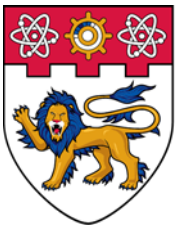

NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

CZ3003
COMPUTER GRAPHICS and VISUALIZATION

LAB 2 REPORT

Parametric Curves

LAB GROUP : **SSP6**

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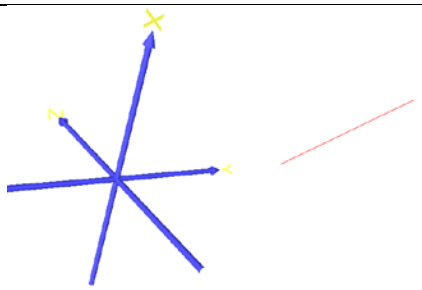
School of Computer Science and Engineering

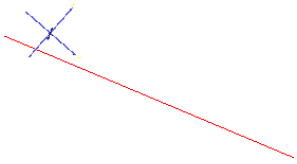
Nanyang Technological University

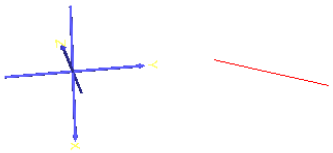
Contents

Straight Line Segment

Mode	VRML	Para Eqn	Domain	Remark

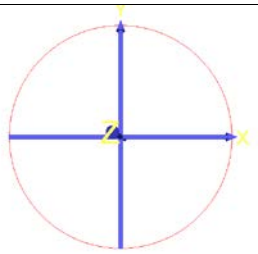
Normal	 Source: straight line.wrl	Let explicit equation be y = 3x + 2
		Then :
		x= u;
		y= 3*u + 2;
		z= 0;"
			(0,1)	A straight line segment away from the origin

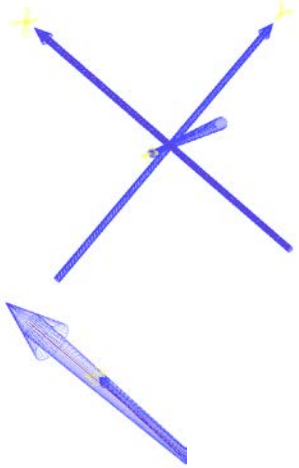
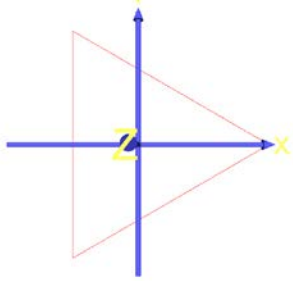
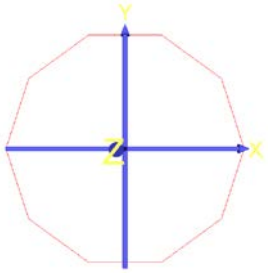
Low Res (2)	 Source: straight line_Res2.wrl			No changes, the resolution affect the number of edge render. In this case there is no edge, therefore no changes should happen.
Low Res (3)	 Source: straight line_Res3.wrl			
High Res (10)	 Source: straight line_Res10.wrl			
Elongate	 Source: straight line_Extend.wrl		(-1,2)	The length is 3 times longer

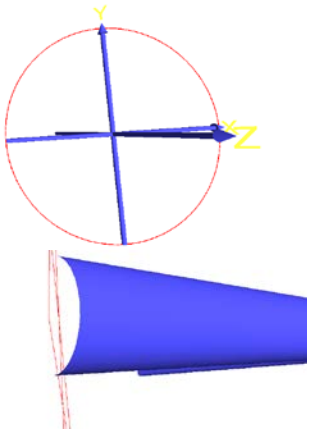
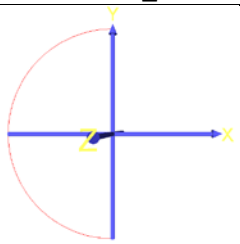
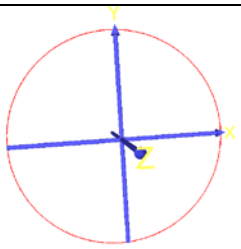
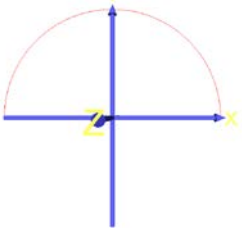
Shorten	 Source: straight line_Shrink.wrl		(0.25,0.75)	The length is shortened by half
Right (Elongate)	 Source: straight line_Extend_Right.wrl		(0,3)	3 times the size of the original length, the right domain is increment by 2
Right (Shorten)	 Source: straight line_Shrink_Right.wrl		(0,0.5)	Shorten by half, the right domain is reduced by 0.5

