



ZW3D CAM

3X Milling

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Key Points:

- \diamond Roughing tool path generation
- ♦ Path pattern & boundary setting
- ✤ Finishing operation type & tool path generation
- \diamond Text engraving creation
- ♦ Tool path edit & transfer

This document is used for advanced 3x milling training. The most important and frequently used operations and its parameter settings will be introduced in this document. In addition, the document will share some skills/tips to help users get familiar with ZW3D 3X milling. For new users, we strongly recommend them starting with another fundamental CAM tutorial (ZW3D_FromEntryToMaster_2X Machining.pdf) before learning this tutorial.

Notice:

- 1) This tutorial is based on ZW3D 2019 version, some functions or icons may not match the current version.
- 2) All the tutorial models can be found in installation folder: ...training\3X machining model

1.1 <u>3X Milling Introduction</u>

Generally, when we start a new 3X milling programing, the first step is to evaluate the manufacturing model so that we will have a general idea on how to simplify a complicated model, and then apply proper roughing, rest roughing, semi finishing, finishing operations to generate tool path. The tool path should be verified to avoid work pieces damage and to ensure high-quality machining. Finally we will specify a suitable post processor to transfer the tool path to GM code for manufacturing. The work flow in ZW3D 3X milling is as below:







1.2 Roughing

Roughing operation is used to quickly remove the material from stock, which will use a big size tool and big stepdown to ensure manufacturing efficiency. And of course, we need to consider leaving a uniform rest material after roughing operation for next process. ZW3D provides 4 types of roughing operations to match different machine situations.





Operation	Pattern	Application scenarios
Smooth Flow		Smooth flow roughing operation used for hard material which requested a uniform chip-load.
Diffset 2D		Offset 2D roughing operation can be used for almost all the material. This operation is recommended as the first choice for roughing operation.
Lace		Lace roughing operation is used for soft material.
Plunge		Plunge roughing operation is used for generating tool path in some model with big size, request special machine to work with it.

Figure2 Roughing operation type

1.2.1 Requirement for generate roughing tool path

To generate roughing tool path successfully there are three necessary requirements:

- Specify roughing operation type
- Specify tool (tool need to smaller than machine area)
- Specify Feature (part, and stock or profile boundary)

Generally, if we specified these three necessary requirements, we can get a tool path. No matter whether the tool path is proper or not.

Task1: Create a roughing tool path





STEP 01 Open "Roughing.Z3" file and double click "3X_CAM" to go into CAM space.

STEP 02 Click Setup > Add Stock to add a stock for the part. (All the setting are by default)

STEP 03 Click "Yes" to hide the stock

STEP 04 Select **3x Quick** > **^mOffset 2D** roughing operation

STEP 05 Select part and stock, then click OK button to define machining object and area for this operation.



Figure3 Define machining object and area

STEP 06 Input "D10R0" and change radius to "0" in pop-up tool define form.

🦉 Tool 🙀 🥊 😵			X 🗆
Name D10R0		 Subtype End 	Add to Lib Load from Lib
	Tool Len (L)	50	
	Flute Len (FL)	50	
	Angle (A)	0	
F FL	Flutes (F)	4	
	Radius (R)	0	2
^R − 4 −D→	Cutter Dia (D)	10	\downarrow
ОК Зріу	Reset	Delete Cancel	Save All Load All

Figure4 Cutter definition





Tips: if the tool define form didn't pop up. Double click "Tool (undefined) "in operation list to call out it.



Figure 5 Callout cutter definition

STEP 06 Click "Yes" to calculate the roughing tool path.

👹 ZW3D		23
Calcula	ite [Rough Offs	et 2d 1] now ?
	Yes	No

Figure6 Tool path calculation

Tips: if the calculation dialog didn't pop up, right click the operation named "Rough Offset 2d 1", then click "Calculate" button to generate the tool path.

operations	
Rough Office	241
Class : 🧼	Insert Operation Before
Param 📄	Calculate
✓ 🗐 Featur	Batch Calculate(QM only)
Stoc	Show/Hide

Figure7 Callout tool path calculation

STEP 07 After calculation we get a result as below:



Figure8 Roughing tool path





1.2.2 Detail setting in 3X roughing operation

In section 1.2.1 we discussed the necessary condition to generate the tool path, but to generate a proper tool path to match real machine situation, we need more parameters to control the tool path generation.

Double click "parameters" on operation list, it will pop up an operation detail setting form.



Figure9 Parameters setting form







1) Primary parameters

💱 Rough Offset 2d 1		□ ∞	
Type: Rough Offset 2d	▼ Basic	Specify UCS	
✓ In Limiting	Frame Speeds,Feeds	Specify spindle speed all kind of movement	l and feed rate of t
Reference Tool	▼ Tolerance and Th	ick	
Specify rest material in	Path Tolerance	0.1	
side & 2 direction	Surface Thick	1	
Lead In	Z Surface Thick		Absolute
XV nlane sten over size	▼ Cutting Steps	Scallop	
AT plane step over size	Stepover	% Tool Dia 45.0	
	▼ Stepdown		
	Stepdown	Absolute 5	Absolute *
Z aixs step down size	Number of Cuts	0	Absolute
			% Flute Len
Reset	Calculate	OK Cancel	
9 🚺 🕈	Л	¥ 🔚 🗲	

Figure10 Primary parameter tab

Frame: Specify a UCS (user coordinate system) to calculate the tool path. The frame should be created before we specify it in the setting form.

Task: Create a new frame and use it to calculate the tool path in the bottom side.

STEP 01 Double click the icon of the stock to show the stock



Figure11 Show stock

STEP 02 Create a new frame at the lower left conner of the stock.







Figure12 Create a frame (UCS)

STEP 03 Right click on Rough offset 2d 1 operation and copy it.









Tips: "Duplicate" option can help you quickly create a new operation by referring an existing operation.

STEP 04 Double click Parameter on new copied operation, then select the Frame 1



Figure14 Specify a frame (UCS)

STEP 05 Calculate the tool path of Rough Offset 2d 2 operation.



Figure15 Specify a frame (UCS)

The Frame have two application scenarios:

1, To create the tool path which the Z Axis direction of the machining area is different from the system default Z Axis direction. See the example above.

2, To output the NC code, the XYZ coordinate value will be set according to the specified frame to output.





1 Machine (undefined)	👰 Output Program	₽ 23
Output Insert NC Insert NC Folder Output CL Output NC Output Operation List CL/NC Setting Operation List Setting X Delete All Toggle Expand/Collapse Customize menu	Vortical Program Part Id I Programmer I Coolant F Coolpath Space I Relation Frame I Tool Changes I Tool Num I Speeds/Feeds I Folder Name I I Display Output I	NC Administrator From Tool Machine Local Frame 1 Administrator Machine Local K

Figure16 Output NC with a specified frame (UCS)

Tips: Holding the mouse pointer above the input box of the corresponding option, it will pop up an illusalution of funciton description.

Type: Rough Offset 2d	▼ Basic		
Basic	Frame	Frame	[1
Boundaries	Speeds,Feeds	Roug	Alternate Frame
Reference Tool	▼ Tolerance and 1	Thick	▲ (I)
Filters	Path Tolerance	0.1	
Link and Lead	Surface Thick	1	
Link	Z Surface Thick		0,0,0
Lead Out	▼ Cutting Steps		
Advanced	Stepover	% Too	Dia 45.0

Figure17 Show the illustration

Path Tolerance: This sets the tolerance for internally converting the part geometry to tessellation (triangulated) geometry

Surface Thick & Z Surface Thick: Specify the rest material for the operation.







Figure18 Surface & Z Surface Thick

Tips: The Surface Thick or Z Surface Thick can be left blank without any value. Different settings will result in different effects. For more details please refer to the image as below:

▼ Tolerance and Th	ick	▼ Tolerance and T	hick	▼ Tolerance and T	hick
Path Tolerance	0.01	Path Tolerance	0.01	Path Tolerance	0.01
Surface Thick	0.5	Surface Thick		Surface Thick	
Z Surface Thick		Z Surface Thick	0.5	Z Surface Thick	

Figure19 Surface & Z Surface Thick setting

For the beginner we suggest setting both the "Surface Thick" and "Z Surface Thick" to avoid mistake.

Number of Cuts: To uniform the rest material at incline surface, ZW3D allow adding specified number of cut at each stepdown layer.







Figure20 Number of cuts

2) Limiting parameters

Limiting tab is used for defining the machining area. In other words, we can set different conditions to control the tool path generating area, such as boundaries, rest material area by calculating a reference tool, checking table, clamps, holder collision, and use filter to remove some tiny tool paths.

• Boundaries

In ZW3D, we allow users to calculate the roughing tool path without defining a stock. Thus, when talk about the boundaries, we can divide it into two parts to discuss – with or without stock.

a) Without stock

When we didn't define a stock for calculating the tool path, the boundary will be defined by containment type – Silhouettes & Simple box. The containment type is only used for calculating the boundary without specifying a stock.



Figure21 Containment type







Figure22 Boundary setting (without stock)

b) With stock

When we only defined a stock for roughing operation, the machining area will be defined by stock. But if we also define a profile containment in it, the machining area will be defined by the intersection area of stock and profile containment.

	Boundary type	Calculate boundary	Tool path	
Stock only	 Features Part · 3X (1) < Roughing Z3 Stock : 3X_Stock.1 (2) < Roughing Z3 	Y ZOO_X Stock		
Stock with profile	 Features Part : 3X (1) < Roughing.Z3 Stock : 3X_Stock.1 (2) < Roughing.Z3 Contain : profile 1 	intersection area		

Figure23 Boundary setting (with stock)

• Other boundaries setting





💱 Rough Offset 2d 1			Ģ	× 1	
Type: Rough Offset 2d	▼ ХҮ		(Restrict the cutting tool path within	
Limiting	Containment Type	Simple Box		the stock or not	
Reference Tool	Limit Tool by Stock	No		Restrict the link and lead in/ out	
Check	Limit Lead Moves	No		movement within boundary containment or not	
Path Setting	Cast Offset	0			
Link and Lead	▼ Z			Quickly calculate a stock by adding a specified thickness above the	
Lead In	Тор			part for generating tool path	
■ Lead Out ■ Display Mathematical Advanced	Bottom			Specify the Z axis direction boundary by specify a point or input a Z coordinate value directly.	
الى مى مى	~~~	(and the second		Specify by point: Click the Top or Bottom button first, then specify the point, and click mouse middle button to confirm.	

Figure24 Other boundary settings

• Reference Tool

A specified reference tool used to determine which regions could not be cut by the reference tool, then generate tool path to remove the rest material.

