

C O U R S E   N O T E S

20

**Computer Animation  
Using Digital Video  
for the Web,  
Multimedia, and  
Broadcast**

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# ACM SIGGRAPH '97 - COURSE #20

Course Title

**Computer Animation Using Digital Video  
for the Web, Multimedia, and Broadcast**

Course level

**Intermediate**

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### Course Abstract

This course is a practical guide for understanding and using digital video for computer graphics animations in applications such as networked video, multimedia, and video broadcasts or presentations. We will present a nuts-and-bolts approach to making effective use of the wide range of digital video in applications such as: animation recording systems, transmission over ATM networks and the World Wide Web, interactive CD-ROMs, scientific visualization, desktop multimedia systems, and high-definition video television standards. We will demonstrate computer animation recording and non-linear editing on a desktop video system, describe in detail various digital video animation systems, and describe the digital video format standards.

### Summary Statement

World wide, computer animation has recently enjoyed an enormous increase of use in a wide range of video applications, from presentations to scientific visualization to education. Video is playing an increasingly important role in our computing environments. With the development of numerous digital video standards, the industry is moving further away from analog systems. More frequently, computer graphics artists, programmers, and animators need to interface with digital video systems and its applications. The World Wide Web and CD-ROM on-line interactive information systems have created even more outlets for digital video animations. With the emergence of multimedia desktop systems and multimedia as a "hot" topic in computing, the role of production video is increasingly important. All areas of computer use—scientific, artistic, educational, and otherwise—are turning to video as a medium for the presentation of information. Most of these new users need a basic education about digital video to increase the quality of their production, yet this information is not easily obtained. Many of these potential video producers are coming to the annual ACM SIGGRAPH conference to learn about the latest techniques in computer animation and multimedia. We feel that the annual ACM SIGGRAPH conference is a perfect place to educate this growing community of novice digital video producers.

This course is a follow-on to the "Practical Guide to Recording Video Animations from Computer Graphics" ACM SIGGRAPH course presented in 1995 and 1996, but it is not a prerequisite for attendance to this course.

In order to provide useful information to a large, diverse audience with varying needs and applications, we will address a wide range of topics: including desktop video systems, video compression, conversion of analog video, transmission over high speed networks, as well as low-bandwidth systems such as the World Wide Web and interactive CD-ROMs. We will also describe in detail and demonstrate several recording/editing system configurations.

The course notes also include technical details of video formats and theory so that the notes will become a reference guide.

### Course Objectives

Our principal objective is to give an overview of digital video and computer animations in a variety of applications. Attendees should leave with enough information to know what to look for in purchasing equipment, how to assemble a system of their own, be knowledgeable enough as to know what hardware and software is needed, and what pitfalls to avoid when producing a video.

We also will explore the upcoming horizons in computer video technology, such as Web-based video, compression, multimedia, ATM video transmission, digital video disks, high-definition television, recording/editing systems, and others.

### Intended Audience

People starting or planning to build a computer based digital video animation recording system, or who are converting their present systems to digital video, Web-page builders with video information, CD-ROM designers with interactive video, or visualization centers for industrial and presentation users.

### Prerequisites

Prior knowledge of the basics of computer graphics is assumed. This course makes few assumptions about any knowledge of video theory, but it would be helpful. Attendees should at least be able to correctly connect a home VCR to a television.

### Course Syllabus

This course is directed toward those who want to:

- record computer generated animations, (Alias/Wavefront, SoftImage, etc.)
- record animations of scientific and visualization data onto video tape, (AVS, in-house software calculation results, raster images, etc.)
- create video segments for viewing on the World Wide Web,
- create video segments for multimedia.

To address the diverse needs and applications of our audience, we cover a wide range of topics including desktop video systems, video compression, conversion of analog video, transmission over high speed networks, as well as low-bandwidth systems such as the World Wide Web and interactive CD-ROMs. We also describe in detail and demonstrate several recording/editing system configurations. With each of these applications we discuss their advantages and disadvantages, the purpose of the equipment, the function of the hardware and software, and what to look for when purchasing video equipment.

We also discuss other related topics, such as audio, image compression, the future of video, and the pitfalls to avoid when producing a video.

It is not possible to cover all aspects of this topic thoroughly in a single day, so we have chosen to include detailed technical and theoretical topics, such as the technical description of the ITU-601 digital video standard, as an appendix in the course notes. Some important information contained in the appendix will be covered in-detail during the course, other topics in the appendix will be touched upon briefly. The course notes are a reference for a wide range of topics and a starting point for a reader to

locate more information. It is our goal to make the course notes useful beyond the end of the conference.

The course is presented in four 90 minute sessions. Bob Judd will introduce each topic so that we may present a coherent course.

## Session 1

- **Overview (10 minutes).** Bob Judd presenter. Bob will introduce the course and answer the questions: Why would one want to record computer graphics animations, for what purpose is it useful (such as analysis, insight, presentation, training, program development, entertainment), and how tools and techniques differ depending of the data source (scientific calculations, artist animation, CAD-CAM modeling, etc.).
- **Analog Video Formats (20 minutes).** Jim Costigan presenter. For people new to the field, we will briefly describe the various analog video formats and discuss their advantages & disadvantages. Topics include: NTSC, Y/C, Y R-Y B-Y, and RGB.
- **Digital Video Formats (30 minutes).** Ross Gaunt presenter. Here we describe today's various digital video formats and discuss their advantages & disadvantages. Topics include: Parallel component video, serial component and composite video, audio and ancillary data formats, consumer DV and DV-Pro video, and Firewire.
- **Video Animation Systems (30 minutes).** Jim Costigan presenter. This section will cover the requirements of a range of animation recording systems. Each new system will build on the previous system. With each configuration we will describe the hardware, discuss their features, advantages & disadvantages, and talk about what to look for when purchasing a device. Topics include: video frame buffers, digital disk recorders, video tape recorders, monitors, time base correctors, distribution amps, sync generators, cables, waveform monitors and vector scopes, SMPTE time codes.

