Nanyang Technological University

Lab 2 Report:

CZ2003 Computer Graphics and Visualization

Parametric Curves

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**Parametric Curves (Experiment on Resolution)**

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| **Curve 1** | **Curve 2** | **Notes** |
|  |  | The resolution can be set to minimum value of 1 and the result will not change. This is because we requires one straight line to create another line.  If the resolution’s value is 0, the straight line disappears. |
| File: straight line 1.wrl  The parametric equation for straight line segment.  x: u  y: u  z: 0  parameters [0 1]  resolution [100] | File: straight line 2.wrl  The parametric equation for straight line segment.  x: u  y: u  z: 0  parameters [0 1]  resolution [10] |
|  |  | The circle will be more accurate and smoother if the resolution is high. This is because points are joined by straight lines which is defined in the formula. When resolution’s value goes down to 2, the straight line will be created directly on x-axis. |
| File: circle 1.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 1]  resolution [100] | File: circle 2.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 1]  resolution [10] |
|  |  | With only 1 sample, it will be straight line. Hence, the higher the resolution, the more smooth the curve is.  Refer: circle 2 - 1 arc.wrl |
| File: circle 1 – arc.wrl  The parametric equation for circle’s arc.  x: cos(0.5\*pi\*u)  y: sin(0.5\*pi\*u)  z = 0  parameters [0 1]  resolution [100] | File: circle 2 – arc.wrl  The parametric equation for circle’s arc.  x: cos(0.5\*pi\*u)  y: sin(0.5\*pi\*u)  z = 0  parameters [0 1]  resolution [2] |
|  |  | To obtain an ellipse, we used the circle’s formula and added a coefficient to any of the axes. Apply coefficient to both axes will give us a circle.  If the resolution is 2, it will be a straight line lying on x-axis, thus we need to add +2 to x equation in order for us to view it. |
| File: ellipse 1.wrl  The parametric equation for ellipse.  x: cos(2\*pi\*u)  y: 0.5\*sin(2\*pi\*u)  z = 0  parameters [0 1]  resolution [100] | File: ellipse 2.wrl  The parametric equation for ellipse.  x: cos(2\*pi\*u)  y: 0.5\*sin(2\*pi\*u)  z = 0  parameters [0 1]  resolution [3] |
|  |  | With only 1 sample, it will be straight line. Hence, the higher the resolution, the more smooth the curve is  Refer: circle 2 – 1 arc.wrl |
| File: ellipse 1 – arc.wrl  The parametric equation for ellipse.  x: cos(0.5\*pi\*u)  y: 0.5\*sin(0.5\*pi\*u)  z = 0  parameters [0 1]  resolution [100] | File: ellipse 2 – arc.wrl  The parametric equation for ellipse.  x: cos(0.5\*pi\*u)  y: 0.5\*sin(0.5\*pi\*u)  z = 0  parameters [0 1]  resolution [3] |
|  |  | The number of resolution is equivalent to the number of straight lines drawn on the x-axis and y-axis. |
| File: 2D spiral 1.wrl  The parametric equation for 2D spiral.  x: u\*cos(4\*pi\*u)  y: u\*sin(4\*pi\*u)  z = 0  parameters [0 1]  resolution [100] | File: 2D spiral 2.wrl  The parametric equation for 2D spiral.  x: u\*cos(4\*pi\*u)  y: u\*sin(4\*pi\*u)  z = 0  parameters [0 1]  resolution [3] |
|  |  | The number of resolution is equivalent to the number of straight lines drawn on the x-axis and y-axis. When z = u, it will create straight lines on x-axis and z- axis. |
| File: 3D Helix 1.wrl  The parametric equation for 3D helix.  x: cos(4\*pi\*u)  y: sin(4\*pi\*u)  z = u  parameters [0 1]  resolution [100] | File: 3D Helix 2.wrl  The parametric equation for 3D helix.  x: cos(4\*pi\*u)  y: sin(4\*pi\*u)  z = u  parameters [0 1]  resolution [3] |