• Check

To check the collision of additional parts (table, clamp, tool holder and so on) and correct the tool path.







Type: Rough Offset 2d Check Primary Primary Pasic Check all of Part Tolerance and Steps Check Shortest Tool Boundaries Consider Tables Reference Tool Safe Distance Table Filters Consider Clamps Link Clamps Link Clamps Lead In Safe Distance Clamp Lead Out Display Mill Region Cutside Check Holder Yes Advanced Check Holder Reset Calculate OK Cancel	💯 Rough Offset 2d 1	When a partia option will tre collision tool	d of the part d eat the whole path generation	lefined as 1 part as ch on	machinin; ecking su	g object, che rface to avo	eck on this id gouge or
Reset Calculate OK Cancel	 Type: Rough Offset 2d Primary Basic Tolerance and Steps Elimiting Boundaries Reference Tool Check Filters Path Setting Link Link Lead In Lead Out Display Advanced 	Check a Check a Check 3 Tables Consid Safe D Clamp Consid Mill Re Safe D Holde Check Safe D	k all of Part Shortest Tool der Tables der Tables der Clamps egion vistance Clamp er Collision er Collision	Yes Yes 1 Yes 1 Yes 1 Yes 1	W w to op W ZV cla ch th ac	Then a tool v older, check fill calculate ool length an peration ma peration ma W3D will co amps and to necking obje tool path cording to s	vith a tool on this option the minimum of output it in nager ptions are on, nsider tables, ool holders as oct, and generate without damage safe distance.
	Reset		Calculate		ОК	Cancel	

Figure25 Check options

• Filters

To filter out some tiny or unnecessary tool path segments.

Type: Rough Offset 2d	▼ Filters			Remove the tool path shorter than % tool diameter (0~100%)
Limiting	% Small Length	0.0		
Boundaries				
Reference Tool	% Small Area	0.0		
Check	5		and the second sec	Remove the region smaller than % tool diameter (0~100%) to
🕺 Filters				generate tool nath
Path Setting	A			generate toor paul
Contraction of Contra				And the second sec



3) Path Setting





Specify the cut direction of fillin (finish) tool path to Climb or Co	ng and cleanup nventional		
Basic	Filling Cut Direction	Any	Pagion First
Interance and Steps	Clean Cut Direction	Climb	Region First
Einiting Reundaries	Cut Order	Region First	
Reference Tool	Path Pattern Guide	Stock	5
🔁 Check	Region Order	Near	
Filters	Synchro ZLevel		Level First
For some case, the rest material is smaller then step down size, click the button and select the flat faces to force the tool path	Corner Control Corner Control Sharp Angle VV Corner Badius	Smooth 90	Specify the method to order the region for generating tool path
generated on those flat faces	% XY Smoothing	30.0	
Control the treatment at corners. (To add a fillet or add D loop at corners)			
Reset		Calculate	OK Cancel
•	មា 🖏	1.	

Figure27 Path setting

• Filling & Cleanup tool path



Figure28 Filling & Cleanup tool path

• Cut Direction

User can set the cut direction to Climb, Conventional, Automatic and Any.







Figure29 Cut direction

Automatic: Selecting automatic will set the direction of cleanup tool path to be the same as filling tool path.

Any: System will assign the tool path to Climb or Conventional in order to get a Zigzag tool path.

• Path Pattern Guide

Control the tool path generated according to part silhouette, stock silhouette, or control by both part and stock.



Figure30 Path pattern guide

• Synchro Z Level

Specify the location that are forced to generate tool path to remove material, so as to ensure a uniform rest material for next process.



Figure31 Synchro Z level





• Corner Control

Specify the method to treat the corner by Smooth or D loop.



Figure32 Corner control

• Sharp Angle (only available for D loop)

If the corner angle of tool path is smaller than specified sharp angle value, the corner will add a D loop.

• XY Corner Radius

Specify the fillet value of the corner.



Figure33 XY corner radius

• %XY Smoothing

Smooth all tool paths based on a percentage of the Step Size.



Figure34 XY Smoothing





4) Link and lead

In ZW3D, the tool movement will be defined as lead in (engage), lead out (retract), cut, plunge, rapid up/down and link segments. In some case, to optimize tool path, some short links will be treated as cutting movement.



In some cases, to optimize tool path, some short link will be treated as cutting movement. Thus the speed setting in Speeds and Feeds table will be as below:





😵 Rough Offset 2d 2				
Speeds		-Feed rates		
Units	RPM *	Units	MMPM *	
Rough	850	Rough	430.0	
Finish	1000	Finish	250	
Rapid	100.00%	Rapid	Rapid	
Step-over (%)	100.00%	Step-over (%)	100.00%	
Plunge (%)	100.00%	Plunge (%)	20.00%	
Engage (%)	100.00%	Engage (%)	60.00%	
Retract (%)	100.00%	Retract (%)	300.00%	
Traversal (%)	100.00%	Traversal (%)	Percent • 100.00%	
Slotcut (%)	100.00%	Slotcut (%)	40.00%	
Slowdown (%)	100.00%	Slowdown (%)	60.00%	

Figure36 Speed and Feed

• Link

The link is used to join the cutting tool path segment. In ZW3D, there are 2 link types: short link and long link. Short link will be mostly used to join the cutting tool path segments in the same cutting region. And long links will be used to join the cutting tool path segments in different cutting regions.

a) Short link

ZW3D provides 5 types of short link to help users meet different machining needs.

Link type	Description	Tool path	Tool lift
On surface	The link will connect the next paths with a straight line and project the line on the surface to get a 3D link		No





Step	The link will move straight to the next path by separated XY movement and Z movement.	No
Spline	System will create a smooth spline between two paths	No
Optimized	The link will lift the tool to safe distance and then move straight to next path by separated XY movement and Z movement.	Yes
Clearance	The link will lift the tool to clearance plane and then move straight to next path by separated XY movement and Z movement.	Yes

Figure37 Short link types







b) Long link

Long link only has optimized and clearance link types which are the same as short link.

Link type	Description	Tool path	Tool lift
Optimized	The link will lift the tool to safe distance and then move straight to next path by separated XY movement and Z movement.		Yes
Clearance	The link will lift the tool to clearance plane and then move straight to the next path by separated XY movement and Z movement.		Yes

Figure38 Long link types





c) Link setting

💯 Rough Offset 2d 1			⊽ ⊠	
Type: Rough Offset 2d	Gouge Check			
Y Service Primary	▼ link		When the specified short link(On	
Tolerance and Stens	Chart Link Turne Calling		surface, Step, Spline) can't	
	Short Link Type	spline	link type to replace	
Boundaries	Long Link Type	Optimized		
Peference Tool	Default Link Type	Optimized	Specify a value to distinguish a link	
🔁 Check	Short Link Limit	10	should be a short link or long link	
Filters	Safe Distance	5	Shown be a short mint of tong mint	
> Path Setting	Classes 7	100		
Link and Lead	Clearance Z	100	Specify a safe distance to avoid	
Lead In	Plunge Length	2	collision when the long link type	
Lead Out	Add Lead to Short Link	No	set to optimized	
Display	% Spline Elasticity 50 Specify a percentage		Specify a percentage value for	
> 🛃 Advanced	·		specify a percentage value for spline elasticity. (only available when link type is spline)	
Reset		Calculate	OK Cancel	
P	មា 🕹	LQ.		

Figure39 Link setting

 \circ Safe Distance

Specify a safe distance to avoid collision when long link type is set to "Optimized".



Figure40 Safe distance





• Lead in/out

ZW3D 3X milling provides 4 types of lead in/out for user, the details are as below.

Lead type	Description	Tool path
None	The lead in/out is created and empty when selecting this type.	
Arc_Line	Extend a tangent line and insert a tangential arc move at the end of the line. So the lead in goes the arc first then the line, the lead out goes the line first then the arc.	
Ramp_Arc	The tool will do a ramp into the material at a specified angle, following an arc with specified radius.	
Along tool path	The tool will do a ramp into the material at a specified angle, following the direction of the cut. If the cut is not close to a span, the lead will follow the reverse direction of the cut.	

Figure41 Lead in/out types

Tips: In some narrow areas, if the space is not enough to create a "Ramp_Arc" type lead in, it will firstly degrade to "Along tool path" type. And if also fail to generate, it will degree to "None" type. The degrade rule will follow the order: "Ramp_Arc" >> "Along tool path" >> "None"

• Lead in/out setting

The setting parameter for lead in and lead out is the same.



3X Milling

💯 Rough Offset 2d 2		₽ 🛛
Type: Rough Offset 2d Primary Basic Tolerance and Steps Limiting Boundaries Reference Tool Check Filters	✓ Gouge Check ✓ Enga When this option is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not. If no retract tool path action is the specified engage create or not.	s ON, ZW3D will check if e or retract tool path can be , it will create engage or cording to degrade rule.
Path Setting	Engage Ramp Height	5
✓	Safe Ramp Length	%Tool Dia 🔻 70.0
Link Lead In Lead Out	Сору	y to Retract from Retract
Adv ed	and the second s	and were presented

Figure42 Engage

\circ Safe Ramp Length

When users use a facing cutter, if the machining region is too small, it may cause tool damage. ZW3D will check the engage tool path according to safe ramp length, if engage tool path is shorter than specified "Safe Ramp Length", it will remove the unsafe tool path to avoid tool damage.



Figure43 Safe ramp length





5) Display

The parameters in this tab are used to control tool path display status, such as color, line type, and display mode and each movement type on or off.

顰 Rough Offset 2d 1	Define the line type a	and width for the tool path
Type: Rough Offset 2d	▼ Options	
P Basic	Style	¥
✓ Imiting	Width	•
Roundaries	Display Mode	User Color
Select the display mode to display the tool path	▼ Filters	
> 🔵 Path Setting	🗹 Engage	
✓	✓ Plunge	
Link	Retract	
Lead Out	☑ Traversal	
Tisplay	🔽 Rapid	
> 🛃 Advanced	🗹 Cut	
	✓ Slotcut	
	Slowdown	
	✓ Stepover	
	Enhance Arcs	
	The check box u display or not	se to control those movement
Reset	Calculate	OK Cancel
9	🖬 😵 艘	

Figure44 Tool path display

6) Advanced parameter

For some special cases or advanced users, ZW3D provides some advanced parameters to help users get the result they expected.

