Stripes, Rings, and Dots!

Oregon State University

Mike Bailey

mjb@cs.oregonstate.edu

Cartesian (X) Stripes

stripes.glib

```
##OpenGL GLIB

Perspective 90
LookAt  0 0 2   0 0 0   0 1 0

Vertex      stripes.vert
Fragment  stripes.frag
Program    Stripes                              \
                uA <0 1. 10>                    \
                uP <0. .25 1.>                  \
                uTol <0. 0. .5>                 \
                uAmp <-5. 0. 5.>                \
                uFreq <0. 10. 20.>
Color    1.0  0.5   0.0
Sphere 1.  200  200
```

Cartesian (X) Stripes

stripes.vert

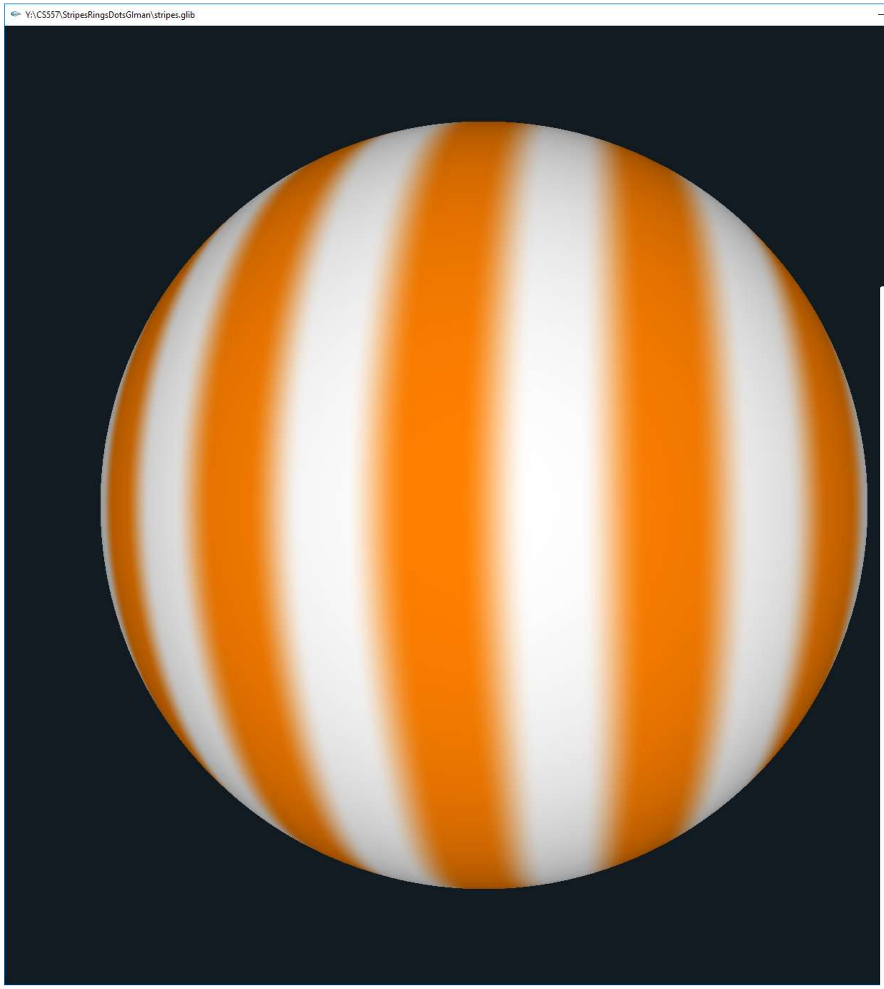
```
#version 330 compatibility

uniform float  uAmp;                    // amplitude of sine wave
uniform float  uFreq;                   // frequency of sine wave

out vec3  vColor;
out float  vX, vY;
out float  vLightIntensity;

const vec3 LIGHTPOS = vec3( 0., 0., 10. );    // light position

void
main( )
{
                vec3 tnorm = normalize( gl_NormalMatrix * gl_Normal );
                vec3 ECposition = ( gl_ModelViewMatrix * gl_Vertex ).xyz;
                vLightIntensity  = abs( dot( normalize(LIGHTPOS - ECposition), tnorm ) );

                vColor = gl_Color.rgb;
                vec3 MCposition = gl_Vertex.xyz;                // model coordinates
                vX = MCposition.x;
                vY = MCposition.y;

                // vX = vX + uAmp * sin( uFreq * vY );

                gl_Position = gl_ModelViewProjectionMatrix * gl_Vertex;
}
```

