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Lab 3 Report: Parametric Surfaces and Solids

CZ2003 – Computer Graphics & Visualization

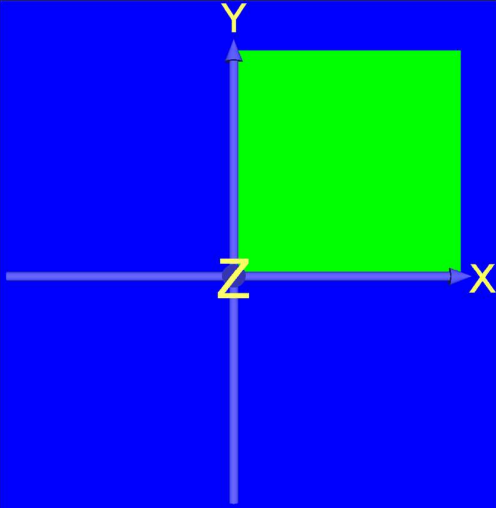
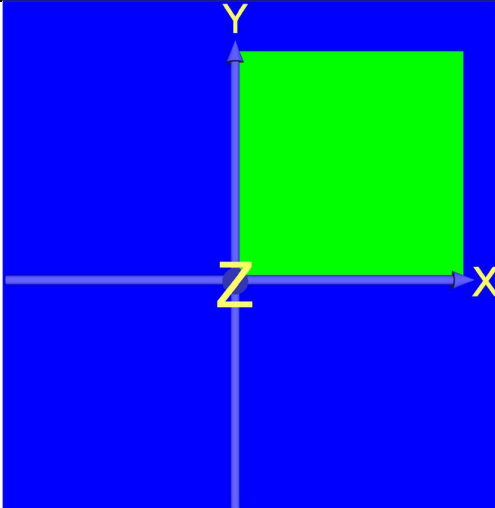
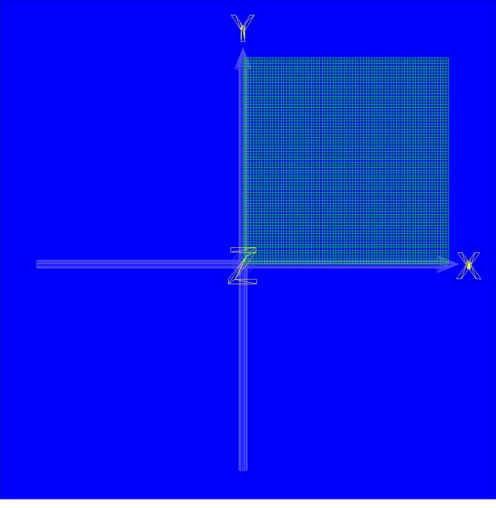
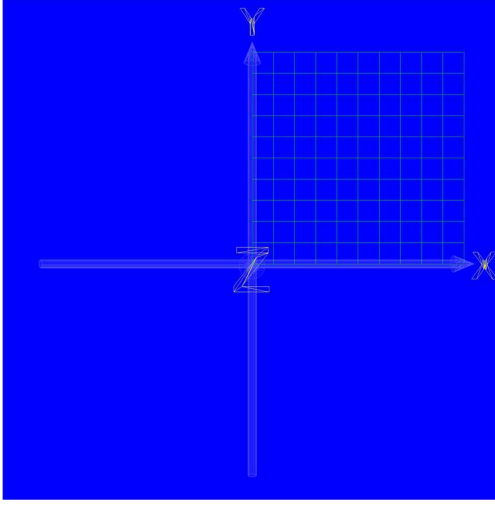
Wilson Thurman Teng
U1820540H
Lab Group: SSR2

