Ornamental Turning Workbench

Version 1.0

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Introduction

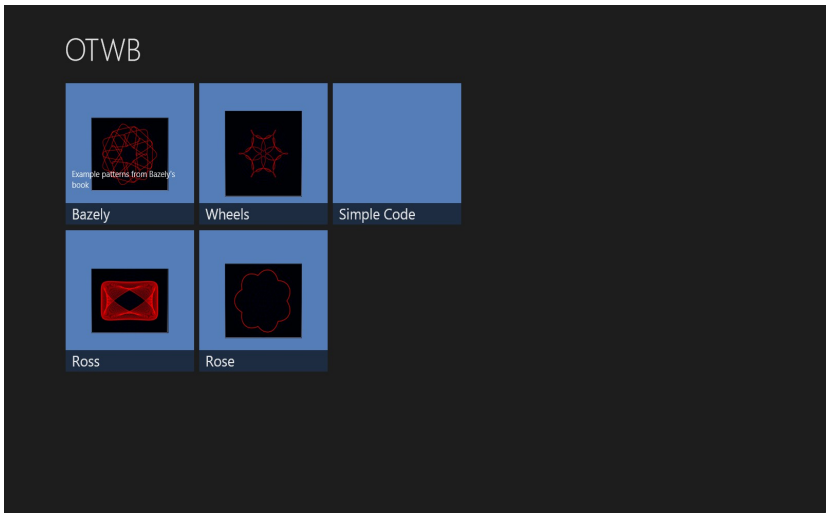
Ornamental turning is a process of cutting complex patterns on materials such as wood, metals and plastics.

One method of doing this is called **Rose Engine Turning** which uses a special lathe upon which a rotating pattern called a rosette is used to rock the lathe headstock from side to side as it rotates. By this means the tool can be made to cut a non circular pattern on the work piece held on the headstock spindle even though this work piece is itself moving in a circular path around the spindle centre. The rocking motion will move the position of the centre of the headstock relative to the tool so that the tool cuts at different radial values as the work rotates.

Another method is to attach a complex device called a **Geometrical chuck** to the spindle of a standard lathe. The geometric chuck is made so that its centre of rotation moves as the spindle rotates. This again causes a non circular path to be cut by a tool in a fixed position.

When simulating this motion on a CNC based system we want to generate the path the cutter would trace on the work piece as a sequence of points. From this sequence of points we can then generate the G code instructions to control our CNC system.

The OTWB program has several options for generating paths displayed on the opening page. Choosing an option will send you to a page dedicated to that option.



Currently there are four options for generating paths

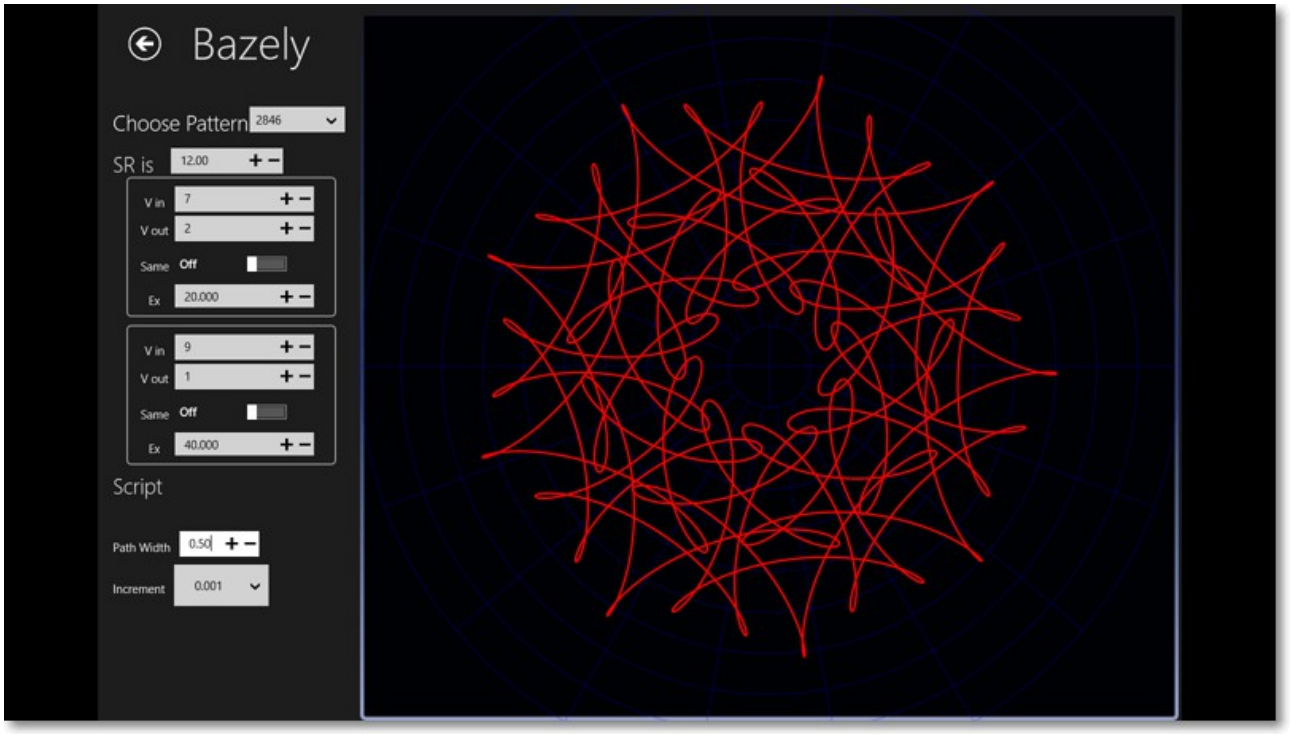
1. Geometric Chuck patterns following Thomas Bazeley
2. Patterns developed by Ross

3. Patterns developed by following the Wheels in Wheels approach
4. Patterns developed by utilising virtual rosettes on a Rose Engine

The final option takes you to the G code generation page.

