

Wrapper Plugin

[Vers 2.1.0]

Purpose

This plugin for CamBam is intended to take a G-Code file defined in X,Y,Z space and transform it into one wrapped around a cylinder shape for either the X or Y-axis is to give an A-axis or B-axis (rotational) model. The Z-axis defines the height of the surface.

Installation

The WrapperPlugin.dll file should be placed into the CamBam installation directory, and inside the Plugins folder. On re-start the plugin will be found in the CamBam Plugins menu.

Data Requirements

No particular constraints are placed on the G-Code file other than it is defined in X,Y,Z space. The Z-axis defines the depth of cut in (X,Y,Z) and then a radial Z on the wrapped model after transformation to the cylinder shape. Either the X or Y axis can be wrapped around the surface of a cylindrical shape.

The following items of data are required (from the G-Code file) and inserted into the plugin (manually):

For an X-wrap:

- The minimum and maximum X values (Xmin and Xmax).
- The base Z value (most likely 0.0, but not necessarily, i.e. the wrapped model surface could be defined at some other Z-value).
- The wrap angles, i.e. the angle (Amin or Bmin) that Xmin maps to, and the angle (Amax or Bmax) that Xmax maps to. By default these values are 0.0 and 360.0 degrees.

For a Y-wrap:

- The minimum and maximum Y values (Ymin and Ymax).
- The base Z value (most likely 0.0, but not necessarily, i.e. the wrapped model surface could be defined at some other Z-value).
- The wrap angles, i.e. the angle (Amin or Bmin) that Ymin maps to, and the angle (Amax or Bmax) that Ymax maps to. By default these values are 0.0 and 360.0 degrees.

The maximum and minimum X and Y values are estimated from the loaded G-code file, but these may require adjusting to correctly refer to the actual finished wrapped surface and not necessarily the (X,Y) range all of cuts (these will vary with tool size, surface slope and so on).

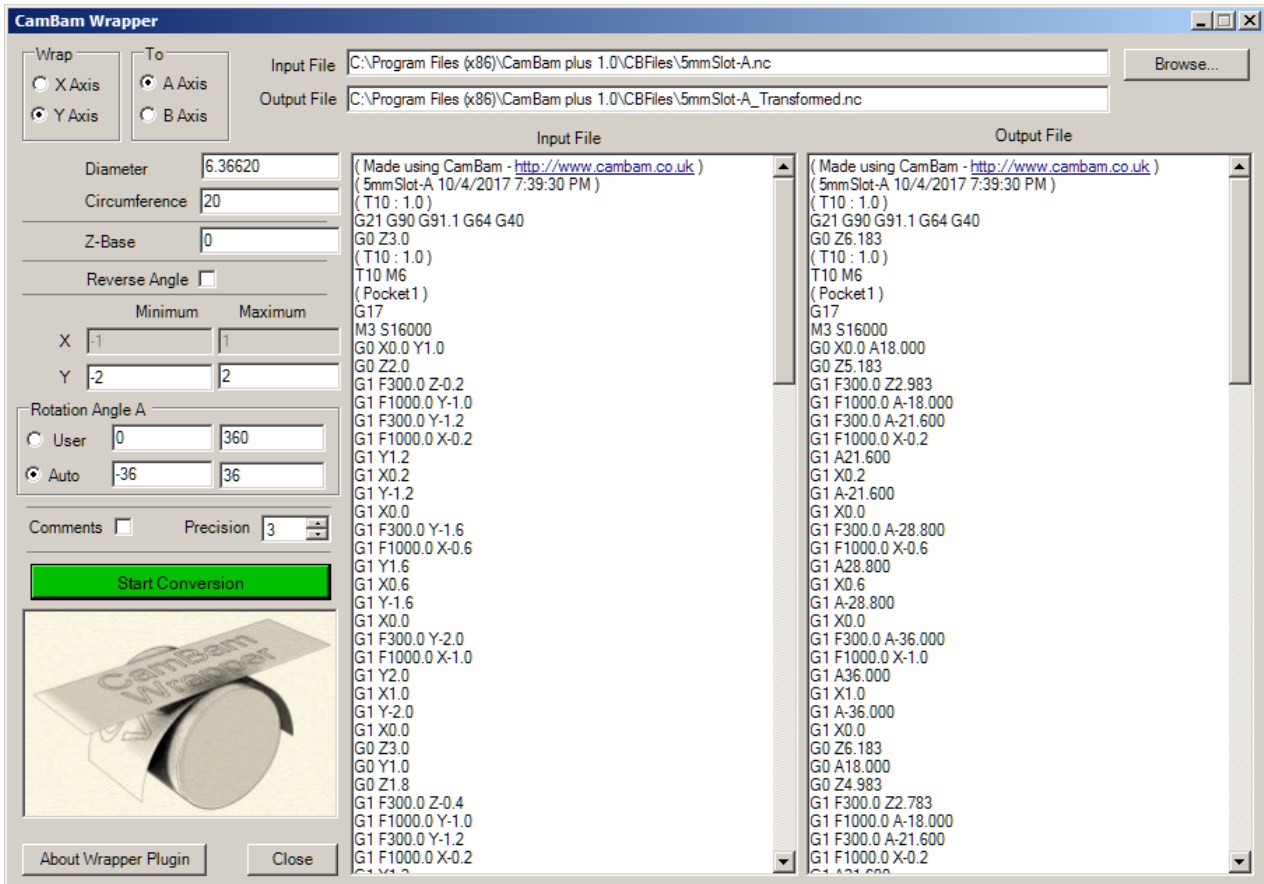
Note that certain G-Codes may not be correctly wrapped, for example:

