

**SCHOOL OF COMPUTER SCIENCE AND ENGINEERING**

CZ2003 Computer Graphics & Visualization Lab 3 Submission

Parametric Surfaces and Solids

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# Lab 3 Tasks

1. Define parametrically in separate files
   * 3D Plane
   * 3D Triangle
   * Bilinear Surface
   * Sphere
   * Ellipsoid
   * Cone
2. Explore how the shapes change when their sampling resolution is changed
3. Define parametrically in separate files
   * Solid Box
   * Solid Sphere
   * Solid Cylinder
   * Solid Cone
4. Consider conversion of any closed surface into a solid object by introducing the third parameter. For example, convert a cylindrical surface into a solid cylinder
5. Study how to make surfaces and solids using the concept of translational and rotational sweeping

# Task 1: Define Parametrically in Separate Files

## 3D Plane

|  |  |
| --- | --- |
| **3D Plane** | **Parametric Equation** |
|  | x = u;  y = u;  z = v;  parameters [0 1 0 1] |

## 3D Triangle

|  |
| --- |
| **3D Triangle** |
|  |
| **Parametric Equation** |
|  |

## Bilinear Surface

|  |
| --- |
| **Bilinear Surface** |
|  |
| **Parametric Equation** |
|  |

## Sphere

|  |  |
| --- | --- |
| **Sphere** | **Parametric Equation** |
|  | x = 0.25\*cos(u\*2\*pi)\*sin(v\*pi);  y = 0.25\*sin(u\*2\*pi);  z = 0.25\*cos(u\*2\*pi)\*cos(v\*pi);  parameters [0 1 0 1] |

## Ellipsoid

|  |  |
| --- | --- |
| **Ellipsoid** | **Parametric Equation** |
|  | x = 0.5\*cos(u\*2\*pi)\*sin(v\*pi);  y = 0.25\*sin(u\*2\*pi);  z = 0.25\*cos(u\*2\*pi)\*cos(v\*pi);  parameters [0 1 0 1] |

## Cone

|  |  |
| --- | --- |
| **Cone** | **Parametric Equation** |
|  | x = u\*cos(2\*v\*pi);  y = -u + 1;  z = u\*sin(2\*v\*pi);  parameters [0 1 0 1] |

# Task 2: Explore How Shape Changes with Sampling Resolution

## 3D Plane

|  |  |
| --- | --- |
| **3D Plane (25 resolution** | **Parametric Equation** |
|  | x = u;  y = u;  z = v;  parameters [0 1 0 1]  resolution [25 25] |
| **3D Plane (3 resolution)** | **Parametric Equations** |
|  | x = u;  y = u;  z = v;  parameters [0 1 0 1]  resolution [3 3] |
| Notes: No changes were observed for 3D plane when resolution was changed, this is due to 3D plane only being made up of 4 straight lines | |

## Sphere

|  |  |
| --- | --- |
| **Sphere (150 resolution)** | **Parametric Equation** |
|  | x = 0.25\*cos(u\*2\*pi)\*sin(v\*pi);  y = 0.25\*sin(u\*2\*pi);  z = 0.25\*cos(u\*2\*pi)\*cos(v\*pi);  parameters [0 1 0 1]  resolution [150 150] |
| **Sphere (25 resolution)** | **Parametric Equation** |
|  | x = 0.25\*cos(u\*2\*pi)\*sin(v\*pi);  y = 0.25\*sin(u\*2\*pi);  z = 0.25\*cos(u\*2\*pi)\*cos(v\*pi);  parameters [0 1 0 1]  resolution [25 25] |
| **Sphere (4 resolution)** | **Parametric Equation** |
|  | x = 0.25\*cos(u\*2\*pi)\*sin(v\*pi);  y = 0.25\*sin(u\*2\*pi);  z = 0.25\*cos(u\*2\*pi)\*cos(v\*pi);  parameters [0 1 0 1]  resolution [4 4] |
| Notes: For a sphere, as the resolution increases, the surface of the sphere becomes smoother but rendering takes a longer time. While with the resolution lowering, the surface starts to become rougher and show signs of edges on surface that should look smooth and rendering time decreases | |

## Solid Cylinder

|  |  |
| --- | --- |
| **Solid Cylinder (150 resolution)** | **Parametric Equation** |
|  | x = u\*cos(2\*v\*pi);  y = w;  z = u\*sin(2\*v\*pi);  parameters [0 1 0 1 0 1]  resolution [150 150 150] |
| **Solid Cylinder (25 resolution)** | **Parametric Equation** |
|  | x = u\*cos(2\*v\*pi);  y = w;  z = u\*sin(2\*v\*pi);  parameters [0 1 0 1 0 1]  resolution [25 25 25] |
| **Solid Cylinder (3 resolution)** | **Parametric Equation** |
|  | x = u\*cos(2\*v\*pi);  y = w;  z = u\*sin(2\*v\*pi);  parameters [0 1 0 1 0 1]  resolution [3 3 3] |
| Notes: similar to how changing the resolution works on sphere | |

# Task 3: Define Parametrically in Separate Files

## Solid Box

|  |  |
| --- | --- |
| **Solid Box** | **Parametric Equation** |
|  | x = u;  y = v;  z = w;  parameters [0 1 0 1 0 1] |

## Solid Sphere

|  |  |
| --- | --- |
| **Solid Sphere** | **Parametric Equation** |
|  | x = w\*cos(2\*u\*pi)\*cos(v\*pi);  y = w\*cos(2\*u\*pi)\*sin(v\*pi);  z = w\*sin(2\*u\*pi);  parameters [0 1 0 1 0 1] |

## Solid Cylinder

|  |  |
| --- | --- |
| **Solid Cylinder** | **Parametric Equation** |
|  | x = u\*cos(2\*v\*pi);  y = w;  z = u\*sin(2\*v\*pi);  parameters [0 1 0 1 0 1] |

## Solid Cone

|  |  |
| --- | --- |
| **Solid Cone** | **Parametric Equation** |
|  | x = v\*u\*cos(2\*w\*pi);  y = -u+1;  z = v\*u\*sin(2\*w\*pi);  parameters [0 1 0 1 0 1] |

# Task 4: Introducing a 3rd Parameter to Change Surface to Solid

A cylindrical surface will only have 2 parameters, u and v. With only the 2 parameter we are unable to create a solid cylinder, by introducing a 3rd parameter w, we will be able to convert the cylindrical surface into a solid. Below shows a cylinder with only 2 parameters (u, v) and another with 3 parameters (u, v, w).

|  |  |
| --- | --- |
| **Cylindrical Surface** | **Parametric Equation** |
|  | x = cos(2\*u\*pi)  y = v;  z = sin(2\*u\*pi);  parameters [0 1 0 1] |

|  |  |
| --- | --- |
| **Solid Cylinder** | **Parametric Equation** |
|  | x = u\*cos(2\*v\*pi);  y = w;  z = u\*sin(2\*v\*pi);  parameters [0 1 0 1 0 1] |

# Task 5: Using Concept of Translation and Rotational Sweeping to Create Surfaces and Solid

|  |  |  |  |
| --- | --- | --- | --- |
| **Translational Sweeping with Cylindrical Surface** | | | |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Translational Sweeping with Solid Cylinder** | | | |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Rotational Sweeping with Cone** | | | |
|  |  |  |  |

|  |  |  |  |
| --- | --- | --- | --- |
| **Rotational Sweeping with Solid Cone** | | | |
|  |  |  |  |