Geometric Chuck

Choosing this option on the main menu allows you to choose one of the many patterns discussed in Thomas Bazely's book.



Above you see an image of the Bazely page showing pattern #2846 there are 3453 patterns described altogether. This covers most of the figures in Bazely's book that can be generated by a single run of the chuck. A run of the chuck is one where all the adjustments are constant. However several patterns in his book are the result of multiple runs with adjustments in between so these patterns are not reproduced accurately (at present) by this software.

You choose the pattern from the Choose Pattern Combo box at the top of the page and the values of the chuck settings are displayed underneath. These settings can be adjusted and the path display is updated to reflect this. You can export these new values to your disc if you want to keep them.

You can also inspect the values of the points along the path by right clicking to see the bottom App bar and then clicking on the points button.

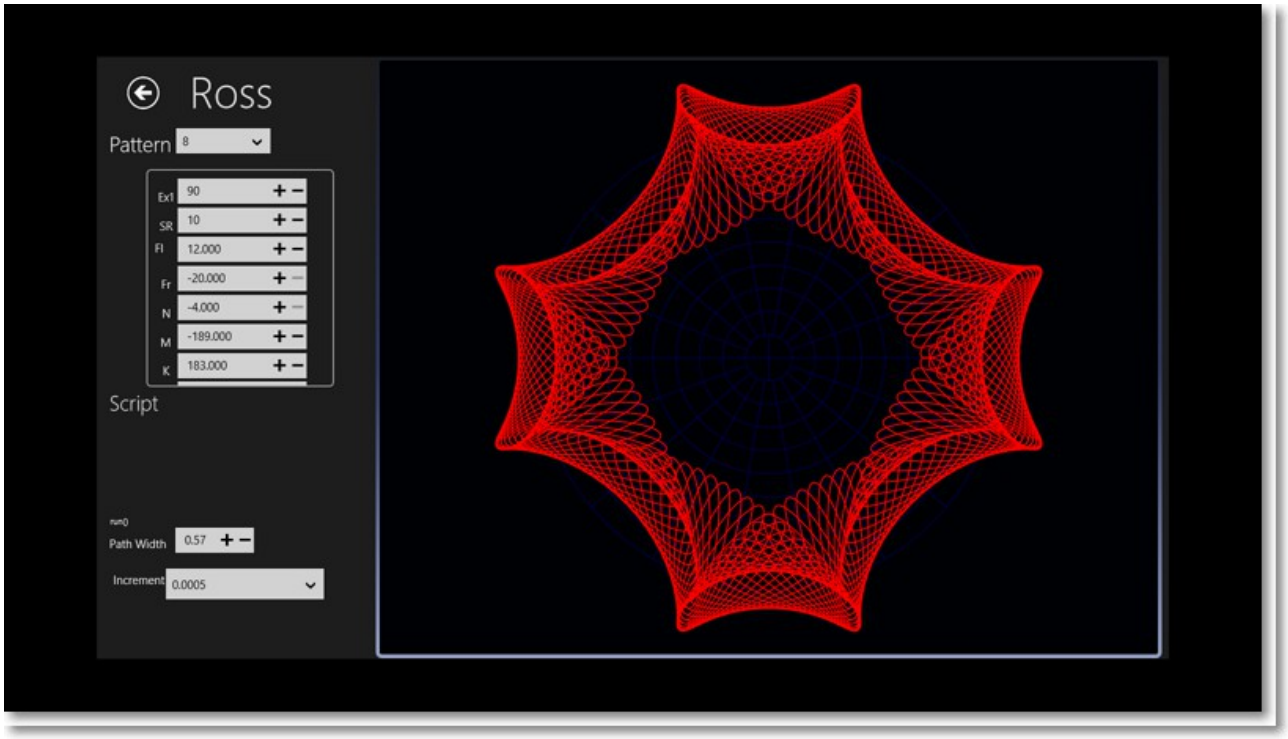
This will cause the points inspector flyout to appear

The scale of the drawing is defined in relation to the grid shown in blue. The scale is set so that the grid just fills the drawing area. You can of course adjust the grid by clicking the edit grid button located at the right hand side of the bottom App bar.