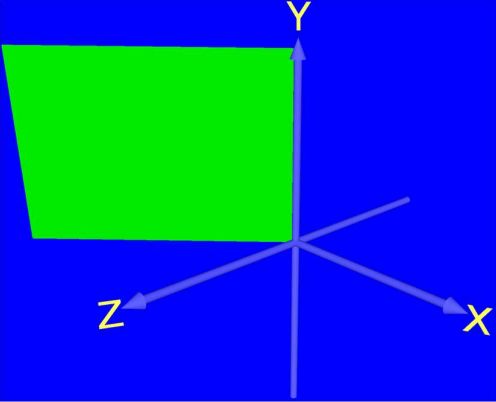
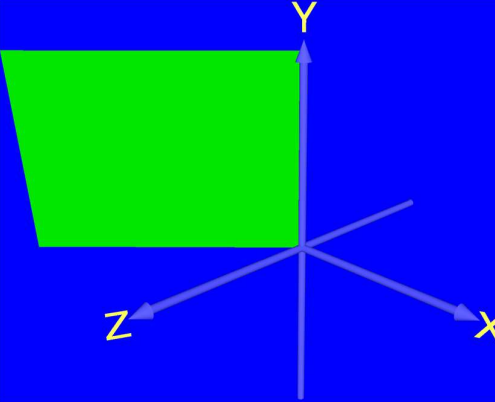
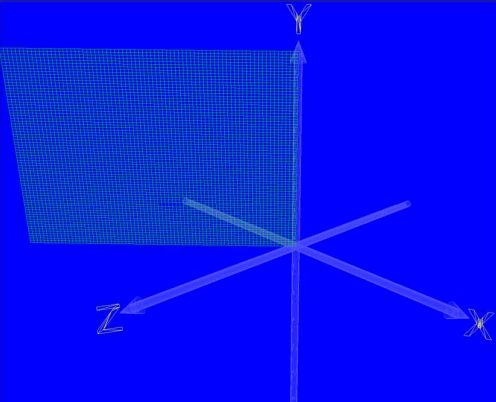
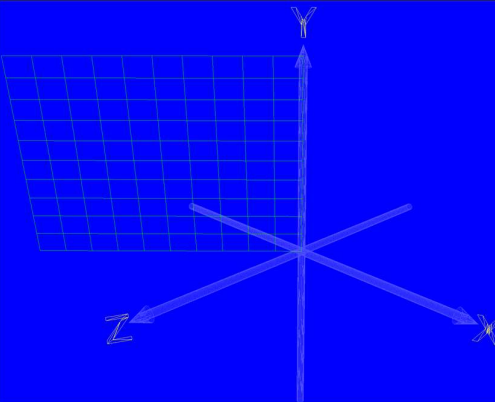
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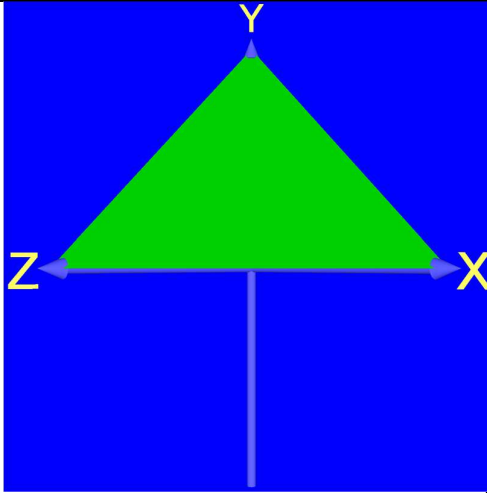
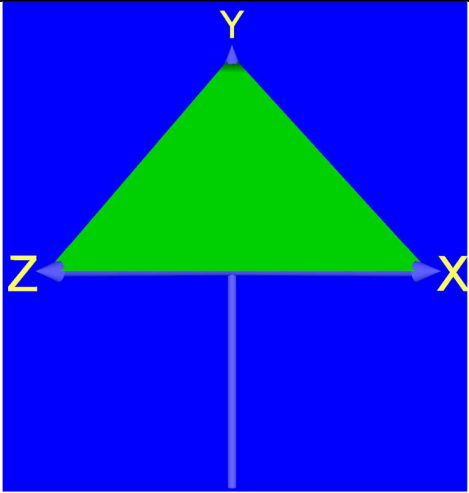
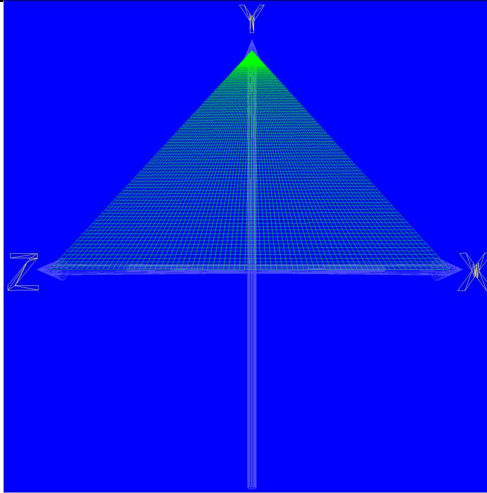
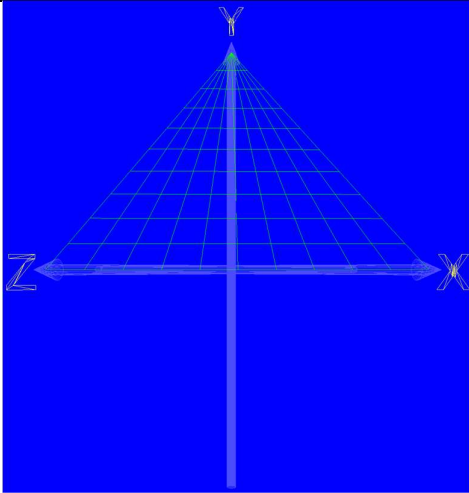
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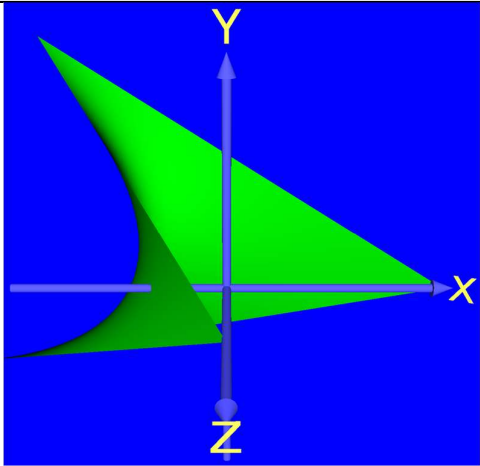
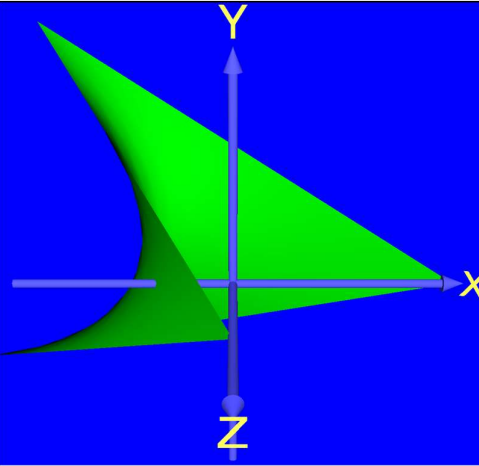
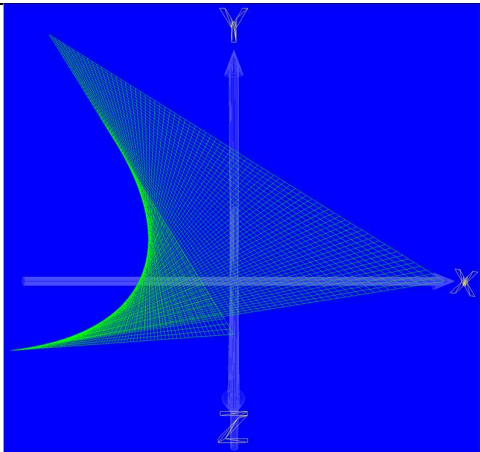
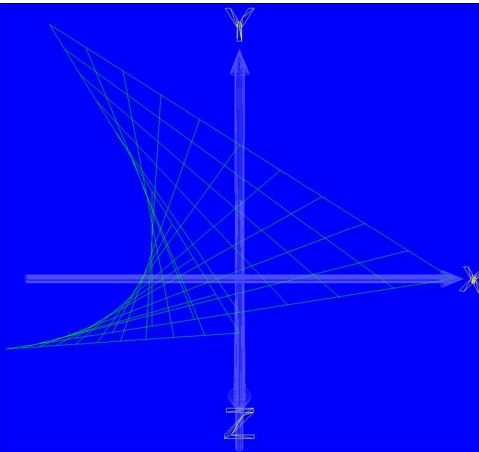
Lab 3

