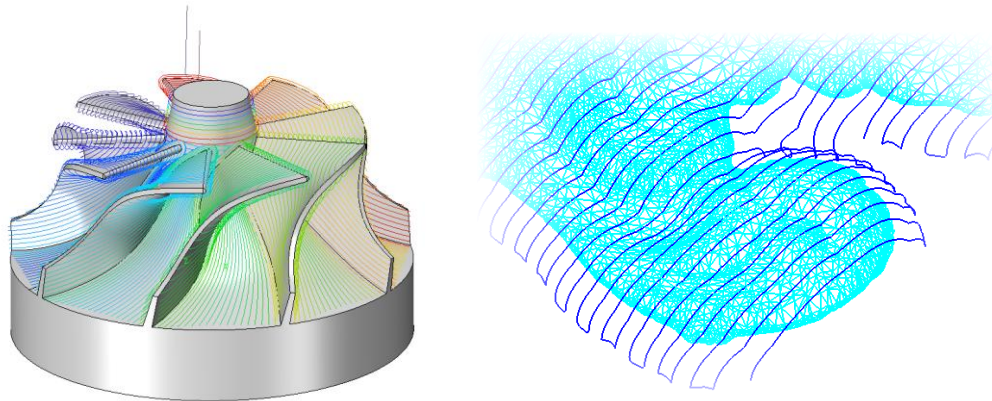


Figure 1: Nurbs Machining and STL Machining

To better understand machining technology, let's take a look at the following chart of machining process, including model preparation, programming tool path, output tool position data, post processing and machining.

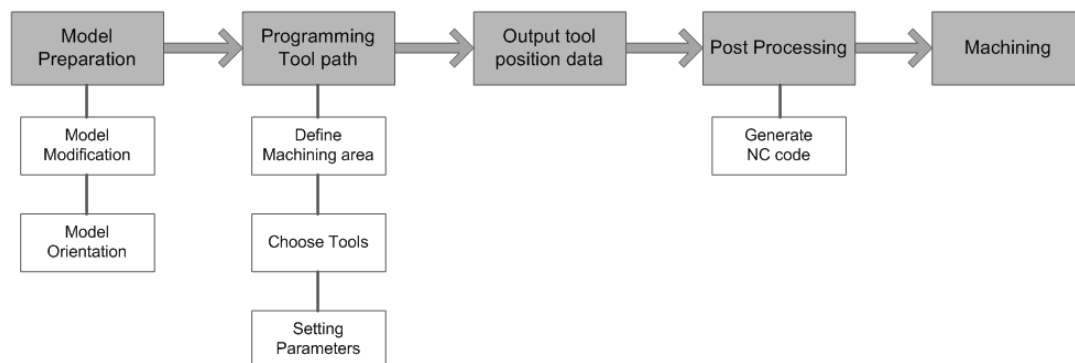


Figure 2: Machining Process

Despite its simple process, machining does inevitably face a lot of challenges:

- 1) Can I update the CAM tool path once the CAD data is updated?
- 2) Is it possible to make it smarter?
- 3) How to make it easier to use?
- 4) How to generate tool paths faster?
- 5) What is the best way to manage the tool path?



6) Is there any better way to deal with CAD data in CAM environment?

If these are the topics that interest you, then this article is worth reading, which focusing on the machining technologies to overcome these challenges.



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## 1. Current Challenges Faced in Products Processing

### 1.1. Design for Manufacturing

Design for machining is a hot topic involving both CAD and CAM, which aims to shorten the CAM machining process by understanding the CAD design.

Design for manufacturing means CAD data and CAM data can be optimized very quickly when there is any update in CAD or CAM. Taking notice of a typical machining procedure, you will find that it can immediately skip a lot of unnecessary exchange communications.

