Dome Projection using a Vertex Shader

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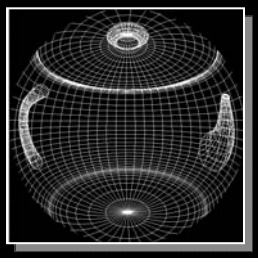
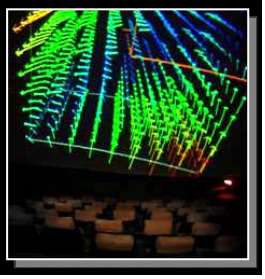
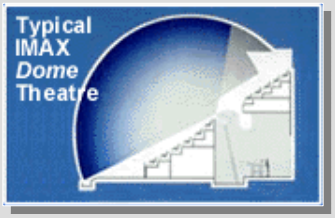
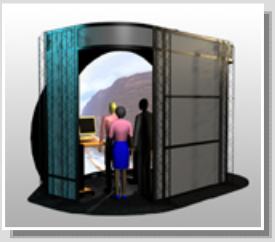
Oregon State University

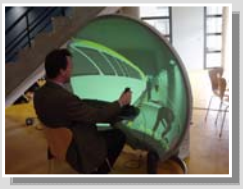


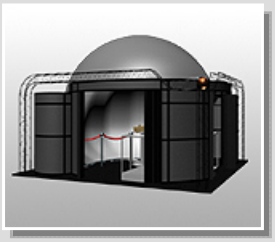


Dome Projection – Becoming more ubiquitous









Only a matter of time until it becomes a routine visualization tool

Dome Projection can be performed with multiple projectors

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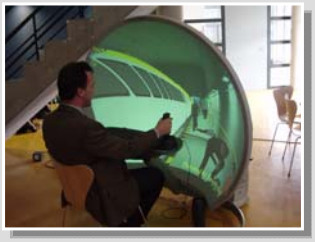
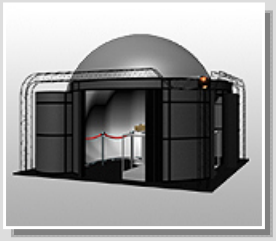
Programming a Dome display is easier when only a single projector is used





A fisheye lens distorts the image so that it spreads out across the dome. The trick is pre-distorting the image so it looks correct after being projected

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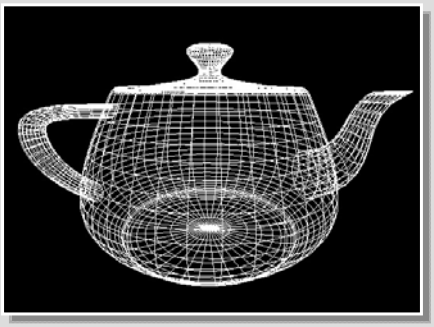
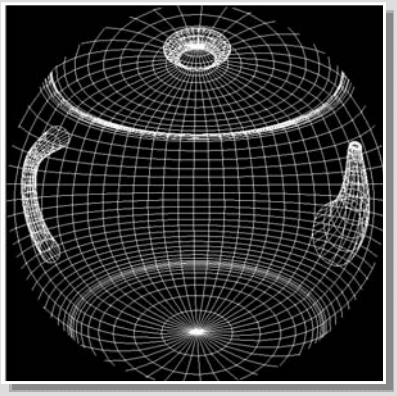
Dome Distortion

Move the audience inside the teapot





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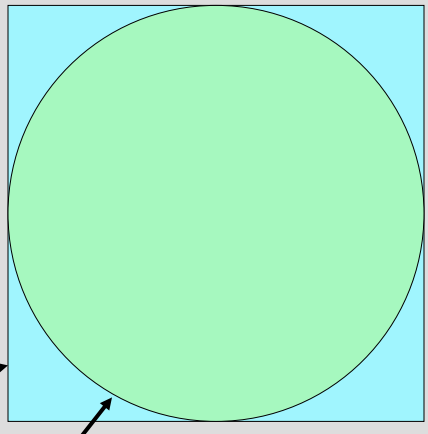
Dome Projection:



Edge of the circle represents the edge of the dome projection = your left, right, bottom, top as you are sitting in the theater.

