**NANYANG TECHNOLOGICAL**

**UNIVERSITY**

**CZ2003**

**COMPUTER GRAPHICS**

**AND**

**VISUALIZATION**

**Labs Assessment**

**Lab 3: Parametric Surfaces and Solids**

**Report**

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***\*Note: All .wrl files are found in Lab 3 🡪 Files.***

**Task 1: Defining parametrically the different surfaces**

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| **Shape Defined:** 3D Plane  **File Name:** 3D\_Plane | |
| **Resolution Value: [75 75]**  **Parameter Value : [0 1 0 1]** | **Resolution Value: [5 5]**  **Parameter Value : [0 1 0 1]** |
| C:\Users\mock_\Desktop\Yr 3 Sem 1 Modules\CZ2003 Computer Graphics & Visualisation\Labs\Lab 3\Diagrams\3D Plane\3D_Plane_R75.PNG  *\*Dig.1*  To obtain a surface that is shown in Dig.1, the following equation is used:  x=u;  y=v;  z=0;  The default **resolution** and **parameter valu**e are **[75 75]**, **[0 1 0 1]** respectively. | *\*Dig.2*  Dig.2 shows a 3D Plane surface that has its **resolution value changed to [5 5]**.  As it could be observed, changing the resolution value of the 3D Plane will not affects the shape of it. The above diagram display the same 3D Plane as the one shown in Dig.1. The reason behind the similarity is due to the fact that a 3D Plane is formed by purely by straight lines, which will not get affected by the resolution value. This means to say that even if the resolution value is [5 5], [15 15] or [90 90], the 3D Plane will always have the same shape.  Another resolution value, [15 15] is used for a confirmation that changing the resolution value will not change the shape of the 3D Plane.  *\*Refer to Lab 3🡪Diagrams🡪3D Plane🡪3D\_Plane\_R15 to see another diagram of the 3D Plane when the resolution value is [15 15]* |

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| **Shape Defined:** 3D Triangle  **File Name:** 3D\_Triangle | |
| **Resolution Value: [75 75]**  **Parameter Value : [0 1 0 1]** | **Resolution Value: [10 10]**  **Parameter Value : [0 1 0 1]** |
| *\*Dig.3*  A 3D\_Triangle can be defined by the following equation:  x=u;  y=v\*u;  z=0;  Dig.1 shows a 3D Triangle with the **resolution value of [75 75]** and **parameter value of [0 1 0 1]** | *\*Dig.4*  To explore how the resolution value will affects the shape of the 3D Triangle, a **new resolution value** of **[10 10]** is used.  Similar to Dig.2, the 3D Triangle retains its shape even when the resolution value that is used to define the shape had been changed. The reason behind this is the same as the one given in Dig.2.  Another resolution value, [85 85] is used for a confirmation that changing the resolution value will not change the shape of the 3D Triangle.  *\*Refer to Dig.2 for more detailed explanation on why 3D Triangle is not affected by the changes in resolution value.*    *\*Refer to Lab 3🡪Diagrams🡪3D Triangle🡪3D\_Triangle\_R85 to see another diagram of the 3D Triangle when the resolution value is [85 85]* |

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| **Shape Defined:** Bilinear Surface  **File Name:** Bilinear\_Surface | |
| **Resolution Value: [75 75]**  **Parameter Value : [0 1 0 1]** | **Resolution Value: [25 25]**  **Parameter Value : [0 1 0 1]** |
| *\*Dig.5*  The following definition will define a Bilinear Surface:  x=u\*v;  y=cos(2\*v);  z=0;  **Resolution value [75 75]** and **parameter value [0 1 0 1]** is used for the shape shown in Dig.5 | *\*Dig.6*  **Resolution value** for the Bilinear Surface is changed to **[25 25]** to explore how it will affects the surface.  As like the previous 2 shapes (3D Plane and 3D Triangle), the changing the resolution value will not have any direct impact on the overall visual of the Bilinear surface. The Bilinear Surface will always have the same shape regardless of the resolution value.  Another resolution value, [85 85] is used for a confirmation that changing the resolution value will not change the shape of the Bilinear Surface.  *\*Refer to Dig.2 for more detailed explanation on why Bilinear Surface is not affected by the changes in resolution value.*  *\*Refer to Lab 3🡪Diagrams🡪3D Triangle🡪Bilinear\_Surface\_R85 to see another diagram of the Bilinear Surface when the resolution value is [85 85]* |