- Path Pattern
 - a) Spiral

Convert the tool path patter to a spiral one, more details setting as below:





W Rough Offset 2d 1			Enable tool path a	spiral
Type: Rough Offset 2d	▼ Spiralize			1100
Rasic	Enable Spiral	Vac	Use to	evaluate whether to spira
Tolerance and Steps	Ellable Spiral	ies	tool pa	ath or not
✓ ■ Limiting	Min Curve Count	4		
Boundaries	% Aggressivity	50.	Use to	control dogrees of spiral
Reference Tool	0	11.16	Use u	gen value apiral degree
Filters	Over Mill	Half	uie bi	a much higgoor
> Path Setting		2	WIII D	e much biggeei
Link and Lead				
🔓 Link	,		10000	
Lead In			$(\bigcirc) ($	
Eead Out				$(\bigcirc))$
 Display Advanced 				
Path Pattern				
Feed Control			None	Half All
More Settin	a second se		and the second second	And I

Figure45 Advanced setting -- Spiralize

 \circ Min curve count

If turns of the filling tool path is smaller than min curve count. It won't spiral the tool path.



Figure46 Min curve count

b) Waves

Transfer a normal tool path pattern to a wave one.









Figure47 Advanced setting -- Waves

c) Plunge

Transfer a normal tool path pattern to a plunge one. The result will be the same as using "Plunge" roughing operation

d) Pause/Break

When machining some hard material, to avoid the tool damage we need to lift the tool and break for a while, the machining operation is repeated in each specified time or distance.

💱 Rough Offset 2d 2				
Type: Rough Offset 2d	▼ Spiralize			
Basic	Enable Spiral	No	•	
✓ ■ Limiting	▼ Waves			
 Boundaries Reference Tool Check Filters Path Setting 	Enable Wave Path	No	•	
	▼ Plunge			
	Enable Plunge Path	No	•	
	▼ Pause/Break			
🛁 Lead In 놀 Lead Out	Break Type	Time	•	
Display Advanced	Time Value	10		
Path Pattern	Retract Type	Relative	-	
More Setting	Retract Distance	10		
	Motion Type	Rapid Move	·	
	Plunge Distance	1		
And the second second	Wait Time	1.	11	

Figure48 Advanced setting – Pause/Break

• Feed Control

AFC (Advanced Feed Control) is an alternative method of calculating QM feeds. It will





automatically change the feed rate according to the chip-load (remove volume of material), smooth the machining operation to get a high-quality and safer milling result, and increase the tool life.

			AFC ON/OFF switch	
Type: Rough Offset 2d	▼ Advanced Feed C	ontrol		
1 Basic	Enable AFC	Yes	•	
Iolerance and Steps Initing Boundaries Reference Tool Check Filters Path Setting Link and Lead Link	Short Span Distance	1		
	Frontal Factor	1.0		
	Radial Factor	1.0		
	Min Feed Rate	100		
	% Max Feed Rate	200.00	D	
Lead In	% Tool Height Load	100	Specify the fee	d rate
Display	-		change rank	urate
✓ Advanced				_
Path Pattern				
More Setting				

Figure49 Advanced setting -- AFC

More setting

W Rough Offset 2d 1		Safe rapid traversal on					
Type: Rough Offset 2d	▼ Advanced Setting	/oll switch					
Basic	Safe RAPID Traversal No	•					
	▼ Enable Arcs						
Boundaries Reference Tool	✓ XY YZ	🗆 xz					
₩ Filters > ● Path Setting	Radius Range 0.1	10000					
Link and Lead Link	Analysis Accuracy						
Lead In	User Value	Enable arc interpolation in Specified plane or type					
 Display Advanced Path Pattern 	Reduce Surface Mesh No	· ·					
Feed Control							
a	and the second second	and the second s					

Figure1 Advanced setting – More setting

\circ Safe RAPID

For some old type machine, they will divide a line traversal to two pieces. Which will move $\triangle X$ and $\triangle Y$ with the same feed rate, if X or Y didn't finish the movement, it will only move the X or Y. Thus, a traversal movement will divide as below:







Figure 50 Advanced setting – Safe rapid

If the calculated traversal movement is different from the real machine movement, it is very dangerous. So ZW3D provides a method to create the traversal which matches special machine type and automatically adjust the improper traversal movement.

1.2.3 Rest roughing operation

Rest roughing operation is used to uniform the rest material for the process of finishing operation after the roughing operation. ZW3D 3X milling provides 3 method to calculate the rest roughing tool path -- reference operation, reference tool, rest stock. Normally, we suggest users using reference operation and rest stock to create the rest roughing operation.

How to create a rest roughing operation?

Open the file "Rest roughing operation.Z3".

• Create by reference operation

STEP 01 Select an operation which you use to calculate the rest roughing tool path



Figure 51 Reference operation step1







STEP 02 Select a reference operation to detect the area of rest material.

Rough Offset 2d 2		These roughing operate		🔮 Select Refer	ence Operation	n	⊂ X3
Class : Rough				Calact Operati			
Tool (undefined)				Select Operation	on		
Parameters				Bough Offs	set 2d 1		
Ref Op (undefine	-()			A nough on.			
Features (undefin	2	Select			_		
Machine : Machine 1 Output	5	Remove	-	-			
NC		Customize menu	1				
			-	3	ОК	Cancel	
✓ San Rough Offset 2d	2	tir s near rougi					
Class : Rough	12						
Tool (undefine	d)						
Parameters	100000						
Ref Op : Rough	n Off	set 2d 1					
S Features (unde	line	u)					
Machine Machine	1						

Figure 52 Reference operation step2

STEP 03 Setting the machining parameters, such as tool, features, step down, step over,

lead in/out and so on.

Part : Drowmord (1) < Rest Toughing operation.2.5
V 🜆 Rough Offset 2d 2
Class - Rough
Tool : D6R3
Parameters
Ref Op : Rough Offset 2d 1
✓ @ Features
Part : blowmold (1) < Rest roughing operation.Z3
Stock : blowmold_Stock.1 (2) < Rest roughing operation.Z3

Figure 53 Reference operation step3

STEP 04 Calculate the tool path



Figure 54 Reference operation step 4

• Create by rest stock

STEP 01 Solid verify the roughing operation





STEP 02 Create the rest stock



Figure 55 Rest stock step2

STEP 03 Select an operation which you use to calculate the rest roughing tool path.









STEP 04 Add the rest stock to the feature and setting associate parameters



Figure 57 Rest stock step4

STEP 05 Calculate the tool path



Figure58 Rest stock step5





1.3 Finishing

The machining purpose of finishing operation is very different from roughing operation. The roughing operation focuses on removing the unnecessary material as much as possible in a short time, thus the roughing operation will use a big step and tool. But finishing operation will focus on the dimension accuracy and surface quality, thus the finishing operation will use a high speed, small step and suitable tool to ensure a high-quality result.

Most of the parameters in finishing operation is the same as roughing operation, we won't explain it one more time, and will introduce the different one or the one that only exists in finishing operation. In addition, different types of finishing operations will have different tool path generation conditions, we will introduce the operations one by one.

1.3.1 Lace operation

Lace operation will generate a group of uniform parallel tool path with equal distance. The lace operation tool path generation theory is that ZW3D will create a group of parallel tool path in XY plane first, and then project it to 3D model. Because of the tool path generation theory, the tool path in steep area will become nonuniform. Thus, this kind of tool path pattern will be suitable for a smooth and gently change machine area but not steep area. Refer to the case as below





• Tool path generation requirement




- Specify tool
- $\circ~$ Specify feature (part or part with profile boundary)
- Associate parameters setting introduce
 - o Primary

💯 Lace 1		₽ 🛛
Type: Lace	▼ Basic	
Basic	Frame	
✓ Im Limiting	Speeds, Feeds	Lace 1
Boundaries Reference Tool	▼ Tolerance an Specify Path Tolerance	the surface thickness
Filters	Surface Thick	0
Path Setting ✓ ≚ Link and Lead	Z Surface Thick	
Link	▼ Cutting Steps	
Lead Out Display Advanced	Stepover Specify the step ov	Scallop V 0.01 Absolute % Tool Dia Scallop Ver type
Reset	Calculate	OK Cancel
🔋 🚺 🐮	1 🕹 🛯	

Figure60 Lace operation -- primary

o Limiting

The containment type definition in finishing operation is a little bit different from roughing operation, and there is a new containment type named "cut contact" in finishing operation

a) Simple box: all the faces inside the boundary box will join into the tool path calculation

b) Silhouette: the silhouette will be the same as the boundary to calculate the tool path.





c) Cut contact: system will not use the boundary to trim the tool path directly but will calculate the point on the boundary where the tool contact to the part. Ensure get a completed tool path to machine the area.



Figure61 Boundaries

Note: 1* The green faces will be joined into the tool path calculation.





o Filter

💯 Lace 1	
🐞 Type: Lace	▼ Filters
💙 📩 Primary	
😗 Basic	% Small Length 0.0
म Tolerance and Steps	% Small Area Define the angle range to
🗸 📠 Limiting	generate the tool path ($0 \sim 90$)
🥪 Boundaries	Angular
Reference Tool	Angle Range 0.0 90.0
🔯 Check	Dense Cost Dis
💹 Filters	
Path Setting	% Antiskate Offset 50.0
✓	
Link	
📥 Lead In	
Out	and a second second second

Figure62 Filter

 \circ Path setting

🦉 Lace 1		
SType: Lace	▼ Cutting Control	Zigzag, Climb, conventional, Bottom to
Basic	Cut Direction Zigza	g top, Top to bottom
 Initing Roundaries 	Cut Angle	Specify angle for tool path generation
Reference Tool	Allow Undercutting No	Select "Yes" to enable tool path
Filters	▼ Corner Control	generated in undercut part.
► Path Setting ► Link and Lead	Z Corner Radius 0	Add a fillet in vertical tool path with
Link Lead In		specified radius
Lead Out Display		
> 🖺 Advanced		
Reset	alculate OK	Cancel
🛛 🖗 🚺	3	

Figure63 Path setting





a) Cut direction

Туре	Zigzag	Climb	Conventional	Bottom to top	Top to Bottom
Pattern		(\rightarrow)			

ZW3D provides several cut direction types for users to select.

Figure64 Cut direction

b) Cut angle

The cut angle defined by the angle between the horizontal directions and the counter clock wise. After setting an angle with horizontal, system will automatically change the start point in order to generate a continue tool path.



Figure65 Cut angle

c) Allow undercutting

Normally, ZW3D will not calculate the tool path where is an undercut. Only choose "allow undercutting" option, and select a proper tool which can cut the material in undercut places, ZW3D will generate the tool paths.



Figure66 Under cut





• Advanced > Uniform cut

Enable the uniform cut, ZW3D will detect the distance between tool paths, if the distance is bigger than the specified step over, it will create a 3D offset pattern tool path to uniform the step over.

