Project 4

CS 557 - COMPUTER GRAPHICS SHADERS

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Project Number: 4
Project Name: Cube Mapping Reflective and Refractive Bump-mapped Surfaces

Video Link: **https://media.oregonstate.edu/media/t/1_v4cfci1r**

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Time: February 9, 2020

- ## What you did and explaining why it worked this way

There are four steps I worked for this project.

The first step is geometry model construction (the displace mapping). This step is finished in the vertex shader, which means for each vertex, I get the new coordinate of Z axis direction by recalculating the equation: z = K * (Y0-y) * sin(2.*PI*x/P) according to the original coordinates of X axis and Y axis.

The second step is calculating the normal of the displacement surface. This step is finished in the both vertex shader. Normal means the vector that is perpendicular to any vectors on the surface. By considering 2D surface only has 2 degree of freedom, vectors in X axis and Y axis is enough for normal vector's calculation. The theory of the normal calculation is calculating cross product on each vertex, which means after gotten tangent value from both x and y direction we can get the normal vector in X axis direction.

The third step is Bump-Mapping. This step is finished in the both fragment shader. In the project, I used the 3D noise to recalculate the normal of original 3D surface normal by using normal rotation matrix. The result of the rotation is the new normal that can show the effect that surface is based on the "eroded geometry". The reason that I used the quotation mark is that the erosion effect is not because of real shape deformation but only the changed surface normal.

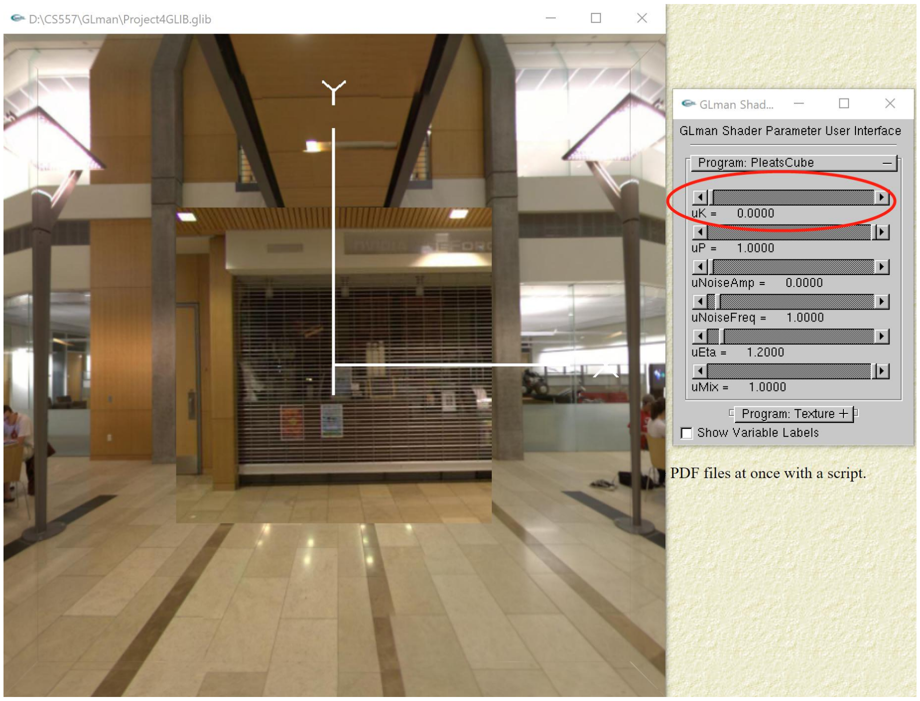
The final step is implementation of Reflective and Refractive affections of Cube Mapping. This step is finished in the both fragment shader. After get the vector subdivision result of eyes looking vector and surface normal vector. We can use uEta to control whether we need refraction. The final result is the mixed result of Reflective and Refractive affections.

- ## Side-by-side images showing different values for the input parameters

There are several major input uniform parameters used in the project. They are: uK, uP, uNoiseAmp, uNoiseFreq, uEta, and uMix.

uK is the parameter control the amplitude of ripple:

When uK = 0.0:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
GLman Shader Parameter User Interface
Program: PleatsCube
Program: Texture +
PDF files at once with a script.