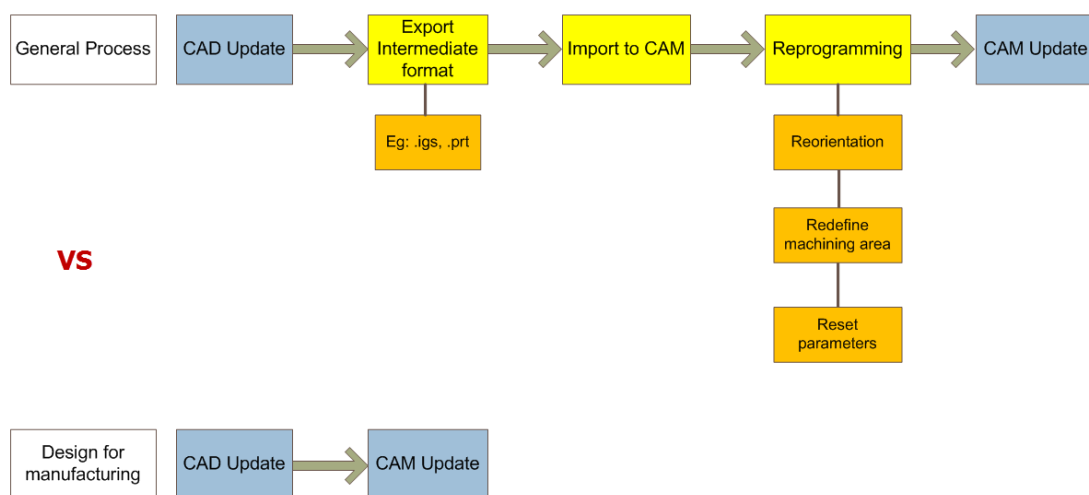


Figure 3: Design for Manufacturing

The biggest challenge faced by Design for Manufacturing is maintaining the data consistency between CAD and CAM, which requires sharing the database between CAD and CAM. Only a few solutions provide this technology currently, but we are certainly going to see more in the future.

Take ZW3D for instance,

(1) CAM is built on the CAD overdrive kernel. When we make a simple change in CAD, it simply updates the CAM data.



Figure 4: CAD Change Updates the CAM Change

(2) With the built-in CAD, the editing of geometry has become far simpler. With the power of hybrid modeling and direct editing technology, imported files can be changed simply by drag and drop.

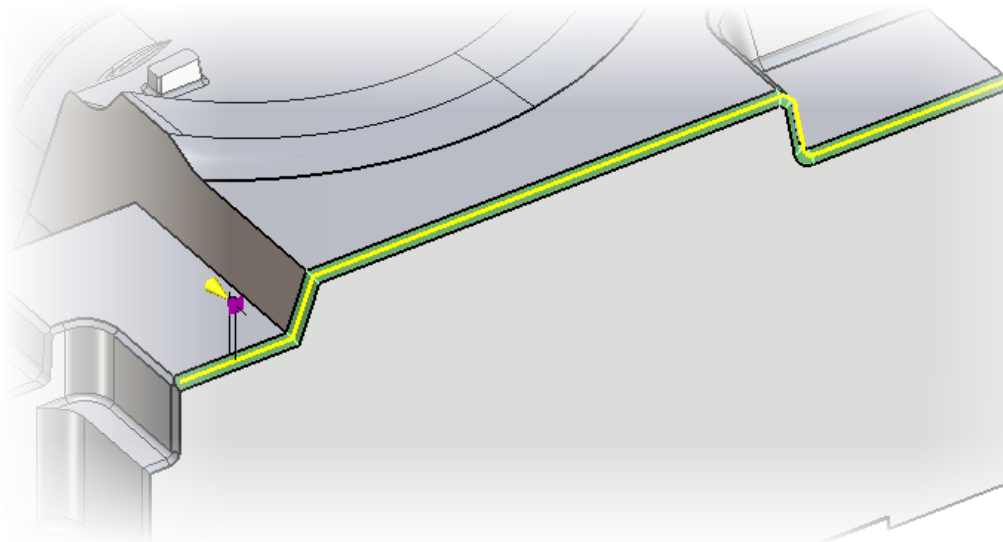


Figure 5: Easy to Modify the Data by Direct-Editing Technology

## 1.2. Smart Machining

Currently, it costs a lot to educate CAM beginners to become experienced users, which makes it even harder to educate a person to be proficient both in CAD and CAM. As a



result, what is really imperative is to make the CAM systems smarter and easier to use.