🐲 Lace 2		₽ %
W Type: Lace	▼ Uniform Cut	
Y Kernery	Add Uniform Cute	Ver
🐨 Basic	Add Uniform Cuts	res
Tolerance and Steps	XY Step Value UC	4
Limiting	7 Sten Value UC	1
Boundaries	2 Step value de	
🛂 Reference Tool	% First Step UC	100.0
🔁 Check	% Smoothing UC	0.0
💹 Filters	Dath Dathan UC	Frame Baum davies
🧶 Path Setting	Path Pattern UC	From Boundaries *
Ƴ ≚ Link and Lead	Enhance Corners UC	Yes *
🕂 Link	Spiralize	
📥 Lead In	▶ Spiralize	
놐 Lead Out	Pause/Break	
冒 Display		
> 🛃 Advanced	Advanced Feed Con	trol
an and a second second	and and	and the second s

Figure67 Uniform cut 1



Figure68 Uniform cut 2





• Example

STEP 01 Open "Lace.Z3" file and go into CAM space



Figure69 Lace operation example Step1





Figure70 Lace operation example Step2

STEP 03 Select Part and profile1 to the feature



Figure71 Lace operation example Step3

STEP 04 Specify a D12R6 tool and use default setting, then calculate the tool path







Figure72 Lace operation example Step4

1.3.2 Offset 3D operation

Offset 3D will generate a 3D equal step tool path all over the part following the silhouette or 3D boundary profile. If the boundary profile is not specified, system will use the part silhouette as base to offset and generate the whole tool path. Otherwise it will follow the 3D boundary profile to offset the tool path.







Figure73 Offset 3D operation

• Path pattern



- Tool path generation requirement
 - \circ Specify tool
 - Specify feature (part or part with profile boundary)
- Associate parameters setting

 \circ Primary





3X Milling

🦉 Offset 3d 2		
Type: Offset 3d	▼ Basic	
Pasic Tolerance and Steps	Frame	
 Limiting Boundaries 	Speeds,Feeds	Offset 3d 2
Reference Tool	▼ Tolerance and Th	hick
Filters	Path Tolerance	0.01
Link and Lead	Surface Thick	0
Lead In	Z Surface Thick	
Lead Out	▼ Cutting Steps	
> Advanced	Stepover	Absolute * 8
	Z Step Value	Specify how many turns of tool
	Number of Cuts	Empty this option will create a
	% First Step	100.0 completed tool path
		Control the Section and a lar
Reset		Calculate Control the first step over value by Calculate percentage of tool diameter
💡 🗾	បា 🛛 💐	¥ E

Figure74 Offset 3D operation -- Primary

\circ Path pattern

💱 Offset 3d 1		Ţ) X	
Type: Offset 3d Frimary	Cutting Control			
Basic	Cut Direction	Zigzag	-	
✓ In Limiting	Path Pattern	From Boundaries	•	
 Boundaries Reference Tool Check Filters Path Setting Link and Lead Link Lead In Lead Out 	▼ Corner Control % Smoothing Z Corner Radius Enhance Corners	Specify tool path genera		m outside or inside
> Advanced		Toward boundaries		From boundaries

Figure75 Offset 3D operation – Path setting

• Example

STEP 01 Open "CAM_TM_Model.Z3" file and go into CAM space



3X Milling



Manager	= 23	+ CAM_TM_Model.Z3 - [blowmold_CAM] ×
 Setup 1 Secometry : 		100
 Clearances Frames Tools 		7 v
 Tactics Operations Machine (undefined) 		

Figure76 Offset 3D operation example Step1





Figure77 Offset 3D operation example Step2

STEP 03 Add part to the feature and specify a profile boundary feature.



Figure 78 Offset 3D operation example Step 3

STEP 04 Specify a D8R4 tool for this operation and set the step over to 5(mm)

✓ ■ Operations	Lead In		Z SUL 2 Fritan		
✓ Soffset 3d 1	🔓 Lead Ou	t	▼ Cutting Steps		
Tool : D8R4 Parameters	 Display Advanced 	\rightarrow	Stepover	Absolute	• 5
Ref Op (undefined)			Z Step Value		
✓			Number of Cuts		
Part : blowmold (1) < CAM_TM_Model.Z					
Machine (undefined)			% First Step	100.0	
Output					
	Reset		Calculate	ОК	Cancel
	💡 [2	ת 🕹	le	-

Figure79 Offset 3D operation example Step4





STEP 05 Calculate the tool path



Figure80 Offset 3D operation example Step5

1.3.3 Drive curve operation

Drive curve operation will generate the tool path by offsetting a specified guide profile in both sides, and the number of turns can be defined by users. The profile can be opened or closed. Users can specify more than one guide profile to generate the tool path.

• Path pattern



- Tool path generation requirement
 - \circ Specify tool
 - o Specify feature (part or part with profile boundary)
 - \circ Specify drive curve (\precsim the profile type should be part)

Tips: The drive curves can be closed or opened

- Parameter setting
 - $\circ \operatorname{Primary}$





🐲 Drive Curve 1		₽ 🛛
Type: Drive Curve	▼ Basic	
9 Basic	Frame	
✓ Im Tolerance and Steps	Speeds, Feeds	Drive Curve 1
Boundaries	▼ Tolerance and Thick	
Check	Path Tolerance Surface Thick Specify	the turns
 Path Setting Link and Lead 	Z Surface Thic	path
Link	▼ Cutting Ster .	
Lead Out	Number of Cuts	20
Display	Stepover	Absolute * 1
> 🖺 Advanced	% First Step	100.0
	Z Step Value	
and the second second	a state and a second	and the second s

Figure81 Drive curve operation -- Primary

Number of cut option can specify how many turns of tool path will be generated by offsetting from the guide profile. When option is empty, ZW3D will generate a tool path along the guide profile. Otherwise it will offset guide profile in both sides to generate the tool path.



Figure82 Drive curve operation – Number of cuts

 \circ Path setting





 Drive Curve 1 Type: Drive Curve Primary Basic 	▼ Cuttinc a Advanc s	pecify a va rea, the are ame as pen	lue to d ea detec cil cut c	etect the machining t method will be the operation
Tolerance and Steps	Path attern		From B	oundaries
	Pencil XY Ra	nge	10	
Boundaries			·	
Reference Tool	Corner Co	ntrol		
🚺 Check				
💹 Filters	% Smoothing	9	0.0	
Path Setting	Z Corner Rad	lius	0	
✓ ≚ Link and Lead	Enhance Cor	ners	No	•
Link		-	<u> </u>	and the second second

Figure83 Drive curve operation – Pencil XY Range 1

In some cases, the drive curve will be very close to the part which is impossible to create the tool path along the drive curve. Set a proper value in "Pencil XY Range", then it will detect a machining area and create a tool path guide by the drive curve.



Figure84 Drive curve operation – Pencil XY Range 2

• Example

STEP 01 Open "Drive curve .Z3" file and go into CAM space



3X Milling











Figure86 Drive curve operation example Step2

- STEP 03 Add the part to the feature
- STEP 04 Define drive curve



Figure87 Drive curve operation example Step4





STEP 05 Define boundary feature



Figure88 Drive curve operation example Step5

STEP 06 Specify a D18R9 tool for this operation and set the associate parameters as below:



Figure89 Drive curve operation example Step6-1





💯 Drive Curve 1		₽ 🛛	
Note: Type: Drive Curve	▼ Options		
Y 🍲 Primary			
Basic	Style	•	
Tolerance and Steps	Width	•	
V III Limiting	· · · · · · · · · · · · · · · · · · ·		
Boundaries	Display Mode	User Color	
Keterence lool	🖾 Cut		
Check			
Path Setting	Filters		
✓ ≚ Link and Lead	🗹 Engage		
Link	V Plunge		
📥 Lead In	C nunge	heck off those	
Lead Out	✓ Retract m	novement type in order	
Display	☑ Traversal to	o observe the tool path	
> 🛃 Advanced	🗹 Rapid	uch easier.	
	✓ Slotcut		
	Slowdown		
	Stepover		
	L Enhance Arcs		
Reset	Calculate OK Cancel		
💡 🚺 🖞	1 😼 艘		

Figure 90 Drive curve operation example Step 6-2

STEP 07 Calculate the tool path



Figure91 Drive curve operation example Step7





1.3.4 Flow 3D operation

Flow 3D operation will morph a pair of guide profile to generate a set of tool path with 3D equal distance to fill with the area between the guide profiles. The guide profile can be opened or closed.

Note:

1. Please pay attention to the direction of the guide profile should be the same, otherwise it will create a twist tool path.

2. Two guide profiles have to be separated in two profile features.

• Path pattern



- Tool path generation requirement
 - \circ Specify tool
 - o Specify feature (part or part with profile boundary)
 - \circ Specify a pair of guide curves (\precsim the profile type should be part)
- Example

STEP 01 Open "Flow_3D.Z3" file and go into CAM space.



Figure92 Flow 3D operation example Step1







	Ø 1	N	\$	1		Ø	1	\$
Lace O	ffset Ang 3D Limit Fin	gle Corner ting Finish ish	Flat Finish	Drive Curve	Z level	Pencil Cut	Flow 3D	Bulge

Figure93 Flow 3D operation example Step2

STEP 03 Add the part to feature

STEP 04 Define guide curves for flow 3D



Figure94 Flow 3D operation example Step4

STEP 05 Specify a 2mm ball end tool



Figure95 Flow 3D operation example Step5





STEP 06 Calculate the tool path.



Figure96 Flow 3D operation example Step6

1.3.5 Z level operation

Z level operation will generate a set of contour tool path in Z axis direction which are used to machine steep wall area.