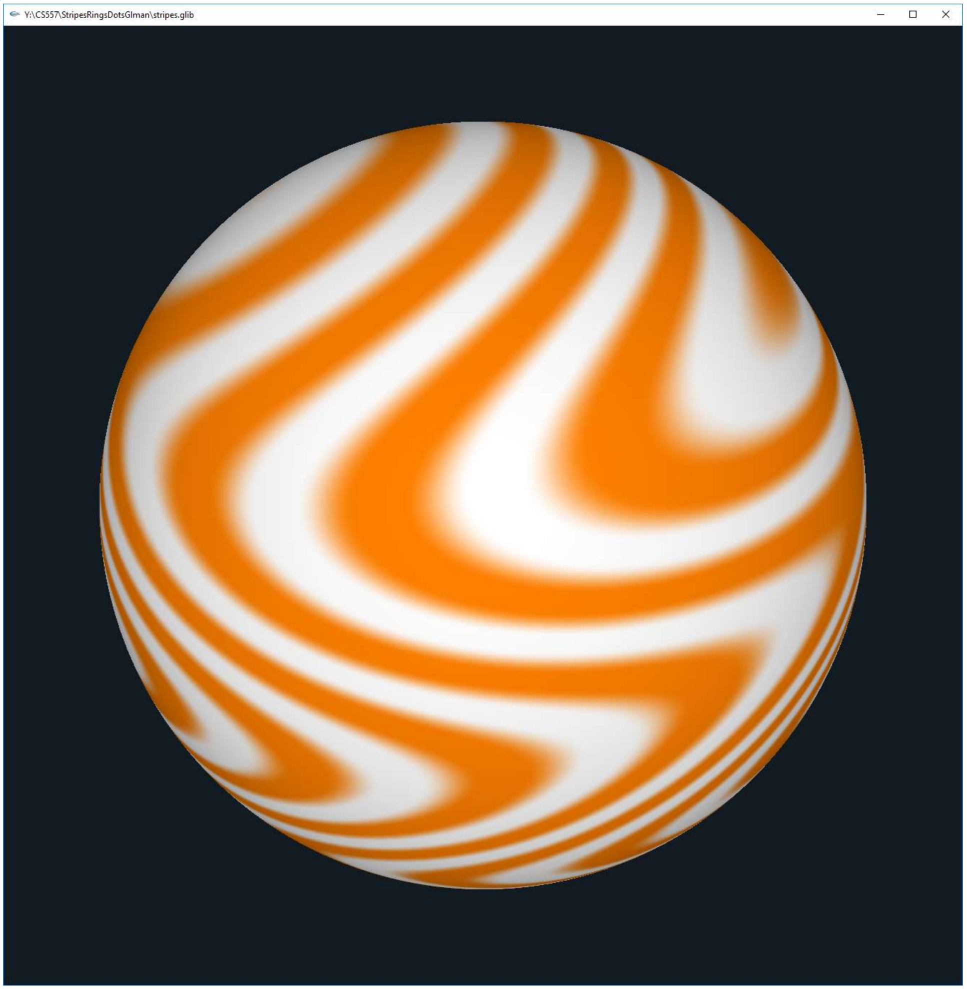
Cartesian (X) Stripes

stripes.frag

```
#version 330 compatibility

uniform float uA;
uniform float uP;
uniform float uTol;

in float   vX, vY;
in vec3  vColor;
in float   vLightIntensity;

const vec3 WHITE = vec3( 1., 1., 1. );

void
main( )
{
        float f = fract( uA*vX );

        float t = smoothstep( 0.5-uP-uTol, 0.5-uP+uTol, f )  -  smoothstep( 0.5+uP-uTol, 0.5+uP+uTol, f );
        vec3 rgb = vLightIntensity * mix( WHITE, vColor, t );
        gl_FragColor = vec4( rgb, 1. )p;
}
```

Cartesian (X) Stripes





Rings

rings.glib

```
##OpenGL GLIB

Perspective 90
LookAt  0 0 2   0 0 0   0 1 0

Vertex      rings.vert
Fragment  rings.frag
Program   Rings                                   \
                    uA <0 5. 10>                  \
                    uP <0. .25 1.>                \
                    uTol <0. 0. .5>
Color    1.  0.5  0.
Sphere 1.  200  200
```

Rings

rings.vert

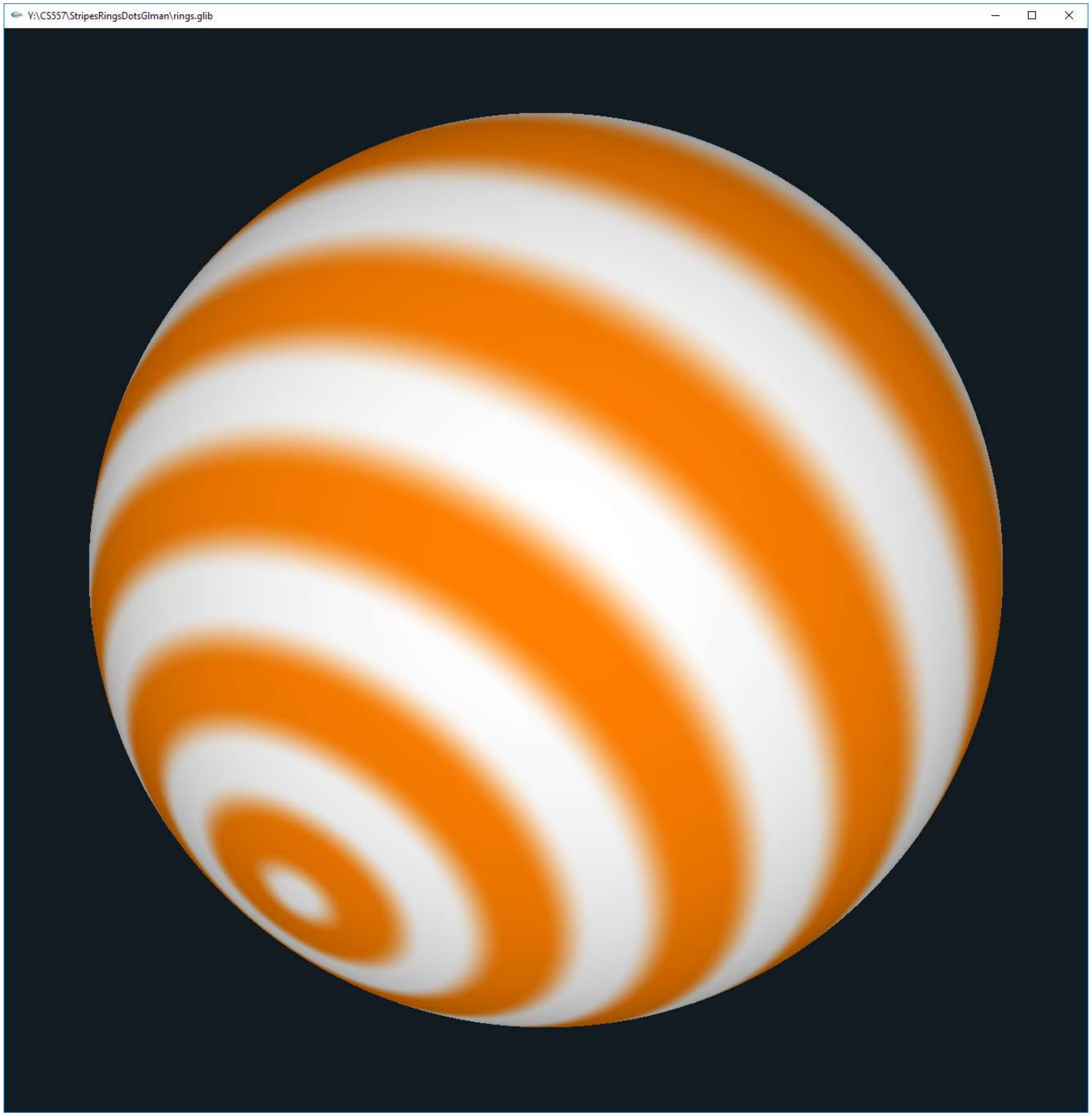
```
#version 330 compatibility

uniform float  uAmp;
uniform float  uFreq;

out vec3  vColor;
out float vX, vY;
out float vLightIntensity;

const vec3 LIGHTPOS = vec3( 0., 0., 10. );

void
main( )
{
        vec3 tnorm = normalize( gl_NormalMatrix * gl_Normal );
        vec3 ECposition = ( gl_ModelViewMatrix * gl_Vertex ).xyz;
        vLightIntensity  = abs( dot( normalize(LIGHTPOS - ECposition), tnorm ) );

        vColor = gl_Color.rgb;
        vec3 MCposition = gl_Vertex.xyz;
        vX = MCposition.x;
        vY = MCposition.y;

        gl_Position = gl_ModelViewProjectionMatrix * gl_Vertex;
}
```

