Cinematic imaging of works of art
Exploring the advantages of computer simulated camera techniques

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Introduction

The reproduction of works of art, particularly paintings, on film or video brings with it many complex issues for both the institution and the producer. Recent developments in micro-computer-based image processing have made it economical to simulate dynamic cinematic techniques using high resolution digital still images.

During production of The Minneapolis Institute of Arts' multimedia project "The Art of Persuasion: 17th Century European Painting" a number of cinematic imaging techniques were successfully developed and incorporated. This paper describes a number of techniques for producing these types of segments and their many advantages over traditional film and video.

History of the problem

Filming or videotaping a work of art is traditionally done in either the gallery or studio setting. In either case, the work is taken off view and methodically surrounded by camera and lighting equipment. This process is time consuming, expensive and places the work at risk of being damaged by light, heat and/or toppling equipment. The tremendous investment and risk involved in this process requires that the producer dedicate days or even weeks in preparing for the shoot and previsualizing every camera move.

Cinematic imaging

In contrast to traditional techniques, cinematic imaging sequences can be produced with existing photographic archives such as transparencies and/or high resolution digital images, leaving the original

work of art undisturbed. Even in cases where such visual resources are not available, the production of a high quality still image is drastically simpler and safer, requiring only photo strobes as light sources.

The photographic images are then scanned or imported into the computer at a high resolution, resulting in an image much larger than the display area. A commercially available software package is then used to program and control the image's movement and manipulation as they are recorded as digital video. Together, these manipulations can accurately simulate fluid pans, tilts, zooms and combinations thereof.

Depending upon their format, the digital video sequences produced through cinematic imaging may be integrated as components of computer-based multimedia programs or can be transferred to a standard analog video format.

Benefits

The advantages of cinematic imaging over traditional methods of filming or videotaping works of art are extensive. The following list summarizes some of its immediate benefits.

- **Economy** - greatly reduced equipment and technical staff requirements.

- **Efficiency** - drastically reduced preparation time.

- **Conservation** - poses little or no additional danger to the original work of art.

- **Quality** - focus, lighting, and movement can be accurately controlled.

- **Access** - with high quality visual archives, access to the original work of art is unnecessary. Even images from overseas collections can be easily processed.

- **Flexibility** - once programmed, a simulated movement can be easily adjusted or redesigned.

- **Archival quality** - all related images and simulated movements can be stored indefinitely with no degradation in quality.

Tools and materials

Hardware

The high resolution digital images required for the cinematic imaging process can be obtained either from a high resolution desktop scanner or from a Kodak Photo CD™. Although Photo CD provides the most efficient method of generating large numbers of high resolution images, desktop scanners provide the operator with the greatest degree of control over the resulting digital image. This is particularly true when working with large format transparencies (4x5 or greater) or with images with subtle shadow or highlight detail.

Scanners

Large Format   There is a wide variety of flatbed desktop scanners available with transparency adapters suitable for cinematic imaging. While scanners with an optical resolution of 300 dpi (dots or pixels per inch) will suffice for 8x10" transparencies. Scanners with an optical resolution of 600 dpi or greater are required for 2 1/4" to 5x7" transparencies. Even at higher resolutions, most flatbed scanners are not capable of accurately digitizing 35mm slides.

35mm Format   The subtle details of a 35mm slide require scanners designed specifically for this format. In order to capture the level of detail necessary for cinematic imaging, the scanner should have an optical resolution of at least 2700 dpi. Some of these scanners also accept 35mm negatives which have also proven to be usable originals.

Photo CD™

A Photo CD is a type of CD-ROM specifically designed for storing digital photographic images. Images shot on 35mm slide or print film can be transferred (digitized) onto a Photo CD during commercial roll film processing, or individually after processing. Once transferred, the digital images can be read by any CD-ROM drive with appropriate software. Consumer Photo CDs contain 5 different size copies of each image ranging from 192 x 128 pixels (136 dpi) to 3072 x 2048 pixels (2176 dpi). The 2000+ dpi image is typically most suitable for cinematic applications. A professional Photo CD process is also available for 2 1/4" film.

Photographic "originals"

As with any form of imaging, the quality and resolution of the photographic "original" determines the optimal quality of the product. Large format color transparencies common for documenting works of art provide the greatest resolution while 35mm originals provide the least. If licensing images from another institution, it is often worth additional expense for a large format transparency.

