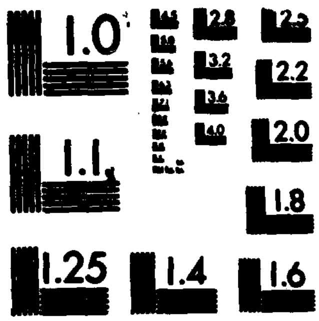
AD-A140 215    AN EXPERIMENTAL VIDEO DISC FOR MAP AND IMAGE DISPLAY    1/1
(U) ARMY ENGINEER TOPOGRAPHIC LABS FORT BELVOIR VA
D J COSTANZO 1984 ETL-R-063

UNCLASSIFIED    F/G 8/2    NL




MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

UNCLASSIFIED

SECU

| | |
|---|---|
| 1. RE **ADA140215**    SION NO. | READ INSTRUCTIONS BEFORE COMPLETING FORM<br>3. RECIPIENT'S CATALOG NUMBER |
| 4. TITLE (and Subtitle)<br>An Experimental Video Disc for Map and Image Display | 5. TYPE OF REPORT & PERIOD COVERED |
| | 6. PERFORMING ORG. REPORT NUMBER<br>R-063 |
| 7. AUTHOR(s)<br>Daniel J. Costanzo | 8. CONTRACT OR GRANT NUMBER(s) |
| 9. PERFORMING ORGANIZATION NAME AND ADDRESS | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>US Army Engineer Topographic Laboratories<br>Fort Belvoir, VA 22060 | 12. REPORT DATE |
| | 13. NUMBER OF PAGES<br>1984 |
| 14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)<br>see 9 | 15. SECURITY CLASS. (of this report) |
| | 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE |

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES



19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

cartographic
video disc
map image
software
microcomputer

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

A cooperative effort between four government agencies recently resulted in the completion of an experimental video disc containing a variety of map and image products. This disc covers several areas in the United STates, as well as selected locations in Korea and the Middle East. The entire process to create the disc covered one year's time. The Engineer Topographic Laboratories (ETL) is presently evaluating this disc and writing the software to control access to it via microcomputer. Copies of the video disc are available for evaluation by interested government, industrial, and academic organizations.

# AN EXPERIMENTAL VIDEO DISC
# FOR
# MAP AND IMAGE DISPLAY

Daniel J. Costanzo
U.S. Army Engineer Topographic Laboratories
Ft. Belvoir, VA 22060

## BIOGRAPHICAL SKETCH

Mr. Costanzo is a project engineer at the U.S. Army Engineer Topographic Laboratories (ETL). He is presently performing research into cartographic applications of video disc technology. Previously, he worked on developing radar reference scene terminal guidance systems. Prior to that, he worked with the U.S. Department of Agriculture on area sampling frame construction using Landsat imagery. Mr. Costanzo holds a Bachelor of Science Degree (with Special Honors) in Cartographic Science from The George Washington Univerity, Washington, DC. He is a member of the American Society of Photogrammetry.



## ABSTRACT

A cooperative effort between four government agencies recently resulted in the completion of an experimental video disc containing a variety of map and image products. This disc covers several areas in the United States, as well as selected locations in Korea and the Middle East. The entire process to create the disc covered one year's time. The Engineer Topographic Laboratories (ETL) is presently evaluating this disc and writing the software to control access to it via microcomputer. Copies of the video disc are available for evaluation by interested government, industrial, and academic organizations.

## INTRODUCTION

Storage and rapid retrieval of cartographic data are problems for both civilian and military users. Often source materials end up in a disorganized pile, stuffed into map file cabinets and drawers. This problem is compounded by the fact that modern cartographic information comes in a variety of formats ranging from digital data tapes, to video tapes, to movie film, to transparencies, to paper photographic prints, to paper maps, charts, and documents. Each of these media has its own space and enviromental requirements for storage and use. The resulting problems involved in dealing with this wealth of diverse data can become both frustrating, expensive, and in some cases life threatening to the military user on the battlefield.

Recently, laser video disc technology has been applied to this problem of storing and displaying mapping data. Video discs offer the advantage of being a compact medium for storing information. A standard sized plastic disc is about the size and shape of a phonograph record. It can store up to 54,000 frames of National Television System Committee (NTSC) standard television pictures per side. These frames are accessed via a low-powered laser beam, reflecting off of microscopic pit and groove patterns on the disc surface. The laser can randomly access any single frame in three seconds or less and hold it on the cathode ray tube (CRT) television screen indefinitely. They can also be interfaced to a microcomputer for automated access and combined with computer graphics to form a versatile and rugged geographic information retrieval system.