uK = 0.0000

uP = 1.0000

uNoiseAmp = 0.0000

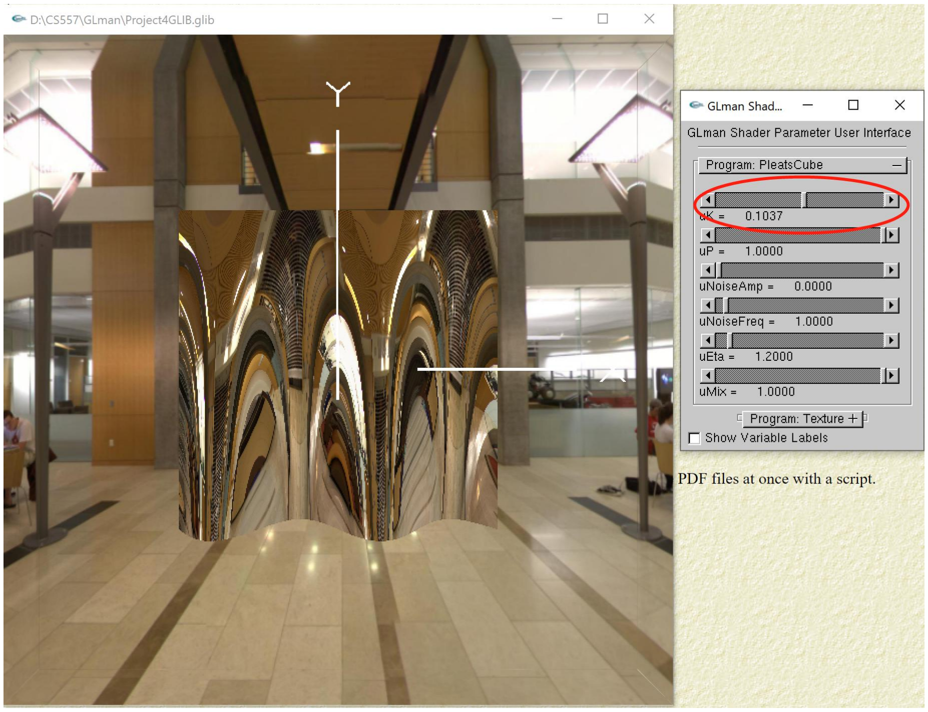
uNoiseFreq = 1.0000

uEta = 1.2000

uMix = 1.0000

□ Show Variable Labels

When uK > 0.0:



D:\CS557\GLman\Project4GLIB.glib

GLman Shad...

GLman Shader Parameter User Interface

Program: PleatsCube

uK = 0.1037

uP = 1.0000

uNoiseAmp = 0.0000

uNoiseFreq = 1.0000

uEta = 1.2000

uMix = 1.0000

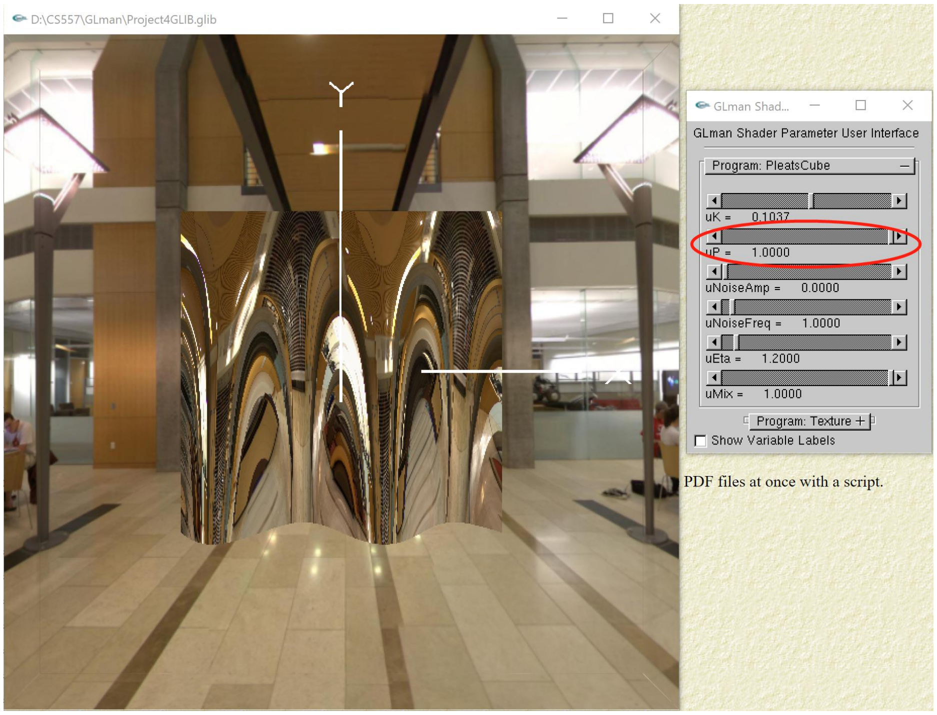
Program: Texture +

□ Show Variable Labels

PDF files at once with a script.

uP is the parameter control the frequency of ripple:

When uP = 1.0:



D:\CS557\GLman\Project4GLIB.glib

GLman Shad...

