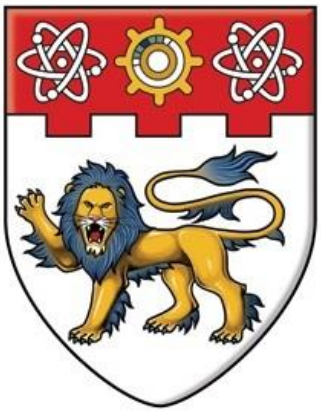


NANYANG TECHNOLOGICAL UNIVERSITY

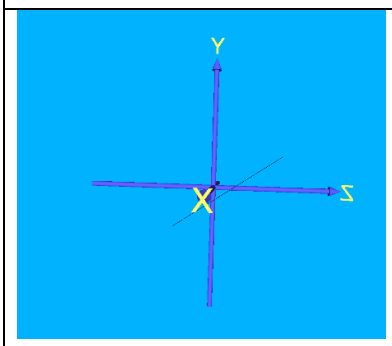
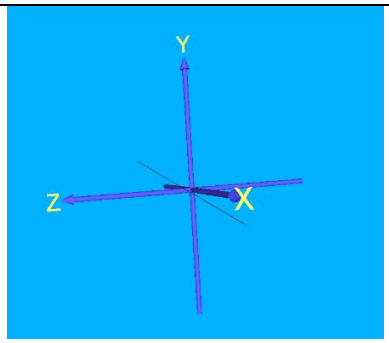
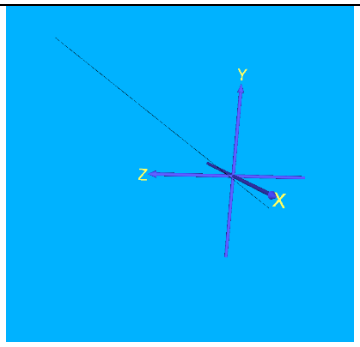
CZ2003 Computer Graphics and Visualization

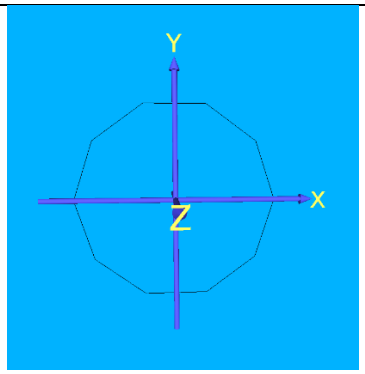
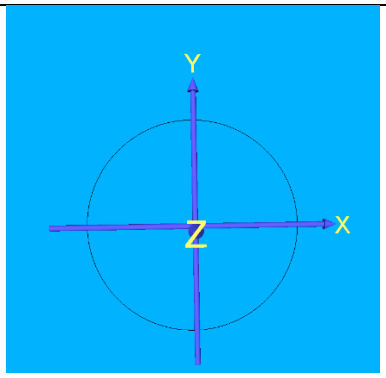
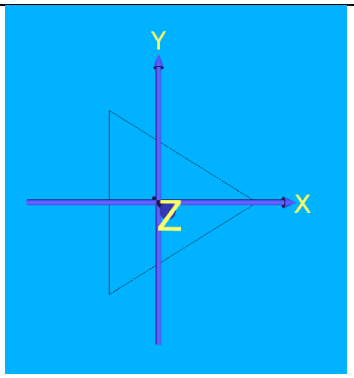
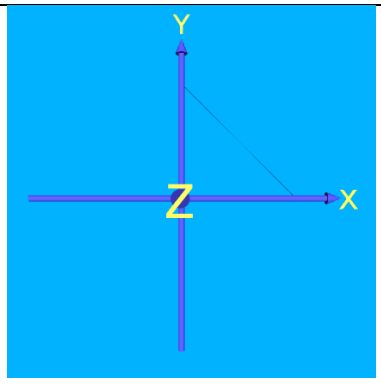
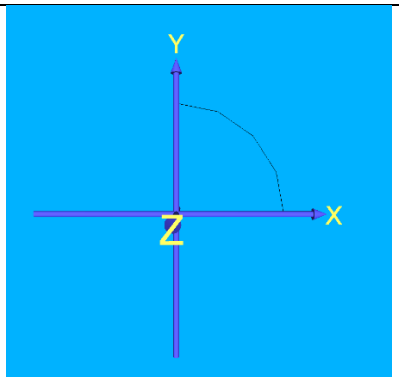
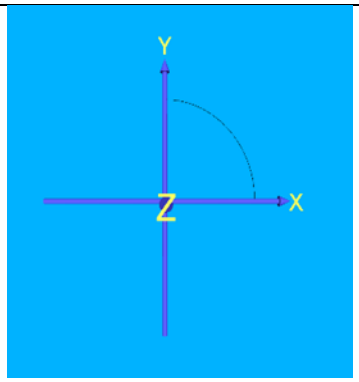
Lab 2 Report: Parametric Curves

