MIT'S SAMPLER DISC OF DISC TECHNIQUES

by Barry Arons

"**D**ISCURSIONS" is an interactive videodisc which demonstrates recent and ongoing work at the Architecture Machine Group of the Massachusetts Institute of Technology. The disc is intended for use with consumer-type laser disc players; the material is organized into chapters

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with picture stops which allow the user to view it in a coherent manner.

The disc design encourages exploration of the material through graphic information frames and a novel layout. The 16 chapters provide simultaneous access to a live video segment or a corresponding slide show, and contain the digitally encoded text of published papers and theses. An introductory chapter and appendices contain descriptions of the disc's organization, a bibliography, a collection of more than 3,000 slides, and other data.

WORK AT THE Architecture Machine Group (AMG) focuses on the exploration of new techniques for natural human/computer interaction. Projects tend to be centered around NTSC-compatible video for display of in-
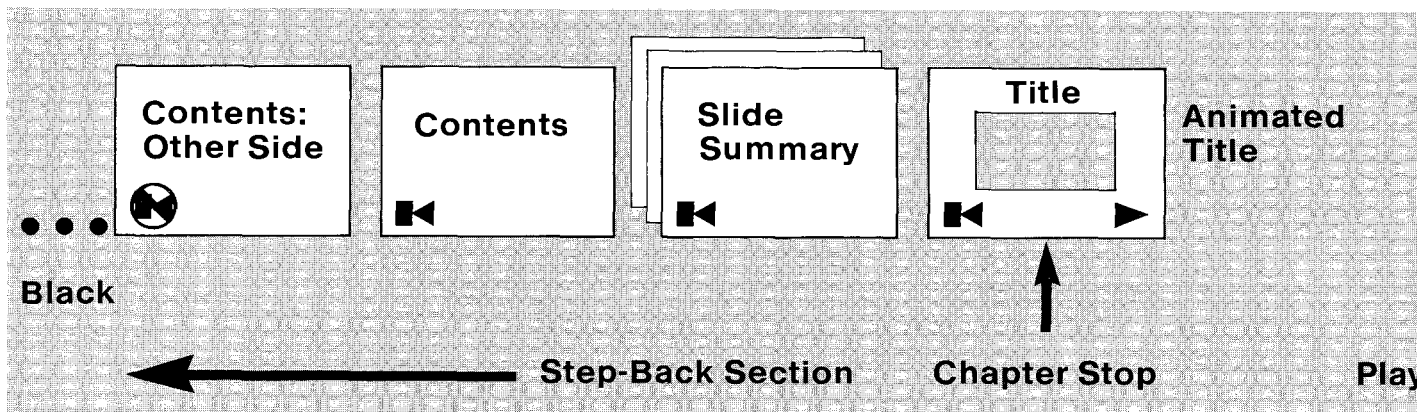
formation because of the availability of components which permit the mixing of computer-generated graphics and conventional video images. As a result, a significant portion of AMG's work has involved the use of interactive videodiscs for picture, sound, and data storage.

In the summer of 1981, AMG pressed the *1981 Demo Disc* which contains a linear assemblage of nine previously recorded videotapes showing lab research. In effect, this laser disc was a 12", circular videotape since it exploited none of the interactive features of the videodisc technology.

By the spring of 1983, the work at the lab had changed and progressed to the point that the material on the '81 disc was significantly out of date. Plans were formulated for a new demonstration disc, one that would be formally designed to be interactive. The result was *Discursions*.

DISC DESIGN

Each of the 16 demonstrations on *Discursions* is organized into a chapter that contains a slide show (a collection of still-frames), a motion video segment (originally recorded on tape), and digitally encoded text from relevant publications. These demonstration segments range in length from approximately 40 seconds to seven minutes, and are found on both sides of the disc — in Chapters 10 through 17 on side one and Chapters 20 through 27 on side two. (The gaps in the numbering are deliberate as I will explain later.) Side two also contains the appendices in Chapters 30 through 35.

