Lab 3

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Parametric Surfaces and Solids

(1) 3D-plane

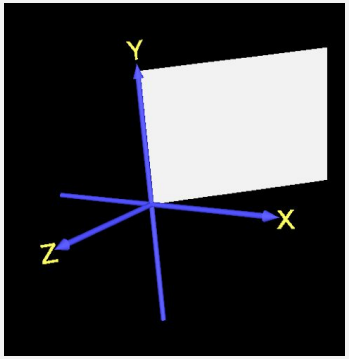

Fig 1.1

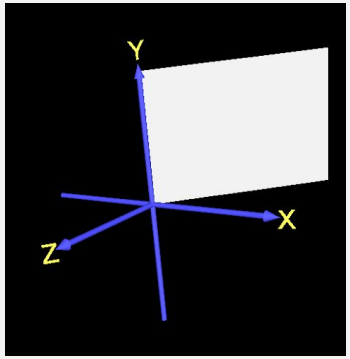

Fig 1.2

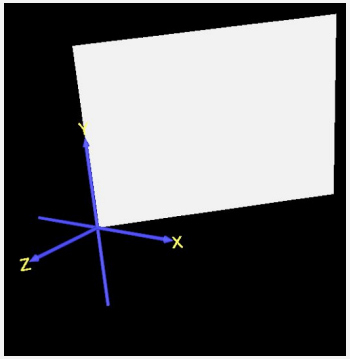

Fig 1.3

The files can be found in the directory ***/3D-plane***

- Fig 1.1: *3D-plane.wrl*
- Fig 1.2: *3D-plane-resolution.wrl*
- Fig 1.3: *3D-plane-domain.wrl*

For the 3D-plane (Fig 1.1):

- Parametric representation is defined as
  x = u,
  y = v,
  z = -u
- **u, v** is given a parameter domain **[0 1 0 1]**
- Sampling resolution is **[75 75]**

The rendering in Fig 1.1 was repeated with a sampling resolution of **[300 300]** to give Fig 1.2. With a higher resolution, the plane takes a longer time to render.

The rendering in Fig 1.1 was repeated with a parameter domain of **[0 2 0 2]** to give Fig 1.3. As such, the length of each side of the plane is twice as long.

(2) 3D-triangle

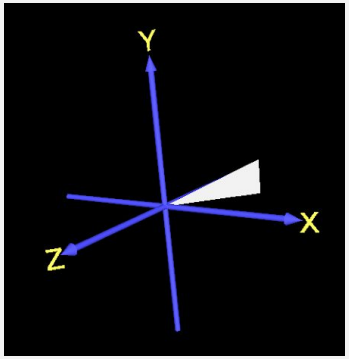

Fig 2.1

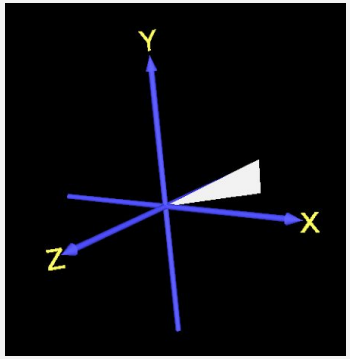

Fig 2.2

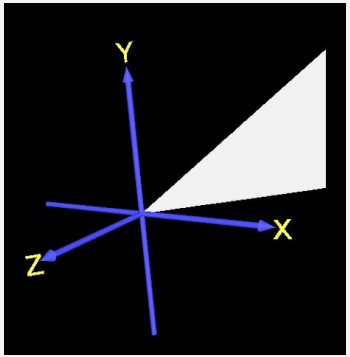

Fig 2.3

The files can be found in the directory **/3D-triangle**

- Fig 2.1: *3D-triangle.wrl*
- Fig 2.2: *3D-triangle-resolution.wrl*
- Fig 2.3: *3D-triangle-domain.wrl*

For the 3D-triangle (Fig 2.1):

- Parametric representation is defined as
  x = u,
  y = u*v,
  z = -u
- **u, v** is given a parameter domain **[0 0.5 0 0.5]**
- Sampling resolution is **[75 75]**

The rendering in Fig 2.1 was repeated with a sampling resolution of **[300 300]** to give Fig 2.2. With a higher resolution, the triangle takes a longer time to render.

