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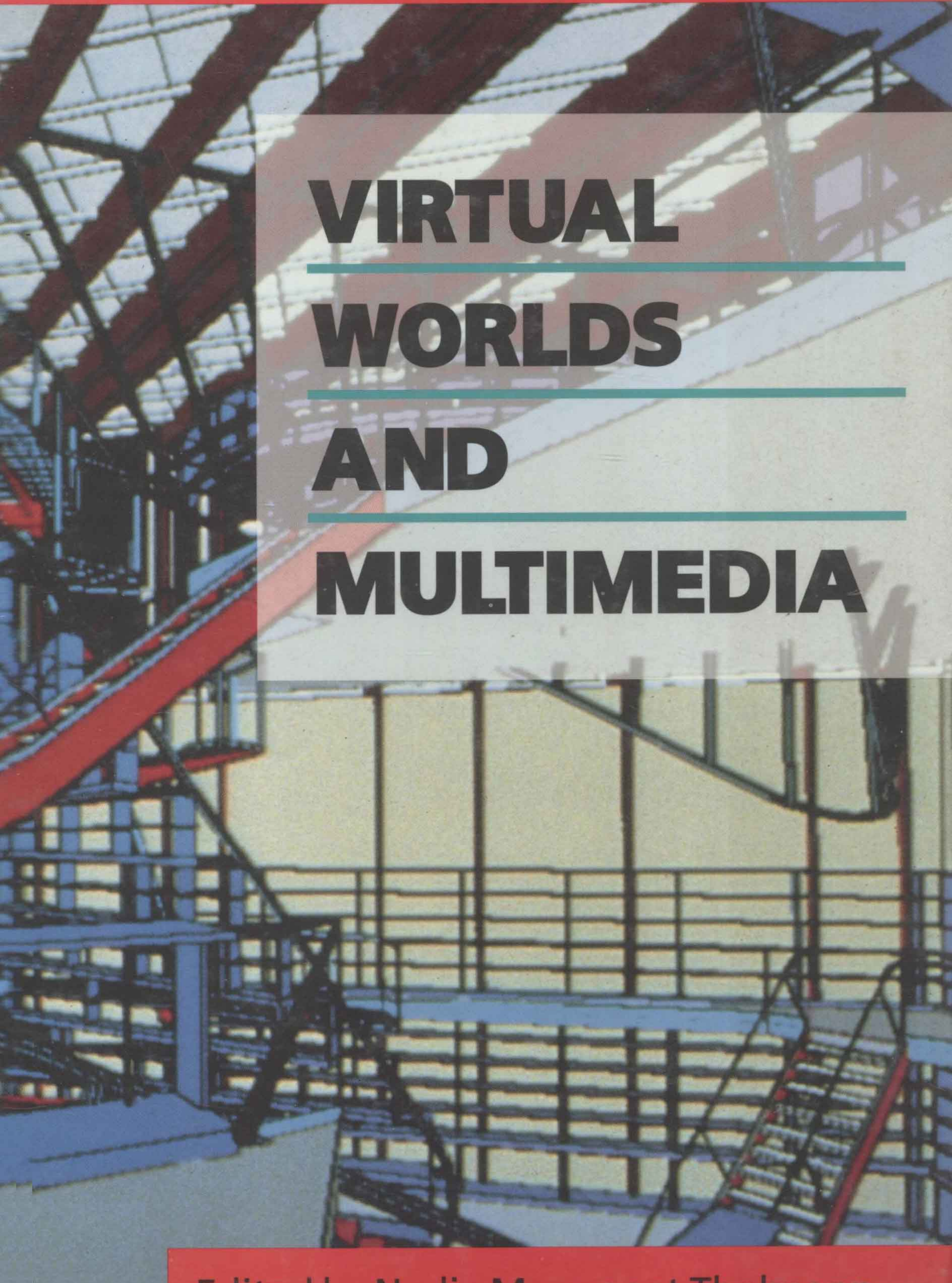

VIRTUAL WORLDS AND MULTIMEDIA

Edited by Nadia Magnenat Thalmann and Daniel Thalmann

Virtual Worlds and Multimedia

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Virtual Worlds and Multimedia

Preface

With 3D virtual worlds, it is now possible to simulate a situation before it happens. New buildings, clothes, trains, subways, environments or behaviors -- all these can be investigated BEFORE anything is physically expressed or built. This technology gives us the power to answer questions like "What would happen if...?" and "How would it look if...?" Moreover, we have reached the point where an operator can have real-time interaction with a virtual world simulation of a real scene. This means that the computer is able to not only provide passive virtual information, but also offer the user a satisfying interaction with virtual actors and scenes in a virtual environment.