The chapter stop is located between the slide show and the live video segment in each section. Thus, from that chapter stop, you can either play forward to view the taped segment and the digital data, or you can step backward to see the corresponding slide show. In this way, a single, searchable chapter provides access to two modes of presentation.

Although counter-intuitive, all the single-frame material, e.g., the slide shows, is organized to be viewed by stepping *backward* through the disc whereas the motion segments move in the normal forward direction. In effect, you could re-label the keys on the disc player so that the "step back" key becomes "slide advance."

Throughout the disc, we used small, iconographic pictures to represent each of the demonstration chapters. After each still or taped sequence, there are "table of contents" frames which list all the searchable chapters so users may skip from one to another according to their interests.

As an additional aid to help viewers find their way around, we also used two small arrow symbols at the bottom of the

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still-frames, both the slide images and the table of contents lists. The symbol at the lower left indicates that still-frame material precedes the current frame and to access it, you would use the "step back" control. The arrow in the lower right is a "play" symbol that indicates the current frame is followed by live, motion footage or a new chapter.
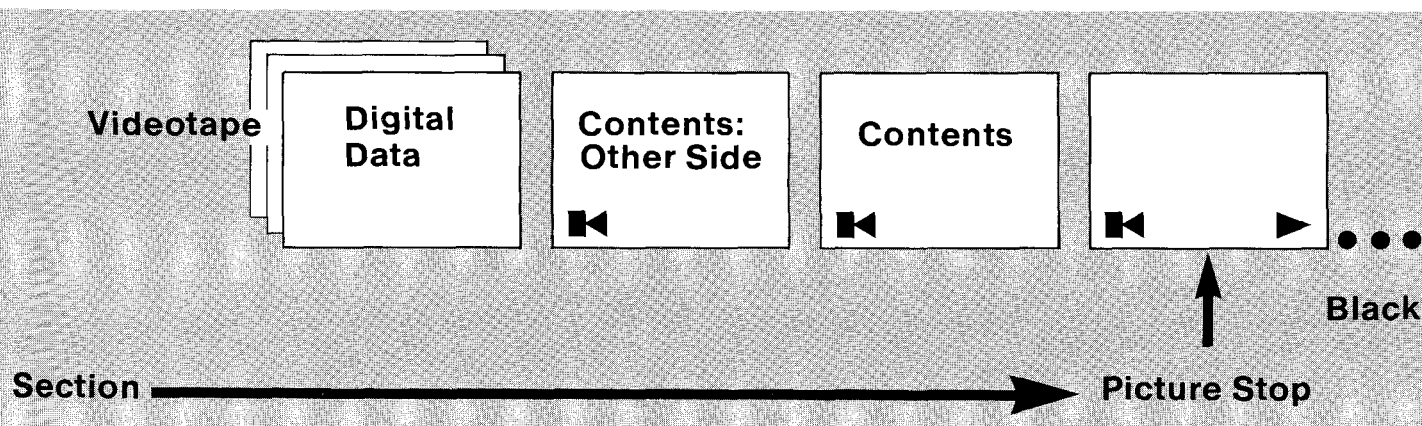
Each side of the disc refers to the other in relative terms. For example, if you were viewing side one of the disc, the table of contents for the chapters on side one is always shown first. Only by stepping back would you access the table of contents for side two, the flip side. Since a viewer can lose track of which side he/she is watching, it would be confusing to label the sides "1" and "2" on the tables of contents. Instead, we simply make a reference to the "other side," which tells you that the frame shows content for chapters on whichever side of the disc it is that you're *not* currently using.

N DESIGNING the disc, we were constrained by some of the limitations of consumer disc players. For example, the minimum suggested length for a searchable chapter is 30 frames, but to use the scan feature on the disc players, there is a requirement of 800 frames, minimum, per chapter. The main demonstration sections are long enough to meet these requirements, but the appendices are not. Because of space limitations — we used within 44 frames of the 54,000-frame limit on both sides of the disc — the appendices don't meet the minimum.

