LIS/GIS Products and Issues: A Manufacturers' Forum

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Dipix, Inc.

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THE DIPIX stand-alone MicroARIES workstation is a new, low-cost, entry level system for image analysis. The MicroARIES combines VAX/VMS versatility and unique ARIES display architecture in a compact, powerful workstation. Baseline components include an ARIES-III Plus image display subsystem with expandable image memory; a 512 color display monitor with interactive tablet and mouse; a 3 MB dedicated VAXstation II CPU with a 95 MB cartridge tape, a 71 MB disk drive and 19-inch graphics terminal with keyboard and mouse; a standard Ethernet interface; and MicroARIES operating and applications software modules and full compatibility with additional ARIES applications software products.

The baseline MicroARIES workstation can be expanded to meet user requirements. The display subsystem can be enhanced with a 19-inch, 60 Hz, non-interlaced 1024 monitor with multi-image window handling. An ARIES Pixel Processor can be added to the display to dramatically increase interactive processing power. Large 268 or 677 MB disk drives and 1600/6250 BPI tape drives are available for large storage and input requirements. A wide range of ARIES integrated imaging peripherals — color film recorders, photodigitizers, frame grabbers, digitizing tables, and ink jet plotters — are also fully supported on the MicroARIES.

The MicroARIES display architecture with its unique image memory allows random access to both very large images (16K by 16K or larger) and multiple image data sets. Up to 63 images of varying rectangular dimensions and pixel depths can be stored in image memory. Spatial resolution and pixel depth can be adjusted for maximum memory utilization.

With the 1024 option on the MicroARIES, six display topologies can be selected directly from the tablet. Ten images can be viewed simultaneously in independent display windows. The windows can be of any rectangular shape. Windows can be moved, enlarged, reduced, or overlaid interactively using the tablet and mouse. Multiple, independent display windows provide efficient desktop flexibility for analyzing complex image data. To further enhance MicroARIES functionality and processing power, an ARIES Pixel Processor (APP) can be integrated into the display subsystem. the APP provides interactive geometric resampling, spatial filtering, expansive/compressive zoom, and image rotation. All functions are controlled with the tablet and mouse. This interactive power and high speed processing makes the MicroARIES with an APP an ideal workstation for both research and production environments.

The ARIES baseline operating system and the Level 1 applications software package are both included with the MicroARIES. This Level 1 package provides data input, display manipulation, and general image processing functions. All ARIES VMS applications software is compatible with the workstation. Advanced remote sensing, GIS, vector, mosaicking, map output, and other packages are currently supported as MicroARIES options. Programming libraries are also available for user-specific software development.

The MicroARIES is the entry point into the expanding world of ARIES-III Plus integrated imaging systems. With full ARIES product compatibility, MicroARIES offers a wide range of configurations to meet current requirements and expanding functionality to meet future needs. The MicroARIES is a single-user system with a 3 or 5 MB CPU embedded into the VAXstation II. The 95 MB cartridge tape, 71 MB internal disks, and optional disk drives provide excellent storage capability for handling large image data sets. The large 19-inch graphics terminal with keyboard and mouse includes a standard windowing function. The user can easily display large amounts of information and view multiple tasks executing concurrently.

The workstation MicroVMS operating system provides fast response time, multi-tasking and excellent networking capability. The standard Ethernet connection or optional DECnet provides networking capabilities for compatible multi-user environments.

ERDAS, Inc.

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ERDAS, INC., a recognized industry leader, provides systems and consulting services that integrate image processing with Geographic Information System (GIS) capabilities. State-of-the-art ERDAS software merges multi-source data, such as maps, satellite imagery, aircraft scanner, digital elevation, and photographs, for easy cost-effective problem solving. ERDAS has conducted over 50 large scale mapping service projects, covering over 500 square kilometres. Over 600 installations worldwide use ERDAS production tested software in land and forest management, remote sensing, mineral exploration, military, site selection, and other non-traditional applications.

In 1979, ERDAS introduced the first microcomputer based system to integrate remotely sensed data and mapped data. Since that time, ERDAS has continued this commitment to excellence by designing a family of systems to meet a variety of application needs and budgets. The following computers are supported as turnkey systems and as KITs for installation on existing computers: IBM PC/AT and selected compatibles; PRIME 50 series; DEC VAX and Micro-VAX II series; Data General MV series; Gould Powernote 6000 series; and SUN Workstation series.

