

|  |
| --- |
| Lab 2 Report:  Parametric Curves |
| CZ2003 – Computer Graphics & Visualization  Wilson Thurman Teng U1820540H Lab Group: SSR2 |

Contents

[**Lab 2** 3](#_Toc24204023)

[2.1 Lines/Curves to be Drawn 3](#_Toc24204024)

[**Straight Line Segment** 3](#_Toc24204025)

[**Circles and its arc** 6](#_Toc24204026)

[**Ellipse and its arc** 9](#_Toc24204027)

[**2D Spiral** 11](#_Toc24204028)

[**3D Helix** 14](#_Toc24204029)

[**2.2** Parametric Representation of **y=sin(x)** 16](#_Toc24204030)

[**2.3** Changing the Sampling Resolution of sin curve 16](#_Toc24204031)

[**2.4** Changing the Domain parameter of sin curve 18](#_Toc24204032)

# **Lab 2**

## Lines/Curves to be Drawn

Changes from previous examples are in bold to show the resultant change when a parameter is adjusted.

|  |  |
| --- | --- |
| **Straight Line Segment** | **Remarks** |
| **line1.wrl** | Straight line defined by parametric equations  [x=u, y=u, z=0] with domain [0,1].  Sampling resolution is 100. |
| **line2.wrl** | Straight line defined by parametric equations  [x=u, y=u, z=0] with **domain [0,2]**.  Sampling resolution is 100.  **Note:**  The length of the straight line is now twice the original due to the domain change from [0,1] to [0,2]. |
| **line3.wrl** | Straight line defined by parametric equations  [x=u, y=u, z=0] with **domain [-1,1]**.  Sampling resolution is 100.  **Note:**  It is also possible to have a negative domain. Since the domain of the straight line extended from [0,1] to [-1,1]. The line will extend in the negative x direction by its original length. |
| **line4.wrl** | Straight line defined by parametric equations  [x=u, y=u, z=0] with domain [-1,1].  **Sampling resolution is 2.**  **Note:**  Although sampling resolution is 2, there is no difference between this line and **line3.wrl**. This is because the lesser number of points sampled across the line does not affect a straight-line segment. |

|  |  |
| --- | --- |
| **Circles and its arc** | **Remarks** |
| **circle1.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=sin(u\*2\*Pi), z=0],  with domain [0,1].  Sampling resolution is 5000. |
| **circle2.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=sin(u\*2\*Pi), z=0],  with **domain [0,2]**.  Sampling resolution is 5000.  **Note:**  There seems to be no change to the circle even though the domain is increased from [0,1] to [0,2]. However, the circle here is rendered twice. |
| **circle3.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=sin(u\*2\*Pi), z=0],  with **domain [0,0.6].**  Sampling resolution is 5000.  **Note:**  As observed, the curve starts from the x-axis and continues anti-clockwise to form 0.6 of a circle as the domain is [0,0.6]. |
| **circle4.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=sin(u\*2\*Pi), z=0],  with **domain [-0.6,0].**  Sampling resolution is 5000.  **Note:**  Since the domain is [-0.6,0], the starts from the -0.6 part of the arc and turns clockwise until it reaches the x-axis. |
| **circle5.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=sin(u\*2\*Pi), z=0],  with domain [0,1].  **Sampling resolution is 4**.  **Note:**  As observed, since the sampling resolution is 4, only 4 points are sampled starting from (1,0,0) and turning anti-clockwise to (0,1,0) and so on, to form a square/diamond. |
| **circle6.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=sin(u\*2\*Pi), z=0],  with domain [0,1].  **Sampling resolution is 8**.  **Note:**  As observed, since the sampling resolution is 8, only 8 points are sampled, and when those 8 points are linked up together using straight lines, an octagon is formed. |

|  |  |
| --- | --- |
| **Ellipse and its arc** | **Remarks** |
| **ellipse1.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=0.3\*sin(u\*2\*Pi), z=0],  with domain [0,1].  Sampling resolution is 5000. |
| **ellipse2.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=0.3\*sin(u\*2\*Pi), z=0],  with **domain [0,0.75]**.  Sampling resolution is 5000.  **Note:**  The arc starts from (1,0) and turns anti-clockwise to form 0.75 of an ellipse. |
| **ellipse3.wrl** | Straight line defined by parametric equations  [x=cos(u\*2\*Pi), y=0.3\*sin(u\*2\*Pi), z=0],  with domain [0,0.75].  **Sampling resolution is 3**.  **Note:**  Since sampling resolution is 3, 3 points beside the starting point (1,0) is sampled, therefore forming 0.75 of a diamond. |

