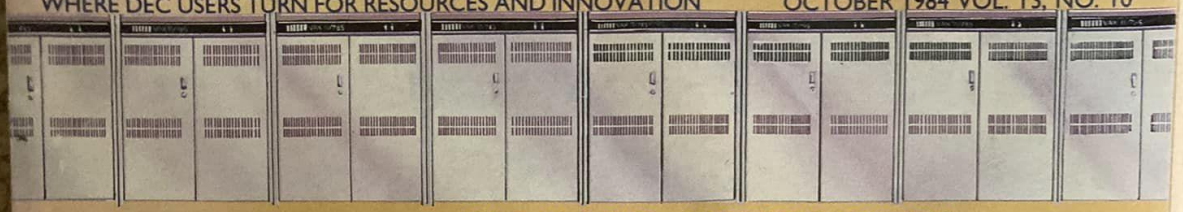
HARDCOPY

WHERE DEC USERS TURN FOR RESOURCES AND INNOVATION OCTOBER 1984 VOL. 13, NO. 10



DYNAMIC ALTERNATIVES TO THE KEYBOARD

DEC-Compatible Color Printers: A Buyer's Guide

Statistical Software For The Whole Family (Micros To VAX, That Is!)

Speakeasy And Carry A Big Stick

President Stan Cohen's math and statistical programming language came to life after it came out for the VAX.

Ever since the 21st amendment to the U.S. Constitution repealed the 18th and ended Prohibition, the Speakeasy language of downtown Chicago has gone from one of the toughest around to one of the most friendly. The primary reason for the Windy City's turnaround in phraseology is a popular programming language called, quite accurately, Speakeasy.

The first version of Speakeasy was a batch language written "for fun" by Stan Cohen, a mild-mannered physicist, almost 20 years ago. Since then, Speakeasy has developed into a VAX/VMS system that provides powerful math and statistical capabilities with graphics, database and report writing tools, and Speakeasy Computing Corp. has matured from a hobby into a million-dollar enterprise.

Although the city of Chicago is still in its formative stages as a nesting place for computer technology, Cohen has found a plush, comfortable home for Speakeasy downtown, in the shadow of the Sears tower, the world's tallest building. The obscure location hasn't affected the forward progress of Speakeasy, however, as the system has established sites in such diverse and prestigious places as MIT, the National Banks of Spain and Italy, the University of Tokyo hospital and the British Aircraft Corp.

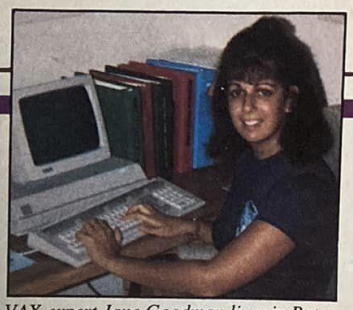
All told, Speakeasy claims well over 200 major installations, including educational institutions, national financial firms and Fortune 500 companies around the world. And the University of Chicago uses Speakeasy, too.

Cohen takes an unusual attitude toward his company's success, indicating that he is satisfied with the excellent reputation that Speakeasy, the language and the business, has achieved. "I'm honestly very happy to stop expanding now," he says. "Ask anybody." But Cohen would still like to expand Speakeasy to run on the Rainbow by Dexpo '85. The system already operates on several leading personal computers including the PC/XT and the Fujitsu Micro 16. Speakeasy the company has established a close relationship with the executives at Fujitsu, and is among the first U.S. firms to design a program for the Japanese system.

Most unique about Speakeasy, however, is its backbone of users and consultants that write new word modules to add on to the original program. The language is very easy to tailor, and suggestions and new programs from engineers, scientists, programmers and students are often used to extend the library.

The system includes line plots, bar, and pie charts integrated with the math, econometric and forecasting functions. Storage and retrieval of data is also provided, along with the capability to produce structured objects.

The Speakeasy language was originally developed when Cohen was working as a physicist at Argon Laboratories. In 1977, Cohen began marketing the system for IBM mainframes with the help of Argon's Steve Piper, who is Speakeasy's "guru of technical stuff," according to Cohen. "Most of our user group is still IBM," says Cohen, "but the VAX system has done extremely well."



VAX expert Jane Goodman lives in Baton Rouge but easily speaks to a computer in Chicago.

Engineers Thor Olsen and Wendy Koenig wrote the conversion to the VAX; and today VAX Speakeasy is maintained by Jane Goodman, who is located 900 miles away at the Louisiana State University in Baton Rouge. "We're probably the only computer company going with a top person so far away," says Cohen.

Speakeasy was transferred to the VAX because Cohen saw the potential for a highly interactive system. The Speakeasy language itself is a very simple series of prompts that lead the user into a library with Fortran-like math and science words, and descriptions of the functions that the words are programmed to perform. The system makes talking to a VAX as easy as talking to a micro, as each word combined with the applicable numbers lets the computer calculate the rest.

But best of all, Chicago has a Speakeasy that isn't so tough.

— Evan Birkhead

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Architectural Imagery: Keep it Simple

GIS Hits the Desktop

Creating Complex Curves

Feature

GIS Hits the Desktop

Exciting changes in geographic information systems have placed this technology in the hands of more users.

By Jane E. Goodman

Geographic Information Systems (GIS) technology has moved out of the back room and landed on the desktops of citizens, decision makers, engineers, administrators, and legislators. Web-based applications make it possible for anyone with Internet access to view and query GIS data. Software is easier to use, less expensive, and seamlessly integrated with standard word processing, spreadsheet, and database applications. Because today's maps must convey more than the locations of streets or cities, GIS is rapidly gaining acceptance. It provides decision support and spatial analysis tools to many, although high prices, lack of training, and insufficient data previously put it out of their reach.

gis

The driving force that is changing the GIS industry is a shift in emphasis from creating geospatial data to leveraging the value in it, Joe Astroth, vice president, GIS Group, **Autodesk Inc.**, says. Now organizations that invested millions of dollars to create spatial data are seeking a high return on their investment. He believes that "an integrated family of GIS products that have user-friendly interfaces, are easily customizable, and break away from proprietary systems" are the key to success. CAD customers are demanding integrated tools for planning, designing, building, and managing infrastructures. They are increasingly using CAD products for mapping, AM/FM products for their outside plant management needs, and GIS products for their geographic-based data creation and analysis needs, he says. Users may not be interested in technology, but they are interested in using the best tools available to automate their business processes.

GIS is increasingly relied upon as a key workflow element. The rapid changes in the development and adoption of Web-based GIS software are the most visible signs of advancement in the GIS software industry this past year, Astroth says. "True network-centric GIS, once a pipe dream, is now a reality," he explains. The GIS industry has become more than a niche by becoming part of organizations' Web strategies. It is also expected to provide easy-to-use, low maintenance applications, and Internet tools that allow the rapid development of applications and a faster return on investment.

GIS On-line

Two years ago, the GIS for St. Peters, MO, functioned primarily as an automated mapping shop that was capable of producing cadastral maps of parcel locations. Mark Terhardt, the city's GIS coordinator, wants users to know that GIS involves more than looking at maps. "Previously, end users were restricted to those who had applications loaded on their desktop, and were trained in their use," Terhardt says. "The cost of the software and hardware greatly reduced the pool of people who could directly access and make use of the data. Now, Web-based applications allow anyone who has access to the Internet to interactively view and query our GIS data." The largest volume of user inquiries (about 80%) are by users who want to know who owns neighboring parcels, and how the parcels are zoned.

Terhardt has discovered that using **Intergraph Corp.**'s GeoMedia Web Map to publish map data on the city's intranet has decreased the need for basic support to end users. For instance, identifying the owner of a specific parcel can now be done on-line. At the same time, more people are put in direct contact with GIS. "We're finding that we may need to customize some of our frequently used applications to make them user-friendly to our non-technical staff," he says. Terhardt's strategy for getting GIS to the desktop includes automating tedious tasks with custom GeoMedia user commands.

GeoMedia, Intergraph's new desktop mapping package, uses a standard Microsoft Windows interface and is compatible with Microsoft Office applications. In addition, it can be customized using Visual Basic, an easy to learn and widely known programming language. Terhardt believes that this is important because more people are using GIS. "Before, you may have only had two or three people doing GIS work at the city, so you

Informative intranet. The St. Peters, MO, intranet lets users retrieve parcel and zoning information that is posted against a backdrop of recently flown aerial photography.

A/E/C LINKS
Autodesk Inc. — www.autodesk.com
Intergraph Corp. — www.intergraph.com

could afford to send them to training," he says. "Now, the number of potential GIS users is over 100 and many of these people have not previously worked in a technical environment. So if your applications are not easy to use, people will not take advantage of them and will continue to do things as they had in the past."

One application currently available provides a tool for selecting by number or address parcels slated for rezoning. Any number of addresses can be entered and then highlighted, a buffer zone of user-defined size is generated around the selected parcels, and all parcels falling partly or fully within the buffer zone are crosshatched. Next, a customized letter is automatically produced by merging an Excel spreadsheet of addresses within the buffer zone, a Word document containing the standard notification information, and a snapshot of the GeoMedia map. Including the map in each letter drastically cuts down on the number of calls the department receives from recipients asking why they received the letter.

"People want more than a desktop mapping system," Steve Reed, senior marketing manager at Intergraph, says. "They want a system that works with their enterprise data and software. This is where GeoMedia fits like a glove. Coupled with products like **Oracle Corp.**'s Spatial Database, you can easily put GIS into mainstream IT."

