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The Basic Map Interpretation and Terrain Analysis Course (MITAC) Videodiscs

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To address deficiencies in low-altitude navigation training, the map interpretation and terrain analysis course (MITAC) was upgraded to a computer-based training format. This report describes the production, post-production, and duplication of a set of videodiscs to store the course content. An outline of the videodisc content and a brief description of research and development plans for the Basic MITAC are presented.

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THE BASIC MAP INTERPRETATION AND TERRAIN ANALYSIS
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THE BASIC MAP INTERPRETATION AND TERRAIN ANALYSIS COURSE (MITAC) VIDEODISCS

INTRODUCTION

In the modern battlefield Army aviators will be forced to fly at extremely low altitudes to avoid detection by enemy electronic sensors. Because of the need to maintain obstacle clearance while remaining masked by terrain features, low-altitude flight requires constant vigilance outside the cockpit. Cockpit scan patterns on instruments, switches, and maps must be executed rapidly and efficiently. Consequently, low-altitude navigation requires superior skill in map interpretation and terrain analysis. To remain geographically oriented at all times, a pilot must be able to glean crucial map information during cockpit scanning and associate that information with the rapidly changing terrain picture outside the cockpit.

Background

Traditional methods of low-altitude navigation training have been unsatisfactory (Fineberg, Meister, & Farrell, 1978; Gainer & Sullivan, 1976; McGrath, 1976). Therefore, the Army Research Institute Aviation Research and Development Activity (ARIARDA) has conducted research to address the low-altitude navigation training deficiency. In 1976 Anacapa Sciences, Inc., under contract to the ARIARDA, developed the Map Interpretation and Terrain Analysis Course (MITAC). The MITAC comprised numerous photographic slides and motion picture films of terrain features and map segments designed to teach low-altitude navigation skills to helicopter pilots in a classroom format. Subsequently, this course was revised to an individualized training format utilizing the equipment of the Beseler Cue/See system (Harman, 1978). Holman (1978a, 1978b) demonstrated the effectiveness of this course by showing that MITAC-trained student pilots and enlisted aerial observers navigated at twice the speed and with one-third of the errors committed by traditionally trained aviators.

Thirteen additional cinematic exercises were developed to provide supplemental training in map interpretation and terrain analysis over a wider range of geographic regions and climates (Kelley, 1979). Each of these exercises consists of a film taken from the front window of a helicopter flying a route at low altitude. The exercises include flights over various geographic regions (e.g., Kentucky, Idaho, Arizona, and Germany) with both snow-covered terrain and summer foliage. These supplemental exercises, termed the Advanced MITAC, have been upgraded recently to a computer-based interactive videodisc format (Miles & LaPointe, 1986). Terrell (1988) demonstrated the training effectiveness of the computer-based Advanced MITAC by comparing the contour-level navigation performance of student pilots who had received the supplemental training with those who had not. A significantly greater proportion of Advanced MITAC students than control (no MITAC) students performed perfectly (i.e., no deviations from the prescribed route) during the post-training navigation test.

Problem

Conversion of the Advanced MITAC exercises to an interactive videodisc format has resulted in an easy-to-use effective part-task trainer. Furthermore, the Advanced MITAC was used in a research program designed to investigate the variables that contribute to effective computer-based training strategies. However, the material and equipment for the original "Basic" MITAC (e.g., 35-mm slides, booklets, projectors, tape players, etc.) seem difficult to use and are unsuitable for computer-based training. A computer-based course that presents basic principles of map interpretation is needed to serve as a prerequisite course to the Advanced

MITAC and for use in the ARIARDA training effectiveness research program.

Objective

The objective of this project was to develop Basic MITAC videodiscs suitable for use in conducting computer-based training. This summary report traces the development of the videodiscs, describes the Basic MITAC subject material, and briefly presents the planned research in the next phase of this project.

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DEVELOPMENT APPROACH

The Basic MITAC videodiscs were developed in three stages: production, post-production, and duplication. Each stage is described below.

Production

The primary activities accomplished during the production stage were:

- composition of a narrative for the Basic MITAC,
- selection of video material to supplement the narrative, and
- development of a script containing the narrative and instructions for taping the narrative and video material.

The narrative was based upon a set of illustrated lectures for Marine Infantrymen (Cross & Rugge, 1982), a classroom handout on low-altitude map interpretation for Army Aviation students (McGrath, 1975), and the Defense Mapping Agency guidelines for drawing 1:50,000-scale topographic maps. Many of the slides, maps, and charts from the original MITAC (i.e., the 35mm slide version) were selected for the Basic MITAC. Additional slides were made by photographing various geographic features in the Fort Rucker training area. New and updated maps were ordered and matched to the features on the slides. Computer-generated graphics and animation were designed to supplement portions of the narrative. The video material was matched to the appropriate segments of the narrative, and a script was written with instructions about the sequence and timing of audio and video material. The script, slides, charts, and maps were provided to the post-production company.

Post-production

The primary activities accomplished during the post-production stage were:

- recording of the narrative on audio tape,
- generation of computer graphics and animation,
- digitization of video material,
- editing of video material on 3/4-inch videotape, and
- dubbing of audio and video on 1-inch master videotape.