While studio quality full frame images are preferable, field or gallery images can also suffice if they are evenly lit, shot squarely and centered. All originals should be evaluated for even lighting, contrast, accurate color balance and defects such as stains and scratches. Images requiring the least correction prior to the digitizing process will always maintain the finest overall quality.

Software

Scanning/Imaging Processing The ability to accurately scan, resize, adjust and change the resolution of images is critical to preparation of images for the cinematic imaging process. Common software programs such as Adobe Photoshop™, HSC Live Picture™ and Light Source Ofoto™ are well suited for the image preparation process.

Digital Video Effects Software Adobe Premiere™ and Adobe After Effects™ are both capable of performing the image manipulation and motion control required for cinematic imaging. While Premiere's moderate price and editing features make it the more common of the two applications, After Effects sophisticated key frame based motion controls, ability to save and repeat complex procedures and professional quality rendering engine makes it worth the extra investment for this process.

The Process

Digital Image Preparation

Efficient production of cinematic imaging sequences requires a clear understanding of the limitations of the available images and imaging equipment.

Rules of Resolution

The most important rule to remember when working with digital images is that the best resolution results when the dpi of the image file is not less than that of the display. For example an image is stored at 72 dpi is displayed at its optimal quality at 100% its original size on a 72 dpi display. Image files of

lesser dpi than the display dpi resolve poorly since they must be stretched or interpolated to remain at 100%.

This rule is critical when calculating the maximum magnification (enlargement) your scanner is capable of and/or the maximum displayable size of an image on a given display. For example:

- A 300 dpi flatbed scanner's maximum magnification is a little over 400% (300 ÷ 72 = 4.17) for a 72 dpi display allowing a 1" film detail to be displayed at 4."

- A 2700 dpi 35mm slide scanner's maximum magnification is 3750% (2700 ÷ 72 = 37.5) for a 72 dpi display allowing a 1/8" slide detail to be displayed at almost 4.7."

- A 3072 x 2048, 2176 dpi Photo CD image (from a 35mm slide) maximum magnification is 3022% (2176 ÷ 72 = 30.22) for a 72 dpi display allowing a 1/8" slide detail to be displayed at almost 3.8."

Determining the required resolution for scanning

In order to avoid hours of trial and error and overscanning images at an unnecessarily high resolution it is useful to predetermine the maximum dpi or magnification required for a specific cinematic imaging effect. Use the following simple formulas below to determine the efficient scanner settings.

Note: If calculations remain proportional they can be performed using either image height or width. Image*width* is used below.

Standard proportional calculations:

Resolution of screen display in dpi or pixels per inch = **a**
Approximate width of the image on the film (inches) = **b**
Width of full image to be displayed on screen (pixels) = **c**
c ÷ b = minimum dpi of scan for display of full image = **d**
(d ÷ a) x 100 = percentage of enlargement/reduction

Additional calculations for detail zooms and enlargements:

Approximate width of the image on the film (inches) = **e**
Width of detail to be displayed on screen (pixels) = **f**
f ÷ e = minimum dpi of scan for detail enlargement = **g**
(g ÷ a) x 100 = percentage of enlargement/reduction

In cases where film detail is too small to measure:

Approximate width of original work of art (inches) = **h**
Approximate width of detail in original image (inches) = **i**
f ÷ (i (h ÷ b)) = minimum dpi of scan for enlargement or = **g**
(g ÷ a) x 100 = percentage of enlargement/reduction