Because the GIS is located in the city's Information Systems department, Terhardt can guide its design to meet citywide needs. His goal is for the city to leverage its investment in creating a basemap by providing support to the engineering, planning, public works, economic development, and police departments. For example, the public works department currently uses the GIS' street inventory and Intergraph's Segment Manager software to create maps that show average daily traffic and pavement conditions. The police department will soon use the GIS to track departmental actions.

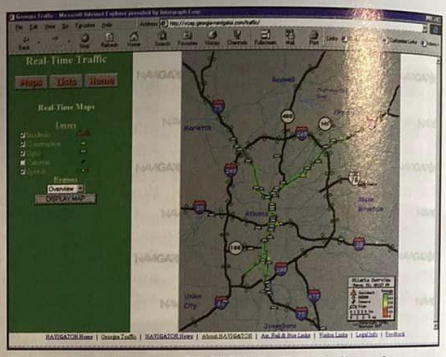
Terhardt organized a GIS users group, and holds brown bag lunches to alert potential users to the capabilities of the evolving system. Education and the development of custom applications are key to gaining citywide acceptance of the GIS.

Seamless Mapping

Jean Baptiste Monnier, senior vice president of Geoengineering at **Bentley Systems Inc.**, describes the most important changes in GIS technology as "two concurrent revolutions that happened at the same time: the Internet and the spatial database revolution." He sees the two revolutions taking advantage of each other to provide powerful new ways to deploy geospatial technologies. Bentley includes spatial indexing and storage as part of its "ModelServer" database infrastructure technology. The technology goes beyond the limits of files, and takes advantage of seamless mapping. "Files are big, they have borders and are an artificial abstraction between the user and data," Monnier says. Spatial data becomes more robust when accessed via the Internet. Spatial indexing means there is less noise in the data transfer because users can control what they want to see, and the amount of information that must be transferred is greatly reduced. GIS no longer stands for "Gigantic, Immobile, Static" because the ModelServer technology makes it possible to provide access to libraries of gigabytes of data and imagery over the Internet.

"Bentley is counting on these new trends to build its future technologies," Monnier says. "Java is the cement between the biggest Oracle servers, desktop browsers, and even the mobile geoengineering devices. As data can be stored in Oracle Spatial Databases, we can take advantage of standard IT-type tools such as replication, parallel processing, etc." Java is the only language capable of this scalability. Bentley's ModelServer Continuum is designed to take full advantage of the Oracle capabilities for IT departments that make specific demands on systems.

As an example, Monnier cites NAVIGATOR, Georgia's intelligent transportation system (*vcap.georgia-navigator.com/traffic*). At its core is the GeoTransport DynGraph toolkit, which combines real-time display with GIS capabilities. It is designed to gather information from a variety of sources, including a video monitoring and detection system, Highway Emergency Response Operators, and the public. NAVIGATOR links the Atlanta Transportation Management Center to the Transportation Control Centers of five surrounding counties and the Metropolitan Atlanta Rapid Transit Authority to create an intelligent transportation network that spans more than 220 freeway miles. Citizens use a browser to select a camera view of the road they are about to travel to see its condition in real time.



Find it on-line. Users can visit ESRI's ArcData On-line to browse and download free and commercial GIS data.

Embedded GIS Capabilities

As the software industry becomes component-based, the GIS industry is responding quickly to provide components that can be embedded in business applications, and to include components from other enabling applications. The evolving standards for software components such as ActiveX, COM, and JavaBeans, as well as industry specific Open GIS Consortium standards, are making it possible to embed GIS capabilities in mainstream IT applications. **ESRI**'s ArcView 3.1 GIS software includes **Seagate Software**'s Crystal Reports and **LizardTech Inc.**'s MrSID raster image compression technology. ESRI's MapObjects, **MapInfo**'s MapX, and Intergraph's GeoMedia objects are examples of products that provide GIS functionality in accessible individual software components. As

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Oracle Corp. — *www.oracle.com*
Bentley Systems Inc. — *www.bentley.com*
ESRI — *www.esri.com*
Seagate Software — *www.seagatesoftware.com*
LizardTech Inc. — *www.lizardtech.com*
MapInfo — *www.mapinfo.com*

part of the component trend, GIS software products are now based on collections of components. For example, Intergraph's free GeoMedia viewer was built entirely from GeoMedia objects.

Christopher Stern, water research and technology officer at the Department of Water and Power in Los Angeles (LADWP), sees the shift to Open GIS technology as a powerful trend. It is advantageous to his operation as he transitions GIS into computer-aided design and work management processes. "Open GIS has allowed us the flexibility to choose the best of breed design and mapping tools for our workflow, and share data with our enterprise systems," he says. "Because of Autodesk's commitment to GIS technology, and the open Windows-based development environment, we can rapidly deploy GIS on the desktops of all our engineering designers. These designers are already skilled in AutoCAD, and drawings they create can easily be exported to our ArcInfo GIS. In addition, when necessary, we can overlay electric facility maps created with the Intergraph design and mapping products used by our Power System." The LADWP no longer views GIS as a standalone operation, but as a technology that will be integrated throughout the enterprise.

Wonderful Wizards

To make the use of GIS even easier, software often includes wizards, or automatic routines, that help users perform specific tasks via a series of instructional panels. ArcView Version 3.1 features new wizards that both users and application developers appreciate because the wizards and their extensions are included in the software and don't have to be compiled. "I can use those extensions from within applications that I'm developing," says Doug Ruppel, an ESRI developer and reseller at Ground Control in Fayetteville, NC. "I can include the ability to access those tools without the end user taking any extra steps in their application."

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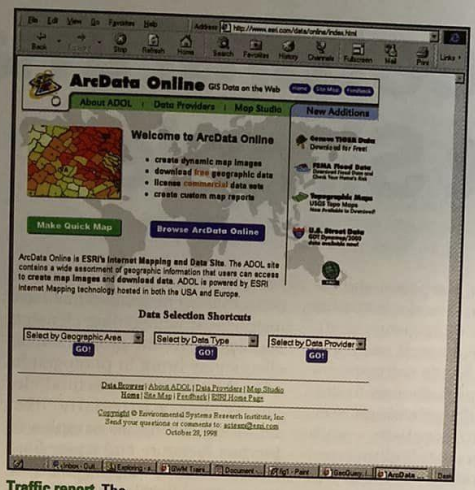

Traffic report. The NAVIGATOR Web site lets citizens in the Atlanta area use their browsers to view current traffic conditions culled from a variety of networked data sources.

"To integrate GIS enterprise-wide, we have to break through the technological barriers," she says. "ArcView wizards and downloadable extensions, as well as on-line access to the ArcView ListServer, are all significant aids toward reaching this goal." Intergraph's GeoMedia Warehouse connection wizard and INI Wizard make configuring and adding new data sources easy and quick. There's no need to look up the syntax for each option because the wizard panels provide instant access to all of the possibilities. Taking the wizard process one step further, GeoMedia provides a Visual Basic add-in that serves as a GeoMedia command wizard and automatically produces a shell VB program that the user can modify to produce a custom GeoMedia user command.

Mobile Computing

As GIS is increasingly deployed in the field, mobile computing hardware, mobile networks for data transmission, and GPS interfaces have rapidly become more technologically advanced. Many applications utilize GIS technology, but hide the GIS from the user. For example, Swiss postal workers carry laptops on their routes and use a simple front-end system to update national name, address, and property files. Utility truck drivers use a pen-based application that emulates familiar systems such as checking off boxes on printed maintenance sheets. By making the GIS function invisible to the user, mobile computing has the potential to greatly improve productivity in the field. GIS software trends such as component objects for specific tasks, open systems, and ease of use, are crucial for successful mobile computing applications.

Changes in Store

As customers use GIS to meet specific business needs, changes are occurring in the GIS data industry. "Customers want more than just raw data," Astroth says. "They want the data they purchase to include the first level of data management bundled with tailored application templates to provide off-the-shelf solutions for specific industries. This is in contrast to the traditional approach of focusing on providing data in a number of common file formats." Autodesk's MapGuide Release 4 offers platform independence via Java clients; applications can run on any Java compatible browser.

ESRI provides the free ArcExplorer, which is both a data viewer and a data retrieval tool. As a stand-alone viewer, it can display and query GIS data in shapefile and ARC/INFO formats, and create thematic maps. As a data retrieval tool, it can access GIS data sites such as ArcData On-line (*www.esri.com/base/data/online/index.html*), browse the spatial data located there, and initiate download of the information as GIS data.