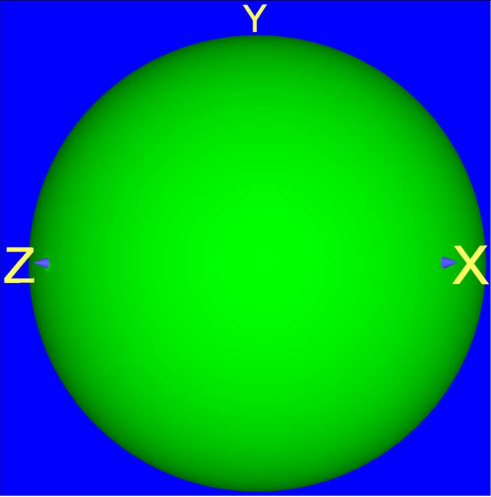
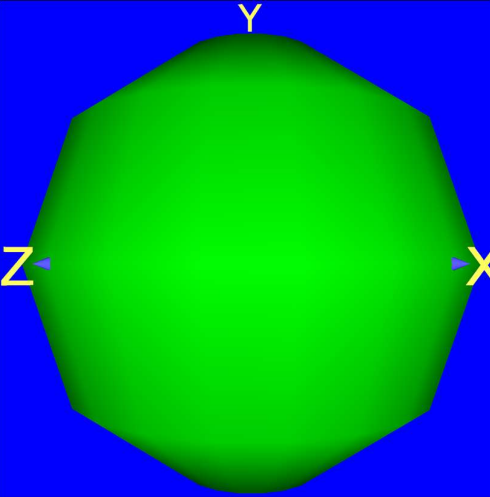
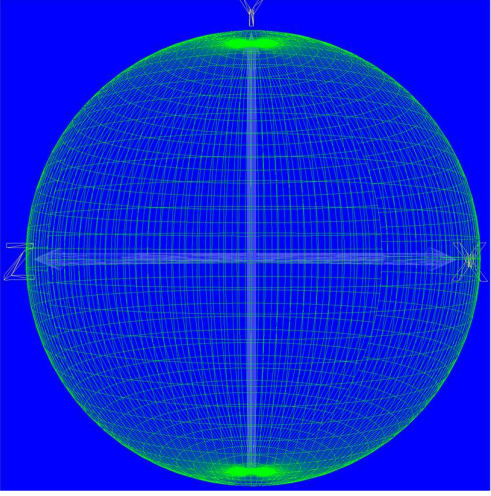
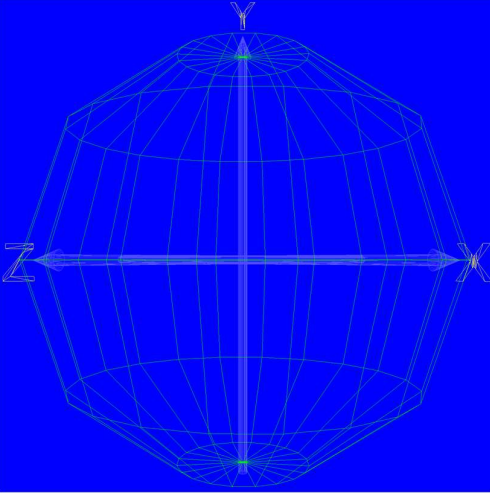
3.1 Surfaces