- Circular moves (G02, G03)
- Drilling and boring (G81 .. G89)

If these codes are detected in the input file a warning message is given. Note that circular moves (G02, G03) can be removed from a CamBam generated G-code file by setting the post-processor "Arc Output" option to "Convert to Lines" where all arc moves are replaced by sets of short lines.

User Interface

This is the user interface:



The fields are:

- **Input File**: the full name of the G-Code file to be wrapped. Must be selected from the Browse button. A text window is provided to allow viewing of the Input File gcode
- **Output File**: the full name of the transformed file. By default this takes the name of the input file and adds "transformed". A text window is provided to allow viewing of the Output File gcode
- **Wrap** : radio buttons: used to select X or Y wrap.
- **To** : radio buttons: used to select the axis Y or Z is mapped to (A or B).
- **Diameter** : the diameter of the wrapped cylinder for the Z-Base value. Press the Enter key after entering a number and the Circumference will automatically update.
- **Circumference** : the wrap circumference. Press the Enter key after entering a number and the Diameter will automatically update.
- **Z-Base** : the base Z height in the X,Y,Z model. This is the Z value that is mapped to the wrapped diameter.
- **Reverse Angle** : checkbox, used to reverse the angular direction of the wrap. This is often required when wrapping text to get the required correct text direction.
- **X Minimum and X maximum** : the minimum and maximum X values in the G-Code file (only required for an X-wrap). The default values are taken from those found in the input file, but these may only be approximate.

- *Y Minimum and Y Maximum* : the minimum and maximum Y values in the G-Code file (only required for a Y-wrap).). The default values are taken from those found in the input file, but these may only be approximate.
- *Rotation Angle : A (or B) Minimum and A (or B) Maximum*, the minimum and maximum angle values to which the X (or Y) minimum and maximum values are mapped to.

There are two options, User or Auto.

User : The user can manually enter values for minimum and maximum angles.

Auto : These value are Read Only, they are calculated from ymin, ymax, xmin, xmax values.

They show the minimum and maximum angles required into which the gcode will fit (unstretched) for either the X axis or Y axis, whichever is chosen.

The calculation for minimum is : $xmin * 360 / Circumference$

The calculation for maximum is : $xmax * 360 / Circumference$

And the same applies for ymin, ymax.

Using the check boxes, User/Auto, it is possible to select which set of values the plugin should use.