GLman Shader Parameter User Interface

Program: PleatsCube

uK = 0.1037

uP = 1.0000

uNoiseAmp = 0.0000

uNoiseFreq = 1.0000

uEta = 1.2000

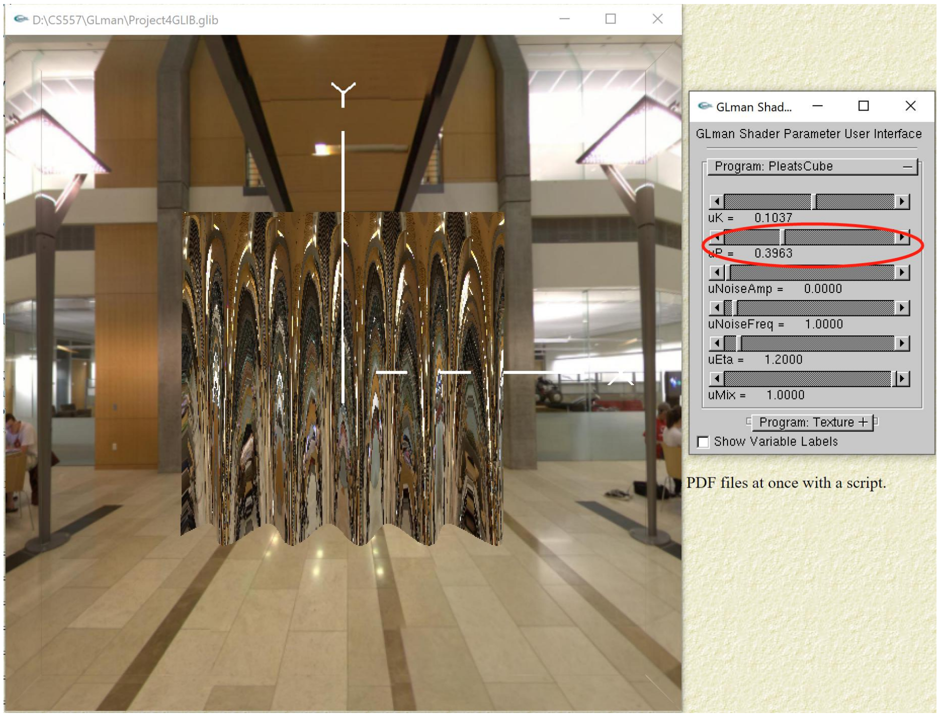
uMix = 1.0000

Program: Texture +

□ Show Variable Labels

PDF files at once with a script.

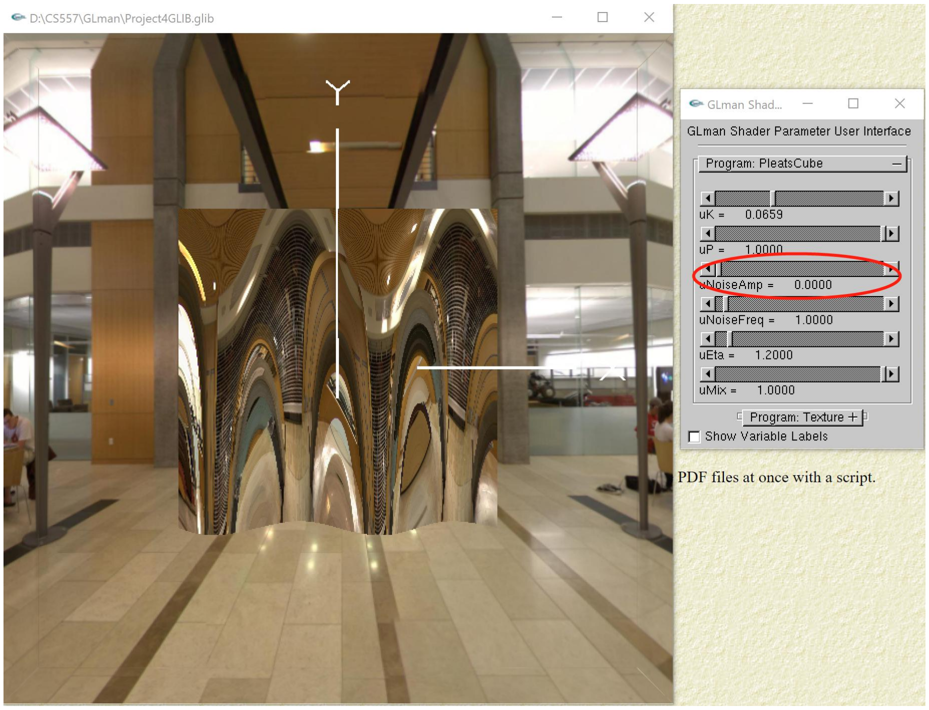
When uP < 1.0:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
GLman Shader Parameter User Interface
Program: PleatsCube
Program: Texture
□ Show Variable Labels
PDF files at once with a script.

