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" Computer Animation Design and Execution :
Integrating Poetry and Technology "

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Introduction

Successful integration of computer technology into the design process, particularly as applied to computer animation, presents several challenges. As with any medium, the artist invests substantial time in mastering the fundamentals, as well as in developing a personal vocabulary of techniques and styles. One begins with simple experiments, testing the capacities of the medium. After some time, a unique interaction with the medium evolves, permitting the artist to fully exploit the medium to maximum effect. With computers, however, there are some unique environmental factors which complicate the process.

First, because computers are highly complex machines, the artist or designer must develop a technical mindset which must coexist with the creative and aesthetic. In the process of image creation on a computer, the artist is denied the tactile interaction with the work experienced in other media. Instead, design problems become almost engineering problems - can the machine execute the vision? What compromises can be made? To what extent and at what point does the medium overtake the message?

Second, the technology is continually changing and advancing, and in somewhat opposite directions. Recent developments in processor, storage, and display technology have made features which were formerly available only on laboratory mainframes accessible on microcomputer based systems. Companion to these advances is a corresponding increase in the level of sophisticated knowledge required of the designer to fully use such systems. This point is worthy of closer examination.

Machines, for all their truly marvelous attributes, lack omniscience, as do their designers. Consequently, the execution capabilities of any

computer graphics system are a synthesis of the design engineer's technical conceits and the sales department's assessment of what is viable in the marketplace. The limits of the medium are not related to its physical properties, as is the case with wood or paint. Rather, they are the limits of convention and expediency in the design of a particular system. As will be illustrated later in this paper, different systems possess different conventions for even the simplest tasks - outlining an object.

All this leads the computer artist to a fork in the road: either one specializes in a particular system and thoroughly masters its application through the technology, or one approaches each system as a unique variation on a common theme. All systems have the primary attributes in common. Digitizing tablets and frame buffers have been common since the late 1960's, pull-down menus and icon based software interfaces since the mid-1970's.

Implicit in the dynamics of change in computer technology is a recognition that any system is outmoded almost as soon as one acquires some mastery of it. This can occasionally lead to a sort of paralysis for computer artists ; present work gets overshadowed in anticipation of the next generation. The overlay of pseudo-engineering specification trivia on top of the complexity and challenge of nurturing a fresh and creative design consciousness results in "Next Generation Narcosis".

Taken together, these factors point to a more basic question. Why should an artist use the computer as an image creation medium at all? Film, video, and photographic techniques cover a tremendous spectrum of image creation, from ultra realistic to utterly abstract. Dale Peterson, in his book "Genesis II", proposes that :

"the camera can only define, or reproduce, something that was really there, whereas the computer (like the paintbrush) can describe something that never really existed." ¹

After all, computer graphics is, in essence, very intense mathematics; hundreds of thousands of calculations per second within and between open and closed ended systems and subsystems. At the same time, computer art is to mathematics as painting is to chemistry or sculpture

is to physics - the infrastructure influences, but not necessarily controls, the result. The challenge to the artist is to apply it to shape the result.

There is great merit in withdrawing from the specifics of the technology to instead focus on the process. Ultimately, the computer is a tool which, to be used creatively and effectively, must function as an extension of the mind. By liberating the brain from repetitive, mind numbing tasks, the computer has the capacity to serve as a catalyst of profound power. This freedom invites new questions, new inspiration. In this way, computer image creation replaces the artist's tactile relationship to the medium with one more visceral.

For the computer artist, the balancing of the left and right hemispheres of the brain is uniquely difficult. There remains a primary dichotomy between the vision of an image or design and its execution. In computer animation, this problem is exacerbated by the basic nature of animation. There is an intuitive unity in the artistic vision of an animation and subliminal thought. The animator "thinks" a complex, closely orchestrated series of images as a whole, single experience. Assuming that the vision can be retained, the artist then proceeds to develop an abstract visual articulation of this "thought". The process continues: the whole is dissected into primary sections, the rhythm and pace are refined. Ultimately, the original vision emigrates from its intuitive source to a tangible state. Then begins the process of execution - image engineering.

The purpose of this thesis work is to explore the utilization of a highly intuitive man-machine interface system (the Macintosh) as bridge to unify the processes of design and execution in computer animation. As such, the body of the work focuses on process; the use of Macintosh technology to prototype imagery, choreography, and execution in preparation for its final realization on the Genographics.

Through this exploration, several key points emerge :

- The importance developing sufficient familiarity with the capabilities and limitations of computer graphic system design architectures ; specifically raster vs. vector based systems.

- The importance of matching the image to the medium. While computer graphics systems are thought of collectively, there are elemental differences between vector and raster based systems which have a

profound impact on the quality and effectiveness of the animations each type of system is capable of rendering.

- The pivotal role of access to the medium. Access to large systems, such as the Genigraphics, is necessarily constrained by environmental requirements, cost, and by the numbers of people desiring access. Such a system is not an appropriate tool for "indulgent" improvisation and experimentation. Lack of access is a fundamental dilemma for the computer artist, who, like any artist, requires that time to explore and develop ideas in his medium. Consequently, a more accessible surrogate computer graphics design system, such as the Macintosh, fills a needed gap.

Documentation of particular techniques is included in this thesis and is intended to be useful specifically for Macintosh and Genigraphics computer graphics community.

The software was chosen and used according to its availability at R.I.T. More powerful, more current, and more expensive programs exist. No animation program was available and therefore *VideoWorks* was purchased at a cost outside the budget of most graduate students. Undoubtedly Macintosh graphics and animation programs will become regularly available to R.I.T. students within the next few years.

The Macintosh as a Developmental Tool

Leading broadcast designer/ animator Harry Marks uses the Macintosh to storyboard most of his work for network television :

"I use a Mac for designing. If you're graphically oriented its the most wonderful tool invented. I love it" 2

He describes its popularity among designers in the Los Angeles area.³ His software tools are simple and focused : MacPaint , ClickArt's "Letters" and "Effects", and a digitising program called "MacVision".

The Macintosh is unquestionably a useful sketch and storyboard tool. It is excellent for design prototyping for four principal reasons :

First, it is artist-friendly. It was originally designed as the computer "*for the rest of us.*" Its user-friendly , icon-clicking design is standard in the computer industry . Inherent in the design is the acknowledgement that not everyone thinks like an engineer. Strange sounding commands are replaced with english; menus and icons replace the highly rigid rules of grammar, unsympathetic to the imperfect typist, The artist is less constrained by engineering specifications and can get on with his work.

Secondly , it incorporates a standard *User Interface*. The use of the mouse, pull down menus, scroll bars , icons , cut, copy, and paste are

identical in many different softwares. Critical time is not spent learning new command structures with each new piece of software.

Thirdly, there is a wealth of compatible graphics programs available for the Macintosh. Its pivotal role in desk-top publishing and more recently in CAD/CAM applications has accelerated their development and support. The designer may choose from paint, draw, draft, paste-up, plot and perspective programs. There are 3-D programs that create, rotate, and give views on 3-D objects. There are bit-mapped animation programs for advanced storyboarding.

Finally, the resolution of the Macintosh is relatively high compared to other microcomputers on the market. Good resolution is an essential factor in the process of design/visualisation. Laser printouts of Macintosh designs are of almost typeset quality ; they may be utilised as is or with addition of color ; at R.I.T. they can be digitised into the Genographics D+ computer, space-colored, and animated.

MacPaint is the original paint program for the Macintosh . It has laid the foundation for the more powerful paint programs that have followed: FullPaint, GraphicWorks, and SuperPaint. The last program offers not only bit-mapped but also object-oriented features. According to Adrian Mello , a Macintosh expert :

" SuperPaint is the best available paint program available on the Macintosh today for all but a few applications. The program's object-oriented drawing and laser printing capabilities make it nearly irresistible." 4

In the original MacPaint there is the power to draw straight and free form lines of variable densities and patterns. Specialised tools are

there to create circles, rectangles, and polygons which may then be flipped, rotated 90 degrees, and inverted. Shapes may be put in perspective, distorted, and rotated free-form when it is used with ClickArt's *Effects*.

