Lab 2

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Parametric Curves

(1) straight-line

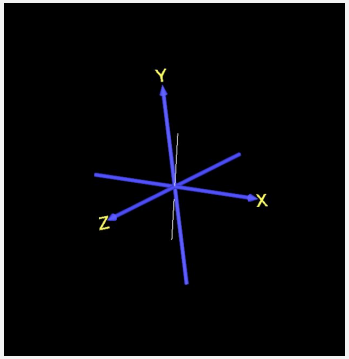

Fig 1.1

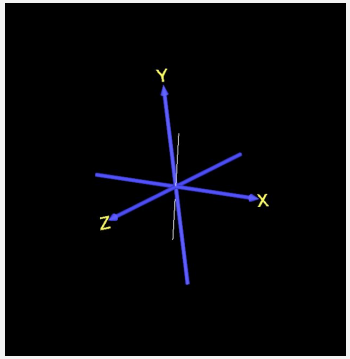

Fig 1.2

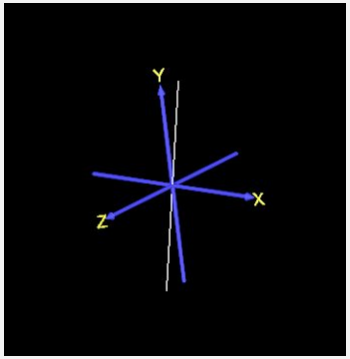

Fig 1.3

The files can be found in the directory ***/straight-line***

- Fig 1.1: *straight-line.wrl*
- Fig 1.2: *straight-line-resolution.wrl*
- Fig 1.3: *straight-line-domain.wrl*

For the straight line (Fig 1.1):

- Parametric representation is defined as
  x = u,
  y = u,
  z = u
- **u** is given a parameter domain **[-1, 1]**
- Sampling resolution is **100**

As it is a straight line, changing the sampling resolution will not affect its appearance, as shown by a sampling resolution of **2** in Fig 1.2.

From Fig 1.1, the parameter domain is increased to **[-2, 2]** in Fig 1.3, and the line elongated. This is because the end points of the line changes from **[(-1,-1,-1), (1,1,1)]** to **[(-2,-2,-2), (2,2,2)]**

(2a) circle

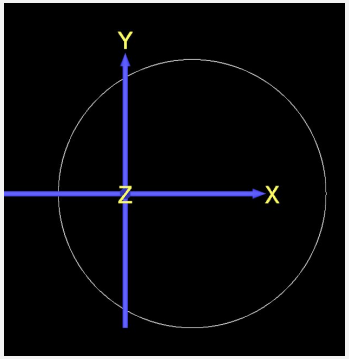

Fig 2.1

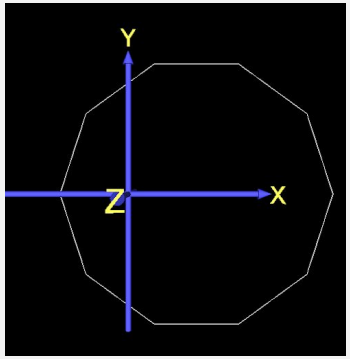

Fig 2.2

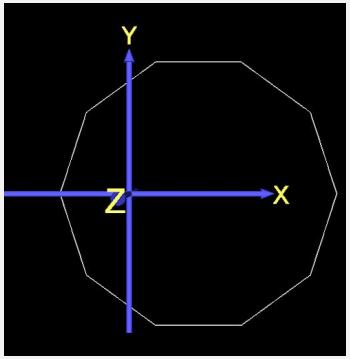

Fig 2.3

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

- Fig 2.1: *circle.wrl*
- Fig 2.2: *circle-resolution.wrl*
- Fig 2.3: *circle-domain.wrl*

For the circle (Fig 2.1):

- Parametric representation is defined as
  x = (cos(2*pi*u))+0.5,
  y = (sin(2*pi*u)),
  z = 0
- **u** is given a parameter domain **[0, 1]**
- Sampling resolution is **100**