• Path pattern



• Tool path generation requirement

 \circ Specify tool

- Specify feature (part or part with profile boundary)
- Associate parameters setting introduce
 - \circ Non-uniform cuts

a) This option is by default set "NO" which means that ZW3D will use uniform step down to create the tool path.

b) For some parts with different angle steep wall, we need to use "non-uniform cuts" to get a better surface quality as shown below:







Figure97 Z level operation – Non-uniform cut 1



3X Milling



💱 Zlevel 1		X 🛱
Stype: Zlevel	Tolerance and Th	ick
P Basic	ath Tolerance	0.01
✓ Limiting S	urface Tolerance	
Boundaries S	urface Thick	0
Check Z	Surface Thick	
Path Setting	Cutting Steps	
Link and Lead	tepdown	Absolute 3
Lead In Z	Min Step Value	
■ Display	Ion-Uniform Cuts	No
Specify the first layer step down value	▼ Cutting Steps	Set to Yes
	Stepdown	Absolute 3
	Non-Uniform Cuts	Yes 🔹
	Boundary Point	PNT#664
boundary point 1	Region Stepdown	Absolute * 2.5
Layer1	Layer	
boundary point 2	PNT#664(2.5)[At PNT#667(3.5)[At	osolute] Specify the boundary point and step down value for each layer from layer 2
	Add Layer	Delete Layer Edit Layer

Figure 1 Z level operation – Non-uniform cut 2

c) How to add a new layer

Image: Non-Uniform Cuts Yes Boundary Point PNT#632	2
Region Stepdown Absolute 2.5 Layer	Select a point on geometry
4 Add Layer Delete Layer Edit Layer	2

Figure98 Z level operation – Non-uniform cut 3





d) How to delete a layer





e) How to edit a layer

Redefine a boundary point	2
Boundary Point PNT#615 Rede	fine the step down value 3
Layer	
PNT#667(3.5)[Absolute] Select a layer to e	dit 1
	Click the button to confirm the input 4
Add Layer Delete Layer Edit Layer	

Figure100 Z level operation – Non uniform cut 5

• Path Setting



Figure 1 Z level operation – Path setting





• Example

STEP 01 Open "CAM_TM_Model.Z3" and go in to CAM space



Figure101 Z level operation example step1

STEP 02 Select Z level operation



Figure102 Z level operation example step2

STEP 03Add part to the feature and specify a profile boundary feature.

STEP 04 Specify a D8R4 tool for this operation





STEP 05 Specify steep area angle range for generating Z level tool path





🛷 Zlevel 1 P X 🖲 Type: Zlevel Filters 📥 Primary % Small Length 0.0 🗣 Basic Tolerance and Steps % Small Area 0.0 🗸 🔳 Limiting Angular 🥪 Boundaries Reference Tool Angle Range 30 90.0 🗊 Check Prev Ci Dir Kilters % Antis e Offset 50.0 Path Setting 💾 Link and Lead * Setting the angle range to define the area 🚰 Link where to generate the tool path. 📥 Lead In * The angle is detected by the included angle 늘 Lead Out of XY plane and face normal. 冒 Display * 30 ~ 90 degree is a recommend angle range Advanced for Z level operation, since the area which the angle range smaller than 30 degree will generate the obvious nonuniform tool path, which will result in a bad surface quality Figure104 Z level operation example step5 STEP 06 Calculate the tool path

Figure105 Z level operation example step6

1.3.6 Angle limiting operation

The angle limiting combined several finishing operations in it, which will automatically detect the machine area is steep or flat, then assign proper operation to those area. Lace or offset 3D part pattern is recommended for shallow area, Z level path pattern is recommended for steep area. The definition of steep area can be adjusted by user. This operation will highly improve our machine efficiency and surface finish.





• Path pattern



- Tool path generation requirement
 - \circ Specify tool
 - \circ Specify feature (part or part with profile boundary)
- Associate parameters setting introduce
 - \circ Primary

💯 Angle Limiting 1				₽ %
Type: Angle Limiting		Basic		
Basic		Frame		
Tolerance and Steps Imiting		Speeds, Feeds	Angle Limiting 1	
Boundaries		Tolerance and T	hick	
🕖 Check	P	ath Tolerance	0.01	
 ₩ Filters ● Path Setting ✓ ≚ Link and Lead 		^{urfa} Specify the _{Sur} type for fla	e tool path pattern at area	
Link		▼ Flat Regions		
Lead In	F	at Pattern	Lace Cut	•
Display	C	ut Direction	Lace Cut	
> 🛃 Advanced	Specify the too type for steep a	l path pattern area	HSM Lace	
		Steep Region.		
	S	teep Pattern	Zlevel	-
	C	ut Direction	Zigzag	-
	S	tepdown	Scallop • 0.01	

Figure106 Angle limiting operation – Primary





\circ Path Setting



Figure107 Angle limiting operation – Path setting

• Example

STEP 01 Open "CAM_TM_Model.Z3" and go to CAM space



Figure108 Angle limiting operation example step1

STEP 02 Select Angle limiting operation



Figure109 Angle limiting operation example step2

STEP 03 Add part to the feature and specify a profile boundary feature.

STEP 04 Specify a D8R4 tool for this operation











STEP 05 Specify path pattern for flat area and steep area

🐲 Angle Limiting 1			₽ %		
Type: Angle Limiting	▼ Basic				
Basic	Frame				
Tolerance and Steps Imiting	Speeds, Feeds	Angle Limiting 1			
Boundaries	▼ Tolerance and Thick				
🗊 Check	Path Tolerance	0.01			
Filters	Surface Thick	0			
✓ ≚ Link and Lead	Z Surface Thick				
Link	▼ Flat Regions				
Lead In	Flat Pattern	Lace Cut	-		
Display	Cut Direction	Zigzag	-		
> 🛃 Advanced	Stepover	Scallop * 0.01			
	Cut Angle				
	▼ Steep Regions				
	Steep Pattern	Zlevel	-		
	Cut Direction	Zigzag	•		
A province of the second second	Stepdown	Scallop • 0.01			

Figure111 Angle limiting operation example step5

STEP 06 Define angle range of steep area





💯 Angle Limiting 1		₽ 🛛
Type: Angle Limiting	▼ Cutting Control	
Pinnary Pasic	Limiting Method	ToolPath 🔹
Interance and Steps	Steep Angle	30.0
✓ I Limiting	Cut Regions	All Regions T
🥪 Boundaries	carnegions	Air Regions
4 Reference Tool	Cut Order	Flat First 🔹
🔯 Check	Overlap	0.0
💹 Filters	Allow Usedana dia a	Ne
Path Setting	Allow Undercutting	NO
V. Verenter and the second second	متحسبين البير	and and and the second



STEP 07 Calculate the tool path



Figure113 Angle limiting operation example step7

1.3.7 Flat finishing operation

Flat finishing operation will detect all of the planar surface within given flat tolerance automatically, and then use lace or offset 2D path pattern to create tool path for all planar surfaces in one operation.

• Path pattern







- Tool path generation requirement
 - \circ Specify tool
 - Specify feature (part or flat region feature)
- Associate parameters setting
 - \circ Path Setting

	Specify th	e tool path	n pattern
💯 Flat Finish 1	Lace Offset2D	Sp	pecify the cut angle for ce tool path pattern
🐌 Type: Flat Finish	▼ Cutting Control	-	
Y 🍲 Primary	Cut Direction	7:	ZW3D will Ignore the flat region
🐨 Basic	Cut Direction	Zigzag	whose inscribed circle diameter
Tolerance and Steps	Path Type	Lace	is smaller than specified TDU
Y 🖪 Limiting	CutAngle		(tool diameter unit).
🥪 Boundaries	Cut Angle		
Peference Tool	Ignore Hole TDU	1.5	Select "Yes" to enable the tool
🔁 Check	Outside In	Vec	path past the boundary. "No" to
💹 Filters	outside in	103	limit the tool path inside the
🔵 Path Setting	Side Finish	0.1	boundary
✓	Bottom Finish	0.1	
🚹 Link	-		
📥 Lead In	▼ Corne, Control		Specify a side finish rest
		Smooth	material thick for the final clear
if the bottom finish rest m	aterial thick	Munut	up tool path
have been set, it will gener	rate one more		
tool path according to spe	cified height		

Figure114 Flat finishing operation – Path setting

• Example

STEP 01 Open "Flat Finishing.Z3" file and go to CAM space

M	anager	= 23	+ Flat Finishing.Z3 - [Flat finishing_CAM] ×	+
- @	🗧 Setup 1			
	🗸 🗢 Geometry :			
	Part : Flat finishing (1)		A	
1	Section 2017			
	Frames			
	Tools			
	🗣 Tactics			
	Operations		69 600 101	
	Machine (undefined)			
2	Dutput			

Figure115 Flat finishing operation example step3





STEP 02 Select flat finishing operation

•				(\$	4		Ø	W	*
	Lace	Offset 3D	Angle Limiting	Corner Finish	Flat Finish	Drive Curve	Z level	Pencil	Flow 3D	Bulge
			Finish					Cut		
		Fig	uro116	Elot fi	niching	onoratio	novomn	la atan?		

Figure116 Flat finishing operation example step2

STEP 03 Add part to the feature and specify a 10mm flat end tool as the tool

Operations
🔺 🤹 💡 Flat Finish 1
Class : Finish
Tool : D10R0
Parameters
4 🧐 Features
🧔 Part : Flat finishing (1) < Flat finishing.Z3

Figure117 Flat finishing operation example step3

STEP 04 Specify the path pattern for flat operation.

💯 Flat Finish 1		₽ %
🛸 Type: Flat Finish	▼ Cutting Control	
Primary Basic	Cut Direction	Zigzag 🔹
Tolerance and Steps	Path Type	Lace 🔹
 Limiting Boundaries 	Cut Angle	
Preference Tool	Ignore Hole TDU	1.5
🔁 Check	Outside In	Yes 🔹
Path Setting	Side Finish	0.1
✓ ≚ Link and Lead	Bottom Finish	0
Lead In	▼ Corner Control	
الأربيل المتعلقين والمعالية		and the state of t

Figure118 Flat finishing operation example step4

STEP 05 Calculate the tool path







Figure 119 Flat finishing operation example step5

1.3.8 Corner finishing operation

Corner finishing operation is a corner cleanup operation, it will detect the rest material by specifying a reference tool and generate tool path to remove those rest materials.

• Path pattern



- Tool path generation requirement
 - \circ Specify tool
 - o Specify a reference tool
 - Specify feature (part or part with profile boundary)
- Associate parameters setting introduce
 - $\circ \operatorname{Primary}$





3X Milling

💯 Corner Finish 1		¢	= 53
Type: Corner Finish	▼ Basic		
Basic	Frame		
➡ Tolerance and Steps ✓ ■ Limiting	Speeds, Feeds	Corner Finish 1 Specify flat area tool p	oath pattern.
Boundaries	▼ Tolerance and Thick		
Check	Path Tolerance	0.01	$\{1,1,1,1\}$
Path Setting	Surface Thick	0 Along	Across
✓ ≚ Link and Lead	Z Surface Thick		
Link	▼ Flat Regions		
Lead Out	Flat Pattern	Along	
Display	Step Value	Scallop • 0.0 Specify the	e steep area attern
> 🖆 Advanced	▼ Steep Regions		
	Steep Pattern	Across	-
	Steep Cut Progress	High to Low	-
	Step Value	Scallop 7 0.01	
		Cussify the weeking of	lineation
		specify the machine of	lirection
Reset	Calculat	High to Low Lo	ow to High
9	บ 🗞	12	
Figure120 Corner finishing operation Primary			

• Example

STEP 01 Open "Mouse_end.Z3" file and go to CAM space



3X Milling



Manager 🗉 🔀	+ Mouse_end.Z3 - [Mouse_cover_CAM] × +
 setup Geometry: Part: Mouse_cover (1) < mouse_end.Z3 Stock: Mouse_cover_stock (2) < mouse_end Clearances Frames Tools Tactics Operations Rough Offset 2d 1 Spiralcut 1 Spiralcut 1 Lace 1 Lace 2 Lace 3 Machine: machine 1 Output 	

Figure121 Corner finishing operation example step1

STEP 02 Select corner finishing operation.