Over 130 easy to use programs provide professional level capabilities for image enhancement, classification, geometric correction, subset and mosaic, and GIS merger and analysis. Software design enables processing of large images (Thematic Mapper, SPOT, digital elevation data), limited only by available disk space. Modular design allows for acquisition of software/hardware modules as applicable. Data input techniques include polygon digitizing (with coordinate conversion and planimetry), video-digitizing, high resolution (4K x 4K) color digital scanning and 9-track tapes (multiple formats). Output products include image and GIS color hardcopy at user-specified scales, statistics, and high resolution (4K x 4K) film writer hardcopy. The Topographic Module incorporates surfacing routines and the use of digital terrain tapes with analysis programs for slope, aspect, and shaded relief, etc. The 3-Dimensional Module merges imagery with terrain data to create a visual simulation from user selected viewpoints.

Advanced menu-driven architecture provides ease of use for advanced users and professionals without previous computer experience. A highly refined user interface includes program dialogue in plain English and intelligently computed default answers.

All ERDAS applications software is production tested and guaranteed by the ERDAS warranty to be free of defects in logic.

The ERDAS-PC was introduced in 1984 as a low-cost integrated image processing and GIS system. This stand-alone system utilizes an unmodified IBM PC/AT with ERDAS' high-resolution 1024 image display featuring hardware ROAM and ZOOM, and fast routines for filtering, image arithmetic, and mapping. System features include color scaled hardcopy, polygon and video digitizing, digital scanning, optical disk storage, auxiliary hard disk, 9-track tape drive, and an array processor. The ERDAS Enhanced Graphics Package provides vector based graphics tied to an image with associated attributes and database management capabilities.

The ERDAS-PC system may also serve as an intelligent workstation to larger computers. Because ERDAS menus and data formats are consistent, the ERDAS-PC complements ERDAS systems developed on the VAX, Micro-VAX II, and PRIME systems. As a workstation, the PC can be used to capture ground truth and signature identification, then transfer data to host for larger scale processing tasks such as full scene classification.

ERDAS provides complete installation and training, including a thorough 400-page User's Guide. For advanced users, the Software Tool Kit contains a library of subroutines for automatic linkage of user developed programs and 200-page Programmer's Manual. The Software Subscription Service provides new releases, program enhancements, and updates. A full-time staff is dedicated to client support, telephone hotline, and User Group activities.

At ERDAS, we assist our clients in meeting their goals by providing solution-oriented systems and services for resource management planning and development efforts.

Intergraph Corporation

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THE INTERGRAPH MAP MODELING SYSTEM (IMAP) embodies a comprehensive approach to GIS/LIS applications that includes not only advanced instrumentation and software, but also training and support in procedures and methodology.

In the past, GIS and LIS tended to represent two schools of thought. GIS applications generally involved small-scale thematic coverage to support requirements such as regional planning and resource management. LIS applications mostly dealt with large-scale cadastral coverage to support municipal, utility, and engineering requirements. Today, the two schools of thought are starting to emerge in support of an improving land ethic and growing demand for more accurate information.

An important concept in GIS/LIS is the shared land- base. The land-base is a vector representation of both man-made and natural features within the relevant area of coverage, supplemented by raster imagery. The Intergraph approach supports the capture, analysis, and revision of both vector and raster data, as well as projections with symbology appropriate for particular applications.

Sometimes with automation, people forget the principles they learned when they were originally trained in their discipline. This should not be the case. Although methodology might properly change, the fundamental principles underlying a discipline do not; that is the essence of a discipline. Surveyors, photogrammetrists, cartographers, and others all play a vital role in GIS/LIS applications. In addition to the role played by these discipline-specific individuals, a new role has emerged for people with interdisciplinary training and experience. It is necessary in an information society for professionals to evolve who can enhance the process of data integration and sharing in a GIS/LIS context. This is why Intergraph, in addition to developing specialized capabilities for the major disciplines, has also developed systems for the integration and sharing of data to support decision-making and operations management for GIS/LIS users.

The Intergraph approach is a network-based approach to facilitate communication between people with different roles and responsibilities in a GIS/LIS. Attached to the network are various nodes designed to match the right component with the right function. Intergraph offers a compatible family of workstations, host processors, peripherals, and software that lives together on a network. The network is the bloodline that links together instrumentation, software, and people to create a synergistic system. That is the essence of IMAP, the Intergraph Map Modeling System, a comprehensive approach to GIS/LIS applications.

A major part of the IMAP approach is the training and support provided to facilitate the implementation of a GIS/LIS. Intergraph has made a significant commitment as an application solutions company to the employment of people trained and experienced in the many disciplines involved in GIS/LIS, as well as the people with interdisciplinary backgrounds so important to successful implementation. The issues associated with GIS/LIS are far more than business issues; they are societal issues. And that is why a true systems approach, supported by qualified people, is so essential.