Circle

Mode	VRML	Para Eqn	Domain	Remark

Normal	 Source : circle.wrl	x=cos(2*pi*u);
		y=sin(2*pi*u);
		z= 0;
			(0,1)	A circle shape from the centre of origin with radius value 1.

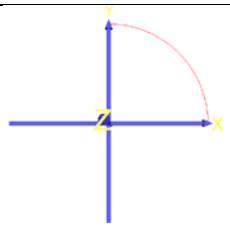
Low Res (2)	 Source: circle_Res2.wrl			A straight line cast on the X-axis. It is only visible when graphic set to wireframe. 2 edges is formed which result in a straight line (180 degrees apart)
Low Res (3)	 Source: circle_Res3.wrl			A triangle shape with 3 edges (120 degrees apart)
High Res (10)	 Source: circle_Res10.wrl			10 edges of a poorly rendered circle. From here we can conclude that the number of resolutions is proportional to the number of edges of the circle. So to have a smooth edges of the circle very high resolution would be needed

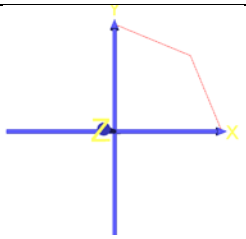
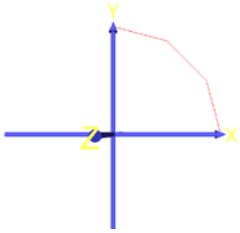
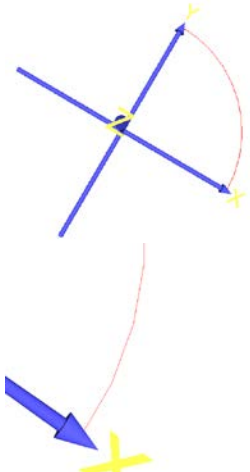
Elongate	 Source: circle_Extend.wrl		(-1,2)	The length is 3 times longer which results in more revolution of the circle. Due to low resolution. We can observe unequal edges on the line closely. This result in the circle to appear thicker.
Shorten	 Source: circle_Shrink.wrl		(0.25,0.75)	The length is shortened by half. As such, it results in a half-circle shape with a 90 rotation anti-clockwise of the x-axis as it starts from 0.25 instead of 0.
Right (Elongate)	 Source: circle_Extend_Right.wrl		(0,3)	3 times the size of the original length, the right domain is increment by 2. Which results in render another 2 revolutions of the circle.
Right (Shorten)	 Source: circle_Shrink_Right.wrl		(0,0.5)	Shorten by half, the right domain is reduced by 0.5. As such, it results in a half-circle shape.

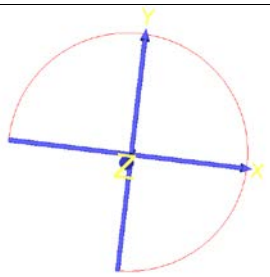
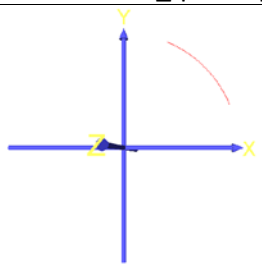
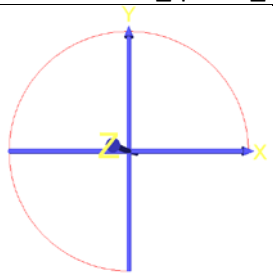
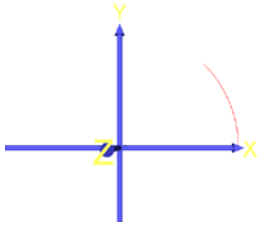
Circle's Arc

- In this case we use ¼ of the circle to represent the arc.