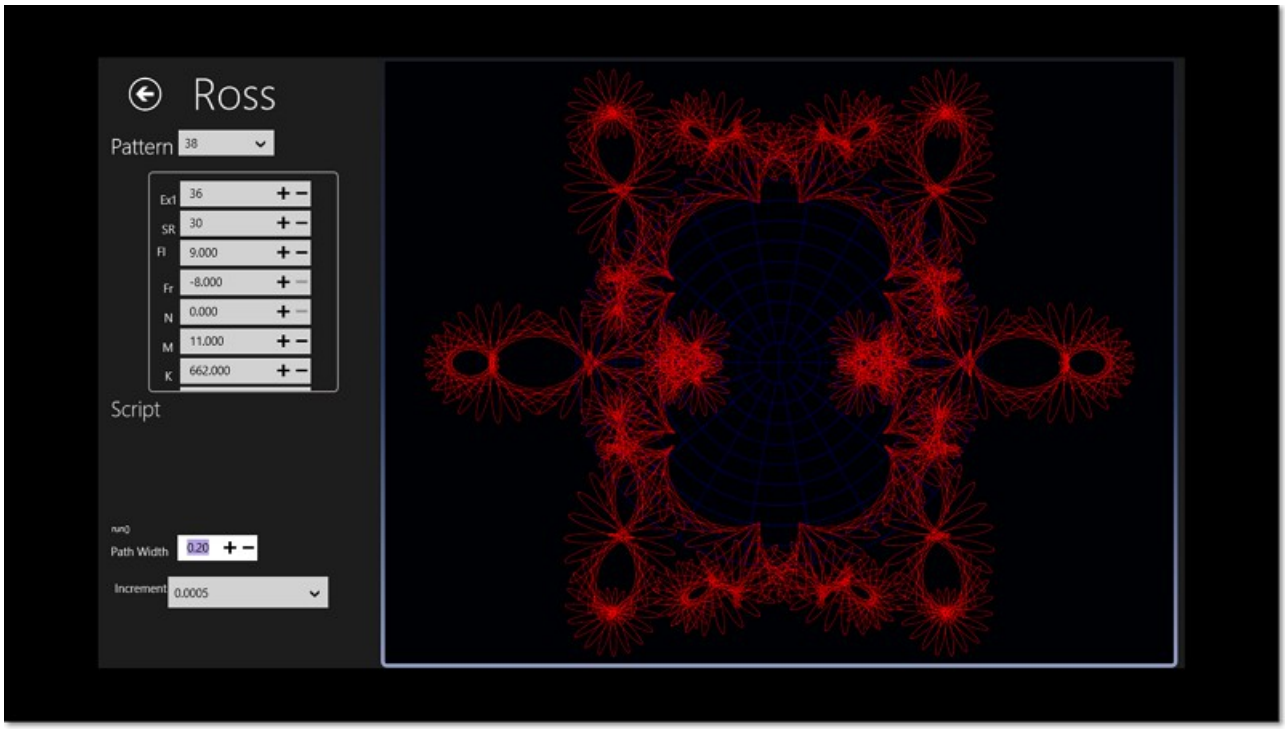
The top range is the Radial range for the grid, whilst the second range is the angular range in both

cases the increment gives the distance between successive markings on the grid.

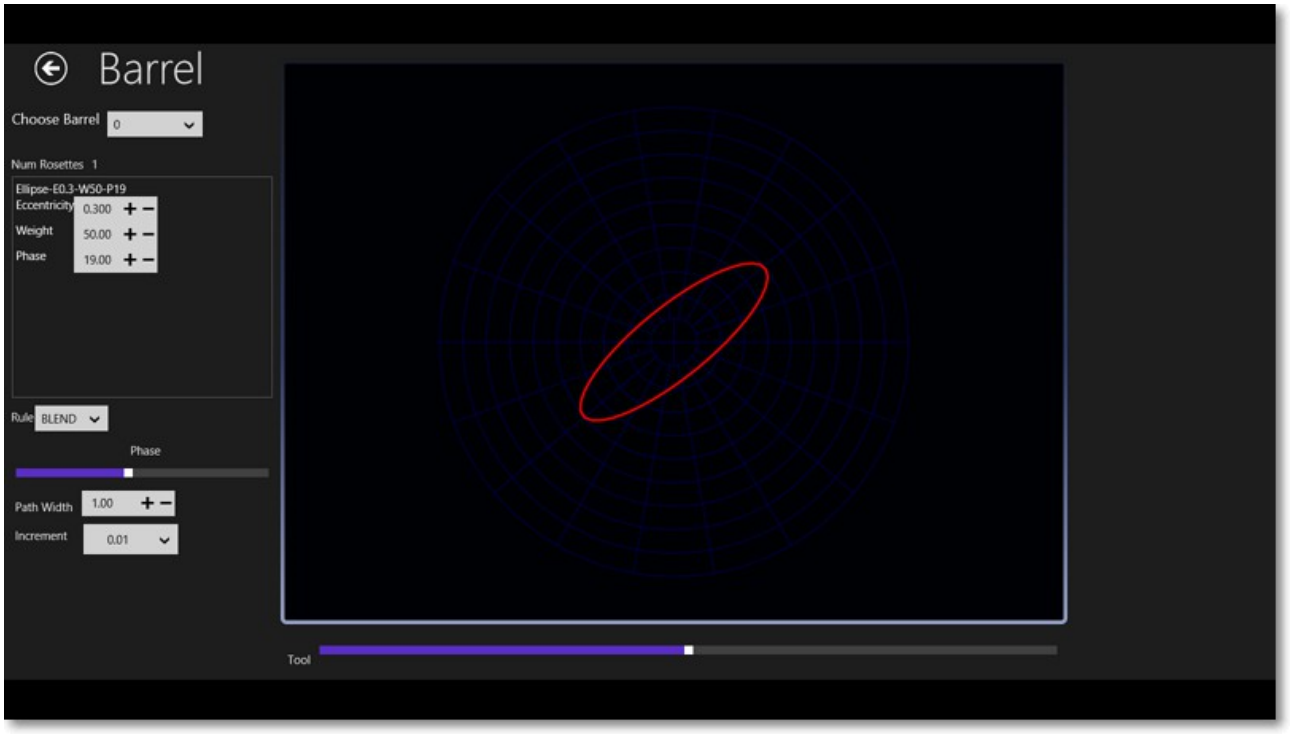
Ross Paths



The page describing the Ross paths is similar to the Bazely page and has the same functionality. You can adjust the initial values and export them to file, then subsequently import them during another session. There are 38 Ross Patterns the image below is the last pre-defined pattern