uK = 0.1037
uP = 0.3963
uNoiseAmp = 0.0000
uNoiseFreq = 1.0000
uEta = 1.2000
uMix = 1.0000

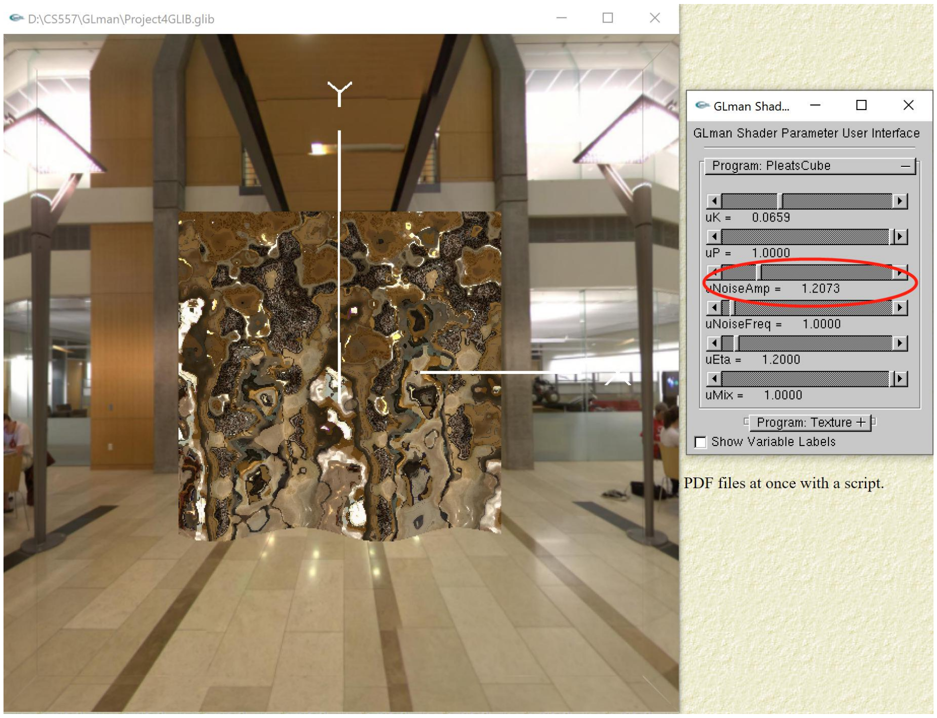
uNoiseAmp is the parameter control the degree of noise Bump-Mapping:

When uNoiseAmp = 0.0:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
GLman Shader Parameter User Interface
Program: PleatsCube
Program: Texture
□ Show Variable Labels
PDF files at once with a script.

uK = 0.0659
uP = 1.0000
uNoiseAmp = 0.0000
uNoiseFreq = 1.0000
uEta = 1.2000
uMix = 1.0000