Mode	VRML	Para Eqn	Domain	Remark

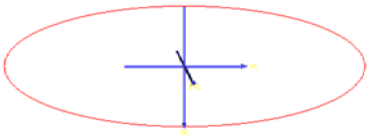
Normal	 Source: circle_quarter_arc.wrl	x=cos(0.5*pi*u);
		y=sin(0.5*pi*u);
		z= 0;
			(0,1)	A quarter of a circle shape from the centre of origin with radius value 1.

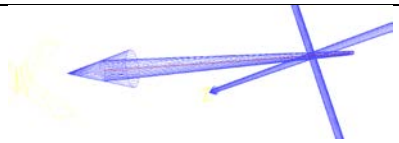
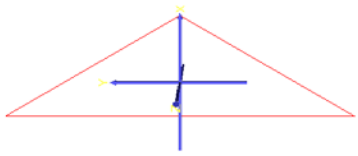
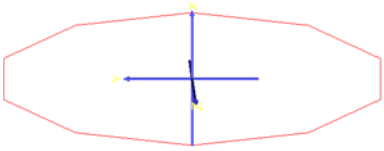
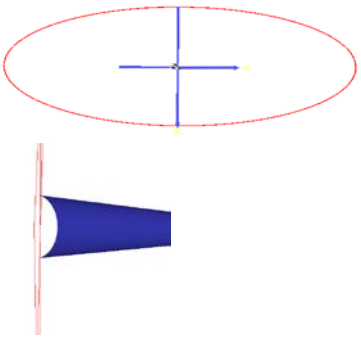
Low Res (2)	 Source: circle_quarter_arc_Res2.wrl			2 edges are formed which result in 2 lines with (45 degrees apart)
Low Res (3)	 Source: circle_quarter_arc_Res3.wrl			3 edges are formed (20 degrees apart)
High Res (10)	 Source: circle_quarter_arc_Res10.wrl			10 edges can be seen closely. From here we can conclude that the number of resolutions is proportional to the number of edges of the circle's arc. So to have a smooth edges of the circle's arc, very high resolution would be needed.

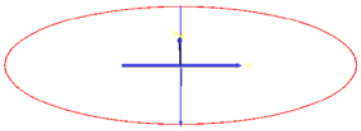
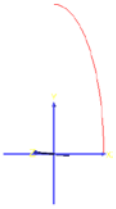
Elongate	 Source: circle_quarter_Extend.wrl		(-1,2)	The length is 3 times longer. The arc is extended at the extreme at both ends of the arc.
Shorten	 Source: circle_quater_Shrink.wrl		(0.25,0.75)	The length is shortened by half. The arc is both shortened extremes ends of the arc.
Right (Elongate)	 Source: circle_quarter_arc_Extend_Right.wrl		(0,3)	3 times the size of the original length, the right domain is increment by 2. Which results in the extent of one end of the arc.
Right (Shorten)	 Source: circle_quarter_arc_Shrink_Right.wrl		(0,0.5)	Shorten by half, the right domain is reduced by 0.5. Which results in the shortening of one end of the arc.

Ellipse

Mode	VRML	Para Eqn	Domain	Remark

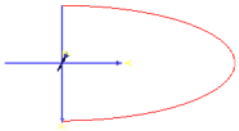
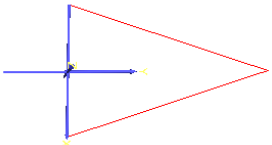
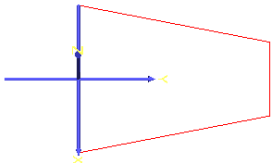
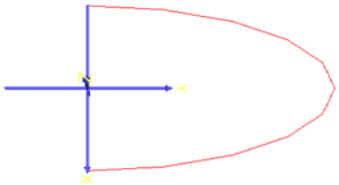
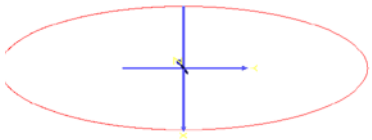
Normal	 Source: ellipse.wrl	x=1*cos(2*pi*u);
		y=3*sin(2*pi*u);
		z= 0;
			(0,1)	A quarter of a ellipse shape from the centre of origin with radius value 1 at X axis and value 3 at Y axis.