(1) Take the tactic technology, for instance. If you want to machine the holes using different tools, instead of complicated operations, all you need is one easy button operation by using the tactic technology, which could help generate all requested tool paths.

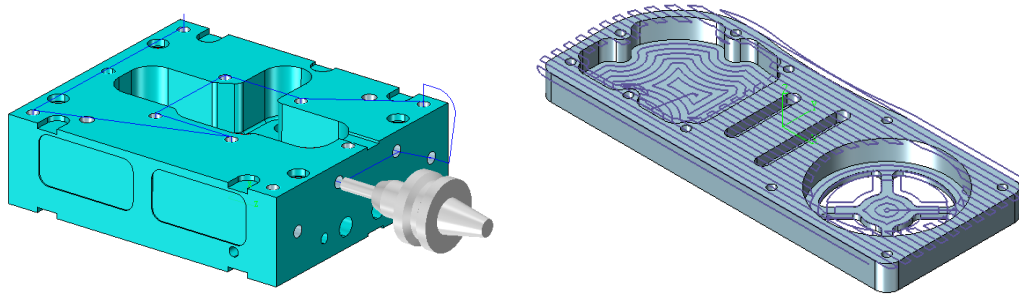


Figure 6: Hole Tactic and 2X Tactic by One-Click

(2) The tool path generation includes a lot of cutting parameters such as step size, tool, boundary and reference tool. With the tool path editor, the time consuming re-calculation of the tool path can be greatly enhanced.

As can be seen from the figure, the change of the tool path doesn't need any calculation, saving a huge amount of time when adjusting the cutting parameters in complex parts.

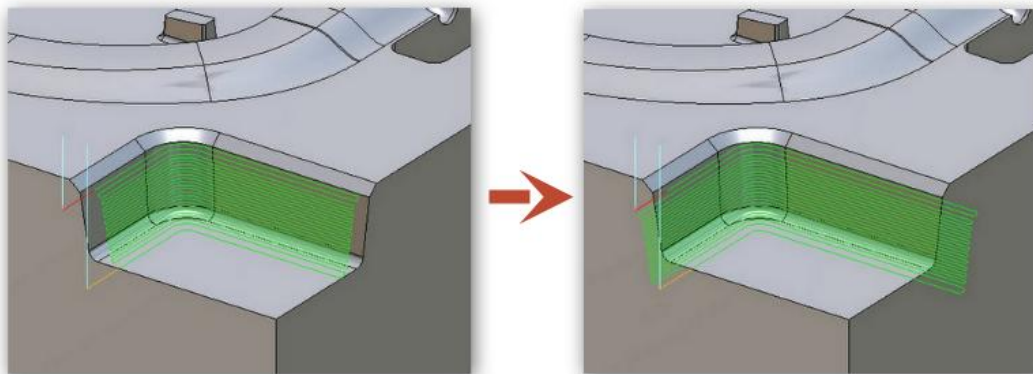


Figure 7: Tool Path Editor

It can, therefore, be concluded that it doesn't matter if you are using tactic technology, smart tool path editor or anything else, CAM must be smart enough to satisfy users' experience.





## 2. Faster and Better Tool Paths

Tool path is the key process of machining. The machining time is valuable and the quality is the precondition of machining.

### 2.1. Faster Tool Path Generation

If we take a close look at the efficiency, we can see that 20-40 percent of time is wasted in tool path generation. By taking advantage of the hardware, we can help to achieve higher efficiency.