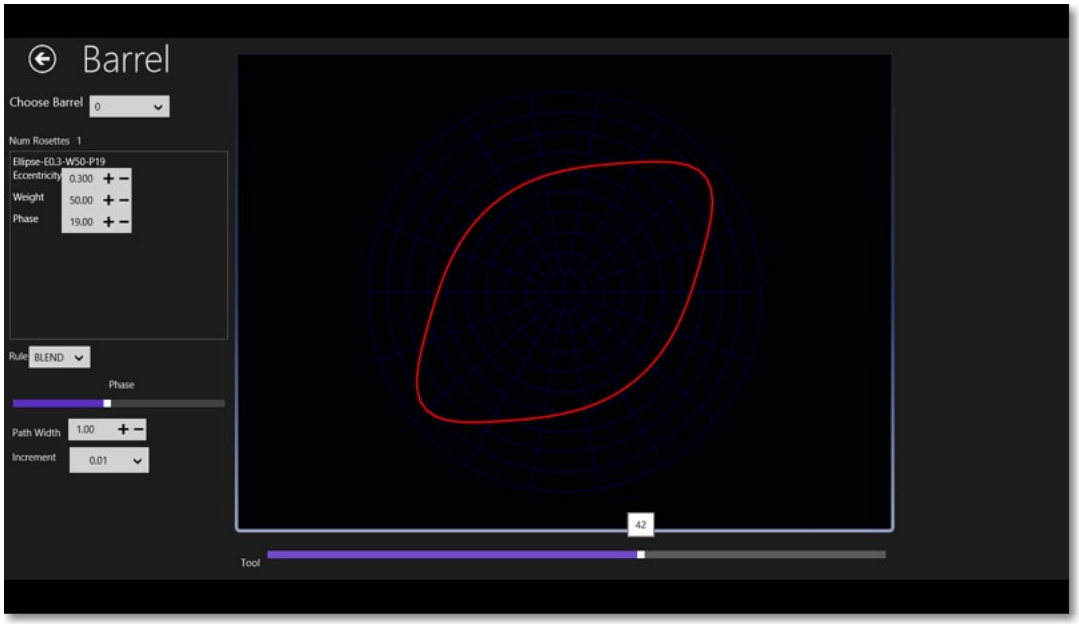
Rose Engine



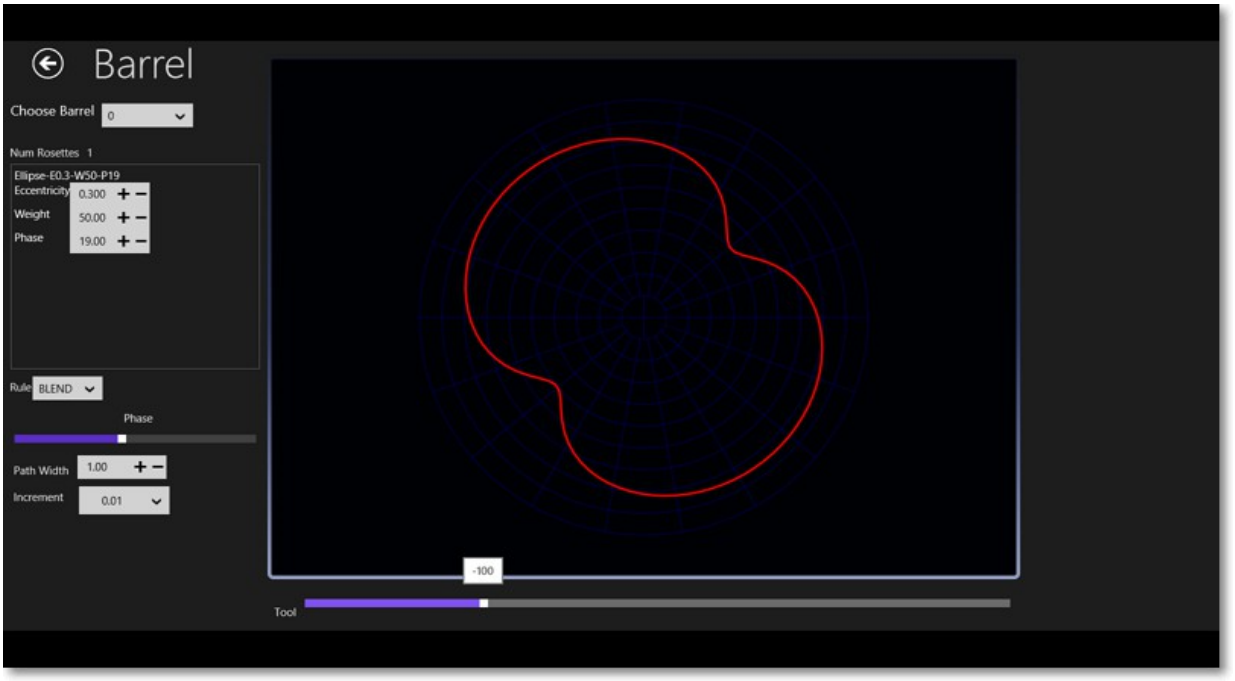
This page is slightly different from the others. Because the rosettes on a rose engine barrel act to offset the headstock from its central position. The values generated by this page are also offsets and not absolute positions.