As we can see, the circle is positioned to the right due to the **+0.5** in x

As a circle (and other curves) are made up of multiple straight lines joining together different points that are defined by the formula, the lower the sampling rate, the less curvy it will appear. When sampling rate in Fig 2.1 is changed from **100** to **10**, it shows a decagon (Fig 2.2)

From Fig 2.1, if the parameter domain is multiplied 10x to **[0, 10],** it will have the same effect as sampling rate dividing by 10x. Thus, the shape will looks like a decagon (Fig 2.3) instead of a circle. When domain drop below **[0, 1]**, it will become an arc instead (refer to 2b)

(2b) circle-arc

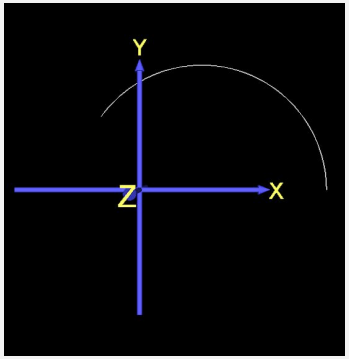

Fig 2.4

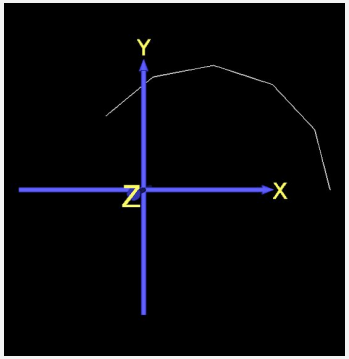

Fig 2.5

The files can be found in the directory **/circle-arc**

- Fig 2.4: *circle-arc.wrl*
- Fig 2.5: *circle-arc-resolution.wrl*

For the circle arc (Fig 2.4), the same parametric representation and sampling resolution is used as the circle (Fig 2.1). However,

- **u** is given a parameter domain **[0, 0.4]**

The sampling resolution has also been changed from **100** to **5** to give Fig 2.5. The explanation as to why it appears less curvy is the same as that in 2a.

(3a) ellipse

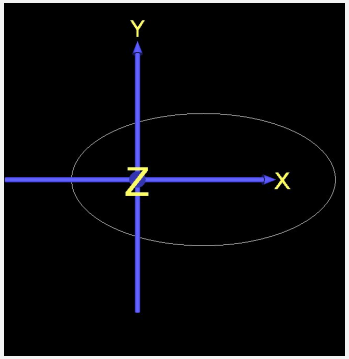

Fig 3.1

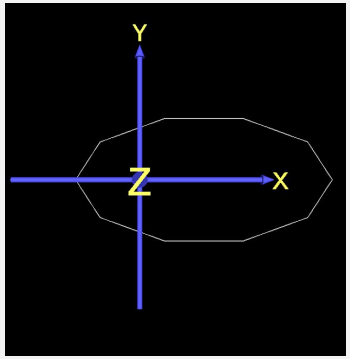

Fig 3.2

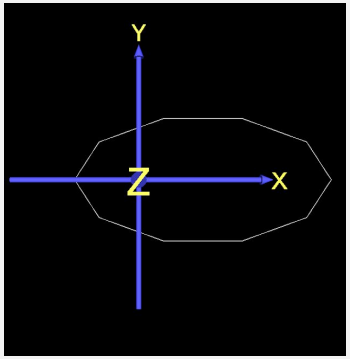

Fig 3.3

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

- Fig 3.1: *ellipse.wrl*
- Fig 3.2: *ellipse-resolution.wrl*
- Fig 3.3: *ellipse-domain.wrl*

For the ellipse (Fig 3.1):

- Parametric representation is defined as
  x = (cos(2*pi*u))+0.5,
  y = 0.5*(sin(2*pi*u)),
  z = 0
- **u** is given a parameter domain **[0, 1]**
- Sampling resolution is **100**

As we can see, the ellipse is positioned to the right due to the **+0.5** in x. It is also appears to be shorter vertically due to y being multiplied by **0.5**.