MacDraw is an object-oriented draw program where the created lines, arcs, polygons, ovals, and rectangles may be reshaped. There are rulers and other design-oriented features that help architects and engineers scale and measure drawings. Using MacDraw with MacPaint and Switcher (allows simultaneous activity of several applications) gives the best of both worlds to those lacking a copy of SuperPaint.

These programs are suitable for sketching and storyboarding. They enable the preparation of the animation more particularly through image overlay. Efert Neilson, in his article "Moving Pictures", describes how animation design is facilitated through the use of *SuperPaint*:

" (It) is made up of two subprograms, each of which occupies a layer on the screen. To create documents to be animated, draw an object in the Paint layer and copy it over to the Draw layer, thereby setting up two overlapping, transparent images. Then select the object in the Paint layer and move or distort it; the original object shows through underneath, allowing you to measure the change precisely from one frame to the next. To make sure that the draw layer won't show up when you save the document, enter the draw layer and place a white rectangle over the object. Save the document in Macpaint format and repeat the procedure as often as necessary. " 5

The animation programs presently available for the Macintosh ought to be used for advanced "storyboarding"; trying to use them as a preview tool for the Genigraphics and other larger systems will lead only to disappointment. They lack the power and speed; they cannot reflect the rhythm and pace that is achieved with those systems. They are appropriate for small animation "pieces", for testing cels, and for exploring animation/design fundamentals in general.

In many cases, then, animation work done on the Macintosh will only be the first part of the process; the work is somehow transferred to another medium. This is most often accomplished by print-outs. Video output would be welcome for animated sketches but there is presently no software under \$500 that will enable the transfer to video tape. This

limitation ought to vanish with the 1987 Macintosh SE and Macintosh II architecture and software.

Two animation programs for the Macintosh are *VideoWorks* , which claims to be the first full-featured animation package for the Macintosh , and *MacMovies* , which claims to be the easiest to use. Both resemble traditional (not vector) animation, where a series of discrete static images merge together to create the illusion of continuous motion:

VideoWorks by MacroMind is designed to simulate the cel techniques of Bray and Hurd:

"Bray and Hurd were the first animators to use celluloid sheets or "cels". Before.....animation was a laborious process involving the creation of thousands of individual frames from scratch. Everything had to be drawn again and again, including the parts of the image that didn't change from one frame to the next,such as the background scenery. With cel animation, each background scene needed to drawn only once on plain opaque stock. The moving parts, on the other hand, were drawn on the transparent cels and overlayed on top of each other,so that the different parts of the same character could be animated separately." 6

The "cels" utilised by *VideoWorks* are actually animated objects (sprites) . Up to 24 cels may interact on the screen at the same time. Each one is a Macpaint file and is either created by a built-in graphics program called *CheapPaint* or is incorporated by a tool called the *Art Grabber* . They are stored and displayed in miniature in a reference window at the bottom of the screen.

VideoWorks has incorporated the standard *Macintosh User Interface* with its pull down menus,scroll bars,*cut,copy* and *paste* . The program is well designed; the editing of animation speed, the insertion , deletion , the redrawing of sprites is done simply in real time. The movements of a particular sprite may be carefully refined through the use of the *Tweak* (the incremental motion generator) window. Repetition of any part of the animation is accomplished quickly with *copy* and *paste* in the log sheet window (the *score*) . Real time recording is offered in addition to frame by frame . A sound generator is also included. The program is equipped to store and simultaneously displays in miniature an astonishing

144 MacPaint files ; 24 small image files or 10 full-page sized files may be manipulated on the screen at once.

The graphics tool *Cheappaint* is good for quick and dirty jobs but not for detailed artwork . It is not suitable for object resizing - size change causes distortion . For this purpose, *Switcher* may be used to combine *MacDraw* and *VideoWorks*. (In a single disc drive situation having all those applications on a single disc precludes disc swapping) . The object created in MacDraw will grow or shrink in that program without distortion; at regular intervals in that process it may be copied over to *VideoWorks* and saved as a *cel* (also called a "castmember" or a "sprite"). The resize animation of an object will be then accomplished with this series of cels ; not by performing resizing on a single cel.

VideoWorks facilitates the cel design process. Traditionally, animators drew cels on transparent sheets of celluloid . The artist could place one sheet on top of another and modify an image in relation to the previous one . *VideoWorks* has a *Matte* feature to convert an opaque cel into a transparent outlined cel ; cels may be overlaid and modified and then converted back to their opaque mode . As described above , another Macintosh approach to this process is to use *SuperPaint*. In *VideoWorks* cels may be modified as the animation runs ; the program constantly "updates" its cels . Any changes made in a particular cel are immediately reflected . This may be accomplished as follows : open the *VideoWorks'* *CheapPaint* window and the *Cast* window ; cels (also called cast members or sprites) are previously created and therefore present in both windows . Click on the member of the *Cast* window to be edited ; it will appear in the top "easel" in the *CheapPaint* window. Modify; changes appear immediately in the running animation. Simple sets of objects could be compared and modified using the overlay feature of the Genographics ; there is however no transparency option analagous to *Matte* . With its time constraints this system is usually more appropriate for execution .

Again, the artist who expects a preview situation will be disappointed. *VideoWorks* animations slow down and shorten with larger amounts of data. It is best for exploration, for testing various components in anticipation of an animation to come.(see Diagrams A,B,C,F,G,H,I,J).

Bech-Tech's *MacMovies* , unlike *VideoWorks* , has no sprite animation ; it is, quite literally ,a "moving pictures" program . It works with

entire frames : characters, objects,background and all; each frame is a separate *MacPaint* file. The playback is smooth due to data compression; only the "differences" between one frame and next are recorded. This can promote the desired ease of use . However, creating and editing within a frame by frame system compared to an object-oriented sprite system may also be cumbersome . If, for example, an element is in the wrong place , it becomes necessary to alter dozens of MacPaint files. MacMovies is well suited for animations of full-screen images.

It is possible to create a 3-D animation using printouts from 3-D programs:there are several 3-D programs available on the market including Mac3D, MacSpace,Easy3d, Phoenix3D and MacModel. Easy3D and MacSpace also are offered in separate, "professional" versions called Pro3D and SpaceEdit. Each offers a unique approach to the problem of representing a 3 dimensional object on a two dimensional surface.

Mac 3D has incorporated the standard *Macintosh User Interface*. The use of the mouse, pull down menus,scroll bars and select are identical to MacPaint. It has cut,copy and paste . Objects are originally created from primitives and may be manipulated through the use of handles ; for more precision the user may use the window called the *Characteristics Box* where coordinates are displayed at all times. The *Align Objects* box will align the centers, sides, tops or bottoms of several objects. The martini glass object illustrated in Diagrams E and F was created with two cones and one cylinder; these primitives are aligned in *T/B Centers* , *F/B Centers* , and in *L/R Centers*. Icons and coordinates are alternate methods to control rotations, moves and camera views. The circular graphic for x,y,z rotation is particularly intuitive and keeps good track of the starting point; preventing the " lost in space " difficulties that occur in other 3D programs.

In his article "3-D, Take 2", Efert Neilson states that :

*"Enabling Technologies' Easy 3D ... offers a superb example of a simple, well-designed user interface. To rotate an object in space, for example, you grab it with a hand icon and swing it around a center point ; the angle of rotation is shown both graphically and numerically. Similarly, to adjust the viewing angle you slide an eye icon up or down a scroll bar."*⁷

However user-friendly it seems, Easy 3-D (1986) was not the best choice for the objective stated earlier : creating a set of 3-D images in various stages of rotation to be used as animation cels. The MacWorld article further states that the Easy 3D objects "are relatively difficult to edit".
8 The software succeeded at the task of constructing an original object through manipulating and then uniting primitives . However, problems surfaced in manipulating the object or object view. The object would distort severely after several rotations in *Camera* ; the program would also crash in *Camera* after 10 or more rotations . The shading on the object would change dramatically and inconsistently . The derived set of images of an object in various stages of rotation were used as cels in an animation program (see Diagram D) but lacked enough visual continuity to succeed. On a final critical note , the program's scrapbook *copy/paste* function was faulty and resulted in a program crash ; *Enabling Technologies* confirmed the existence of this serious bug on the telephone.

The impression of a "simple, well designed user interface" quickly disperses once the difficulties in object manipulation arrive . The control that a coordinate system provides is lacking.

