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TITLE: IMAGE MANIPULATION IN THE SIGGRAPH INTERACTIVE PROCEEDINGS

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Image manipulation in the SIGGRAPH Interactive Proceedings

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ABSTRACT

We built a multimedia document system for the SIGGRAPH Interactive Proceedings to demonstrate the potentials and challenges in using technology to capture better the essence of SIGGRAPH conferences. The prototype system uses the NeXT computer system to present textual, mathematical, illustrative, colorful, audio, video and animated material. Special attention was given to including tools for interactive manipulation of images included in typical SIGGRAPH papers.

1. INTRODUCTION

Once published in printed form any document, book or paper, dies a little — or at least ossifies. This is especially true with a scientific publication and is most pronounced in journals where an author is subject to stringent page count limitations. Forced to adhere to that, many papers become so taut as to sacrifice exposition. Figures or illustrations that might have helped to enlighten are omitted for the sake of brevity. Also, mathematical presentations are reduced to a bare minimum — clarifying intermediate steps in a development are often sacrificed due to space limitations. And, unless it's a highly specialized publication, the likelihood of finding important fragments of computer code in a paper is nearly nil. In an electronic publishing environment most of these limitations disappear. There is an opportunity to resuscitate the work and restore to it much of the vitality that accompanied its preparation and, perhaps, presentation.

Armed with modern workstation technology, we can provide an electronic reading environment that permits one to reach into this new form of publication and pull out the mathematics so that we can manipulate it to experiment with it, to derive new results, to simulate different situations with different parameters; we can take the illustrations and move the eye-point, change the lighting conditions or use the model with our own algorithms; we can manipulate the animations and study the effects to learn and understand what has been accomplished; and we can make it possible for people to extract useful material and incorporate it with their work.

The technology to support the actions described above is largely available. There are many programs which manipulate text and graphics, including high resolution digital images in color. A few systems provide for embedded voice messages, but most are experimental and require expensive add-on hardware. Animation can be produced by video add-in cards and videodisk players. Textual annotation is available through the "Post-it" metaphor in several word processing systems. What is not available, however, is a completely integrated system, hardware and software, that combines all of these features. The SIGGRAPH conference proceedings, which for years have been characterized by extraordinary quality, provide an excellent source of material. The SIGGRAPH Interactive Proceedings project^{1,2} was initiated to capture *all* of the technical content of a SIGGRAPH conference in electronic form. Figure 1 illustrates the appearance of the workstation desktop after browsing through the SIGGRAPH interactive proceedings for awhile. Elements of many of the different media are visible on the display.