The rendering in Fig 2.1 was repeated with a parameter domain of **[0 1 0 1]** to give Fig 2.3. Since the height of the triangle is defined as **u*v**, it will increase by 4 times from (1x1=1) to (2x2=4) while the base only increases by 2x. Thus, the shape of the triangle changes and is no longer similar to the original triangle (Fig 2.1)

(3) bilinear-surface

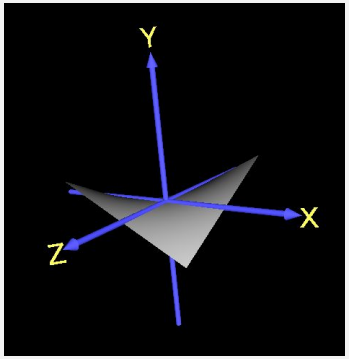

Fig 3.1

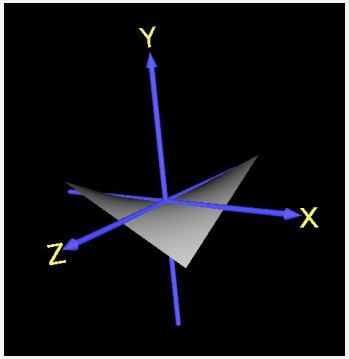

Fig 3.2

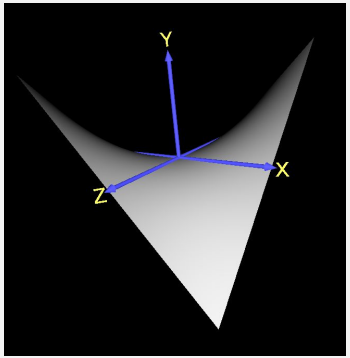

Fig 3.3

The files can be found in the directory ***/bilinear-surface***

- Fig 3.1: *bilinear-surface.wrl*
- Fig 3.2: *bilinear-surface-resolution.wrl*
- Fig 3.3: *bilinear-surface-domain.wrl*

For the bilinear surface (Fig 3.1):

- Parametric representation is defined as
  x = u,
  y = u*v,
  z = -v
- **u, v** is given a parameter domain **[-0.5 0.5 -0.5 0.5]**
- Sampling resolution is **[75 75]**

The rendering in Fig 3.1 was repeated with a sampling resolution of **[300 300]** to give Fig 3.2. With a higher resolution, the surface takes a longer time to render.

The rendering in Fig 3.1 was repeated with a parameter domain of **[-1 1 -1 1]** to give Fig 3.3.

(4) sphere

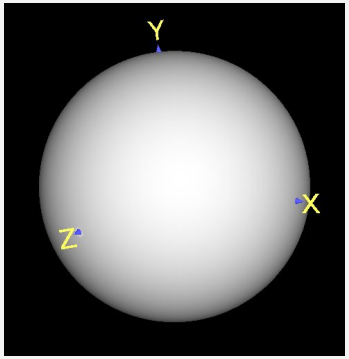

Fig 4.1

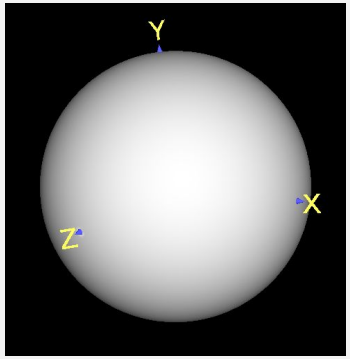

Fig 4.2

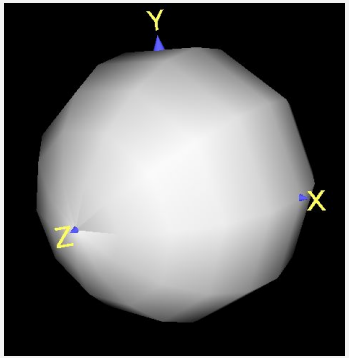

Fig 4.3

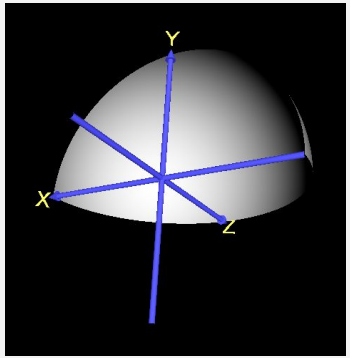

Fig 4.4

The files can be found in the directory ***/sphere***

- Fig 4.1: *sphere.wrl*
- Fig 4.2: *sphere-resolution-increase.wrl*
- Fig 4.3: *sphere-resolution-decrease.wrl*
- Fig 4.4: *sphere-domain.wrl*

