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Using Noise to Automatically Generate Generic Terrain

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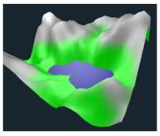

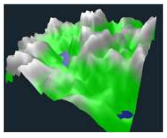

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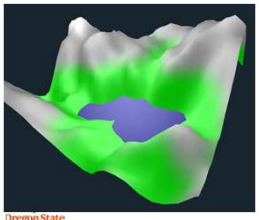
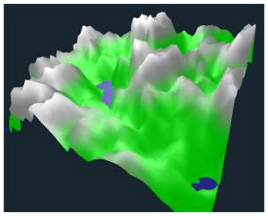
The General Idea

Use noise to determine terrain heights. Utilize as many different parameters as we can to give a variety of terrain.





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terrainnoise.glib

```
##OpenGL GLIB
Perspective 70
LookAt 0 0 3  0 0 0  0 1 0

Vertex      noiseterrain.vert
Fragment    noiseterrain.frag
Program     NoiseTerrain                    \
            uNoiseAmp <0. 0. 5.>            \
            uNoiseFreq <0.1 0.2 0.5>        \
                        uDelta 0.1          \
                        uBiasx <-2. 0. 2.>  \
                        uBiasy <-2. 0. 2.>  \
                        uBiasz <0. 0.1 1.>  \
                        uLevel1 <0.1 0.2 0.8>   \
                        uLevel2 <0.4 0.6 1.0>   \
                        uTol <0. 0.2 01.0>      \
                        uKa <0. 0.1 1.0>        \
                        uKd <0. 0.6 1.0>        \
                        uKs <0. 0.3 1.0>        \
                        uShininess <3. 10. 200.>    \
                        uLightX <-20. 0. 20.>       \
                        uLightY <-20. 0. 20.>       \
                        uLightZ <5. 10. 20.>        \
                        uSpecularColor {1. 1. 1. 1.}

QuadXY  -0.2  1.  1000 1000
```


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terrainnoise.vert, I

```
#version 330 compatibility

uniform sampler3D Noise3;
uniform float uNoiseAmp;
uniform float uNoiseFreq;
uniform float uBiasx, uBiasy, uBiasz;
uniform float uLightX, uLightY, uLightZ;

out vec3 vNs;
out vec3 vLs;
out vec3 vEs;
out vec3 vMC;
uniform float uDelta;


vec3 DELTAX = vec3( uDelta, 0., 0. );
vec3 DELTAY = vec3( 0., uDelta, 0. );


float
Height( vec3 mc )
{
        vec3 newmc = vec3( mc.x+uBiasx, mc.y+uBiasy, mc.z );
        vec4 nv = texture( Noise3, uNoiseFreq * newmc );
        float n = nv.r + nv.g + nv.b + nv.a;
        n = n - 2.;
        n = n + uBiasz;
        n *= uNoiseAmp;
        return n;
}
```

Reading a texture from within the vertex shader

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terrainnoise.vert, II

```
void
main( )
{
        float h00 = Height( gl_Vertex.xyz );
        float hp0 = Height( gl_Vertex.xyz + DELTAX );
        float hm0 = Height( gl_Vertex.xyz - DELTAX );
        float h0p = Height( gl_Vertex.xyz + DELTAY );
        float h0m = Height( gl_Vertex.xyz - DELTAY );

        float dzdx = hp0 - hm0;
        vec3 xtangent = vec3( 1., 0., dzdx );
        float dzdy = h0p - h0m;
        vec3 ytangent = vec3( 0., 1., dzdy );
        //vNs = normalize(  gl_NormalMatrix * cross( xtangent, ytangent ) );
        vNs = normalize( cross( xtangent, ytangent ) );

        vec3 new = gl_Vertex.xyz;
        new.z += h00;               // displace the point
        if( new.z < 0. )
                new.z = 0.;
        vMC = new;

        vec4 ECposition = gl_ModelViewMatrix * vec4( new, 1. );
        vec3 eyeLightPosition = vec3( uLightX, uLightY, uLightZ );

        vLs = normalize( eyeLightPosition - ECposition.xyz );
        vEs = normalize( vec3( 0., 0., 0. ) - ECposition.xyz );

        gl_Position = gl_ModelViewProjectionMatrix * vec4( new, 1. );
}
```

Cross product to get a normal vector

It's always a heated discussion about how much quality lighting to put on terrain. We usually don't multiply by the normal matrix because you generally don't turn a landform around in your hands.

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terrainnoise.frag, I

```
#version 330 compatibility

uniform float       uLevel1, uLevel2, uTol;
uniform float       uKa, uKd, uKs;
uniform vec4        uSpecularColor;
uniform float       uShininess;

in vec3 vNs;
in vec3 vLs;
in vec3 vEs;
in vec3 vMC;

const vec3 BLUE   =  vec3( 0.1, 0.1, 0.5 );
const vec3 GREEN  =  vec3( 0.0, 0.8, 0.0 );
const vec3 BROWN  =  vec3( 0.6, 0.3, 0.1 );
const vec3 WHITE  =  vec3( 1.0, 1.0, 1.0 );
const vec3 GRAY   =  vec3( 0.5,  0.5, 0.5 );
```

terrainnoise.frag, II


```
void
main( )
{
	vec3 Normal = vec3( 0., 0., 1. );
	vec3 color = BLUE;
	if( vMC.z > 0. )
	{
		float t = smoothstep( uLevel1-uTol, uLevel1+uTol, vMC.z);
		color = mix( GREEN, GRAY, t );
		Normal = normalize( vNs );
	}
	if( vMC.z > uLevel1+uTol )
	{
		float t = smoothstep( uLevel2-uTol, uLevel2+uTol, vMC.z);
		color = mix( GRAY, WHITE, t );
		Normal = normalize( vNs );
	}

	vec3 Light = normalize( vLs );
	vec3 Eye = normalize( vEs );
	vec3 ambient = uKa * color;
	float d = dot(Normal,Light);
	vec3 diffuse = uKd * d * color;

	float s = 0.;
	if( d > 0. )		// only do specular if the light can see the point
	{
		vec3 ref = normalize( 2. * Normal * dot(Normal,Light) - Light );
		s = pow( max( dot(Eye,ref),0. ), uShininess );
	}
	vec3 specular = uKs * s * uSpecularColor.rgb;

	gl_FragColor = vec4( ambient.rgb + diffuse.rgb + specular.rgb, 1. );
}
```

What does it mean to do specular lighting on *terrain*? No, I don't know either, but here it is if you want it.

Lots of Parameters Can Be Changed