3D Visualization of Mars Satellite Images

March 21, 2003

Ramkrishna Chakrabarty Mentor: Dr. Alan Shih

Graduate Student Department of Computer and Information Sciences University of Alabama at Birmingham Student Assistant Enabling Technology Laboratory Department of Mechanical Engineering University of Alabama at Birmingham



Problem Definition:

To visualize 2D monochrome high resolution images of Mars in 3D.

> Given are some satellite images of the Mars surface.

> The objective is to use the data available from the images like luminosity etc to create a 3D visualization of the same.

2D Mars Images





Top Level Block Diagram



Image Resize

Image Resize Algorithms Used:

> Bilinear Interpolation> Bicubic Interpolation

Image Resize : Bilinear Interpolation

Bilinear interpolation linearly interpolates along each row of the image

 Then uses that result in a linear interpolation down each column in the image.

 With this method, each estimated pixel in the output image is a *weighted* average of its four nearest neighbours in the input image



Image Resize : Bicubic Interpolation

The bicubic interpolation
 estimates the color at a pixel in the destination image by an weighted average of 16 pixels surrounding the closest corresponding pixel in the source image.

The bicubic method yields a smoother result since its convolution kernel is of size 4x4.

 This is a computationally intensive resizing method, but produces *better* results when there is *drastic change* in dimensions



Bilinear/Bicubic Comparison







Bicubic



Bilinear

Resize factor = 1/4

Heightmap Generation - 1

What is a heightmap ?

Heightmap it's a set of numbers arranged so that they form a two-dimensional grid, like a bitmap, except each *number represents a ground elevation* instead of a color.

Heightmap Generation Algorithm

First, traverse the whole image pixel by pixel at the *angle of the sun*.
 This is possible due to the fact that the image has been converted into a *continous space* after bicubic interpolation.



> Then, the height of each pixel is estimated from
> Grayscale value of each pixel of the original image.
> Grayscale value of the *previous* pixel in the path.
> Grayscale value of the *next* pixel in the path.



> Once the heightmap is generated, the same is fed into the *OpenGL* based visualization module to render it in 3D.

> This program also does the *lighting* and is *interactive*.

And the result...



And the result...





3D Visualization of Mars Satellite Images



3D Visualization of Mars Satellite Images

...more results







Terrain Project.



On the ETLab VisBox [Stereoscopic Display]







Scope for Future

> The algorithms can be improved. This is a starting point and more research needs to be done to develop new and better algorithms.

> Error checking: the application should be able to distinguish between dark objects (rocks etc.) and shadows.

> One of the ideas is to traverse the image at an other angle than the sun's angle, and find out the gradient differences to figure out shadows etc.