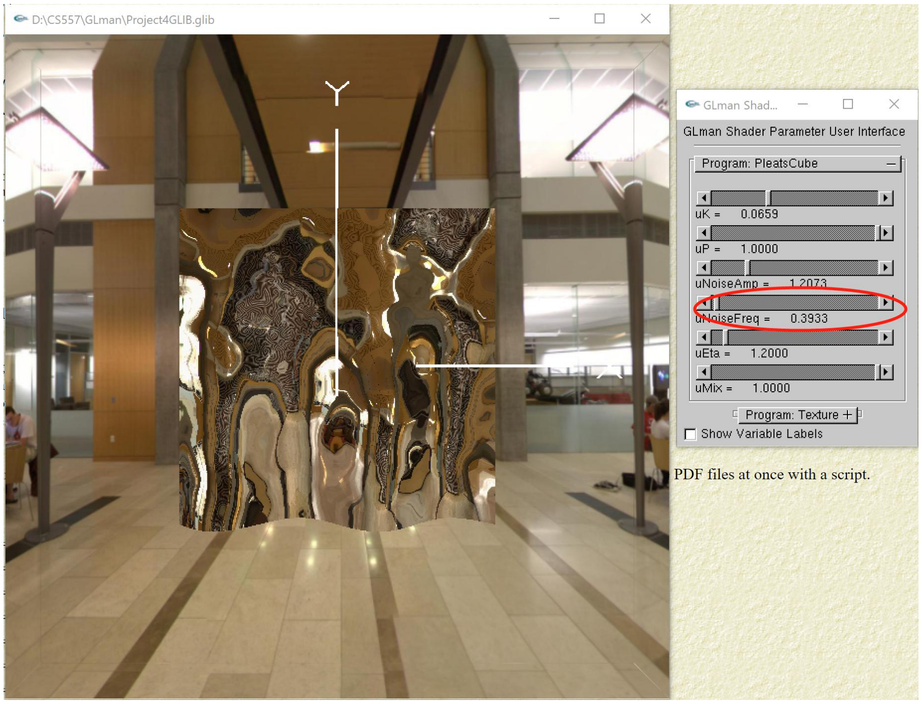
When uNoiseAmp > 0.0:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
GLman Shader Parameter User Interface
Program: PleatsCube
Program: Texture +
□ Show Variable Labels
PDF files at once with a script.

uK = 0.0659
uP = 1.0000
uNoiseAmp = 1.2073
uNoiseFreq = 1.0000
uEta = 1.2000
uMix = 1.0000

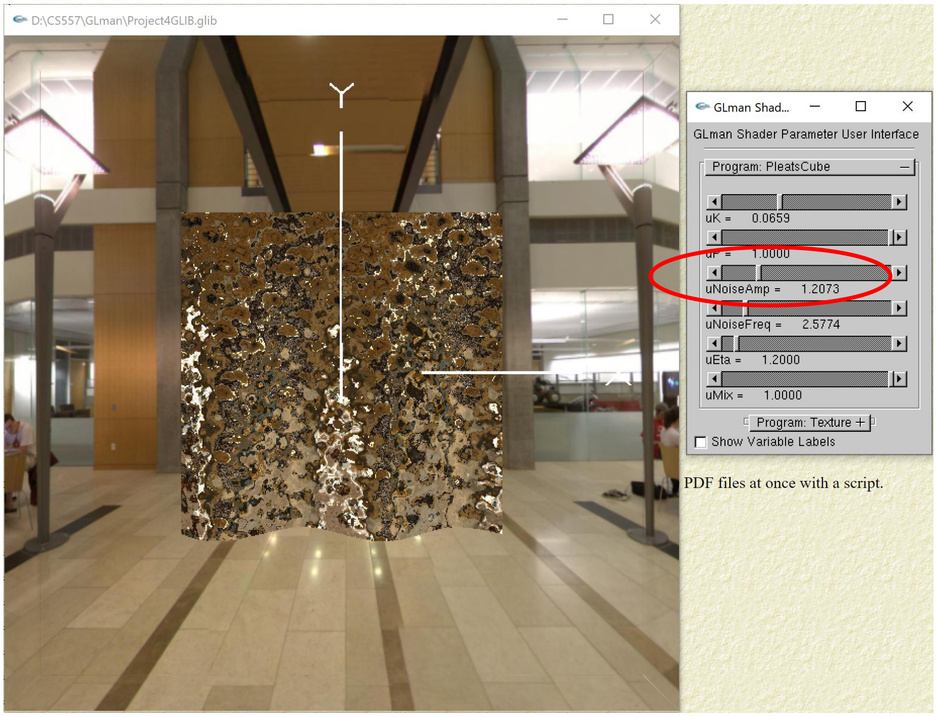
uNoiseFreq is the parameter control the frequency of noise Bump-Mapping:

When uNoiseFreq near 0.0:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
GLman Shader Parameter User Interface
Program: PleatsCube
Program: Texture +
□ Show Variable Labels
PDF files at once with a script.

uK = 0.0659
uP = 1.0000
uNoiseAmp = 1.2073
uNoiseFreq = 0.3933
uEta = 1.2000
uMix = 1.0000

When uNoiseFreq farther larger than 0.0:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
PDF files at once with a script.