Intergraph offers all members of the National Association of Counties a free GIS starter kit. It includes a copy of GeoMedia desktop software; data sets of the member's county that includes roads, boundary files, and demographics from the U.S. Census Bureau; USGS DLG and GNIS data; GDT Dynamap/2000 data layers; county applications; and training. Also included are four GIS solutions that work with this data to help solve common county issues. Users can also download free sample data by state at *www.intergraph.com/geomedia/viewer*. In addition, Intergraph is including address matching and GeoCoding functionality in GeoMedia 2.1 that works directly with GDT data. ●

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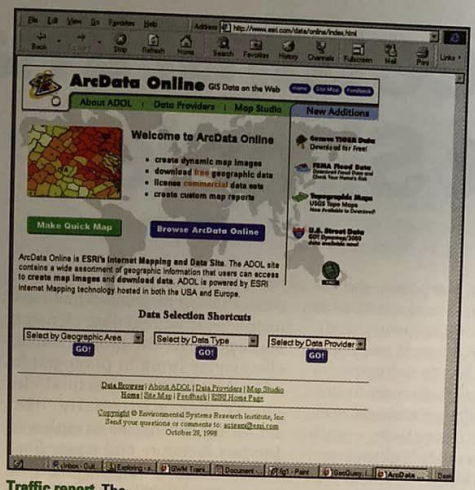

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MicroStation Utilities for GIS Users

JANE E. GOODMAN

Geographic analysis using MicroStation as the CAD engine can be carried out with a variety of different commercial GIS packages, but no matter which package you choose, certain tedious and time consuming tasks must be routinely performed. This review article looks at a variety of utilities that can enhance your workflow by saving you time and effort in your quest to compile accurate, informative and attractive maps.

LINE CLEANING

Perhaps the most labor-intensive step in the GIS process is generating "clean" line work. This step is required to produce polygons, which can then be crosshatched or color-filled to illustrate boundaries such as a flood zone area, a particular land use type or political boundary. You can simply use the MicroStation **Create Complex Chain** command, followed by the **Pattern Area** or **Change Color Fill** commands, or you can generate the polygons automatically using a GIS package--but first you must prepare your line work. Often during the digitizing process, small errors result in undershoots or overshoots where two lines either cross or don't quite meet. The tips of these undershoots and overshoots are referred to as "free end points." In addition, parts of the polygons may be digitized more than once, resulting in duplicate line segments or duplicate points. Sometimes elements intersect because of an inexperienced operator's "spaghetti digitizing." If you are digitizing in three dimensions, you may have unintentionally varied the active depth during the digitizing process. Another issue is GIS packages require a node (line or line string end point) at every point where lines intersect, and often during the digitizing process lines are not broken at these intersection points. Plotting out your file and examining it closely will help you locate these errors, but because the mistakes are often very small, unaided visual inspection may be insufficient. Furthermore, manually fixing each error using some combination of the **Partial Delete**, **Insert Vertex** and **Modify** commands is a wearisome process.

Three different collections of line cleaning utilities were tested for this review. The first, Line Cleaner, is part of Intergraph's MGE Base Mapper GIS product. This utility flags or fixes the invalid line work according to options and tolerances that you provide. It corrects undershoots, overshoots, intersections and duplicate line segments, and handles lines, line strings, arcs, curves, shapes, ellipses, complex strings and complex shapes. It can produce an output list file that you can view sequentially using the **MGE Queued Locate** commands. Line Cleaner works by placing a tolerance box around each free endpoint and then extending lines within the tolerance box to see if they meet. You can choose whether or not lines that meet outside the box can be bent in order to meet. It fixes intersections by breaking each element where it crosses itself or another element, and creates new elements. Since Line Cleaner outputs all corrections as line work, you can specify a tolerance for stroking arcs that is the maximum deviation or separation from the stroked arc to the original arc. Line Cleaner flags all free endpoints with a box of user-defined size, placed on a user-defined level, and all intersections with a circle of user-defined size placed on a user-defined level. You can flag errors, then manually fix them, or you can attempt automatic fixing and attach the flagged file as a reference file with only the levels with boxes and circles turned on, allowing you to inspect locations where changes have been made. A report summarizing the number of elements processed, flagged and fixed is generated as part of the line cleaning process. Before running Line Cleaner, you can run Line Weeder to reduce the size and complexity of your line work by removing excessive vertices within a user-defined tolerance. You can run Edge Matcher after line cleaning to correct line work to match lines across design files.

MAPS-3D provides several application modules related to generating clean line work. In addition to finding intersections and free endpoints, CHECK-3D can find line segments where the horizontal or vertical distance between two consecutive vertices exceeds a maximum value; where the Z coordinate of each vertex of an element increases from beginning to end (uphill drainage); where the angle formed by three consecutive vertices is less than a minimum value (slivers); and even where different portions of the same linear feature have been digitized in different directions. Lines can also be checked to see if they are sufficiently level by testing if uphill or level variance is exceeded. The tolerances for each of these criteria are defined outside MicroStation using the DMP-3D Database Management program, and can be set individually for each map feature. No external database management software is required. MAPS-3D supplies an enhanced version of the MicroStation XBASE database server. The LINK-3D program is then run to tag selected graphic elements as particular map features.

One of the output files created by CHECK-3D is an error file that can be examined within MicroStation. An **Error Types** dialog box provides toggle buttons for specifying which types of errors (directionality, XY sliver, etc.) are to be displayed, and an EDIT-3D command palette provides commands to assist in locating and processing the flagged errors as they are displayed. Different error types are displayed using different cells (which can be modified if desired) from a special cell library. The editing process is similar to examining a reviewer's proofreading marks and making appropriate corrections if desired. The cells are only temporarily placed in the file and are removed when the editing session is concluded. You can move forward and backward in the queue and acknowledge errors as acceptable. EDIT-3D can also be used to view errors generated by other applications such as POLY-3D (a polygon processing module), TIN-3D (a Triangulated Irregular Network generator), and map joining and edge matching modules. MAPS-3D replaces some MicroStation primitive commands with enhanced versions that are very useful for correcting errors. For example, the **Insert Vertex** command interpolates the new Z value for the

inserted vertex and the **Move** commands scroll the view in the desired direction by 90 percent instead of 25 percent. Additional commands include **Move Z**, which modifies the elevation of an element, **Change Direction**, which changes the direction of a linestring, and **Node Modify**, which creates an intersection of two elements with a new node if an undershoot occurs.

Another MAPS-3D module, NODE-3D, can be used to automatically correct overshoots and undershoots and remove isolated line segments and duplicate vertices. A hierarchy value ranging from 0-99 can be specified for each feature. The Z values of the feature with the greatest hierarchy value are used to interpolate the Z value of a node where multiple features intersect. The CHECK-3D and NODE-3D applications are controlled either by specifying in a parameter file which error types should be handled or by modifying the runtime options, which are displayed in an easily modified menu. In addition to the corrected output file, a report file and deleted elements design file are generated.

In a test on a large design file with many small overshoots and undershoots, the MAPS-3D application's CHECK-3D procedure ran much faster than the MGE PC-2 version of Line Cleaner and slightly faster than the UNIX MGE version. CHECK-3D was more sensitive to design file errors and did not process files once an error was encountered. The manual specifies that all input files must be valid, and that this can be verified by using EDG and entering

```
SET VERIFY/RANGE
SET VERIFYLENGTH
EOF
```

and then fixing any errors before proceeding. You will probably uncover errors you are not aware of and may not be sure how to fix them using EDG. The FileFixer from Axiom Software can be used to diagnose errors before they wreak havoc, and repair many of them automatically. It can also be used in an expert mode, allowing you to control which elements are deleted, and allowing you to specify what types of elements should not be found in the design file and what levels you use. FileFixer can be run in batch mode or interactively.

The Intergraph and MAPS-3D utilities discussed above are part of full-featured GIS packages. If you are just looking for a utility to flag and fix line work, pt_mend from Geographic Resource Solutions provides a command line interface to specify an input design or list file name, tolerance distance, input types, levels, colors, weights, classes and styles to be processed, as well as flag level and flag size. If used in conjunction with MGE, it can also invoke MGE's List Builder process to allow you additional options for specifying which elements should be processed. However, design files are processed using an indexing algorithm, which speeds the process up substantially. While Line Cleaner did not fix free overshoots or undershoots when the boxes flagging these errors overlay, pt_mend was able to successfully process these situations. NODE-3D fixed all the errors with the least amount of input from the user. Since the tolerances are defined in the database management program, no tolerance needs to be supplied when you run NODE-3D to process the file.

Perhaps the most labor-intensive step in the GIS process is generating "clean" line work

Geographic Resource Solutions also offers the command line-driven utility, segjoin, to consolidate line work by removing unnecessary breaks in lines, linestrings, curves and arcs. It can join lines together based on common symbology, weed lines, stroke arcs to lines and lines to curves, and flip the order of linestrings based on the angle of the line from first to last coordinate. One workflow is to use segjoin with the nojoin flag specified to split apart all elements, then use pt_mend to perform line cleaning, and then rerun segjoin with the join flag specified to reconnect the corrected line work. Currently, pt_mend and segjoin run only on the Intergraph CLIX platform, but DOS, Windows and Windows NT versions are planned. An expanded user interface is also under consideration. MAPS-3D offers SEW-3D, which can be used to combine line strings together before patterning, to form closed shapes and to merge short lines and FILTER-3D for weeding. Bentley is developing MicroStation Mapper, which will provide line cleaning capabilities. One of its features, demonstrated at the Spring IGUG, was RAINBOW, which displayed all line work in a spectrum of colors to make unnoded intersections and other errors more easily visible.

DATA TRANSLATION

Translating data from diverse sources to generate a MicroStation design file is another common GIS-related chore. One very useful utility is Intergraph's ASCII Loader. Its use requires installation of the MGE base product. It provides a user-friendly interface which displays lines from a text format input data file, and prompts you to click on the starting and ending columns for each attribute value and for the start and end of the coordinate pair. The coordinates can be separated by a comma or space, and can be in long/lat or Northing/Easting format. If the feature being generated is a linear or boundary feature, the ASCII file can include a lines-to-follow line for each graphic element. ARC/INFO export files can be converted to ASCII/LOADER format via a simple script file. You may need to write a small program to convert your data to ASCII Loader format (for example, the longitude values for western hemisphere locations require negative signs), but once this is accomplished, you can quickly create symbolized, attributed maps in the projection system of your choice. MAPS-3D offers ASCII-3D to translate a design file into an ASCII file and vice versa, as well as two other modules primarily of use in Canada.

