Geometric Morphing with the Vertex Shader

Morphing a Sphere into a Circle

Blend = 0.00
Blend = 0.25
Blend = 0.50
Blend = 0.75
Blend = 1.00
vertex shader:

```glsl
uniform float uOffsetS, uOffsetT, uBlend;
out vec2 vST;
out float vLightIntensity;
out vec3 vColor;

const float TWOPI = 2.*3.14159265;
Const vec3 LIGHTPOS = vec3( 5., 10., 10. );

// original model coords (sphere):
vec4 vertex0  = gl_Vertex;
vec3 norm0   = gl_Normal;

// circle coords:

vST= gl_MultiTexCoords0.st;
float radius = 1. - vST.t;
float theta = TWOPI * vST.s;
vec4  circle = vec4( radius*cos(theta), radius*sin(theta), 0., 1. );
vec3  circlenorm = vec3( 0., 0., 1. );

vST += vec2( uOffsetS, uOffsetT );

// blend:
vec4 theVertex = mix( vertex0, circle, uBlend );
vec3 theNormal = normalize(  mix( norm0, circlenorm, uBlend )  );

// do the lighting:
vec3 tnorm = normalize( vec3( gl_NormalMatrix * theNormal ) );
vec3 ECposition = vec3( gl_ModelViewMatrix * theVertex );
vLightIntensity = abs( dot( normalize(LIGHTPOS - ECposition), tnorm ) );
vColor = gl_Color.rgb;

gl_Position = gl_ModelViewProjectionMatrix * theVertex;
```

A possible vis application ??
What an interesting 2D view of Earth!
Morphing a Cow into a Sphere

```cpp
vec4 vertex = gl_Vertex;
vertex.xyz *= 4.0 / length(vertex.xyz);
```

Note: the “face” in the sphere cow is there because the normals were not morphed into sphere normals – they were left as cow normals.

基本上将所有顶点坐标缩放为距离原点4.0。基本上将所有顶点坐标缩放为距离原点4.0，然后将坐标限制在范围−2.0到+2.0。

Morphing a Cow into a Cube

```cpp
const float SIDE = 2.0;
vec4 vertex = gl_Vertex;
vertex.xyz *= 4.0 / length(vertex.xyz);
vertex.xyz = clamp(vertex.xyz, -SIDE, SIDE);
```

Note: the “face” in the cube cow is there because the normals were not morphed into cube normals – they were left as cow normals.

基本上将所有顶点坐标缩放为距离原点4.0，然后将坐标限制在范围−2.0到+2.0。
**What If We Go Outside the 0. to 1. Range for t?**

- $t = -1.$: more cow and negative sphere
- $t = 0.$: all cow and zero sphere
- $t = +1.$: zero cow and all sphere
- $t = +2.$: negative cow and more sphere

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**For you movie fans, what about “Real Morphing”?**

“Real Morphing” involves interpolating key points from one object into key points in another. This flies in the face of graphics hardware’s philosophy of dealing with one triangle and then getting rid of any record of it. Movies do this in software. We got away with it in our class because we knew the equation of a disk, a sphere, and a cube and so could interpolate in a vertex shader.

The first movie-morphing I remember seeing is from the fantasy movie *Willow*:

https://www.youtube.com/watch?v=IKzbsDG58pc

The "making of" video for this is here:

https://www.youtube.com/watch?v=kxVwNjZDQJ0

But, my nomination for #1 morphing ever is in Michael Jackson’s *Black or White* video:

https://www.youtube.com/watch?v=F2AitTP15U0

The morphing starts at around 05:30.