GLman Shader Parameter User Interface

Program: PleatsCube

uK = 0.0659

uP = 1.0000

uNoiseAmp = 1.2073

uNoiseFreq = 2.5774

uEta = 1.2000

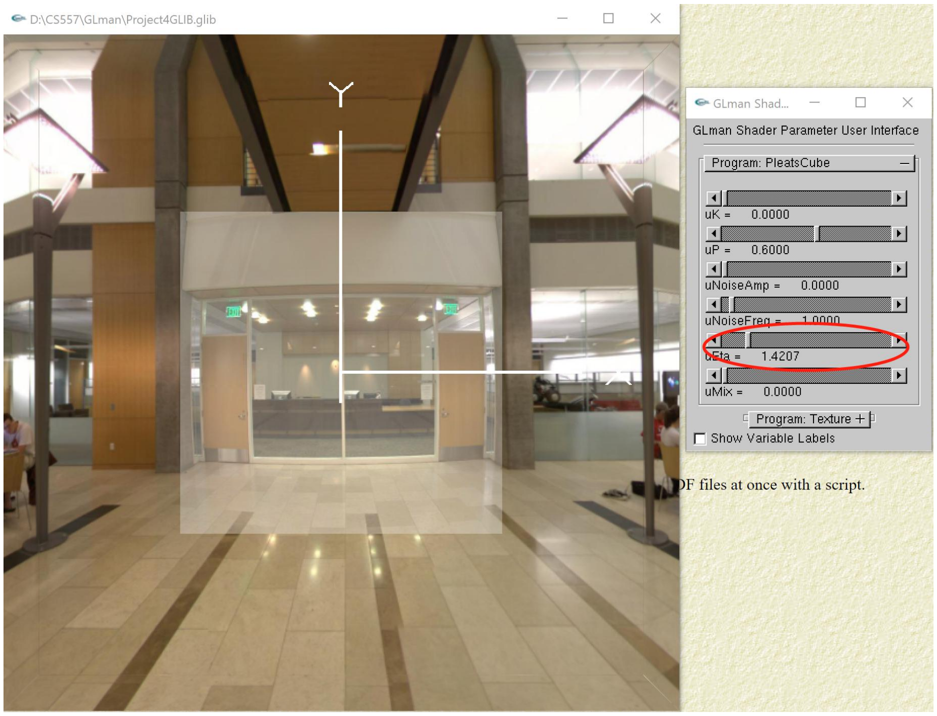
uMix = 1.0000

Program: Texture +

□ Show Variable Labels

uEta is how much the refraction you want:

When uEta near 1, it will be looks like pass the air:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
DF files at once with a script.

GLman Shader Parameter User Interface

Program: PleatsCube

uK = 0.0000

uP = 0.6000

uNoiseAmp = 0.0000

uNoiseFreq = 1.0000

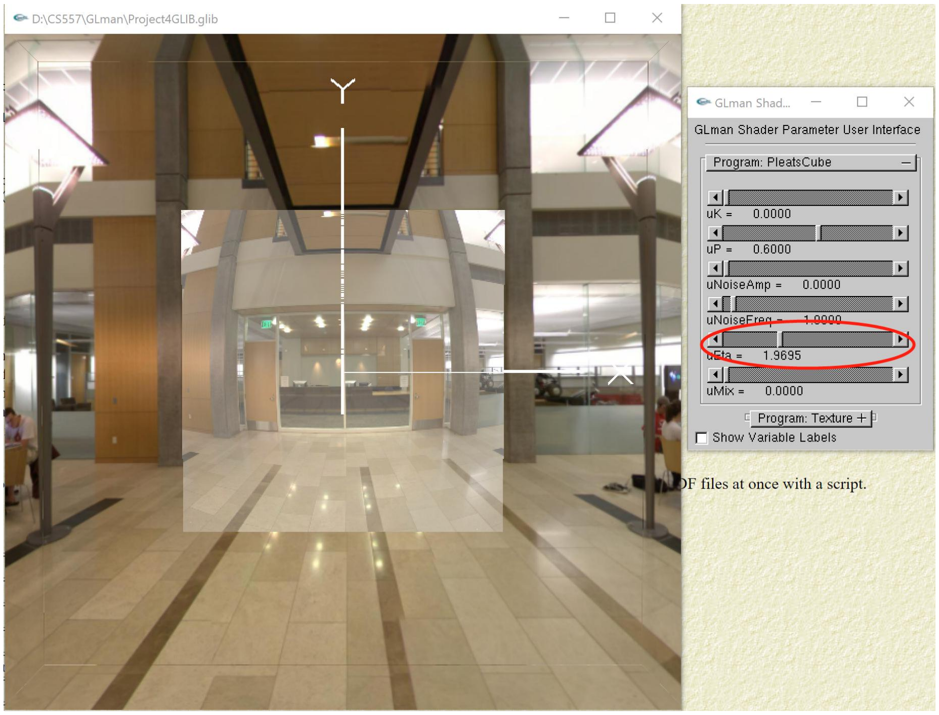
uEta = 1.4207

uMix = 0.0000

Program: Texture +

□ Show Variable Labels

When uEta >> 1, it will show passing some material dense than air:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
DF files at once with a script.