**Parametric Curves (Experiment on Parameter Domain)**

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| **Curve 1** | **Curve 2** | **Notes** |
|  |  | The parameter domain affects the length of the straight line where parameters [a b], a = starting point and b = ending point. |
| File: straight line 1 PD.wrl  The parametric equation for straight line segment.  x: u  y: u  z: 0  parameters [0 2]  resolution [100] | File: straight line 2 PD.wrl  The parametric equation for straight line segment.  x: u  y: u  z: 0  parameters [0 2]  resolution [10] |
|  |  |
| File: straight line 1 PD - 1.wrl  The parametric equation for straight line segment.  x: u  y: u  z: 0  parameters [1 2]  resolution [100] | File: straight line 2 PD - 1.wrl  The parametric equation for straight line segment.  x: u  y: u  z: 0  parameters [-1 2]  resolution [10] |
|  |  | The circle will be more accurate and smoother if the resolution is high. This is because points are joined by straight lines which is defined in the formula.  As mentioned above, resolution will determine the accurate and smoothness of the circle. If we increased the parameter, then we are supposed to increase the resolution. From circle 1 PD -2.wrl, in order to make it smoother, the higher resolution is needed.  Refer: circle 1 PD - 2 – 1.wrl |
| File: circle 1 PD.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 3]  resolution [100] | File: circle 2 PD.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 3]  resolution [10] |
|  |  |
| File: circle 1 PD - 1.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 10]  resolution [100] | File: circle 2 PD - 1.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 10]  resolution [10] |
|  |  |
| File: circle 1 PD - 2.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 15]  resolution [100] | File: circle 2 PD - 2.wrl  The parametric equation for circle.  x: cos(2\*pi\*u)  y: sin(2\*pi\*u)  z: 0  parameters [0 8]  resolution [10] |
|  |  | The parameter u is drawing the circle. For example 0.5\*4\*pi = 2pi. A full circle is 2pi. |
| File: circle 1 – arc PD 1.wrl  The parametric equation for circle’s arc.  x: cos(0.5\*pi\*u)  y: sin(0.5\*pi\*u)  z = 0  parameters [0 3]  resolution [100] | File: circle 2 – arc PD 1.wrl  The parametric equation for circle’s arc.  x: cos(0.5\*pi\*u)  y: sin(0.5\*pi\*u)  z = 0  parameters [0 3]  resolution [2] |
|  |  |
| File: circle 1 – arc PD 2.wrl  The parametric equation for circle’s arc.  x: cos(0.5\*pi\*u)  y: sin(0.5\*pi\*u)  z = 0  parameters [0 4]  resolution [100] | File: circle 2 – arc PD 2.wrl  The parametric equation for circle’s arc.  x: cos(0.5\*pi\*u)  y: sin(0.5\*pi\*u)  z = 0  parameters [0 2]  resolution [2] |
|  |  | When the parameter domain is increased, it will elongate the number of rotation. However, we need higher sampling resolution to generate a smooth curve. |
| File: ellipse 1 PD.wrl  The parametric equation for ellipse.  x: cos(2\*pi\*u)  y: 0.5\*sin(2\*pi\*u)  z = 0  parameters [0 10]  resolution [100] | File: ellipse 2 PD.wrl  The parametric equation for ellipse.  x: cos(2\*pi\*u)  y: 0.5\*sin(2\*pi\*u)  z = 0  parameters [0 2]  resolution [3] |
|  |  |
| File: ellipse 1 PD 1.wrl  The parametric equation for ellipse.  x: cos(2\*pi\*u)  y: 0.5\*sin(2\*pi\*u)  z = 0  parameters [0 15]  resolution [100] | File: ellipse 1 PD 2.wrl  The parametric equation for ellipse.  x: cos(2\*pi\*u)  y: 0.5\*sin(2\*pi\*u)  z = 0  parameters [0 20]  resolution [100] |
|  |  | Same explanation as circle 1 - arc PD section. |
| File: ellipse 1 – arc PD.wrl  The parametric equation for ellipse.  x: cos(0.5\*pi\*u)  y: 0.5\*sin(0.5\*pi\*u)  z = 0  parameters [0 3]  resolution [100] | File: ellipse 2 – arc PD.wrl  The parametric equation for ellipse.  x: cos(0.5\*pi\*u)  y: 0.5\*sin(0.5\*pi\*u)  z = 0  parameters [0 3]  resolution [3] |
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| File: ellipse 2 – arc PD 1.wrl  The parametric equation for ellipse.  x: cos(0.5\*pi\*u)  y: 0.5\*sin(0.5\*pi\*u)  z = 0  parameters [0 2]  resolution [3] | File: ellipse 2 – arc PD 2.wrl  The parametric equation for ellipse.  x: cos(0.5\*pi\*u)  y: 0.5\*sin(0.5\*pi\*u)  z = 0  parameters [0 4]  resolution [3] |
|  |  | When the parameter domain is increased, it will elongate the number of rotation. However, we need higher sampling resolution to generate a smooth curve. |
| File: 2D spiral 1 PD.wrl  The parametric equation for 2D spiral.  x: u\*cos(4\*pi\*u)  y: u\*sin(4\*pi\*u)  z = 0  parameters [0 3]  resolution [100] | File: 2D spiral 2 PD.wrl  The parametric equation for 2D spiral.  x: u\*cos(4\*pi\*u)  y: u\*sin(4\*pi\*u)  z = 0  parameters [0 3]  resolution [3] |
|  |  |
| File: 2D spiral 1 PD 1.wrl  The parametric equation for 2D spiral.  x: u\*cos(4\*pi\*u)  y: u\*sin(4\*pi\*u)  z = 0  parameters [1 3]  resolution [100] | File: 2D spiral 2 PD .wrl  The parametric equation for 2D spiral.  x: u\*cos(4\*pi\*u)  y: u\*sin(4\*pi\*u)  z = 0  parameters [0 2]  resolution [3] |
|  |  | The higher the parameter, the more rotation it goes. However the shape is getting closer to straight lines. |
| File: 3D Helix 1 PD.wrl  The parametric equation for 3D helix.  x: cos(4\*pi\*u)  y: sin(4\*pi\*u)  z = u  parameters [0 3]  resolution [100] | File: 3D Helix 2 PD.wrl  The parametric equation for 3D helix.  x: cos(4\*pi\*u)  y: sin(4\*pi\*u)  z = u  parameters [0 2]  resolution [3] |
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| File: 3D Helix 1 PD 1.wrl  The parametric equation for 3D helix.  x: cos(4\*pi\*u)  y: sin(4\*pi\*u)  z = u  parameters [-1 10]  resolution [100] | File: 3D Helix 2 PD 1.wrl  The parametric equation for 3D helix.  x: cos(4\*pi\*u)  y: sin(4\*pi\*u)  z = u  parameters [0 3]  resolution [3] |