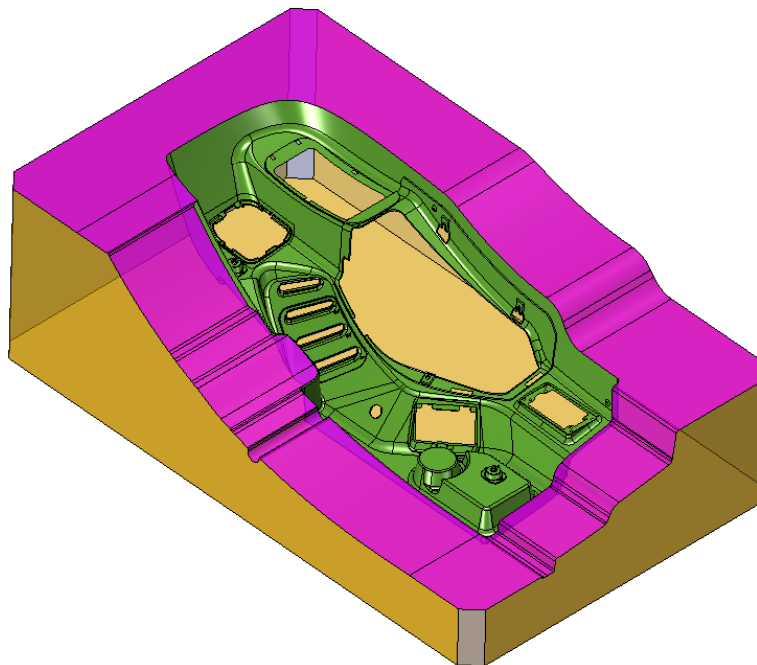


Figure 8: Tool Path Generation Time

More and more CAM systems are using 64 bit computing technology, however this does not mean that 64 bit is twice as fast as 32 bit. In other words, 64 bit will not accelerate the calculation, but will help in dealing with bigger data by eliminating the computer memory limitations of a 32 bit operating system. Take the background computing for instance. Background computing technology helps the user to continue working without interrupting the tool path computing. With 64 bit technology, it works with much greater stability and ease to deal with larger data, which benefits the big part machining.

With the faster development of CPU and GPC technology, the time of tool path generation can be tremendously decreased by using the Multi-thread computing technology of CPU and GPU computing.



## 2.2. Better Quality Of Tool Path

A lot of operations are optimized to generate different kinds of tool paths. The control of tool paths involving roughing and finishing are even more important, which is exactly what you need for part machining.