Another constraint caused us to lay the disc out so that each chapter number begins with a frame whose number is a multiple of 100. This eases access problems on disc players which do not support chapter searches. In addition, chapters must be numbered consecutively and continuously, beginning with zero. Since the chapters on side one are numbered from 10 upward, we had to create frames for the unused chapter numbers, i.e., from 2 through 9, even though they do not contain any program material.

We used these blanks to build the potential for change into the disc. Several of the projects demonstrated were in the very early developmental stages when the disc was put together, particularly the Phone Slave and Communication News projects. (These will be described briefly a little later.) Therefore we alloted additional space for future updates of the live video segments. At some later time, we can insert a revised segment into a region that is black on the current master tape. In this way, we can make an updated disc without changing the chapter or frame numbering.

Videodiscs can store digital data in conjunction with conventional images — the

data can be encoded into the video signal in a manner similar to that used for broadcast teletext. The AMG encoding format allows storage of up to 10,000 user bytes per frame. This permitted us to store the text of 21 published papers and theses — approximately 1.4 million characters — on frames that occupy about five seconds of the total time available on the disc.

PRODUCTION

The scrolling credits, title frames, and other graphic images were generated at the AMG, using a 640×480×8-bit frame buffer. The source material for the small, iconographic pictures on the table of contents and title frames ranged from digitized slides to existing videodisc stills and frame-buffer images.

Most of the still-frames originated as 35mm slides which were individually shot on 35mm movie film. The live segments were produced at the AMG on 2" quad videotape. The digital data was encoded and recorded in real time on 1" videotape. The 35mm film and 2" tape material was then transferred to the 1" format, and everything was time coded.

From these 1" source tapes, we duped ¾U videocassettes with visible time code. These were our work tapes which were viewed off-line, and each video segment and group of still-frames was logged, using a computerized decision list editor (EDL). The EDL allowed us to move sequences around by using commands that are analogous to those used by a word processor when it moves lines and paragraphs. Each time we made a change, the EDL updated all the edit in/out times and frame counts. The 1" master tape was prepared from the final edit decision list.

CONTENT

To give you some idea of the scope of *Discursions*, let me discuss the content of each chapter briefly:
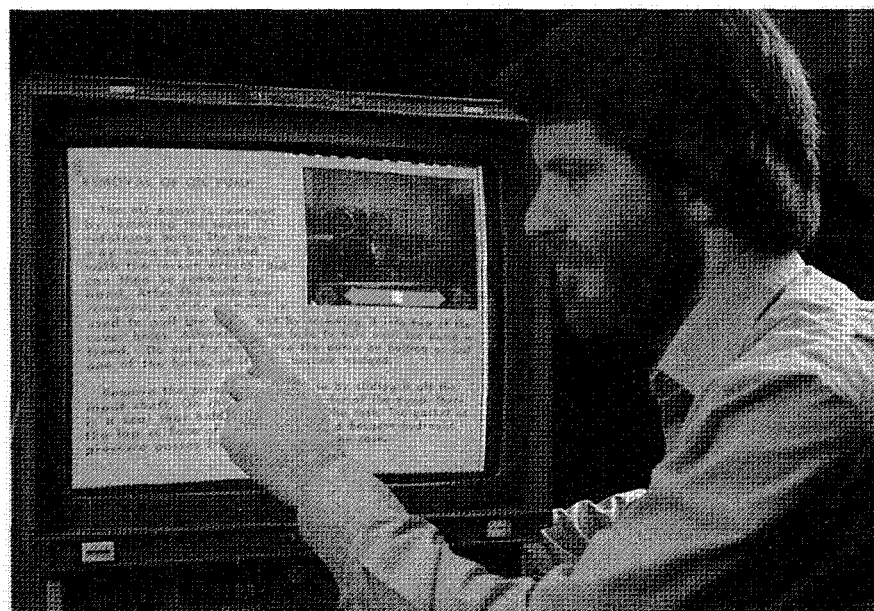
CHAPTER 0: Titles and Credits.

