

Squircle Pro Plugin

[Vers 1.0.1]

Purpose

This plugin for CamBam is intended to create squircle and super ellipse-shaped polylines. The squircle (or rounded square, super ellipse, or perhaps more correctly the Lamé curve) is a shape that is somewhere between a circle (or ellipse) and a square (or rectangle). It is a shape that has certain aesthetic qualities and is often used in the design and manufacture of tactile objects.

This “Pro” version is a further development of the original plugin that extends the shape capabilities to the *Superellipse* family as described on the Wolfram Research web site (<http://mathworld.wolfram.com/Superellipse.html>).

These polylines can then be used to construct CamBam models.

Installation

The SquircleProPlugin.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

The plugin can generate shapes from two different (and loosely related) algebraic expressions (expressed in polar coordinates):

Simple Shapes:

$$r(\theta) = \left[\left| \frac{\cos^n(\theta)}{r_a^n} \right| + \left| \frac{\sin^n(\theta)}{r_b^n} \right| \right]^{-1/n}$$

Where:

- θ is the angle from the X-axis
- $r(\theta)$. Is the radius at this angle.
- n is the exponent power
- r_a and r_b are the shape radii in the X and Y directions.

The power value (n) is often taken to be 4.0, and this produces a rather interesting “squared-circle” shape, but other values are possible. Some useful values are:

- $n = 2$: produces a true circle or ellipse.
- $n > 2$: produces a rounded square or rectangle, the shape approaches a square (or rectangle) as the value of n increases.
- $n > 1$ & $n < 2$: produces a “rounded diamond shape”
- $n > 0$ & $n < 1$: produces a “concave diamond shape”.

This option corresponds to the first version of the plugin (the “Non-Pro” version!).

Complex Shapes:

$$r(\theta) = \left[\left| \frac{\cos^{n_2}(\frac{1}{4}m\theta)}{a} \right| + \left| \frac{\sin^{n_3}(\frac{1}{4}m\theta)}{b} \right| \right]^{-n_1}$$

Where:

- θ is the angle from the X-axis
- $r(\theta)$. Is the radius at this angle.
- m is the fold parameter.
- $n1, n2, n3$ are the exponent powers
- a and b are shape parameters for the shape.

This expression can produce a wide variety of shapes from various combinations of parameter values. Some examples can be seen on the Wolfram Research web site (<http://mathworld.wolfram.com/Superellipse.html>). Users are encouraged to check out this resource for example shapes and the required parameter values.

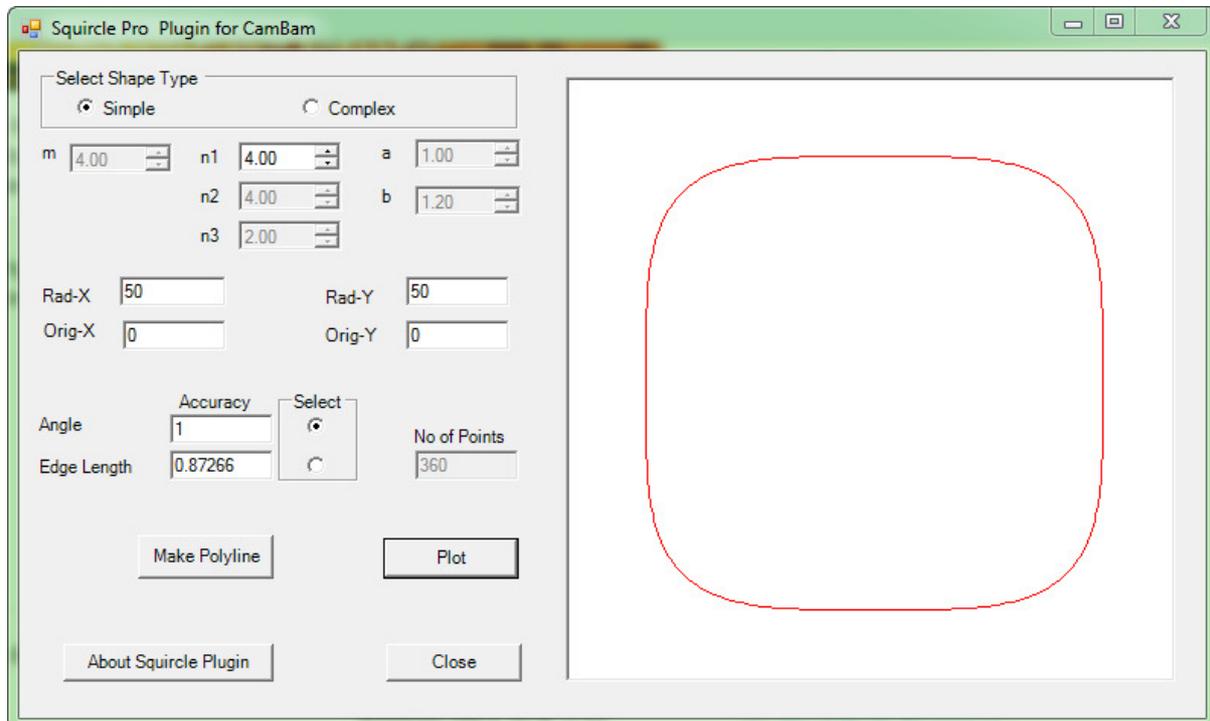
In this case the shape is essentially “square” or “circular” and the shape parameters describe variations in the perimeter “bumps” and to some degree the actual dimensions of the shape.. The plugin will attempt to re-scale the shape to the required X-Y proportions for the CamBam model as set by the X and Y radii, but this will not always be precise.