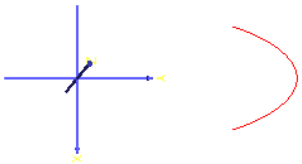
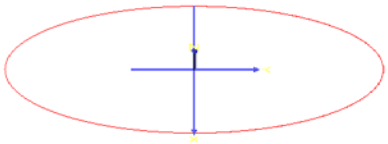
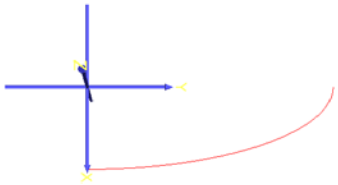
Low Res (2)	 Source: ellipse_Res2.wrl			2 edges are formed which result in straight lines with (180 degrees apart). Such an appearance is the same as a circle shape.
Low Res (3)	 Source: ellipse_Res3.wrl			3 edges are formed, the unequal length is the result of differences in radius.
High Res (10)	 Source: ellipse_Res10.wrl			10 edges can be seen. From here we can conclude that the number of resolutions is proportional to the number of edges of the ellipse. So to have a smooth edge of the ellipse, very high resolution would be needed.
Elongate	 Source: ellipse_Extend.wrl		(-1,2)	The length is 3 times longer. The ellipse is extended at both extreme ends of the ellipse. Unequal edges can be seen closely due to low resolution of 100.

Shorten	 Source: ellipse_Shrink.wrl		(0.25,0.75)	The length is shortened by half. The ellipse is shortened both extremes ends of the arc. Result in half ellipse.
Right (Elongate)	 Source: ellipse_Extend_Right.wrl		(0,3)	3 times the size of the original length, the right domain is increment by 2. Which results in the extent of one end of the ellipse.
Right (Shorten)	 Source: ellipse_Shrink_Right.wrl		(0,0.5)	Shorten by half, the right domain is reduced by 0.5. Which results in the shortening of one end of the ellipse.

Ellipse's Arc

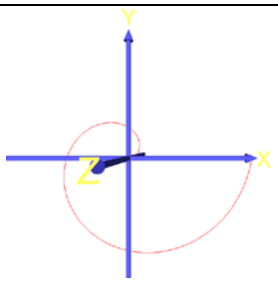
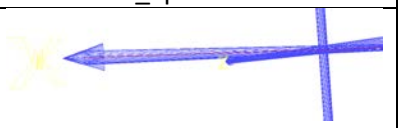
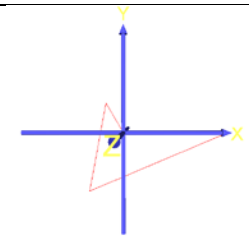
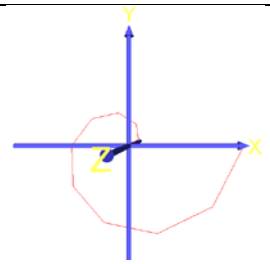
- In this case we use ½ of the ellipse to represent the arc.