Rings

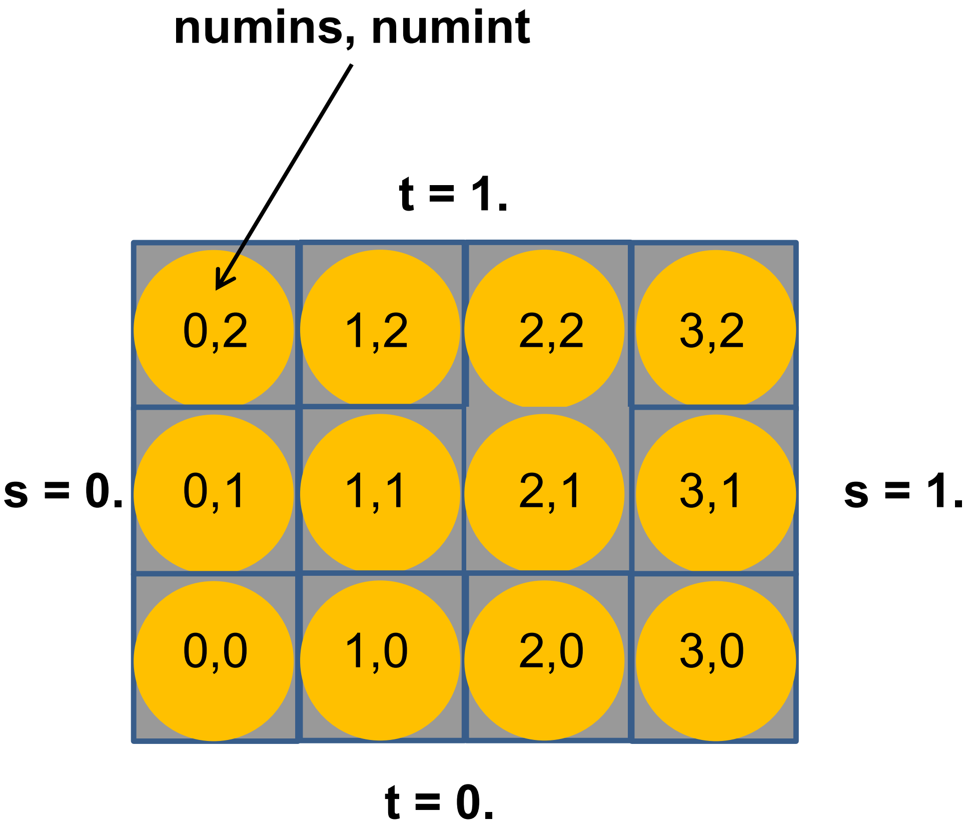
rings.frag

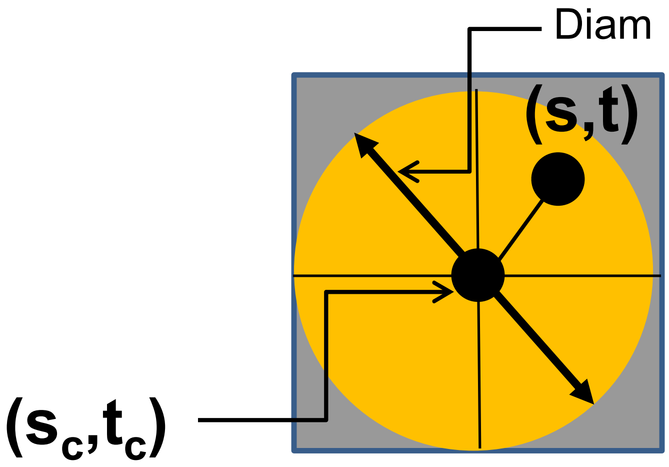
```
#version 330 compatibility

uniform float uA;
uniform float uP;
uniform float uTol;

in float   vX, vY;
in vec3  vColor;
in float  vLightIntensity;

const vec3 WHITE = vec3( 1., 1., 1. );

void
main( )
{
        float r = sqrt( vX*vX + vY*vY );
        float rfrac = fract( uA*r );

        float t =     smoothstep( 0.5-uP-uTol, 0.5-uP+uTol, rfrac )  -
                      smoothstep( 0.5+uP-uTol, 0.5+uP+uTol, rfrac );            // "smoothpulse"

        vec3 rgb = vLightIntensity *  mix( WHITE, vColor, t );
        gl_FragColor = vec4( rgb, 1. );
}
```