GLman Shader Parameter User Interface

Program: PleatsCube

uK = 0.0000

uP = 0.6000

uNoiseAmp = 0.0000

uNoiseFreq = 1.0000

uEta = 1.9695

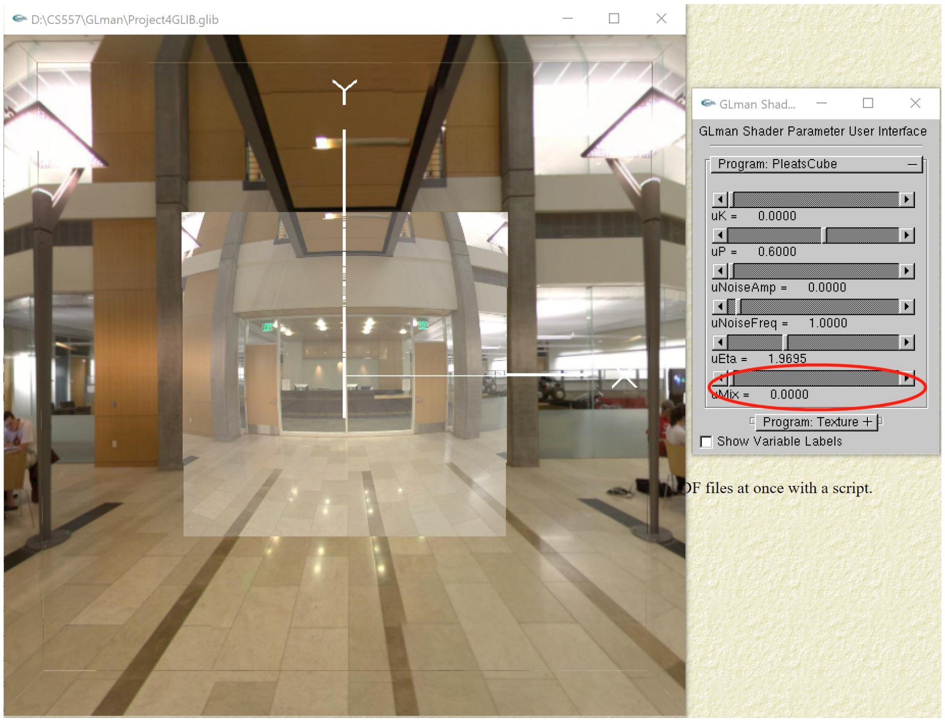
uMix = 0.0000

Program: Texture +

□ Show Variable Labels

uMix shows how much the combination of refraction and reflection you want:

When uMix = 0, there is only refraction:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
DF files at once with a script.