Therefore the path generated by a tool is dependent on the tools position as well as the arrangement of rosettes on the barrel and finally the overall phase of the barrel.

At the bottom of the display there is a slider to allow you to change the position of the tool relative to the headstock set central position. At the side of the display is another slider to allow you to set the overall phasing of the barrel.



The image above is of the tool path when the tool is offset by a value of 42mm whilst the image below shows the path created by the barrel with a tool offset value of -100mm.



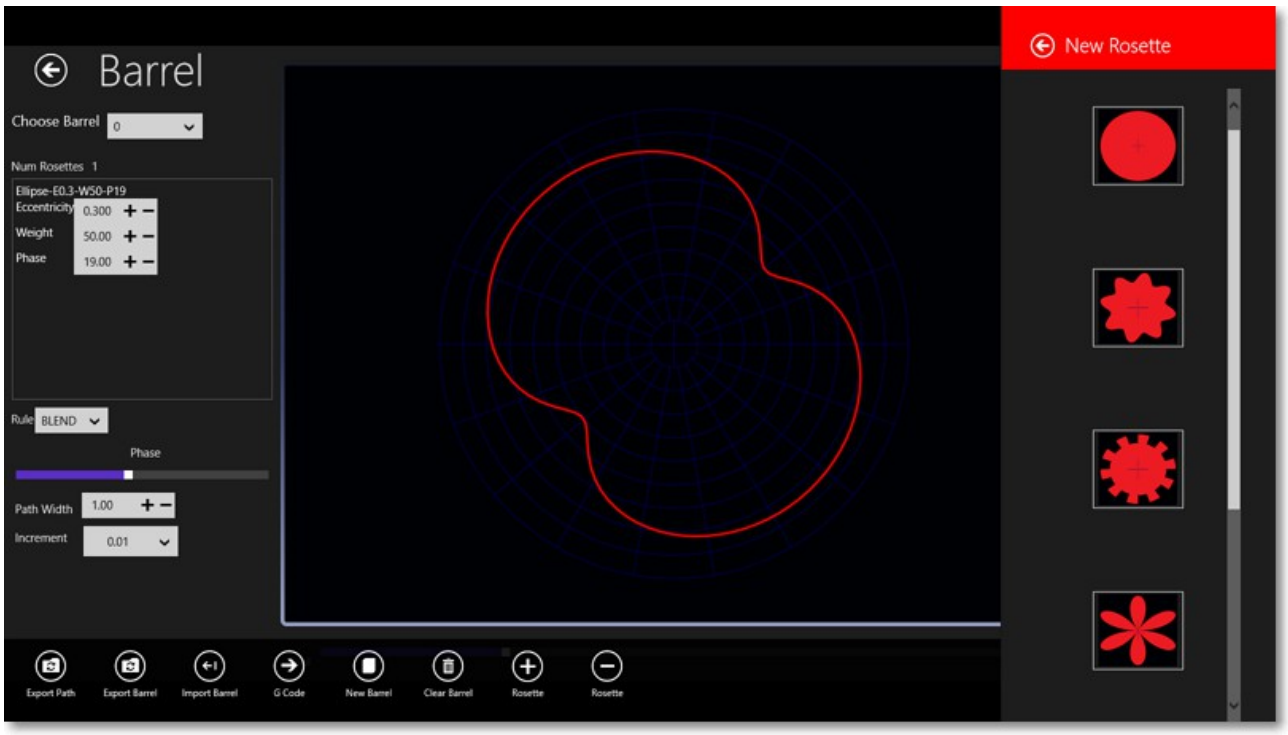
The Barrel

Comprises of one or more rosettes. These rosettes are displayed in the scrollable view to the side of this display. Again like the other pages the rosette parameters can be adjusted and the display is updated to reflect the changed path.

There are buttons on the bottom app bar that allow you to

1. Export the path
2. Export the barrel data
3. Import a barrel
4. Create a new empty barrel which is then automatically selected.
5. Clear the currently selected barrel this means remove all its rosettes.
6. Add a rosette (+)
7. Remove a rosette (-)
8. Change the grid size
9. View the points on the path.

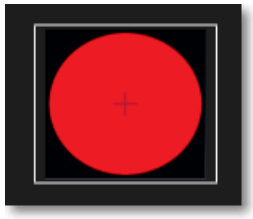
When you choose to add another rosette you the choice options are displayed on a flyout to the right of the screen



Types of Rosette

You can choose between

An Elliptical - Circular Rosette

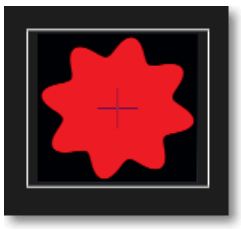


There are 3 parameters

- *Eccentricity* - this is the ratio between the two radii. A value of 1 gives a circle a value less than 1 gives an ellipse whose thickness depends on the value. So a value of 0.5 will result in an ellipse whose vertical thickness is half its width
- *Weight* - this is a multiplying factor that gives the size of the ellipse. The standard ellipse is 1 unit wide so set the weight to 20 to get one 20 units wide.
- *Phase* - this determines the rotation of the ellipse around its centre.