Rings (= Polar Stripes)



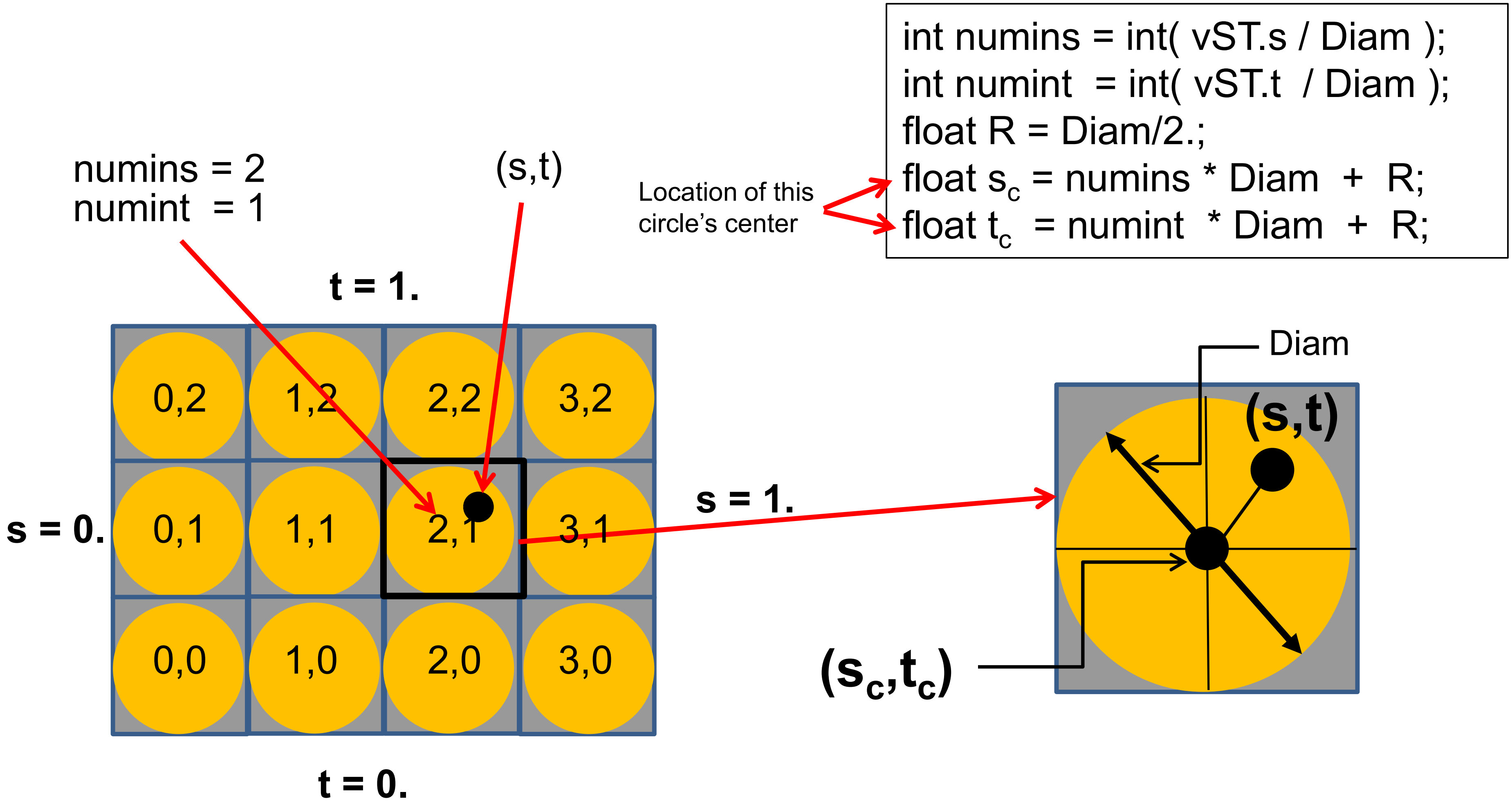
Circular Dots are a “Local Pattern”