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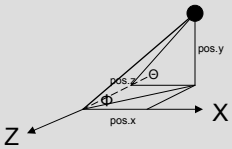
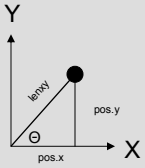
Dome Vertex Shader:

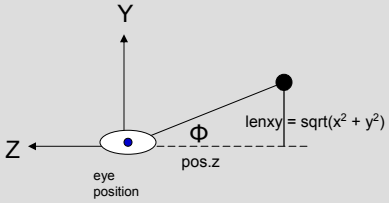
God's-eye View:



As the eye sees it:



From the side:




```
const float PI =  3.14159265f;

void
main( void )
{
        vec4 pos = gl_ModelViewMatrix * gl_Vertex;
        float lenxy = length( pos.xy );

        float phi = atan2( lenxy , -pos.z );
        float r_over_len = ( phi / (PI/2.) ) / lenxy;
        pos.xy = r * ( pos.xy * r_over_len );

        gl_Position = gl_ProjectionMatrix * pos;
}
```

Note: (pos.xy / lenxy) = (cosΘ,sinΘ)

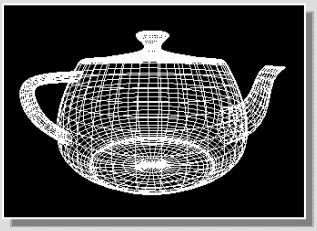
Not all fisheye lenses are so linear

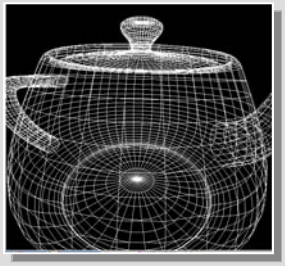
$$r = c_1\Phi + c_2\Phi^2 + c_3\Phi^3 + c_4\Phi^4 + c_5\Phi^5$$

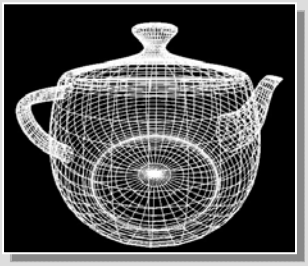
```
const float C1 =  0.7145;
const float C2 = -0.0544;
const float C3 =  0.1871;
const float C4 = -0.1974;
const float C5 =  0.0509;

    float r_over_len = (  phi* (C1 + phi* (C2 + phi* (C3 + phi* (C4 + phi*C5) ) ) )  ) / lenxy;
```

Cartesian:

Dome:







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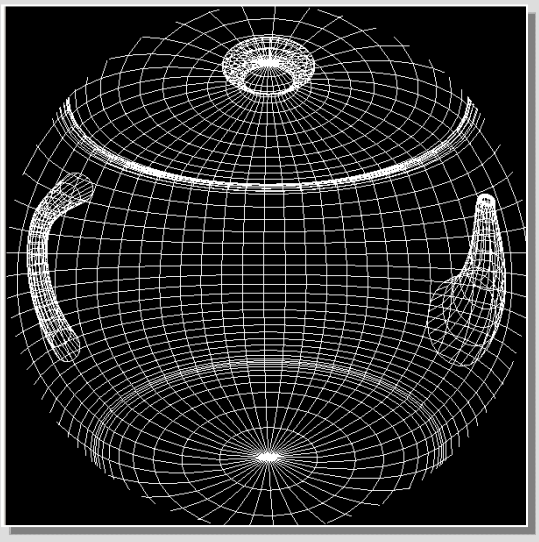
Dome:



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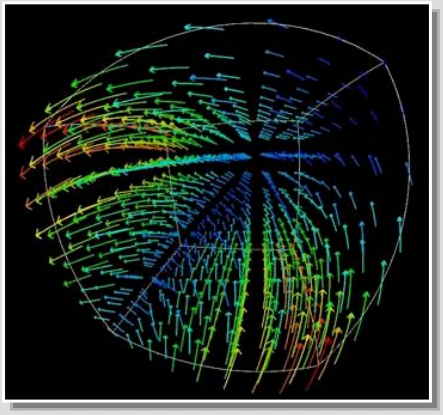
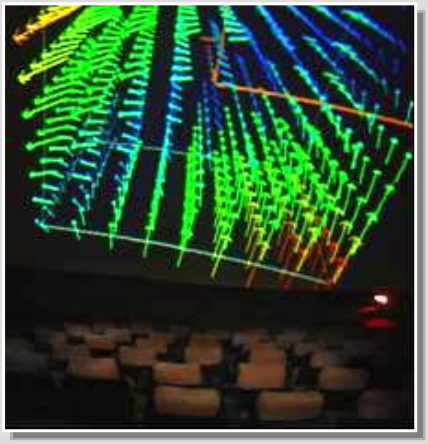
Flow Visualization in the Dome





