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| Lab 3 Report:  Parametric Surfaces and Solids |
| CZ2003 – Computer Graphics & Visualization  Wilson Thurman Teng U1820540H Lab Group: SSR2 |

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# **Lab 3**

## Surfaces

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|  | **3D Plane** | | |
|  | **Sampling Resolution=75** | **Sampling Resolution=10** | **Remarks** |
| **Smooth Mode** | **3D\_plane1\_HighRes.wrl** | **3D\_plane1\_LowRes.wrl** | Both images define a 3D square plane with [x=u, y=v, z=0], with domain [0,1 0,1].  **3D\_plane1\_HighRes.wrl** has a sampling resolution of 75 while **3D\_plane1\_LowRes.wrl** has a sampling resolution of 10.  They is no difference in the smoothness of the surface as the surface is constructed by straight lines. |
| **Wireframe Mode** | **3D\_plane1\_HighRes.wrl** | **3D\_plane1\_LowRes.wrl** | As expected, the number of lines that forms the surface is lesser for **3D\_plane1\_LowRes.wrl**. |

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|  | **Sampling Resolution=75** | **Sampling Resolution=10** | **Remarks** |
| **Smooth Mode** | **3D\_plane2\_HighRes.wrl** | **3D\_plane2\_LowRes.wrl** | Both images define a 3D square plane with [x=-u, y=v, z=u], with domain [0,1 0,1].  The x=-u reflects the plane by the y-axis and z=u causes the plane to orientate to be in between the z-axis and x-axis.  **3D\_plane2\_HighRes.wrl** has a sampling resolution of 75 while **3D\_plane2\_LowRes.wrl** has a sampling resolution of 10.  There is no difference in the smoothness of the surfaces as both surfaces are constructed by straight lines. |
| **Wireframe Mode** | **3D\_plane2\_HighRes.wrl** | **3D\_plane2\_LowRes.wrl** | As expected, the number of lines that forms the surface is lesser for **3D\_plane2\_LowRes.wrl**. |

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|  | **3D Triangle** | | |
|  | **Sampling Resolution=75** | **Sampling Resolution=10** | **Remarks** |
| **Smooth Mode** | **3D\_triangle1\_HighRes.wrl** | **3D\_ triangle1\_LowRes.wrl** | Both images define a 3D triangle using Bilinear Surface Parametric Representation where P1 = (0,0,1), P2 = (1,0,0) and P3 = P4 = (0,1,0).  Therefore, the parametric equation is [x=u-uv, y=v, z=1-u-v+uv], with domain [0,1 0,1].  **3D\_ triangle1\_HighRes.wrl** has a sampling resolution of 75 while **3D\_ triangle1\_LowRes.wrl** has a sampling resolution of 10.  There is no difference in the smoothness of the surfaces as both surfaces are constructed by straight lines. |
| **Wireframe Mode** | **3D\_ triangle1\_HighRes.wrl** | **3D\_ triangle1\_LowRes.wrl** | As expected, the number of lines that forms the surface is lesser for **3D\_ triangle1\_LowRes.wrl**. |

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|  | **Bilinear Surface** | | |
|  | **Sampling Resolution=75** | **Sampling Resolution=10** | **Remarks** |
| **Smooth Mode** | **3D\_ bilinear1\_HighRes.wrl** | **3D\_ bilinear1\_LowRes.wrl** | Both images define a 3D Bilinear using Bilinear Surface Parametric Representation where P1 = (-1,1,-1), P2 = (0,0,0.5), P3 = (1,0,0) and P4 = (-1,-1,-1).  Therefore, the parametric equation is [x=-1+u+2v-3.5uv, y=1-u-v, z=-1+1.5u+v-2.5uv], with domain [0,1 0,1].  **3D\_ bilinear1\_HighRes.wrl** has a sampling resolution of 75 while **3D\_ bilinear1\_LowRes.wrl** has a sampling resolution of 10.  There is no difference in the smoothness of the surfaces as both surfaces are constructed by straight lines. |
| **Wireframe Mode** | **3D\_ bilinear1\_HighRes.wrl** | **3D\_ bilinear1\_LowRes.wrl** | As expected, the number of lines that forms the surface is lesser for **3D\_ bilinear1\_LowRes.wrl**. |