- *Comments* : check box, if checked then comments are added to the Output File, otherwise no comments are added.
- *Precision* : used to select the number of decimal places for calculated values, i.e. rotation angles for A & B and Z value. A value of 1 to 5 is allowed.
- *Start Conversion* : button, executes the wrapping and saves the transformed G-Code file.

The set parameters are saved for the current CamBam session.

Some Guidelines to Get Started Using the Wrapper Plugin

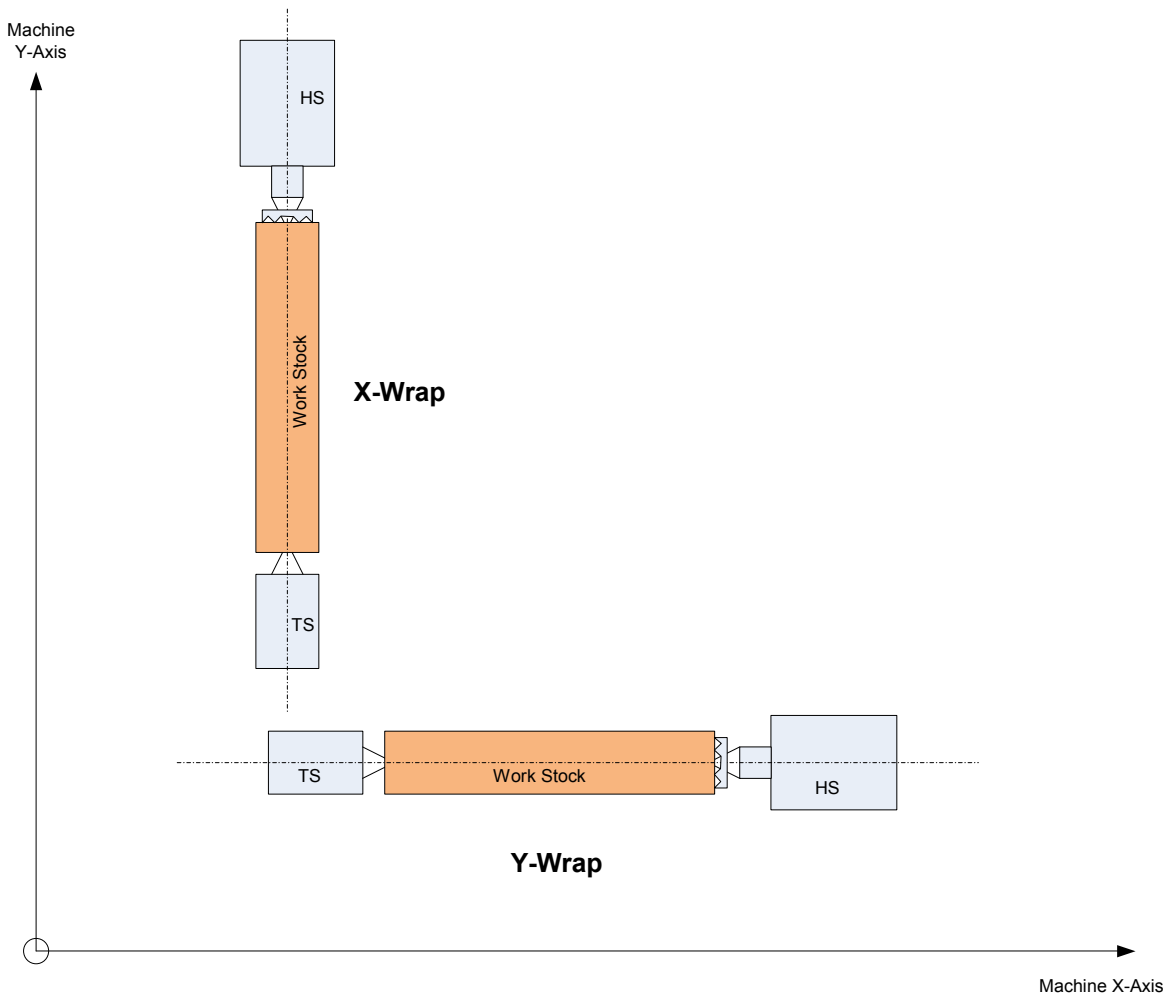
The process to set up a model suitable for wrapping then cutting, and how it is visualised in Mach3 (for example) is a bit complicated so these notes may assist with explaining what is happening. While various strategies are possible the following notes describe one approach that may be a useful starting point.