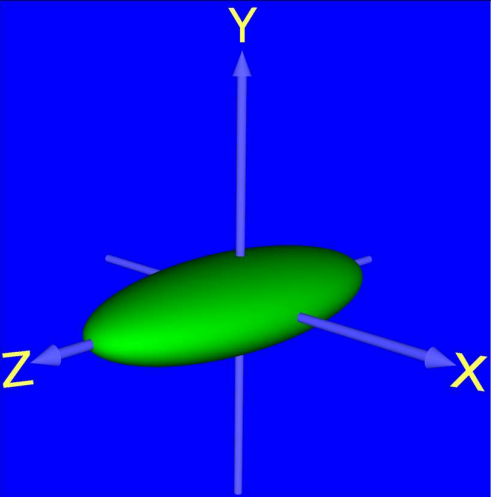
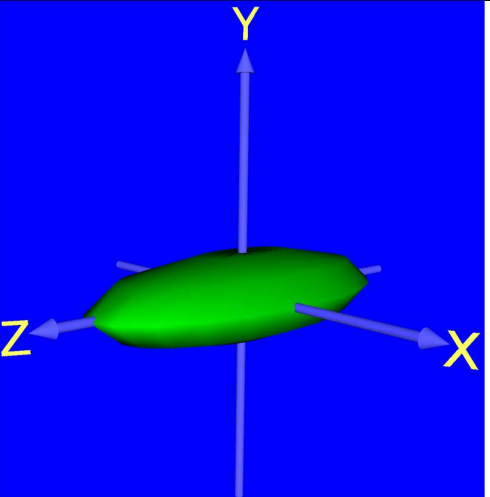
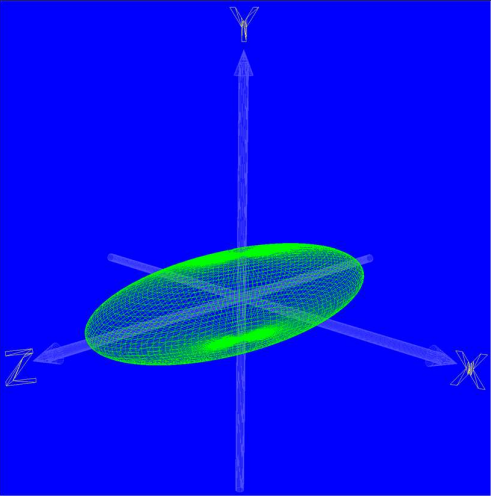
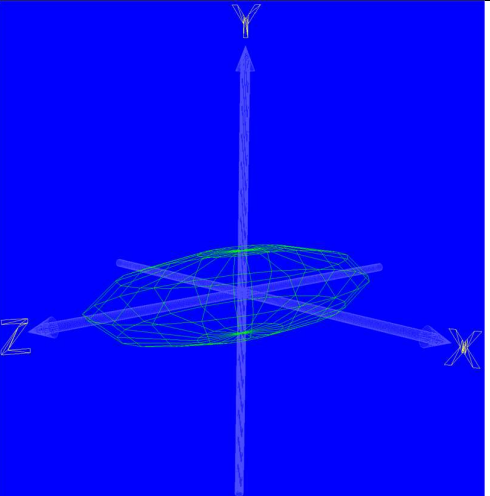
3D Plane			
Sampling Resolution=75		Sampling Resolution=10	Remarks
Smooth Mode			<p>Both images define a 3D square plane with $[x=u, y=v, z=0]$, with domain $[0,1,0,1]$.</p> <p>3D_plane1_HighRes.wrl has a sampling resolution of 75 while 3D_plane1_LowRes.wrl has a sampling resolution of 10.</p> <p>There is no difference in the smoothness of the surface as the surface is constructed by straight lines.</p>
	3D_plane1_HighRes.wrl	3D_plane1_LowRes.wrl	
Wireframe Mode			<p>As expected, the number of lines that forms the surface is lesser for 3D_plane1_LowRes.wrl.</p>
	3D_plane1_HighRes.wrl	3D_plane1_LowRes.wrl	

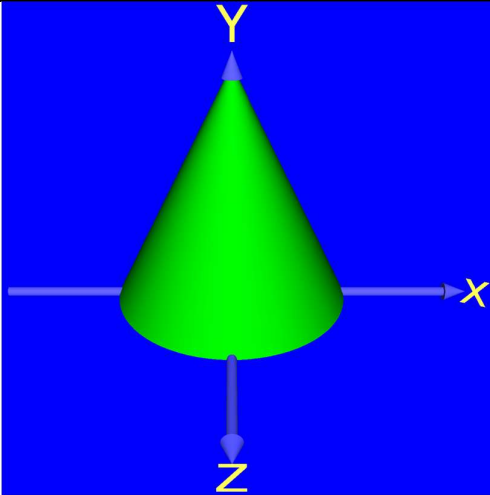
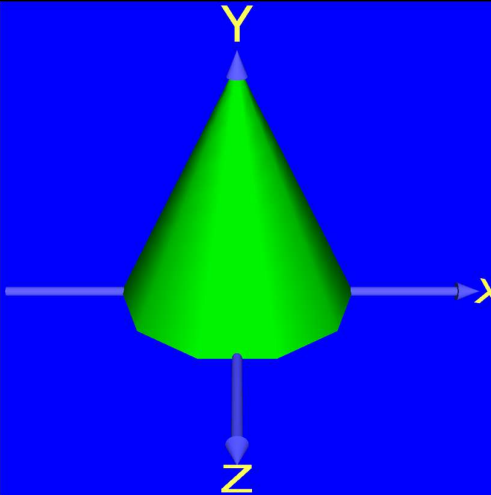
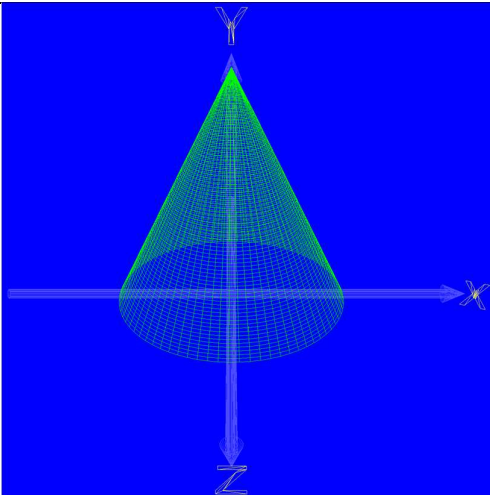
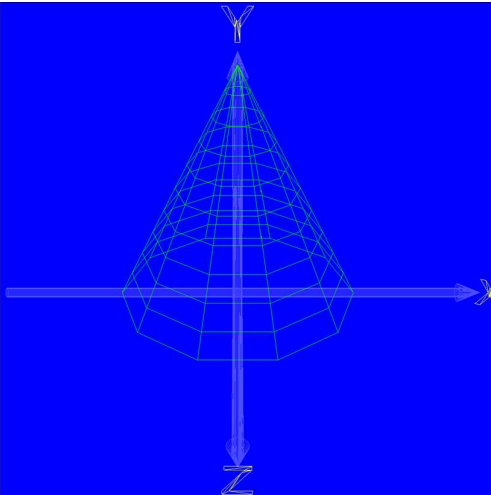
	Sampling Resolution=75	Sampling Resolution=10	Remarks
Smooth Mode	 <p>3D_plane2_HighRes.wrl</p>	 <p>3D_plane2_LowRes.wrl</p>	<p>Both images define a 3D square plane with $[x=-u, y=v, z=u]$, with domain $[0,1,0,1]$.</p> <p>The $x=-u$ reflects the plane by the y-axis and $z=u$ causes the plane to orientate to be in between the z-axis and x-axis.</p> <p>3D_plane2_HighRes.wrl has a sampling resolution of 75 while 3D_plane2_LowRes.wrl has a sampling resolution of 10.</p> <p>There is no difference in the smoothness of the surfaces as both surfaces are constructed by straight lines.</p>
Wireframe Mode	 <p>3D_plane2_HighRes.wrl</p>	 <p>3D_plane2_LowRes.wrl</p>	<p>As expected, the number of lines that forms the surface is lesser for 3D_plane2_LowRes.wrl.</p>