To better ascertain the potential mapping applications for this medium, a group of four government organizations joined together in 1982 and 1983 to create an experimental video disc. These organizations were the U.S. Army Engineer Topographic Laboratories (ETL), the U.S. Army Corps of Engineers Water Resources Support Center (WRSC), the U.S. Geological Survey National Cartographic Information Center (NCIC), and the U.S. Navy Civil Engineering Research Laboratory (NCEL).

## CREATING THE VIDEO DISC

The disc was intended to contain as many different mapping products as possible. To assist with this goal, ETL, WRSC, and NCIC provided various maps, remotely sensed images, three-dimensional perspective terrain views, engineering drawings, harbor charts, ground photographs, slides, movies, video tapes, documents, and organizational logos. The NCEL provided no materials directly, but did work with the WRSC on selecting materials of interest to both organizations. This resulted in a total of 48 different kinds of products represented on the disc (Table 1). It required over nine months to accumulate and organize these products either by ordering them through source agencies, creating them using computer graphic three-dimensional software, or by filming out in the field.

The materials covered several geographic areas. The most important of these was the mouth of the Columbia River in Washington and Oregon. A nearly complete set of maps and remotely sensed imagery covering this area was available. In addition to static imagery, a helicopter flew a movie film camera over a network of paths through the Columbia River study area. One set of images was taken every 250 feet (ft.) or 76 meters (m) horizontally at an elevation of 1500 ft. (460 m). A second set of images was taken every 50 ft. (15 m) horizontally at an elevation of 50 ft. (15 m). In addition to recent helicopter movies, the WRSC obtained several dates of standard aerial photographs and Landsat imagery.

The WRSC also contributed media covering the waterfront of Cleveland, Ohio. This included maps, harbor charts, aerial photomosaics, ground photographs, as well as an aerial video tape following the Cleveland water front. Limited maps and imagery were also included for Duluth, Minnesota and Detroit, Michigan.

Table 1. CARTOGRAPHIC PRODUCTS ON THE EXPERIMENTAL VIDEO DISC

* Numbers of items are given in parenthesis.
* Scales are given as scales of the original product.
* Scale of product appearing on the cathode ray tube (CRT) varies with monitor size.

**Topographic Maps and Charts**

| | | |
|---|---|---|
| (1) | 1:7,500,000 | U.S. Geological Survey (USGS), shaded relief map. |
| (1) | 1:5,000,000 | American Geographical Society of New York, general topographic map. |
| (2) | 1:2,000,000 | Defense Mapping Agency (DMA), Jet Navigation Charts. |
| (2) | 1:1,000,000 | DMA, Operational Navigation Charts. |
| (3) | 1:500,000 | DMA, Tactical Pilotage Charts. |
| (11) | 1:250,000 | DMA, Joint Operations Graphics. |
| (5) | " | USGS, 2 degree quadrangle maps. |
| (6) | 1:62,500 | USGS, 15' quadrangle maps. |
| (2) | 1:50,000 | DMA, topographic maps.. |
| (1) | " | U.S. Army Engineer Topographic Laboratories (ETL), experimental map. |
| (9) | 1:24,000 | USGS, 7 1/2' quadrangle maps. |

**Thematic Maps**

| | | |
|---|---|---|
| (1) | 1:250,000 | USGS, Land-Use and Land-Cover. |
| (1) | 1:100,000 | USGS, Land-Use and Land-Cover. |
| (1) | 1:50,000 | ETL, Cross Country Mobility. |
| (1) | " | ETL, Lines of Communication. |
| (1) | " | ETL, Non-Urban Culture Features. |

**Planimetric Maps**

| | | |
|---|---|---|
| (1) | 1:2,000,000 | USGS, part of National Atlas. |
| (1) | 1:250,000 | USGS, general planimetric map. |
| (1) | " | USGS, Hydrologic Units. |
| (1) | " | USGS, Census County Subdivisions. |
| (1) | " | USGS, Political Units. |

**Other Maps and Charts**

| | | |
|---|---|---|
| (4) | 1:25,000 | DMA, orthophotomaps. |
| (5) | 1:18,000 to 1:2,400 | U.S. Army Corps of Engineers (COE), Harbor Charts. |