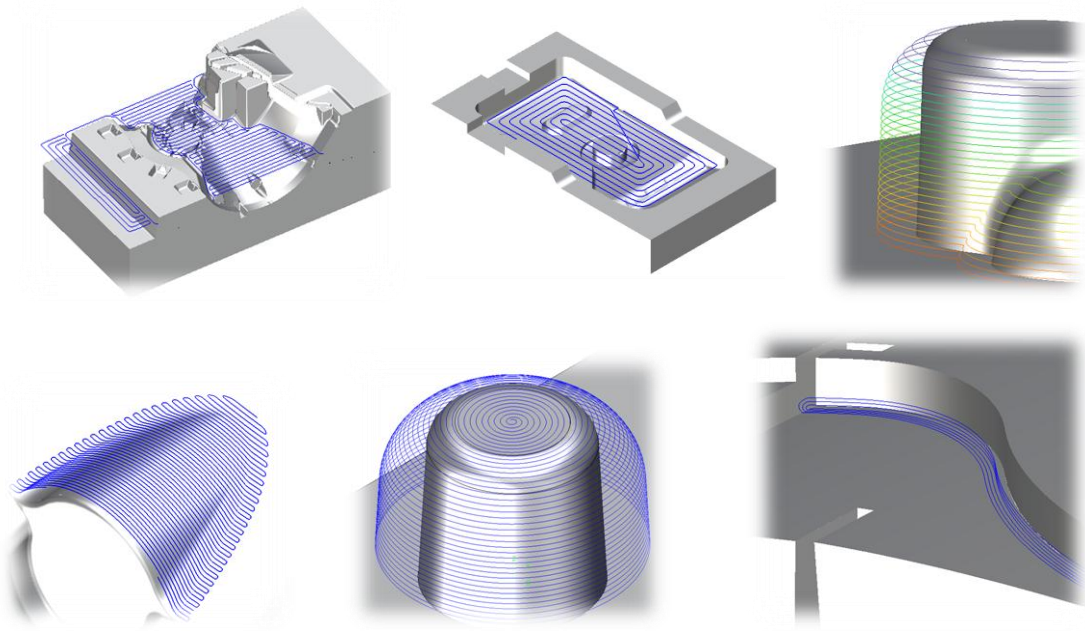


Figure 9: Different Kinds Of Tool Paths

Take ZW3D for example, with the advantage of Quick Mill technology,

1. Smooth Flow adjusts the tool load and extends the tool life.

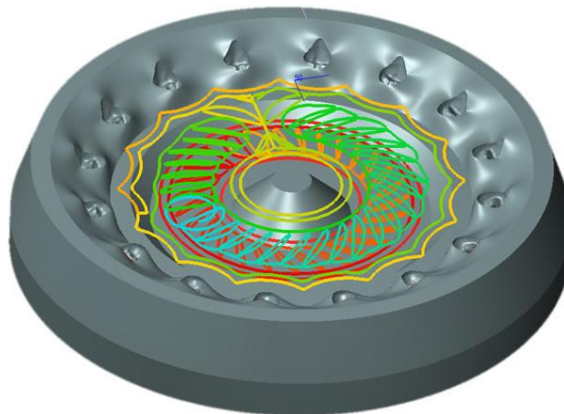


Figure 10: Smooth Flow Tool Path

2. For roughing, the advanced feed rate control can smoothly adjust the feed rate to cut the parts during the machining

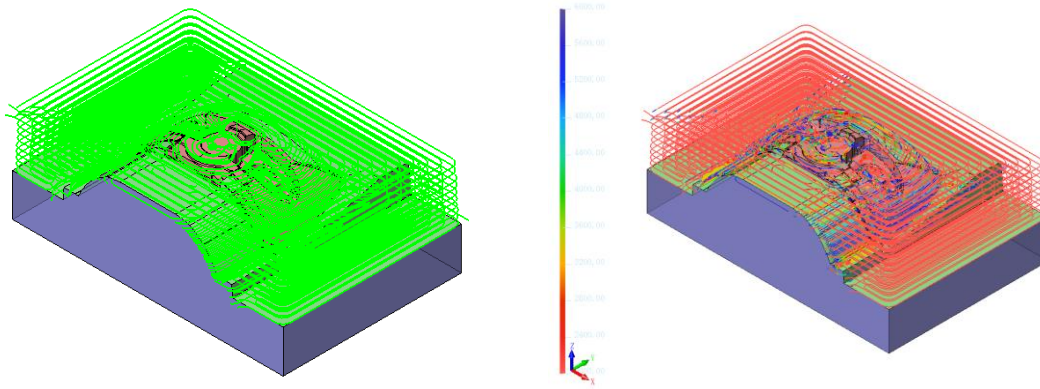


Figure 11: Adaptive Feed Rate Control

3. For the rest roughing, it simply takes the roughing for reference, and generates the quickest rest roughing operation

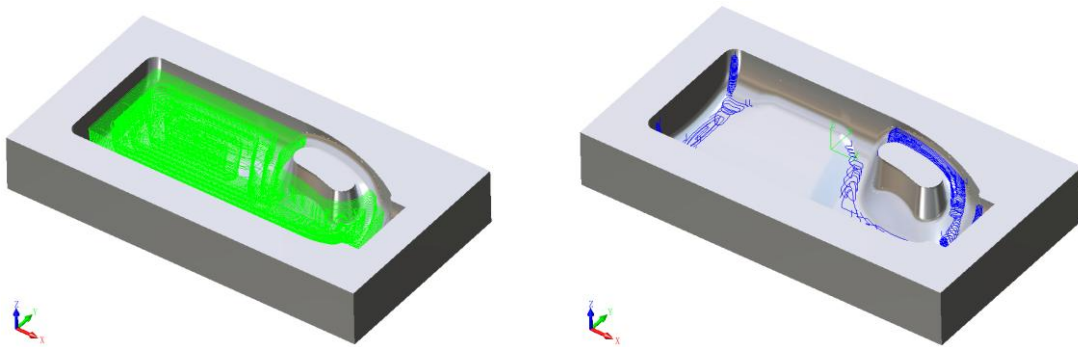


Figure 12: Roughing and Rest Roughing

4. For the finishing, the tangent containment allows for the machining of the exact area.

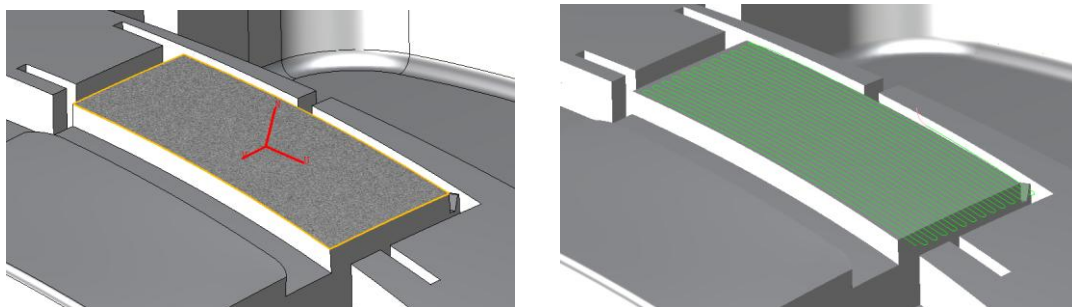


Figure 13: Tangent Containment Techniques Generate the Exact Tool Path

The quality of the tool path is hugely important, and can also be guaranteed by the Solid Simulation in ZW3D

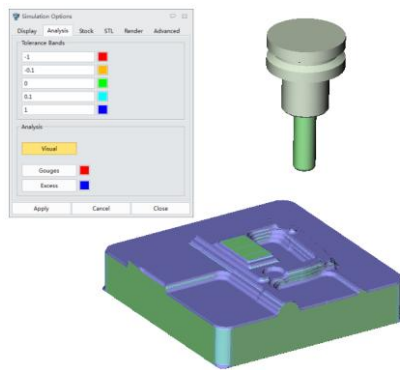


Figure 14: Solid Verification

### 3. Advantages of CNC Machining

#### 3.1.Flexibility

When working with a specified product, we might get a lot of specified requests, such as the flexibility of CAM.

Operation view is the standard view in CAM. It is very easy to customize and generate different views.

| All Details                      |                    | Opdef List |           | Machine Details      |                | Tool Details                      |          | Speed Feed Details |   |