|  |  |
| --- | --- |
| **2D Spiral** | **Remarks** |
| **2D\_spiral1.wrl** | Straight line defined by parametric equations  [x=u\*cos(u\*2\*Pi), y=u\*sin(u\*2\*Pi), z=0],  with domain [0,1].  Sampling resolution is 100. |
| **2D\_spiral2.wrl** | Straight line defined by parametric equations  [x=u\*cos(u\*2\*Pi), y=u\*sin(u\*2\*Pi), z=0],  with **domain [0,2]**.  Sampling resolution is 100.  **Note:**  Since domain increase from [0,1] to [0,2], the number of rotations increased, resulting in a longer arc. |
| **2D\_spiral3.wrl** | Straight line defined by parametric equations  [x=u\*cos(u\*2\*Pi) **- Pi/4**, y=u\*sin(u\*2\*Pi) **- Pi/4**, z=0],  with domain [0,2].  Sampling resolution is 100.  **Note:**  By using an offset of **-Pi/4** in the cos and sin functions, the curve was rotated by pi/4 in the **clockwise** direction. |
| **2D\_spiral4.wrl** | Straight line defined by parametric equations  [x=u\*cos(u\*2\*Pi) **+ Pi/4**, y=u\*sin(u\*2\*Pi) **+ Pi/4**, z=0],  with domain [0,2].  Sampling resolution is 100.  **Note:**  On the other hand, by using an offset of **Pi/4** in the cos and sin functions, the curve was rotated by pi/4 in the **anti-clockwise** direction. |
| **2D\_spiral5.wrl** | Straight line defined by parametric equations  [x=u\*cos(u\***4**\*Pi) + Pi/4, y=u\*sin(u\***4**\*Pi) + Pi/4, z=0],  with domain [0,2].  Sampling resolution is 100.  **Note:**  The number of rotations can also be increased by increasing the angle, in the case, from 2\*Pi to 4\*Pi.  However, due to the elongation, the spiral appears to have distinct points where straight lines are joined together to form the spiral. This can be mitigated by having a higher resolution. Therefore, whenever there is an elongation, either through the increase in domain or an increase in angle, the resolution should also be increased accordingly to generate a smooth curve. |
| **2D\_spiral6.wrl** | Straight line defined by parametric equations  [x=cos(u\*4\*Pi) + Pi/4, y=0.3\*sin(u\*4\*Pi) + Pi/4, z=0],  with domain [0,1].  **Sampling resolution is 20**.  **Note:**  To further illustrate the effect of a low sampling rate resulting from a low resolution, the resolution is further decreased to 20.  As observed, the distinct points are obvious and straight lines and drawn between those points to from the “curve”. |

|  |  |
| --- | --- |
| **3D Helix** | **Remarks** |
| **3D\_helix1.wrl** | Straight line defined by parametric equations  [x= cos(u\*4\*2\*Pi), y= sin(u\*4\*2\*Pi), z= u],  with domain [0,1].  Sampling resolution is 100.  **Note:**  By initializing the z parametric as u, the 2D circle is made into a 3D helix. |
| **3D\_helix2.wrl** | Straight line defined by parametric equations  [x= **u\***cos(u\*4\*2\*Pi), y= **u\***sin(u\*4\*2\*Pi), z= u],  with domain [0,1].  Sampling resolution is 100.  **Note:**  By multiplying the x and y parametric equations by u, a spiral which grows from origin (0,0) is created as domain u increases from 0 to 1. |
| **3D\_helix3.wrl** | Straight line defined by parametric equations  [x= u\*cos(u\*4\*2\*Pi), y= u\*sin(u\*4\*2\*Pi) **+ u**, z= u],  with domain [0,1].  Sampling resolution is 100. |

## Parametric Representation of **y=sin(x)**

|  |  |
| --- | --- |
| **sin\_curve1\_parametric\_representation.wrl** | Straight line defined by parametric equations  [x= u, y= u\*sin(u\*2\*Pi), z= 0],  with domain [0,1].  Sampling resolution is 100.  **Note:**  With a sampling resolution of 100, 100 other points are sampled besides the starting point at origin (0,0). Therefore, the curve looks smooth. |

## Changing the Sampling Resolution of sin curve

|  |  |
| --- | --- |
| **sin\_curve2\_parametric\_representation.wrl** | Straight line defined by parametric equations  [x= u, y= u\*sin(u\*2\*Pi), z= 0],  with domain [0,1].  **Sampling resolution is 6.**  **Note:**  With a sampling resolution of 6, only 6 other points are sampled besides the starting point at origin (0,0). The “curve” does not look smooth at all. |
| **sin\_curve3\_parametric\_representation.wrl** | Straight line defined by parametric equations  [x= u, y= u\*sin(u\*2\*Pi), z= 0],  with domain [0,1].  **Sampling resolution is 3.**  **Note:**  With a sampling resolution of 3, only 3 other points are sampled besides the starting point at origin (0,0). The “curve” looks pointy as straight lines are drawn to connect the 3 points. |
| **sin\_curve4\_parametric\_representation.wrl** | Straight line defined by parametric equations  [x= u, y= u\*sin(u\*2\*Pi), z= 0],  with domain [0,1].  **Sampling resolution is 2.**  **Note:**  When the sampling resolution is 2, no curve is observed. This is due to only 2 points being sampled (*as illustrated on the left*), which results in a straight-line y=0, along the x-axis.  Therefore, it can be concluded that when drawing curves, a sampling resolution of 2 is strongly discouraged unless it is for a specific purpose. |

## Changing the Domain parameter of sin curve

|  |  |
| --- | --- |
| **sin\_curve5\_parametric\_representation.wrl** | Straight line defined by parametric equations  [x= u, y= u\*sin(u\*2\*Pi), z= 0],  with **domain [0,0.5].**  Sampling resolution is 1000.  **Note:**  By decreasing the domain from [0,1] to [0,0.5], the curve is shortened to half of the original curve. |
| **sin\_curve6\_parametric\_representation.wrl** | Straight line defined by parametric equations  [x= u, y= u\*sin(u\*2\*Pi), z= 0],  with **domain [0,2]**.  Sampling resolution is 1000.  **Note:**  By increasing the domain from [0,1] to [0,2], the curve Is elongated and appears as 2 cycles of itself. |