For the sphere (Fig 4.1):

- Parametric representation is defined as
  x = cos(2*pi*u)*sin(pi*v),
  y = sin(2*pi*u)*sin(pi*v),
  z = cos(pi*v)
- **u, v** is given a parameter domain **[0 1 0 1]**
- Sampling resolution is **[75 75]**

The rendering in Fig 4.1 was repeated with a sampling resolution of **[300 300]** to give Fig 4.2. With a higher resolution, the surface takes a longer time to render. As curve surfaces are made of multiple flat surfaces joining together, the circle looks less curvy (Fig 4.3) with a lower resolution of **[10 10]**

The rendering in Fig 4.1 was repeated with a parameter domain of **[0 0.5 0 0.5]** to give Fig 4.4. Range of x, y, z are [-1, 1], [0, 1], and [0, 1] respectively. Thus, only a portion of the sphere is rendered.

(5) ellipsoid

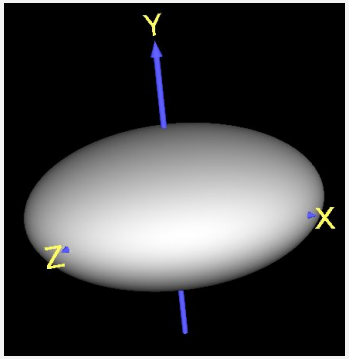

Fig 5.1

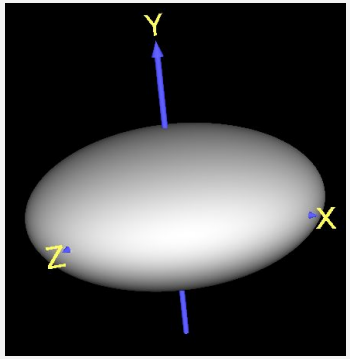

Fig 5.2

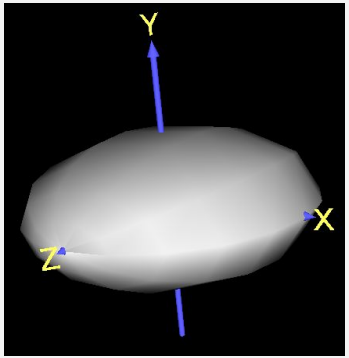

Fig 5.3

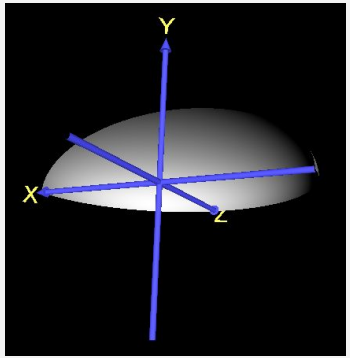

Fig 5.4

The files can be found in the directory ***/ellipsoid***

- Fig 5.1: *ellipsoid.wrl*
- Fig 5.2: *ellipsoid-resolution-increase.wrl*
- Fig 5.3: *ellipsoid-resolution-decrease.wrl*
- Fig 5.4: *ellipsoid-domain.wrl*

For the ellipsoid (Fig 5.1):

- Parametric representation is defined as
  x = cos(2*pi*u)*sin(pi*v),
  y = 0.5*sin(2*pi*u)*sin(pi*v),
  z = cos(pi*v)
- **u, v** is given a parameter domain **[0 1 0 1]**
- Sampling resolution is **[75 75]**

The rendering in Fig 5.1 was repeated with a sampling resolution of **[300 300]** to give Fig 5.2. With a higher resolution, the surface takes a longer time to render. As curve surfaces are made of multiple flat surfaces joining together, the circle looks less curvy (Fig 5.3) with a lower resolution of **[10 10]**

The rendering in Fig 5.1 was repeated with a parameter domain of **[0 0.5 0 0.5]** to give Fig 5.4. Range of x, y, z are [-1, 1], [0, 0.5], and [0, 1] respectively. Thus, only a portion of the ellipsoid is rendered.