## Three-Dimensional Computer Generated Terrain Scenes

| | | |
|---|---|---|
| (4) | Scale Varies | USGS, paper plots. |
| (3) | " | ETL, experimental graphics. |
| (149) | " | ETL, 35 millimeter (mm) terrain scene slides. |
| (73) | 1:50,000 | ETL, coverage maps for 149 terrain scenes. |

## Aerial Photographs

| | | |
|---|---|---|
| (2) | 1:56,000 to 1:48,000 | COE, color infrared (CIR) mosaics. |
| (1) | 1:30,000 | USGS, natural color mosaic. |
| (9) | 1:24,000 to 1:9,600 | COE and USGS, black and white mosaics. |
| (4) | Scale Varies | USGS, individual black-and-white photographs. |
| (1) | " | USGS, individual natural color photograph. |
| (2) | " | USGS, individual CIR photographs. |

## Landsat Satellite Imagery

| | | |
|---|---|---|
| (1) | 1:250,000 | USGS, false-color multispectral scanner (MSS) mosaic. |
| (1) | " | USGS, individual false-color MSS scene. |
| (1) | 1:125,000 | USGS, black-and-white Return Beam Vidicon mosaic. |
| (2) | Scale Varies | USGS, individual MSS scenes. |
| (5) | " | USGS, individual Thematic Mapper scenes. |

## Other Imagery

| | | |
|---|---|---|
| (51) | Scale Varies | COE, ground based photographs. |
| (1) | " | COE, aerial video tape sequence. |
| (1) | " | Moving dot sequence for aerial video tape. |
| (2) | " | COE, aerial movie sequences. |
| (2) | " | Moving dot sequences for aerial movie. |

## Miscellaneous Products

| | | |
|---|---|---|
| (1) | - | USGS, topographic map symbols chart. |
| (1) | - | COE, building floor plan. |
| (2) | - | COE, dredge ship plans. |
| (1) | - | COE, page from typewritten document. |
| (4) | - | Organization logos. |

ETL contributed a variety of maps and computer-generated map products clustered around Cache, Oklahoma. The vast majority of these were military maps having a wide range of scales. These included standard topographic maps and orthophotomaps. In addition, ETL generated 149 three-dimensional terrain scenes using a minicomputer. These were spaced every kilometer over a 5.6-by-5.6 mile (9-by-9 kilometer) grid. Once generated and stored in the computer, the scenes were recalled and photographed onto 35-millimeter (mm) film. ETL also contributed several experimental map products created during research programs performed by the Topographic Developments Laboratory of ETL. Map graphics of the Middle East and the San Francisco area were also contributed.

The NCIC contributed a wide variety of its standard map and image products. These included aerial photographs, Landsat imagery, and standard topographic maps. It also contributed computer-generated terrain views matching the Columbia River study area.

Other materials which were contributed to the disc were a structural diagram of a dredge ship, a sample government regulation, organizational logos for the contributing organizations, and a map of the Korean Demilitarized Zone.

All of these materials were delivered by March of 1983 to a contractor. They were first filmed onto 35-mm movie film according to a predesignated pattern using a specific frame size and overlap. Film was used before conversion to video tape because it provided the best quality image when converting the frames to video tape. Film also provides a more permanent record of the map and image frames. And it can be converted to high resolution video tape which is expected to become available in a few years.

For the Columbia River materials, a set of registered map scenes was filmed along with remotely sensed images. Filming was done at five scales, thus providing five scale levels for zooming in the final video disc product. Each new scale level was twice as large as the one previous, with overlap among individual frames varying from 20-55 percent. For both the Columbia River movie and Cleveland video tapes, a series of moving dot sequences were filmed where a small circle was placed on a map or photomosaic and moved frame-by-frame as it followed the path of the helicopter.

ETL and NCIC materials were filmed using a progressively smaller frame size like the Columbia River sequence, but were, in general, not registered to each other. First the whole map was filmed, then a 1/4 section, then a 1/16 section, a 1/64 section, down to a 1/256 section of the map. At each sectional level, the maps were filmed at each given frame size until the entire map was covered. Overlap here varied from 15-25 percent. The computer generated scenes recorded onto 35 mm slide film were directly converted to 35 mm movie film. For each of these scenes, a transparent template was placed onto a 1:50,000 scale map and photographed to show the ground coverage and direction of view for each terrain scene.