Machine Coordinates and 4th Axis Location

There are two basic setups for a 4th axis:

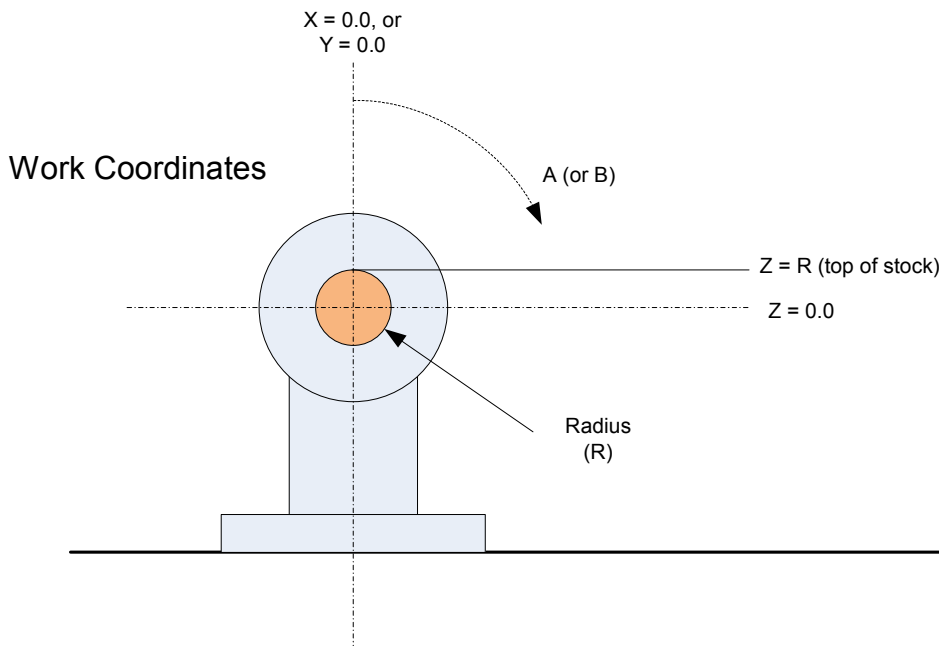
- X-wrap where the X-axis is wrapped around a cylinder, and the X coordinates are converted into A-axis angles. The centre line of the 4th axis is then aligned with the machine's Y-axis.
- Y-wrap where the Y-axis is wrapped around a cylinder, and the Y-coordinates are converted into A-axis angles. The centre line of the 4th axis is then aligned with the machine's X-axis.

The resulting angles may be associated with an A or B axis – depending on your machine setup, A is usual for a 4th axis.



Work Coordinates

For a given machine configuration, a CamBam model must then be built so that the chosen wrap axis can be wrapped correctly. The required work coordinates are then defined (when looking at the 4th axis headstock with the work stock attached).



CamBam Modelling:

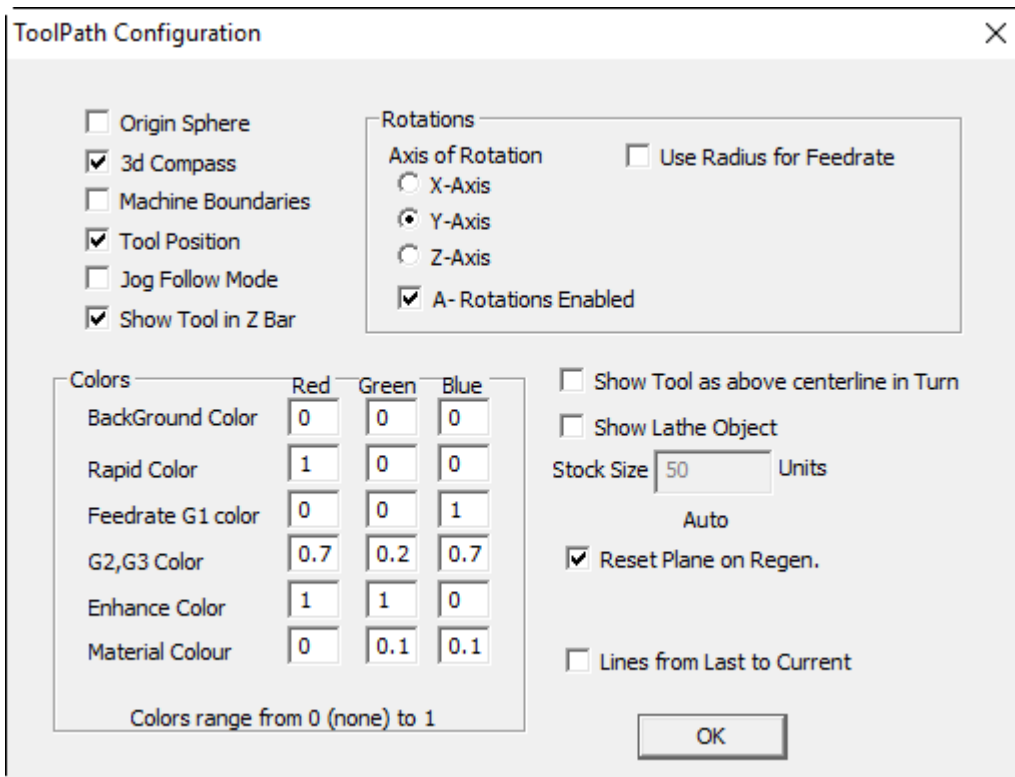
1. Assuming 3D work stock is a round cylinder of radius R or, if not round, then R is the maximum distance from the centre to the edge of the stock. If the stock is square then R is $0.707 \times \text{side length}$.
2. In CamBam, the stock height will represent the radius (R), i.e. the surface of the 3D stock cylinder, so that the top of stock should be set to (+) R.
3. For X-wrap:
 - a. The model X length will represent circumference that will map to the A (or B)-axis (e.g. X = 0 to 300 mm maps to A = 0 to 360 deg. to map the X length around a full circle)
4. For Y-wrap:
 - a. The model Y length will represent circumference that will map to the A (or B) axis (e.g. Y = 0 to 300 mm maps to A = 0 to 360 deg. to map the Y length around a full circle)
5. In CamBam set stock clearance to $R + (\text{some appropriate clearance value})$
6. Create MOPs from the top of 2D stock, i.e. from $Z = R$ with decreasing Z values (only down to 0 makes sense)
7. If the model contains arcs (as circles, arcs or parts of polylines or text) then these will not be able to be wrapped directly. The CamBam Postprocessor option "Arc Output" should be set to "Convert to Lines" to ensure that all arcs are converted into straight line segments (increases size of G-code file).
8. Generate and save G-code file from CamBam.