## Session 2

- **Analog to Digital Video Conversion (30 Minutes).** Ross Gaunt presenter. Converting from RGB to digital video, and back to analog can be complex. Results will vary depending on factors such as word length, color space, sampling frequency, and others. Topics include: color space conversion, 8-bit vs. 10-bit digital video, sampling rates, gamma correction, and resolution.
- **Desktop Video Systems (60 minutes).** Ross Gaunt presenter. With nearly 100 systems available, it has become a challenge for a person to evaluate these systems on his or her own, yet today's buyer wants a system that will meet their needs for today and the future, while maximizing the price/performance. One half of this section will discuss the advantages and disadvantages of various configurations for desktop video recording/editing systems. The second half will be devoted to evaluating most of the desktop video systems currently on the market.

### Session 3

- **Non-Linear Video Recording System Demonstration (30 minutes).** Jim Costigan presenter. Video production requires one to balance time and budget against the creative process. This section will demonstrate various practical methods for recording and editing an animation for video on a desktop non-linear editing system. Topics include: rendering time, digital effects, transitions, compression, audio, video pitfalls, and titles.
- **Digital Video Compression (30 minutes).** John Mareda presenter. Compression of video is increasingly important, for example, in the U.S. the next generation of television broadcasting will employ compressed video. Due to its high data rate and massive storage requirements, uncompressed video is impractical for all but the most high-end applications. Also, until high-speed networks are common in households, compressed video images will be a requirement for transmission over networks. Here we contrast numerous methods of compression and discuss their applications. Topics include: loss-less compression, JPEG, Motion-JPEG, MPEG-1, MPEG-2, MPEG-4, QuickTime™, AVI, fixed bandwidth and variable bandwidth systems.
- **High Definition Television (30 minutes).** John Mareda presenter. An update on the US high-definition advanced television standard. Topics include: currently available hardware/software, how does ATV fit into the computer graphic animation process, and an example of a basic ATV animation recording system.

### Session 4

- **Networked Video (30 minutes).** Jim Costigan presenter. As information providers move away from static text-based pages, video on the Web is gaining in popularity. Depending on the network, this may be easy or a time consuming task for a user. This section will explore a number of approaches being taken to deliver network video. Topics include: high end networked video over ATM, Web-based video, video conferencing, and compression techniques as they relate to transmitting video over the Web.
- **Digital Video in Multimedia (60 minutes).** John Mareda presenter. There are a number of approaches being taken to deliver video to the home over the Web and CD-ROM. Topics include: streaming video which allows the user to get a preview of the sequence as it is being downloaded, hybrid CD systems which play videos from a local CD while accessing supplementary information from the Web, and simulcast technology such as MSNBC where a live video broadcast is integrated with supplementary Web information. This course will also describe techniques for creating video sequences suitable for transmission over the Web, incorporating live video into a 3D scene, as well as discussing alternatives to transmitting video. Other topics include VRML, QuickTime VR and RealSpace.

### Course Organizer Information

Bob Judd is the main point of contact. E-mail correspondence should be addressed to [s96video\\_course@lanl.gov](mailto:s96video_course@lanl.gov). This will ensure communication to the entire course team.

**Bob Judd**

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Bob is a technical staff member of CIC-6 Customer Service group in the Computing, Information and Communications Division of Los Alamos National Laboratory. His technical work has been in the areas of scientific visualization, computer graphics, high-speed networking, and desktop systems support. He recently has been helping K-12 education sites become connected to the Internet. He was the Group Leader of the Computer Graphics Group at Los Alamos for nearly seven years and also founded the first UNIX workstation support group at Lawrence Livermore National Laboratory. Bob was the conference co-chair for SIGGRAPH '93 and Panels Chair for SIGGRAPH '89 & '91. Bob is currently the information manager of SIGGRAPH.ORG and the chair of the ACM Electronic Services Working Group (ESWG). Bob was also the first president and founding director of the International Sun Users Group.

## Speaker Information

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Jim Costigan is an audio/video professional who deals on a daily basis with a wide variety of video systems and configurations for industrial and trade show productions. His work includes bid estimation, system design, configuration, assembly, and real-time fault detection & correction.

**Ross Gaunt**

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Ross has been involved in video animation of scientific data at Lawrence Livermore National Laboratory for five years. Prior to receiving his degree in computer science, he worked over ten years as an electronic technician in computer and video hardware. He has designed and built three computer video animation and editing systems that are in use at the laboratory. He has presented several computer animation video tutorials at the laboratory. Currently, he is building a multimedia CD-ROM recording facility, and a computer video animation system with real-time recording and graphics effects of uncompressed images stored on SCSI disks.

**John Mareda**

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John Mareda has been involved in video animation of scientific data at Sandia National Laboratories for over ten years. He has set up several video animation systems that are currently in use throughout the laboratories. He has given numerous presentations on video animation technology including co-chairing a panel session on HDTV at SIGGRAPH '91. John is currently applying his knowledge of computer generated animation to the field of multimedia.