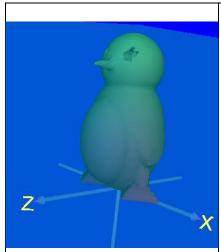


CZ2003 COMPUTER GRAPHICS & VISUALIZATION EXPERIMENT 4: IMPLICIT SOLIDS LAB REPORT

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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($0.1^2-(x+0.3)^2-z^2,y$),0.4-y),z); fulleg1= max(min(min($0.1^2-(x+0.3)^2-z^2,y$))

 $z^2,y,0.3-y,z,\min(\min(\min(z,y),(5/3)*x - (5/2)*y - (5/3)*z + 1),-6*x - 9*y - 6*z);$

$$\begin{split} leg2 &= min(min(min(0.1^2 - (x-0.3)^2 - z^2, 0.4 - y), y), z); \\ & fulleg2 = max(min(min(min(0.1^2 - (x-0.3)^2 - z^2, 0.3 - y), y), z), \\ & min(min(min(z, y), 6*x - 9*y - 6*z), -(5/3)*x - (5/2)*y - (5/3)*z + 1)); \end{split}$$

 $body = 0.4^2-x^2-((0.7*(y-0.2))-0.25)^2-(z/0.9)^2;\\bod = 0.427^2-x^2-((0.7*(y-0.06))-0.25)^2-(z/0.9)^2;\\body = 0.3^2-x^2-((0.7*(y-0.15))-0.25)^2-((z-0.2)/0.9)^2;$

wing $1=1-(5*z)^2-((10/3)*y-1.2)^2$; wing final=min(min(1-(5*z)^2-((10/3)*y-1.2)^2)

2.1)²,0.42+x),0.42-x);

wingtap=min(wingfinal,bod);

$$\label{eq:head-max} \begin{split} head=& max(min(min(0.3^2-x^2-(y-1.2)^2-z^2,-min(0.05^2-(x+0.15)^2-(y-1.3)^2,z-0.1)), -min(0.05^2-(x-0.15)^2-(y-1.3)^2,z-0.1)), beak); \end{split}$$

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($(z-0.6)^2-((x)^2)/0.2^2-((y-1.3)^2)$

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(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.

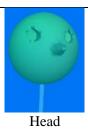


Feet

The "feet" of the penguin is created from a pyramid solid object with the plane halfspace $z \ge 0$.

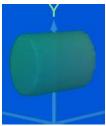
feet2=min(min(min(z,y),6*x - 9*y - 6*z),-(5/3)*x - (5/2)*y - (5/3)*z + 1);

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(c).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)); Full Leg 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; 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-0.2))-0.25)^2-(z/0.9)^2; body2=0.3^2-x^2-((0.7*(y-0.15))-0.25)^2-(z/0.9)^2; full body 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-z,z-0.1),0.5-z));		
leg2= min(min(min(0.1^2-(x-0.3)^2-z^2,0.4-y),y),z); Leg 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),z),min(min(min(x,y),6*x - 9*y - 6*z),-(5/3)*x - (5/2)*y - (5/3)*z + 1)); Full Leg 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; body = 0.4^2-x^2-((0.7*(y-0.2))-0.25)^2-(z/0.9)^2; body = 0.4^2-x^2-((0.7*(y-0.2))-0.25)^2-(z/0.9)^2; body = 0.4^2-x^2-((0.7*(y-0.15))-0.25)^2-((z-0.2)(0.9)^2; full body = max(body,body2); 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-	Va	
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beak=min($(z-0.6)^2 - ((x)^2)/0.2^2 - ((y-0.6)^2)$	Sphere	
		object with the equation:
$(1.2)^2/0.2^2$, min(min(0.1^2-(x)^2-(y-1.2)^2,z-0.1),0.5-z));	X	11 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1
	D1-	1.2 <i>)</i> , 7.2), 0.2, 7.1 min(min(0.1, 7.2-(X), 7.2-(Y-1.2), 7.2-0.1), 0.3-Z));
Beak	Веак	



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.

 $\begin{array}{l} eye1=min(0.05^2-(x+0.15)^2-(y-1.3)^2,z-0.1);\\ eye2=min(0.05^2-(x-0.15)^2-(y-1.3)^2,z-0.1);\\ head=max(min(min(0.3^2-x^2-(y-1.2)^2-z^2,-min(0.05^2-(x+0.15)^2-(y-1.3)^2,z-0.1)),-min(0.05^2-(x-0.15)^2-(y-1.3)^2,z-0.1)),beak);\\ \end{array}$



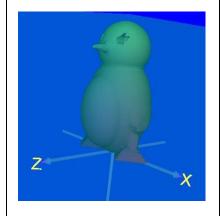
In order to make the "wings" of the penguin, we first create an elliptical cylinder solid object as seen on the left with the equation:

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;"