(6) cone

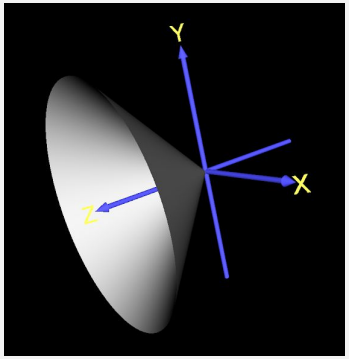

Fig 6.1

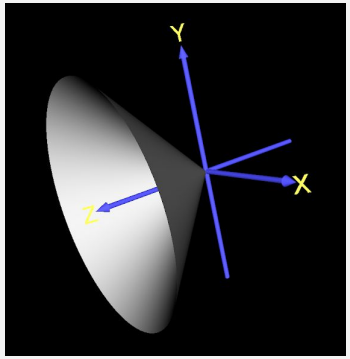

Fig 6.2

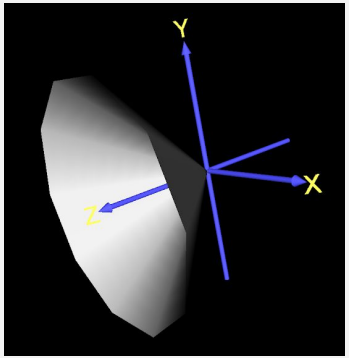

Fig 6.3

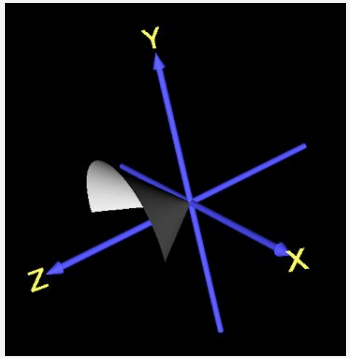

Fig 6.4

The files can be found in the directory **/cone**

- Fig 6.1: *cone.wrl*
- Fig 6.2: *cone-resolution-increase.wrl*
- Fig 6.3: *cone-resolution-decrease.wrl*
- Fig 6.4: *cone-domain.wrl*

For the cone (Fig 6.1):

- Parametric representation is defined as
  x = v*cos(2*pi*u),
  y = v*sin(2*pi*u),
  z = v
- **u, v** is given a parameter domain **[0 1 0 1]**
- Sampling resolution is **[75 75]**

The rendering in Fig 6.1 was repeated with a sampling resolution of **[300 300]** to give Fig 6.2. With a higher resolution, the surface takes a longer time to render. As curve surfaces are made of multiple flat surfaces joining together, the circle looks less curvy (Fig 6.3) with a lower resolution of **[10 10]**

The rendering in Fig 6.1 was repeated with a parameter domain of **[0 0.5 0 0.5]** to give Fig 6.4. Range of x, y, z are [-0.5, 0.5], [0, 0.5], and [0, 0.5] respectively. Thus, half the cone is rendered, and height of cone is halved.