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|  | **Sphere** | | |
|  | **Sampling Resolution=75** | **Sampling Resolution=10** | **Remarks** |
| **Smooth Mode** | **sphere1\_HighRes.wrl** | **sphere1\_LowRes.wrl** | Both images define a sphere surface with [x=cos(2\*pi\*u)\*sin(pi\*v), y=sin(2\*pi\*u), z=cos(2\*pi\*u)\*cos(pi\*v)], with domain [0,1 0,1].  **sphere1\_HighRes.wrl** has a sampling resolution of 75 while **sphere1\_LowRes.wrl** has a sampling resolution of 10.  A difference in the smoothness of the surface can be observed. |
| **Wireframe Mode** | **sphere1\_HighRes.wrl** | **sphere1\_LowRes.wrl** | As expected, the number of lines that forms the surface is lesser for **sphere1\_LowRes.wrl** due to the lower sampling resolution. This results in an uneven surface. |

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|  | **Ellipsoid** | | |
|  | **Sampling Resolution=75** | **Sampling Resolution=10** | **Remarks** |
| **Smooth Mode** | **ellipsoid1\_HighRes.wrl** | **ellipsoid1\_LowRes.wrl** | Both images define a sphere surface with [x=0.35\*cos(2\*pi\*u)\*sin(pi\*v), y=0.2\*sin(2\*pi\*u), z=0.8\*cos(2\*pi\*u)\*cos(pi\*v)], with domain [0,1 0,1].  **ellipsoid1\_HighRes.wrl** has a sampling resolution of 75 while **ellipsoid1\_LowRes.wrl** has a sampling resolution of 10.  A difference in the smoothness of the surface can be observed. |
| **Wireframe Mode** | **ellipsoid1\_HighRes.wrl** | **ellipsoid1\_LowRes.wrl** | As expected, the number of lines that forms the surface is lesser for **ellipsoid1\_LowRes.wrl** due to the lower sampling resolution. This results in an uneven surface. |

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|  | **Cone** | | |
|  | **Sampling Resolution=75** | **Sampling Resolution=10** | **Remarks** |
| **Smooth Mode** | **cone1\_HighRes.wrl** | **cone1\_LowRes.wrl** | Both images define a sphere surface with [x=0.5\*u\*cos(2\*pi\*v), y=1-u, z=0.5\*u\*sin(2\*pi\*v)], with domain [0,1 0,1].  **cone1\_HighRes.wrl** has a sampling resolution of 75 while **cone1\_LowRes.wrl** has a sampling resolution of 10.  The cone surface is formed by rotational sweeping of straight line y=1-u.  A difference in the smoothness of the surface can be observed. |
| **Wireframe Mode** | **cone1\_HighRes.wrl** | **cone1\_LowRes.wrl** | As expected, the number of lines that forms the surface is lesser for **cone1\_LowRes.wrl** due to the lower sampling resolution. This results in an uneven surface. |

## Solids

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| **Solid Box** | | |
| **Closed Surface** | **Solid Object** | **Remarks** |
| **3D\_plane1\_HighRes.wrl**  x=u,  y=v,  z=0  Domain: [0 1 0 1]  Sampling Resolution: 75 75 | **solid\_cube.wrl**  x=u,  y=v,  z=w  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **3D\_plane1\_HighRes.wrl** is converted to **solid\_cube.**wrl by adding one additional parameter w to allow for “growing” along the z-axis, otherwise known as translational sweeping. |
| **Solid Sphere** | | |
| **Closed Surface** | **Solid Object** | **Remarks** |
| **disk.wrl**  x= v\*cos(2\*pi\*u),  y= v\*sin(2\*pi\*u),  z= 0  Domain: [0 1 0 1]  Sampling Resolution: 75 75 | **solid\_sphere.wrl**  x= v\*cos(2\*pi\*u)\*sin(pi\*w),  y= v\*sin(2\*pi\*u) \*sin(pi\*w),  z=cos(pi\*w)  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **circle.wrl** is converted to **solid\_sphere.wrl** by adding one additional parameter w to allow rotational sweeping of **disk.wrl**. |