This may represent a case in point for many computer artists who cite their horror of numbers ; who find that the mathematical process of image execution creates an absolute dichotomy between the vision of an image or design and its execution. Can the artist expect to approach three dimensional graphics "intuitively " ? Software engineers will undoubtedly continue to devise new and better man-machine interface systems but the without numbers the artist can never truly master three dimensional graphics.

The computer graphics artist is " a cross between a poet and an engineer" ; this is nothing new : in the past artists received training not

only in materials and but also in an intellectual sense of "informed ideas". Harold Rosenberg discusses the education of artists; the fundamentalist attitude versus the avant-garde attitude in his book "The De-definition of Art". He argues that former doesn't recognise the important fact that artists must develop their ideas through unfocused playing with their medium ; he argues that the latter are equally mistaken :

"In overstressing (the constraining nature of) technique...the avant-gardists ... mistake the nature of art in our time. Despite modern technological self-consciousness, art in the twentieth century is technical to a lesser degree than it was in the age of the potter's wheel or the maulstick..."

The contemporary sculptor who inscribes instructions and a loose sketch on a sheet of blueprint paper and sends it to the foundry for execution is a man of words and mathematical symbols, a cross between a poet and an engineer , and you don't get people like that without intellectual training - I mean , as opposed to training with paint-brushes, hammers, and other messy materials " 9

Dan Flavin, a sculptor whose medium is florescent light tubes, argues a biting Artforum article "On an American Artist's Education" that "intuitive good sense" is no longer to be relied on :

" The romance of days of ... precious, pious, ... studio-bound labor by haphazardly informed 'loners,' ... relying desperately on intuitive good sense, is passing from art. The contemporary artist is becoming a public man, trusting his own intelligence, confirming his own informed ideas." 10

The questions involved in reconciling the "intuitive" with the "technological" are very apt for this beginning discipline. Computer Graphics is an art form created by a crossing-over of several previously unrelated disciplines ; a balancing of the left and right hemispheres of the brain . The crossing-over is occurring not only in the science/art respect but in the fine and applied arts : painting, commercial design, animation, photography . Each brings its own approach to the questions : how does technique enhance or intrude upon the original conception ? What are the fundamental differences and shared qualities between creating a beautiful equation , a beautiful vision , a beautiful design ?

Execution and Technique on the Genigraphics

Several techniques of cel style animation have been experimented with over the past few years in the R.I.T. computer graphics laboratory. Documentation of some of these methods has begun and will greatly benefit future R.I.T students.

A key point for every computer graphics student is the importance of matching the task to the medium. An animation composed of several hundred "cels" would not be impossible but would be a cumbersome and tedious endeavor on the Genigraphics. The user would be constantly strategising around the (no room in animation table) "out of memory" problem rather than utilising the capabilities that the machine has to offer. On the Genigraphics, the number of drawings or "cels" used will be, to some extent, constrained by the amount of (animation table) computer memory available.

It is possible to achieve an exciting animation using a minimal number of cels. A cyclical series, where the end cel returns to the beginning cel, achieves effective visual impact through repetition. It leaves lots of computer memory to spacecolor, build upon or otherwise enhance the rest of the picture.

"Whatever type of artwork he uses, the animator studies the motion which he is going to create, picking out certain key positions-i.e. extremes which characterise that motion. He also looks for the possible repetitiveness of an action within the animated movement. For example, with a character rowing, only one series of drawings is needed for the complete cycle of movement; these are then used over and over again"¹¹

It is worthwhile to first document a problematic method with unhappy results that has been chosen by one or more students a year for several years. It involves the animation of non-Euclidean shapes on the Genigraphics when they are created as point-to-point drawings (vertex to vertex) on the Genigraphics under Trace. Shapes (cels) that create, for example, an animation of a running man or a leaping frog often require a

larger number of vertices to be visually effective than the Euclidean design shapes that the Genigraphics was originally designed to handle. The problem arises when the student, for whatever reason, decides to animate his man or frog cels using the Genigraphics "*Transform*" option. He might have been inspired to use the option as an in-betweening tool after having successfully tried the straightforward star/square transformation exercise found in the Genigraphics manual.

Ideally, the student would create the transformation entry as follows: cel 1 would be selected either in "group" or in "object" (so that all the vertices of the cel would be captured in one fell swoop) and designated as the "start" point of the transformation. Cel 2 would then be selected in "group" or "object" and designated as the "end" point; this process would be repeated for the entire series of cels. (This assumes that the student has correctly designed his cels so that each component vertex of each particular cel has a correctly placed corresponding vertex in every other cel of the series). The Genigraphics would then provide a flawlessly in-betweened leaping frog.

A careful appraisal of this procedure reveals its flaws. The student is attempting to choreograph a "cast of thousands"; i.e., vertices. *Transform* works well when the number of vertices involved is manageable. It works well in situations where the vertices composing the objects are spread widely apart, are easy to locate (i.e., located at lines' ends, at corners, etc) and the task involves moving them in a linear or Euclidean fashion. *Transform* can be an extremely tedious process with large numbers of vertices that overlap and/or are hard to track. In a non-Euclidean situation it is usually necessary to go in, track individual vertices and to refine their movement. The process becomes impractical quickly.

The student needs to consider the type of animation that *Transform* is capable of rendering. There is a certain redundancy in carefully designing the vertex movement so that the frog will move in imitation of nature and in using *Transform*. *Transform* is designed to save the user the task of Euclidean in-betweening. The non-Euclidean in-

betweening that is desired in this case must be completely worked out on paper beforehand ; no work is saved.

Finally , even the quality of the motion that *Transform* creates is to be considered. *Transform* is used for abstract, mathematically precise motion. Traditional animation works due to a physiological phenomenon described as ***persistence of vision*** :

"When a single image is flashed at the eye, the brain retains that image longer than it is actually registered on the retina. So when a series of images is flashed in rapid order, as a movie projector does, and when the images themselves are only slightly changed, one to the next, the effect is that of continuous motion. This very remarkable illusion is the perceptual foundation of film and television. " 12

Experiments have been made on the Genigraphics using Eadweard Muybridge 's sequential photographs of animals in motion . The photographs were *Traced* ; an animation was created by *Transforming* the resulting shapes . Although at first this might seem a foolproof and shortcut method for producing a realistic result, this was not been the case . An annoying peripheral fluid motion resulting from the *Transform* process was apparent along with the intended realistic movement of the leaping animal. The brain is more tolerant of animation that is abstract than when it is comparing it realistically. It is possible that in this case, *Transform* closed those gaps that the *persistence of vision* had let the brain fill in ; that the animation became too explicit.

The alternative method is to utilise the "Inhibit " option Following the directions in the Genigraphics manual, the user creates a repeating animation cycle in which each cel will appear (be " active ") in those frames specified only. The number of frames in a particular cycle is

calculated according to the number of cels in the series and the number of frames required to hold each cel. (One frame per cel is usually too fast). A 50 frame cycle could consist of 10 5-frame cel holds ; 250 frames of animation would be created by repeating the cycle 5 times.

Before creating the *Inhibit* entry the cels must be put in correct overlay order and in correct alignment. Although the ("animation table") computer memory may run out if the number and/or size of the cels is large , the user can get around this by placing the remaining cels on Genigraphics "pages" 2 and 3.

It is usually best to create the *Inhibit* entries first, especially when the user wishes to perform a simultaneous *Move* on the cels (as in moving a jumping frog across the picture); unpredictable results occur when the *Move* entries are done first. Performing *Inhibit* on the group of cels first may make it difficult to capture the entire group at once . *Inhibit* and *Move* can be performed on the whole group as follows: the *Inhibit* entry is structured so that the group reappears on the screen after the last specified frame. The *Inhibit* entry is created for *x* number of frames. "N" is entered in response to "Off for the **last (end)** frame and after?" This means that the entire group will be reassembled for the **last (end)** frame and all frames after . The user can then *Go To* this frame , capture the whole group , and create the *Move* entry over the same frames. The eventual videorecording of this particular segment ought to stop 1 frame prior to that last frame.("Y" is specified in response to the prompt "Off for the first frame and before?" ; the start frame specified for Cel 1 is 0 , not 1 ; Cel 1 is specified *off* for frame 0 and before.) The alternative method for this same illusion is more expedient in certain cases: moving the background in a reverse direction while the animated figure remains in the same location .