(7) solid-box

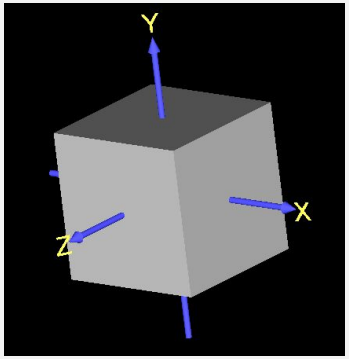

Fig 7.1

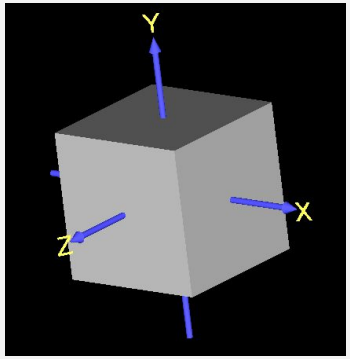

Fig 7.2

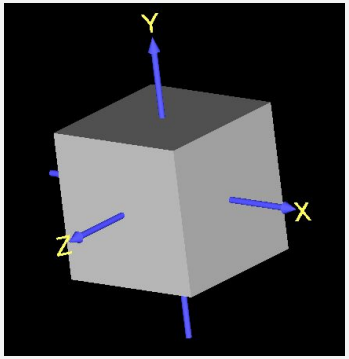

Fig 7.3

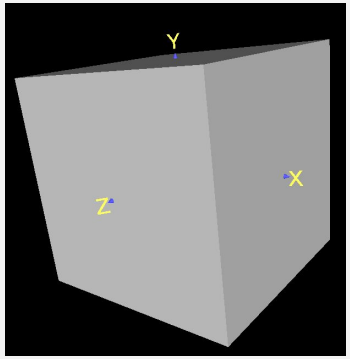

Fig 7.4

The files can be found in the directory ***/solid-box***

- Fig 7.1: *solid-box.wrl*
- Fig 7.2: *solid-box-resolution-increase.wrl*
- Fig 7.3: *solid-box-resolution-decrease.wrl*
- Fig 7.4: *solid-box-domain.wrl*

For the solid box (Fig 7.1):

- Parametric representation is defined as
  x = u,
  y = v,
  z = w
- **u, v, w** are all given a parameter domain **[-0.5 0.5]**
- Sampling resolution is **[75 75 75]**

The rendering in Fig 7.1 was repeated with a sampling resolution of **[300 300]** to give Fig 7.2. With a higher resolution, the surface takes a longer time to render. As the surfaces are all flat, the circle looks the same with a lower resolution of **[10 10]**

The rendering in Fig 7.1 was repeated with a parameter domain of **[-1 1 -1 1 -1 1]** to give Fig 7.4. Range of x, y, z are all [-1, 1] respectively. Thus, the length of the sides are all doubled.

(8) solid-sphere

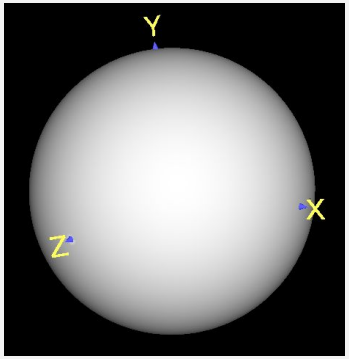

Fig 8.1

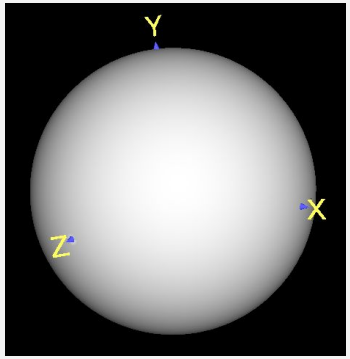

Fig 8.2

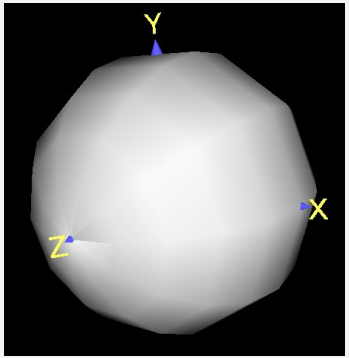

Fig 8.3

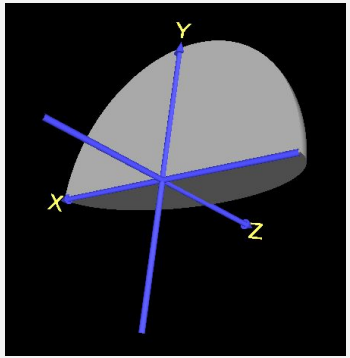

Fig 8.4

The files can be found in the directory ***/solid-sphere***

- Fig 8.1: *solid-sphere.wrl*
- Fig 8.2: *solid-sphere-resolution-increase.wrl*
- Fig 8.3: *solid-sphere-resolution-decrease.wrl*
- Fig 8.4: *solid-sphere-domain.wrl*

For the solid sphere (Fig 8.1):

- Parametric representation is defined as
  x = cos(2*pi*u)*sin(pi*v),
  y = sin(2*pi*u)*sin(pi*v),
  z = w*cos(pi*v)
- **u, v, w** are all given a parameter domain **[0 1]**
- Sampling resolution is **[75 75 75]**