Intergraph MGE-layered products include USGS and TIGER/Line data translators. One utility included with the TIGER/Line translator is the Demographic Area Creation processor. It processes line work that has attributes representing codes for areas to the left and to the right of the linear feature. Using this information, it can generate polygons representing area boundaries by selecting just the lines where the left and right values differ. It simultaneously places centroids (points inside the polygons) with attributes corresponding to the attribute values of line work inside the polygon where left and right values are identical. Intergraph will soon offer a U.S. Spatial Data Transfer Standards (SDTS) format translator for use with MGE. Much of the data available through the USGS on the Internet is available in SDTS format. Geographic Resource Solutions offers USGS DLG and DTM translators and an ARC/INFO translator.

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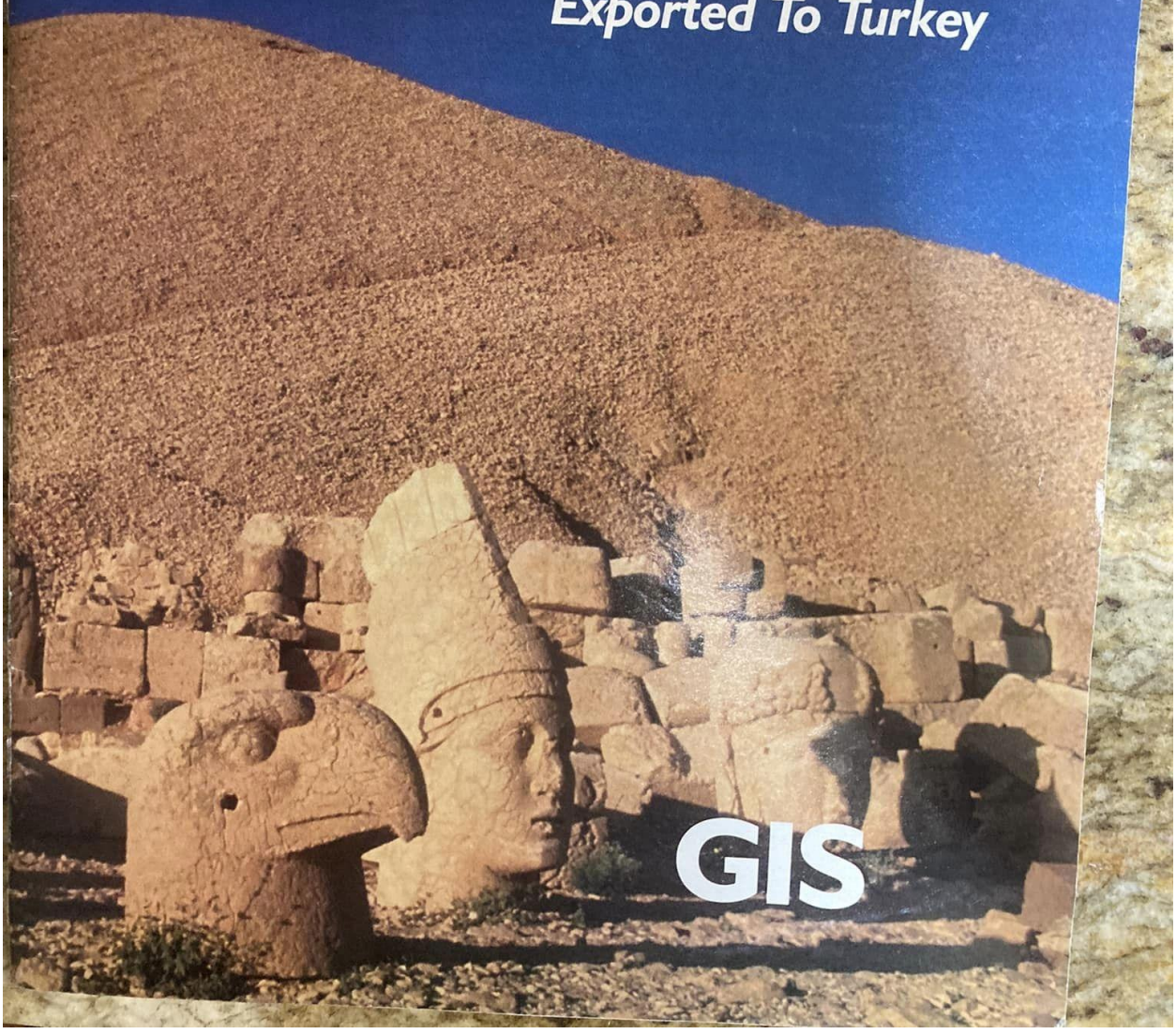
GIS Expertise Exported To Turkey



GIS

MicroStation GeoGraphics and MicroStation Descartes

Jane E. Goodman

As experts in the measurement and analysis of data, surveyors require increasingly sophisticated computer applications to process the huge quantities of information generated using new data-gathering techniques. Information derived from aerial photography, satellite imagery, GPS collection, soils, demographic and species distribution studies, as well as traditional boundary, planimetric and topographic data, all must be recorded to use land and resources properly. The new GeoEngineering initiative from Bentley Systems, Inc. delivers two products, MicroStation Descartes and MicroStation GeoGraphics, that extend the MicroStation computer-aided design graphics environment to meet these needs. MicroStation Descartes, developed by HMR, Inc. provides tools referred to as Applets to edit, transform, enhance, mosaic or georeference images using an interactive interface featuring outstanding display speed. MicroStation GeoGraphics delivers a spatial data input, management, manipulation, analysis and visualization GIS solution that includes a subset of the MicroStation Descartes raster engine.

Both products support the popular MicroStation operating system platforms Windows 3.1x, Windows NT, Windows 95 and DOS. Additionally, by year-end MicroStation Descartes and MicroStation GeoGraphics will run under Sun Solaris, HP-UX, Intergraph CLIX and DEC Alpha NT. MicroStation GeoGraphics releases for SGI, IBM RS6000 and Macintosh Power Mac are also planned. MicroStation GeoGraphics can be used on any system that meets MicroStation 95 hardware requirements, but requires connection to a database for full functionality. Any database supported by MicroStation, including Oracle, Microsoft Access, Microsoft SQL Server, INFORMIX and Intergraph RIS can be used. Additional memory requirements depend on the database application selected. An additional 3Mb of RAM for the executable and 2.5Mb of RAM for the default image buffers is recommended for MicroStation Descartes Image Manager, included with both MicroStation Descartes and MicroStation GeoGraphics.

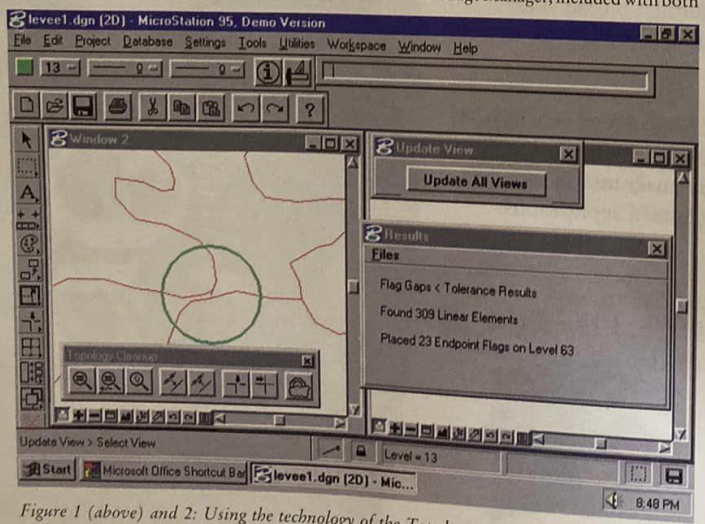


Figure 1 (above) and 2: Using the technology of the Topology Cleanup Find Dangles tool, extra portions of an element that extend past a point intersection with another element can be flagged or deleted. After cleanup, buffer zones around points and areas can be created using the Topology Creation tool box.

Extension of MicroStation

MicroStation GeoGraphics is installed as an extension of MicroStation and is woven into the MicroStation user interface. Starting MicroStation GeoGraphics invokes MicroStation with modified pull-down menus, and added tool boxes but MicroStation functionality is unaffected. MicroStation Descartes is loaded as a MicroStation Development Language application and a tool box is displayed with icons for the Image Manager, Image Edit, Vectorize, Register and Image Transform applets.

MicroStation Descartes Image Manager capabilities include importing and exporting TIFF, RLE, CIT, and COT raster formats. You can simultaneously use black-and-white, gray scale and color (8-bit) images at differing scales and resolutions. The familiar MicroStation view controls can be used to repaint the screen, and additional image display controls such as fit all images to view, send an image to back or front and copy images from one view to another, extend viewing flexibility. Images can be dynamically panned at high speed, and contrast and brightness are adjusted using simple dial controls.