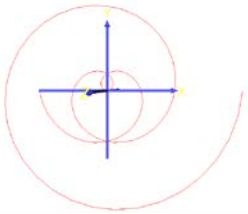
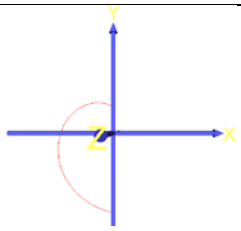
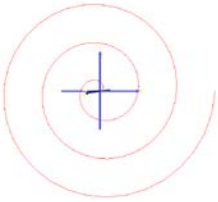
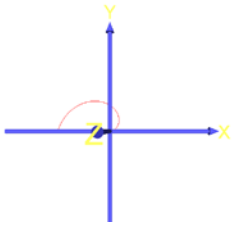
Mode	VRML	Para Eqn	Domain	Remark
Normal	 Source: ellipse_half_arc.wrl	x=1*cos(pi*u); y=3*sin(pi*u); z= 0;	(0,1)	A quarter of a ellipse's arc shape from the centre of origin with radius value 1 at X axis and value 3 at Y axis.
Low Res (2)	 Source: ellipse_half_arc _Res2.wrl			2 edges are formed which result in straight lines with (90 degrees apart).
Low Res (3)	 Source: ellipse_half_arc _Res3.wrl			3 edges are formed, the unequal length is the result of differences in radius.
High Res (10)	 Source: ellipse_half_arc _Res10.wrl			10 edges can be seen. From here we can conclude that the number of resolutions is proportional to the number of edges of the ellipse's arc. So to have a smooth edge of the ellipse's arc, very high resolution would be needed.
Elongate	 Source: ellipse_half_arc _Extend.wrl		(-1,2)	The length is 3 times longer. The ellipse's arc is extended at both extreme ends of the ellipse's arc. Unequal edges can be seen closely due to low resolution of 100.

Shorten	 Source: ellipse_half_arc _Shrink.wrl		(0.25,0.75)	The length is shortened by half. The ellipse's arc is shortened both extremes ends of the arc.
Right (Elongate)	 Source: ellipse_half_arc _Extend_Right.wrl		(0,3)	3 times the size of the original length, the right domain is increment by 2. Which results in the extent of one end of the ellipse's arc.
Right (Shorten)	 Source: ellipse_half_arc _Shrink_Right.wrl		(0,0.5)	Shorten by half, the right domain is reduced by 0.5. Which results in the shortening of one end of the ellipse's arc.

2D Spiral

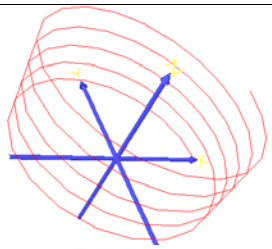
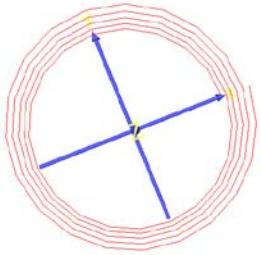
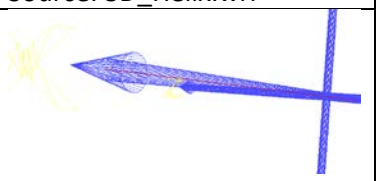
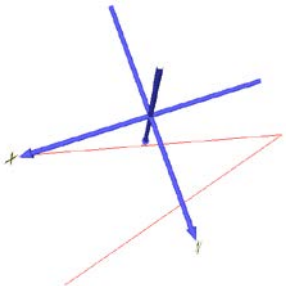
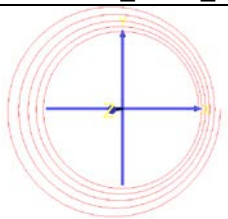
- To achieve 2D Spiral the radius will varius with a parameter(u)
- The number of resolution depends on
    - Domain range
    - Sine and Cosine number of revolution with respect of parameter u (2*pi = 1 revolution)

