

MAP SYMBOLS FOR USE IN THE THREE DIMENSIONAL GRAPHIC  
DISPLAY OF LARGE SCALE DIGITAL TERRAIN MODELS  
USING MICROCOMPUTER TECHNOLOGY

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BIOGRAPHICAL SKETCHES

Charles T. (Tim) Traylor is Associate Professor of Geography at Memphis State University specializing in cartography, air photo interpretation and remote sensing of the environment and is also Director of the Cartographic Services Laboratory. He earned a B.S. degree in Biology and a M.S. degree in Geography at the University of Alabama in Tuscaloosa and the PhD degree from the University of Kansas. He was the Cartographic Director for both the "Atlas of Alabama" and the "Atlas of Mississippi".

James F. Watkins is Professor of Design and Color in the Department of Art at Memphis State University. He is currently coordinating the implementation of digital imaging equipment into the Department's Graphic Design Program. He holds an MFA Degree from the University of Alabama. His articles on kinetic art and visual illusions have been published in LEONARDO, an international journal of visual art. As a winner in an international educational toy design competition, his work has been displayed in the Smithsonian Institute.

ABSTRACT

The need for a better way to display classified LANDSAT images prompted this study. It was found that students had trouble visualizing the look of the ground cover when the information was presented in the traditional form of colored pixels on a video monitor, especially when looking at a small area displayed at a large scale. Converting the image into a three dimensional block diagram that was colored according to the classification scheme helped, but still some troubles persisted. A method is presented whereby the colored pixels of the three dimensional terrain model are substituted with symbols that represent the ground cover. The method includes converting digital terrain data into a gridded block diagram, coding the surface according to the LANDSAT classification and superimposing specially designed symbols as appropriate from a growing library of land cover representations.

The difficulty is enhanced even more when the image is enlarged to the extent that each pixel is an obvious rectangle; the perception of looking at the earth's surface is lost. Figure 2 (previous page) is an example of an 18 pixel by 20 row classified LANDSAT image.

This paper describes a procedure that assists one in the visualization of such a image by using two dimensional symbols placed on a psuedo 3-D block diagram.

#### BACKGROUND

Other ways of viewing this data have been observed: Spectral Data has an algorithm in their RIPS system that allows the classified surface to be viewed in perspective.\* The Defense Mapping Agency has a program to generate block diagrams of digital terrain models in color that appear to the eye to be plastic relief models of a topographic map.(USAETL 1977) Small scale LANDSAT images have been portrayed as information on a relief model.(McKeown & Denlinger 1982) At the other end of the spectrum, CAD systems have been developed for designing small environments and to allow one to interactively take a tour by computer looking at various components (Atherton 1981), rooms, hallways, side views of buildings and even the local community. However, the data for these projects are very precise and specific to a given project.

Many advances in computer graphics have been made in the last few years. On large computer graphic systems such attributes as surface texture, color, light reflectance and others have been considered. Computer images are being seen daily on television, some so convincing that the average person does not realize the part that computers have played. Artists and designers have become involved with computers that have high resolution color capability, and have begun to use the digitizer and monitor as their design medium. The procedure presented here uses ideas from many of the current applications put together in a unique way.

#### EQUIPMENT

The heart of the capability that is presented here is the low cost add-on graphics board produced by SCION Inc. for the IBM PC. The PC640 board is a "high resolution" color monitor driver that produces a 640 by 480 resolution screen with 16 colors displayed out of a possible 4096 colors. The PC640 board appears to the computer as an additional 256 K byte bank of memory. As such, it can be addressed easily by any program. The set of 67 primitives built into the firmware includes such operations as move, draw, box, fill, flood, copy, pie, text and others. The software used in part of this project was the EASEL program by TIME-ARTS. Other commercial software is available that uses the SCION board. Another section of the project was done on the APPLE II+ microcomputer using the APPLEWORLD software package by United Software of America.

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\* Personal Communication

## INTRODUCTION

As a teacher of remote sensing, I have observed that some students have more difficulty than others in relating to the colors of a classified LANDSAT scene. This is especially true when the display is on a microcomputer which has limited resolution and color capability. Figure 1 shows a typical classified LANDSAT scene as it might appear on a microcomputer.