3D Triangle			
Sampling Resolution=75		Sampling Resolution=10	Remarks
Smooth Mode	 <p>3D_triangle1_HighRes.wrl</p>	 <p>3D_triangle1_LowRes.wrl</p>	<p>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 $[0,1 \ 0,1]$.</p> <p>3D_triangle1_HighRes.wrl has a sampling resolution of 75 while 3D_triangle1_LowRes.wrl has a sampling resolution of 10.</p> <p>There is no difference in the smoothness of the surfaces as both surfaces are constructed by straight lines.</p>
	 <p>3D_triangle1_HighRes.wrl</p>	 <p>3D_triangle1_LowRes.wrl</p>	

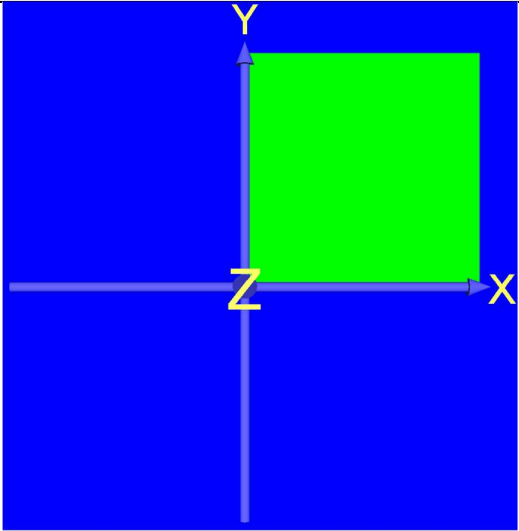
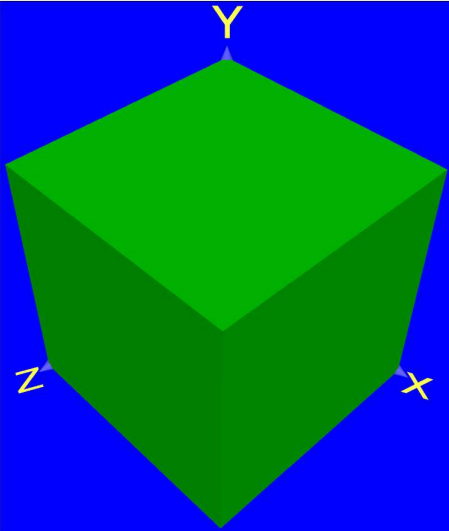
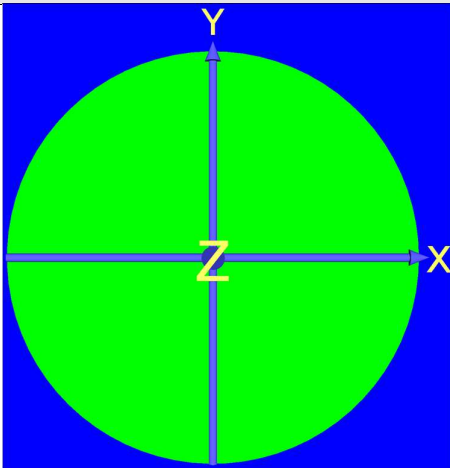
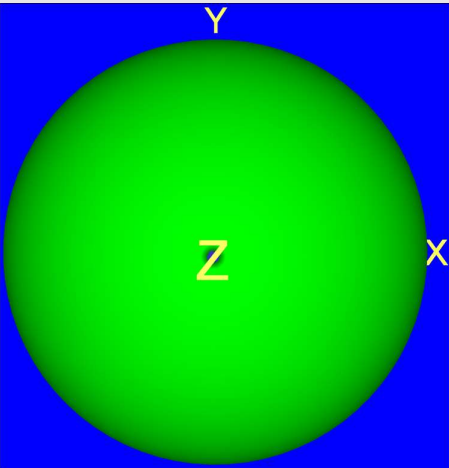
Bilinear Surface			
	Sampling Resolution=75	Sampling Resolution=10	Remarks
Smooth Mode	 <p>3D_bilinear1_HighRes.wrl</p>	 <p>3D_bilinear1_LowRes.wrl</p>	<p>Both images define a 3D Bilinear using Bilinear Surface Parametric Representation where $P1 = (-1,1,-1)$, $P2 = (0,0,0.5)$, $P3 = (1,0,0)$ and $P4 = (-1,-1,-1)$.</p> <p>Therefore, the parametric equation is $[x=-1+u+2v-3.5uv, y=1-u-v, z=-1+1.5u+v-2.5uv]$, with domain $[0,1,0,1]$.</p> <p>3D_bilinear1_HighRes.wrl has a sampling resolution of 75 while 3D_bilinear1_LowRes.wrl has a sampling resolution of 10.</p> <p>There is no difference in the smoothness of the surfaces as both surfaces are constructed by straight lines.</p>
Wireframe Mode	 <p>3D_bilinear1_HighRes.wrl</p>	 <p>3D_bilinear1_LowRes.wrl</p>	<p>As expected, the number of lines that forms the surface is lesser for 3D_bilinear1_LowRes.wrl.</p>