In addition, modern networks can handle a variety of information. This information can take various forms -- images, sounds, real TV sequences, speech, text, results of calculations, graphics, etc. -- and can lead to sophisticated multimedia systems. Using virtual reality techniques, we will be able to send specific gestures, forces, positions, and attitudes through a system of networking and control equipment, to a computer anywhere in the world.

This book covers both theoretical and practical aspects of Virtual Worlds and Multimedia. It presents advanced research and surveys on key topics like: image compression, HDTV, synthetic actors, synthetic TV, 3D copying, 3D interaction, Virtual Reality, electronic books, and architectural space.

Most of the text was presented in the "Multimedia and Virtual Worlds Workshop," held in October 1993 at the University of Geneva. This workshop was sponsored by the "Troisieme Cycle Romand d'Informatique" and allowed participants to discuss the state of Swiss research in these aeras. We would like to thank Professor Yves Pigneur from HEC Lausanne for his constant encouragement and the "Troisieme Cycle Romand d'Informatique" for their generous support in offering all workshop participants a copy of this book, so nicely edited by John Wiley and Sons. Finally, we would like to thank Gaynor Redvers-Mutton for her active collaboration in the making of this book.

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Contents

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An Overview of Hypermedia and Multimedia Systems

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1.1. Introduction

The terms "multimedia", "hypermedia" and "hypertext" are often used quite interchangeably in the literature. Although we concur with the by now fairly common practice to use "hypermedia" and "hypertext" synonymously (and we choose "hypermedia" throughout this chapter) we feel that it is useful to distinguish "multimedia" and "hypermedia" systems not only on the basis that "hypermedia systems are multimedia systems with link-based navigation" but also by demanding that hypermedia systems are large and networked. Also, we take the somewhat narrow view that in all such systems (be it multi- or hypermedia) all information should be stored in digital form.

We elaborate on the above points (following (Maurer 1993b)) a bit more in this section. In section 1.2 we present the main special features of Hyper-G, our largest current research and development project, and mention a few smaller projects that have materialized as "fall-outs" from our Hyper-G efforts. Section 1.3 presents the "philosophical" underpinnings of our work, i.e. the reasons why we feel that hypermedia efforts have a significant potential of impact in many areas. We conclude this chapter with a brief summary and an ample list of references.

Computer-based multimedia systems allow the integration of various types of information (misleadingly often called "media") on a computer. In addition to traditional textual and numeric data, other types of information including graphics, raster images, audio- and video-clips can be handled in such a multimedia system in digital form.

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Two important issues should be kept in mind:

(1) We should distinguish very explicitly between graphics in the sense of pictures consisting of two- or three-dimensional geometric primitives (in the sense of GKS (Graphics Kernel System) or PHIGS (Programmer's Hierarchical Interactive Graphics Standard) (see e.g. (Bono et al. 1990) and (Van Dam 1988)) and in the sense of raster images ("pixel maps"). For the sake of this chapter let us refer to the former as computer graphics and to the latter as raster images. The main difference between the two is that in pictures based on computer graphics, objects are available in "coded form" and hence are parametrizable and can be readily manipulated, while raster images have no further "substructure": they just consist of rows of points (pixels), each with a certain colour value and can hence be manipulated only in some very trivial ways (such as moving, clipping or zooming). Observe that many computer packages (e.g. CAD software) generating technical drawings, architectural designs, or animation packages (see e.g. (Magnenat Thalmann and Thalmann 1990, 1991)) will always produce computer graphics allowing changes of views of scenes by just modifying parameters determining the attributes of some of the objects shown or the viewer's position. Raster images can be easily obtained by scanning a picture or digitizing a frame of a video-clip, i.e. without much computational effort; depending on the resolution (number of pixels and number of colours) they require a large amount of space unless sophisticated compression techniques are used: a medium-quality 640 × 480 raster image with 256 colours requires over 300 kByte, and a high-quality 1200 × 800 raster image with some 17 million colours (3 bytes colour information) - uncompressed - some 3 MByte. Also, a typical raster image may still be scaled, moved and rotated (in the plane), but changing just e.g. the view-point in a 3D scene is quite impossible. Note that most multimedia systems such as HyperCardfor the Mac, or ToolBookfor the PC, usually only support raster images with some simple compression techniques. In view of the fact that such raster images are often less flexible and more space consuming, the exclusion of computer graphics is a somewhat surprising phenomenon.