|----------------------------------|--------------------|------------|-----------|----------------------|----------------|-----------------------------------|----------|--------------------|---|
| CAM PLAN OPERATION SHEET SUMMARY |                    |            |           |                      |                |                                   |          |                    |   |
| SEQ #                            | Name               | Type       | Tool Name | Min Tool Hang Length | Total Distance | Total Time                        | Z Min    | Z Max              | Graphics  |
| 1                                | Rough SmoothFlow 1 | Standard   | D30R5     | 65.50861             | 53577.40       | 321.65                            | -55.9900 | 50.0000            | <a href="#">More details (Rough SmoothFlow 1)</a> |
| 2                                | Zlevel 1           | Standard   | D20R0.8   | 30.49962             | 30978.74       | 124.72                            | .0010    | 50.0000            | <a href="#">More details (Zlevel 1)</a>           |
| 3                                | Lace 1             | Standard   | D10R5     | 30.50063             | 15583.40       | 63.67                             | .0000    | 50.0000            | <a href="#">More details (Lace 1)</a>             |
| TOTAL DISTANCE AND TIME FOR ALL  |                    |            |           | 100139.54            | 510.03         | Click on link to see more details |          |                    |   |
| ZW Software Corp.                |                    |            |           |                      |                |                                   |          |                    |   |