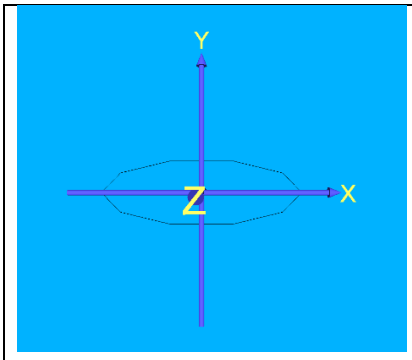
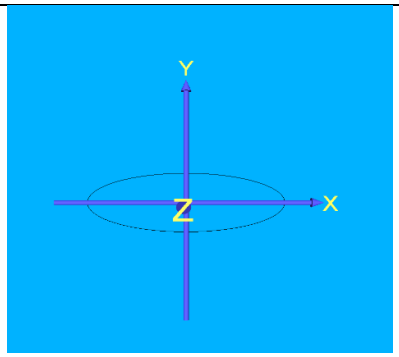
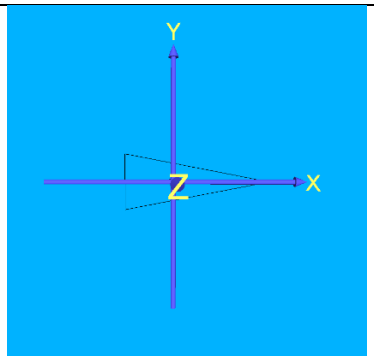
ACHARYA ATUL

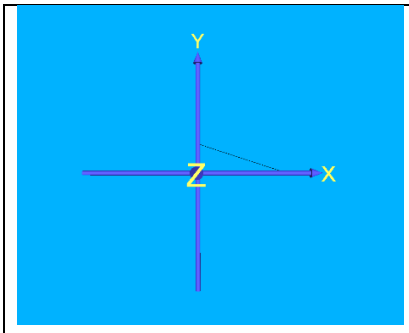
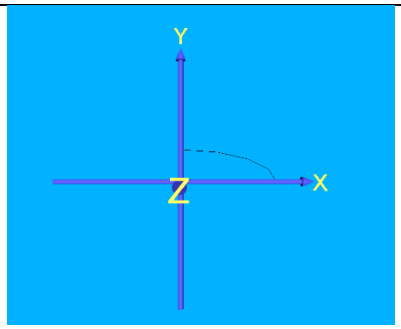
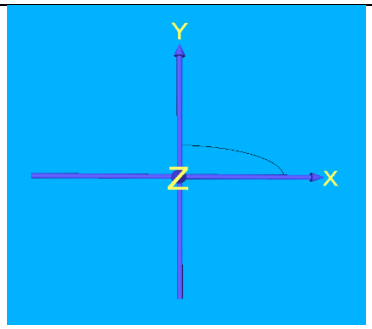
U1923502C