Figure122 Corner finishing operation example step2

STEP 03 Add the part to the feature and specify a D4R2 tool for this operation





STEP 04 Specify path pattern for flat and steep area.





💱 Corner Finish 1				23
Type: Corner Finish	▼ Basic			
Basic	Frame			
✓ ■ Limiting	Speeds,Feeds	Corner Finish 1		
Reference Tool	► Tolerance and Th	ick		
Filters	▼ Flat Regions			
Path Setting ✓ ✓ Link and Lead	Flat Pattern	Along		-
Link	Step Value	Scallop *	0.01	
Lead Out	Steep Regions			
> 🛃 Advanced	Steep Pattern	Across		•
	Steep Cut Progress	High to Low		*
	Step Value	Scallop *	0.01	
and growing and	و المحمد المر			



STEP 05 Specify a reference tool to detect the rest material area and set the min rest height

💱 Corner Finish 1		₽ X
Type: Corner Finish	▼ Reference Tool	
Basic	Reference Tool	D6
✓ ■ Limiting	Min Rest Height	0.1
Reference Tool	Expand Area	0.2
Check	Rest Rough	No
Path Setting	and some of a	the three three to be

Figure125 Corner finishing operation example step5

Min Rest Height: This parameter sets the minimum height to detect the rest material area according to the specified reference tool.

STEP 06 Calculate the tool path







Figure126 Corner finishing operation example step6

1.3.9 Pencil operation

Pencil operation is another corner cleanup operation, it will detect all the corner where the corner radius is equal to or smaller than the specified tool, then create tool path and follow the corner shape to rest material.

Note: The tool radius should be bigger than or equal to the cleanup corner radius, otherwise it can't generate tool path.

• Path pattern



- Tool path generation requirement
 - \circ Specify tool
 - \circ Specify feature (part or part with profile boundary)
- Example

STEP 01 Open "Mouse_end.Z3" file and go to CAM space



3X Milling



Mai	ager 🗉 🖾	+ Mouse_end.Z3 - [Mouse_cover_CAM] × +
	ager ■ < Imager ■ Imager <th>+ Mouse_end.23 - [Mouse_cover_CAM] X +</th>	+ Mouse_end.23 - [Mouse_cover_CAM] X +



STEP 02 Select pencil operation.



STEP 03 Add the part to the feature and specify a D4R2 tool for this operation



Figure129 Pencil operation example step3

STEP 04 Specify the number of cuts




💯 Pencil Cut 1		⊽ X
🚳 Type: Pencil Cut	▼ Basic	
Basic	Frame	
✓ Im Tolerance and Steps	Speeds, Feeds	Pencil Cut 1
Boundaries Reference Tool	▼ Tolerance and Thick	
Check	Path Tolerance	0.01
M Filters	Surface Thick	0
Path Setting Link and Lead	Z Surface Thick	
Link	▼ Cutting Steps	
Lead In	Number of Cuts	3
Display	Stepover	Scallop * 0.01
> 🖆 Advanced	% First Step	50.0
	Z Step Value	
and the second	and the second second	and the second second

Figure130

Pencil operation example step4











1.3.10 Bulge operation

Bulge operation creates a network of bulges on a surface using two intersecting curves referred to as a drive curve (Directrix) and a generator curve (Generatrix). This operation is useful in dispersion networks for automotive lighting parts or as an artistic hammer-paint effect. The Generatrix is used as a pattern generator that is guided by the Directrix.

Note:

1) The first profile in feature group will be defined as Generatrix

2) The second profile in feature group will be defined ad Directrix

3) The interaction point of Generatrix & Directrix will be defined as the origin to array the tool path



Figure132 Bulge operation

• Path pattern



- Tool path generation requirement
 - \circ Specify tool
 - o Specify array guide curve (Generatrix & Directrix)
 - \circ Specify feature (part or part with profile boundary)





• Associate parameters setting

\circ Primary

💱 Bulge 1		
	▼ Basic	
Basic	Frame	
 Limiting Boundaries 	Speeds,Feeds	Bulge 1
Reference Tool	▼ Tolerance and Th	lick
Filters	Path Tolerance	0.01
$\checkmark \stackrel{\text{\tiny Link}}{=}$ Link and Lead	Surface Thick	0
Lead In	Z Surface Thick	
Lead Out	Cutting Steps	Step over size
> 🖺 Advanced	Generatrix Step	5
	Directrix Step	5
PL	and the second sec	and the second se

Figure133 Bulge operation – Primary

 \circ Path setting



Figure134 Bulge o

Bulge operation – Path setting





1.4 Engraving

Except creating tool path to machine product, company logo, produce specification code or some other design pattern are also needed to add into the product. This chapter will introduce how to create those engraving tool path.



1.4.1 Engraving for design pattern

For design pattern engraving, ZW3D provides several methods to assist users create the tool path easily and efficiently. Such as using surface engraving, spiral finishing, drive curve operation. Here we will use 3 examples to introduce the engraving tool path generation.

• Filling tool path into design pattern



Figure136 Filling tool path into design pattern

For this kind of pattern, spiral finishing operation is recommended to use. To fill the tool path into the design pattern, which requests the profile to be closed. If the profile is an open one, we need to use CAD function to modify it first.





STEP 01 Open "Engraving.Z3" file and go into the CAM space.

STEP 02 Call out the 3X Nurbs ribbon menu first.

Right Click on the blank area of ribbon tool bar	1				
ualize Inquire	2018 x64 Cam Plan - Ribbon Appearance Ribbon Tabs	[eng	iravi	ng.Z3 - [Part001_CA	M]]
Drive Z level Pencil F Curve Cut	Ribbon Panels ToolBars Styles Customize)))	✓ ✓ ✓	Drill 2x Mill 3x Nurbs 3x Quick	ow
options. filter.	v ∎ Cut v] 3	✓ ✓ ✓ ✓ ✓	Turning Tool Path Editor Output Tools Visualize Inquire	Check on this option 3



STEP 03 Select the spiral finishing operation.

1	3x Nurbs	3x Quicl	k Turning	Tool	Path Edit	tor (Dutput	Tools	١
			1/2					5	
٦r	Spiral Zig	zag Box	Contour	Spiral	Zigzag	Box	Contour	Profile	2
		Cast				Finis	h		

Figure138 Spiral operation

STEP 04 Select all the curves and define it as part profile and add the part to feature.









Figure139 Define operation feature





STEP 05 | Specify a 1mm ball endmill.



Figure140 Specify a 1mm ball end tool



Set engraving depth, step over value, the other option use default setting.



Figure141 Specify maching parameter

STEP 07 Calculate the tool path. (The green lines are the tool path)



Figure142 Final result of engraving 1





Summary: Tool path generation requirement for spiral finishing operation

- $\circ \ \ Specify \ a \ tool$
- Specify the boundary profile and set the profile type to "part"
- \circ Add the part to feature
- $\circ~$ Specify the engraving depth and step over size.
- Filling tool path outside the design pattern



Figure143 Filling tool path outside the design pattern

The method of calculating the tool path outside the boundary is very similar to "Fill tool path into design pattern", the only difference is the boundary profile.

STEP 01 Duplicate the operation that we just created and remove profile 1















STEP 03

Don't modify associate parameters and calculate the tool path directory.







• Create tool path on the design pattern



Figure147 Create tool path on the design pattern

To create tool path on design pattern, ZW3D provides two methods to do it. One is using surface engrave operation, the other is using drive curve operation.

• Step of create tool path by surface engrave operation

STEP 01	Sele	ct surfa	ace eng	rave op	peratio	on				
2x Mill	3x Nur	1	Quick	5x Mill	Turn	ing	Tool Path	Editor	put T	
ש 	1		Y	U V		6	W		*	
ontour	Side	Peeling	Also	3x iso	Map	Rest	Pencil Trace	Scallop Removal	Surface Engraving	
					Cu	t				
	Figure	148	Create	tool patl	n on the	e desig	n patterr	n example	step1	

STEP 02 Select all the design pattern as profile and select part to feature. We can reuse the profile feature which are created in spiral finishing operation.



Figure149 Create tool path on the design pattern example step2

STEP 03 Select 1mm ball end tool









STEP 04 Specify the engraving depth by setting bottom thickness

🦉 Surface Engrave 1			
Surface Engrave	▼ Basic		
Basic Interance and Ste	Frame		
Limiting Path Setting	Speeds,Feeds	Surface Eng	grave 1
Link and Lead	▼ Tolerance and T	hick	
Link	Path Tolerance	0.1	
Lead Out	Curve Thick	0	
Display	Surface Thick	0	
	Bottom Thick	-0.1	
- marker .	▼ Cutting Steps		a sure of

Figure151 Create tool path on the design pattern example step4

STEP 05 Calculate tool path by keeping associate parameters with default value.



Figure152 Create tool path on the design pattern example step5

• Steps of creating tool path by drive curve operation

STEP 01 Select drive curve engrave operation



Figure153 Drive curve engraving example step1





STEP 02 Select all the design pattern as profile and select part to feature.



Figure154 Drive curve engraving example step2

STEP 03 Select a 1mm ball end tool





STEP 04 Specify the engraving depth by setting Z Surface Thick.

💱 Drive Curve 1		
Type: Drive Curve	▼ Basic	
Basic Interance and Steps	Frame	
Limiting Boundaries	Speeds,Feeds	Drive Curve 1
Reference Tool	▼ Tolerance and Th	nick
Filters	Path Tolerance	0.01
✓ ≚ Link and Lead	Surface Thick	0
Link Lead In	Z Surface Thick	-0.1
Lead Out	▼ Cutting Steps	
> 🖺 Advanced	Number of Cuts	0
العبورين المعطونين		Caracterian and the second

Figure156 Drive curve engraving example step4

STEP 05 Calculate tool path by keeping associate parameters with default value.





Figure 157 Drive curve engraving example step5

Summary: Tool path generation requirement for surface engrave or drive curve operation

- \circ Specify a tool
- Specify the boundary profile and set the profile type to "part"
- Add the part to feature
- Specify the engraving depth.