MicroStation Descartes Image Edit provides despeckle, erase, raster fill and other image editing tools that can be "undone," along with image enhancement tools such as contrast stretching and density slicing, and mosaicing capabilities. You can set an image pixel value to be transparent and view overlapping images stacked underneath through the resulting holes, or set an image pixel value to be translucent and produce a weighted display of overlapping pixels from multiple images. You can also stamp vectors from a design file onto the raster image to create a high-quality image for use with other applications.

MicroStation Descartes Image Transform includes transformation (move, scale, rotate, mirror) and document layout tools, as well as a Corridor tool that lets you copy regions of one or more images contained in a vector-defined polygon to a single uniform file containing an output polygon of the same shape. The Image Register applet provides a set of

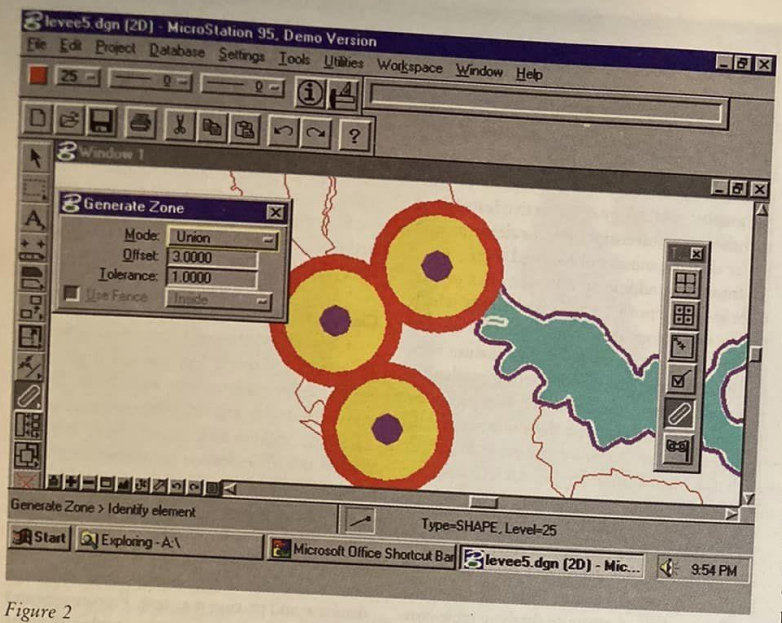


Figure 2

dynamic, interactive image and vector warping tools to geometrically correct images or vectors to a given coordinate system. The control points can come from an image, a vector file or a list of known points. Numerous warping transformation models are supported, and transformed images can be resampled using a variety of methods.

Useful Aids

MicroStation Descartes Vectorize is used to manually create vector files from a raster image. Automated vectorization development is in progress. Features include editing tools to place and continue line strings, and place one-point elements. Among the useful aids for vectorization are Raster Snap that causes a shift of the mouse data point to the closest raster element, and a Spy Window that pops up at the position of the cursor and displays the area at a user-specified zoom factor. Function key definitions provide quick access to commands such as deleting the most recent point and centering the view on the cursor or last point. The Theme Styler can be used to define unique graphic symbology definitions (color,

line weight, etc.), called themes, that can then be selected before placing line strings or points.

Included with MicroStation GeoGraphics are the image manager capabilities of the MicroStation Descartes package enabling MicroStation GeoGraphics to serve as an extra, low cost seat for raster viewing. Since the image-editing functions are not included, only pixel values designated as a transparent or translucent using MicroStation Descartes can be displayed in this manner. The Image Manager can be used to edit the image header values corresponding to the image origin and pixel size. Hybrid raster/vector plotting is fully supported as it is in the MicroStation Descartes product.

Feature-Based Design

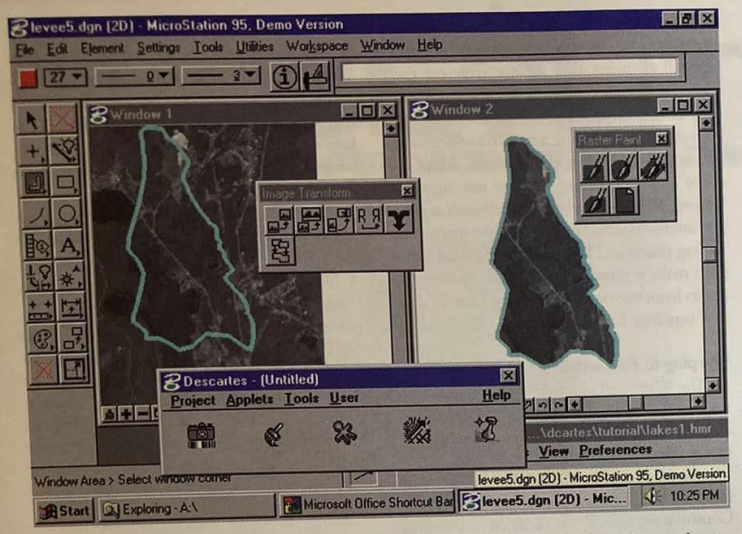
MicroStation GeoGraphics extends MicroStation's level-based functionality to include feature-based design. Features (for example "tax.lot.line" and "tax.lot.label") and Categories (for example, "Tax Map") are set up using the Feature Administrator. Feature definition includes specifying an element type (line string, text, or cell, for example), line weight, line type, color, and a variety of other settings based on the selected element type. For example, extensive text settings including character spacing, slant, font and line spacing are supplied for Text Element features. Graphic elements are tagged as one or more feature using the Features tool box making it possible to select elements based on feature definitions as well as graphics based characteristics. The Attach Best settings tools can be used to test elements to see how well they match the graphic symbology of the active feature and to make the feature assignment for elements with better than the minimum required score.

Interesting additional characteristics of features include Priority, which determines which feature symbology definition is used for display of graphic elements with multiple feature tags, and Element Strength, which determines whether a graphic element can be tagged as a particular feature if its element type does not match the feature definition. A feature command definition such as a MicroStation key-in, BASIC script or MDL command, can optionally be associated with a feature. Commands are classified as either AUTOPLACE or AUTOMODIFY, depending on whether they define how a feature should be placed or how the feature should be modified.

A user-defined attribute database table contains the non-graphics, tabular attribute information associated with a feature (address, acc value, etc.) The Database Menu pull down vides a Structured Query Language SQL ager box to query, insert, and update data records and to review graphic elements attac to the records. Tools to build SQL comma control display order of selected records, to SQL statements for reprocessing and to tables together are supplied. Printed repo spreadsheets and business graphics can be gen ated using MicroStation BASIC, OLE auton tion, and MDL tools.

Customization Possible

Customized thematic maps and legends c be created by modifying selected graphic el ments' color, weight, line style, color fill an pattern, based on their database attribute value Thematic actions lists include SQL selectio criteria and MicroStation resymbolization com mands. The legend cells are generated from th thematic action lists according to user option and a legend can be placed by specifying two points indicating its size and location. Annota- tion can be added by taking information from a database and placing it as text. Feature area and perimeter calculated from the graphic element



Using the Descarte Corridor tool, the region of an aerial photograph enclosed by a polygon has been copied to an output polygon of the same size. If more than one photograph is enclosed, they are merged in the resulting image.

can be loaded to the graphic feature's attribute table using the desired unit of measurement.

Topology Cleanup Kit

Data that has been entered into MicroStation GeoGraphics by digitizing off a paper map or using heads-up digitizing on a scanned image must be preprocessed before spatial processing can be carried out. MicroStation GeoGraphics provides an eight-tool Topology Cleanup kit for performing clean-up operations. These tools provide options to move, delete or merge duplicate or similar linework, and flag or repair line fragments and dangling lines according to user-defined tolerance settings. Tools to reduce the number of vertices in linear elements (line thinning) and to break linear elements into separate elements (segmenting) are also provided in this tool kit. All of these tools are enhanced by the ability to rollback changes if undesirable results occur and to choose a facitization option that tries to avoid large problems by breaking a large area into grid cells. The Topology Creation tool box provides an attribute masking tool that is used to modify the graphic display characteristics of

elements selected based on their database attribute for easier viewing.

The MicroStation GeoGraphics manual defines topological processing as an approach to the analysis of areas where the focus of both the data structure and algorithms is on the boundaries of areas rather than on the areas themselves. MicroStation GeoGraphics topology layers are in-memory models created from loading graphic elements through a fence command, and multiple layers can be held in memory at one time. The topology layers are not saved from session to session, so they are always up-to-date. The Validate Topology tool checks that boundaries surround areas, with each area containing exactly one centroid. To create a polygon topology layer there must be no lines that overlap or cross over, all areas must be exclusive and not overlap, and all linear elements must be area boundaries. Point and Line layers can also be generated. Once a topology layer has been built, you can move your mouse over the file and highlight areas under the cursor or areas adjacent to cursor, create closed elements (areas), centroids (points inside areas), and copy linkages from centroid to area, centroid to boundary, area to centroid, and boundary to centroid.

Buffer zones around shape, line or point elements using union, intersection and exclusive OR (all elements that do not intersect each other) can be generated using the Generate Zone tool. Zones on the inside of a shape element can be created by specifying a negative offset value. The zones are graphic elements that adopt the active level's symbology and are not tagged as features. Polygon overlay operators such as polygon intersection and union, polygon merge, and finding points and lines contained within polygons make it possible to combine selected elements from two or more topology files to create new topology layers.