Kern Instruments, Inc.

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KERN & CO. OF SWITZERLAND has developed INFOCAM, a system for the management and administration of geographic spatially related data.

INFOCAM is based on Digital Equipment Corporation's VAXstation family. These interactive graphic workstations are fully network compatible, allowing the system to grow with the user's demand. The central component for INFOCAM is a spatially related database for the management of tacheometric measurement, point coordinates, geometric object structure, and attached thematic attributes. Advantages of this database are (a) there are no limits on the size of the database in terms of data structure or data input; (b) access time during interactive graphic data processing is independent from the quantity of stored information; (c) INFOCAM has no mapsheet limitations; and (d) interrogation of the database information and the output of graphical interpretations are treated as separate operations.

Currently the three software modules available to manipulate the database are TASCAL (Tacheometric Surveying Calculations), IMAGE (Interactive Manipulation of Geo-Elements), and ATOS (Automatic Triangulation of Surfaces). INFOCAM includes interfaces for (a) data transfer to/from field data loggers (for example, KERN SICORD); (b) data transfer to/from photogrammetric instruments (for example, KERN DSR11/KERNCAM); and (c) generation of sequential files for data back up and data transfer to/from external systems. Also, there is a clearly defined interface for additional functions and program applications.

Spatial relation means that the data describe the structures of spatially fixed, normally unmovable objects on the Earth's surface and shallow sub-surface. There are generally two ways of identifying and linking together data: (1) by geographic position or (2) by thematic description. Depending on the application, either of the two possibilities has priority. The data structure of INFOCAM is designed to favor space limited prompts. Features of the INFOCAM spatially related data structure are (a) the access time during interactive graphic data processing is independent from the quantity of stored information; (b) the maximum size of the database depends entirely on physical limits; and (c) no map sheet limitations exist.

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The highest administration level in the database is the project. The project contains all the data necessary within a certain area to perform a job. Tacheometric measurement, point data, and geometrically and thematically defined objects will all be administered within a project. Generally an object is defined by any number of elements. Each element belongs to one of the following four classifications: symbol, polyline, text, or thematic attribute. The data structure of INFOCAM handles points as independent data elements. Points do not lose their independence once they are linked to one or more objects; they are still recorded with all the information of their origin, such as field measurements or digitized data.

The user may define the description of all objects and their respective elements by the use of thematic tables. The transformation parameters for the graphical representation are defined by graphic tables. All tables in the system may be user modified or exchanged. A large library of symbols, line types, and text types for a flexible graphic output is available. Each table may contain up to 1000 options. The inherent separation between the long term thematic facts of the data and the relatively short term graphic presentation form the foundation of INFOCAM as a highly powerful geo-information system that can meet the demands for a great variety of graphic interpretations.

Typical applications of INFOCAM include cadastrial survey, civil engineering, engineering survey, topography, urban development, environmental planning, amelioration, design, and maintenance of water/gas/power supply line networks, forestry, refineries, utilities of industrial plants, etc.

Kork Systems, Inc.

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THE KORK GEOGRAPHIC INFORMATION SYSTEM (KGIS) is an on-line, transaction-oriented, map-based information system designed for the maintenance of spatially referenced data. It is suited to applications such as land records and parcel management, land-use planning, utility network management, and county or municipal facilities management.

KGIS employs a new concept in geographic data management to provide interactive response to even the most complex database queries. When cartographic features are entered into KGIS, either through interactive digitizing or bulk loading, all intersections between the features in the specified data layers are computed, as each element is entered. When these cartographic features are edited, the intersections are instantaneously updated. Because the intersections are maintained automatically, all polygon overlays are available for on-line inspection. There is never a need to batch process several data layers to compute polygon overlays. Editing and queries can be intermingled, and KGIS maintains the polygons with every change made.

KGIS maintains spatial information at two levels of organization, cartographic and topologic, with links between them. The cartographic and topologic data are maintained in an object-oriented network DBMS optimized for managing spatial information. The topological elements are clustered geographically onto disk pages in one large seamless database file, such that all features near one another spatially can be accessed in as few disk accesses as possible. The speed of access is independent of the size or domain of the geographic area being maintained. At the cartographic level, geographic features such as power poles, parcel lines, and soil types are represented by cartographic elements such as points, lines, and polygons. Each geographic feature is individually addressable. Spatial attributes, such as length, perimeter, and area, are computed on-line rather than being accessed from a table of out-of-date measurements. At the topologic level, data are maintained as topologic elements such as nodes (0-cells), edges (1-cells), and faces (2-cells) which are derived from the cartographic representations of geographic features and their intersections. It is these topologic elements that facilitate polygon overlay, adjacency relationship, and network analysis.

