DISPLAYS ON DISPLAY

Editors: Frank Crow and Charles Csuri

Fractal landscape modeling using octrees

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This method for modeling and rendering landscapes combines contour line descriptions and random data into a linear octree data structure. Two-dimensional data is mapped onto the surface and underlying volumes.

Because entire volumes are described, rather than flat surfaces, this method can be applied to geophysical data encoding.

Complex surfaces are modeled and displayed, using a linear description of an octree. The generation of a fractal surface involves recursive subdivision, so little additional computation needs to be performed to generate an octree structure. Octants are subdivided if their corners lie both above and below the fractal surface. Since samples might not catch centered peaks, subdivisions can be enforced if the fractal surface is oscillating extensively.

Two factors control the fractal surface in the images shown here: One is the "amplitude," the other the "frequency" of the oscillation.

Figure 1 shows a fractal coral bank with a low amplitude and a high frequency factor.

Instead of using random points at every level of subdivision, an underlying structure may be selected. In this application a 256×256 array containing height samples was used. The degree of approximation is determined by the level at which the octree generator switches from the given structure to random height sampling. Costly interpolation between contour lines is thereby avoided, and realistic images are the result.

For Figures 2 through 5 the contour lines were digitized, and the heights entered into the array using a simple polygon fill.

Figures 2 and 3 show different levels of approximation of a crude contour line model consisting of five contour lines.

Different regions can be described by adding various materials to the underlying structure. In Figures 4 and 5, models of the Matterhorn, the glacier areas are distinguished from the rocky parts in this way.

Any two-dimensional image can be converted into a quadtree and then superimposed onto the octree structure during display. In Figure 5 a checkerboard is mapped onto the octree model of the Matterhorn.

Two Bézier surfaces are the underlying structures in Figure 6. Fractal octrees were generated at a low level of approximation. The union of these solids produced the cavelike structure, which is viewed from its interior.

A variable bitcode was used for the linear octree description, allowing many different materials to be encoded. Using this data structure, an average of 1.8 bits per cube was achieved. The displayed pictures show objects of 100,000 to 1,000,000 cubes, with storage requirements of 25 to 250K bytes per solid.

The images were computed on a DEC-10 at the Center for Interactive Computing of the Swiss Federal Institute of Technology in Zurich. They were photographed from a DeAnza IP8500 display system. Computation time for the generation of the 3-D objects ranged from 30 CPU seconds to three minutes. The renderings were done in one to five minutes. ■

Franz Herbert continues his work in solid modeling and color graphics at Superset, Inc., in San Diego. Before joining Superset he was a research assistant at the Swiss Federal Institute of Technology. He studied Informatik at the Technical University of Vienna, Austria, and received an ME in computer and systems engineering from Rensselaer Polytechnic Institute in 1981.

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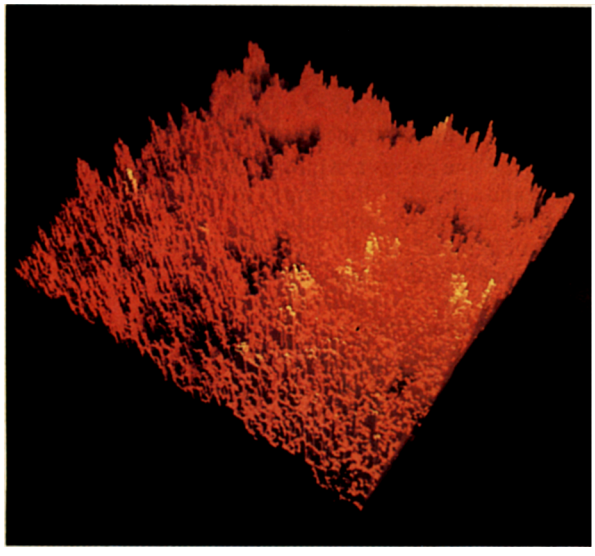


Figure 1.

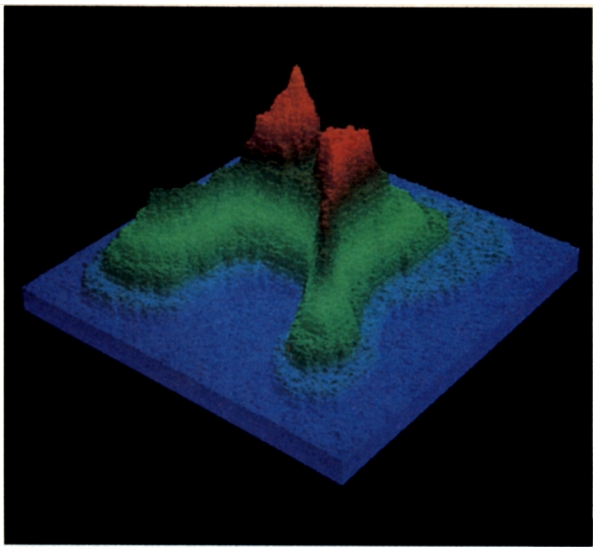


Figure 2.