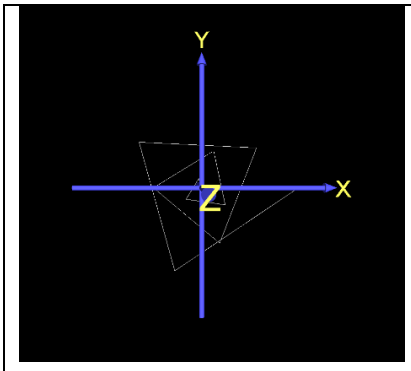
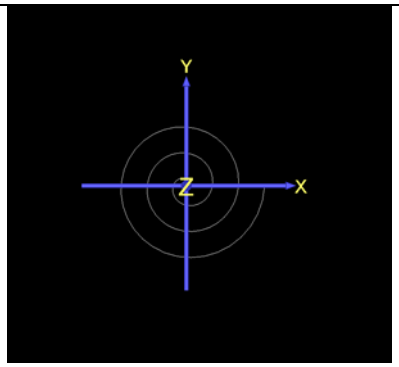
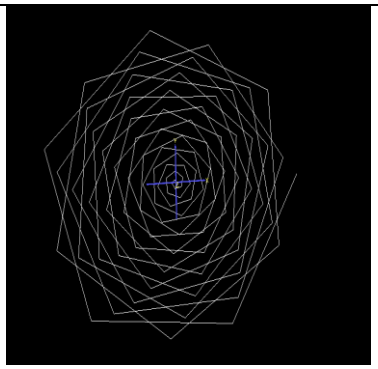
SSP1

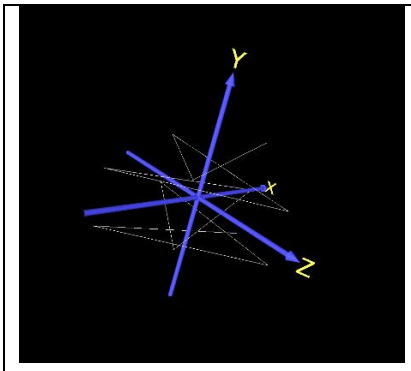
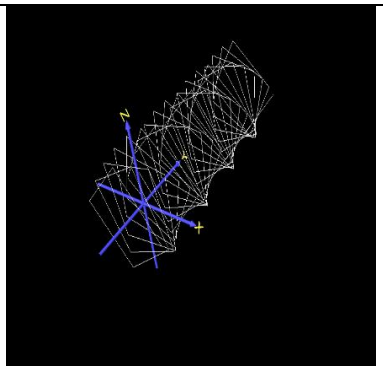
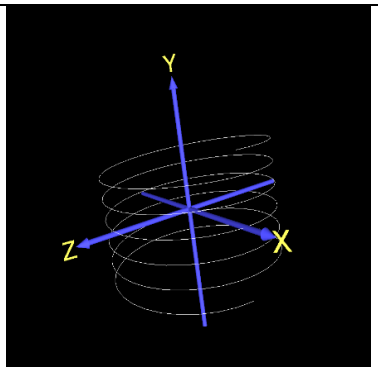
Curve 1	Curve 2	Curve 3	Notes
			The minimum sampling resolution to draw a straight line is 1. This is because any straight line can be drawn using 2 points, that is, it requires only 1 straight line to be drawn. Sampling resolution of 2 over the domain [0,1] samples the points when u=0:(0.5, -0.25, -0.25) and u=1: (0.4,0.25,0.5)
Above is a snapshot of "**Line 1.wrl**" with the following properties: Parametric Equation: x = 0.5 - 0.1*u y= -0.25 + 0.5*u z= -0.25 + 0.75*u Domain: [0,1] Resolution: 2	Above is a snapshot of "**Line 2.wrl**" with the following properties: Parametric Equation: x = 0.5 - 0.1*u y= -0.25 + 0.5*u z= -0.25 + 0.75*u Domain: [0,1] Resolution: 100	Above is a snapshot of "**Line 3.wrl**" with the following properties: Parametric Equation: x = 0.5 - 0.1*u y= -0.25 + 0.5*u z= -0.25 + 0.75*u Domain: [0,3] Resolution: 100	