Warping to Fit Control

The Warping/Coordinate Setup item from the Utilities menu can be used to transform a set of graphic elements to fit a known set of monuments. The transformation can be affine or conformal, and the weighting options include uniform least squares and inverse distance squared. Control points can be manipulated in a control point settings box, which is used to build and edit ASCII control files for projecting source points to a set of target points. When the graphic elements in the source design file are transformed, options to copy or move the
and to process only fenced elements
vided. Tools for defining map projecti
forming transformations between pr
and a customization capability are cur
beta test, using technology that is the re
cooperative effort between Bentley an
Systems Ltd. (Vancouver, Canada).

New capabilities and further merging
functionality of MicroStation GeoGraph
MicroStation Descartes is an on-going p
A Web-enabled version of MicroSt
GeoGraphics that includes a browser, URI
port and Web publishing tools is currently i
test, and will further simplify acces
GeoEngineering data that frequently mu
shared across networks and platforms. The
products enable an increasingly div
MicroStation user group to fortify the stren
of an already familiar engineering environm
with integrated and customizable add-ons t
suited to their needs. ■

*JANE E. GOODMAN is President of GeoQue
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training. She can be reached at 504-767-701*

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Hooked on MDL

JANE E. GOODMAN

If you are an experienced MicroStation user, try MDL.

MMM ONLINE

Additional examples that go with this letter are available in ASCII file format on the Intergraph Bulletin Board System (IBBS). The file, MM411JG.zip, is located on the IBBS. To log in, dial 205/730-8786, with the modem settings at 8-bits, no parity, 1 stop bit. To access the MicroStation Manager *magazine (MMM) library, dial IBBS; log into system; select menu option for Application Platforms under TOP menu; select menu option for MicroStation; for Intergraph Product Centers; enter F and hit<return>to access the file libraries. Select the menu option for* MicroStation Manager *magazine. For further information on how to access the IBBS, refer to page 76 of the December, 1993 issue.*

Have you been meaning to try MDL programming for a while? You've heard how powerful it is—platform independence, full access to MicroStation CAD engine and database, modularity of code and an event driven Motif or Windows user's interface. You know it's free and waiting for you on your MicroStation CD, along with online hypertext formatted manuals, a debugger, lots of examples and the MDL Development Environment (MDE). You've seen the results--the many MDL applications distributed as part of MicroStation, on the Synergy and IGUG CDs, as add-ons marketed by third party developers and custom applications developed at your own site. You may have even bought some of the MDL programming books or tried to build one of the example applications, but were put off by all the ensuing error messages.

If you feel there are too many obstacles to overcome, consider the following: as an experienced MicroStation user, you are an expert in event-driven logic and a graphical user interface, perhaps without even knowing it. You may not know C, but if you are competent in any programming language, you understand the basic concepts you will need to apply—defining variables, writing code with loops, using control flow, conditional expressions, functions, and building a finished application. In your imagination, you can visualize an MDL application whose dialog box fills your heart with glee. It's up to you to make it a reality. Give it one more try.

Once you ascend the initially perilous slope of the MDL learning curve, you will be amazed at the power and the speed at which your knowledge will grow. Check that you have installed the MicroStation version 5 MDE environment. On the PC, it will be under the directory ustation\mdl. If it is not yet installed, you must install it from the CD kit as it is not included on the installation floppies.

Installation of MDE requires about 7.5 Mb of disk space and you will need to install the Help resource so that the manuals are available online, at least until you have the printed versions. Although the *MDL Programmer's Guide* and the *MDL Function Reference Manual* were included with version 4 they must be ordered (and paid for) separately with version 5. To access the help, select **Help>File>mdehelp.hc** from the MicroStation command window.

To build an MDL application use the **bmake** command. The procedure is similar to the UNIX make utility which maintains, updates and regenerates groups of programs. The **bmake** file contains all the rules for combining the source, resource and include files together to generate the finished application. It is a platform independent file and all paths are given using the forward slash "/". Don't look too closely at this file yet—you need some more confidence building first. Typically, the **bmake** file is given the same name as the applica-

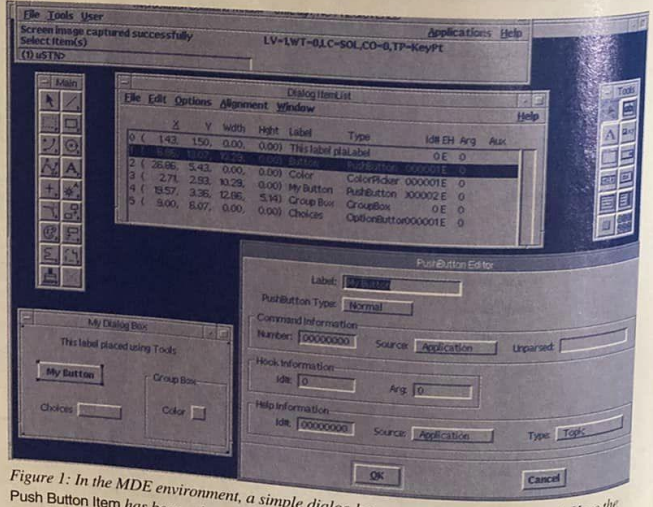


Figure 1: In the MDE environment, a simple dialog box can quickly be prototyped. Here the Push Button Item *has been selected from the* DialogItemList *and the* PushButton Editor *is being used to modify its label. The* MDE Tools *palette has icons for placing group boxes, push buttons and many other dialog box items. The MicroStation palette is displayed with the* command dialog *mainframe.*

To build an MDL application use the bmake command.

tion and the extension .mke. Move to the directory ustation\mdl\examples\dlogdemo which contains an MDL example illustrating the functionality of a variety of dialog box items. Set up your environment by adding \ustation\mdl\bin to your PATH variable in autoexec.bat. This is where the **bmake** executable resides and once it's "in your path" you can invoke it from any directory. You must also define the variable *MS* to correspond to the directory where MicroStation is installed (c:\ustation on the PC and /usr/ip32/mstation on the Intergraph workstation) and use the -I option to **bmake**, to specify the directory where the file mdl.mki is located. Issue the command **bmake -I/ustation/mdl/include dlogdemo**. You will get lots of commentary and dlogdemo will be successfully built.

If you are running MicroStation from DOS, you may want to issue the ! command to shell out to DOS rather than exiting from MicroStation each time you want to make a new application. If your machine has only 8 Mb of memory, you will need to allocate some memory for external programs using the **User>Preferences>External Programs (Ext'd)**. Specify the extended memory size in Kb. A suitable number is 2000. If the number you choose is too small, MicroStation will hang in mid-build.

Enter MicroStation and keyin `mdl load dlogdemo`. Try out the options on the dialog box that appears. If you want to explore all the latest in dialog box item capabilities ("dialog items" is the lingo for referring to the push buttons, toggle buttons, color pickers, etc., that can be displayed on the dialog box for user interaction), go to the newitems directory under examples and use the **bmake** command to generate this application. Enter **mdl load newitems** and watch closely what happens to the MicroStation command window. You can use the Examples pulldown to check out the new features—including dialog boxes with multiple color text listings, radio buttons, vertical scales and multiline push buttons. Use the Applications pulldown to switch between the default command window and the special newitems window. Try making some of the examples in the other directories as well.

If you would like to know the commands associated with your newly made application, load the application, enter a ? in the command window, tap the Tables push button and choose your application. The first word of the command will appear in column 1. Selecting that command will display any possible modifiers to that the command. Again, selecting a modifier will display further modifiers to it in the third column. For a good example, load scrncapt, enter ? to bring up

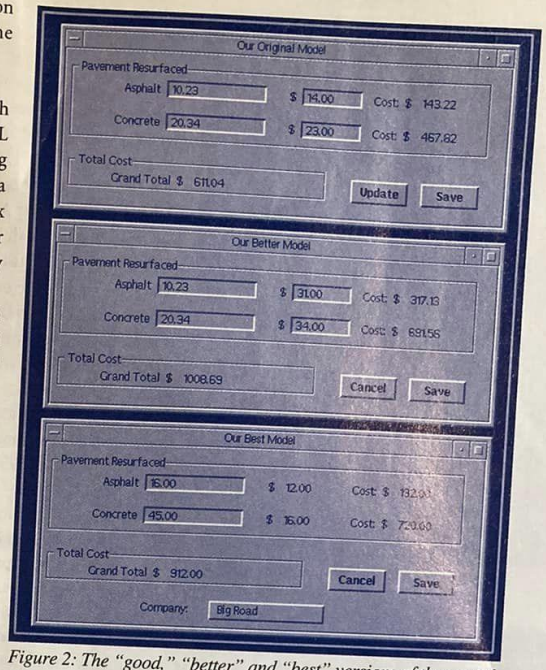


Figure 2: The "good," "better" and "best" versions of the spread sheet program are shown here. A new MDL programmer can start with a very simple application and gradually take advantage of the full range of user interface, CAD engine and database access capabilities MDL provides.

Changing the information will change the dialog box display.

the browser, select scrncapt after tapping the Tables push button, then highlight capture, followed by view, followed by window. If an application has no keyin commands, this just means that it is accessible only from its dialog box.

Now switch to the MDE workspace by invoking MicroStation with the command **ustation -wumde**. The available pulldown menus in the command window are File, Tools and User. You can bring up the customary tool palettes by keying in dialog mainframe in the command window. Access Tools>Dialog Box Builder and use the Select push button to choose an MDL application and a dialog box. A Dialog Item List is displayed when the dialog box is opened, and double clicking on a dialog box item will display the item's full specification.