$$(s - s_c)^2 + (t - t_c)^2 \le \left(\frac{Diam}{2.}\right)^2$$

Circular Dots

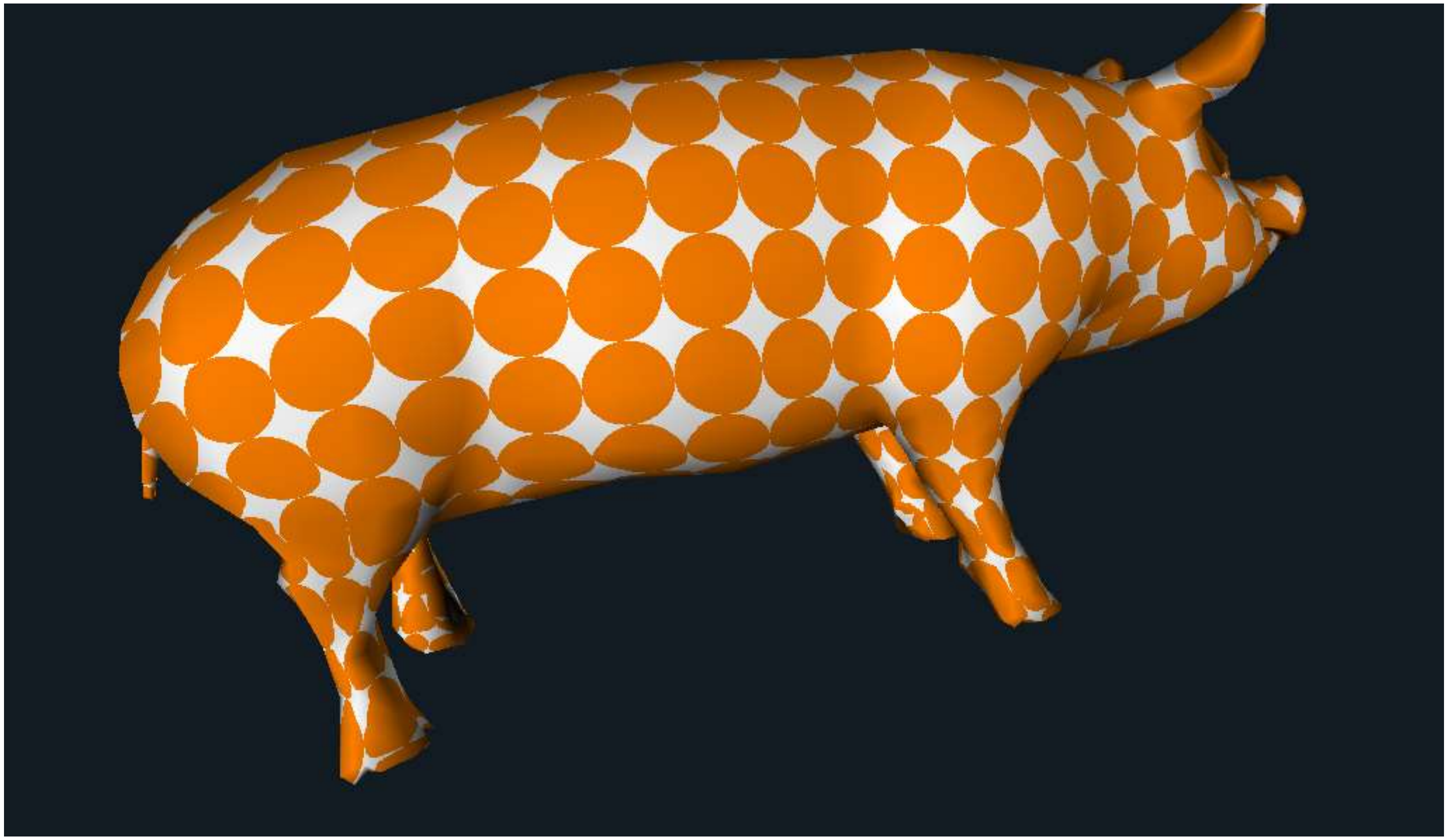


```
int numins = int( vST.s / Diam );
int numint  = int( vST.t  / Diam );
float R = Diam/2.;
float sc = numins * Diam  +  R;
float tc  = numint  * Diam  +  R;
```

Location of this circle's center

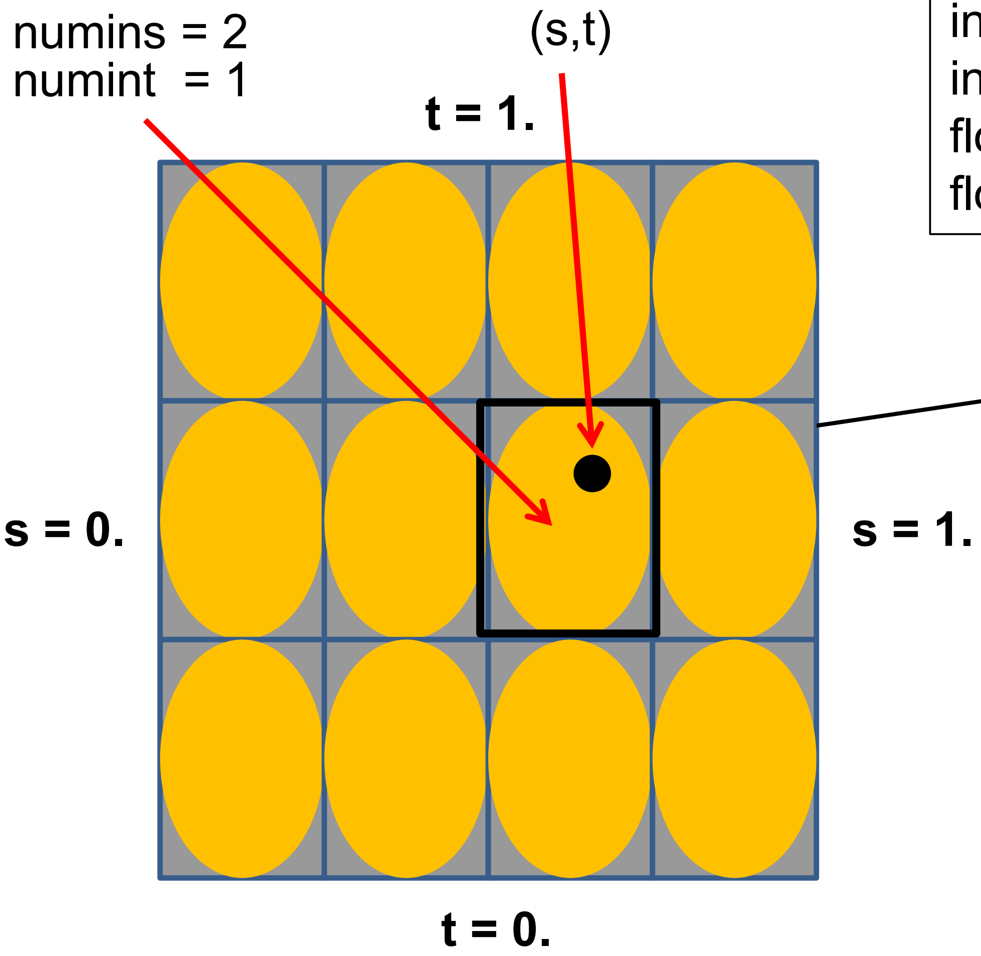
$$(s - s_c)^2 + (t - t_c)^2 \leq (R)^2$$