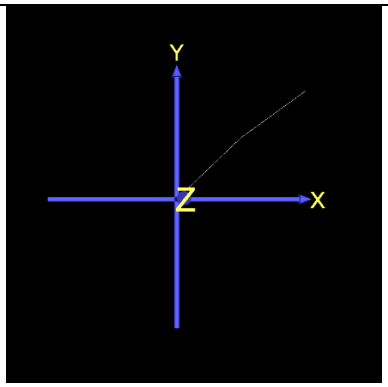
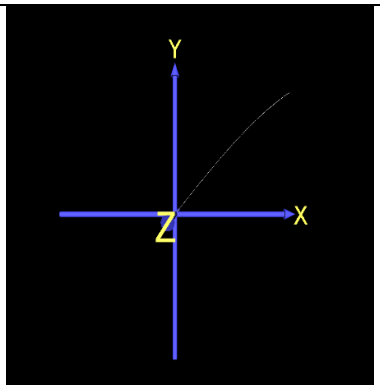
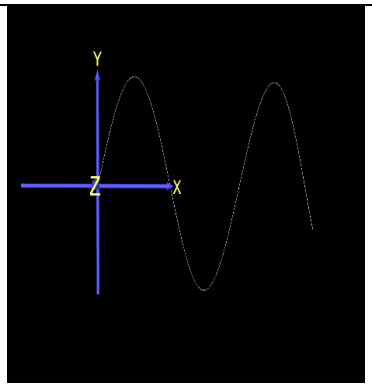
 Above is a snapshot of "**circle 1.wrl**" with the following properties: Parametric Equation: x = 0.75*cos(2*π*u) y = 0.75*sin(2*π*u) z = 0 Domain: [0,1] Resolution: 10	 Above is a snapshot of "**circle 2.wrl**" with the following properties: Parametric Equation: x = 0.75*cos(2*π*u) y = 0.75*sin(2*π*u) z = 0 Domain: [0,1] Resolution: 100	 Above is a snapshot of "**circle 3.wrl**" with the following properties: Parametric Equation: x = 0.75*cos(2*π*u) y = 0.75*sin(2*π*u) z = 0 Domain: [0,1] Resolution: 3	Higher the sampling resolution, the more accurate and smooth a circle will be. This is because a circle is drawn by joining multiple straight lines together between points that lie on the circle. If the sampling resolution is 3, it will form a triangle joining the points when u = 0, 0.33 and 0.66.
 Above is a snapshot of "**circular arc 1.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (0.5*π*u) y = 0.75*sin (0.5* π *u) z = 0 Domain: [0,1] Resolution: 1	 Above is a snapshot of "**circular arc 2.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (0.5*π*u) y = 0.75*sin (0.5*π*u) z = 0 Domain: [0,1] Resolution: 4	 Above is a snapshot of "**circular arc 3.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (0.5*π*u) y = 0.75*sin (0.5*π*u) z = 0 Domain: [0,1] Resolution: 100	Just like the circle, a circular arc can be accurately drawn by increasing the sampling resolution. If the sampling resolution is 1, it will display a straight line joining the points corresponding to u = 0 and u = 1.

			The greater the sampling resolution, the more accurate is the ellipse. An ellipse can be obtained using the equation of a circle but placing coefficients to any of the axes. If coefficients are applied to both axes, they should not be equal, else we get an ellipse. If only 10 points were sampled, we get a polygon-like figure whose points lie on the ellipse.
Above is a snapshot of "**ellipse 1.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (2*π*u) y = 0.25*sin (2*π*u) z = 0 Domain: [0,1] Resolution: 10	Above is a snapshot of "**ellipse 2.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (2*π*u) y = 0.25*sin (2*π*u) z = 0 Domain: [0,1] Resolution: 100	Above is a snapshot of "**ellipse 3.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (2*π*u) y = 0.25*sin (2*π*u) z = 0 Domain: [0,1] Resolution: 3	