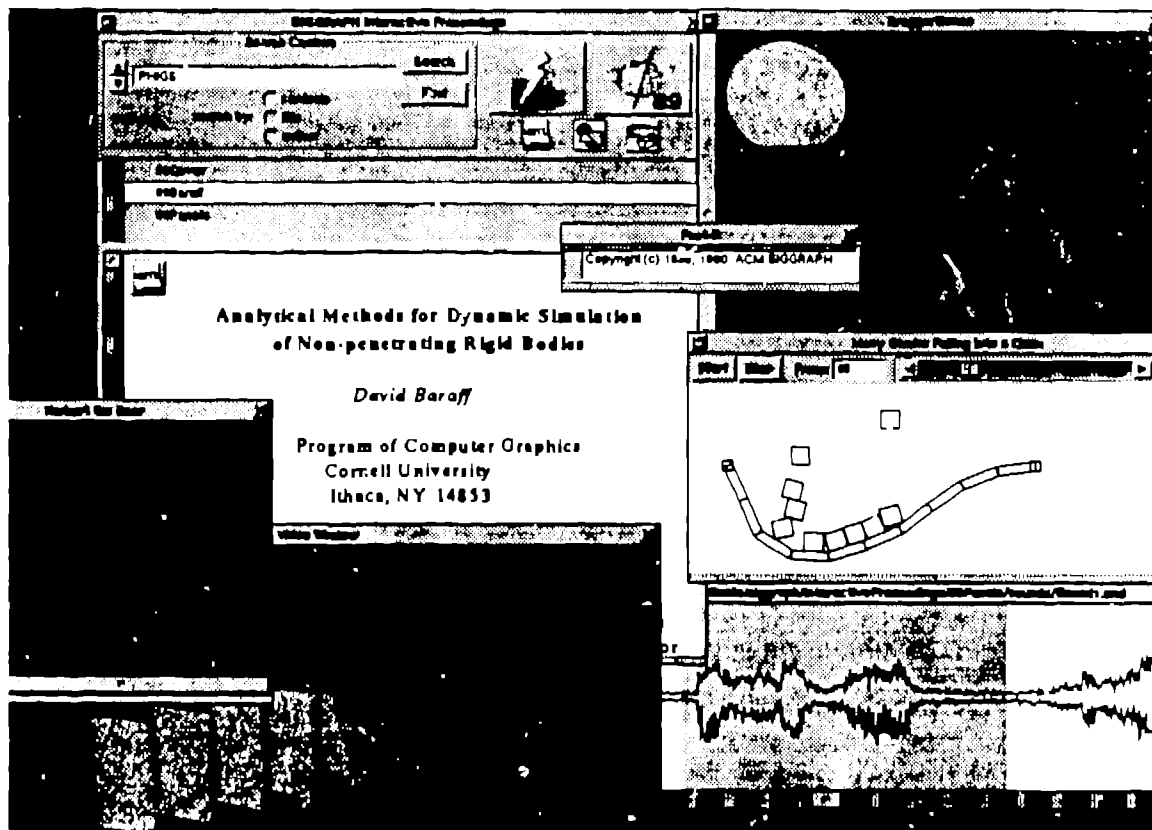


Figure 1. A screen shot of the SIGGRAPH Interactive Proceedings application, showing the entire screen with several windows open.

2. OVERVIEW OF THE INTERACTIVE PROCEEDINGS

The vehicle for the Interactive Proceedings project are papers from a recent volume of the SIGGRAPH conference proceedings. These proceedings offer an especially rich and challenging testbed for this project. The proceedings are archival and thus of lasting interest. The graphics is unrivaled and is the standard against which other publications are measured. All the important algorithms of computer graphics and their mathematical development have appeared in the proceedings. Based on this content, a volume of the proceedings cast into the interactive format offers the following features:

- Keyword retrieval of any word or phrase in the volume and random access to that part of the document. Any collection of text can be copied and then pasted into a text editor or word processing program.
- Figures that accompany text can be viewed and, if desired, extracted for processing by another program. This capability applies to simple line drawings or 24 bit/pixel full color images.
- The mathematical expressions, which for depiction are represented as PostScript, have a backing format that is compatible with the Mathematica² language. Thus, by double clicking on an equation, its semantics are conveyed to Mathematica, where the user can perform a variety of symbolic and numerical operations.
- While perusing a paper the reader may activate an icon that indicates an animated sequence accompanies the text. A window will open and an animated sequence will be displayed there. Controls attached to the window allow single stepping and selective freezing and extraction of frames.

Here's an example animation from a SIGGRAPH '89 paper.⁴

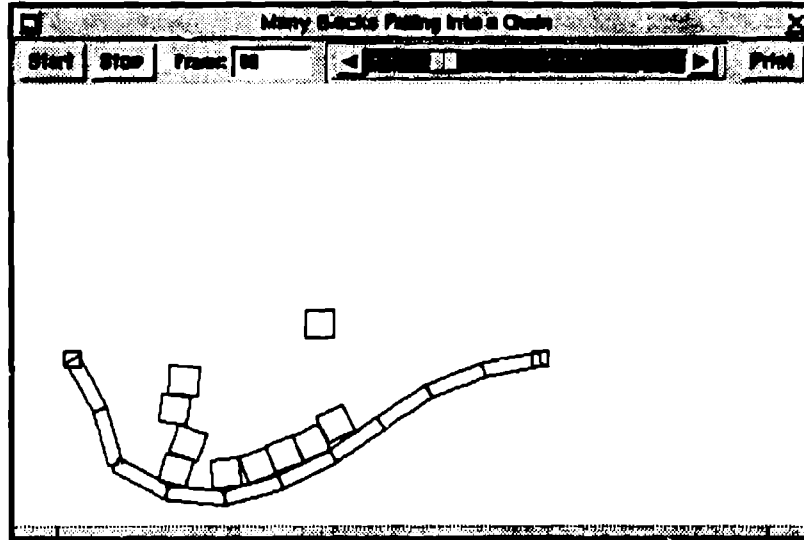


Figure 2. Blocks falling onto a quiescent chain

- Another icon style indicates that an audio insert is available for listening, e.g. part of the question and answer session. The sound fragment can be simply played back through a built-in speaker or it can be captured by a sound editor for incorporation in another multi-media document.
- The reader may wish to make notes in the "margin" of the document. These can be voice annotations or could be in the form of textual or graphical "Post-it" notes which are logically attached to a position in the paper. Subsequent readers can see and play back those comments. Thus, a teacher who is using the interactive proceedings in a course can expand on points in the paper *in situ*.

Doubtless many other capabilities and applications can be imagined for an interactive volume. An augmented digital SIGGRAPH proceedings would offer a wide range of interactive manipulations. It would be a simple matter to audiotape the sessions where the papers are presented and incorporate a digital version in the proceedings. In addition, authors who show videotapes at their presentation could contribute them for incorporation in an expanded proceedings. Another possibility is for authors to make available image databases, algorithmic models, and perhaps even code fragments as an accompaniment to their papers.

3. COLOR IMAGE SUPPORT

The reader has several viewing options upon encountering a color image. One can view a miniature gray image within the document on the NeXT display, a full-size gray image in a separate window (to permit scrolling the text while viewing the image), or a full-color frame buffer image on a separate color display. The gray image options will be useful even when the NeXT workstation display can support color images, due to the increased storage and processing requirements for color images. Therefore, whenever a color image appears within a document, it is represented by a button, shown in Figure 3, which, when pressed, presents a menu of the choices for displaying the associated image.