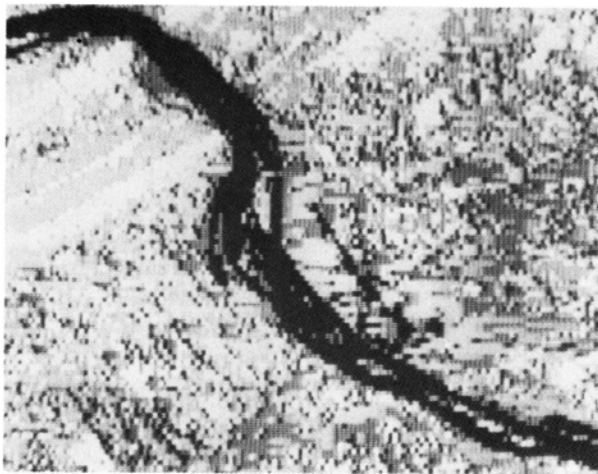


Fig. 1 LANDSAT scene displayed on an APPLE II at a resolution of 140 pixels by 96 rows (B/W photograph of a color monitor).

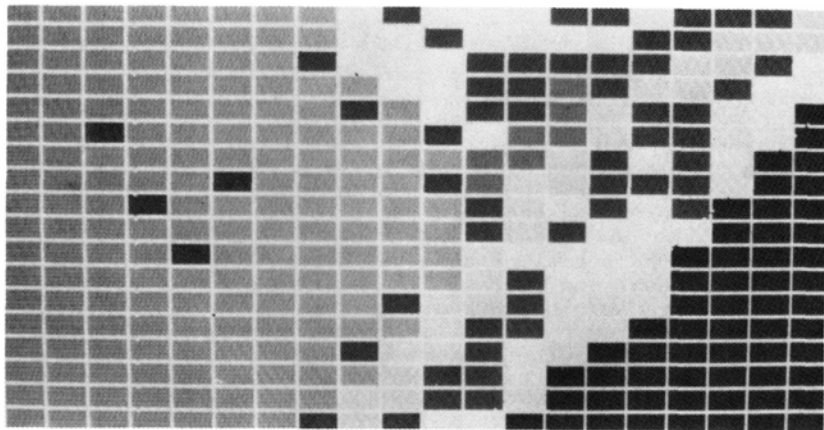


Fig. 2 Large scale LANDSAT classified image

## PROCEDURE

The first step in this project was to produce the three dimensional terrain model. This was done by geo-referencing the LANDSAT data to a 1:24000 scale topographic map. Elevations were then sampled at the corners of each pixel in the 18 by 20 pixel study area. The size of the matrix is restricted because of the limited memory in the APPLE II+ microcomputer. One program was written to store the elevation matrix, and another to add the coordinate information and to format the output file. The file was then read by the APPLEWORLD program and converted to the three dimensional model. The model was then digitized as input into the LEADING EDGE (an IBM PC compatible) with the EASEL software. The LANDSAT color classification was transferred to the cells of the digital model. Figure 3 shows the monitor at this stage.

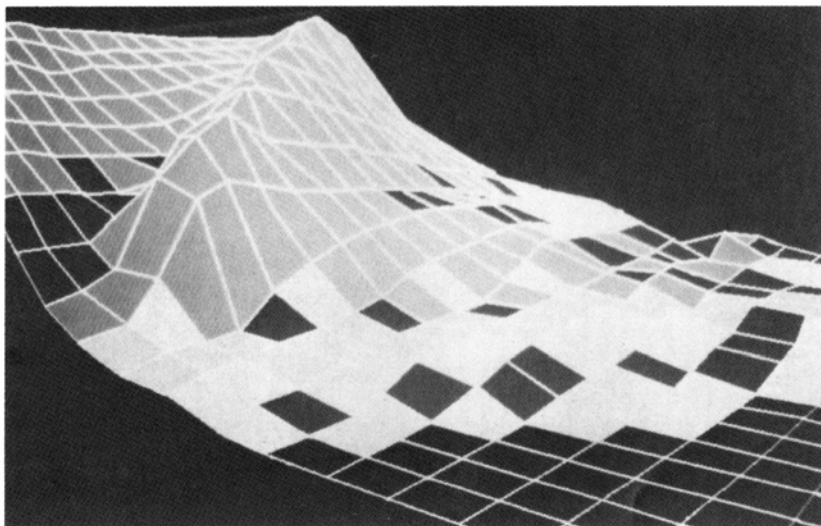


Fig.3 Block diagram of elevation and pixel location with LANDSAT classification

A series of symbols was developed for placing on the surface of the block diagram in place of the color coded classification scheme. It was thought that if the classification was, for example, "Forest," then the viewer's perception would be better served if there were trees on the surface. Symbols were also developed to represent deciduous forest, mixed forest, evergreen forest, scrub forest, pasture, various agricultural crops, residential, urban, commercial and others. The work on the types of symbolic representations is not complete and other types are being added to the list. Figures 4-5 are examples of some of the symbol library.