Changing the information will change the dialog box display. In addition, you can use the Tools palette to place additional dialog items in the dialog box. You will find that you can intuitively use the Dialog Box Builder Tool to easily modify the appearance of a dialog box and add new items to it. You can also use this set of tools to prototype dialog boxes for MDL applications that will actually be written by someone else (*see Figure 1*).

You are now ready to start writing some code by following steps leading to a deluxe application. The example is a simple spread sheet which makes use only of the dialog box capabilities of MDL (*see Figure 2*). The application is not an interface to the CAD engine but an interface can be added later by tying the spread sheet entries to the length of graphic elements. The "good" version you start with calculates the products of two sets of user-entered numbers representing number of miles of concrete and asphalt road to repave and cost per mile for each type. It is inadequate because the user has to press a button to update the spreadsheet and the print button does not really do anything. In the "better" version, a hook function is attached to the text items so updates occur when a new value is entered. Now the Update button is no longer needed and can be replaced with a Cancel button. The print function is added, an easy job for a C programmer which requires no MDL training. Finally, in the "best" model an option button is added to automatically set the prices based on which company is selected. Error checking is done by modifying the text item resource definitions so that a minimum and maximum allowed value is specified. The code for all three versions and a guide for modifying each version to reach the next level is available on the IBBS and Compuserve's MicroStation Forum.

From a programming standpoint, this exercise illustrates how to design a dialog box using group box, push buttons, option buttons and text items. It shows the use of hook functions—user written functions that are attached to the dialog box or dialog item—and how the message sent to the hook function. **(DITEM_MESSAGE_BUTTON, DIALOG_MESSAGE_DESTROY)** can be used to determine what further function to call. It also makes clear the difference between a dialog item's internal value (stored in the item's private data structure and based on its current display) and its external state which is the value of the application data (the cost, miles and totals variables) that the item controls. By defining synonym resources (a list of dialog items), an MDL function **mdlDialog_synononymsSynch** can be used to synchronize the listed items' internal values (i.e., their appearance in the dialog box) to match their external states calculated in the spreadsheet application.

Think of yourself as a system integrator or designer and you can avoid getting initially hung up in coding details. Start with the "the good" version, which includes an easily modified **bmake** file and all needed source in just 400 lines of code total. The initial program provides:

1) required include file lines of the form (#include <dlogitem.h>) which enable you, as a programmer, to use mnemonics like PUSHBUTTON_OK (the standard OK button) rather than a cryptic -4 in your code.

2) code to load the dialog box, initialize the variables and compute the new values. This code requires understanding C structures and can be first appreciated just by following the pattern until you reach a more in depth understanding.

3) function and hook declarati
including one dialog box hook fu
tion, which calls the funct
unload_dialogHook to unload the
log box when the window menu but
Close pulldown is selected, and a di
item hook function **main_buttonH**
that uses a switch statement to
which push button has been pres
and branched accordingly. This c
structure is integral to all MDL appli
tions and makes plugging in alre
existing code (for example, printing
spread sheet results to an output f
very simple.

Think of yourself as a system integrator or designer.

The instructions will guide you in t
changes. Feel free to look at the code f
"better" and "best" if you get stuck alo
the way. You will find that tools for cor
paring files to find changed lines, searc
ing files with certain text, such as fun
tion names you are interested in callin
and lots of time for experimenting w
assist you greatly in your MDL educ
tion. When you finish with this projec
you will be ready to modify the applic
tion to perform calculations that a
interesting to you and to consider int
gration with graphics. Keep at it. La
month, your support staff couldn't writ
a single line of MDL code and their bos
was at wit's end. Now they're shoutin
"we're hooked on MDL!" and you ca
be, too. Just call the IBBS and receiv
your free kit today!

*Jane Goodman, president of GeoQuery
Inc., Baton Rouge, La., taught an MDL clas
of 12 students this summer, many of whom
had little or no C experience. Jane know
that at least one of them is now a self
described "MDL addict." If you would like to
communicate with her about strategies for
learning MDL, she can be reached at
504/767-7019.* WSV

MicroStation and data input for a GIS

JANE GOODMAN

Entering data into a Geographic Information System (GIS) is a multi-faceted task which often consumes the major portion of a GIS project budget and requires substantial CAD and database manipulation know-how. The data may exist in a variety of formats, including raster images, vector based design files, digital data records gathered by disparate processes ranging from a Global Positioning System (GPS) to a national census and paper maps. It may vary in map projection, scale or resolution and require translation from one commercial GIS platform to another. Despite the interdisciplinary nature of the problem, a single person or group is often charged with the responsibility for planning and carrying out a wide variety of GIS data input tasks. Thus there is the need for an intensive, multi-platform, workflow-based training sequence.

MMM ONLINE

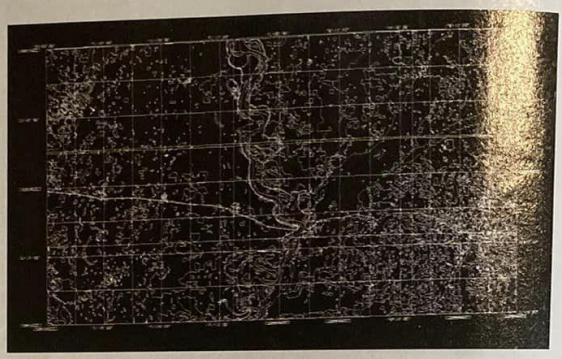
The examples referred to in this article are available in ASCII file format on the Intergraph Bulletin Board System (IBBS). The file, MM402JG.ZIP, is located in the MicroStation Manager magazine (MMM) file library. To extract the data from this file, use the PKUNZIP utility (pk204g.exe) located in the BBSUTIL file library. The MMM file library can be reached via modem (300-14,400 baud, 8bits, no parity, 1 stop bit) at 205/730-8786. Navigate by selecting MicroStation from the Application Platforms, or key in /GO MSTNFILEMMM for a short cut. Help is available within the library, or call Keith Ford (sysop) at 205/730-1413.

This article describes my approach and solutions to several MicroStation based issues I encountered while preparing a GIS data input workshop offered by the Tri-Service CADD/GIS Center located at the U.S. Army Corps of Engineers' Waterway Experiment Station (WES) using data corresponding to its Vicksburg, Miss., location. The data was obtained in-house and from various agencies including the United States Geological Survey (USGS), the National Aerial Photography Program (NAPP), the U.S. Census Bureau and SPOT Image Corporation. I spent nearly two months preprocessing and subsetting the data for lab exercises and preparing a 100-page training manual.

My goal was to provide the 12 students, including system managers, GIS coordinators, cartographers and CAD managers, with four and a half days of training that would sufficiently familiarize them with the tools and techniques of GIS data input to meet the varied needs of their home sites. Since the only prerequisite for attending the class was MicroStation familiarity, this was truly a formidable challenge.

The Center's computer facility is a networked UNIX environment including six Intergraph workstations. Among the wide range of Intergraph software available are MicroStation, I/RAS, I/SCAN and the Modular GIS Environment (MGE) along with MSPM for mapping projection transformation, ISI for image processing, MGA for spatial analysis and MGT-US for data translation. Other equipment includes an 1800 dpi plotter, large format scanner and a GPS data collection system.

As system dependent details were not a main focus and previous experience with GIS minimal, it was particularly important for the required start-up work to be very simple and for the system to function smoothly. A two-day visit prior to the class provided time to install the necessary software and use the MGE Import Utility to create six copies of the project I had prepared. The imported project contained files for the students to modify and process. In addition, the raw data files, processed raster files that would be displayed and custom UNIX scripts were all placed under one common directory structure. The software was installed on each machine's internal hard drive. The user accounts were located on three different partitions of two NFS-mounted hard drives. Printed signs listed each machine's name, the account which should be used and the home directory name. A panel menu for each project containing the products available on the local machine was created by pressing the VT button from the MGE Manager display and then keying in



This is raw 2 minute by 1 minute USGS Land Use Land Cover dat set for the Jackson, Miss. quadrangle. Numerous steps are required before GIS analysis can be performed.

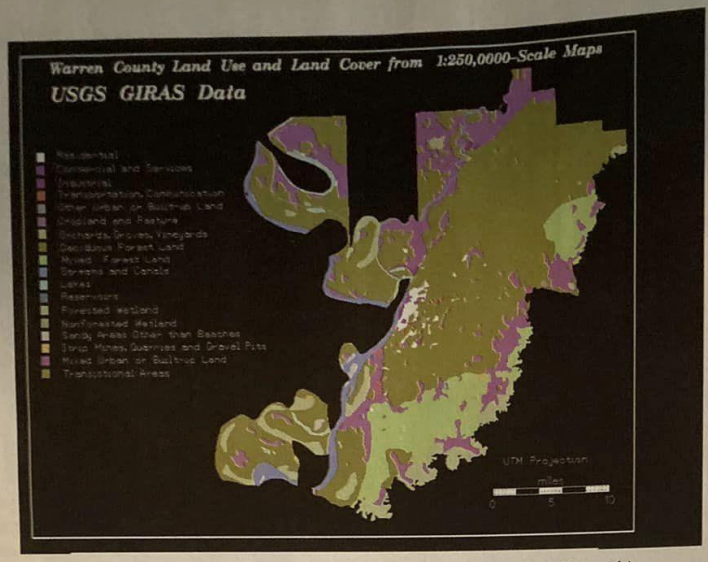
```
ksh /usr/mge/bin/setup_menus.sh
```

The setup_menus script created the necessary files in a directory found by searching the file /Usr/Ip32/Mstation/Umenus/Ustn_Prods for the text string "menus." The line which assigned this directory to the variable *MENUDIR* is:

```
MENUDIR=`grep menus $MS_DIR/umenu/ustn_prods | awk '{print
$2}'`
```

If a project is named course1 and the line in Ustn_Prods is menus /usr/ip32/menus then the script will set *MENUDIR* to the second argument in this line and create the files Course1.cfg and Course1.amm in the directory /Usr/Ip32/Menus/Cfg and the file Course1_Pnl in the directory /Usr/Ip32/Menus/Menus, assuming you have write privilege in these two subdirectories. The products selected will be all those listed in the ustn_prods file.