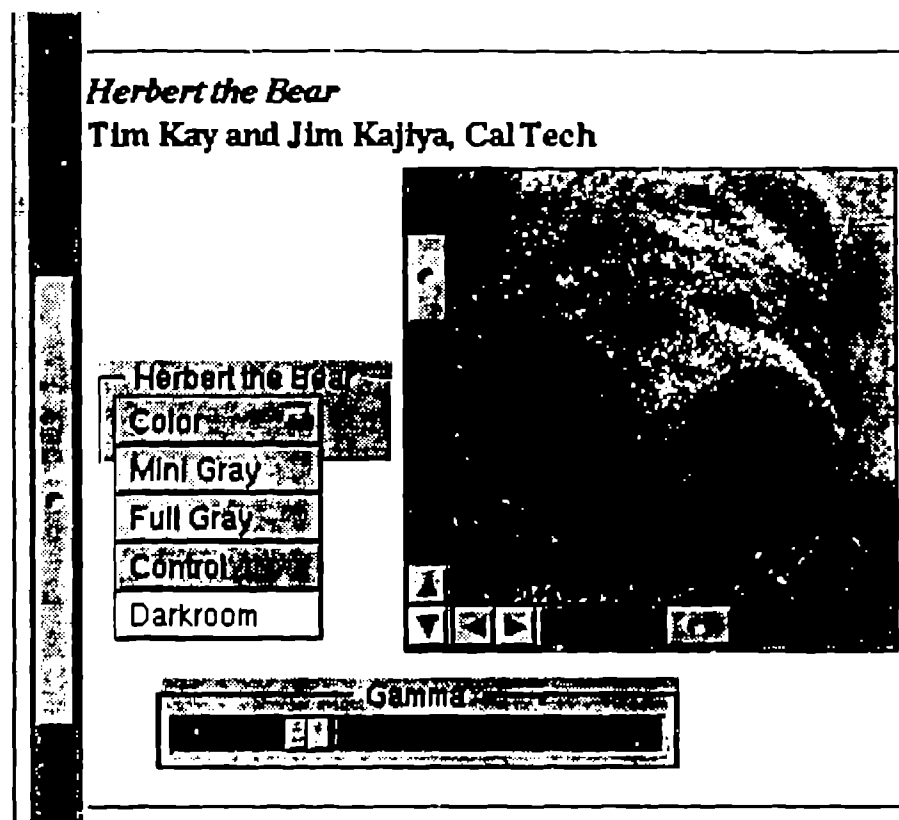


Figure 3. The color image menu button, showing choices for viewing a color image as a full-color image, a miniature gray image within the document, a full-size gray image, requesting a color control slider for adjusting the gamma value and selecting digital darkroom functions. The image of the bear is a miniature image and the gamma slider has been requested and inserted into the document.

One motivation for a color image button was the desire to provide interactive color controls. The color images in a SIGGRAPH proceedings often have a variety of color settings, especially gamma, for the different monitors and viewing conditions where the images were created. As well, different authors choose differently whether to include gamma compensation in the image or not. Most image formats in use by SIGGRAPH authors do not represent the gamma value or, if the format can, then this feature is rarely used. When several such images are collected and presented together, the reader needs a control to adjust the gamma value for selected images. Therefore, a color control is another choice provided in the color image button menu. When requested, a gamma control slider is positioned within the document, shown in Figure 3. Manipulating the slider causes the slave color display program to adjust the color lookup table entries by applying a new gamma value.

More extensive tools for image manipulation are available by requesting the **Darkroom** button option, as has been done in Figure 3. This provides the reader with image processing functionality that is based on the work of Holzmann.⁵ When in this mode, a complete C-style language is available for manipulating and compositing images. If the reader wishes, however, many functions can be applied by the press of a button. Figure 4 shows an image of Herbert the Bear⁶ that has been reduced in the "darkroom" by a factor of two and brightened by a factor of five. The **Shear** button at the top accesses one of many operations that can be easily applied to an image. This effect is shown in Figure 5.



Figure 4. Herbert the Bear, shrunk and brightened.



Figure 5. Herbert the Bear, sheared.

Finally, Figure 6 shows part of a mosaic image created by replicating small images of the bear.



Figure 6. Herbert the Bear replicated.

4. NEXT STEPS

The completed SIGGRAPH Interactive Proceedings project will be presented at the SIGGRAPH '90 hypermedia exhibit. The content will include all of the technical papers from SIGGRAPH '88 and all of the transcribed panel sessions from both SIGGRAPH '88 and '89.

There is nothing inherent in the Interactive Proceedings application that limits it to SIGGRAPH material. In fact, because SIGGRAPH paper content is so demanding, other material may be more easily accommodated. Therefore, we shall pursue generalizing the application to make it more corpus-independent. Other corpora, such as selected chapters from *Alice in Wonderland*, have already been tested in the application.

The current image support will be extended to include full color processing capabilities in the Darkroom module. Additional interface tools will be developed that will free the reader from having to learn the C-like language for advanced image manipulation.

5. ACKNOWLEDGMENTS

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