CHAPTER 1: Table of Contents and Introduction to the Disc.
Both of these appear on both sides of the disc to provide a common starting point. They give a single-frame summary of suggested ways to navigate around the disc's geography. (Chapters 2 through 9 are not used.)

CHAPTER 10: Interactive Movie Map (Aspen).
A dynamic, interactive map, based on videodisc technology, which the viewer uses to take a simulated drive through an unfamiliar space. The driver (or map-reader) is presented with images that were taken by single-frame cameras and that replicate the actual imagery from the space, or the images may be computer-synthesized replicas of the real scenes.

The display on the monitor is from one of the manuscripts that have been stored on the videodisc as digital data. Because so much data can be stored, the disc contains 21 papers and theses.

The map-reader may control the speed, route, angle of view, and mode of presentation. He/she may access spatially ancillary data stored in buildings or other locales in the environment. The map includes topographic views and both optically and electronically processed images, and it provides a responsive, virtually complete representation of the environment of Aspen. Of all the AMG projects, this one is probably the best known.

CHAPTER 11: Movie Manual.
This section proposes the prototype of a system based on interactive discs for use as an electronic book. The Movie Manual combines computer-generated text and graphics with live video and still images from the videodisc to create dynamic "video pages." The user interacts with them via a touch-sensitive screen. This technique is being investigated for use in personalized instruction, but it could be applied to other types of publication and entertainment.

CHAPTER 12: Communication News.
This project is aimed at developing an adaptive, highly interactive interface to data which changes rapidly. The current model, a personal electronic newspaper, combines a remote access data search system (NEXIS), a low-bandwidth connection to a personal computer, local videodisc storage, and full-color display. The computer surrogate edits the newspaper by directing the database search operations and the layout of the display. You "read" the newspaper through voice and touch control, and it draws upon a growing local database.

CHAPTER 13: Desk File.
Desk File explores using the writable videodisc to enhance the content and appeal of information, plus the usefulness of electronic mail. It encodes such textual fields as the sender and subject in the form of graphic icons which are subsequently used as keys by which to access the messages.

CHAPTER 14: Talking Heads.
Our talking head is a three-dimensional surface in the shape of a particular person's head. The facial expressions are imaged on that surface by a video projector in real time, with sound-sync, and with dynamic spatial correspondence.

CHAPTER 15: Zero Bandwidth Video.
This project explores several teleconferencing techniques, including two based on videodiscs, in which locally stored images are driven by low-bandwidth audio and data connections to simulate the presence of people at remote sites.

CHAPTER 16: Lip Sync.
Here, we use a board level speech recognizer and a personal computer to determine formant location and to drive a color video display in sound sync with speech.

CHAPTER 17: Charicature Generator.
This project describes a technique that amplifies the nuances of the human face into a computer-generated charicature. The method involves comparing the face to a norm, then distorting the face even further away from that norm than it already is.

On the flip side of the videodisc, we have:

CHAPTER 20: Phone Slave.
This shows a personalized telecommunications system that handles both voice and electronic mail messages. A conver-

MIT's Sampler Disc

sational answering machine gathers incoming voice messages, and the system's owner may access messages by phone through the use of voice commands, or locally by using a touch-sensitive screen and color display.

CHAPTER 21: Put That There.

A voice and gesture interactive system allows a user to build and modify a graphic database on a large-format video display. Natural language and pointing, i.e., "put that there," provide a conversational interface to a sophisticated computer interaction.

CHAPTER 22: Graphical Marionette.

This section demonstrates that a natural and effective way of capturing the subtle dynamics of human motion is to track that motion directly. With the goal of complete body-tracking, AMG has developed a prototype system for designing "graphical marionettes" that are animated by diverse inputs. It is illustrated here.