Once filming was completed, the film was transferred to video tape. From this video tape, a video disc master was made using a high-powered laser. Once the master was completed, copies of the video disc were replicated onto plastic. The final video disc measures 12 inches (in.) or 30 centimeters (cm) in diameter, and is 0.043 in. (1.1 mm) thick. Thus, materials that normally occupied several map file cabinets were reduced to 45132 frames on a phonograph record sized disc. Eighty of these video discs were delivered by the contractor to ETL in July 1983.

## ACCESSING INFORMATION FROM THE VIDEO DISC

The sequence of figures at the end of this paper displays important features of this video disc. Figure 1 shows the microcomputer system utilized by ETL to access information stored on the disc. It consists of an 8-bit microcomputer interfaced to a video disc player, television signal decoder, touch panel controlled CRT monitor, and hard copy device. The video disc is spun in the player at 1800 revolutions per minute while passing under a low-powered laser beam. The operator then manually selects a frame number on the disc or uses a prepared computer program to have the computer automatically select frames for display on the monitor. One of the great lessons learned from this video disc was the necessity of specifying that a detailed frame index be provided along with the disc. Otherwise, not much can be done with the disc until the mapping frames are indexed and correlated.

The next series of figures were photographed as they appeared on the CRT monitor. They show various types of information accessible from the disc. They include (in order) a standard topographic map of the Columbia River, a standard Landsat scene of Mount St. Helens, a frame from the aerial movie of the Columbia River, and a computer-generated terrain scene of the Cache, Oklahoma area. Close examination reveals the fine lines resulting from the raster pattern of the CRT screen. One interesting discovery was that the resolution of continuous tone images, such as Landsat scenes appeared much less degraded by the 525 line CRT raster resolution than were line graphic products, such as maps. With almost all maps, the frame size had to be reduced down to about 2x3 in. (5x7 cm) before all features and letters could be observed with clarity.

Another lesson learned from this disc is the necessity for having large amounts of overlap between individual frames. The necessity of viewing only a small portion of the map for maximum clarity requires that the video disc user be able to maintain orientation while panning around the map base. Examples of overlap ranging from 15 to 95 percent were available for evaluation. It was found that at least 75 percent overlap is necessary to avoid a jumpy and disorienting sense of motion when panning from frame to frame.

ETL is presently developing software to access specific frames contained in a geographic data base stored on the disc. This software basically accesses the frames and uses them as a background for overlaying computer-generated graphics on the single CRT monitor. It is important to keep in mind that without this extensive software, use of the video disc is very limited. Software development is concentrating on materials covering the Columbia River area, and has progressed to a point that allows zoom steps down through five scale levels, and panning capability at each level of zoom. In addition, the variety of disc media ranging from maps, to aerial photographs, aerial movies, and satellite images can be accessed in almost identical, registered formats.

## CONCLUSION

The experimental video disc described above is a useful demonstration medium for the problems and potential uses for mass storage of maps and imagery. It has a wide variety of source materials on it, and thus offers a unique way of determining how different types of cartographic media can be utilized in video disc systems. For this purpose a limited quantity of sample video discs are available from ETL for evaluation by interested organizations. They may be obtained by contacting the author at the address given at the beginning of this paper.

Figure 1.