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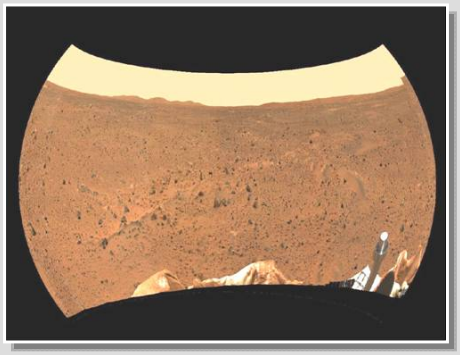
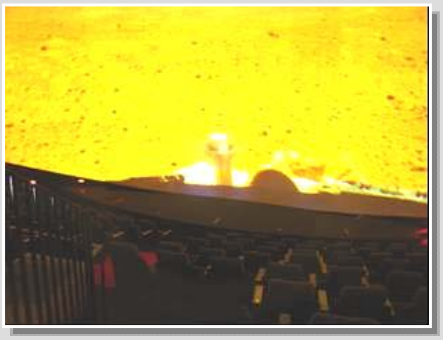
Mars Panoram in the Dome





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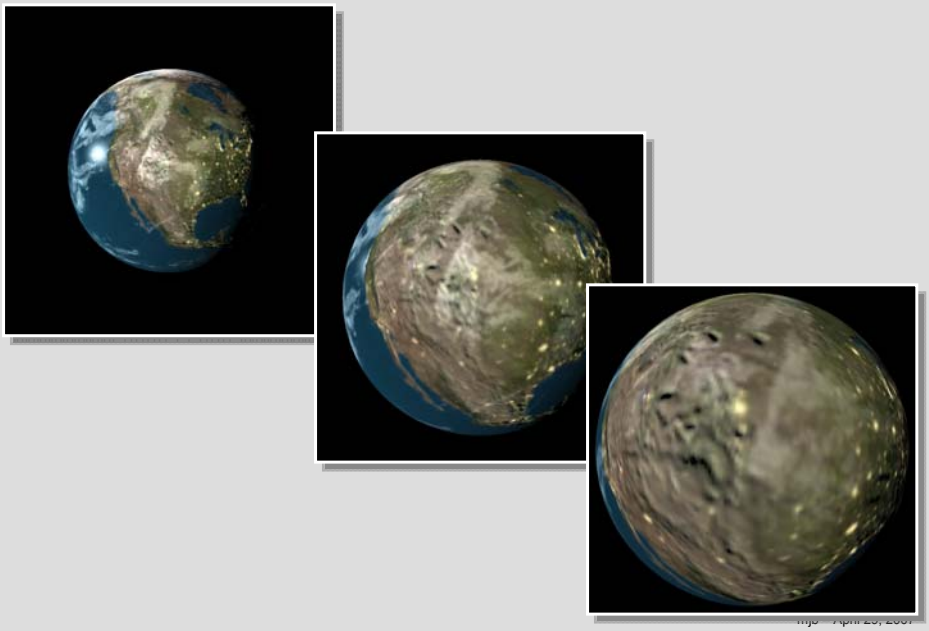
World Fly-around in the Dome



Large Lines and Polygons Need to be Tessellated

Note: This edge does not pass through the flow vectors!

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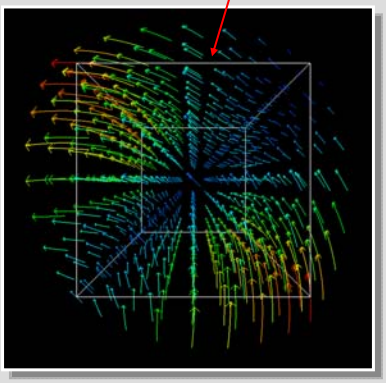

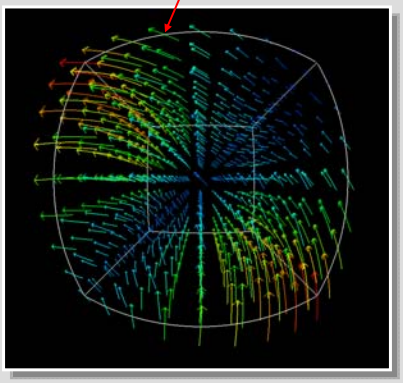

Bounding Box edges <u>were not</u> tessellated. Straight lines on the monitor produced curved lines on the dome.

Bounding Box edges <u>were</u> tessellated. Curves lines on the monitor produced straight lines on the dome.

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