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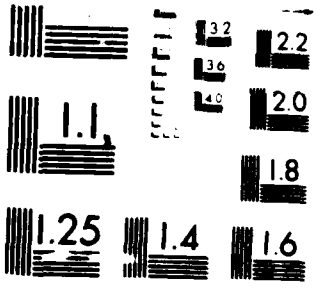

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The U.S. Army has taken two critical steps designed to assure that the digital topographic data needs of our troops on the battlefield of the future are satisfied. The first step is to establish, in concert with the Defense Mapping Agency, standards and architectures for composition, use, and distribution of digital topographic data. The second step is to establish, within the U.S. Army Engineer Topographic Laboratories (USAETL), a group whose sole mission is to serve as the Army's center of technical expertise for all military applications of digital topographic data. This paper will discuss the details and significance of these events and how the future Army will be affected by them.

AN ARMY TOPO STRATEGY FOR THE 1990's

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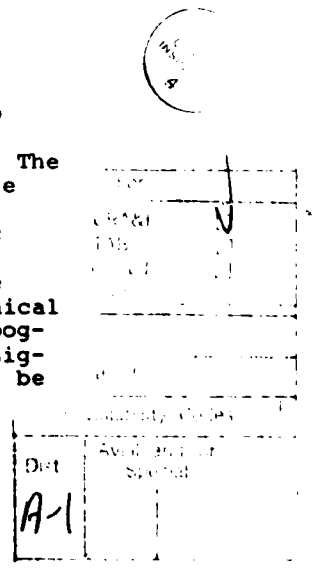
BIOGRAPHICAL SKETCHES

Mr. Messmore graduated from Illinois Wesleyan University with a Bachelors Degree in 1969. He subsequently attended Old Dominion University and received a Master's Degree in Environmental Biology in 1975. Mr. Messmore joined USAETL in 1977 and has participated in numerous projects addressing the development of computer assisted feature extraction techniques. His current assignment in the Concepts and Analysis Division, Requirements Analysis Branch involves the analysis of the Army's digital topographic data requirements. Mr. Messmore is a member of the American Society of Photogrammetry and Remote Sensing and Sigma Xi.

Mr. Scott earned BS degrees in Engineering and Forestry from the State University of New York, College of Environmental Science and Forestry at Syracuse University in 1977. He earned a MS degree in Civil Engineering (Surveying and Mapping) from the University of Wisconsin, Madison in 1979. Since joining USAETL in 1982, Mr. Scott has worked as an Engineer on numerous Defense Mapping Agency sponsored R&D programs. Currently, Mr. Scott is Acting Chief, System Concepts Branch, Concepts and Analysis Division. He is a member of the American Society of Photogrammetry and Remote Sensing.

ABSTRACT

The U.S. Army has taken two critical steps designed to assure that the digital topographic data needs of our troops on the battlefield of the future are satisfied. The first step is to establish, in concert with the Defense Mapping Agency, standards and architectures for composition, use, and distribution of digital topographic data. The second step is to establish, within the U.S. Army Engineer Topographic Labs (USAETL), a group whose sole mission is to serve as the Army's center of technical expertise for all military applications of digital topographic data. This paper will discuss the details and significance of these events and how the future Army will be affected by them.



INTRODUCTION

The fielding of Army systems today must be accomplished with emphasis on providing the ways and means for successful mission performance against the threat on any future battlefield. Future warfare will be characterized by a battlefield expanded into the depth of enemy formations, intense battles at decisive points, difficult command and control, extended lines of communication, and the vital need for time-sensitive intelligence. Offensive operations to take the battle to the enemy, disrupt him, and stop his momentum will require operations deep in rear areas to attack command posts, communication centers, and other critical sites. Aircraft and ground vehicles will transport the attacking forces over long distances. Forces will be required to fight in any direction, possibly for extended periods, with minimal support from upper command echelons.