After the narrative was recorded, the audio tape was time-coded according to instructions from the script. The time-coded audio tape was used later to edit the video material on 3/4-inch videotape.

Graphics artists generated charts and animation segments using 2-dimensional (2-D) and 3-dimensional (3-D) computer graphics packages. The charts show the names and symbols of the various features that are portrayed on maps. The 2-D animation illustrates various strategies for map interpretation. The 3-D animation illustrates the contour line portrayal of terrain relief.

The slide and map images were digitized with a digitizing camera and stored in computer files. Then the digitized images, computer-generated charts, and animation were transferred to 3/4-inch tape according to the instructions from the script and the time-coding from the audio tape. The audio and video material were combined when the 1-inch master tape was dubbed.

Duplication

The primary activities of the duplication stage were:

- generation of master videodiscs from the 1-inch master tape, and

- production of videodisc copies from the master videodiscs.

Both the generation and the duplication of the master videodiscs were accomplished according to the standard procedures of Optical Recording Project/3M.

COURSE OUTLINE

As a prerequisite to the Advanced MITAC, the Basic MITAC is designed to teach strategies for the interpretation and analysis of 1:50,000-scale topographic maps. The course content is presented on two videodiscs (4 sides) divided into six general topics:

- Interpretation of Terrain Relief (Side 1),
- Interpretation of Inland Hydrography (Side 2),
- Interpretation of Vegetation (Side 3),
- Interpretation of Transportation Lines (Side 3, continued),
- Interpretation of Cultural Features (Side 4), and
- Interpretation of Buildings and Populated Places (Side 4, continued).

Interpretation of Terrain Relief

The discussion of terrain relief interpretation is divided into five sections. The first section introduces terrain relief interpretation and presents information about contour lines, contour intervals, spot elevations, and benchmarks. The second section presents strategies used to portray steep, gentle, convex, concave, and vertical slopes on the map. The third section discusses the portrayal of basic landforms such as hills, ridges, saddles, spurs, draws, valleys, alluvial fans, and flat-topped landforms. The fourth section describes strategies for conceptualizing the lay of the land from the map portrayal of terrain relief. The fifth section discusses concepts and strategies related to terrain masking.

Interpretation of Inland Hydrography

The discussion of inland hydrography is divided into four sections. The first section presents some of the cartographic principles for using color coding, shape coding, line continuity, textured fill, and alphanumeric labeling to portray hydrographic features. The second section discusses the portrayal of streams, waterfalls, and rapids on the map. The third section discusses the portrayal of lakes, ponds, and dams on the map. The fourth section discusses the portrayal of miscellaneous hydrographic features, such as springs, marshes, swamps, aqueducts, and canals.

Interpretation of Vegetation

The discussion of vegetation covers the cartographic principles for portraying natural and cultural vegetation on the map. The discussion of natural vegetation includes strategies for portraying patches of woodland, scattered trees, scrub, mangrove, nipa, and tropical grass. The two types of cultural vegetation that are described are orchards and vineyards.

Interpretation of Transportation Lines

The discussion of transportation lines covers the cartographic principles for portraying roads, railroads, and bridges. The discussion focuses on the categorization of roads as divided highways, primary highways, secondary highways, light duty roads, and unimproved roads (or trails) and the corresponding map symbology. Instructions are presented for developing strategies of geographic orientation by road identification. Railroads are described as operating or non-operating and single-track or multiple-track. The discussion ends with a presentation of cartographic principles for portraying bridges on the map.

Interpretation of Cultural Features

The discussion of cultural features covers many miscellaneous man-made aerial obstructions and navigation cues, excluding transportation lines (covered under the previous heading) and buildings (covered under the next heading). Cartographic principles are described for portraying aerial obstructions such as lookout towers, water towers, chimneys, antennas, and windmills. Other useful navigation cues are discussed, including pipelines, power lines, cemeteries, aircraft landing areas, mines, and quarries.

Interpretation of Buildings and Populated Places

The discussion of buildings and populated places presents the cartographic principles for portraying permanent and temporary structures, churches, schools, and ruins (or abandoned buildings). Principles are described for portraying various categories of populated places with clusters of building symbols or pink area tint.

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PLANNED RESEARCH

Research with the Basic MITAC videodiscs will take several directions. First, a program will be written to provide interactive training using the videodiscs. Several strategies and tactics of computer-based instruction will be investigated. For example, experimental courseware will be developed to examine different computer-based branching routines for remediating knowledge or skill deficiencies. Different methods for presenting drills and tutorials will be compared. Several capabilities of the videodisc medium will be evaluated, including the differential effects of full-motion and still graphics, digital and analog imagery, and the effects of audio narrative on knowledge or skill acquisition.

Second, research will be conducted to evaluate the effectiveness of the Basic MITAC as a prerequisite to the Advanced MITAC. In the process, the research will evaluate the effectiveness of the course in training general map interpretation and terrain analysis skills. Ultimately, the results of the research will support recommendations about the kind of training that can be accomplished with computer-based methods and the kinds of methods that are most effective. Finally, recommendations will be made about the use of the Basic MITAC and Advanced MITAC for training student aviators to navigate at low altitudes and for sustainment of these navigation skills after aviators are assigned to their respective aviation units.

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