



1

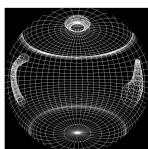
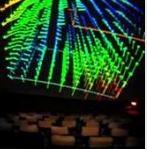
## Dome Projection using a Vertex Shader



This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](https://creativecommons.org/licenses/by-nc-nd/4.0/).



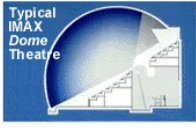
**Oregon State University**  
Mike Bailey  
mjb@cs.oregonstate.edu


Computer Graphics mjb - December 22, 2023



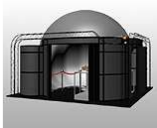
2


## Dome Projection – Becoming more Common



Typical IMAX Dome Theatre



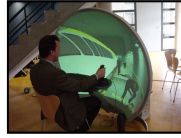




I believe that it's only a matter of time until it becomes a routine visualization tool

Computer Graphics mjb - December 22, 2023

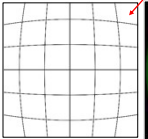
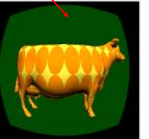
3

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

A fisheye lens in the projector distorts the image so that it spreads out across the dome.

The trick is pre-distorting the image in the other direction so that it looks correct after being projected.

Computer Graphics mjb - December 22, 2023

4

## One Night at the Reuben H. Fleet Science Center in San Diego...



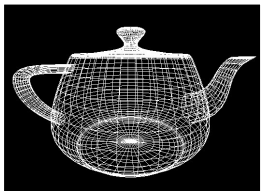

Computer Graphics mjb - December 22, 2023

5

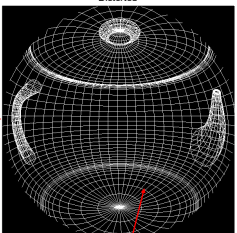
## Dome Distortion

Move the teapot so it surrounds the audience

Undistorted



Distorted



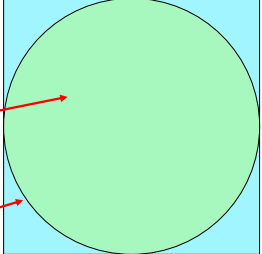
A fisheye lens in the projector distorts the image so that it spreads out across the dome.

The trick is pre-distorting the image in the other direction so that it looks correct after being projected.

Computer Graphics mjb - December 22, 2023

6

## Dome Projection



Viewing Volume = (-1,-1) to (1,1)

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

Computer Graphics mjb - December 22, 2023

**Dome Vertex Shader:**

God's-eye View: As the eye sees it: From the side:

```

const float PI = 3.14159265;

void
main( )
{
    vec4 pos = gl_ModelViewMatrix * gl_Vertex;
    float lenxy = length( pos.xy );
    float phi = atan( lenxy , -pos.z );
    pos.xy = ( phi / (PI/2. ) ) * ( pos.xy / lenxy );
    gl_Position = gl_ProjectionMatrix * pos;
}

```

**Note:**  $( pos.xy / lenxy ) = ( cos\theta, sin\theta )$

Computer Graphics mjb - December 22, 2023

**Dome Vertex Shader:**

Undistorted Distorted

Oregon State University Computer Graphics mjb - December 22, 2023

**Dome Vertex Shader:**

Distorted

Oregon State University Computer Graphics mjb - December 22, 2023

**Flow Visualization in the Dome**

Distorted Projected

Oregon State University Computer Graphics mjb - December 22, 2023

**Mars Panoram in the Dome**

Projected Projected

Oregon State University Computer Graphics mjb - December 22, 2023

**Large Lines and Polygons Need to be Tessellated**

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

Note: This edge does pass through the flow vectors!

Bounding Box edges were *not* tessellated. Straight lines on the monitor produced curved lines on the dome.

Bounding Box edges were tessellated. Curved lines on the monitor produced straight lines on the dome.

Oregon State University Computer Graphics mjb - December 22, 2023