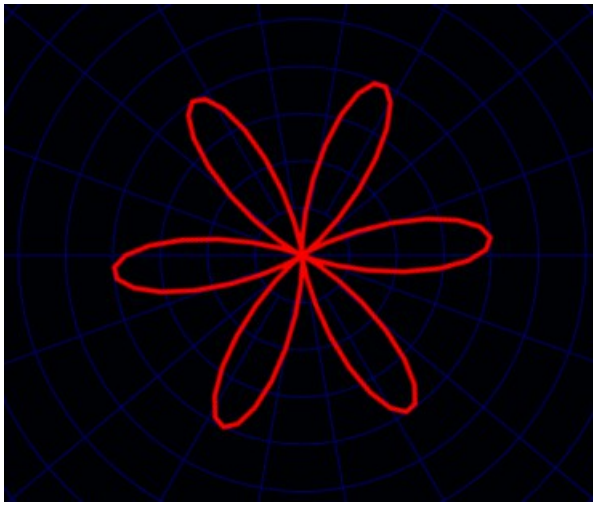
A sine wave rosette

Again three parameters

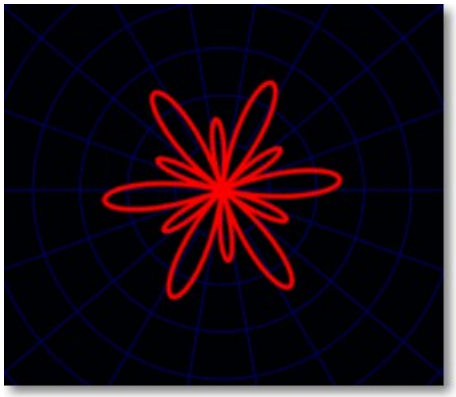


- *Frequency* – this gives the number of waves
- *Weight* – this gives the height of a wave
- *Phase* – the rotation around its centre

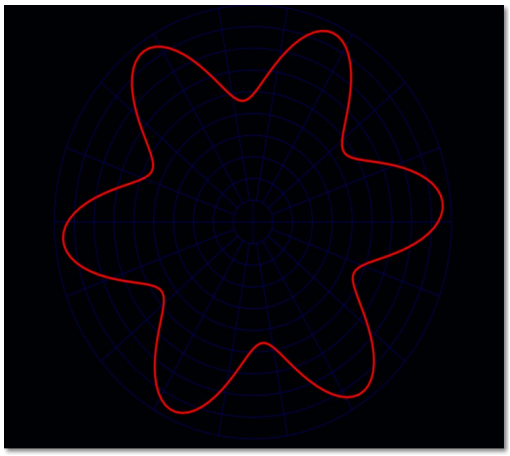
Note that if you set the tool offset equal to the weight then the path has lobes and keeps keeps going back to the origin as shown by image below.

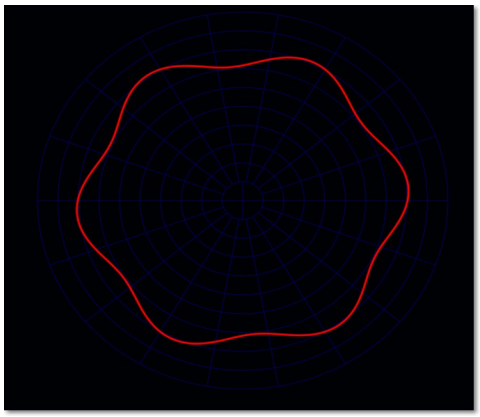


If you make the tool offset less than the weight but still positive you get alternating large and small lobes.



Waves with an offset value greater than the weight look as below. But note you may need to reduce the weight to quite small values to obtain a gentle ripple.

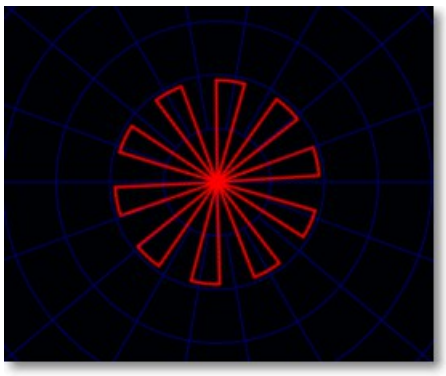




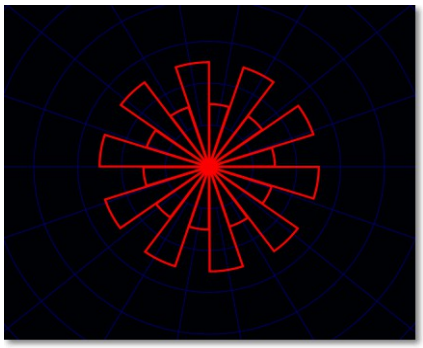
Same tool offset as the previous image with a reduced weight to give a smaller ripple.

Square wave rosette

The square wave rosette has the same three parameters as the sine wave and it also behaves in the same way as it is a also a wave (though one with steep sides)



In the above image the tool position is set equal to the rosette weight so path keeps returning to the zero position. The image below shows what happens when the tool offset is less than weight of the rosette.