Some experimentation is required to find interesting, or useful, combinations of parameters. Note that there will be some parameter value combinations that may produce rather “odd” shapes and the shapes are not always symmetrical.

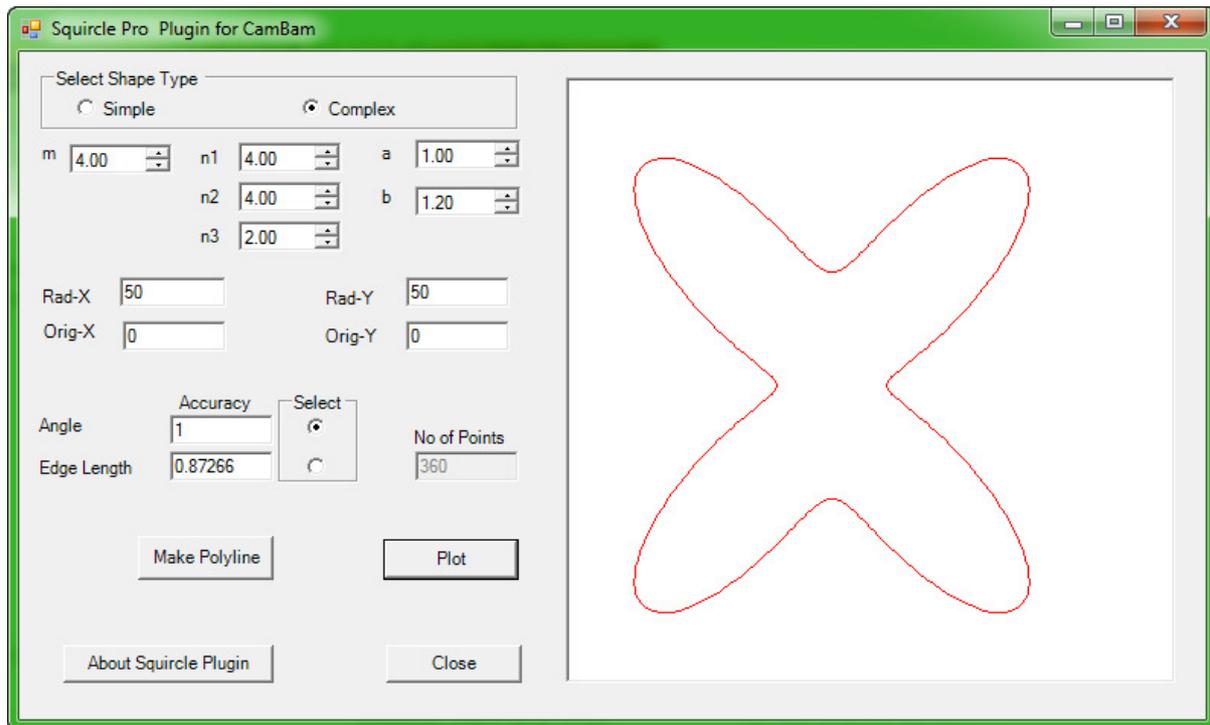
User Interface

This is the user interface:

Simple Option:



Complex Option:



The fields are:

- The **Simple** and **Complex** radio buttons select the required function. The Simple option enables only the required parameters.
- **m**: the fold parameter value (> 0.0) that determines the basic outline shape (3 sided, 4 sided, etc)
- **n₁**, **n₂**, **n₃**: the exponent parameter values (n_1 is used for n in the Simple model)
- **Rad-X** and **Rad-Y**: the radii (half widths) in the X and Y-directions. For the complex shape option the actual dimensions of the polyline shape when inserted into the CamBam model may not match exactly, but can be subsequently scaled (transformed) to fit.
- **Orig-X** and **Orig-Y**: the X and Y positions of the "centre" of the shape.
- The polyline shape is made up from a number of straight line segments. The accuracy can be defined by either setting the average angle each of these makes at the centre, or the average length of the segments by selecting the **Angle** or **Edge Length** radio buttons, and entering the **Angle** value (in degrees) or the **Edge Length** (in model units). Typically an angle less than 1 deg, or an edge length less than 1 mm, will produce a relatively smooth curve. Large angles, or edge lengths, will produce "polygon" like shapes. These may be useful in their own right.
- The **Plot** button will display a drawing of the shape in the graphics panel (auto-scaled to fit), as a preview the shape to be generated.
- The **No of Points** field shows the number of line segments generated. If this number is more than 4000 a warning is given, and if more than 20000 an error is generated.
- The **Make Polyline** button inserts the generated polyline into the currently active layer of the CamBam model at its nominated location and with a Z-value of zero. From here it can be further edited as required.

The Up and Down controls on the text fields can be used to increment or decrement a value by 1.0 (or 0.1 for the a and b fields) for convenient data entry for testing parameter value options.

The set parameters are saved for the current CamBam session.

Versions

Version	Date	Notes
1.0.1	24-01-2015	First version for testing