KGIS stores non-spatial attributes as tabular data in a separate, relational database. The user, however, sees the graphic and tabular databases as one integrated database, accessed using a SQL-based query language which has been enhanced with extensions to support spatial queries and transactions.

A stand-alone KGIS configuration provides integrated data management on a DEC VAX or MicroVAX II computer running DEC's VMS operating system, using Kork's geographic database in conjunction with any relational database supporting SQL, such as ORACLE. KGIS can also be connected on-line to an existing relational database, on the same computer or on another computer of a different type; adding the power of KGIS graphics while preserving existing tabular data management investments.

Terra-Mar Resource Information Services, Inc.

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THE WIDESPREAD USE of computers and computer graphics by the Earth resource and land-use mapping community, as well as other industries, is dependent upon the availability of appropriate information management tools. It is becoming evident that substantial gains in organizational productivity can result if the right kind of computer tools are applied.

With an in-depth understanding of computer technology and resource mapping applications, Terra-Mar has methodically developed extremely powerful and cost-effective computer systems for capturing, interpreting, and storing various data that are tied to a geographic frame of reference. Terra-Mar's high performance geographic analysis workstations, with full image processing and GIS capabilities, represent a dramatic breakthrough for a manager attempting to improve the throughput of his organization while upgrading the quality of management's decisions.

Terra-Mar has been able to advance computer-aided mapping technology by utilizing relatively inexpensive microcomputers tied to 32-bit microprocessors, high-capacity Winchester and optical disk storage devices, and specialized VLSI-based graphics and imaging subsystems. These rapidly evolving devices are removing the barriers related to size and mathematical manipulation of large geographic databases. However, an equally important contributing factor is Terra-Mar's development of discipline-specific software for comprehensive analysis of complex digital data.

Although the capability to process digital imagery from airborne and satellite scanners has existed for more than 15 years, the costs and complexity of software implementation prevented the utilization of these valuable information sources—except for the most sophisticated and affluent end-users. Today, Terra-Mar's micro-based workstations and applications software designed specifically for resource managers and land planners have virtually eliminated the reasons not to maintain and manipulate extensive data sets in a digital/raster format. In addition, Terra-Mar has taken the analytic process one step further by creating a software technique for transferring imagery in the *raster* domain to a digital map data base that, for the sake of efficiency, is maintained in a *vector* file structure. In this form, information is stored as point data (power poles or wells), line data (rivers and roads), and polygon data (lakes or classified land-use areas). Terra-Mar's vector GIS software is more than an automated mapping package; it gives the computer "geographic intelligence." The GIS allows any combination of up to thirty point, line, and polygon layers using Boolean operators (i.e., AND, OR, NOT).

With Terra-Mar's powerful data processing and interpretation tools, resource managers or land planners are able to access critical elements of information in a completely dynamic manner. Merg-

ing the interpreter's image analysis requirements with the resource manager's need for mapping capabilities in a turnkey standalone workstation represents the basis for providing a single information tool that will enhance the productivity of an organization sufficiently to generate payback in less than two years.

Wild Heerbrugg Systems

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WILD HEERBRUGG'S design of the SYSTEM 9 Geographic Information System features the new fully-integrated analytical photogrammetric workstation, the S9-AP, which communicates interactively with the SYSTEM 9 relational database. The S9-AP is the latest in a family of workstations which include the S9-D digitizing, the S9-E editing, the S9-Q alphanumeric query, and the S9-S fileserver stations. Each of these workstations incorporates a Sun-3 UNIX-based computer with a 32-bit processor, and an integrated color graphics screen. SYSTEM 9 workstations can be operated independently or in an ETHERNET Local Area Network.

The primary application of the SYSTEM 9 analytical stereoplotter workstation is the efficient and productive photogrammetric digital data acquisition from stereo pairs. To this end the operator of the S9-AP digitizes three-dimensional objects using online database management programs which perform online and offline editing, automatic topographic and topologic data checking, and the entry of non-graphic elements. Although the acquisition of data for geographic information systems is the main task of the S9-AP, it can also perform all other photogrammetric mensuration tasks such as aerial triangulation (data acquisition and block adjustment); the scanning of profiles, grids, and other DTM applications; and the restitution of non-topographic photographs.