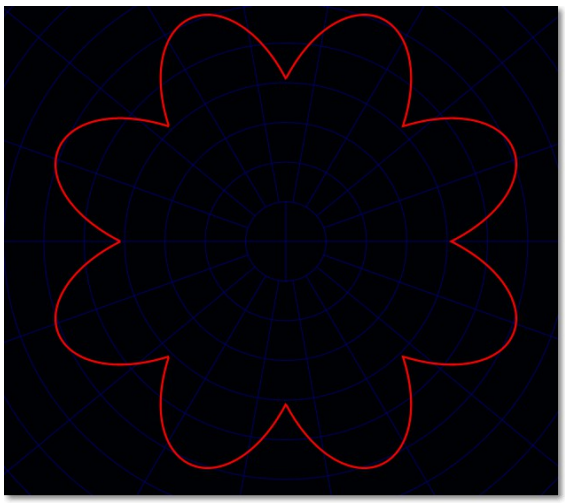


A petal rosette

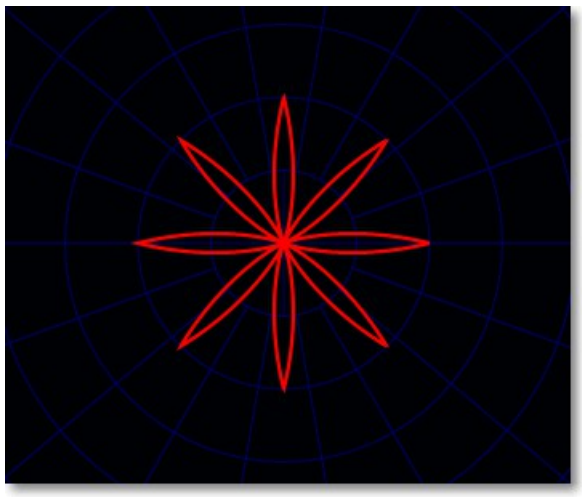
Similar to the standard wave it is in fact an absolute wave. That means when on the ordinary wave the values start to go negative on the petal they stay positive. It has the same three parameters

- *Frequency* – this time there are twice the number of petals as the frequency value
- *Weight* – same as wave
- *Phase* – same as wave

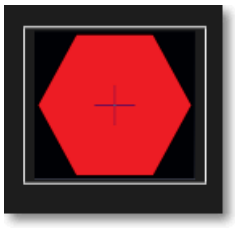
Again the tool position determines the shape of the path generated in one rotation. However unlike the wave the bumps are steeper and meet at a cusp.



By setting the tool position to negative of the weight you get a petal with sharp this sides



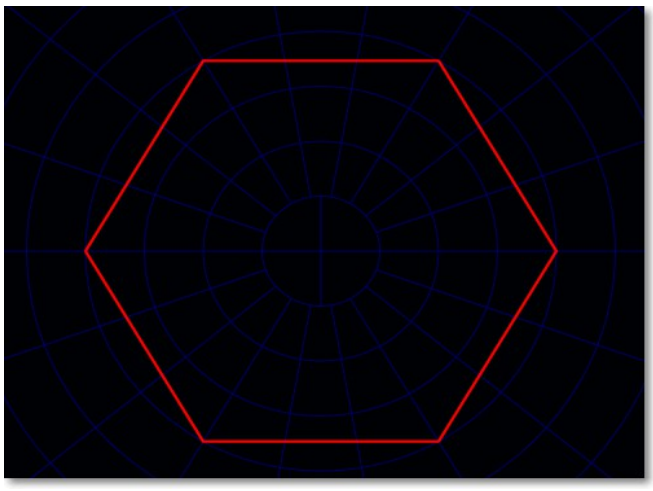
Polygon rosette



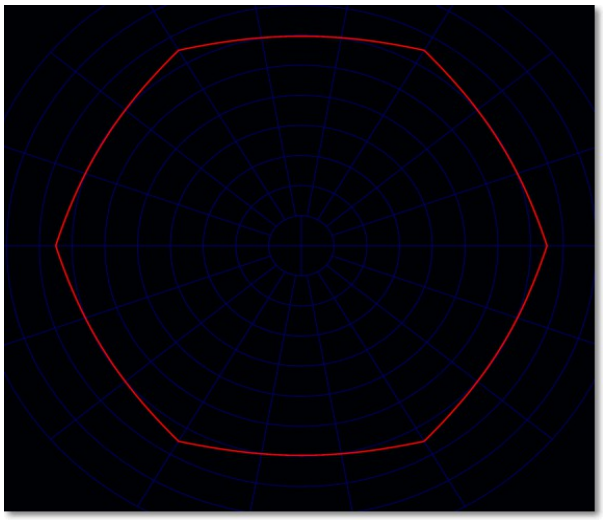
Parameters are

- *Number* of sides
- *Weight*
- *Phase*

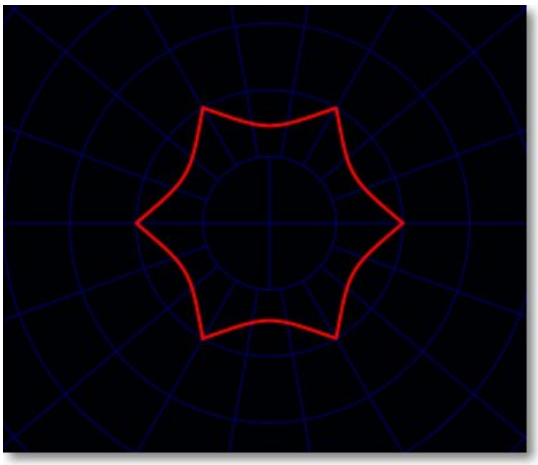
Again tool position is important. Setting the tool position to zero gives flat sides