To fight this battle of the future, one of the most critical command needs is an accurate, concise, and multi-user geometric picture of the battlefield. This picture has traditionally been provided by the hard copy map product. However, future requirements to simultaneously destroy close combat, rear area, and deep strike targets have changed the characteristics of the battlefield and increased the need to present to the commander an instantaneous snap shot of a rapidly changing situation. For his combat forces to be effective, their role in battle must be synchronized with this snap shot to maximize the use of opportunity when the enemy's momentum and battle plan have been disrupted. This can only be accomplished by use of a digital, fully attributed, high resolution terrain data base of the battlefield. Additionally, this data base must be efficiently utilized by every battle element. Terrain data is the common thread that will bind the critical elements of a successful battle command into a cohesive fighting force.

Army has recognized that the scenarios, strategies and concepts just described are not easily achieved without proactive management of digital terrain data and its full utilization by Army battle assets of the future. To this end, two actions have been taken to support the Army research, development, and acquisition community: (a) the development of two digital terrain data (DTD) standards designed to provide common, multi-user, data base support of all major functional areas of land combat; (b) the establishment of a group at USAETL to act as the center of technical expertise within the Army for digital terrain data.

TERRAIN DATA STANDARDS

During 1982-1984, the Army performed a study of their materiel development, acquisition, operations research, training, and doctrine commands that documented all known

and anticipated requirements for digital terrain data. Based upon this study, two standards were developed to provide for the consolidation of DMA production efforts and to support the entire spectrum of Army users. These standards, termed TACTICAL TERRAIN DATA and SPECIAL TERRAIN DATA are described as follows:

Tactical Terrain Data. Tactical terrain data (TTD) is comprised of a data set similar in content, accuracy, and resolution to a Class B, 1:50,000 scale topographic map/terrain analysis study. TTD will contain unsynthesized and unsymbolized feature and attribute data plus elevation data. Feature and attribute data will include information about the size, shape, location, and height of extracted features. The elevation matrix will contain elevation posts every 30 meters referenced to the World Geodetic System (WGS 84). TTD is considered the Army's operational support data base and will meet most user requirements. (Figure 1 describes TTD in more detail.)

Special Terrain Data. Special terrain data (STD) is comprised of elevation and feature data sets similar to TTD. This data base, however, is much more detailed and accurate than TTD, being relatively equivalent to a 1:12,500 scale topographic map. Figure 1 also provides detail on STD.

Status of Standards

The Defense Mapping Agency (DMA) has recognized Army's need for the TTD product, but indicated that STD would be difficult to produce using current and planned production systems at DMA. Higher-resolution STD is still needed, but new DMA production solutions are needed. Some possibilities, at least on an interim basis, include having an Army user employ TTD as a base to establish geometry, best-fit it to higher-resolution source material such as the new generations of multispectral imagery, and extract more dense feature data as required; or applying the emerging technology of the DMA Digital Point-Positioning Data Base to let the user extract the more dense data he needs in localized areas from deployable photogrammetric systems.

TTD Specification Development

Recognizing the need for an operational data base to support land combat operations, negotiations are on-going to refine tri-service TTD product specifications in anticipation of volume production in the 1990's. These product specifications will be used to support the addition of TTD to DMA's Mark 90 product line. Included in this specification will be the content, format, and storage/distribution media. The format will be two dimensional Standard Linear Format. Media for the foreseeable future will be 9 track 1600 bpi magnetic tape.