GLman Shader Parameter User Interface

Program: PleatsCube

uK = 0.0000

uP = 0.6000

uNoiseAmp = 0.0000

uNoiseFreq = 1.0000

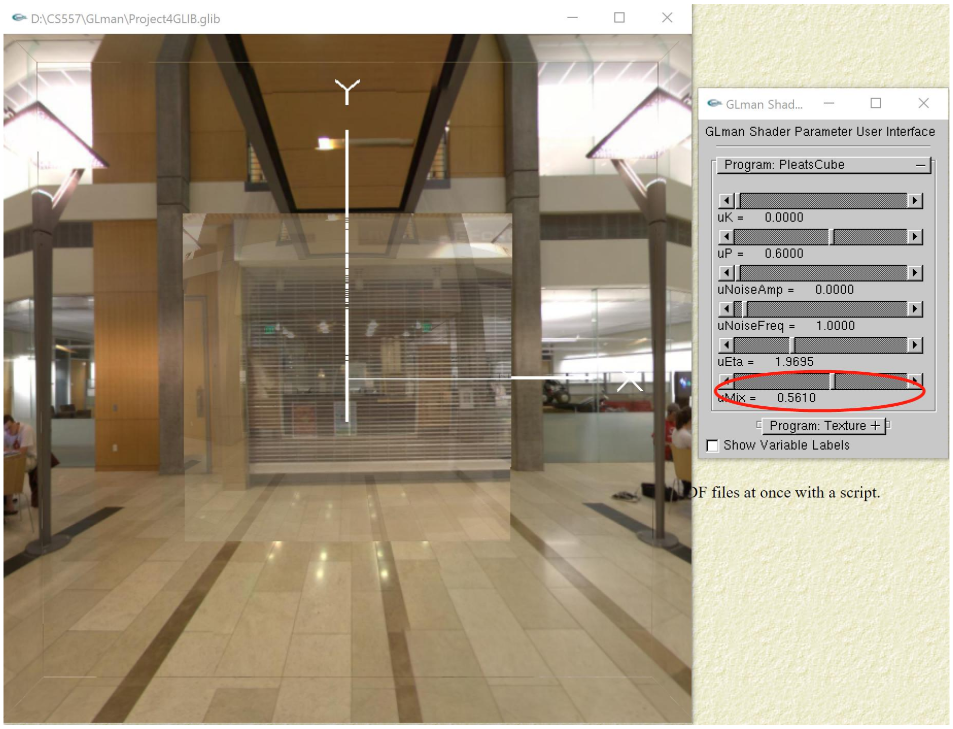
uEta = 1.9695

uMix = 0.0000

Program: Texture +

□ Show Variable Labels

When uMix > 0, the square will have some reflection affection:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
GLman Shader Parameter User Interface
Program: PleatsCube
Program: Texture +
□ Show Variable Labels
DF files at once with a script.

uK = 0.0000

uP = 0.6000

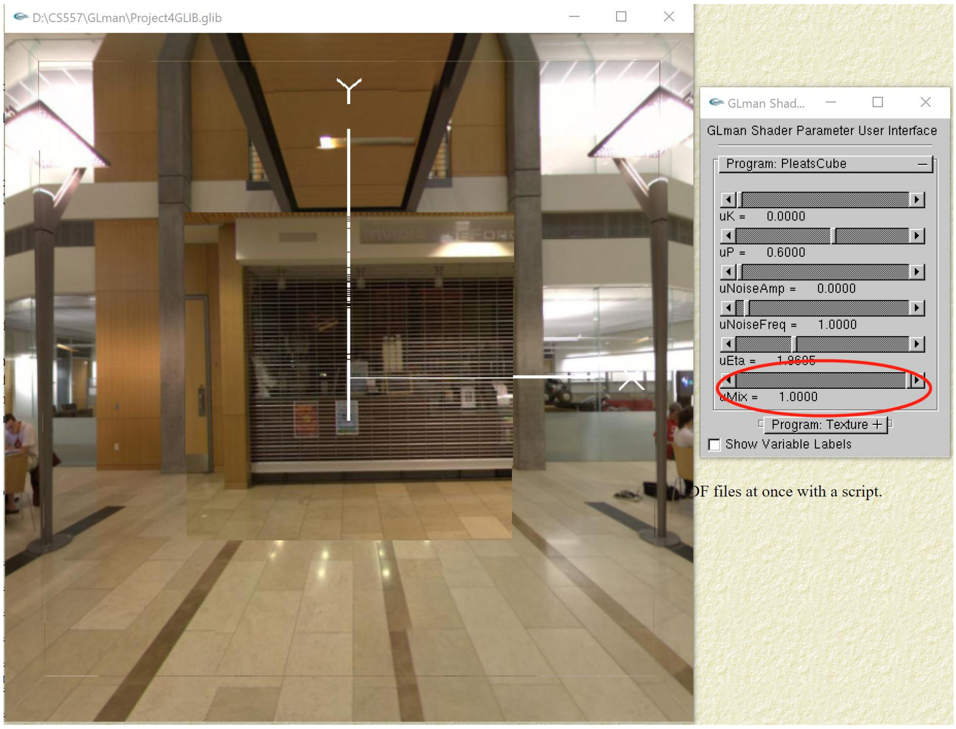
uNoiseAmp = 0.0000

uNoiseFreq = 1.0000

uEta = 1.9695

uMix = 0.5610

When uMix = 1, the square will have total reflection affection:


D:\CS557\GLman\Project4GLIB.glib
GLman Shad...
GLman Shader Parameter User Interface
Program: PleatsCube
Program: Texture +
□ Show Variable Labels
DF files at once with a script.

uK = 0.0000

uP = 0.6000

uNoiseAmp = 0.0000

uNoiseFreq = 1.0000

uEta = 1.9695

uMix = 1.0000