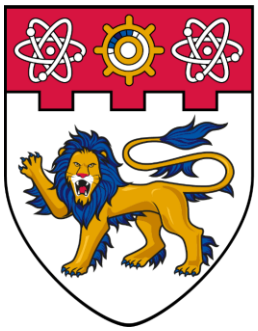


NANYANG TECHNOLOGICAL UNIVERSITY
SINGAPORE

CZ2003 COMPUTER GRAPHICS & VISUALIZATION

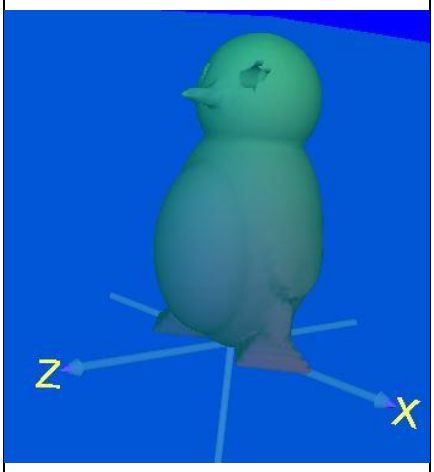
EXPERIMENT 4: IMPLICIT SOLIDS

LAB REPORT

Shearman Chua Wei Jie (U1820058D)

LAB GROUP: SS2

Complex Implicit Solid

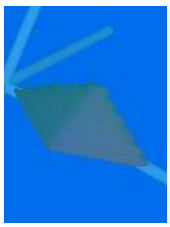


The code for the following experiment can be found in the file "lab4.wrl"
On the left is the snapshot of the final implicit solid generated using the following function:

```
frep(x,y,z,t){
        feet1=min(min(min(z,y),(5/3)*x - (5/2)*y - (5/3)*z + 1),-6*x - 9*y - 6*z);
        feet2=min(min(min(z,y),6*x - 9*y - 6*z),-(5/3)*x - (5/2)*y - (5/3)*z + 1);
        leg1= min(min(min(0.1^2-(x+0.3)^2-z^2,y),0.4-y),z);
        fulleg1= max(min(min(min(0.1^2-(x+0.3)^2-z^2,y),0.3-y),z),min(min(min(z,y),(5/3)*x - (5/2)*y - (5/3)*z + 1),-6*x - 9*y - 6*z));
        leg2= min(min(min(0.1^2-(x-0.3)^2-z^2,0.4-y),y),z);
        fulleg2=max(min(min(min(0.1^2-(x-0.3)^2-z^2,0.3-y),y),z),min(min(min(z,y),6*x - 9*y - 6*z),-(5/3)*x - (5/2)*y - (5/3)*z + 1));
        body = 0.4^2-x^2-((0.7*(y-0.2))-0.25)^2-(z/0.9)^2;
        bod= 0.427^2-x^2-((0.7*(y-0.06))-0.25)^2-(z/0.9)^2;
        body2=0.3^2-x^2-((0.7*(y-0.15))-0.25)^2-((z-0.2)/0.9)^2;
        wing1=1-(5*z)^2-((10/3)*y-1.2)^2;
        wingfinal=min(min(1-(5*z)^2-((10/3)*y-2.1)^2,0.42+x),0.42-x);
        wingtap=min(wingfinal,bod);
        head=max(min(min(0.3^2-x^2-(y-1.2)^2-z^2,-min(0.05^2-(x+0.15)^2-(y-1.3)^2,z-0.1)),-min(0.05^2-(x-0.15)^2-(y-1.3)^2,z-0.1)),beak);
        eye1=min(0.05^2-(x+0.15)^2-(y-1.3)^2,z-0.1);
        eye2=min(0.05^2-(x-0.15)^2-(y-1.3)^2,z-0.1);
        beak=min((z-0.6)^2 - ((x)^2)/0.2^2 - ((y-1.2)^2)/0.2^2,min(min(0.1^2-(x)^2-(y-1.2)^2,z-0.1),0.5-z));
        final = max(max(max(max(max(fulleg1,body),fulleg2),wingtap),head),body2);

        return final;}
```

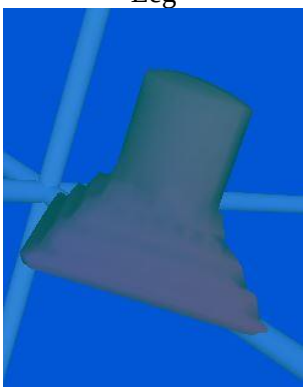
The complex implicit solid is a penguin and in order to make the final function less complex, each body part of the penguin is broken down and given a label.