Difference: The tool path created by surface engraving or drive curve methods seems to the same, but also has its usage scene. Since we need to create a deep engraving and the tool can bear the depth in one time, we need to divide the depth to several times which are under the tool safe load. In this situation, we suggest using surface engraving operation because it can set step down value. But in other scenes, the depth is proper, we just want a much bigger size engraving. Of course we can get the result by changing a much bigger tool. Or we can use drive curve operation by offset the tool path in XY direction. Normally, without special request, surface engrave operation is recommended.



Figure158 Surface engraving





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Type: Drive Curve Primary Basic Tolerance and Steps Beders, Feeds Drive Curve 2 Boundaries Reference Tool Check Path Tolerance and Thick Path Setting Surface Thick Link and Lead Link Lead In Lead Out Display Number of Cuts Stepover Absolute 0.1 % First Step 50 Z Step Value	💱 Drive Curve 2		Ģ	×	
Reference Tool Check Path Setting Path Setting Surface Thick Surface Thick Lead In Lead Out Display Madvanced Number of Cuts Stepover Absolute * 0.1 % First Step 50 Z Step Value	 Type: Drive Curve Primary Basic Tolerance and Steps Limiting Boundaries 	▼ Basic Frame Speeds,Feeds	Drive Curve 2		
Path Setting Path Setting Link and Lead Link and Lead Link Lead In Lead Out Display Metric Steps Stepover Absolute * 0.1 % First Step Z Step Value	Reference Tool	▼ Tolerance and T	hick		
↓ Link Z Surface Thick ↓ Lead In ▼ Cutting Steps ↓ Lead Out ▼ Cutting Steps ▶ Mumber of Cuts 2 Stepover Absolute * 0.1 % First Step 50 Z Step Value ✓	Path Setting	Path Tolerance Surface Thick	0.01		
Cutting Steps Number of Cuts 2 Stepover Absolute * 0.1 % First Step 50 Z Step Value	Link Lead In	Z Surface Thick			
Mumber of Cuts 2 Stepover Absolute * 0.1 % First Step 50 Z Step Value Image: Constraint of Cuts	Display	Cutting Steps			
Stepover Absolute 0.1 % First Step 50 Z Step Value	Advanced	Number of Cuts	2		_
% First Step 50 Z Step Value	-	Stepover	Absolute * 0.1	- FON	
Z Step Value		% First Step	50	230	
		Z Step Value			3
	and shared	and a second second second	and a second a second		S

Figure159 Drive curve engraving

1.4.2 Engraving for text

The method introduced in last section will get a uniform engraving depth, the method is also suitable for creating engraving for text, just as below:



This section will introduce another method to create the engraving tool path for text, the engraving depth is nonuniform which will assign the depth, according to the gap of outline letters. The theory is to make the tool always tangent to the outline of letter.



Figure161 Engrave 2D operation

Steps for create engraving tool path by engrave 2D operation.





STEP 01 Open "Engrave 2D.Z3" file and go into "Engrave_2D_CAM" environment.

STEP 02 Select Engrave 2D operation

3x Quick	Mill Tu	urning	Tool Pa	th Edito	r 🧿	ut Tools
🔞 🍝	A		J)		5	Ŷ
Corner Flat Finish Finish	Drive Curve	Z level	Pencil	Flow 3D	Bulge	Engrave 2D
			Cut			Engrave



STEP 03 Select all the text curve as the profile and set the type to "part".









STEP 04 Add the part to the feature





STEP 05 Create a Taper ball end tool, the detailed parameters are as below:

7 Tool 🙀 🍞 😗		P
Name T30R0.2	Type Mill * Subtype Taper Ball	End • Add to Lib Load Tool Shape
	Tool Len (L) 15	
	Shank Dia (SkD) 6.00444	
SkD	Flute Len (FL) 5	
	Flat Dia (FD) 0	
FL	Flutes (F) 4	
	Angle (A) 30	
K = FD →	Radius (R) 0.2	
ОК Арріу	Reset Delete Ca	ncel Save All Load All

Figure165 Engrave 2D operation example step4

STEP 06 Calculate the tool path (The engraving depth will be decided by system according to the gap of outline letter)



Figure166 Engrave 2D operation example step5





Summary: Tool path generation requirement for engraving 2D operation

- Specify a tool (taper ball end mill is recommended)
- Specify the boundary profile and set the profile type to "part". (The text should be hollow font)
- Add the part to feature

1.5 Tool Path Editor

During machining, perfect part always requires great manufacturing skills and experience to generate proper tool path. But generating proper or accurate tool path as we expected is no easy work, and will take quite a time to adjust the parameter, boundary, auxiliary face/line to get the result. Tool path editor is a more intuitive and easier to use tool, which can save quite a lot of CAM programming time.

In ZW3D, the tool path editor functions have been classified into modification functions and transfer functions

1.5.1 Tool path modification

Tool path modification will trim unnecessary or improper tool path, relink the tool path, extend tool path and re-order tool path.

• Trim

Trim function is used to trim the tool path of activated operation. ZW3D provides 3 methods to select tool path for trimming.







🦉 Tool Path T	rim	3 select me improper t	thod to trim ool path
Trim Type	Polygon 🥖		
	Box Select		
	Chain Select		
	Polygon		
🗆 Use New I	ead and Link Para	meter	
Lea	d and Link Parame	eter	
ОК	Cancel	Apply	

Figure167 Tool path editor -- Trim

Tips: To use trim function, users should activate (select) operation which to trim first, then select trim function.

 $\circ \operatorname{Box} \operatorname{select}$

User can hold mouse left key to drawing a box, all the tool path segments inside or cross by the box will be selected and deleted.



Figure168 Tool path editor – Trim (Box select)

Chain select

User can hold "shift" key to select the chain tool path segments to delete.



Figure169 Tool path editor – Trim (Chain select)

\circ Polygon

This method is different from other two methods, it doesn't delete the tool path segments. Only the tool path inside the polygon will be trimmed.







Figure170 Tool path editor – Trim (Polygon)

• Use new lead & link parameter

Check this option to set new lead & link parameters. The parameters are temporary, only available for adding lead & link at trimmed tool path. If this option is off, system will use the same lead and link parameter of activated operation to add new lead and link at trimmed tool path.







Figure171 Use new lead and link parameter

• Relink

Change all the lead and link of activated operation with new set parameter. Here, ZW3D have 3 places to change the lead and link parameter, below are the differences.

○ In tool path edit > trim





Figure172 Relink in trim

o In relink

It will use the new lead and link parameter to change lead and link in selected operation including the lead & link created by trim function. It would not re-calculate the operation but only change the lead and link



• In operation parameters

It will delete all the tool path and recalculate the tool path again according to current parameter.







• Extend

Extend the tool path with a specified distance by selecting tool path and its short link.



Figure175 Tool path editor -- Extend

Tips: Extend the tool path can be used to ensure a completed machining and protect some sharp edge, or the stock is bigger than part.





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• Re-order

Tool paths are made up with cuts and Re-Order will list all cuts in the sheet, allowing users to select the target cuts to edit. Re-Order methods include delete cuts, change the order in a region or between regions. We don't recommend new users without rich machine experience to use this function, which will cause tool damage or machine accident.

2		Begin Point	End Point	Length	lumbe	*
	6	-65.41,-17.6	-65.41,-17.6	142.43	63	
2	7	-65.52,-17.6	-65.52,-17.6	141.67	61	
	8	-65.56,-17.7	-65.56,-17.7	141.39	60	
	9	-65.56,-17.7	-65.56,-17.7	141.39	60	
	10	-65.56,-17.7	-65.56,-17.7	141.39	60	
	11	-65.56,-17.7	-65.56,-17.7	141.39	60	
	12	-65.56,-17.7	-65.56,-17.7	141.39	60	=
	13	-65.56,-17.7	-65.56,-17.7	141.39	60	
	14	-65.56,-17.7	-65.56,-17.7	141.39	60	
	15	-05.56,-17.7	-65.56,-17.7	141.39	60	
	16	-05.50,-17.7	-05.56,-17.7	141.39	60	
	17	-03.30,-17,7	-03.36,-17.7	141.39	60	1000
	18	-03.30,-17.7	-03.30,-17.7	141.59	60	
	20	-65 56 -17 7	-65 56 -17 7	141 30	60	
	21	-37 58 -19 5	-37 58 -19 5	137.71	72	
	22	-36.69 -19.5	-36.69 - 19.5	132.11	68	
	23	-36.1019.6	-36.1019.6	128.36	68	
	24	-35.6719.6	-35.6719.6	125.67	64	
	25	-35.36,-19.6	-35.3619.6	123.74	64	ψ.

Figure177 Tool path editor -- reorder





Tips:

1) All of those operation (trim, relink, extend and re-order) only effect to current existed tool path, if users re-calculate the operation, the effect of trim, relink, extend and re-order will disappear. Please pay attention.

2) All of those operation (trim, relink, extend and re-order) should select target operation first, then specify the tool path edit function. Otherwise it can't calculate the tool path.

1.5.2 Tool path transfer

Tool path transfer provides a method to quickly create a serial of similar tool path by move, pattern, mirror and scale. Which will highly speed up our daily work efficiency.

There are two methods to call out tool path transfer function.

1) Create transfer tool path by right menu



Figure178 Create transfer tool path by right menu





2) Create transfer tool path by ribbon menu

- Operations	File	Setup	Drill	2x Mil	I 3x C	Quick	Turning	Tool	Path Editor
Class : Finish	X	- 10	2	-	12	-		U.	4
Tool : Tool 1	Trim	Move	, 2	Mirror	Scale	Re-Or	der Re	-Link	Extend
Ref Op (undefined)		more	-		beare	ne on		LINK	Enterio
✓	Trim		Theref	orm		Peore	lor D	olink	Extend
Part : Part004 (1) < Part004.Z3	111111		mansi	onn		Reord	ler K	ennk	Extend
Machine (undefined)									
🔜 Output									
 ✓ Operations ✓ Zlevel 1 Class : Finish Tool : Tool 1 Parameters Ref Op (undefined) ✓ Features Part: Part003 (1) < Part003.Z3 ✓ Xform 1 of Zlevel 1 Class : Finish Tool : Tool 1 Parameters Ref Op : Zlevel 1 ✓ Features Machine (undefined) 				Requir From point Number	red	Select tr corresp	ransfer f bonding	type a param & & & & & & & & & & & & &	nd leter 3

Figure179 Create transfer tool path by ribbon menu

• Move

Move the target tool path point to point, a direction, rotate around a direction or align frame to another frame. Copy number can be specified



 \circ Point to point

Figure180 Tool path transfer – Move (point to point)





\circ Along a direction





o Rotate

	✓ X	23 ()
	▼ Required	
Rotate center point	22 24 25 25	
Specify a direction to	Point 🗧	• 🗄
define a rotate axis on	Direction	• 👱
rotate center point	Angle 0 dec :	• 👱
Rotate angle	1	



Tool path transfer – Move (rotate)

 \circ Frame to frame

Plane to plane



Figure183 Tool path transfer – Move (plane to plane)





Point and Axis





• Pattern

Array target tool path by linear pattern or circle pattern

o Linear pattern

	X			
✓ X	0			
▼ Required				
	*			
Direction	× ± -			
Number 2	¢ 🖢 🔹	1		
Spacing 200	mm 🗘 堡 🝷			
Direction				
Number 2	Specify the machine or for the array patterns	rder		
Spacing	for the array patterns.			Y
▼ Sequence				
Automatic Sequencing	5 .			X
User Segence	<u> </u>	E M M M		
▼ Settings				
Create Copy at Orig				
		6 2		
	962 🦻			
		• • • • • • • • • • • • • • • • • • • •		







o Circle pattern



Figure186 Tool path transfer – Circle pattern

• Mirror

Mirror the target tool path by a selected plane or datum defined by a point with a normal.