(2) In defining multimedia systems we have specifically mentioned that all data should exist in digital form. In many computer driven multimedia applications audio-clips and video-clips are often **not** stored in digitized form yet, but are obtained from an analog source, most often a video-disk player: on such a laser-disk pictures are **not** stored as raster images but just as digitized analog signals. Since it is not universally understood why this is such a drawback, let us briefly mention the two main points: (i) picture quality is restricted to TV quality; (ii) certain interactions with the picture (like zooming in at any point chosen by the user, viewing a panoramic scene in all directions at will, etc.) are not possible. The reason why video-disks are still being used is the fact that the digital storage of pictures (and audio material) is still somewhat both a storage capacity and a speed problem: while a video-disk can hold 50,000 still images of TV quality, a CD-ROM (with some 600 MByte capacity) can only hold some 2000 images of similar quality, unless sophisticated compression techniques are used. Similarly, a video-disk can hold 40 minutes of video; a large 2 GByte harddisk can hold only 5 minutes of video if no data compression is used. Further, the data transfer of

uncompressed raster images necessary to display some 20 medium-resolution pictures per second as required for a movie is only possible using very fast harddisks, and is impossible using CD-ROMs. For this reason most systems supporting "software movies" show "stamp-sized" movies only: a 2 GByte harddisk can hold - even without data compression - about 2 hours of stamp-sized movie (150 × 100 pixels with 256 colours). Above mentioned restrictions on storage and speed only apply in the absence of high-quality data compression. However, such compression techniques are by now well-known and indeed standardized for still pictures (see (Wallace 1991)) and two competing techniques (MPEG (Moving Picture coding Experts Group) vs. DVI) are available for movies (see (Le Gall 1991), (Green 1992), and (Poole 1991)). Above techniques allow the storage of tens of thousands of still pictures of reasonable quality or of 1-3 hours of TV quality movie in digitized form requiring 1 GByte. The only drawback of the compression techniques mentioned is that decompression is such a complicated process that ordinary computers require special decompression chips (JPEG (Joint Photographic Expert Group), MPEG, or DVI (Digital Video Interactive)). However, those chips (and fast CD-ROM drives that are also compatible with Kodak's photo-CD) are going to be standard components of the next generation of Mac's, PC's, and of multimedia workstations. Furthermore, new "fractal based" and "affine transformation based" high quality compression techniques requiring no special hardware for decompression are appearing on the horizon (see e.g. (CulikII and Dube 1991) and (Barnsley et al. 1988)). Thus, the integration of data in the form of text, graphics, raster images, audio and video leading to genuine digitized multimedia systems has just become possible.

The main applications of multimedia systems are in the area of information presentation, education and in the gray-zone inbetween, "edutainment" and computer games. Information presentation applications range from the presentation of companies and institutions, to public information terminals, electronic guides for exhibitions and museums (Maurer and Williams 1991), to the whole spectrum of electronic publishing (from computerized encyclopedias and dictionaries to road maps or other cartographic material). Multimedia applications can also be used for educational purposes e.g. to enhance classroom teaching, and, to a lesser degree, as partial replacement for personal instruction. Too much euphoria that multimedia applications such as cleverly designed HyperCard stacks will revolutionize the learning process is, however, unjustified: many issues more important than the display of colourful moving pictures have to be solved first (see e.g. (Makedon et al. 1987), (Huber et al. 1989)). How successful multimedia applications will be in the "edutainment" sector remains to be seen. Some of the more likeable pieces of software such as "Just Grandma and me" (Broderbond SW) still cannot rival the allure of top adventure games such as the likes of "Loom", "Space Quest" or "Larry"!

Multimedia systems clearly not only must provide a combination of various types of information, but also convenient access to that information. Various mechanisms such as simple query languages, menus, usage paradigms like "stacks of information cards", etc. are used, often combined with the notion of "links attached to clickable buttons": certain "hot-spots" (words, parts of pictures, ...) are distinguished on the screen and activating them leads "kind of associately like we tend to think" to related information.