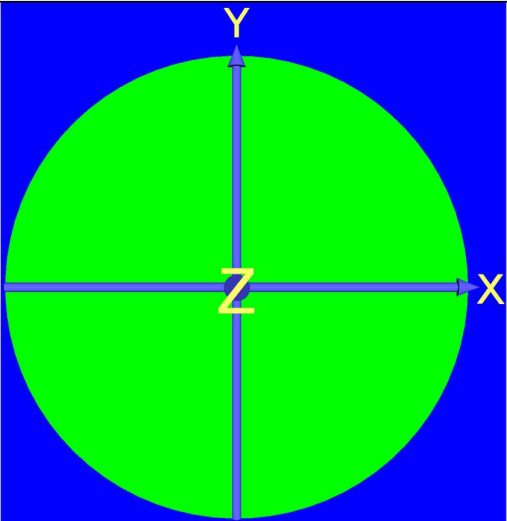
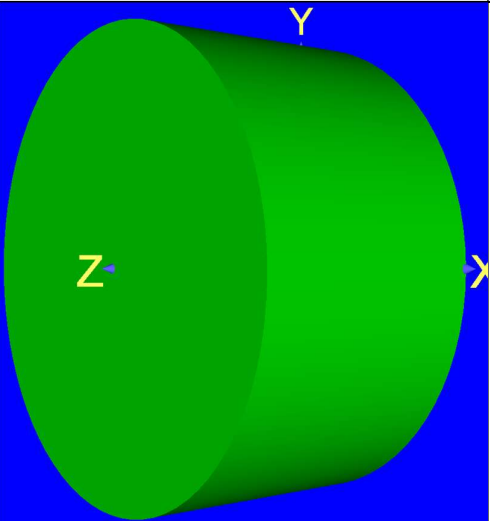
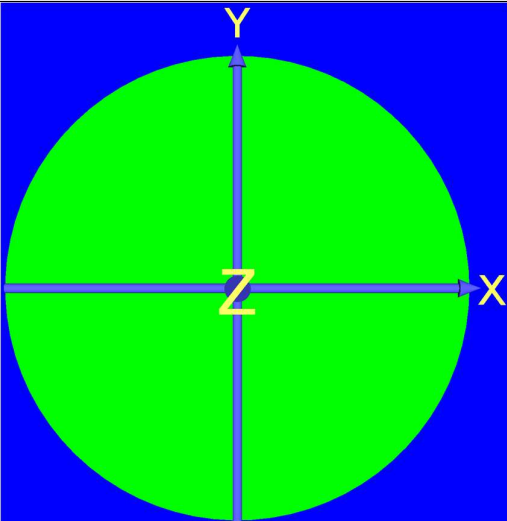
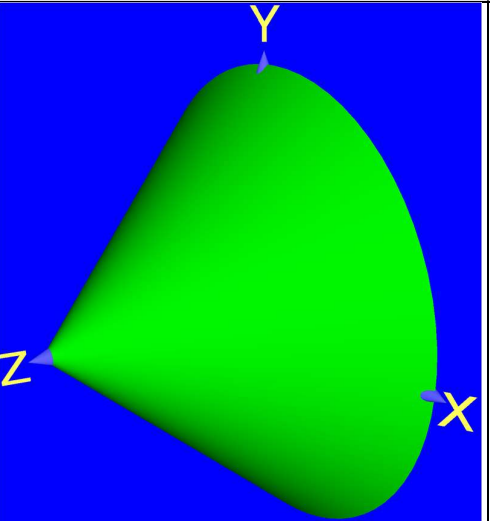
Sphere			
Sampling Resolution=75		Sampling Resolution=10	Remarks
Smooth Mode	 sphere1_HighRes.wrl	 sphere1_LowRes.wrl	<p>Both images define a sphere surface with $[x=\cos(2\pi u)\sin(\pi v), y=\sin(2\pi u), z=\cos(2\pi u)\cos(\pi v)]$, with domain $[0,1\ 0,1]$.</p> <p>sphere1_HighRes.wrl has a sampling resolution of 75 while sphere1_LowRes.wrl has a sampling resolution of 10.</p> <p>A difference in the smoothness of the surface can be observed.</p>
	 sphere1_HighRes.wrl	 sphere1_LowRes.wrl	

Ellipsoid			
Sampling Resolution=75		Sampling Resolution=10	Remarks
Smooth Mode			<p>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 $[0,1\ 0,1]$.</p> <p>ellipsoid1_HighRes.wrl has a sampling resolution of 75 while ellipsoid1_LowRes.wrl has a sampling resolution of 10.</p> <p>A difference in the smoothness of the surface can be observed.</p>
	ellipsoid1_HighRes.wrl	ellipsoid1_LowRes.wrl	
Wireframe Mode			<p>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.</p>
	ellipsoid1_HighRes.wrl	ellipsoid1_LowRes.wrl	