**Convert explicitly defined curve y = sin(x) to parametric**

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|  | x = 2\*u;  y = sin(u\*10);  z = 0;  parameters [0 1]  resolution [100]  Refer: 3 - 0.wrl |
|  | x = (0.75+0.25\*sin(20\*pi\*u))\*cos(pi\*u);  y = (0.75+0.25\*sin(20\*pi\*u))\*sin(pi\*u);  z = 0;  parameters [0 1]  resolution [100]  Refer: 3 – 1.wrl |
|  | x = 0.5\*sin(8\*pi\*u)\*cos(2\*pi\*u);  y = 0.5\*sin(8\*pi\*u)\*sin(2\*pi\*u);  z = 0;  parameters [0 1]  resolution [100]  Refer: 3 – 2.wrl |
|  | x = sin(u\*7\*pi\*sin(-1.5\*pi));  y = sin(u\*4\*pi\*sin(-1.5\*pi));  z = 0;  parameters [-1 1]  resolution [100]  Refer: 3 – 3.wrl |
|  | x=cos(u\*36\*pi);  y=sin(u\*36\*pi);  z = 0;  parameters [-1 1]  resolution [100]  Refer: 3 – 4.wrl |
|  | x= 1\*(cos(2\*pi\*u))^3;  y= 1\*(sin(2\*pi\*u))^3;  z = 0;  parameters [0 1]  resolution [100]  Refer: 3 – 5.wrl |
|  | x= cos(3\*u);  y= 2\*sin(u);  z = 0;  parameters [0 6.28]  resolution [100]  Refer: 3 – 6.wrl |
|  | x=-1+u\*2;  y=u\*sin(u\*12\*pi);  z=0;  parameters [0 1]  resolution [100]  Refer: 3 – 7.wrl |
|  | x=0.9\*cos(u\*2\*pi+pi/4);  y=0.9\*sin(u\*2\*pi+pi/4);  z=0;  parameters [0 1]  resolution [4]  Refer: 3 – 8.wrl |
|  | x=0.9\*cos(u\*16\*pi+pi/4);  y=0.9\*sin(u\*16\*pi+pi/4);  z=2\*u;  parameters [0 1]  resolution [32]  Refer: 3 – 9.wrl |
|  | x=0.9\*cos(u\*2\*pi+pi/10);  y=0.9\*sin(u\*2\*pi+pi/10);  z=0;  parameters [0 1]  resolution [5]  Refer: 3 – 10.wrl |
|  | x=cos(u\*2\*pi\*-1.5);  y=sin(u\*2\*pi\*-1.5);  z=0;  parameters [0 1]  resolution [18]  Refer: 3 – 11.wrl |