The rendering in Fig 8.1 was repeated with a sampling resolution of **[300 300]** to give Fig 8.2. With a higher resolution, the surface takes a longer time to render. As curve surfaces are made of multiple flat surfaces joining together, the sphere looks less curvy (Fig 8.3) with a lower resolution of **[10 10]**

The rendering in Fig 8.1 was repeated with a parameter domain of **[0 0.5 0 0.5 0 0.5]** to give Fig 8.4. Range of x, y, z are [-1, 1], [0, 1], and [0, 1] respectively. Thus, only a portion of the sphere is rendered.

(9) solid-cylinder

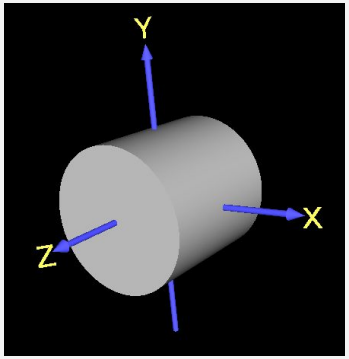

Fig 9.1

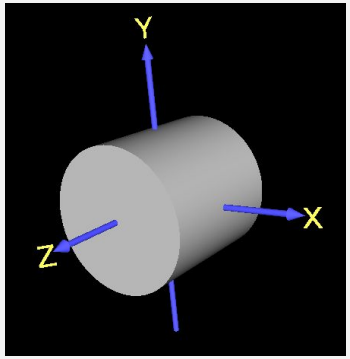

Fig 9.2

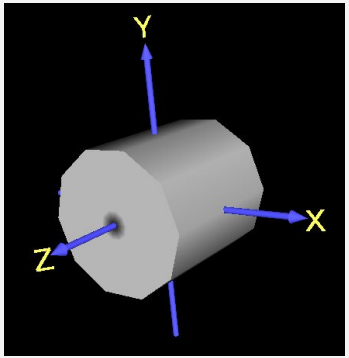

Fig 9.3

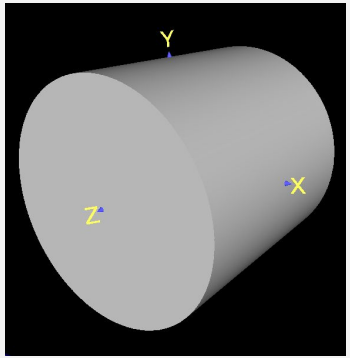

Fig 9.4

The files can be found in the directory ***/solid-cylinder***

- Fig 9.1: *solid-cylinder.wrl*
- Fig 9.2: *solid-cylinder-resolution-increase.wrl*
- Fig 9.3: *solid-cylinder-resolution-decrease.wrl*
- Fig 9.4: *solid-cylinder-domain.wrl*

For the solid cylinder (Fig 9.1):

- Parametric representation is defined as
  x = v*cos(2*pi*u)
  y = v*sin(2*pi*u)
  z = w
- **u, v, w** are all given a parameter domain **[-0.5 0.5]**
- Sampling resolution is **[75 75 75]**

The rendering in Fig 9.1 was repeated with a sampling resolution of **[300 300]** to give Fig 9.2. With a higher resolution, the surface takes a longer time to render. As curve surfaces are made of multiple flat surfaces joining together, the cylinder looks less curvy (Fig 9.3) with a lower resolution of **[10 10]**

The rendering in Fig 9.1 was repeated with a parameter domain of **[-1 1 -1 1 -1 1]** to give Fig 9.4. Range of x, y, z are all [-1, 1] respectively. Thus, the cylinder's radius and length are all doubled.