The sampling resolution has also been changed from **100** to **10** to give Fig 3.2. The explanation as to why it appears less curvy is the same as that in 2a.

From Fig 2.1, if the parameter domain is multiplied 10x to **[0, 10],** it will have the same effect as sampling rate dividing by 10x. Thus, the shape will looks like a decagon (Fig 3.3) instead of a ellipse. When domain drop below **[0, 1]**, it will become an arc instead (refer to 3b)

(3b) ellipse-arc

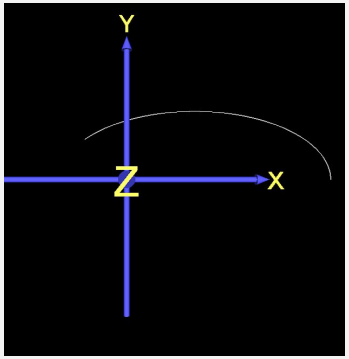

Fig 3.4

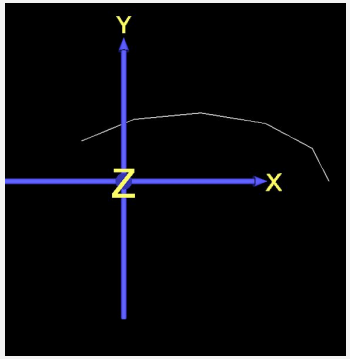

Fig 3.5

The files can be found in the directory **/ellipse-arc**

- Fig 3.4: *ellipse-arc.wrl*
- Fig 3.5: *ellipse-arc-resolution.wrl*

For the ellipse arc (Fig 3.4), the same parametric representation and sampling resolution is used as the ellipse (Fig 3.1). However,

- **u** is given a parameter domain **[0, 0.4]**

The sampling resolution has also been changed from **100** to **5** to give Fig 3.5. The explanation as to why it appears less curvy is the same as that in 2a.

(4) 2D-spiral

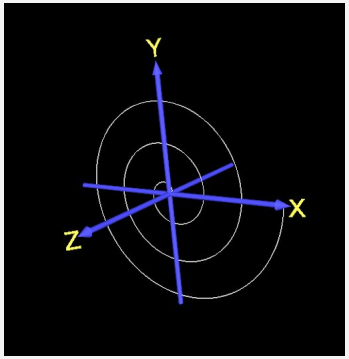

Fig 4.1

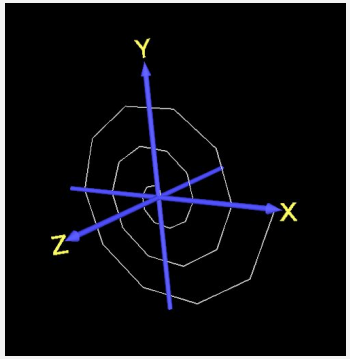

Fig 4.2

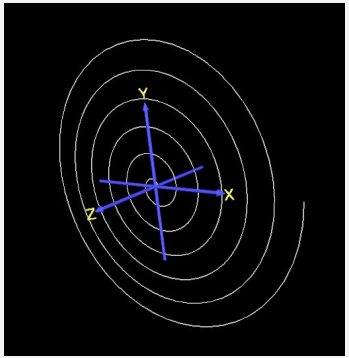

Fig 4.3

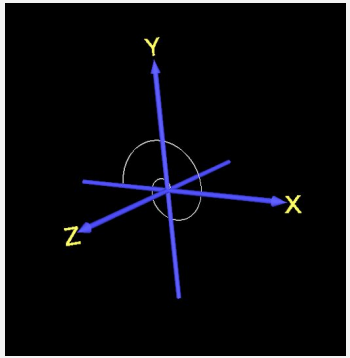

Fig 4.4

The files can be found in the directory ***/2D-spiral***

- Fig 4.1: *2D-spiral.wrl*
- Fig 4.2: *2D-spiral-resolution.wrl*
- Fig 4.3: *2D-spiral-domain-elongated.wrl*
- Fig 4.4: *2D-spiral-domain-shortened.wrl*

