

TUESDAY PLENARY SESSIONS

Three plenary sessions were held on Tuesday, November 6. James Corbett chaired the first which focused on Mathematical Cartography. John Pfaltz presented "Efficient Multi-Attribute Retrieval Over Very Large Geographic Data Files". He described and mathematically analyzed a method of multi-attribute retrieval of a geographic data file using a technique of indexed descriptor files which is easily implemented, which supports range searching, whose efficiency improves as more query attributes are specified, and which is fast. To support the latter contention, in the only fully operational systems using this method, uniquely identified (by 9 attributes) records can be retrieved from a file of 1.44 million Census data records with an average of 3 disk accesses.

Jean Claude Muller discussed "The Geometry of Possible/Impossible Maps". He noted that geographical separation may be represented by many factors in addition to Euclidean distances, but these are often not isometrically mappable onto a plane. A procedure for obtaining approximate map solutions was developed, and its characteristics studied in order to gain insight into the relation between socio-economical spaces and physical space. He reviewed the fidelity and limitations occurring in two-dimensional cartography of non-Euclidean or non-metric spaces.

Waldo Tobler presented a paper on "Generalized Spatial Operators". It notes that geographical data do not usually arrive at uniform spatial intervals. In order to apply techniques used in image processing to these data, these techniques must be generalized. The linearity of the operators can be exploited to derive filters for irregularly arranged point observations. More commonly, the data are aggregated into polygons (census tracts, counties, etc.). For these we need to invent "pointless" operators. Examples are given for the smoothing of choropleth maps and for "pointless" interpolation.

The final presentation was by Marvin White. Entitled "A Survey of the Mathematics of Maps", it states that the application of mathematics, especially abstract algebra and topology, to cartography provides the

structural foundation for automation that was left to the intuition in the past. Topology deals with characteristics of a map that are independent of distances, angles and shapes. Graph theory is also a rich source of theoretical constructs applicable to cartography. A connection with topology, viz. planar graphs, is especially enlightening because of the shared symmetry-duality. Still more abstract theories, lattice theory and hypergraph theory, deal with the set theoretic structure embodied in a map, such as the nesting and overlap of various geographic regions like state, county and SMSA. Analytic and projective geometry is widely understood in the field and its application to projections, scaling and coordination is a traditional topic of study for cartographers.

The second plenary session entitled Software and Design Problems was chaired by Judy Olson. Digital terrain models were reviewed by Thomas Peucker, his paper gives an overview of the development in the area of Digital Terrain Models. It concentrates on three types of DTM's, which presently are used in North America. These three types are: (1) the regular grid (usually square); (2) the irregular grid (usually triangular); (3) the rectangular patches. The fields covered are: data gathering; data structures; triangulation; interpolation; surface manipulations (slope maps and line of sight); surface display (contouring, perspective view block diagrams, relief shading and inclined contours and shaded contours).

Hanan Samet presented a paper on "Tree Structures for Region Representation which he co-authored with Azriel Rosenfeld. This paper describes a method of representing arrays by trees of degree 4, which are constructed by recursively subdividing the array into blocks of constant value. In particular, this method can be applied to binary arrays representing regions (1's are region points). Algorithms for conversion between this and other region representations, and for measuring geometric properties of regions represented in this way, are informally described.

John Dalton discussed "Interactive Mapping Software of the Domestic Information Display System". His paper states that Domestic Information Display System (DIDS) produces single and bivariate choropleth maps in color of socio-economic data by county and Congressional

District at the national and state level. The original demonstration version of the system was based on raster display technology developed for the analysis of digital imagery from earth resources and meteorological satellites. It required sophisticated display hardware logic and extensive on-line direct access storage. A bidirectional run length coding scheme has been developed for the raster encoding and rapid display of polygonal areas. This display terminal and map compression technique will be combined in a moderate cost, LSI minicomputer-based system providing all of the capabilities of the current demonstration system and with potential for use in either a stand alone mode or as part of a network for data sharing and distributed applications.

Albert Zobrist presented "Data Structures and Algorithms for Data Processing". In his paper he contends that a key to the successful development of a geographic information system that involves raster data processing is the design of data structures and algorithms for efficient representation and processing of spatial data. Geographic data typically requires a double file organization; the first file containing statistics aggregated by spatial units together with the names of these units and a second file giving the name key again together with the geo-location specification. A raster version of this double file is described. Algorithms to deal with raster data processing fall into several areas. Intricate format conversions are needed to integrate vector and raster data. "Rubber sheet" operations are used to register a raster data set to a map base. Adjacent raster data sets are sometimes mosaicked. Raster representations of areas of densities need to be tabulated by district or tables of data need to be crosstabulated by area fractions. To solve problems like these, general software techniques to optimize processing speed are described.

Dean Edson organized the third plenary session on behalf of the International Cartographic Association, Commission III on Computer Assisted Cartography. Theodor Johannsen discussed "Automated Cartography as an Aid to Define Air Traffic Noise Protection Areas". In his paper he notes that in the Federal Republic of Germany in 1971, a law established the so called "Noise Protection Areas". The definition of these protection areas is not just derived from actual noise levels but

mainly based on a combination of the actual as well as the projected flight activities. The cartographer's task has been to depict the results of the physicist's computations in a map. This included co-ordinate transformations from local two-dimensional to spheroid surface. The subsequent representation of the areas in two maps, 1:50,000 and 1:5,000, the latter in form of an atlas were important steps before the regulations can be published in the federal official journal.

The next paper was presented by Michael McCullagh, "Triangular Systems in Surface Presentations". In his paper he states that exploration work is intimately involved with the creation of structural maps and maps of distributions over geographic space. In many cases a triangular system can be a more compact and accurate representation of a reality provided by the data points. In certain cases such as faulting it allows significantly greater flexibility than a conventional grid representation of the surface. It should also be realized that the increase in precision achieved by the triangular representation is not counter-balanced by a drastic increase in computer time.

Henryk Kowalski discussed "A Video-Cartographic System". The abstract of his presentation follows:

Elements of a map image matrix can be recorded as separate images on a video-matrix and can form a cartographic data bank. To compose a map illustrating a problem of interest to us, we must simply place corresponding elements of the map content matrix stored on the video-matrix upon a screen made of special glass and illuminated with laser light. Presented in the paper are some experiments made using this system for the production of environmental engineering maps of Poland.

Dean Edson concluded by reviewing the activities of Commission III, these include international representation in both formal and informal settings for technical exchange and education. One recent event was the presentation of a seminar on Computer Assisted Cartography in Nairobi, Kenya for the benefit of the emerging nations of the Third World. He concluded by describing similar planned events.