Cel animation may be accomplished with the Genigraphics paint software using " panels" :

" On vector based systems ... (which contain both vector and paint screens) ... the vector image is created first. A vector type object is created to display a portion of the raster image from a

seperate screen...the Genigraphics Corporation refers to this object as a panel" 13

The object called a panel therefore exists on the vector screen as a reference to a part of the raster screen (called the " canvas"). It simply displays whatever is on the canvas; when a different picture file is called up on the raster screen , the panel on the vector screen will appear to change. On a canvas containing a set of cel paintings a panel may be made for each cel. An animation with panels may be created and saved but will run with any canvas.

A certain flexibility is therefore built into an animation created with panels. The canvases can be interchanged .This is useful in many ways. In cases where there are many cel/panels, the tracking becomes complex. Working with numbered cel/panels facilitates the tracking; the original unnumbered cel/panels are substituted when it comes time to record. It is also possible substitute a canvas of running men shapes for a canvas of walking men shapes (substitute shapes exactly aligned over originals) and in this manner obtain more than one animation from a single animation table. The key to success is the correct placement of the shapes on the canvas : alignment can be checked by putting the original canvas on **A**; the substitute canvas on **B** ; then switching back and forth between screens.

An inherent limitation of vector-based systems in manipulating digitised images is their ability to color map substitutions/corrections. The method of color correcting painted imagery on the Genigraphics may seem cumbersome and imprecise to artists familiar with raster systems. Digitised imagery usually requires correcting . Solid white and black backgrounds rarely come through the digitising process as a single color ; nuances of shade and light get translated to create visual "noise". Color corrections must be achieved by filling, masking or painting over .The process varies in difficulty according to the background and shapes involved.

If precise control is required to mask around images it is advisable to create the panel with the uncorrected paint canvas. *Regen* the vector page without moving the panel. *Trace* or otherwise create the vector mask in a solid color. *Cut* and *paste* the mask the paint canvases without

moving it. The mask will then be registered correctly on the panel; the solid color can be quickly filled with an opaque color or with the invisible (0 chroma 0 hue - 0 value) black; the panel is then recreated .

This process is time consuming when there are many cels to be cut-out, painted or otherwise manipulated. With limited access time on the Genigraphics , it is advisable to prepare the image for digitising . The cels may be cut out with an exacto knife and mounted on a desired background or on black chartpak paper .

The Geni's (0-0-0) black is used for masking . This is a variation on a feature found in raster systems. Any portion of an image filled with (0-0-0) black becomes "clear" and when the image is copied and pasted over a background, any underlying imagery shows through. The rectangular borders of the Geni panels "disappear" when this black is used as a mask , allowing other panels and/or objects underneath to show through. 0-0-0 black objects on Pages will not copy or paste to canvases . It is sometimes necessary to check the number values on a black ; it is easy to confuse this color with other blacks . The *fill* function does not seem to recognise the difference either and will not replace an opaque black with the 0-0-0 , "invisible" black . To achieve this it is necessary to fill the opaque black with some other color , then to fill that color with the "invisible" black.

Aliasing problems can result when backgrounds show through Geni panels. Artists trained on the Artronics will be familiar with custom anti-aliasing techniques. It is wise to check newly created panels in *full screen* before proceeding ; such shapes can appear with beautiful clarity on the menu screen ; and display an annoying dark,irregular outline in *full screen* . It is a most unhappy phenomenon to discover at a late moment.

Macpaint , Fullpaint, and similar Macintosh programs have the ability to *invert* Macintosh images ; the background becomes black and the figure, white. Mac-Art , MacMemories, or other Macintosh "canned" images can be laser printed and digitised into the Geni in their inverted form. The black backgrounds will *fill* quickly ; the white drawings will accept a tint nicely. This is a nice effect used with the old engravings available through MacMemories.

It is difficult to successfully tint with darker greys (0 chroma) ; sometimes the result is an undesired light, pastel tint of a higher chroma.

One solution is to select the darker color along with a very transparent, large square brush ; choose horizontal movement in steps of 32.

The addition of panels to the Geni program makes the *Regeneration* time of the screen an important factor in the planning and execution of, animations. Large panels are slow to *regen*. Each panel adds a certain amount of *regen* time depending on its size and also on its position relative to the frame of the Page. *Regen* time for a single panel can lengthen considerably when it is either *Moved* outside the frame or *Grown* . The artist should compare the total *Regen* time for all his frames with the amount of Geni access time that he has left; it is necessary for every frame to *Regen* during video-recording . *Regen* time of 1 minute per frame means 5 hours of Genigraphics time to record a miniscule 10 seconds of animation.

Conclusion

It is tempting, and even facile, to be drawn into the metaphysical aspects of using the computer as a tool for creativity. One can range from the highly specific to grossly general. In the preceding discussion of specific techniques, the medium of the computer has permitted a re-definition of normative perceptions held close and dear. We can restructure time, alter space, view a single object from many angles simultaneously without moving. It is abundantly clear, through their comments and by the content of their work, that to dismiss the impact of these "philosophical" consequences of computer graphics technology on the artists and designers who use it, would be to sidestep a critical and fundamental impact. Too often, the computer has been paradoxically denigrated to an all-seeing, all-knowing super phenomenon : a monkey can do it with a computer. But why not? If a monkey can, why can't we? Indeed, we, who use and live by this medium and these modes of expression, have been inclined to short-sell our work, our accomplishment, our inspiration, our vision, and our skill in addressing and shaping this new medium.

Of course, the computer artist has been victim to the broader sociology of the computer. For the traditionally-schooled artist, it seems too easy to experiment with different lay-outs and color schemes with response times measured in sub-seconds instead of days or weeks. We are inclined to feel guilty, to justify our work in traditional terms, instead of focusing on the fundamentals.

It is almost axiomatic that any advance in technology is accompanied by a companion advance in expectations. The railroad, the cotton gin, the harvester, the automobile, the telephone, the radio, the vaccine all have led society at large to increment its demands to the upper limit of the technology available; work is more efficient, we can communicate more easily, fewer people get sick. In this way, the advance of technology is a constant assault on fundamental values. We spend less

time on the basic tasks of survival; but how has this time been replaced? Certainly, it is not with leisure. As the currency of expectations has risen in value, so too have the consequences. We certainly work as hard, and struggle as hard. But these are delivery systems; the specific activity of the work has changed and been molded, to some important degree, by the technological environment, but its content and value remain.

It is within this framework that we can lend meaning to the creative genesis of computer graphics design and animation. For all of its facility in more efficiently executing traditional design, or even in leading the artist toward a new vision, the computer is far too primitive a delivery system to alter the basics of visual creativity. The artist begins with an impulse and a vision and seeks a mode of expression. The process begins and ends with this stirring within, and for all its fascination and magic and utility, the computer, or any technology, is no substitute. As the technology can humble us in its capabilities of technique, we must constantly renew our capacity to humble it, with our vision.

Bibliography

1. Bloomer, Carolyn M. *Principals of Visual Perception*. New York : Van Nostrand Reinhold, 1976
2. Deken , Joseph. *Computer Images : State of the Art* New York : Stewart, Tabori & Chang, 1983.
3. Halas,John. *Computer Animation*. New York:Hastings House, 1976.
- 4._____, and Walter Herdez. *Film & T.V. graphics*. New York : Hastings House, 1967.
5. _____, and Roger Manville. *Art in Movement: New Directions in Animation*. New York: Hastings House,1970.
6. Herdeg,Walter. *Film & TV Graphics 2*. New York : Hastings House, 1976.
7. Laybourne,Kit. *The Animation Book* . New York : Crown Publishers,1979.
8. Leavitt,Ruth, ed. *Artist and Computer* . New York : Harmony Books, 1976.
9. Muybridge,Eadweard. *Animals in Motion* and *The Human Figure in Motion*. New York : Dover,1955 and 1956 , respectively .
10. Perisic, Zoran. *The Animation Stand*. London : Focal Press ,1976.
11. Peterson, Dale. *Genesis II: Creation and Recreation with Computers* . Reston,VA: Reston Publishing Co.,1983.
12. Rosenberg,Harold. *The De-definition of Art*. New York : Collier Books ,1973.
13. White, Jan V. *Graphic idea notebook*. New York : Watson-Guptill Publications,1980.
14. Wulforst, Harry . *Breakthrough to the Computer Age* . New York: Charles Scribner's Sons , 1982.