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| **Shape Defined:** Sphere  **File Name:** Sphere | |
| **Resolution Value: [75 75]**  **Parameter Value : [0 1 0 1]** | **Resolution Value: [5 5]**  **Parameter Value : [0 1 0 1]** |
| *\*Dig.7*  A Sphere can be defined by the following equation:  x=cos(2\*pi\*u)\*sin(pi\*v);  y=sin(2\*pi\*u)\*sin(pi\*v);  z=cos(pi\*v);  Dig.8 shows a Sphere will a **resolution value of [75 75]** and **parameter value of [0 1 0 1]**. | *\*Dig.8*  The **resolution value** for the Sphere shown in Dig.8 has been changed to **[5 5]**.  Unlike the previous cases, the Sphere has change it shape once the resolution value has been changed. Instead of a round 3D circle that is shown in Dig.7, the Sphere now has become a 3D five-sided pentagon. Different from the other shapes where it was created by connecting straight lines, a Sphere is created by connecting multiple lines that can turn in all direction. These lines are subjected to changes according to the given resolution value. For example, if the resolution value is changed to [25 25], the Sphere will turn into a circle with small corners. Hence, any changes made to the Sphere resolution value will directly affects the shape of the Sphere.  *\*Refer to Lab 3🡪Diagrams🡪Sphere🡪Sphere\_R25 to see a Sphere with the resolution value of [25 25]* |

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| **Shape Defined:** Ellipsoid  **File Name:** Ellipsoid | |
| **Resolution Value: [75 75]**  **Parameter Value : [0 1 0 1]** | **Resolution Value: [5 5]**  **Parameter Value : [0 1 0 1]** |
| *\*Dig.9*  The following equation is used to define a Ellipsoid:  x=cos(2\*pi\*u)\*sin(pi\*v);  y=0.5\*sin(2\*pi\*u)\*sin(pi\*v);  z=cos(pi\*v);  The Ellipsoid in Dig.9 is defined with a **resolution value of [75 75]** and **parameter value of [0 1 0 1]**. | *\*Dig.10*  To explore how resolution value will change the shape of the Ellipsoid, Dig.10 is a Ellipsoid that has a **new resolution value of [5 5]**  Similar to what has happen in Dig. 8, the new Ellipsoid has also changed its shape upon receiving the new resolution value. The Ellipsoid now has more points and is no longer smooth and round. The reason on why do this happen is the same as Dig.8  Another resolution value of [10 10] is also used to confirm that the Ellipsoid will change it shape accordingly to the new resolution value.  *\*Refer to Dig.8 for more detailed explanation on why does the Ellipsoid changes it shape when a new resolution value is given.*  *\*Refer to Lab 3🡪Diagrams🡪Ellipsoid🡪 Ellipsoid\_R10 to see a Ellipsoid with the resolution value of [10 10]* |