			The elliptical arc is drawn by modifying the argument in the sine and cosine functions in the equation of the ellipse. If the sampling resolution was 1, we get a straight line joining the points: (0.75,0) and (0,0.25).
Above is a snapshot of "**elliptical arc 1.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (0.5*π*u) y = 0.25*sin (0.5*π*u) z = 0 Domain: [0,1] Resolution: 1	Above is a snapshot of "**elliptical arc 2.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (0.5*π*u) y = 0.25*sin (0.5*π*u) z = 0 Domain: [0,1] Resolution: 4	Above is a snapshot of "**elliptical arc 1.wrl**" with the following properties: Parametric Equation: x = 0.75*cos (0.5*π*u) y = 0.25*sin (0.5*π*u) z = 0 Domain: [0,1] Resolution: 100	

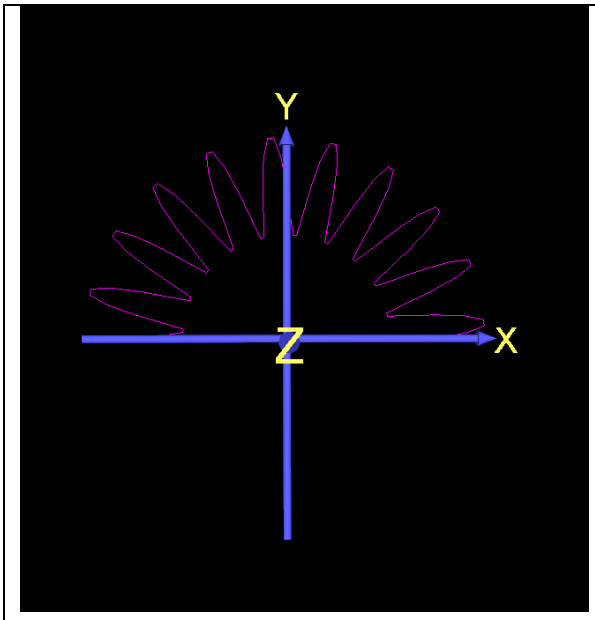
			Lowering the sampling resolution, we get a rough curve which is connected by line segments joining few points lying on the curve. Increasing the sampling resolution smoothens the curve. Increasing the domain elongates the curve. When a curve is elongated, the resolution should be increased in order to obtain a smooth curve.
Above is a snapshot of "**2D Spiral 1.wrl**" with the following properties: Parametric Equation: x = 0.75*u*cos(6*π*u) y = 0.75*u*sin(6*π*u) z = 0 Domain: [0,1] Resolution: 10	Above is a snapshot of "**2D Spiral 2.wrl**" with the following properties: Parametric Equation: x = 0.75*u*cos(6*π*u) y = 0.75*u*sin(6*π*u) z = 0 Domain: [0,1] Resolution: 100	Above is a snapshot of "**2D Spiral 3.wrl**" with the following properties: Parametric Equation: x = 0.75*u*cos(6*π*u) y = 0.75*u*sin(6*π*u) z = 0 Domain: [0,6] Resolution: 100	

			When the sampling resolution is less, the number of points sampled is less and hence the curve appears as a combination of zig-zag lines. Increasing the domain of the curve while keeping the resolution, more or less, the same decreases the smoothness of the curve.
Above is a snapshot of "**3D Helix 1.wrl**" with the following properties: <u>Parametric Equation:</u> x = 0.75*cos(12*π*u) y = -0.5 + u z = 0.75*sin(12*π*u) <u>Domain</u>: [0,1] <u>Resolution</u>: 10	Above is a snapshot of "**3D Helix 2.wrl**" with the following properties: <u>Parametric Equation:</u> x = 0.75*cos(12*π*u) y = -0.5 + u z = 0.75*sin(12*π*u) <u>Domain</u>: [0,4] <u>Resolution</u>: 100	Above is a snapshot of "**3D Helix 3.wrl**" with the following properties: <u>Parametric Equation:</u> x = 0.75*cos(12*π*u) y = -0.5 + u z = 0.75*sin(12*π*u) <u>Domain</u>: [0,1] <u>Resolution</u>: 200	