I came prepared with a brief shell script of my own. When memory filled up with message queues, shared memory and semaphores used for



These are the same polygons after processing. Only the portion which lies within Warren County has been displayed and the polygons have been shaded according to land use classification.

interprocess communication, the **ipcs** command listed currently active processes and the **ipcrm** command removed the processes from the system. The commands are issued from the MGE Manager window after exiting from graphics by pressing the VT button to call up a terminal window. Multiple processes may have to be removed and students' initial interest in these commands fell off very rapidly after several invocations. The solution was a simple shell script that generated a new shell script with the appropriate commands to remove all the unwanted processes.

```
sh cleanup.sh
```

This script (cleanup.sh) used one stream editor command file (Ipc_Script) and is listed here:

```
cleanup.sh:
USER_NAME = `who am i | awk '{print $1}'`
ipcs | grep $USER_NAME | cut -c1-9 | sed -f ipc_script >
clean.sh
sh clean.sh
      ipc_script:
s/^/ipcrm -/g
```

After an introductory slide show/introduction to GIS lecture and a lecture and lab covering mapping concepts such as projections and grid generation, we commenced with data input. Although some students would return to primarily GRASS, ARC/INFO or PC-1 (MGE for a PC) platforms, the labs were carried out in the MGE environment. Since MGE uses MicroStation as its graphics engine, the students found it familiar and quickly took advantage of the integrated raster/vector capabilities and RIS Structured Query Language (SQL) database interface.

The USGS 1:24,000 Geographic Names Information System (GNIS) data base, available at a cost of only US$32 per state, is a perfect first dataset. Over 38,000 records exist for Mississippi, so I created a file containing only the 533 records for Warren County where WES is located. The general format of the file (with blank space removed for clarity) was WJFL-AM (Vicksburg) tower Warren 28149 322045N0905212W Vicksburg East.

The field "Tower" indicates the feature type and students choose among school, church, hospital, etc. The field "28149" is the FIPS code for Warren County. A shell script, gnis.sh, with two arguments (feature type and output file name) was prepared in advance to show how stringing together simple UNIX, MicroStation and RIS commands could quickly and accurately generate a map of attributed place locations. An MGE point feature named gnis _ftr and associated table gnis_table, had already been created as part of the imported project. The script, invoked as sh gnis tower towers (arguments should be eight characters or less) created two files. The first (Towers.ll) is a keyin file with lines in the format "ll=-90:52:12,32:20:45" and the second (towers.sql) contains SQL statements of the format "update gnis_table set gnis_name='WJFL-AM (Vicksburg) ' where mslink = 1 ;" The keyin file contained the longitude and latitude of each of the points in the form of a long/lat precision keyin command and was executed from within MicroStation (with Projection Manager active) by entering:

```
wt=3
co=4
place point (or place cell)
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at the Command Window.

After running MGE Feature Maker and choosing to load blank records so that each point was tagged as a gnis _ftr feature and associated with a blank database record, the second file which loaded each blank record with the actual tower name was processed with RIS (MGE's RDBS interface). The commands are:

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ris
default schema course;
read towers.sql;
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In just a few minutes students created a fully attributed data set without having to digitize a single point or type in a single attribute value. The exercise was quite illuminating. It showed clearly how tabular attribute data can be linked to graphics information by entering both in the same order. The same script, with small modifications for formatting, can be used on other similarly structured data sets. It is satisfying to be able to tap on one of the newly placed points to display the name of a church or school which you just drove past on the way to class.

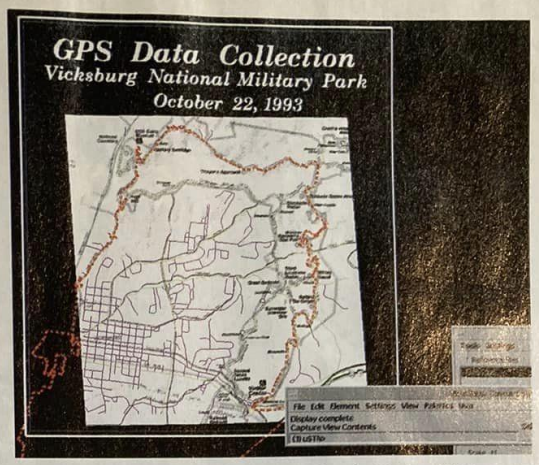
After this exercise the class proceeded on to USGS DLG data and USGS Land Use Land Cover data. The Land Use or GIRAS data provided an opportunity to discuss several MicroStation related issues. First, since Intergraph does not provide a GIRAS translator, it is necessary to perform the translation elsewhere. The ARC/INFO command

girasarc converts to ARC/INFO format. The ARC/INFO command **arcigds** converts the resulting ARC/INFO format dataset to MicroStation format. The **export info** command obtains a listing of the corresponding database values, one for each land use polygon. After defining a mapping projection, performing registration to spatial coordinates, line cleaning and feature making, it remains to link the centroids of the land use polygons with the land use attribute values.

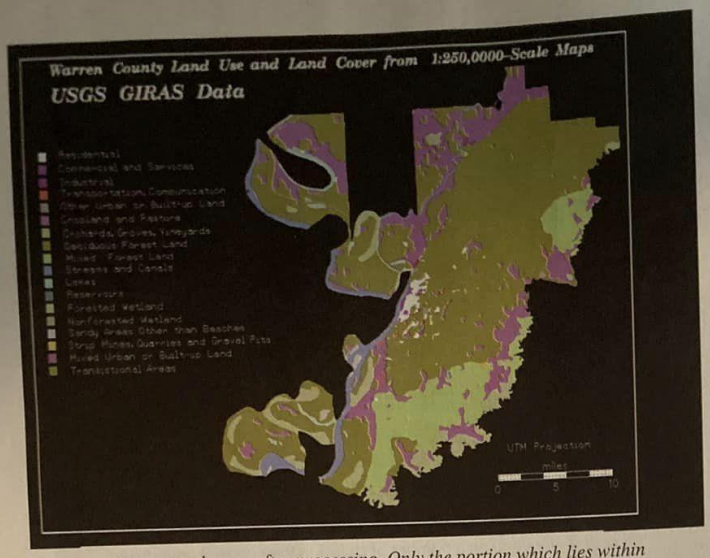
A procedure similar to that used with the GNIS data was employed. A topology file describing the spatial relationships of the polygons was successfully generated. The class learned the following:

One option was to generate a color coded display of the different land use classifications. However, owing to the large number of nested polygons (polygons within polygons) and very complex polygons with many vertices, this step failed on the first try. The MicroStation complex shapes which were generated "leak" when AREA FILL was turned on. An area which was first colored green was colored blue when an adjacent polygon was filled. The solution (which I knew from experience prior to this class) was to create another file such as a grid with blank labeled centroids, and then build a topology file for the grid. Combining the land use topo file with the grid topo file created a new topo file with linkages to both datasets. A design file generated from the resulting topo file contained very small polygons resulting from the overlay of the grid on the land use polygons. It did not have any leakage problems and plotted properly.

The next topic was scanning and heads up digitizing. Students at two of the workstations confronted an odd problem. Their cursor and the resulting tentative line completely disappeared when they moved over an area covered by a raster image. My attempts to correct this (change your highlight color, check your preferences) were of no help, nor was the last resort suggestion to exit, clean up all processes and restart. As a very last resort, I suggested using I/RAS instead of MicroStation and this alleviated the problem. A call to Intergraph revealed that this bug, which showed up in MicroStation release 4.4.0.2, will be corrected in the first release of MicroStation version 5.



This is the route of our GPS trip overlaid on the National Military Park map along with DLG transportation data.



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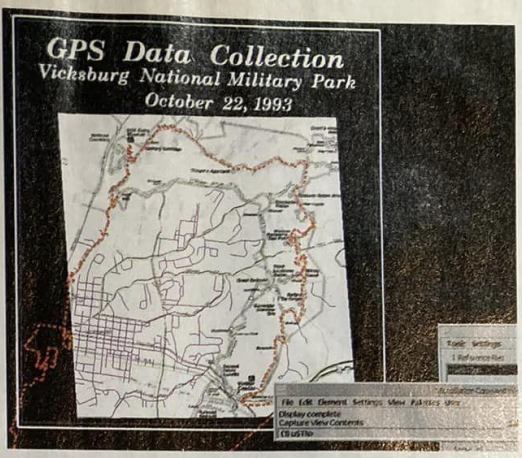

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