Of great interest is the development of the Raster-Injected Verification Subsystem (RIVS) which simultaneously injects the perspective images of the digital map into the left and right eyepieces of the analytical stereoplotter. At a glance, the operator can check the completeness and precision in planimetry and height, and the feature coding of the geometric extent of the database. The two raster monitors project their images by means of beam splitters into the optical train between the photograph and the eyepiece at a 5× or 10× reduction to display line widths of approximately 0.025 mm or 0.015 mm, respectively, in the photo plane. The powerful RIVS microprocessor CPU includes a MC68020 processor, a MC68881 floating point co-processor, an expandable 4 MByte vector memory, and two raster graphics memories (bitmaps) of 2048 by 2048 pixels each, with four graphics processors to control fast, smooth scrolling (panning) in the x and y directions on both monitors independently. Using the orientation parameters, the RIVS processor immediately transforms the ground coordinates of the features extracted from the database into image coordinates and stores them in the vector memory, separately for the left and right photographs. Because the vector memory can hold up to 200,000 vectors, large data sets can be downloaded and stored so that they are immediately available for display. The monitors are updated at a frequency of 60 Hz. Smooth panning is realized over the entire stereomodel with bitmaps that hold four times the area of the monitor and which are updated with new pixel blocks constructed in the unused areas in response to the change in position of the center of the field of view. Thus, for the operator moving within the stereomodel, the superimposed lines appear to remain fixed relative to the photographic image because the realtime bitmap panning of the RIVS module is locked to the movement of the measuring mark in the stereomodel.

Carl Zeiss, Inc.

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Carl Zeiss

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THE MAJOR COMPONENTS in the line of photogrammetric instruments made today by Carl Zeiss, Oberkochen, are the RMK photogrammetric survey cameras and the wide range of analytical plotting systems with their fast microcomputers and powerful software.

Because of the unsurpassed quality and information density of aerial photographs, Zeiss holds that the RMK system with forward motion compensation and focal lengths of 3 1/2 inches, 6 inches, 12 inches, and 24 inches will remain the most important cartographic sensor until far into the next millenium.

In the analytical plotting field, analytical rectification with the Z2 Orthocomp merits special mention because the speed and quality of direct optical rectification of aerial photographs to orthophotos has not yet been matched by digital methods.

In photogrammetric R&D Zeiss currently concentrates on photogrammetric and cartographic plotting. The decade of success of the C 100 family has made the name Planicomp a synonym for reliable analytical plotters with flexible and comprehensive application software. The latest additions are PROSA for progressive interactive sampling of digital terrain models, BINGO/SPOT for unrestricted plotting of transparent SPOT copies with the Planicomp and the Orthocomp (orthophotos) and InduSURF for automatic measurement of industrial objects by means of digital image correlation. About 80 percent of all customers have used the C 100 software interface to integrate user-written software.

A major contribution to improving digital mapping systems was made by the PLANIMAP mapping software and the VIDEOMAP system for superimposing graphical data on the model. Virtually clean topographical data can be obtained directly with Planicomp, analog plotters and two-dimensional digitizing instruments. The sequential data structure of PLANIMAP allows not only direct mapping, but also data integration in geographic information systems (GIS).

The feature-oriented topological data structure of the new PHOCUS photogrammetric and cartographic software system from Zeiss has further enhanced the integration capabilities. PHOCUS combines the adaptive capabilities of databases with very flexible handling (use of menus and command entries) and supports a wide variety of input and output instruments.

The most important of the measuring instruments supported by PHOCUS are the new Zeiss P-Series Planicomp analytical plotters which were also introduced at the ACSM/ASPRS Annual Meeting in Baltimore in 1987. These plotters all feature a rugged photocarriage system and viewing ray trace and a new highly integrated control unit with built-in microprocessor. The P 1 Planicomp with its large-size photocarriages (300 mm by 240 mm), which can hold several models simultaneously, and its digitizing tablet is the top-of-the-line system. The P 2 is the proven C 120 viewer in a PHOCUS environment, and the P 3 is a new low cost desktop viewer with ergonomic height adjustment and a digitizing tablet. Both the P1 and the P 3 feature a photogrammetric 3-D cursor for versatile floating mark guiding and direct measurement control. All plotters can be equipped with handwheels, foot disk, foot switch, and optical ports for VIDEOMAP and CCD cameras.

Zeiss has taken steps to ensure that the high quality of analytical photogrammetric systems can serve geographic information systems as well as digital image processing in the future.