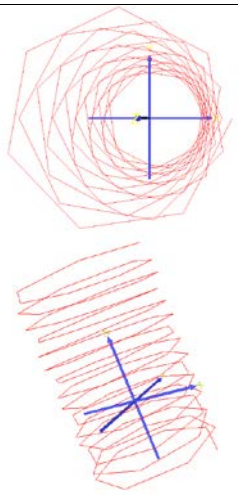
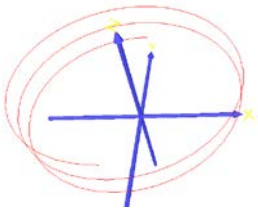
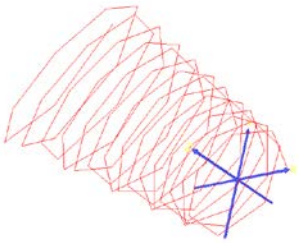
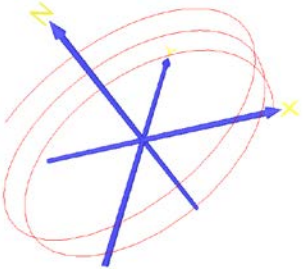
Mode	VRML	Para Eqn	Domain	Remark
Normal	 Source: 2D_Spiral.wrl	x=u*(cos(2*pi*u)); y=u*(sin(2*pi*u)); z=0;	(0,1)	A revolution of a spiral as radius changes from 0 to 1 value
Low Res (2)	 Source: 2D_Spiral_Res2.wrl			2 edges are formed which result in straight lines with (180 degrees apart). Same effect as an ellipse and a circle.
Low Res (3)	 Source: 2D_Spiral_Res3.wrl			3 edges are formed, the unequal length is the result of differences in radius.
High Res (10)	 Source: 2D_Spiral_Res10.wrl			10 edges can be seen. From here we can conclude that the number of resolutions is proportional to the number of edges of the 2D spiral. So to have a smooth edge of the 2D spiral, very high resolution would be needed.

Elongate	 Source: 2D_Spiral_Extend.wrl		(-1,2)	The length is 3 times longer. The 2D spiral is extended at both extreme ends of the 2D spiral.
Shorten	 Source: 2D_Spiral_Shrink.wrl		(0.25,0.75)	The length is shortened by half. The 2D spiral is shortened both extremes ends of the shape.
Right (Elongate)	 Source: 2D_Spiral_Extend_Right.wrl		(0,3)	3 times the revolution, the right domain is increment by 2. Which results in the extent of one end of the 2D spiral.
Right (Shorten)	 Source: 2D_Spiral_Shrink_Right.wrl		(0,0.5)	Shorten by half revolution, the right domain is reduced by 0.5. Which results in the shortening of one end of the 2D spiral.

3D Helix

- To achieve 3D Helix
    - Coordinate Z needs to vary with a parameter(u).
        - This result in the render being perform we respect to changes with Z
- Coordinate X and Y will be used as a circle shape equation

Mode	VRML	Para Eqn	Domain	Remark
Normal	  Source: 3D_Helix.wrl	x=1*(cos(10*pi*u)); y=1*(sin(10*pi*u)); z=u;	(0,1)	5 revolution of a spiral as radius changes from 0 to 1 value. (Notice, edges can be seen due to low resolution)
Low Res (2)	 Source: 3D_Helix _Res2.wrl			2 edges are formed which result in straight lines with (180 degrees apart). Same effect as an ellipse, a circle, a 2D spiral.
Low Res (20)	 Source: 3D_Helix _Res20.wrl			20 edges are formed while spiraling upward equally. The reason for such result is due to 5 revolution with 20 edges the best it can produce it in this form.
High Res (200)	 Source: 3D_Helix _Res200.wrl			200 edges.From here we can see it is smoother as compared to the normal 100 resolution.

Elongate	 Source: 3D_Helix_Extend.wrl		(-1,2)	The 3 times longer in revolution. The 3D helix is extended at both extreme ends of the 3D helix. Due to such extension the edges are stretch apart result in rough edges.
Shorten	 Source: 3D_Helix_Shrink.wrl		(0.25,0.75)	The revolution is shortened by half. The 3D helix is shortened both extremes ends of the shape.
Right (Elongate)	 Source: 3D_Helix_Extend_Right.wrl		(0,3)	3 times the revolution, the right domain is increment by 2. Which results in the extent of one end of the 3D helix. The edges stretch result in a rough curve.
Right (Shorten)	 Source: 3D_Helix_Shrink_Right.wrl		(0,0.5)	Shorten by half revolution, the right domain is reduced by 0.5. Which results in the shortening of one end of the 3D helix. The edges is squeezed result in a smooth curve.