Wrapping

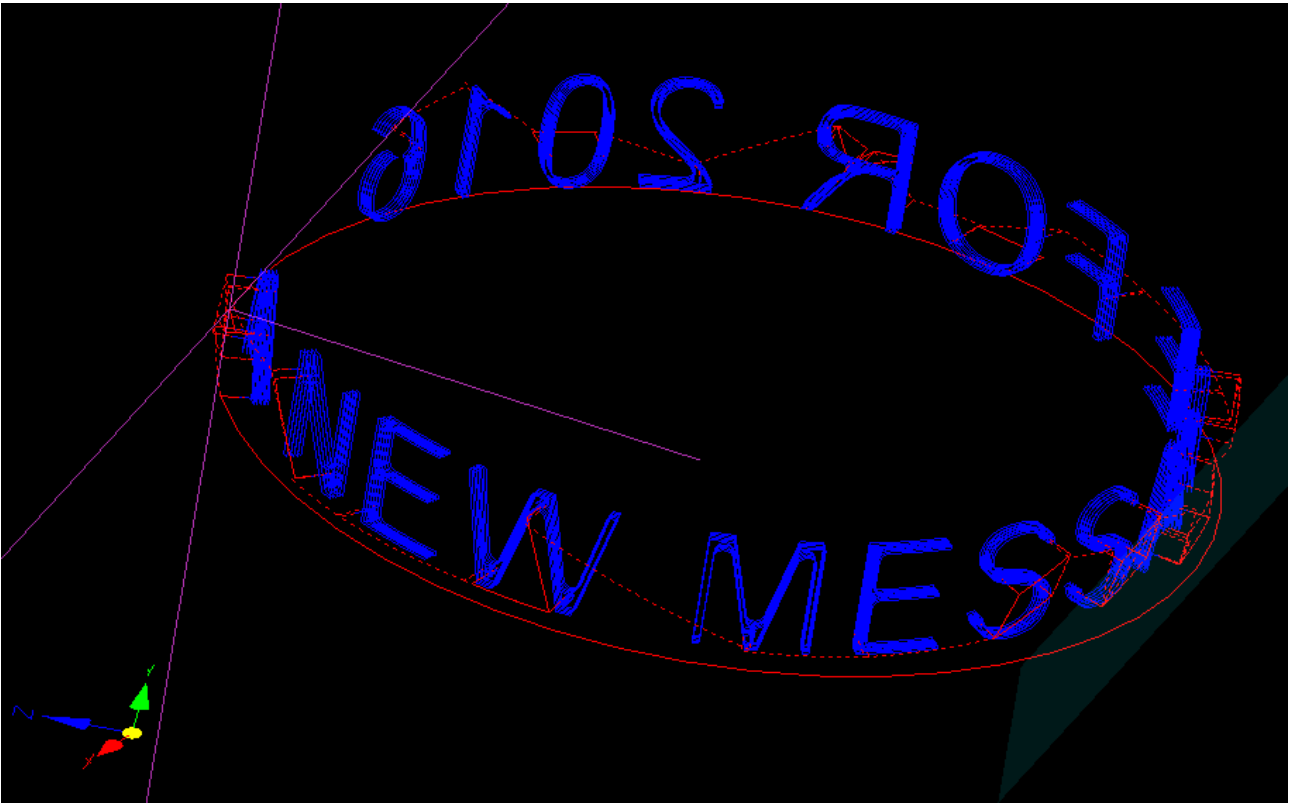
1. Load the plugin and import the generated G-code file.
2. Set wrap X -> A (or X -> B, or Y -> A or Y -> B) as required.
3. Adjust the Xmin and Xmax (or Ymin and Ymax) values if required. On loading the G-code file these values are estimated from the range of values found in the file, but these may not be exactly what is required for the wrapping process.
4. Set Amin and Amax (or Bmin and Bmax) to required values (e.g. 0 to 360 deg)
5. Set diameter to $(2 \times R)$
6. Set Z-base to R.
7. Create the transformed G-code file from the <Start Conversion> button.

Machining in Mach3:

1. For X wrap:
 - a. set 4th axis to align with Y-axis,
 - b. set work X=0 to centre line of 4th Axis
 - c. set work Y=0 to required position along Y-axis of stock
2. For Y-wrap:
 - a. set 4th axis to align with X axis
 - b. set work Y=0 to centre line of 4th Axis
 - c. set work X = 0 to required position along X-axis of stock
3. Set Z = R when cutter just touches top of stock to reference the tool to the work stock.
4. Mach3 must be correctly configured to visualise the cutter path from the ToolPath options dialog (Config|ToolPath), e.g. For X-wrap, choose <Y-Axis of Rotation> and check <A-Rotations Enabled>.



5. Load the transformed G-code file into Mach3, it should display correctly like this:



Note that there are other configuration/setup options that may provide the desired results, but practice and careful checking is required to prevent accidents.