Image Control and Manipulation

Zooms

One of the simplest and most useful cinematic imaging techniques is that of dynamic magnification or "zooming." This is simulated by using the digital video effects software, in this case Adobe After Effects, to reduce the entire image so that it fits within the display area. The effects software is then programmed to incrementally enlarge the "virtual image" over a specified number of video frames filling the entire display area with a predefined image detail. See figure 1.
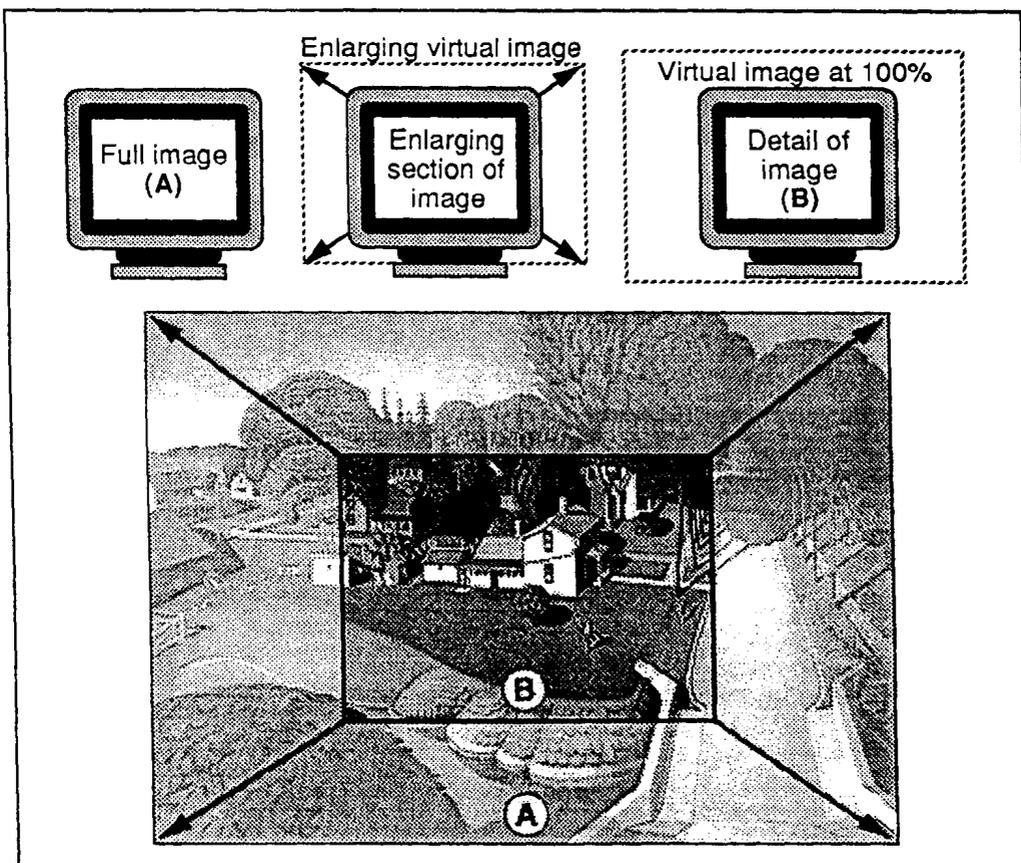

Figure 1. Zoom in

The following steps summarize the process for producing a zoom:

1. Scan and save the "original" film image at the resolution defined by (g) in the equations provided earlier.

2. Launch the digital video application and import the scanned image.

3. Create a new project/composition window the size of the desired display window. Note: If the end product is to be displayed as a Quicktime™ or AVI™ movie it is often preferable to select recommended display window size for optimum playback speed.

4. Drag the image into the project window and reduce the scaling so the entire image fits within the display area. See figure 2.
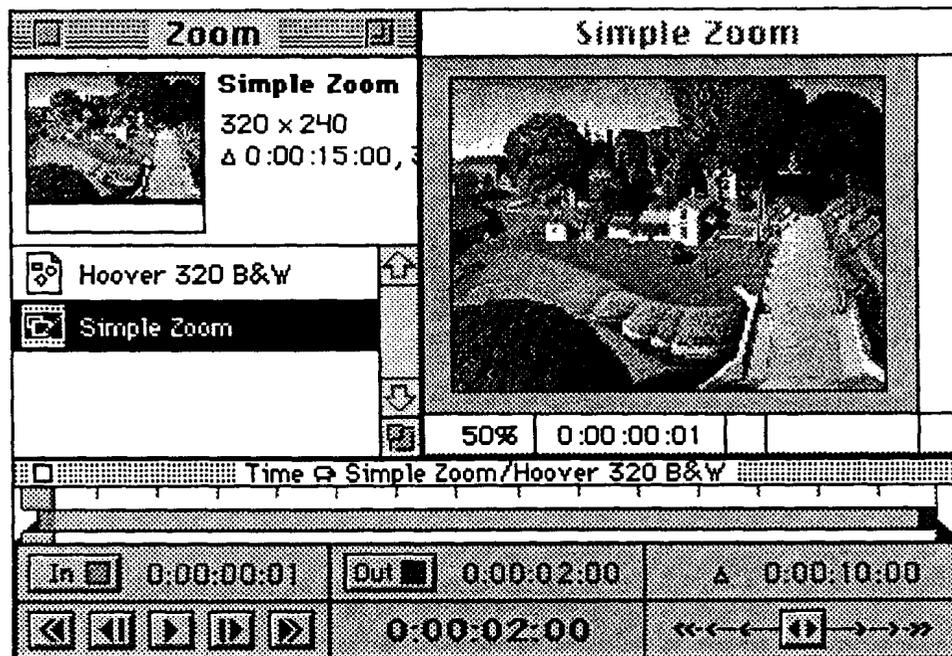

Figure 2. Setting up initial full image view

5. Set a key frame at this point on the timeline by clicking the keyframe checkbox. A type of motion control such as linear ease or smooth may also be selected to provide a more natural acceleration and/or deceleration of the motion.