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| **Shape Defined:** Cone  **File Name:** Cone | |
| **Resolution Value: [75 75]**  **Parameter Value : [0 1 0 1]** | **Resolution Value: [12 12]**  **Parameter Value : [0 1 0 1]** |
| *\*Dig.11*  To define a Cone, the definition below is used:  x=cos(2\*pi\*u)\*v;  y=sin(2\*pi\*u)\*v;  z=v;  A **resolution value of [75 75]** and **parameter value of [0 1 0 1]** is used for the Cone shown in Dig.11. | *\*Dig.12*  Dig.12 shows a Cone with a new **resolution value of [12 12]**  As observed, the Cone has also become less smooth and the corner points has becomes more visible. This observation is consistent with the one made in Dig.8 and 10. Details on why the Cone change its shape when there is a new resolution value can be found in Dig.8.  A separate resolution value of [5 5] is also used to check if the Cone will change it shape accordingly to the new resolution value.  *\*Refer to Dig.8 for more detailed explanation on why does the Cone changes it shape when a new resolution value is given.*  *\*Refer to Lab 3🡪Diagrams🡪Cone🡪 Cone\_R5 to see a Cone with the resolution value of [5 5]* |

**Task 2: Define parametrically the different solids and consider converting closed surface into solid object.**

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| **Shape Defined:** Solid Box  **File Name:** Solid\_Box | **Shape Defined:** Solid Sphere  **File Name:** Solid\_Sphere |
| **Solid Box**    A Solid Box can be converted from a 3D Plane surface by adding in a new parameter ‘w’. The parameter ‘w’ defined will allows the original 3D Plane to extend towards the z-axis, hence creating a new Solid Box shape.  The following equation will show how to define a Solid Box with the new parameter:  x=u;  y=v;  z=w;  parameter [0 1 0 1 0 1]  resolution [75 75 75]    *\*To cater for the new parameter ‘w’, additional parameter and resolution value are needed.* | **Solid Sphere**    Similar to a Solid Box, a Solid Sphere is defined by adding a new parameter ‘w’. The definition below will define a Solid Sphere:  x=w\*cos(2\*pi\*u)\*sin(pi\*v);  y=w\*sin(2\*pi\*u)\*sin(pi\*v);  z=cos(pi\*v);  parameter [0 1 0 1 0 1]  resolution [75 75 75]    *\*To cater for the new parameter ‘w’, additional parameter and resolution value are needed.*  A rotational sweeping is done here by the formula: sin(pi\*v). |

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| **Shape Defined:** Solid Cylinder  **File Name:** Solid\_Cylinder | **Shape Defined:** Solid Cone  **File Name:** Solid\_Cone |
| **Solid Cylinder**    To define a Solid Cylinder, 3 parameters will be required and this will result in the following definition for a Solid Cylinder:  x=w\*cos(2\*pi\*u);  y=w\*sin(2\*pi\*u);  z=v;  parameter [0 1 0 1 0 1]  resolution [75 75 75] | **Solid Cone**    A Cone Surface can be converted to a Solid Cone by adding a new parameter ‘w’ to the definition equation of a Cone Surface. The new definition for a Solid Cone will be as follows:  x=w\*cos(2\*pi\*u)\*(1-v);  y=w\*sin(2\*pi\*u)\*(1-v);  z=v;  parameter [0 1 0 1 0 1]  resolution [75 75 75]    *\*To cater for the new parameter ‘w’, additional parameter and resolution value are needed.*  The above Solid Cone is defined by a rotational sweeping. The formula (1-v) is the formula that performs the rotational sweeping on the Solid Cone. |

**Task 3: Use y=sin(x) to make a solid by using rotational and translational sweeping.**

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| **File Name:** y=sin(x) |
| **C:\Users\mock_\Desktop\Yr 3 Sem 1 Modules\CZ2003 Computer Graphics & Visualisation\Labs\Lab 3\Diagrams\y=sin(x)\y=sin(x).PNG** |
| The diagram above shows a solid helix that is defined by the following equation:  x=(0.1\*v\*cos(pi\*2\*u)+0.3+0.5\*w)\*sin(w\*6\*pi+pi/2);  y=-0.5+sin(2\*u\*pi)\*0.1+w;  z=(0.1\*v\*cos(pi\*2\*u)+0.5+0.2\*w)\*cos(w\*6\*pi+pi/2);  Both translational and rotational sweeping method are used to define the Solid Helix. |

**---End of Report---**