• Scale

Expand or shrink the target tool path by %Scale value.

 \circ By datum

If the orientation of scaled tool path is the same as the reference tool path, "By datum" is recommended, which is needed to specify a reference datum and a target point.



Figure187 Tool path transfer – Scale by datum

\circ By frame

If the orientation of scaled tool path is different from the reference tool path, "by frame" is recommended. While the orientation can be defined in fly.









Tips : The X direction and Y direction is up down side at the moment, please pay attention to it. And we will enhance it in next version.

1.6 Others

In this chapter, we will introduce some tools or methods to speed up our work efficiency. Such as the QuickMill batch calculation, CAM template and operation library.

1.6.1 QuickMill batch calculation

In some complicated cases, the tool path calculation will be quite a time-consuming work. The normal tool path calculation method will freeze the operation window of ZW3D until the calculation is completed. So ZW3D provides batch calculation method to deal with the complicated tool path, so the users can continue his work without the operation window frozen. When the calculation is finished, users then import to the corresponding operation, which will highly improve our work efficiency.

Tips: The batch calculation only works for QucikMill operation.

Here is the work flow for QuickMill batch calculation.

STEP 01 Open the "Batch calculation.Z3" file and go to CAM space.





STEP 02 Create an offset 2D roughing operation without calculating the tool path, the detailed

setting is as below.

🗠 Tactics
✓
✓ 🧾 Rough Offset 2d 1
Class : Rough
Tool : D10R0
Parameters
Ref Op (undefined)
V 🤤 Features
Part : 3X (1) < Batch calculation.Z3
Stock : 3X_Stock.1 (2) < Batch calculation.Z3

Figure189 QuickMill batch calculation step2

STEP 03 Select this operation and call out the "Batch Calculation" with right menu





STEP 04 Check the calculation status by 3X Quick > "QM Batch Mgr". If all the tasks have been completed, import the tool path into operation.







Figure191 QuickMill batch calculation step4

1.6.2 QuickMill Tools

QuickMill use incremental steps to generate tool path, most of the tool path calculation will create some caching files which will be reused in further tool path generation by ZW3D QuickMilling's advanced caching control. The caching control includes tool path generation caching files and STL data (ZW3D QM calculate the tool path base on the STL data), which will save in User folder. But after many calculations, ZW3D may create quite a lot of caching files, User can use "Clean QM Cache" and "Clean QM Dir" to clear those caching files.

• Clean QM Cache

Clean QM Cache will clean all the caching files except STL data.

• Clean QM Dir

Clean QM Dir will delete the whole caching folder which is in user folder. Thus all the caching files including the STL data will be deleted.

1.6.3 Cam Template

For some routine machining, the machining condition including the used operation, the parameters in corresponding operations and the tools, can be similar. Only the products have a few differences. In this case, we can create some CAM template to speed up the work efficiency.





How to create a CAM template?

STEP 01 Create a whole CAM plan with all necessary operation have been created and set the machine parameter.





STEP 02 Delete all the geometry and tool path, then save the file.





CAM template step2



STEP 03 Open the template library file



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Open in ZWCAD	0	Managar						
Class	Recent Files	Filter All	* Preview	Off				
o Close	ETT STORES		rienen					
Close All	Recent Directories	Find	in	Name				
Save			Name	~	Туре	Modified	Last Modified	Create
Sure		PartTemplate(MM)			Part		2010/02/10	2009/05
Save As		E_H(ANSI)			Drawing		2013/01/25	2013/01
Save All		D_H(ANSI)			Drawing		2013/01/25	2013/01
Jure All		C_H(ANSI)			Drawing		2013/01/25	2013/01
Save/Close		B_H(ANSI)			Drawing		2013/01/25	2013/01
and the second second		A_V(ANSI)			Drawing		2013/01/25	2013/01
		A_H(ANSI)			Drawing		2013/01/25	2013/01
A A A	a sector parts - Branks	A4_V(IS)			Drawing		2013/02/25	2013/01
Search Paths	Ball and the second Barrow	A4_V(ISO)			Drawing		2013/02/25	2013/01
		A4_V(GB)			Drawing		2013/01/29	2012/08
Properties		- August	and the second s	100 3	51	all all and	2013/01/23 11	1013101
Templates		-						
File Recovery		A1_H(DIN)			Drawing		2013/01/25	2013/01
		A1_H(ANSI)			Drawing		2013/01/28	2013/01
Manage Session		A0_H(JIS)			Drawing		2013/02/25	2013/01
		A0_H(ISO)			Drawing		2013/02/25	2013/01
Manage Vault		A0_H(GB)			Drawing		2013/01/29	2012/08
		A0_H(DIN)			Drawing		2013/01/25	2013/01/
Recent		A0_H(ANSI)			Drawing		2013/01/28	2013/01



STEP 04 Copy the CAM plan file

Manager								X
Filter All		-	Preview	Off		*		
Find			in	Name		•		
Name	Ŧ	Т	ype	Modi	fied	Last	Modified	
model		Assen	nbly			2007	/06/21	2
bottle		Part				2007	/06/21	2
blowmold_Stor	:k.1	Part				2015	/06/29	2
blowmold_CAN blowmold		Edit	NI			2015 2015	/ <mark>06/29</mark> /06/29	2
	<i>™</i> ≣ €2	Rena Dele	ame ete					
	8	Cut						
		Rela	ted cut					
	3	Сор	у					
		Rela	ted copy	13				
and the second s		Par	اللهم. ا	- A	-			

Figure195 CAM template step4

STEP 05 Paste the CAM plan file to template library file by "Ctrl +V", and save the library file.





Manager	_				= X3
Filter All	Past	e the cam pla	n to "Templat	es_mm.Z3" fil	e
Find	by "	Ctrl +V"		-	
Name 🔻	·ype	Modified	Last Modified	Create Time	Descrip
blowmold_CAM	Cam Plan	YES	2015/06/29	2015/06/29	
PartTemplate(MM)	Part		2010/02/10	2009/05/27	
E_H(ANSI)	Drawing		2013/01/25	2013/01/25	
D_H(ANSI)	Drawing		2013/01/25	2013/01/25	
C_H(ANSI)	Drawing		2013/01/25	2013/01/25	
B_H(ANSI)	Drawing		2013/01/25	2013/01/25	
A M/ANCIN	Description		2012/01/25	2012/01/25	

Figure196 CAM template step5

How to reuse the CAM template

STEP 01 Open the model which is needed to create CAM programming.(CAM_TM_Model.Z3)

STEP 02 Click the entry to go to the CAM space and select the corresponding template.



Figure197 Reuse cam template step2





STEP 03 Add stock for this model

~ X	3		0
* Required	d		
	91	Sn	
Shapes	1 picked		×
Plane			*
▼ Dimensi	ions		
Stock			
Length (X) 222	mr 🕻 🖞	<u>b</u> -
Right 0	mr 🗘 👲 * Left	t 0 mm 🕻 🖞	<u>b</u> -
Width (Y	() 160	mr : s	<u>k</u> -
Back 0 r	mrr 🗘 生 * Front	t 0 mr : 🔮	<u>k</u> -
Height (Z) 45.0086	mr 🕄	<u>b</u> -
Top 0m	m 🕄 👲 🔹 Bottor	n 0mr : 🖞	<u>b</u> -
Side Incr	rement 0	mr 🕻 💈	<u>v</u> -











Reuse CAM template step4





Figure200 Reuse cam template step5

STEP 05 Recalculate all the operations, then all works are done.

1.6.4 Operation library

Since ZW3D allows users to create their own operation library to improve our work efficiency.

How to create an operation library?

STEP 01 Create a new CAM plan file in template library file.

STEP 02 Open the newly created CAM plan file



Figure201 Cam operation library step2




STEP 03 Paste all the operations you want to save to this CAM plan file. Except features (machining object or boundary) all the machining parameters can be saved, including the tool, spindle, feed rate, step over, step down and so on.

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Tool Para Ref	Calculate Batch Calculate(QM only)	Mac The Insert Operation Insert Operation Folder
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		 ✓ Coperations ✓ Rough Offset 2d 1 Class : Rough Tool : D20R0.8 Parameters Ref Op (undefined) ✓ Features (undefined) ✓ Machine (undefined) ✓ Output
	Figure202	Cam operation library step3



How to reuse the operation library?

STEP 01 Open ZW3D and go to the configuration to specify the saved operation library.



Figure203 Reuse CAM operation library step1





STEP 02 Right click on the operation tree and use import function to call out the operation.

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	🍠 Machin <	Insert Operation	Lace D8R4		
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	2	lmport			
		Spreadsheet Interface	4 OK Cancel Apply		
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Figure204 Reuse CAM operation library step2

STEP 03 All parameters which have been saved in the library will be called out.

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	Engage (%)	100.00%	Engage (%)	60.00%				
			5.5.1.					
	Retract (%)	100.00%	Retract (%)	300.009	5			

Figure 205 Reuse CAM operation library step3





Epilogue

Thank you for your valuable time.

In this tutorial, we've shown you how to create 3X toolpaths with the key parameters explained in detail. We hope this tutorial can help you understand the way to apply 3X machining in ZW3D.

Notice: This tutorial is based on version ZW3D 2019, some functions or icons may not match the current version. If you have any suggestions or questions about this tutorial, please contact us at

ZW3D Global Website: https://www.zwsoft.com/zw3d/

ZW3D Forum: https://www.zwsoft.com/forum/forum-18.html

ZW3D Support Team: <u>zw3d@zwsoft.com</u>