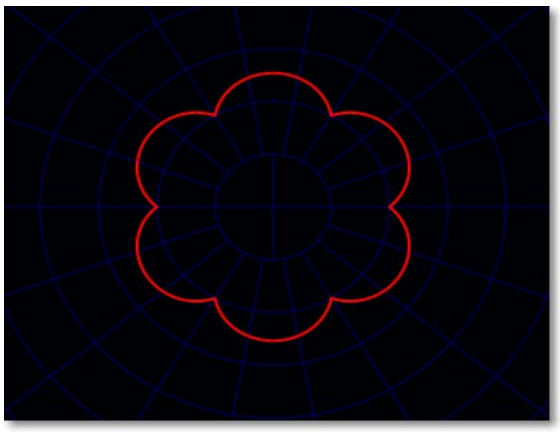
However increasing the tool position tends to make the sides more convex



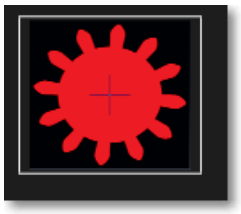
Here the weight is 40 whilst the tool position is set at 35. Alternatively decreasing the tool position makes the sides more concave so long as the tool position is between zero and – the weight.



In the image above the weight is 40 and the tool position is -20. You get a different effect when the tool position is less that the negative weight value. The image below is for a weight of 40 and a tool position of -60.



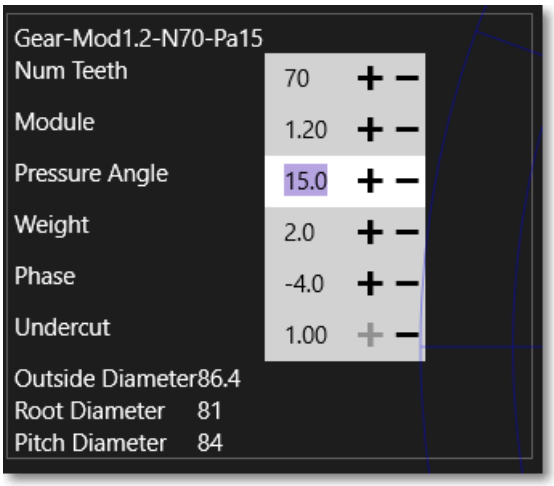
Gear Rosette

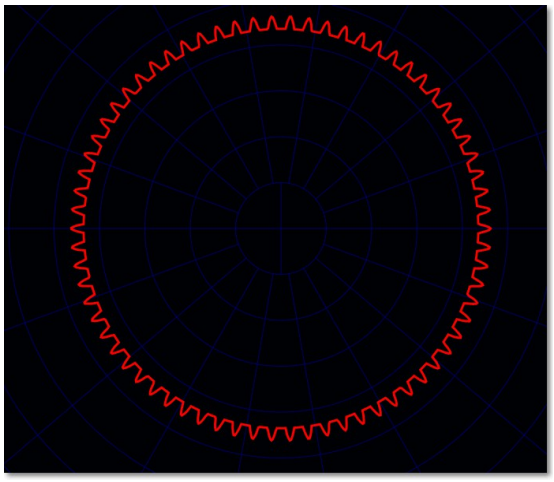


This is still very experimental and the code is not quite correct. It produces the outline of a spur gear. This rosette is totally different from the others because its size is not dependant on tool position. Instead the size of the gear path depends upon a standard set of parameters shown below.

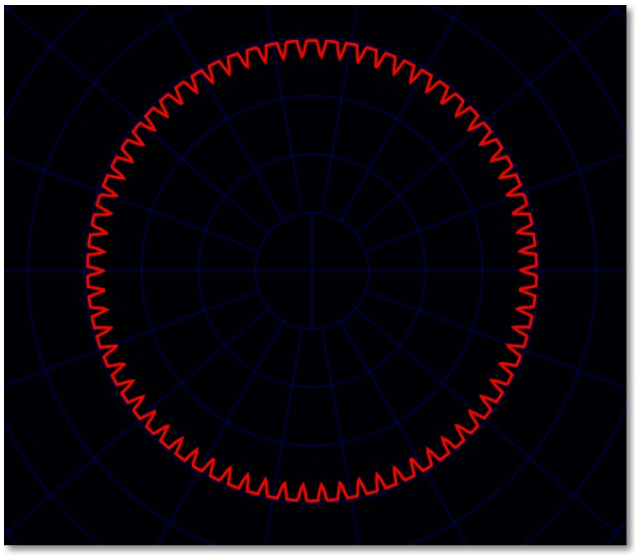
parameters

- The number of teeth in the gear
- The module value
- The pressure angle
- The weight has no effect at present as the diameter of the gear is solely dependent on the previous parameters.
- Phase
- Undercut – currently a fudge factor to get something like the correct tooth shape.





Gear wheel produced with parameters set as in image above. However setting a negative tool position does have an effect and it is to produce an internal gear wheel. That is one with the teeth pointing inward rather than outward. The path below was generated by setting the tool position to -80.



Remember that with all these rosettes a negative tool position simply means that on a real mechanical rose engine the tool is set to the opposite side of the barrel than the rubber.

Multiple Rosettes on a Barrel

When you add several rosettes to a barrel, the path traced is the combined outline of these rosettes.

Code Generation

The previous options were concerned with representing the tools path across the workpiece as a sequence of points. This section is concerned with transforming that sequence of points into a full G code program.