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| **Solid Cylinder** | | |
| **Closed Surface** | **Solid Object** | **Remarks** |
| **disk.wrl**  x= v\*cos(2\*pi\*u),  y= v\*sin(2\*pi\*u),  z= 0  Domain: [0 1 0 1]  Sampling Resolution: 75 75 | **solid\_cylinder.wrl**  x= v\*cos(2\*pi\*u),  y= v\*sin(2\*pi\*u),  z=w  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **disk.wrl** is converted to **solid\_cylinder.**wrl by adding one additional parameter w to allow for “growing” along the z-axis, otherwise known as translational sweeping. |
| **Solid Cone** | | |
| **Closed Surface** | **Solid Object** | **Remarks** |
| **disk.wrl**  x= v\*cos(2\*pi\*u),  y= v\*sin(2\*pi\*u),  z= 0  Domain: [0 1 0 1]  Sampling Resolution: 75 75 | **solid\_cone.wrl**  x= v\*cos(2\*pi\*u)\*w,  y= v\*sin(2\*pi\*u)\*w,  z=1-w  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **disk.wrl** is converted to **solid\_cone.wrl.wrl** by adding one additional parameter w to allow for translational sweeping of **disk.wrl** along the straight line z=1-w. |

## Sweeping

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| **Rotational Sweeping** | | |
| **Object 1** | **Object 2** | **Remarks** |
| **disk.wrl**  x= v\*cos(2\*pi\*u),  y= v\*sin(2\*pi\*u),  z= 0  Domain: [0 1 0 1]  Sampling Resolution: 75 75 | **solid\_sphere.wrl**  x= v\*cos(2\*pi\*u)\*sin(pi\*w),  y= v\*sin(2\*pi\*u) \*sin(pi\*w),  z=cos(pi\*w)  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **disk.wrl** is converted to **solid\_cylinder.**wrl by performing rotational sweeping. |
| **Translational Sweeping** | | |
| **Object 1** | **Object 2** | **Remarks** |
| **circle1.wrl**  x= cos(2\*pi\*u),  y= sin(2\*pi\*u),  z= 0  Domain: [0 1 0 1]  Sampling Resolution: 5000 | **translational\_sweeping.wrl**  x= cos(2\*pi\*u),  y= sin(2\*pi\*u),  z=v  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **circle1.wrl** from lab 2 is converted to **solid\_cone.wrl.wrl** by allowing for translational sweeping of **circle1.wrl** along the z-axis. |

## Sin-curve Sweeping

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| **Sin-curve Sweeping** | | |
| **Object 1** | **Object 2** | **Object 3** |
| **sincurve\_sweeping1.wrl**  x= 0.05\*v\*sin(2\*pi\*u)  y= 0  z= 0.05\*v\*cos(2\*pi\*u)+0.5  Domain: [0 1 0 1]  Sampling Resolution: 75 75 | **sincurve\_sweeping2.wrl**  x= 0.05\*v\*sin(2\*pi\*u)  y= (0.05\*v\*cos(2\*pi\*u)+0.5)\*sin(2\*pi\*w)  z= (0.05\*v\*cos(2\*pi\*u)+0.5)\*cos(2\*pi\*w)  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **sincurve\_sweeping3.wrl**  x= 0.05\*v\*sin(2\*pi\*u)+w  y= (0.05\*v\*cos(2\*pi\*u)+0.5)\*sin(2\*pi\*w)  z= (0.05\*v\*cos(2\*pi\*u)+0.5)\*cos(2\*pi\*w)  Domain: [0 1 0 1]  Sampling Resolution: 5000 |
| **Object 4** | **Object 5** | **Remarks** |
| **sincurve\_sweeping4.wrl**  x= 0.05\*v\*sin(2\*pi\*u)+w  y= (0.05\*v\*cos(2\*pi\*u)+0.5)\*cos(6\*pi\*w)  z= (0.05\*v\*cos(2\*pi\*u)+0.5)\*sin(6\*pi\*w)  Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **sincurve\_sweeping5.wrl**  x= 0.05\*v\*sin(1\*pi\*u)+w  y= (0.05\*v\*cos(1\*pi\*u)+0.5)\*cos(6\*pi\*w)  z= (0.05\*v\*cos(1\*pi\*u)+0.5)\*sin(6\*pi\*w) Domain: [0 1 0 1 0 1]  Sampling Resolution: 75 75 75 | **Object 1** is converted into **Object 2** by performing rotational sweeping around the x-axis.  **Object 2** is converted into **Object 3** performing translational sweeping using the w parameter along the x-axis.  **Object 3** is converted to **Object 4** by increasing the number of cycles the shape in **Object 1** will be rotating for. In this case, the cycle was increased from 1 cycle to 3 cycles (6pi/2pi).  **Object 4** is converted to **Object 5** by decreasing the angle of the original shape, **Object 1** by half, effectively decreasing the domain by half and hence results in a semi-circle shape being rotated instead of a full circle. |