For the 2D spiral (Fig 4.1):

- Parametric representation is defined as
  x = u*(cos(6*pi*u)),
  y = u*(sin(6*pi*u)),
  z = 0
- **u** is given a parameter domain **[0, 1]**
- Sampling resolution is **300**

As **(6*pi*u)** is being used with the domain of **[0, 1]**, the maximum value for x is **-cos(6*pi)**, which explains why the spiral forms 3 complete oscillation.

The sampling resolution has also been changed from **300** to **30** to give Fig 12. The explanation as to why it appears less curvy is the same as that in 2a.

From Fig 4.1, a parameter domain of **[0, 2]** & **[0, 0.5]** are used to produce Fig 4.3 and Fig 4.4 respectively. Having twice / halve the maximum value for u means that the number of oscillation made are doubled / halved respectively.

(5) 3D-helix

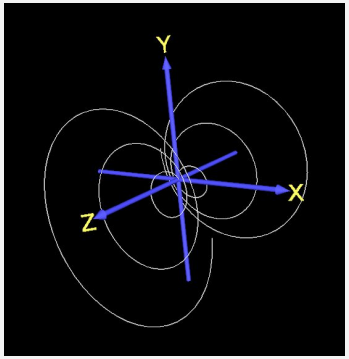

Fig 5.1

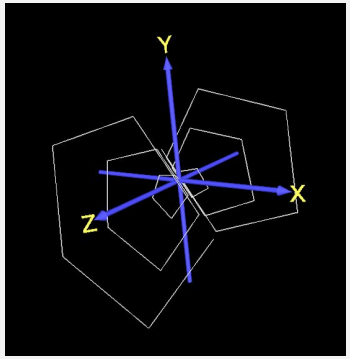

Fig 5.2

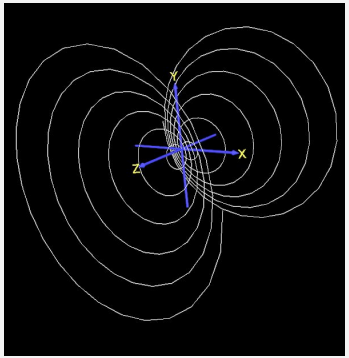

Fig 5.3

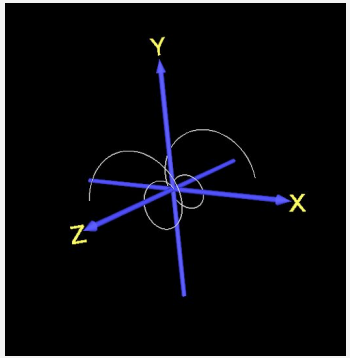

Fig 5.4

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

- Fig 5.1: *3D-helix.wrl*
- Fig 5.2: *3D-helix-resolution.wrl*
- Fig 5.3: *3D-helix-domain-elongated.wrl*
- Fig 5.4: *3D-helix-domain-shortened.wrl*

For the 3D helix (Fig 5.1):

- Parametric representation is defined as
  x = u*(cos(6*pi*u)),
  y = u*(sin(6*pi*u)),
  z = u
- **u** is given a parameter domain **[-1, 1]**
- Sampling resolution is **300**

As the domain of **[-1, 1]** is used, the spiral goes both ways along the z-axis as z = u. Similarly to the 2D-spiral, the formula and domain resulted in 3 complete oscillations.

The sampling resolution has also been changed from **300** to **30** to give Fig 5.2. The explanation as to why it appears less curvy is the same as that in 2a.

From Fig 5.1, a parameter domain of **[-2, 2]** & **[-0.5, 0.5]** are used to produce Fig 5.3 and Fig 5.4 respectively. Having twice / halve the maximum value for u means that the number of oscillation made are doubled / halved respectively.