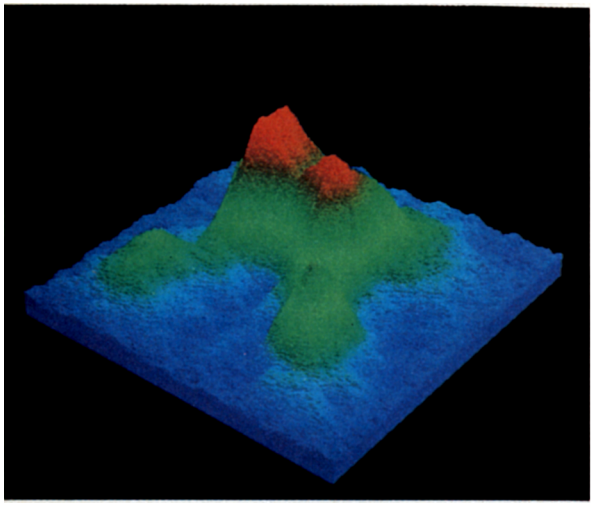


Figure 3.

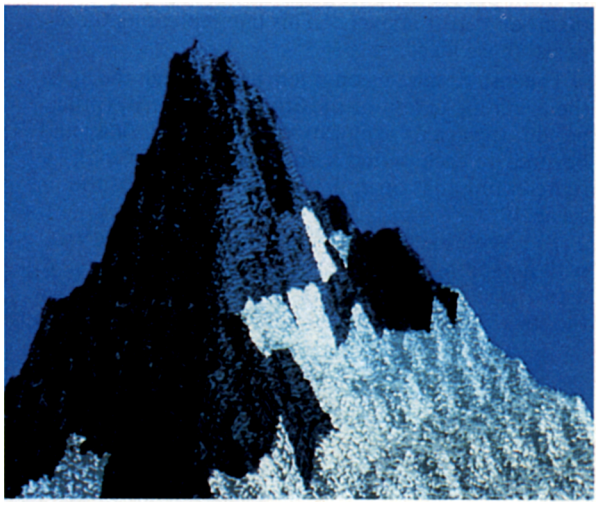


Figure 4.

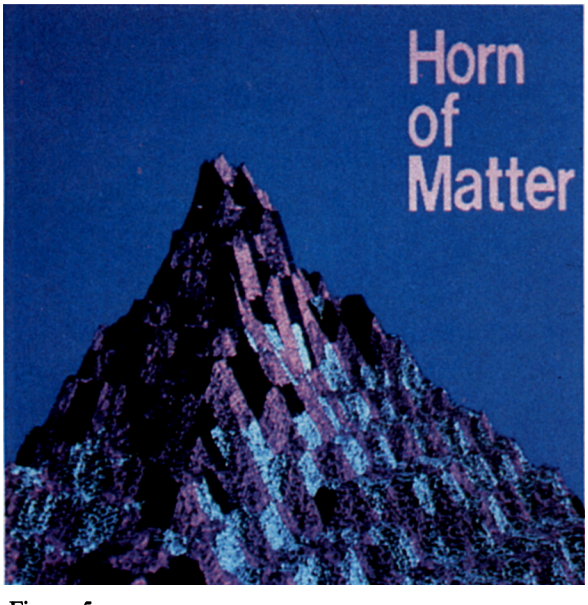


Figure 5.

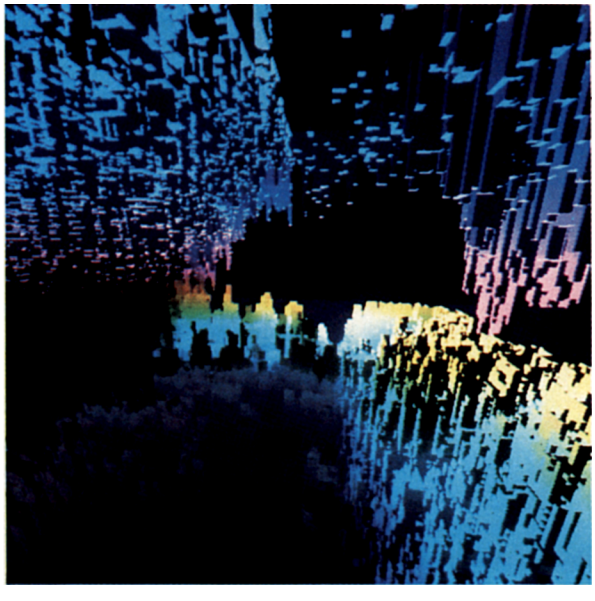


Figure 6.