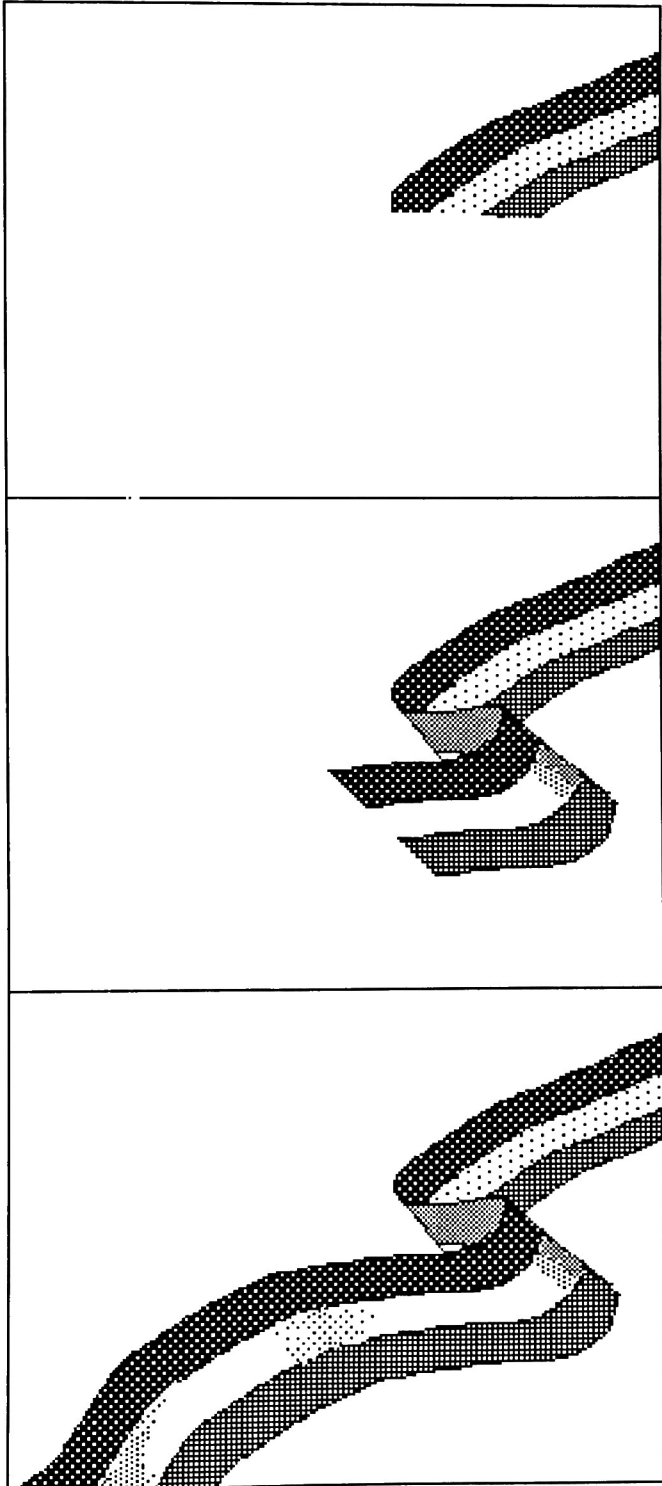
Footnotes

1. Peterson,Dale . *Genesis II: Creation and Recreation with Computers* . (Reston,VA: Reston Publishing Co.),1983 , pp. 70-71.
2. Armbrust, Roger . "In the Mind of . . . Harry Marks, cgi's Hot Designer " . *Computer Pictures* , Sept/Oct 1985 , p.20.
3. _____ , p.20.
4. Mello , Adrian . "MacPaint's Successors " . "*MacWorld Magazine* " , January 1987 , p. 101.
5. Neilson, Efert . "Moving Pictures". *Macworld Magazine* March 1987 , p.107.
6. VideoWorks Manual, Hayden Software Company , 1986 , p.8.
7. Neilson, Efert . "3-d,Take 2 ". *Macworld Magazine* , May 1987 , p.123.
8. _____ , p. 124 .
9. Rosenberg , Harold . *The De-definition of Art* . (New York : Collier Books,1973) pp. 45, 47.
10. _____ p.45.
- 11.Perisic, Zoran. *The Animation Stand*. (London : Focal Press ,1976) , p.12.
12. Laybourne,Kit. *The Animation Book*. (New York : Crown Publishers,1979), p.28.
13. Nelson, Loree . "How to Choose a Presentation Graphics System " . *Computer Pictures* , July/August 1987 , p.52.

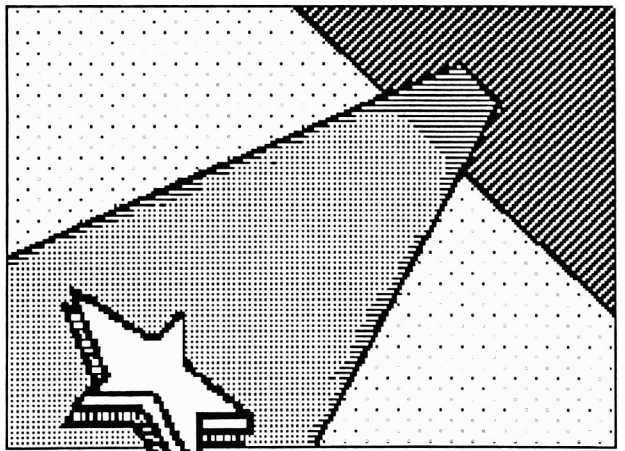
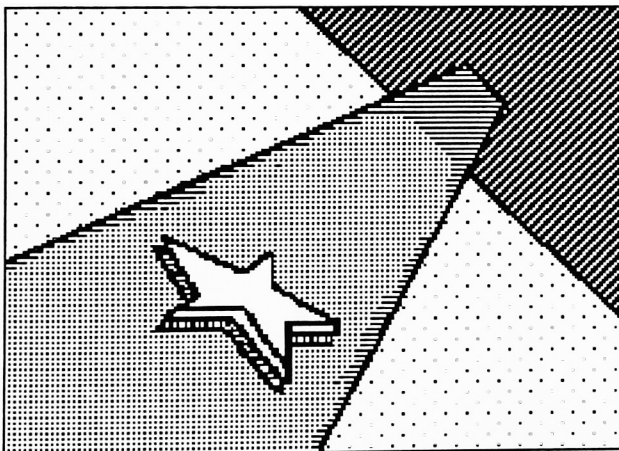
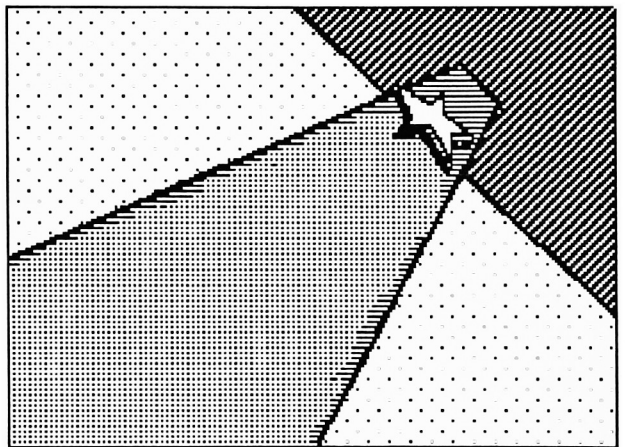
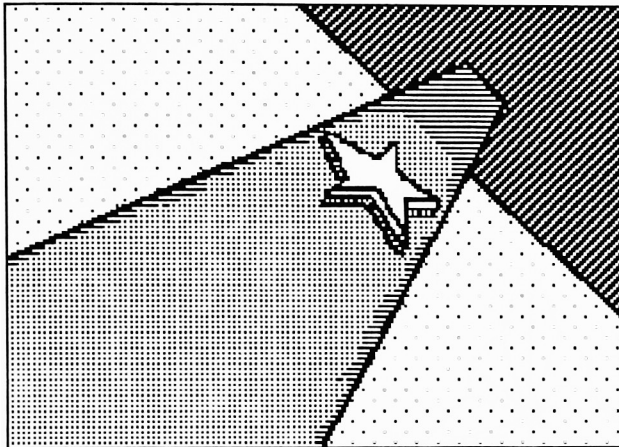
Diagrams