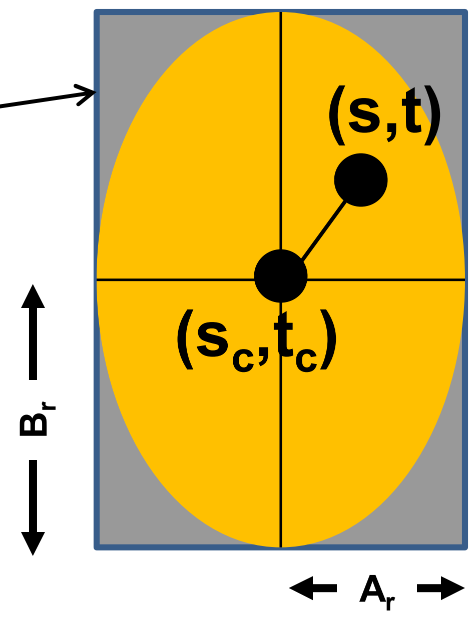
Circular Dots



Elliptical Dots

```
float Ar = Ad/2.;
float Br = Bd/2.;
int numins = int( vST.s / Ad );
int numint  = int( vST.t / Bd );
float sc = numins *Ad  +   Ar;
float tc = numint  *Bd   +  Br;
```

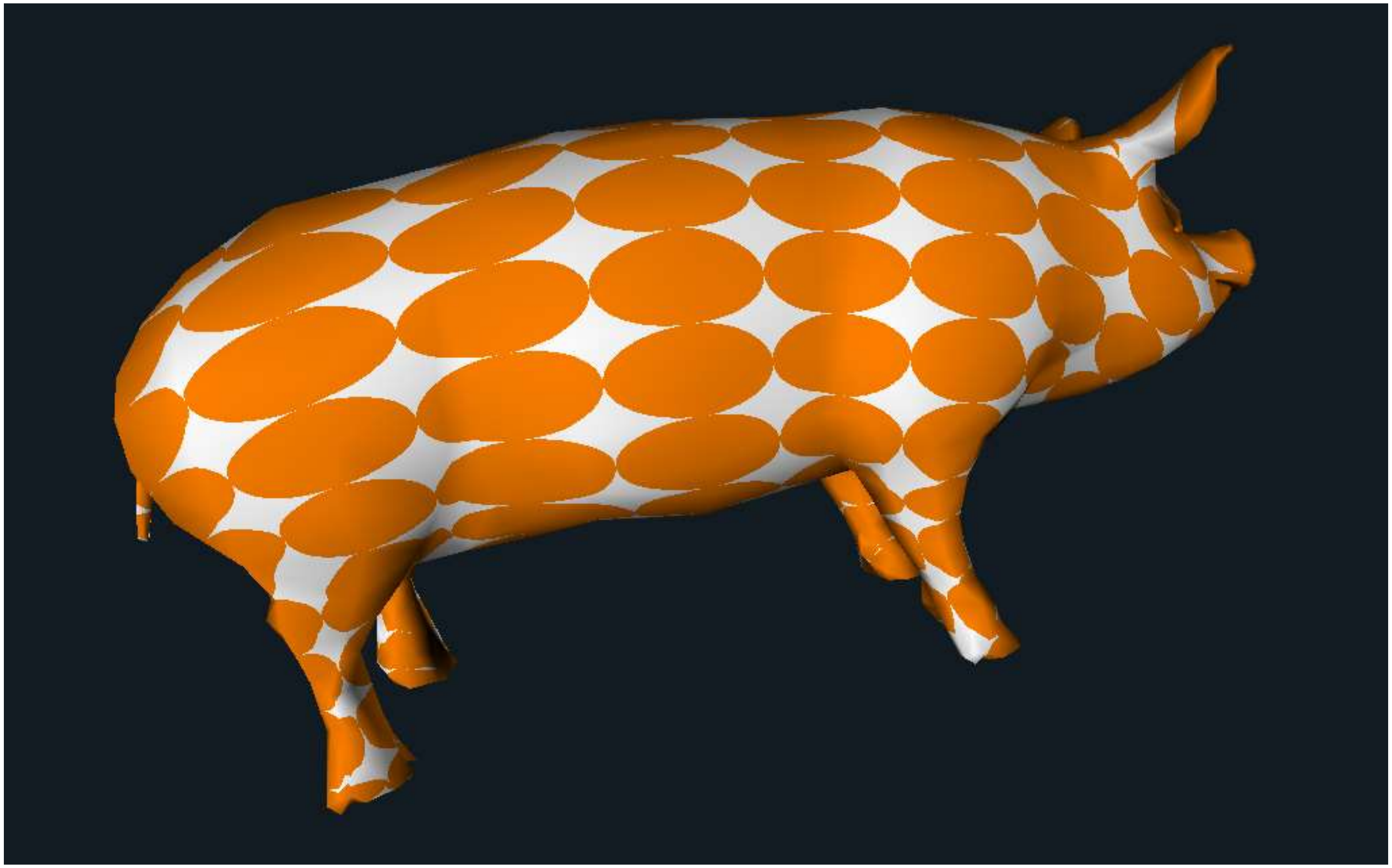




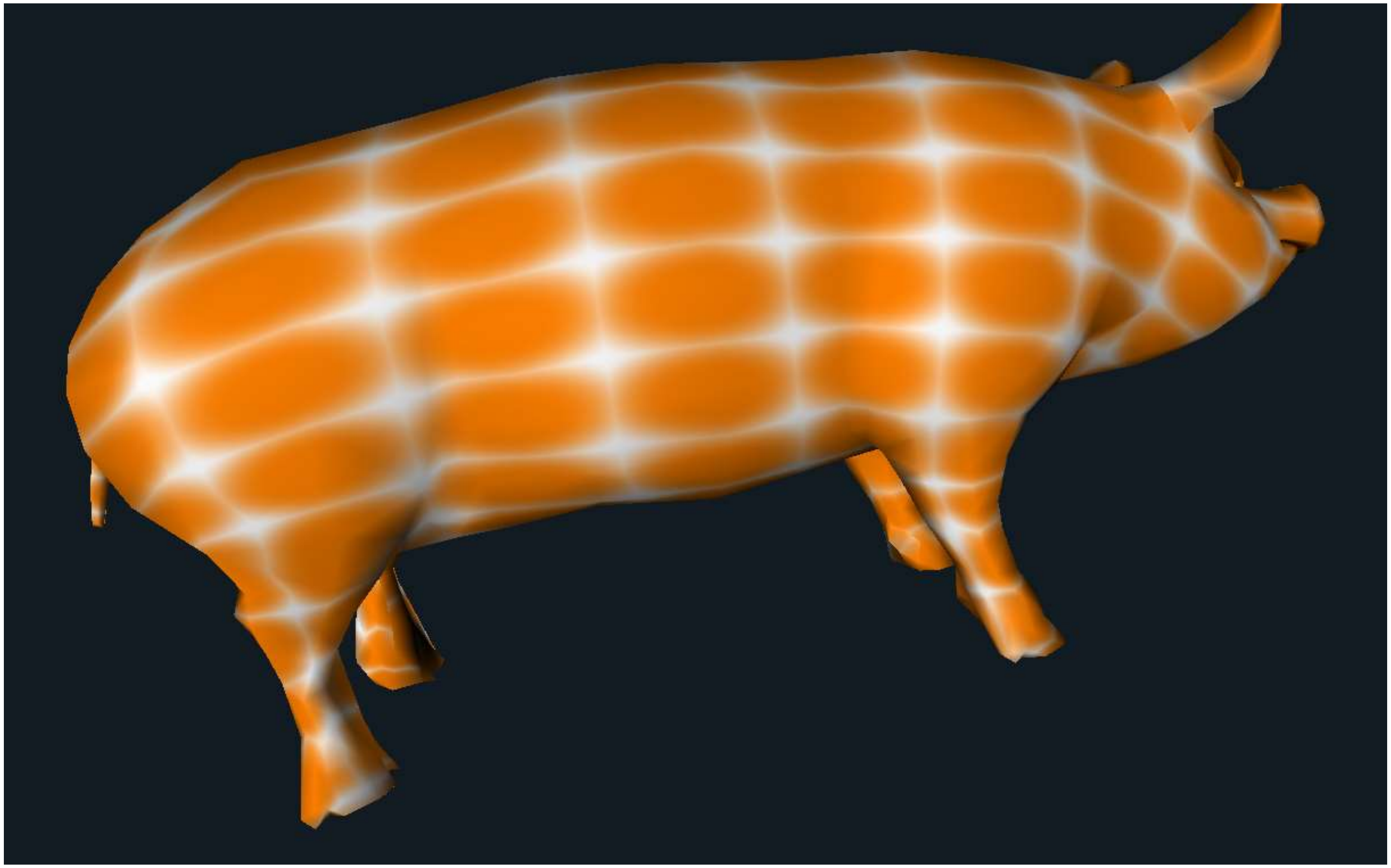
$$(s-s_c)^2+(t-t_c)^2 \le R^2 \Rightarrow \left(\frac{s-s_c}{R}\right)^2+\left(\frac{t-t_c}{R}\right)^2 \le 1 \Rightarrow \left(\frac{s-s_c}{A_r}\right)^2+\left(\frac{t-t_c}{B_r}\right)^2 \le 1$$