DISPLAYS

TRW "Line"

The latest 30-second commercial created for TRW at Robert Abel and Associates is titled "Line." The concept of the commerical was the "drawing of a line," says Kenny Mirman, art director. Since the beginning of man, people have set goals and then gone beyond them, or "crossed over." This line represents those goals, those ideas.

The visuals take us on a journey through the ages: the Neolithic period of the Stone Age, the Egyptian period, the age of exploration, and finally today and beyond. In each period a drawing or writing tool, representing that time, draws a red line across the scene.

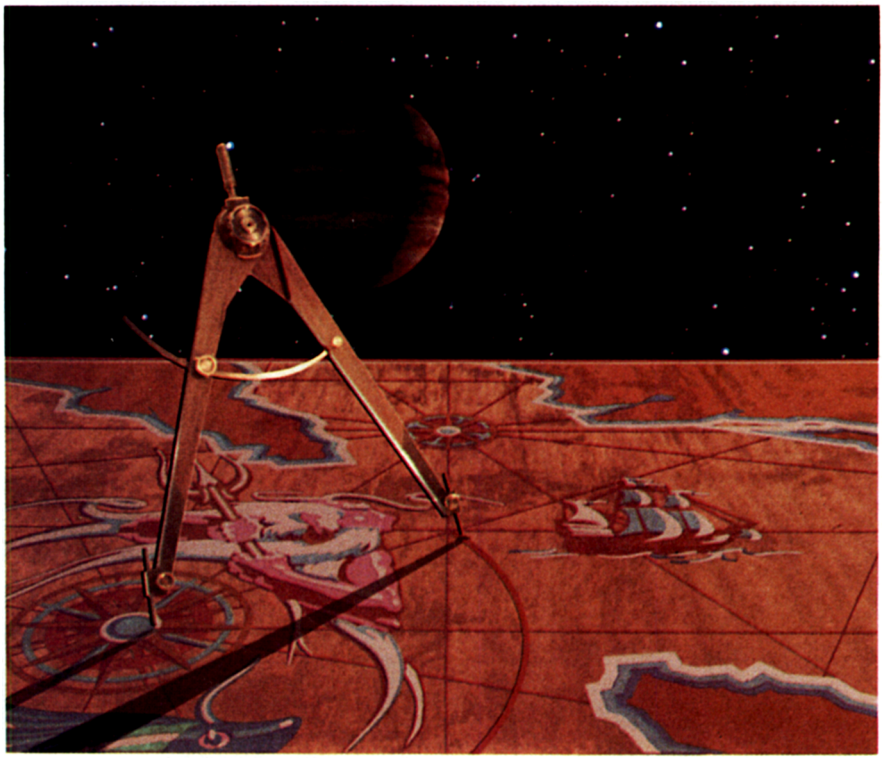
The Neolithic period is represented by a cave wall with a painting of an elk and a hunter with bow and arrow. The paintings appear to come "alive," and as the stick paints a red line across the wall, the elk jumps over it and runs toward us and away from the hunter, who stops running and lowers his bow.

The elk transforms into a ram-god carved into an Egyptian panel, as a gold-leafed Egyptian writing tool draws a red line over the panel.

As the line passes a symbolic cobra, the snake comes alive and the panel doors open to reveal the next period, the age of exploration. This period is marked by an old sea chart with Neptune, blowing up the traditional storm, and galleons. An old mariner's compass made of brass and wood scribes a red line upon the chart around Neptune.

As the sea chart lowers in the frame, the night sky becomes visible, and we enter into the final period: today and beyond. An aluminum computer light pen enters the sky, which is now seen to be only a reflection on the glass of a computer monitor. The light pen touches a point next to the approaching raster simulation of the planet Jupiter, and then a three-dimensional red line appears. We cross over this line, into the stars and beyond.

The mark of this particularly ambitious commercial is its elegant look. This look is achieved by combining different mediums. Most of the tools at Robert Abel's were used for this: They include a variety of motion control cameras, an Evans and Sutherland PS 200 vector system, a Vax-750, and a motion control system designed specifically for shooting the drawing tool models used in the commercial. The production house tunes and retunes its hardware and software to meet design requirements of commercials. These tools make it possible to be extremely flexible and versatile, claims Mirman. The team that produced this commercial also produced two other notable TRW commercials, "Changing Picture" and "Exchanging Ideas."■



Sea chart with compass drawing line around Neptune as night sky appears in the background.