- A.** Ribbon Animation. *VideoWorks, MacPaint* Softwares
- B.** Star Animation . *VideoWorks, MacPaint* Softwares
- C.** Origami Animation . *VideoWorks* Software
- D.** Example of 3D Object Distortion :
Rotating Camera Views of a Sphere/rectangle .
Easy 3D Software
- E.** 1. Rotating a Martini Glass Shape .
2. Combining rotated shapes in one "World" .
Mac 3D Software
- F.** 1. Screen dump from Earthplot program
2. Earthplot screen dumps reduced through Fullpaint
to be animated in VideoWorks
Earthplot, Fullpaint Softwares
- G. , H. , I.** Thesis Sketches 1,2,3
MacPaint, MacDraw, Easy 3D Softwares
- J.** Atom animation
VideoWorks, Fullpaint Softwares

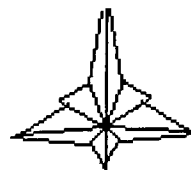
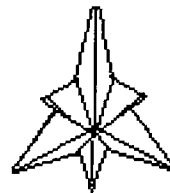
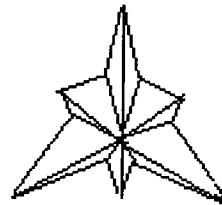
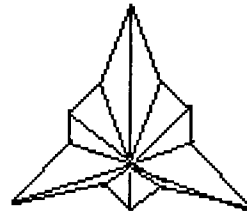
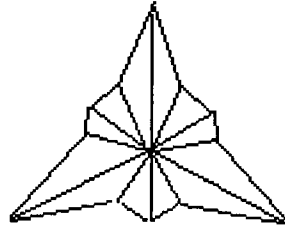
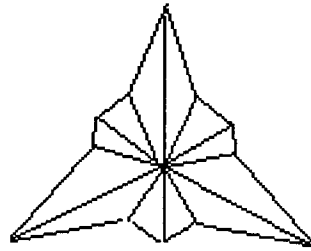
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Ribbon Animation
C.Kirby 1987



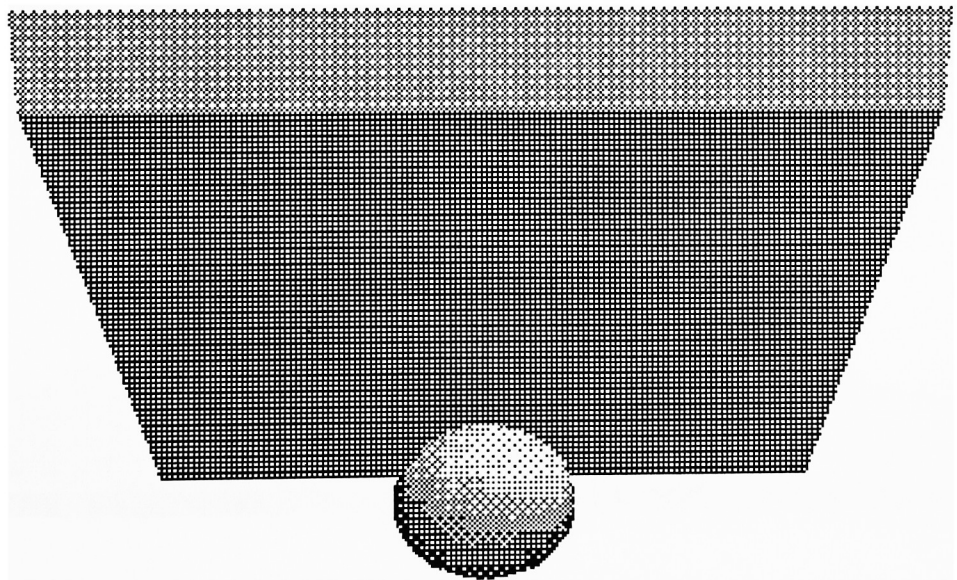
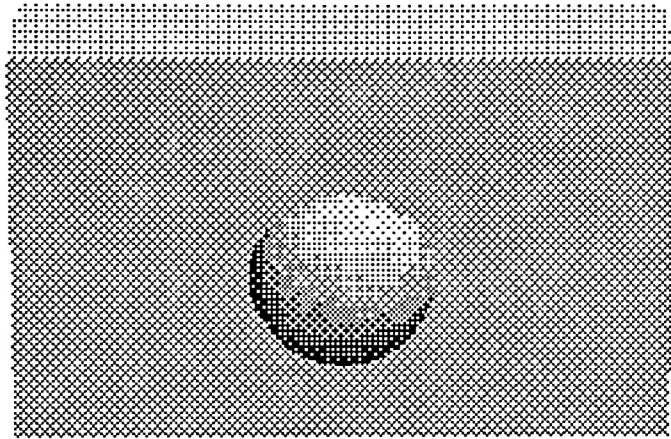
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Star Animation
C.Kirby 1987



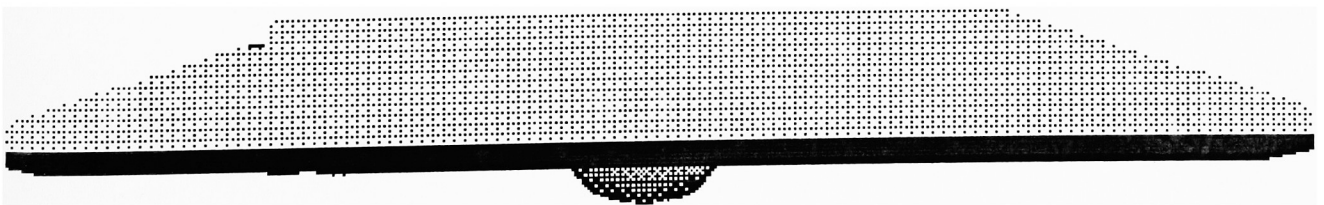
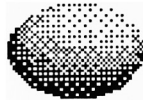
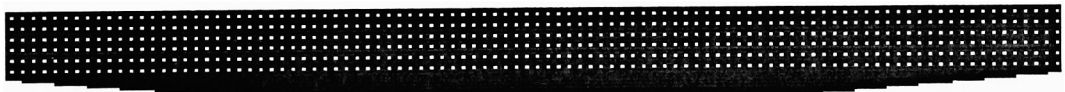
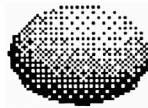
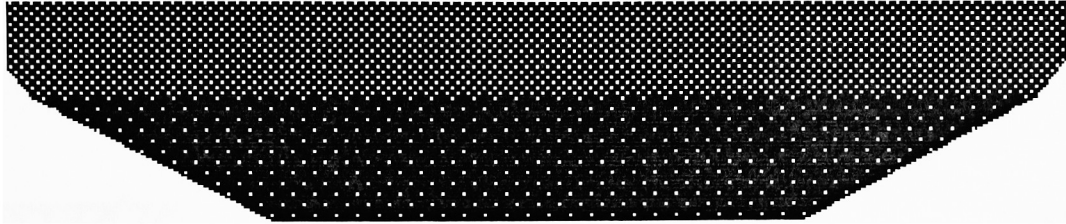
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D. Easy 3D Software
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Rotating Camera Views of a Sphere and Rectangle
Example of Object Distortion
C.Kirby 1987