6. Specify the total duration of the zoom, in this case 2 seconds, by moving the timeline control bar to the end point and setting another key frame.

7. Set the scaling of the image to 100% (at this point the "virtual image" will extend well beyond the display window) and drag the image to accurately frame the detail on which the zoom will end. See figure 3.
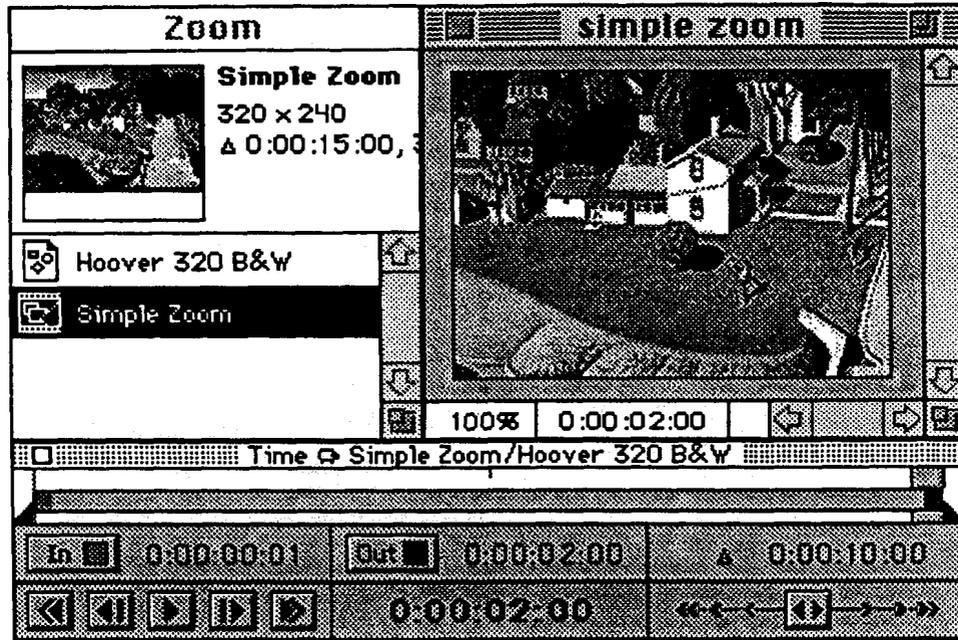

Figure 3. Setting up "zoom in" detail view

Note: To program the zoom out back up to the wide view after zooming in and repeat steps 5 and 6 in reverse order.