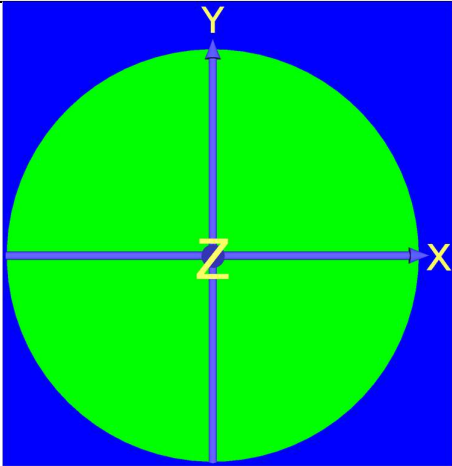
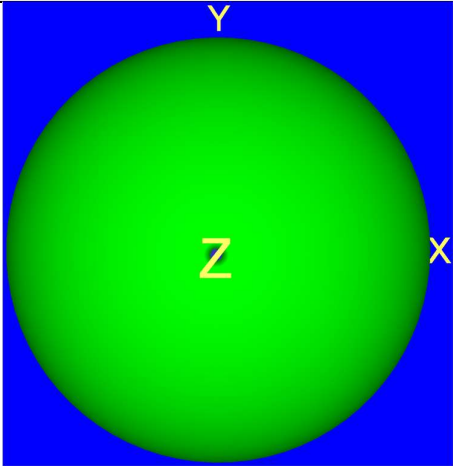
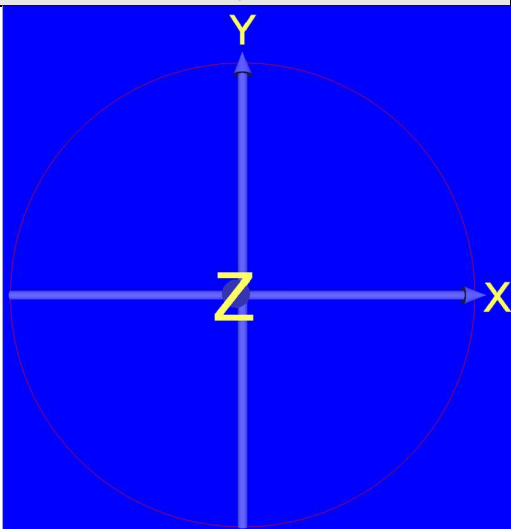
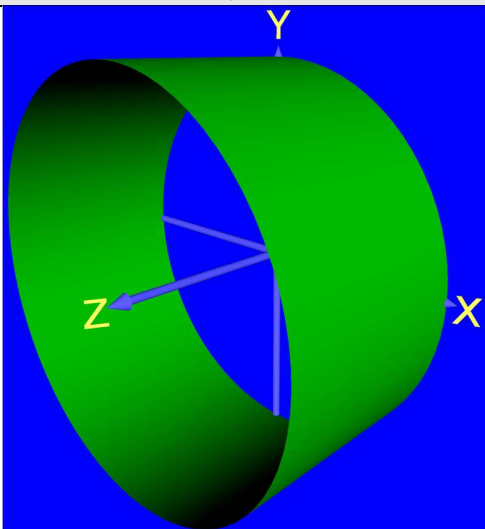
Cone			
Sampling Resolution=75		Sampling Resolution=10	Remarks
Smooth Mode	 cone1_HighRes.wrl	 cone1_LowRes.wrl	<p>Both images define a sphere surface with $[x=0.5*u*\cos(2*\pi*v), y=1-u, z=0.5*u*\sin(2*\pi*v)]$, with domain $[0,1\ 0,1]$.</p> <p>cone1_HighRes.wrl has a sampling resolution of 75 while cone1_LowRes.wrl has a sampling resolution of 10.</p> <p>The cone surface is formed by rotational sweeping of straight line $y=1-u$.</p> <p>A difference in the smoothness of the surface can be observed.</p>
	 cone1_HighRes.wrl	 cone1_LowRes.wrl	

3.2 Solids

Solid Box		
Closed Surface	Solid Object	Remarks
 <p>3D_plane1_HighRes.wrl $x=u,$ $y=v,$ $z=0$ Domain: [0 1 0 1] Sampling Resolution: 75 75</p>	 <p>solid_cube.wrl $x=u,$ $y=v,$ $z=w$ Domain: [0 1 0 1 0 1] Sampling Resolution: 75 75 75</p>	<p>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.</p>
Solid Sphere		
Closed Surface	Solid Object	Remarks
 <p>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</p>	 <p>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</p>	<p>circle.wrl is converted to solid_sphere.wrl by adding one additional parameter w to allow rotational sweeping of disk.wrl.</p>