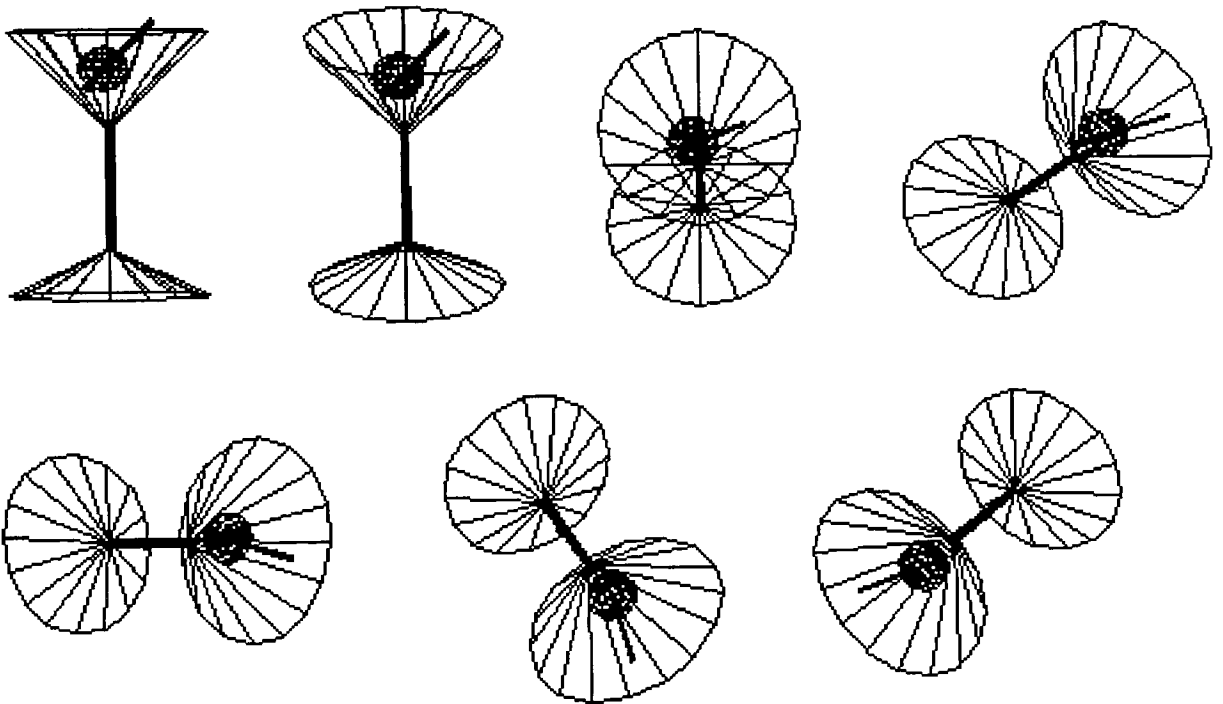


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Example of Object Distortion
C.Kirby 1987

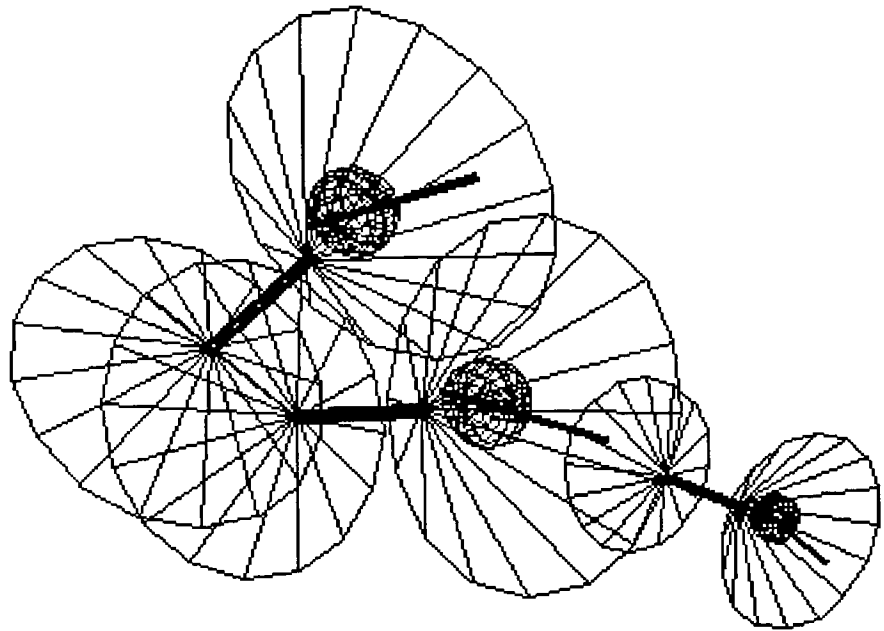


C.Kirby 1986

E. Mac 3D Software
Challenger Software
Rotating a Martini Glass Object Set
C.Kirby 1987



E. (cont.) Mac 3D Software
Challenger Software
Combining rotated *Martini Glass Object Sets* in one "World"
C.Kirby 1987



F. Earthplot Software

MacCursor

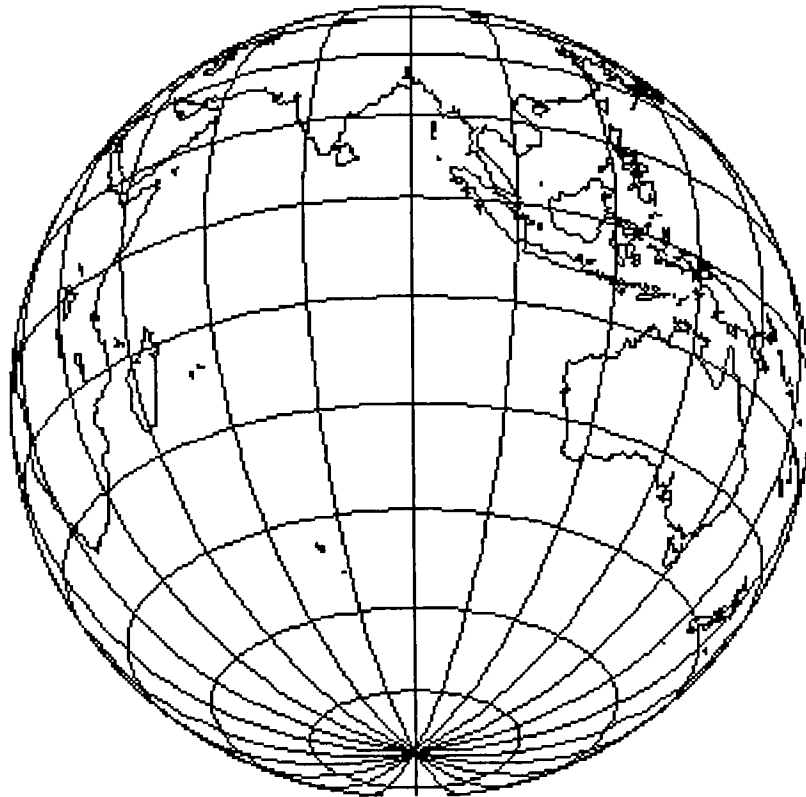
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Bottom: reduced in Fullpaint;

