

A Windows™ application for generating
input models for numerical modeling

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INTRODUCTION

We present a Microsoft Windows™ application that facilitates the generation of 2-D gridded models (initial conditions) for use during numerical modeling on a personal computer. Numerical approximations of physical phenomena are commonly used to support interpretations, provide synthetic data for testing processing and acquisition parameters, and for teaching purposes. Before a governing partial-differential equation can be approximated numerically, however, initial conditions (i.e. physical parameters) must be assigned to each node or element in the model. Assigning initial conditions to a discrete model that is complex may become difficult if visual methods are not used. Furthermore, the input models used for numerical modeling have increased in size and complexity due in part to faster and more robust computer processors.

The program discussed here (GENMODEL) is graphical, extremely easy to use, and uses a drawing program that is included with Microsoft Windows™. The program is ideal for academic purposes because it is suitable for generating input parameters for multiple numerical-modeling problems such as seismic waves, heat-flow, gravity, or ground-water flow.

Sophisticated graphics are essential for visually-oriented applications. The graphical front-end, however, has historically been as difficult to code as the application itself. Recently, object-oriented programs have become commonplace for PC-compatible users due in part to the advent of Microsoft Windows™ and visual-based compilers, such as Visual Basic™. Furthermore, drawing applications such as PAINTBRUSH™ are distributed with Microsoft Windows™ and can generate suitable output for modeling purposes if used properly.

CONCEPT AND GENERALIZED PROGRAM FLOW

Overview

The concept behind GENMODEL is simple, straightforward, and easy to implement. The fundamental idea of our method is to draw a picture of the model using colors to differentiate contrasting model properties, and then use the drawing to generate an input array for numerical modeling. To accomplish this efficiently, we let each pixel (or picture element) in the drawing represent a single node (or element) in the model. The objective, therefore, is to define the size of a drawing in pixels, manipulate the color of each pixel, convert the drawing into an array of physical-property indicators, and then assign physical properties to the physical-property-indicator array in a subsequent modeling routine.

Example

Figure 1 is a drawing of a hypothetical geologic model and illustrates the fundamental concepts of the GENMODEL program. The sample model is 300 by 300 pixels (the real model units are defined later) and contains 9 distinct geologic layers each represented by a unique color (shown in Fig. 1A in shades of gray). Each pixel in the drawing represents a single node (or element) and consists of a single color. GENMODEL reads the color value of each pixel (Fig. 1B) and assigns an integer value to the corresponding element in the outputted 2-D array. The application of this procedure to our model results in a 2-D array that consists of 90,000 elements (300 by 300) where each element is an integer. Because the output is a 2-D array of integer numbers that represents differences within the model and not pre-specified geologic properties, it can be used for a variety of modeling objectives.

PROGRAM AVAILABILITY

Single copies of the program are included with this report on a 3.5" (1.4 MB) diskette. The diskette contains a runtime (compiled and linked) version of the program, the computer listings, required auxiliary files, and a file (readme.wri) containing operating instructions. The program was written in the Visual Basic™ language for PC-compatible computers with Microsoft Windows™.

DISCUSSION AND CONCLUSIONS

The program GENMODEL, written in Visual Basic™, is a Microsoft Windows™ application that enables complex geologic models to be input into numerical-modeling algorithms easily and efficiently. GENMODEL requires as input a rasterized drawing (*.BMP) of the model and outputs a physical-property-indicator array to a user-named file. Physical properties of individual nodes (or elements) are represented by the color of individual pixels in the drawing. The output array serves as an input file for project-specific modeling routines and allows physical parameters to be assigned easily and automatically. This technique reduces the time, effort, and difficulty associated with creating complex input grids for numerical modeling. GENMODEL is fast, simple, easy to implement, and generalized for use in multiple disciplines.

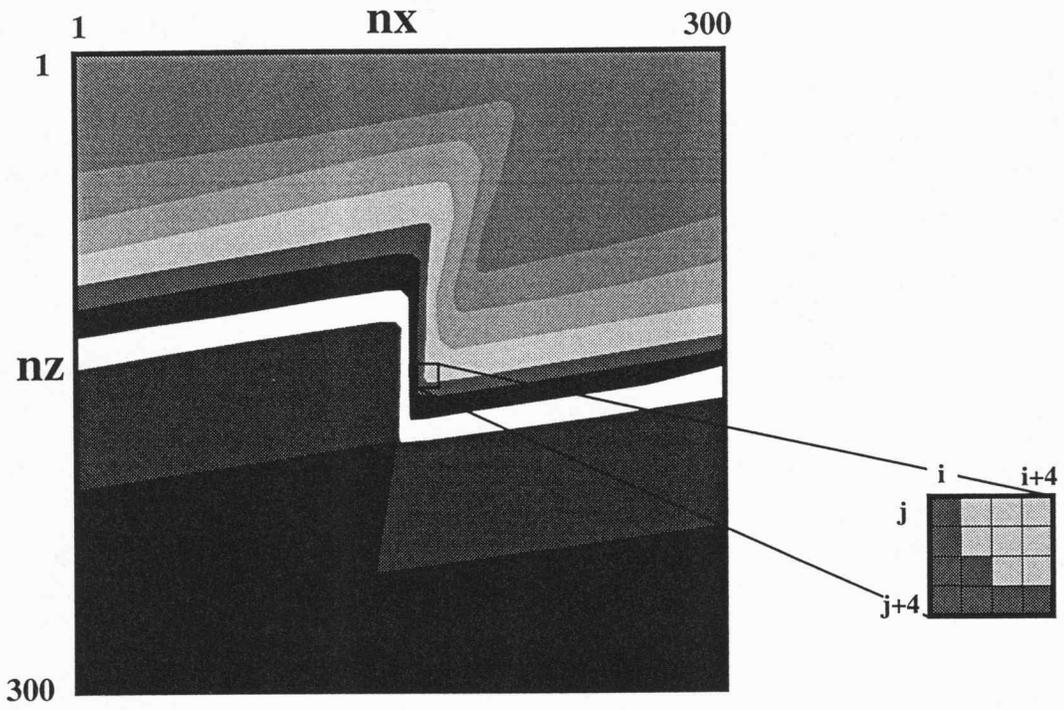
ACKNOWLEDGMENTS

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FIGURE CAPTION

Fig. 1. The fundamental concept of GENMODEL is illustrated by this example. A). The sample model contains nine distinct units, each delimited by color (shown here in shades of gray), defined over a 300 by 300 pixel model. A portion of the model is expanded to show a few of the individual 90,000 picture elements. B). GENMODEL interprets the color of each pixel and creates a 300x300-element array of integer numbers, where each integer represents a specific color (and therefore a specific model property). The integer array is then used to assign physical parameters to the model during subsequent project-specific modeling programs.

A



B