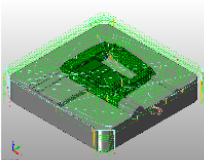
| Operation Parameters for Rough SmoothFlow 1   |                    |                    |  |  |  |                       |          |  |  |
|---|--------------------|--------------------|--|--|--|-----------------------|----------|--|--|
|  | Milling Parameters |                    |  |  |  | Speed Feed Parameters |          |  |  |
|   | Name               | Rough SmoothFlow 1 |  |  |  | Spindle Speed         | 850 RPM  |  |  |
|   | Class              | Rough              |  |  |  | Cutting Feed          | 0.2 MMPR |  |  |
|   | Op Type            | Rough SmoothFlow   |  |  |  |                       |          |  |  |
|   | Tool               | D30R5              |  |  |  |                       |          |  |  |
|   | Process            | Setup 1            |  |  |  |                       |          |  |  |
|   | Subtype            | Standard           |  |  |  |                       |          |  |  |
|   | Ref Opn            |                    |  |  |  |                       |          |  |  |
|   | Surface Thick      | 1                  |  |  |  |                       |          |  |  |
|   | Z Surface Thick    |                    |  |  |  |                       |          |  |  |
|   | Stepover           | % Tool Dia         |  |  |  |                       |          |  |  |
|   |                    | 45.0               |  |  |  |                       |          |  |  |
|   | Stepdown           | Absolute           |  |  |  |                       |          |  |  |
|   | 5                  |                    |  |  |  |                       |          |  |  |
| ZW Software Corp.   |                    |                    |  |  |  |                       |          |  |  |

Figure 15: Operation Parameters

So far much has been said of the ease of use of CAM systems. Meanwhile, the experienced users always ask for more flexibility to empower their capability in machining.



By controlling the parameters, operations provide huge flexibility. What is more, the advantage of the template can help a lot in similar parts machining, where all the similar parts can be cut by the same machining template, which is simply a one-button tool path calculation for experienced users.

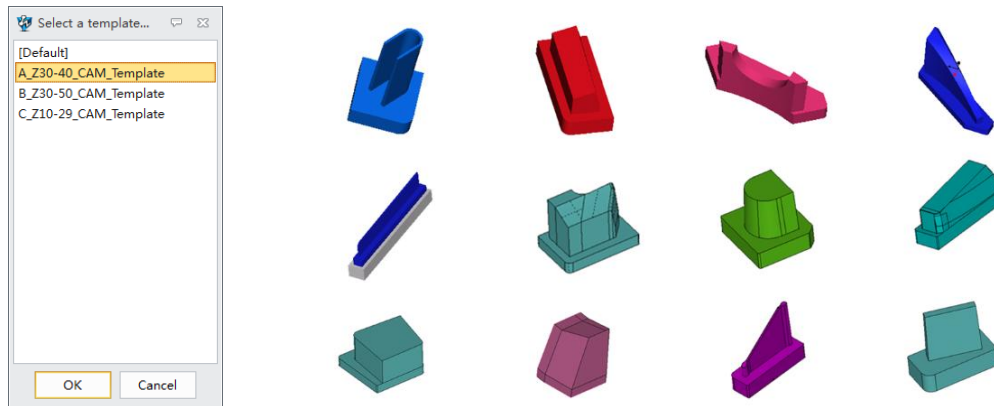


Figure 16: Using Template Techniques to Machine Similar Electrodes with Only One-Click

### 3.2. Simplified Work Flow

Post processor is the connection between CAM software and machines. Typically, the post processor generates a standard CL file and then transfers it to the G codes to the corresponding machines.