(10) solid-cone

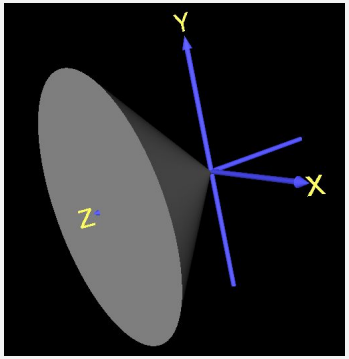

Fig 10.1

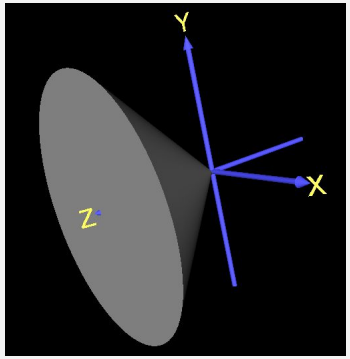

Fig 10.2

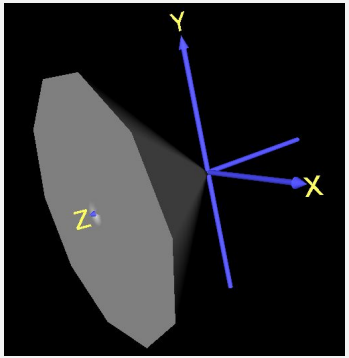

Fig 10.3

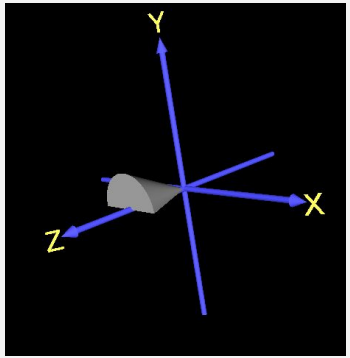

Fig 10.4

The files can be found in the directory ***/solid-cone***

- Fig 10.1: *solid-cone.wrl*
- Fig 10.2: *solid-cone-resolution-increase.wrl*
- Fig 10.3: *solid-cone-resolution-decrease.wrl*
- Fig 10.4: *solid-cone-domain.wrl*

For the solid cone (Fig 10.1):

- Parametric representation is defined as
  x = w*v*cos(2*pi*u)
  y = w*v*sin(2*pi*u)
  z = w
- **u, v, w** are all given a parameter domain **[0 1]**
- Sampling resolution is **[75 75 75]**

The rendering in Fig 10.1 was repeated with a sampling resolution of **[300 300]** to give Fig 10.2. With a higher resolution, the surface takes a longer time to render. As curve surfaces are made of multiple flat surfaces joining together, the cone looks less curvy (Fig 10.3) with a lower resolution of **[10 10]**

The rendering in Fig 10.1 was repeated with a parameter domain of **[0 0.5 0 0.5 0 0.5]** to give Fig 10.4. Range of x, y, z are [-0.25, 0.25], [0, 0.25], and [0, 0.5] respectively. Thus, half the cone is rendered, cone's radius (along x and y axis) is divided by 4 and cone's height (along z axis) is divided by 2.

(11a) sinx

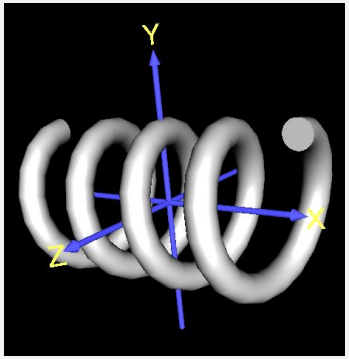

Fig 11.1

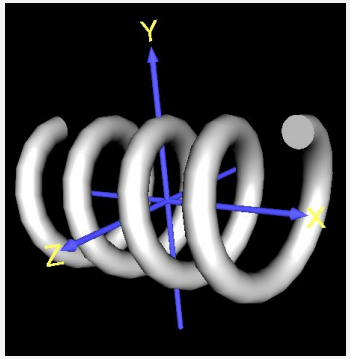

Fig 11.2

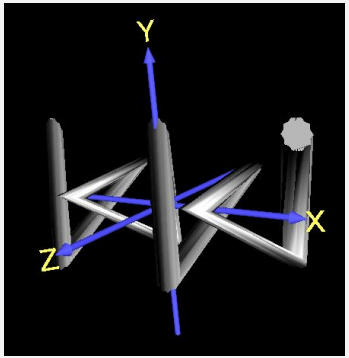

Fig 11.3

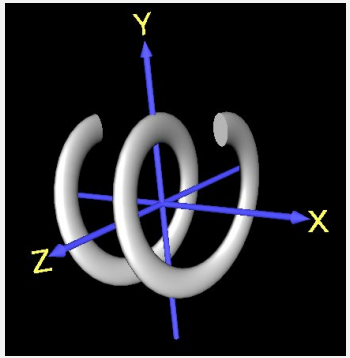

Fig 11.4

The files can be found in the directory ***/sinx***

- Fig 11.1: *sinx.wrl*
- Fig 11.2: *sinx-resolution-increase.wrl*
- Fig 11.3: *sinx-resolution-decrease.wrl*
- Fig 11.4: *sinx-domain.wrl*