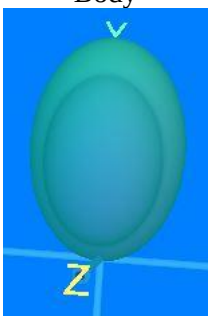


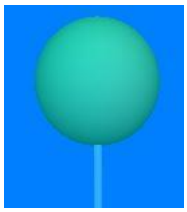
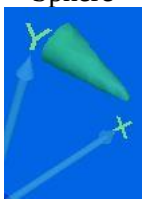
Feet

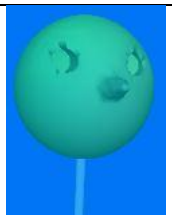
The "feet" of the penguin is created from a pyramid solid object with the plane halfspace z >= 0.

```
feet2=min(min(min(z,y),6*x - 9*y - 6*z),-(5/3)*x - (5/2)*y - (5/3)*z + 1);
```

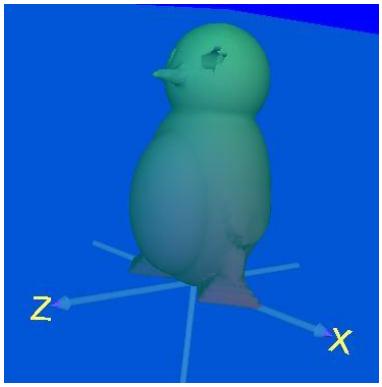

Leg
 
Full Leg
	The “leg” of the penguin is created using a cylinder solid object intersected with the plane halfspace z >= 0.
	
	leg2= min(min(min(0.1^2-(x-0.3)^2-z^2,0.4-y),y),z);
	
	By using the union of the “feet” and “leg” objects, we obtain the full leg of the penguin with the equation:
	
	fulleg2=max(min(min(min(0.1^2-(x-0.3)^2-z^2,0.3-y),y),z),min(min(min(z,y),6*x - 9*y - 6*z),-(5/3)*x - (5/2)*y - (5/3)*z + 1));


Body
 
Full body
	The “body” of the penguin is fist created using an ellipsoid according to the following equation:
	
	body = 0.4^2-x^2-((0.7*(y-0.2))-0.25)^2-(z/0.9)^2;
	
	Then, to make the body look more like the body of a penguin, we union the larger body with another smaller ellipsoid to obtain the final body as shown on the left.
	
	body = 0.4^2-x^2-((0.7*(y-0.2))-0.25)^2-(z/0.9)^2;
	body2=0.3^2-x^2-((0.7*(y-0.15))-0.25)^2-((z-0.2)/0.9)^2;
	fullbod = max(body,body2);


Sphere
 
Beak
	In order to make the “head” of the penguin, we first create a solid sphere object using the equation:
	
	sphere= 0.3^2-x^2-(y-1.2)^2-z^2;
	
	Next, we create the “beak” of the penguin using a cone solid object with the equation:
	
	beak=min((z-0.6)^2 - ((x)^2)/0.2^2 - ((y-1.2)^2)/0.2^2,min(min(0.1^2-(x)^2-(y-1.2)^2,z-0.1),0.5-z));


Head
	Finally, the head is obtained by the union of the head and the beak, and the “eyes” of the penguin are obtained by the subtraction of two cylindrical objects from the sphere.
	
	eye1=min(0.05^2-(x+0.15)^2-(y-1.3)^2,z-0.1);
	eye2=min(0.05^2-(x-0.15)^2-(y-1.3)^2,z-0.1);
	head=max(min(min(0.3^2-x^2-(y-1.2)^2-z^2,-min(0.05^2-(x+0.15)^2-(y-1.3)^2,z-0.1)),-min(0.05^2-(x-0.15)^2-(y-1.3)^2,z-0.1)),beak);


Cylinder
 
Wing
	In order to make the “wings” of the penguin, we first create an elliptical cylinder solid object as seen on the left with the equation:
	
	wingfinal=min(min(1-(5*z)^2-((10/3)*y-2.1)^2,0.42+x),0.42-x);
	
	In order to taper the cylinder so that the wings look more curved, we used the cylinder obtain and intersect it with an ellipsoid object to obtain the figure shown on the left with the equation:
	
	bod= 0.427^2-x^2-((0.7*(y-0.06))-0.25)^2-(z/0.9)^2;
	wingtap=min(wingfinal,bod);

	We set a variable colour through the function-defined diffuse colour according to the equation: diffuseColor "r=(u+0.2)/2+0.3; g=(v+0.1)/2; b=(w+0.3)/2+.2;"