INTERACTIVE EDUCATION FOCUSED COMPUTER SIMULATIONS FOR THE VISUALIZATION AND ANALYSIS OF TOPOGRAPHY DATA. J. H. Roark[1], J. R. Zimbelman[2], S. H. Williams[2], and C. M. Masuoka[3], [1]Science Systems and Applications, Inc. Code 698, NASA GSFC, Greenbelt, MD 20771, jim.roark@gsfc.nasa.gov, [2]Smithsonian National Air and Space Museum, Washington, D.C. 20013, [3]University of Maryland, College Park, MD 20742.

Introduction: The Center for Earth and Planetary Studies at the Smithsonian Institution's National Air and Space Museum teamed up with the Planetary Geodynamics Laboratory at NASA's Goddard Space Flight Center to develop two interactive education focused computer simulations based on the visualization and analysis of topography data from Earth and Mars. The goal was to produce teaching tools that would aid instructors and be useful to students who are getting their first exposure to topographic mapping.

Topographic mapping skills are fundamental to Earth and Planetary science and are an important part of the national education standards in geography, and to a lesser extent in engineering [1]. When combined with appropriate learning materials, the simulations can be useful for introducing fundamental skills and concepts related to topographic maps.

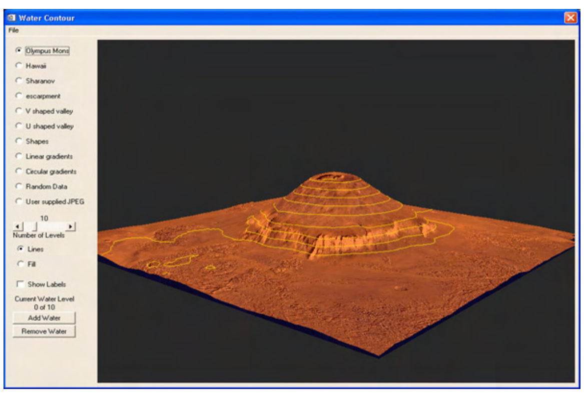

Figure 1. The Default "Water Contour" application view showing the Mars volcano, Olympus Mons.

Both applications were developed using the Interactive Data language's [2] (IDL) object graphics capabilities to create 3D simulations that can help students understand how topographic maps are a 2-D representation of a 3-D surface. Each application includes built-in user selectable landforms such as volcanoes (Olympus Mons, Hawaii), escarpments, craters/basins, V-shaped valleys, U-shaped valleys, and various geometric shapes. They also have the capability to import user supplied JPEG format greyscale topography data and the ability to dynamically create a random topography surface. The user has full control of 3-D object rotation which allows the viewing of the simulation from any angle. The graphic display can be saved as a JPEG format image at any time.

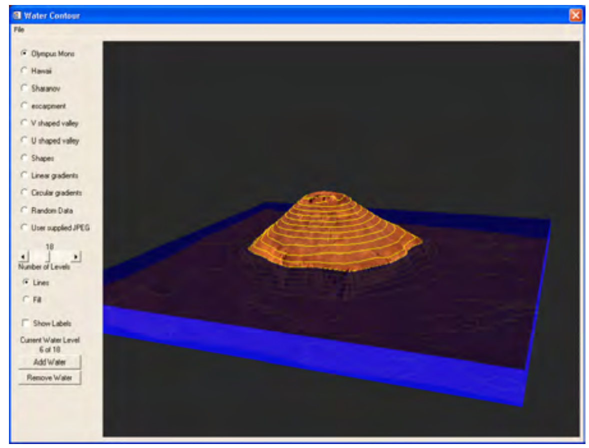

Figure 2. "Water Contour" showing additional contour levels and simulated water.

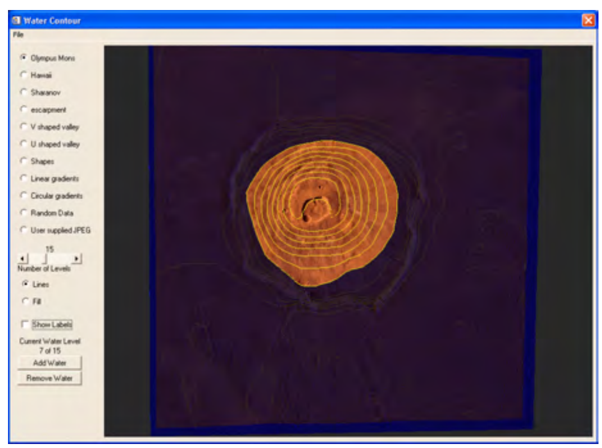

Figure 3. "Water Contour" showing object with water rotated to a plane view.

Simulation 1 (Water Contour): The goal of the Water Contour application is to illustrate the concept of contouring and how it is used in topographic maps. The simulation is based on a commonly performed "wet tank" exercise in which an object is placed in a container and water is added and removed to show how various water levels can be used to illustrate the concept of contouring. The user begins by selecting a topographic object to display. The user can then interactively select and change the desired number of levels or contours from 1 to 40 which will then be displayed as contour lines on the 3-D object. The levels can alternatively be viewed as solid filled colors instead of lines. The user can then use an "Add Water" or "Remove Water" button for animating the adding and removing of simulated water to each successive level or contour. This exercise reinforces the notion that water level at a constant depth can be used to illustrate various contour levels.