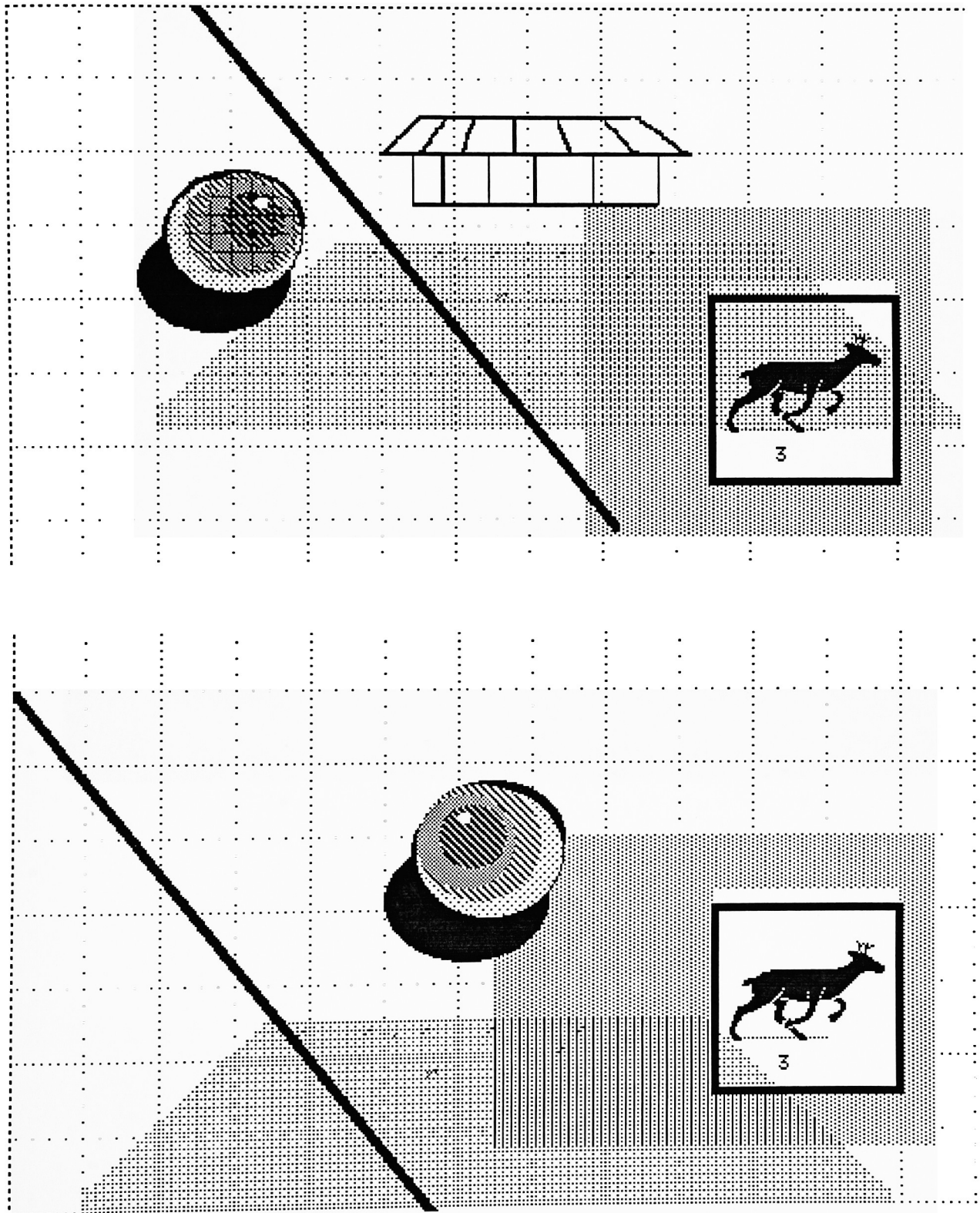
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MacCursor, Ann Arbor Softworks, MacroMind Inc.

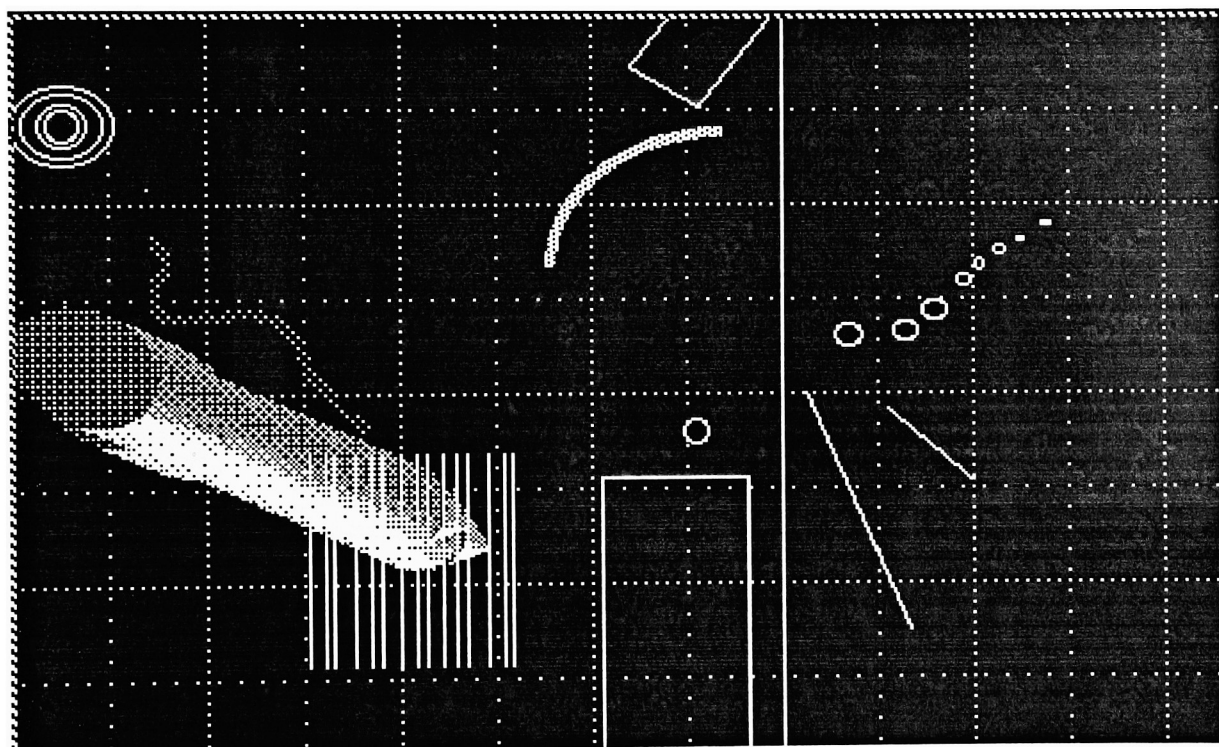
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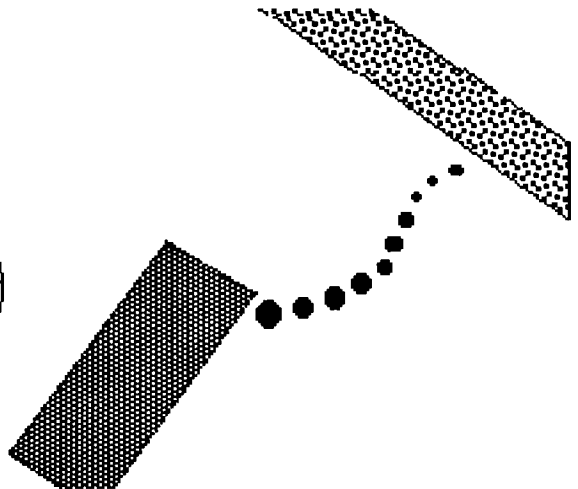
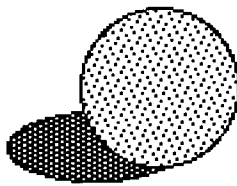
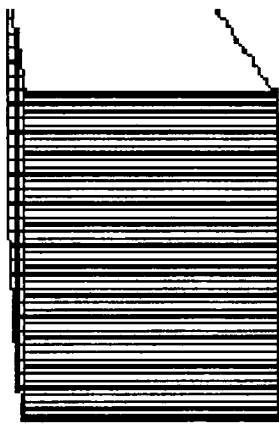
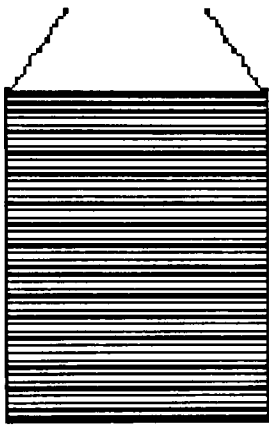
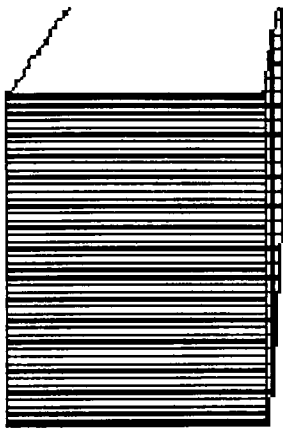
G. VideoWorks Software
MacroMind Inc.
Sketch for Thesis 1,2
C.Kirby 1987



H. Easy 3D Software, VideoWorks Software
Enabling Technologies, MacroMind Inc.
Sketch for Thesis 3
C.Kirby 1987



I. VideoWorks Software
MacroMind Inc.
Sketch for Thesis 4
C.Kirby 1987



J. VideoWorks Software
MacroMind Inc.
Atom Animation
C.Kirby 1987