 Above is a snapshot of "**sine curve 1.wrl**" with the following properties: <u>Parametric Equation:</u> x = u y = sin(u) z = 0 <u>Domain</u>: [0,1] <u>Resolution</u>: 2	 Above is a snapshot of "**sine curve 2.wrl**" with the following properties: <u>Parametric Equation:</u> x = u y = sin(u) z = 0 <u>Domain</u>: [0,1] <u>Resolution</u>: 100	 Above is a snapshot of "**sine curve 3.wrl**" with the following properties: <u>Parametric Equation:</u> x = u y = sin(u) z = 0 <u>Domain</u>: [0,3.14] <u>Resolution</u>: 100	When the sampling resolution is as little as 2, the sine curve is formed by 2 straight lines. Increasing the domain increases the length of the curve. We can control the smoothness of the curve by changing the resolution and we can control the length of the curve by changing the domain.

Extra Curves:

The following curves can be found in the folder "**Lab 2 Extras**".



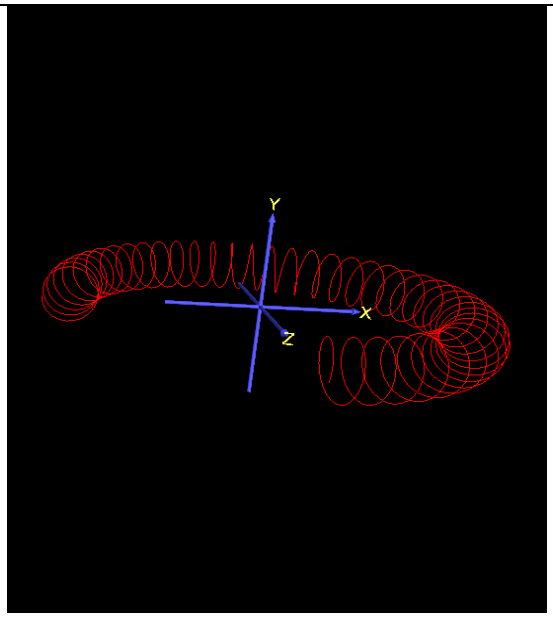
Above is a snapshot of
"**Extra 1.wrl**" with the following properties:

Parametric Equation:
x = (0.75+0.25*sin(20*π*u)) * cos(π*u)
y = (0.75+0.25*sin(20*π*u)) * sin(π*u)
z = 0

Domain: [0,1]

Resolution: 100

The figure describes a sine wave that follows a semicircle with the radius of 0.75. The curve makes 10 periodic oscillations moving counter-clockwise around the semicircle with the oscillation amplitude of ± 0.25.



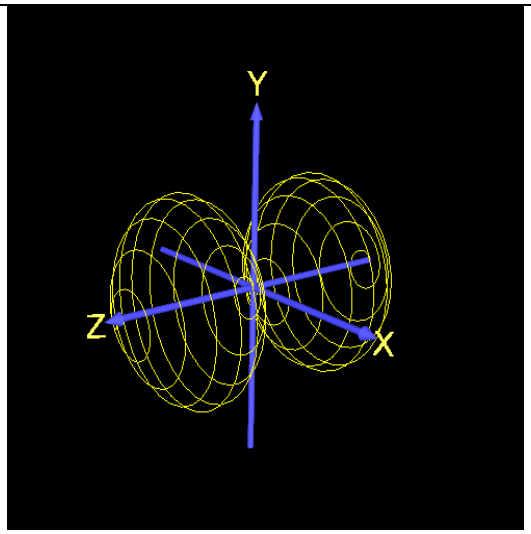
Above is a snapshot of
"**Extra 2.wrl**" with the following properties:

Parametric Equation:
x = (0.3*cos(80*π*u) + 2) * sin (1.5*π*u)
y = 0.3*sin(80*π*u)
z = (0.3*cos(80*π*u) + 2) * cos (1.5*π*u)

Domain: [0,1]

Resolution: 1000

The figure describes a curve created by 40 revolutions with radius 0.3 moving along the circle of radius 2. The curve starts at the positive Z axis and rotates counter-clockwise until it reaches the negative X axis.