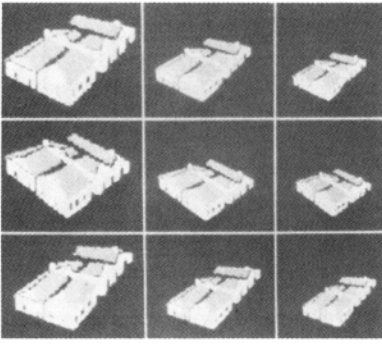


Fig. 4 Residential area

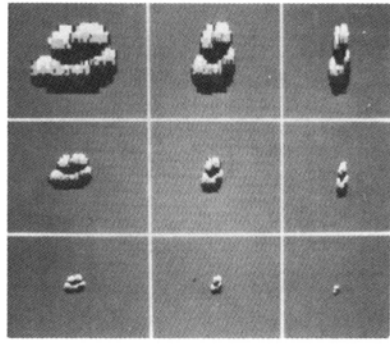


Fig. 5 Deciduous trees

The symbols are stored on disk and are interactively recalled, scaled and placed on the surface model much as a rubber stamp. Several symbols of the same category are available in the cell buffer so that the scene can have some variation of pattern. Figure 6 is an example of a final product. The view is from Fort Hunter, Pa. looking southwest across the Susquehanna River toward the community of Marysville.

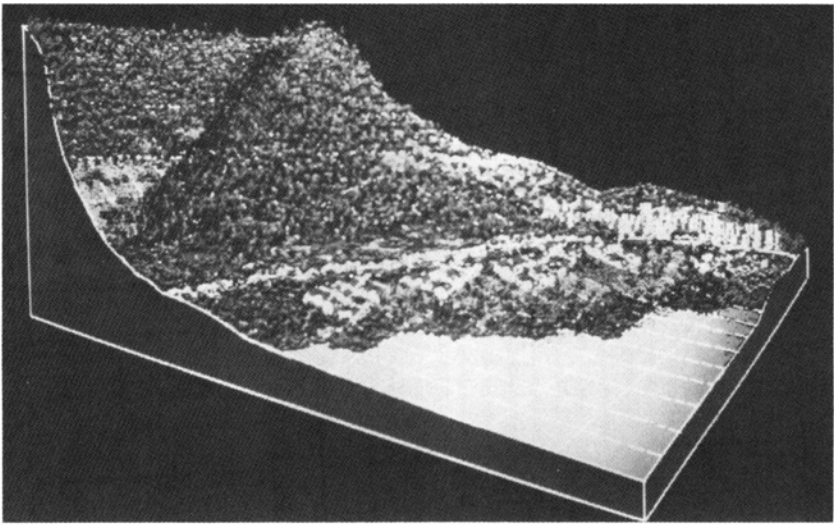


Fig. 6 Terrain model with stylized symbols representing LANDSAT classification

## CONCLUSIONS

The results show that microcomputers can be used to convert LANDSAT imagery into a different format of presentation. Three-dimensional block diagrams with stylized surface symbols representing the classification scheme is a new way of displaying this data. The addition of an artist's interpretation is certainly subjective but the result should be easier for the untrained to visualize what the surface might look like.

## REFERENCES

- Atherton, Peter R. 1981, A Method of Interactive Visualization of CAD Surface Models on a Video Display: *Computer Graphics*, Vol. 15, No. 3, pp. 279-287
- McKeown, David M., Jr. and Denlinger, Jerry L. 1982, Graphic Tools for Interactive Image Interpretation: *Computer Graphics*, Vol. 16, No. 3, pp. 189-198
- United States Army Engineer Topographic Laboratory (Fort Belvoir, Va.) 1977, Experimental Three Dimensional Map