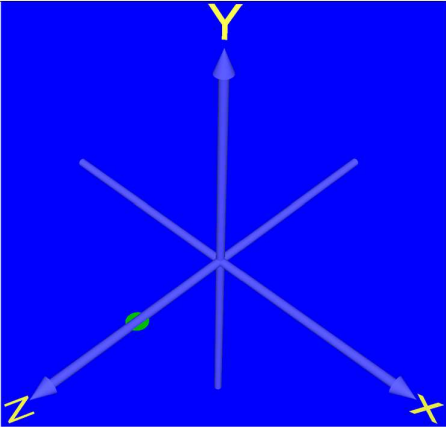
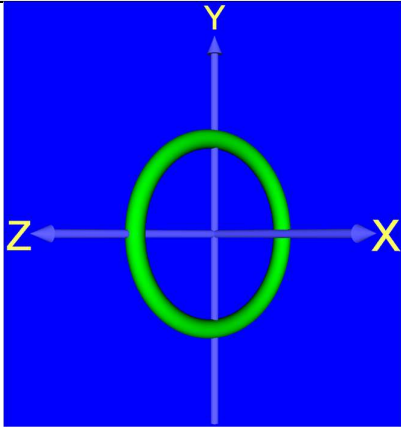
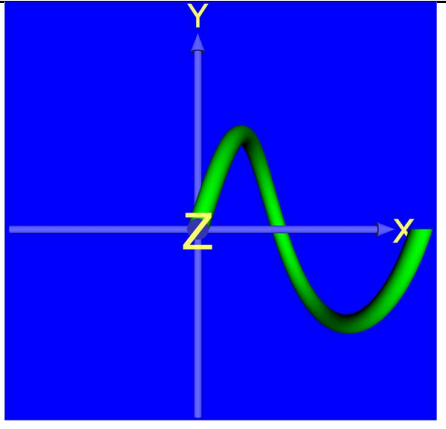
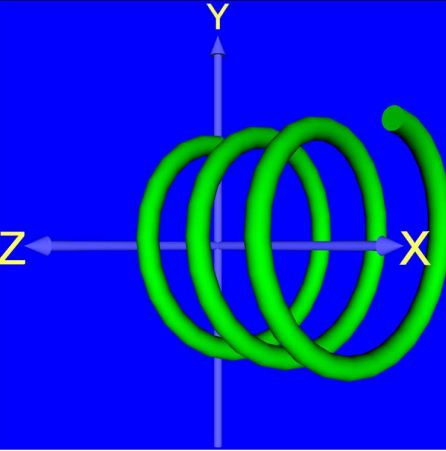
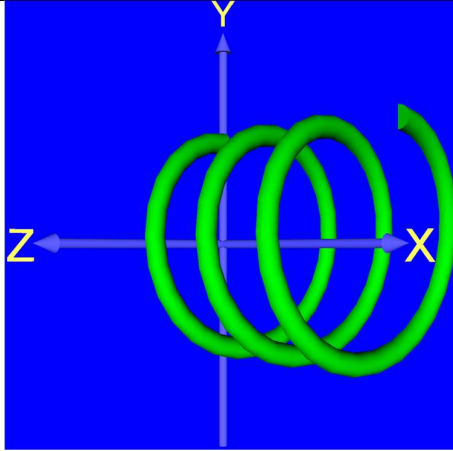
Solid Cylinder		
Closed Surface	Solid Object	Remarks
 <p>disk.wrl $x = v \cdot \cos(2 \cdot \pi \cdot u)$, $y = v \cdot \sin(2 \cdot \pi \cdot u)$, $z = 0$ Domain: [0 1 0 1] Sampling Resolution: 75 75</p>	 <p>solid_cylinder.wrl $x = v \cdot \cos(2 \cdot \pi \cdot u)$, $y = v \cdot \sin(2 \cdot \pi \cdot u)$, $z = w$ Domain: [0 1 0 1 0 1] Sampling Resolution: 75 75 75</p>	<p>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.</p>
Solid Cone		
Closed Surface	Solid Object	Remarks
 <p>disk.wrl $x = v \cdot \cos(2 \cdot \pi \cdot u)$, $y = v \cdot \sin(2 \cdot \pi \cdot u)$, $z = 0$ Domain: [0 1 0 1] Sampling Resolution: 75 75</p>	 <p>solid_cone.wrl $x = v \cdot \cos(2 \cdot \pi \cdot u) \cdot w$, $y = v \cdot \sin(2 \cdot \pi \cdot u) \cdot w$, $z = 1 - w$ Domain: [0 1 0 1 0 1] Sampling Resolution: 75 75 75</p>	<p>disk.wrl is converted to solid_cone.wrl by adding one additional parameter w to allow for translational sweeping of disk.wrl along the straight line $z = 1 - w$.</p>

3.3 Sweeping

Rotational Sweeping		
Object 1	Object 2	Remarks
 <p>disk.wrl $x = v \cdot \cos(2 \cdot \pi \cdot u)$ $y = v \cdot \sin(2 \cdot \pi \cdot u)$ $z = 0$ Domain: [0 1 0 1] Sampling Resolution: 75 75</p>	 <p>solid_sphere.wrl $x = v \cdot \cos(2 \cdot \pi \cdot u) \cdot \sin(\pi \cdot w)$ $y = v \cdot \sin(2 \cdot \pi \cdot u) \cdot \sin(\pi \cdot w)$ $z = \cos(\pi \cdot w)$ Domain: [0 1 0 1 0 1] Sampling Resolution: 75 75 75</p>	<p>disk.wrl is converted to solid_cylinder.wrl by performing rotational sweeping.</p>
Translational Sweeping		
Object 1	Object 2	Remarks
 <p>circle1.wrl $x = \cos(2 \cdot \pi \cdot u)$ $y = \sin(2 \cdot \pi \cdot u)$ $z = 0$ Domain: [0 1 0 1] Sampling Resolution: 5000</p>	 <p>translational_sweeping.wrl $x = \cos(2 \cdot \pi \cdot u)$ $y = \sin(2 \cdot \pi \cdot u)$ $z = v$ Domain: [0 1 0 1 0 1] Sampling Resolution: 75 75 75</p>	<p>circle1.wrl from lab 2 is converted to solid_cone.wrl.wrl by allowing for translational sweeping of circle1.wrl along the z-axis.</p>

3.4 Sin-curve Sweeping

Sin-curve Sweeping

Object 1	Object 2	Object 3
 <p>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</p>	 <p>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</p>	 <p>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</p>
Object 4	Object 5	Remarks
 <p>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</p>	 <p>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</p>	<p>Object 1 is converted into Object 2 by performing rotational sweeping around the x-axis.</p> <p>Object 2 is converted into Object 3 performing translational sweeping using the w parameter along the x-axis.</p> <p>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 ($6\pi/2\pi$).</p> <p>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.</p>