Circle **Circle** **Ellipse**

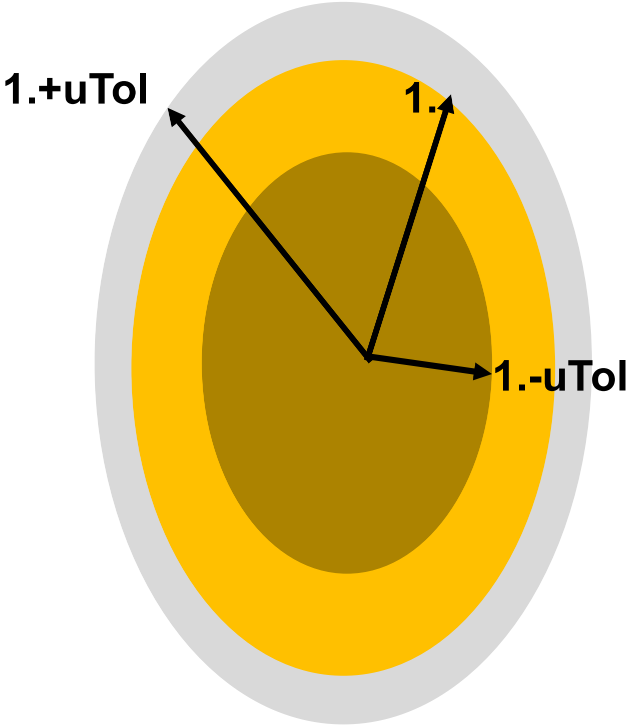
Elliptical Dots

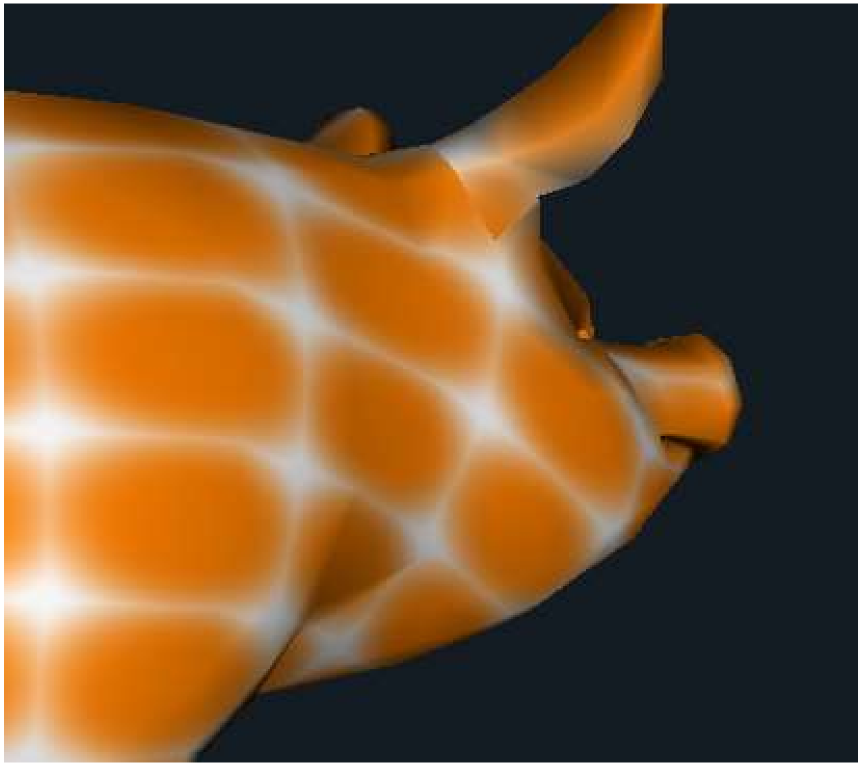


Elliptical Dots with Tolerance



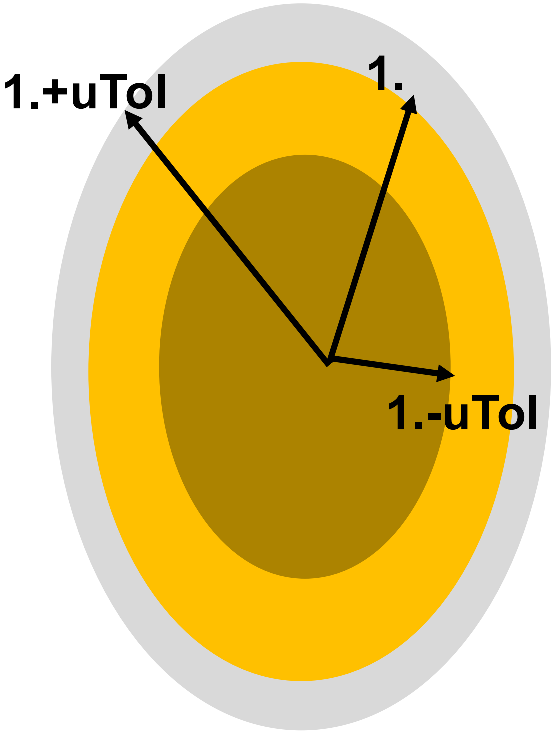
Elliptical Dots with Tolerance

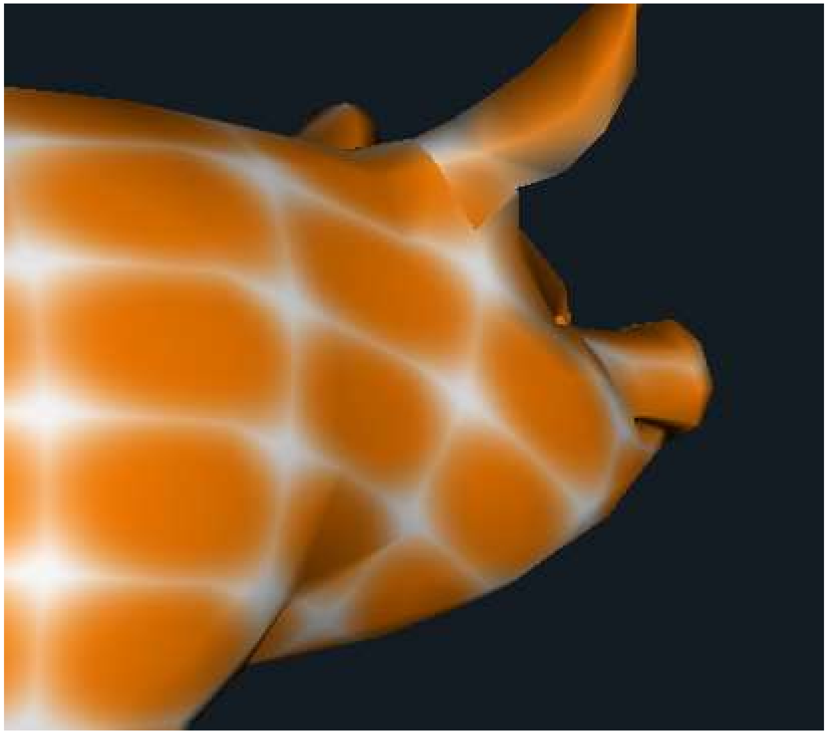




$$1 - uTol \;\le\; \left(\frac{s-s_c}{A_r}\right)^2 + \left(\frac{t-t_c}{B_r}\right)^2 \le 1 + uTol$$

Elliptical Dots with Tolerance





$$1 - uTol \le \left(\frac{s - s_c}{A_r}\right)^2 + \left(\frac{t - t_c}{B_r}\right)^2 \le 1 + uTol$$

$$float\ d = \left(\frac{s - s_c}{A_r}\right)^2 + \left(\frac{t - t_c}{B_r}\right)^2$$

Inside the ellipse, d < 1.
At the boundary of the ellipse, d = 1.
Outside the ellipse, d > 1.

```
float t = smoothstep( 1.-uTol,  1.+uTol, d );
vec3 color = mix( ORANGE, WHITE, t );
```

Soon we will see how to create patterns using elliptical dots with Noise!