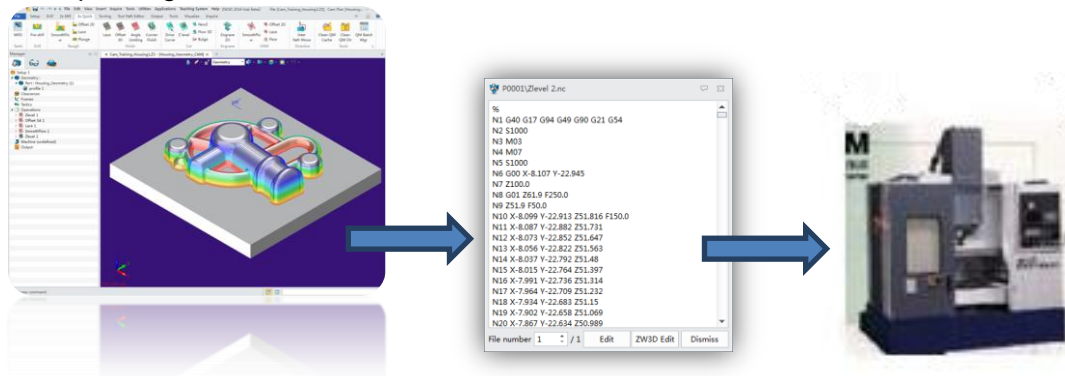


Figure 17: Connect the Software and Machines by Post Processor

In the past, the post processor has always been a separate application and the final step before stopping the machine, which is mostly because the post processor is difficult to understand. Obviously, there is still plenty of room to improve this workflow.

Take ZW3D for instance:

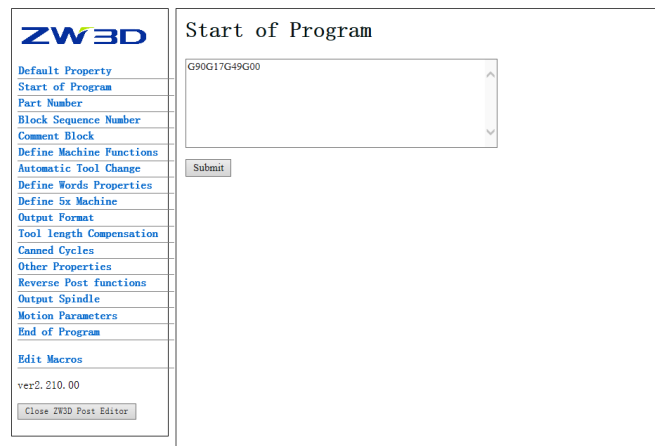


Figure 18: Visual Post Processor Editor

- (1) It includes popular ready post processors like Fanuc, Siemens and Heidenhains.
- (2) With a built-in post processor, ZW3D is able to customize the post processor to adjust to different machines using the visual editor.

The workflow should be complete and the built-in post processor should be included in any CAM systems.

#### 4. Conclusion

Today, confronted with the increasing demands of users, CAM is constantly required to be smarter and easier to use. With the innovations of the CAM technologies, we can use optimized tool paths and smart tactic techniques. For example, with the simplified work flow of CAM, CAM learning becomes easier. With a built-in post processor, beginners can start to machine real parts. With the flexibility of CAM, experienced users can realize their imagination to do a lot of impossible jobs. However, the biggest challenge is always the CAD and CAM collaboration. By using the real all-in-one CAD/CAM solution of ZW3D, the changes made in CAD can always be updated in CAM.

In CAM, ZW3D greatly enhances machining and makes it smarter and easier to use. With the application of the design for manufacturing by which the CAM tool path will be updated whenever the CAD data is updated, ZW3D help greatly shorten the CAM machining process by understanding the CAD design. Plus, the tool path generation can be tremendously boosted with the advantage of Multi-thread computing technology of CPU and GPU computing technology. The Solid Simulation in ZW3D guarantees the quality of tool path. Providing simplified workflow and great flexibility

#### ZW3D HQ

Address: 4F, No. 886, Tianhe North Rd., Guangzhou,  
510635, P. R. China

Tel: +86-20-38259726

Fax: +86-20-38288676

Email: [sales@zwsoft.com](mailto:sales@zwsoft.com)

Website: <http://www.zwsoft.com/ZW3D/>

#### USA Subsidiary

Address: 907 E Strawbridge Ave., Suite 200  
Melbourne, FL 32901 USA

Tel: +1-(321) 676-3222

Fax: +1-(321) 676-2181