For the spiral (Fig 11.1):

- Parametric representation is defined as

  x = (0.1*v*cos(2*pi*u)) + w
  0.1*v*cos(2*pi*u) is used to defined the circular shape of the end of the object. **w** is used to allow it to have a spiral looking shape along the x-axis

  y = (0.1*sin(2*pi*u) + 0.5) * cos(4*pi*w)
  z = (0.1*sin(2*pi*u) + 0.5) * sin(4*pi*w)
  0.1*sin(2*pi*u) is used to defined the circular shape of the end of the object. Adding **0.5** let the radius of the circle of 0.5 unit around the x-axis. As the object revolves around the x-axis in a counter-clockwise manner from y-axis to z-axis, y is multiplied by **cos(4*pi*w)** while z is multiplied by **sin(4*pi*w)**. 4*pi is used instead of 2*pi to make it revolves around x-axis twice.

- **u, v, w** are all given a parameter domain **[-1 1]**
- Sampling resolution is **[75 75 75**

(11b) sinx

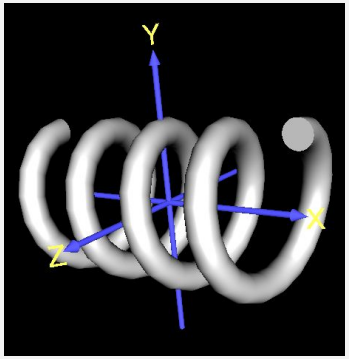

Fig 11.1

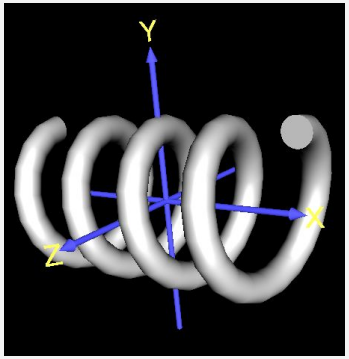

Fig 11.2

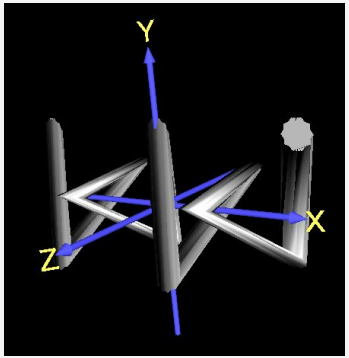

Fig 11.3

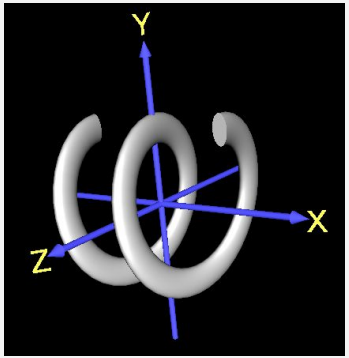

Fig 11.4

The rendering in Fig 11.1 was repeated with a sampling resolution of **[300 300 300]** to give Fig 11.2. With a higher resolution, the surface takes a longer time to render. However, as curve surfaces are made of multiple flat surfaces and polygons joining together, the object looks more curvy.

On the other hand, with a sampling resolution of **[10 10 10]**, the object appears more distorted and sharp (Fig 11.3). This is because object 10 samples are taken for w , thus resulting in 10 sharp turns on the object, as it moves through the x-axis. In addition, the end of the object is no longer circular because 10 samples of u are taken.

The rendering in Fig 11.1 was repeated with a parameter domain of **[-0.5 0.5 -0.5 0.5 -0.5 0.5]** to give Fig 11.4. Referring to it's parametric representation, the end of the spiral object is no longer round but ellipse-shaped as v is halved. Also, the number of oscillation on each side of the x-axis is also halved as the range of w is halved.