CONTENT	ELEVATION DATA	FEATURE DATA
TTD & STD	ALL HYPSOMETRIC DATA (TERRAIN VEGETATION HEIGHTS AVG. HGTS IN URBAN AREAS)	SURFACE CONFIGURATION SURFACE DRAINAGE SURFACE MATERIALS VEGETATION TRANSPORTATION OBSTACLES URBAN AREAS SPECIAL FEATURES SUPPLEMENTARY DATA
ACCURACY		
TTD	±20M LINEAR ERROR (LE) 90%	50M CIRCULAR ERROR (CE) 90%
STD	±5M LINEAR ERROR (LE) 90%	12.5M CIRCULAR ERROR (CE) 90%
RESOLUTION		
TTD	30M	1:50,000-SCALE EQUIVALENT
STD	10M	1:12,500-SCALE EQUIVALENT
FORMAT		
TTD & STD	GRIDDED	GRIDDED & VECTOR (CHAIN-NODE [SLF])

FIGURE 1: DIGITAL TERRAIN DATA STANDARDS

Near-Term Events

Prior to volume production of TTD in the mid 1990's, potential users can expect the following: (a) formalization and distribution of draft specifications for TTD to Army system developers. This is expected to be completed by April 1987; (b) development and distribution of Interim Terrain Data (ITD) sets. These are data, available as a by product of normal DMA production operations, that will be reformatted into a format that approximates TTD. ITD will be provided to those with immediate needs for data; and (c) development of a demonstration TTD data set in 1987/1988 time frame to support system test and evaluation.

CONCEPTS AND ANALYSIS DIVISION

Coupled with the development of the data standards described above, the Army recognized the need to control and coordinate DTD requirements to ensure: (a) that they were not overstated, (b) that they could be met today via DMA standard products and in the future via TTD and/or STD, and, (c) that the Army does not pay more than once for the same technology.

To undertake the task of DTD coordination and control, it was determined that a new operating element was needed at USAETL to provide the technical capability to assist in early identification, evaluation, and control of emerging DTD requirements. For this purpose, the Concepts and Analysis Division was established at USAETL on October 1, 1986.

The Concepts and Analysis Division will perform the following functions: (a) provide technical support in the form of analytical studies and trade-off analyses to the Army R&D community; (b) assist in defining minimum essential DTD requirements and support the materiel development process; (c) conduct technical liaison with DMA, DOD, Dept of Army, and private industry to maintain a complete awareness of all requirements and state-of-the-art means to meet these requirements; (d) provide technical assistance to the Army R&D community to distribute information on data availability and state-of-the-art technology; (e) interact with combat developers and the Army Analysis Community to inform them of potential applications and limitations of DTD and related technology; (f) serve as the Army focal point for the distribution and evaluation of prototype digital topographic data bases to insure centralized control of developer requirements; and (g) develop special software for manipulating DMA standard digital products to optimize utilization of DMA produced DTD and minimize transformation costs.

Implementation of USAETL's Concepts and Analysis Division goals will result in numerous benefits for the Army. It will provide the Army with the capability for identifying emerging DTD requirements as early in the R&D cycle as possible, when implementation costs are lowest. It will also provide the technical support necessary for productive management of DTD requirements. In some cases, analysis will play a key role in precluding the development of systems that cannot be cost effectively supported with existing or reasonably available DTD. This work alone will save the Army millions of dollars in R&D, operations, and maintenance costs.

To date, Army developers have been forced into seeking ad hoc solutions to data transformation problems. In the future, the number of tactical users of DTD will increase dramatically. The battlefield of the future requires that these systems perform using a common multi-user data base. It is hoped that inefficient expenditure of resources and use of unique specialized data bases by Army developers will be minimized in the near-term and eliminated in the long-term through the efforts of the Concepts and Analysis Division. It will provide a single focal point for DTD-related technical information and expertise for all Army users. It will also ensure that development, distribution and evaluation of all future prototype data bases is accomplished at one centralized location.

CONCLUSION

The battlefield of the 1990's and beyond will be characterized by the need for agility, deception, rapid manuever over long distances, and efficient use of all fire power For the Army to be successful in this lethal environment it must proactively manage the critical element of these activities; digital terrain data. The establishment of the TTD and STD standards provides a strong foundation. The efforts of the Concepts and Analysis Division to maintain close control of DTD requirements will facilitate the integration of terrain information into planning and operational decisions and, in this way, will improve the future Army's overall combat effectiveness.

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