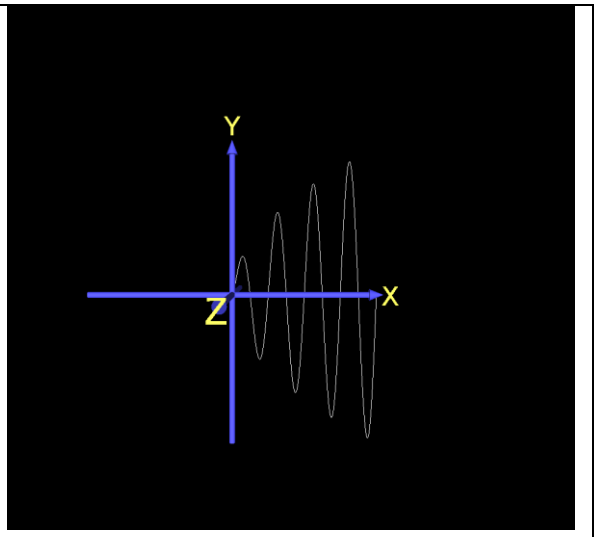
Above is a snapshot of
"**Extra 3.wrl**" with the following properties:

Parametric Equation:
$x = 0.6*|\sin(2*\pi*u)|*\cos(36*\pi*u)$
$y = 0.6*|\sin(2*\pi*u)|*\sin(36*\pi*u)$
$z = -1+2*u$

Domain: [0,1]

Resolution: 500

The figure describes a 3D helix with a variable radius of $0.6*|\sin(2*\pi*u)|$ whose value lies between 0 and 0.6. The curve makes 18 revolutions about the Z axis.



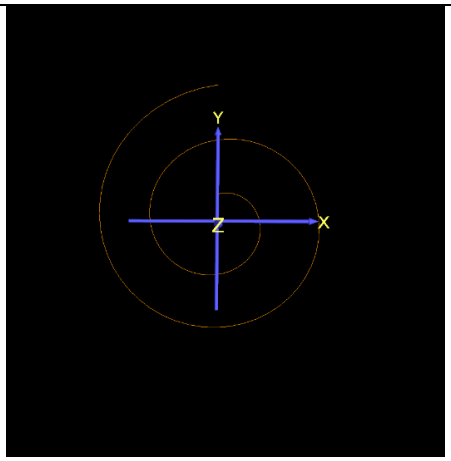
Above is a snapshot of
"**Extra 4.wrl**" with the following properties:

Parametric Equation:
$x = u$
$y = (u^{0.5}) * (\sin(8*\pi*u))$
$z = 0$

Domain: [0,1]

Resolution: 500

The figure describes a sine curve whose amplitude is modified by the function $x = y^2$.



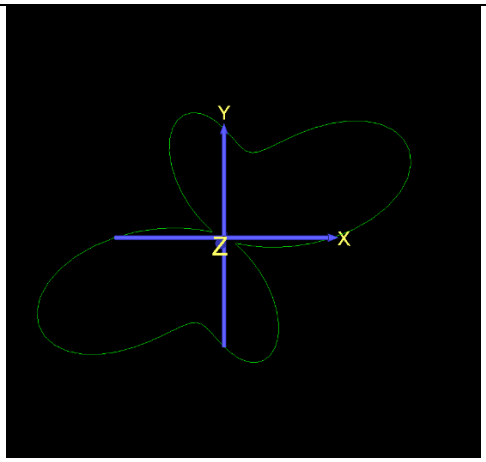
Above is a snapshot of
"**Extra 5.wrl**" with the following properties:

Parametric Equation:
x=(0.3+1.2*u) *cos (0.5*π -4*π*u)
y=(0.3+1.2*u) *sin (0.5*π -4*π*u)
z=0

Domain: [0,1]

Resolution: 100

The figure describes a spiral whose radius increases linearly from 0.3 to 1.5 which starts from the positive Y axis and rotates clockwise.