8. Use the preview feature to test the zoom and make any adjustments necessary.

9. Select "Make Movie" and the highest quality settings to render the final zoom movie.

Pan and tilts

Another very useful cinematic imaging technique is that of the pan and/or tilt which simulates a camera movement across a surface or object. When combined with a "zoom in" this effect can be used to follow compositional elements and guide viewing. In this case, the effects software is programmed to zoom in on one detail and then smoothly move to reveal one or more other details. See figure 4.
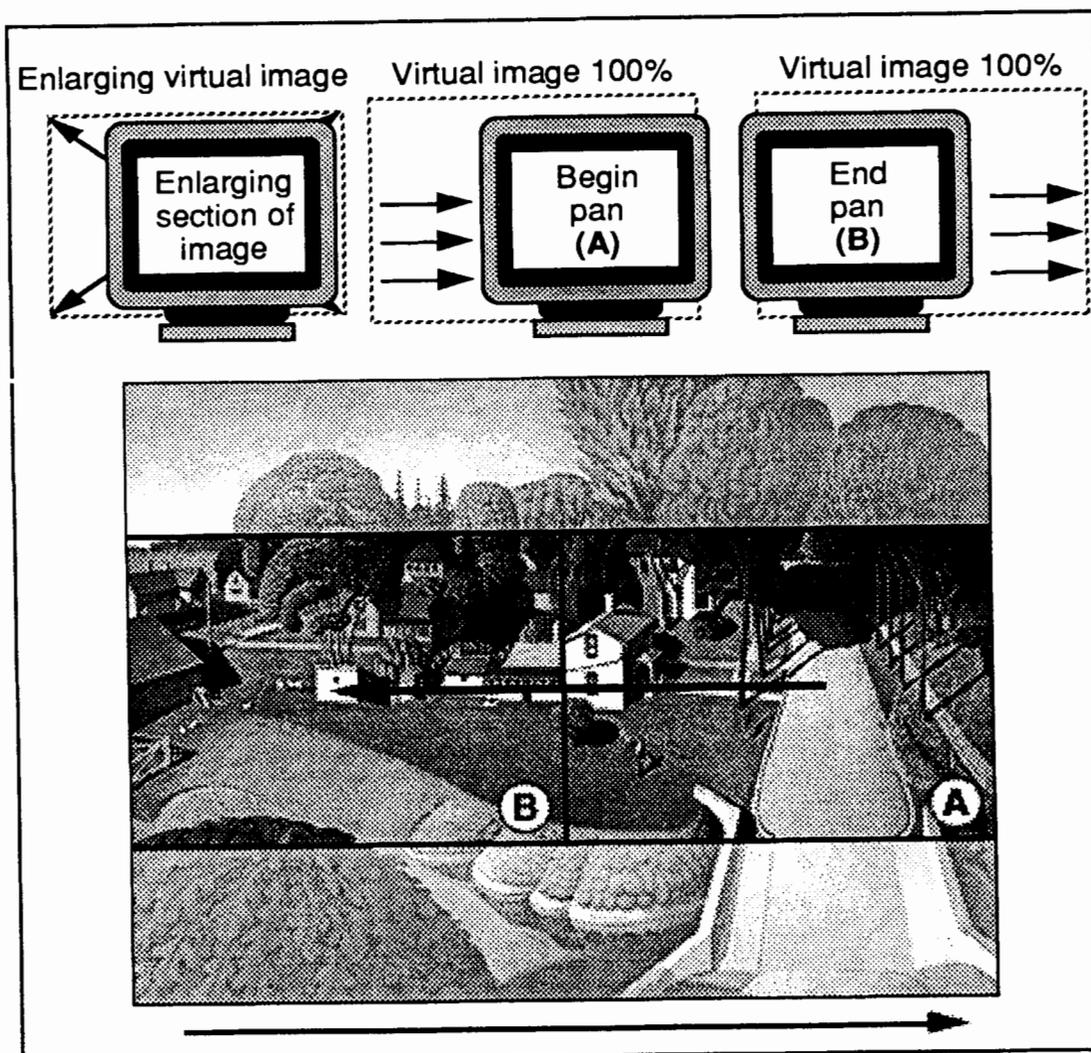
Figure 4. Zoom in and pan (left)

The following steps summarize the process for producing a pan or tilt:

1. To zoom in and pan and/or tilt, first setup the zoom in by following steps 1-8 above or, to start immediately with a close-up follow steps 1-5 above.

2. Determine the total duration of the pan and/or tilt and the intermediate points where turns or pauses will take place.

3. Set the scaling of the image to 100% and drag the image within the display window to accurately frame the detail on which the pan and/or tilt will begin and set a keyframe.

4. Specify the duration of the movement by moving the timeline control bar to the ending point and setting another keyframe.

5. Drag the image within the display window to accurately frame the detail to which the pan and/or tilt should move. If the movement includes shifts or turns, the "smooth" motion control can be used to soften the transitions between movements.

6. Repeat steps 4 and 5 until the entire path of the movement has been defined.

7. Use the preview feature to test the movement(s) and make any adjustments necessary.

8. Select "Make Movie" and the highest quality settings to render the final movie.

Additional Effects

In addition to simulating simple camera moves, cinematic imaging can be used to produce a wide variety of effects to assist the viewer in examining particular aspects of a work of art. These techniques include such effects as selective enlargement and shifts in perspective. Complex effects can be constructed by combining the above techniques with other digital video effects such as transitions and mattes. Simultaneous effects, such as zooming out while panning, can often provide a simple solutions to a complex visual problems. In most cases, the greatest constraints are those imposed by the producer rather than the technology.

Conclusion

While digital imaging is still in its infancy in the fine arts, the movement towards digital image archiving and computer-based multimedia systems makes the future of cinematic imaging highly compatible with the continuing demands for cinematic documentation. As more and more works become available in the digital domain, advanced image processing techniques are likely to become standard procedures in media production and museum documentation. With this shift, museum professionals must continue to research and reassess the benefits and limitations of emerging tools and techniques.

Reference

Nikon, (1994) Scanning Essentials: The Nikon guide to desktop film scanning, Nikon Inc., Melville, NY