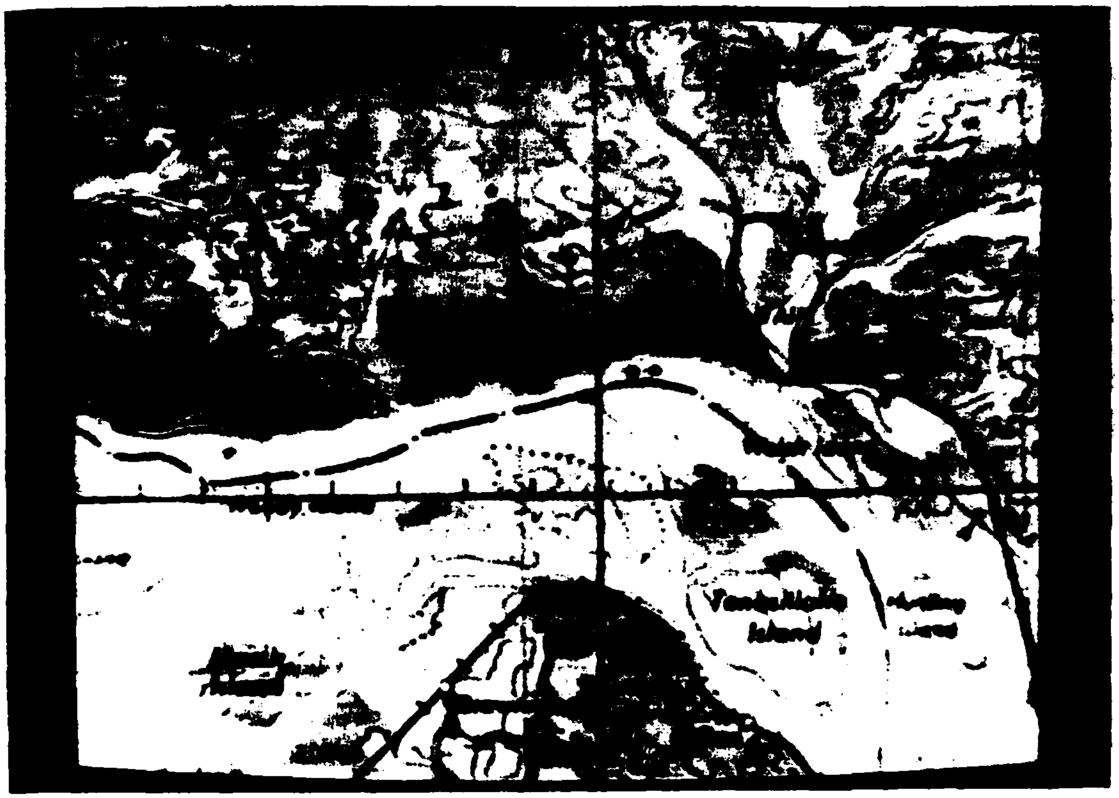


Figure 2.

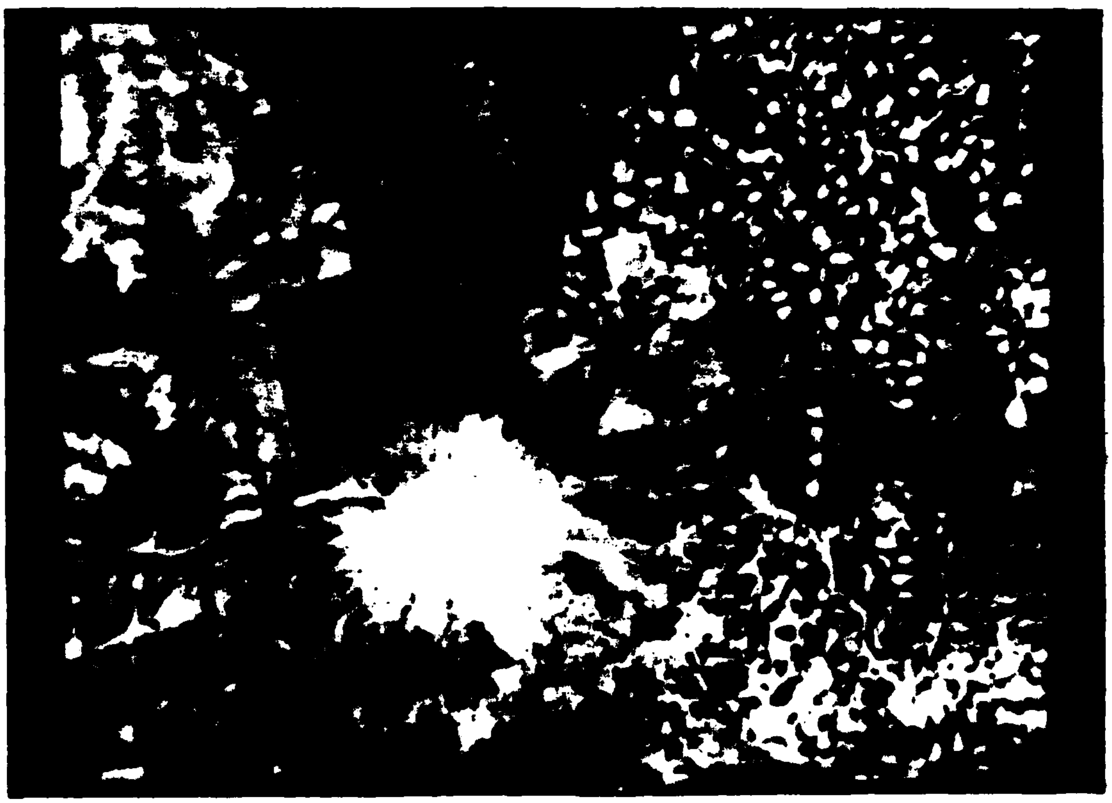


Figure 3.

Figure 4.

Figure 5.

DAT
FILM