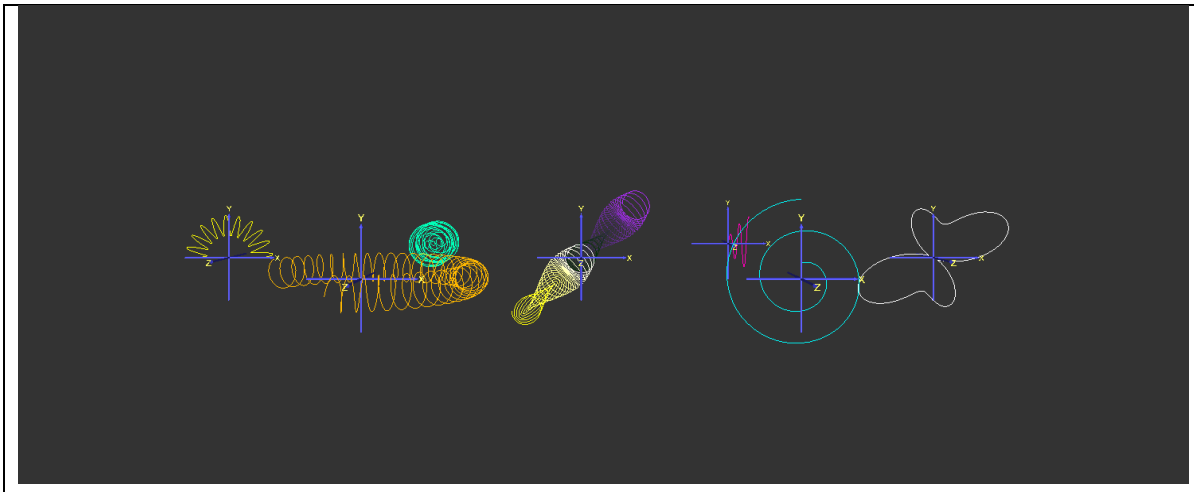
Above is a snapshot of
"**Extra 6.wrl**" with the following properties:

Parametric Equation:
x = (1+cos(2*π*u) *sin(6*π*u)) *cos(2*π*u)
y = (1+cos(2*π*u) *sin(6*π*u)) *sin(2*π*u)
z = 0

Domain: [0,1]

Resolution: 100

The curve is derived from the polar equation:
r = 1 + cos(α)cos(3α) where α = 2πu and
α ∈ [0, 2π].



Above is a snapshot of "**Combined.wrl**". In addition to all the curves mentioned above, it contains a curve defined by parametric equations:
x = 0.2*(2*π*u - 1.6*cos(48*π*u))
y = 0.2*(2*π*u - 1.6*sin(50*π*u))
z = 0
with domain of [-1, 1] and resolution of 2000.

This file contains curves defined with time variable 't' to make **motions**. The file contains function definitions that describes **acceleration** as well as **deceleration**.

Example:

The definition of the curve defined in "**Extra 2.wrl**" was changed to:
x = (0.3*cos (80*π*u*sin (0.5*π*t)) + 2) * sin (1.5*π*u*sin (0.5*π*t))
y = 0.3*sin (80*π*u*sin (0.5*π*t))
z = (0.3*cos (80*π*sin (0.5*π*t)) + 2) * cos (1.5*π*u*sin (0.5*π*t))
The argument sin (0.5*π*t) simulates deceleration.

This file also contains curves whose colour changes with time.

Example:

The colour definition of the curve defined in "**Extra 4.wrl**" was changed to:
r=1
g=0
b=t
The colour of the object changes from red to pink at a **uniform speed**.