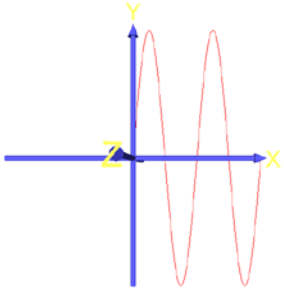
Sine Equation

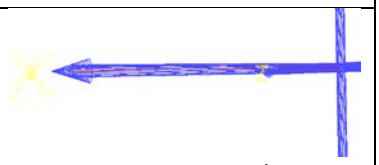
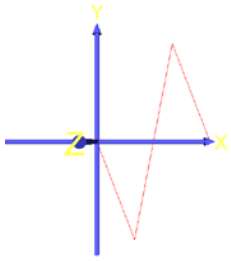
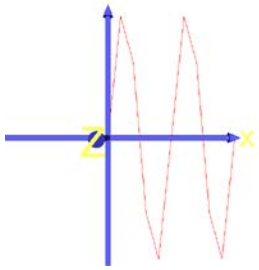
y = sin(x)

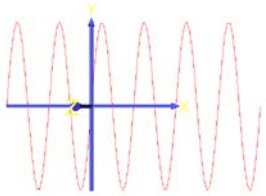
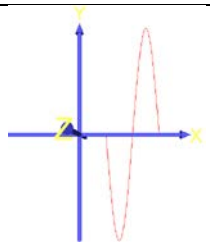
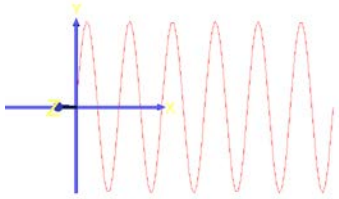
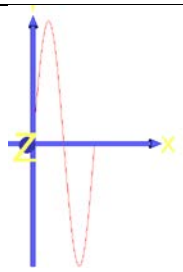
In parametric form

- Let x be u
- Then
  - x = u
  - y = sin(u)
  - z = 0
- In order to observe better, the sine wave was extend to 2 periods/cycles (4*pi*u)

Mode	VRML	Para Eqn	Domain	Remark

Normal	 Source: sine.wrl	x= u;
		y= sin(4*pi*u);
		z= 0;
			(0,1)	2 periods of sine wave.

Low Res (2)	 Source: sine_Res2.wrl			1 straight line can be seen with graphic set to wireframe. In this case only half of the x-axis seen due to the face that it is not rotation like other shapes it is a projection of sine wave.
Low Res (3)	 Source: sine_Res3.wrl			3 edges are formed while projecting the sine wave of the extreme peak.
High Res (10)	 Source: sine_Res10.wrl			10 edges.The curve is smoother compared to resolution value set at 2 and 3. From here, we can see that the more resolution the more smoother the curve it can be.

Elongate	 Source: sine_Extend.wrl		(-1,2)	The 6 periods long. The sine wave is extended at both extreme ends of the sine wave.
Shorten	 Source: sine_Shrink.wrl		(0.25,0.75)	Single period. The sine wave is shortened both extremes ends of the curve.
Right (Elongate)	 Source: sine_Extend_Right.wrl		(0,3)	6 periods, the right domain is increment by 2. Which results in the extent of one end of the sine wave.
Right (Shorten)	 Source: sine_Shrink_Right.wrl		(0,0.5)	The period was reduced by half, the right domain is reduced by 0.5. Which results in the shortening of one end of the sine wave.

In summary, base on the experimentation, we can observe that the shape is rendered edge by edge (excluding the start point). The domain control where it starts and ends of the edge. The number of edges depends on the resolution value. Having a high-resolution result in smooth curves but in return require more computational power to execute completely. In practical design, the value of resolution should be chosen base on the observer's perspective, as long as it appears to be a smooth curve then it should be enough. What is the minimum value to ensure a smooth curve, is another theory we have yet to learn.