CHAPTER 23: Archfile and CHAPTER 24: Picassofile.

These two both demonstrate that the linking of an optical videodisc with an interactive database creates a new type of visual information system.

Archfile is comprised of more than 5,000 records of modern American architecture. The data and corresponding images are accessible by date, designer, location, and building type. Similarly, Picassofile stores more than 700 images of Picasso's work for access by style, period, location, or subject. Current work by the AMG features browsing rather than database access, and stresses the importance of the image in such systems.

CHAPTER 25: Viewpoint Dependent Imaging.

The display for this project is an interactive stereoscopic image that acts as a window into a three-dimensional visual environment. As the user moves, the image is continuously updated to the change in point of view through the use of a computer-controlled optical videodisc and body tracking.

CHAPTER 26: Steroscopic Workspace.

This project takes a conventional frame store and uses it for three-dimensional display, with left/right eye views interlaced in video and viewed through PLZT shutter goggles. The video monitor is seen reflected in a mirror which is only half-silvered. The mirror projects the image into a workspace within which one can manipulate the image directly with a three-dimensional digitizer.

CHAPTER 27: Facemaker.

This project describes the technique of pictorially synthesizing facial imagery by using optical videodiscs that are controlled by computers. Using a catalog of whole faces and facial features, one can perform search, selection, and averaging processes that will yield a composite, expressive, and recognizable face.

The demonstration projects end with this chapter. The balance of the flip side of *Discursions* is occupied by appendices:

CHAPTER 30: Disc Design.

This is an overview of the layout of the disc. (Much of the text of this article appears in this chapter.) Ten frames are used to make a graphic presentation of the details of disc and chapter layout.

CHAPTER 31: Digital Data.

This has a description of how the data sections of the disc were generated, and a discussion of the potential for publishing data on optical discs.

CHAPTER 32: Bibliography.

As the name indicates, this is a selected list of recent publications written at the Architecture Machine Group. Reproductions of the title pages of relevant papers may be found following the slide show of each chapter, or in the chapter's digital data section.

CHAPTER 33: Mapping by Yourself (Do-It-Yourself Aspen).

This contains selected source material from the Aspen Movie Map disc. The footage takes you in a figure eight around two blocks in Aspen, which provides enough imagery to allow anyone who has a disc player that can be controlled by computer to create his/her own interactive mini-Movie Map.

CHAPTER 34: ArcMan in Action (24 Hours at the 'Mac).

This appendix provides a quick view of life in the terminal garden, a central area at AMG where we do most of our work. We recorded one frame per minute for a total of 24 hours onto our write-once optical disc player, which compresses the day into an event-filled 48 seconds. The still-frame portion of this chapter on the other side of the chapter stop is a slide show that highlights the people and environment of the Architecture Machine.

CHAPTER 35: ArcMac Slidathon.

The final chapter is a mass collection of more than 3,000 still images that have been gathered by members and friends of the AMG. The material is loosely organized into lab-related topics, followed by personal slide shows. The accompanying sound track features Smokehouse and the Flames, a band made up of several former members of the Architecture Machine. Stepping back from the chapter stop gives you a slide show overview of the lab.

T HE JACKET DESIGN for *Discursions* is an artistic interpretation of the disc's layout and digital data. The photographs for the circular labels were taken through a special anamorphic lens that was used in conjunction with the Aspen project.

The disc was mastered and 100 copies were pressed literally only days before its first showing at a computer graphics conference. After the disc was thoroughly checked, another 900 copies were made.

Interestingly enough, the most widely debated part of the entire project was what to name the disc. *Discursions*, excursions by videodisc, has proved an excellent vehicle for publishing our ideas and for demonstrating the work of the Architecture Machine Group to industry and other laboratories. Beyond that, however, it also serves to demonstrate the power of the interactive videodisc, and some of its potential applications in the fields of entertainment, education, and industry. □

ADDITIONAL DISC DATA