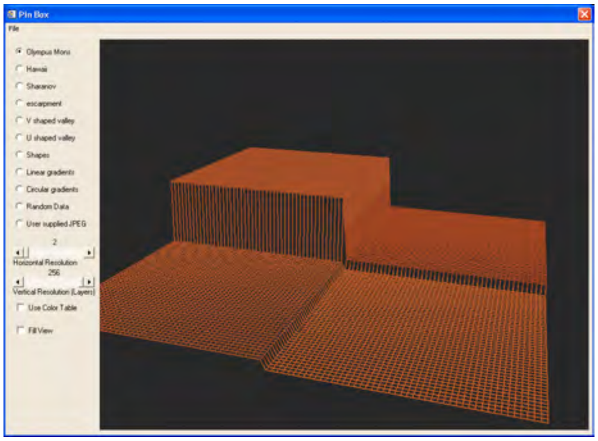

Figure 4. Initial "Pin Box" view of a 2 by 2 pin grid.

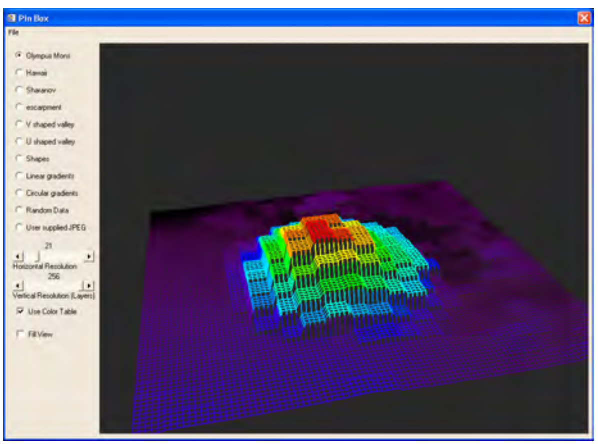

Figure 5. Pin Box view of a 21 by 21 pin grid using the optional color table view.

Simulation 2 (Pin Box): The goal of the Pin Box simulation is to illustrate the concept of resolution, both horizontally and vertically, and its affects on the quality and presentation of topographic data. The simulation is based on a common "Pin Box" exercise in which a box of movable pins of a given size is lowered onto an object. The various heights of the object will cause the pins to rise to a corresponding height when they contact the object. Smaller and more numerous pins will result in a finer detailed pin surface as opposed to a "Pin Box" consisting of larger and fewer pins.

As with the Water Contour application, the user begins by selecting a topographic object. The object is initially displayed with a minimal horizontal resolution using a 2 by 2 pin grid, but with the maximum number (256) of possible vertical layers. The user can then separately modify the horizontal resolution up to a maximum of a 95 by 95 pin grid and vertical resolution with a range between 2 to 256 possible layers. The resulting pin topography object can be alternatively colored using a built-in color table and shown as a wire mesh, the default, or a solid filled view.

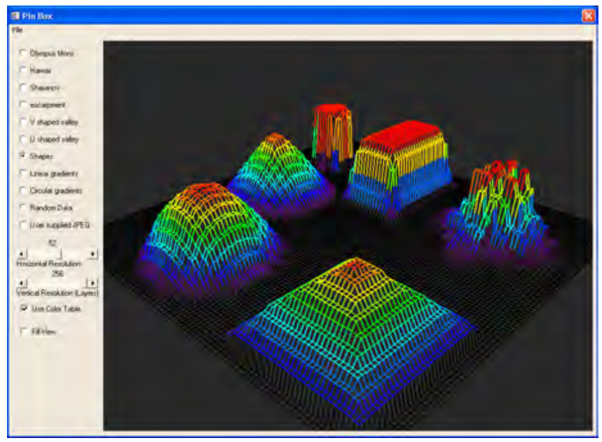

Figure 6. Pin Box view of various geometric shapes shown with a 52 by 52 pin grid and color table.

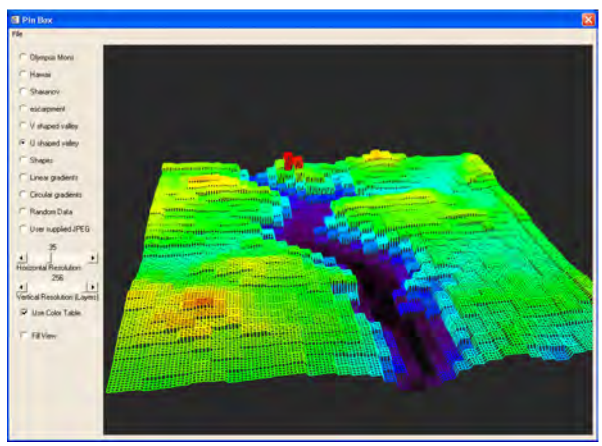

Figure 7. Pin Box view of a U-shaped valley shown with a 35 by 35 pin grid and color table.

References:[1] McREL (2006) http://www.mcrel.org/compendium/topicsDetail.asp?topicsID=313&subjectID=8 [2] ITT (2006) http://www.ittvis.com/idl/.