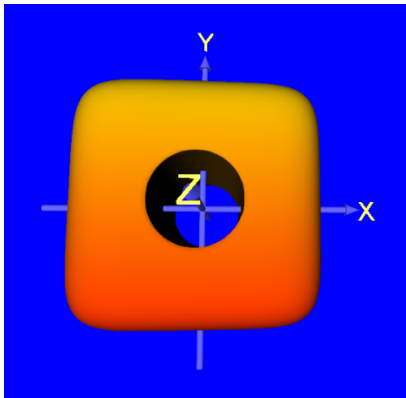# CZ2003 Computer Graphics and Visualisation

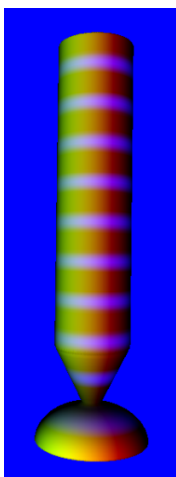Experiment 4: Implicit Solids

Name: Ngo Jun Hao Jason

Matriculation Number: XXXXXXXXX

Lab Group: XXX

Exercise 1

Exercise 2

- plane halfspace
  - line > 0
- ellipsoid
  - $1 - (x/a)^2 - (y/b)^2 - (z/c)^2 > 0$
- cylinder
  - $1 - (x/a)^2 - (y/b)^2 > 0$
- cone
  - $(z/c)^2 - (x/a)^2 - (y/b)^2 > 0$

- start with infinite cylinder with radius 1 going through x-z plane:
  - $1 - (x/1)^2 - (z/1)^2 > 0$
  - $infCylinder = 1 - (x/1)^2 - (z/1)^2$
- plane halfspace used to cut bottom of infinite cylinder:
  - y > 1
   - y - 1 > 0
  - bottomPlane = y - 1
- half-infinite cylinder:

- o min(infCylinder, bottomPlane) > 0
- plane halfspace used to cut top of half-infinite cylinder:
  - o y < 2
    - ▪ 2 - y > 0
  - o topPlane = 2 - y
- finite cylinder:
  - o min(min(infCylinder, bottomPlane), topPlane) > 0
  - o cylinder = min(min(infCylinder, bottomPlane), topPlane)

- infinite cone with height of 2, radius of 1, going through x-z plane:
  - o $(y/2)^2 - (x/1)^2 - (z/1)^2 > 0$
  - o infCone = $(y/2)^2 - (x/1)^2 - (z/1)^2$
- plane halfspace used to cut bottom of infinite cone:
  - o y > 0
  - o bottomPlane = y
- half-infinite cone:
  - o min(infCone, bottomPlane) > 0
- plane halfspace used to cut top of half-infinite cone:
  - o y < 1
    - ▪ 1 - y > 0
  - o topPlane = 1 – y
- finite cone:
  - o min(min(infCone, bottomPlane), topPlane) > 0
  - o cone = min(min(infCone, bottomPlane), topPlane)
- pencil:
  - o max(cylinder, cone) > 0
  - o pencil = max(cylinder, cone)

- ellipsoid with radius of 1.5 in x- and z-direction, radius of 1 in y-direction, and offset of 0.5 in negative y-direction :
  - o $1 - (x/1.5)^2 - ((y+0.5)/1)^2 - (z/1.5)^2 > 0$
  - o ellipsoid = $1 - (x/1.5)^2 - ((y+0.5)/1)^2 - (z/1.5)^2$
- plane halfspace used to cut bottom of ellipsoid:
  - o y > -0.5
    - ▪ y + 0.5 > 0
  - o bottomPlane = y + 0.5
- half-ellipsoid:
  - o min(ellipsoid, bottomPlane) > 0
  - o pencilStand = min(ellipsoid, bottomPlane)

- pencilOnStand (final shape):

o   max(pencil, pencilStand) > 0
o   pencilOnStand = max(pencil, pencilStand)

Exercise 3

- bounding box centre: 0 5 0
- bounding box size: 3 12 3
- resolution: [150 150 150]

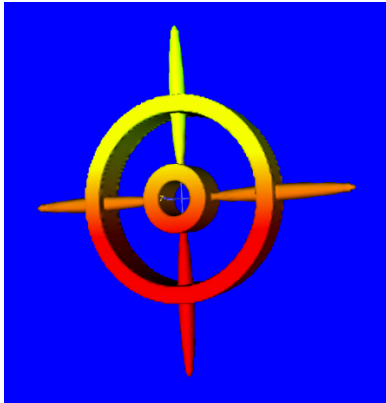## Exercise 4
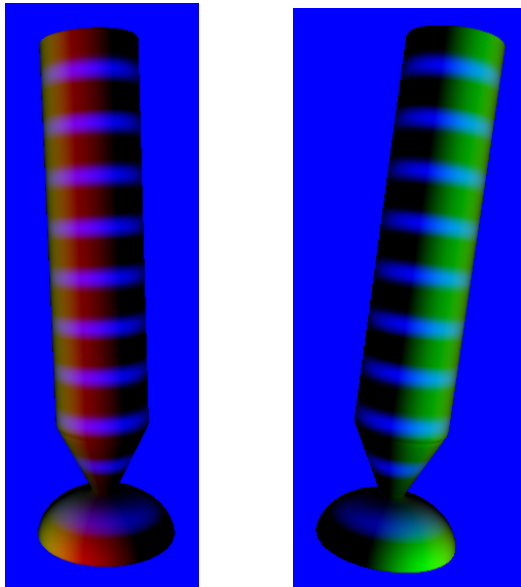
- r = (u + w)/2
- g = w
- b = sin(2π*v)

Exercise 5

- refer to the folder "Created_Shapes"

Exercise 6

- refer to this report

Additional Shape

- ship's steering wheel (under the folder "Created_Shapes)
    - o I have trouble rendering the slanted rods, so I left them out
        - ▪ it was possible to render 1 of them at a time, but not as a whole
    - o code for one slant rod:
        - ▪ slant_slice = min(x+0.3-y,y-x+0.3);
        - ▪ depth_slice = min(z+0.3,0.3-z);
        - ▪ intermediate_slice = min(depth_slice, slant_slice);
        - ▪ end_slice = min(y+x-1,8-x-y);
        - ▪ north_east_rod = min(intermediate_slice, end_slice));