1994

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Schira, Cynthia. "The Influence of Computer Technologies on Contemporary Woven Fiber Art." *Contact, Crossover, Continuity: Proceedings of the Fourth Biennial Symposium of the Textile Society of America, September 22–24, 1994* (Los Angeles, CA: Textile Society of America, Inc., 1995).

THE INFLUENCE OF COMPUTER TECHNOLOGIES ON CONTEMPORARY WOVEN FIBER ART

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It is generally agreed upon, by both the participants in the field and those few who have chronicled it, that the fiber art movement as we know it today began with Jean Lurcat in France in the late 1950's. He was among the first, if not the first, to make designs or cartoons specifically for the medium of tapestry. Previously, paintings were translated into the medium of tapestry. As well as creating the design or cartoon, he personally oversaw the actual weaving process. This direct connection between the process and the concept or image, the manual and the mind, laid the groundwork for the fiber arts of today. In 1962 Lurcat founded the Lausanne Tapestry Biennale, the international exhibition whose contents have profoundly influenced the course of this field.

In fiber art, textiles are separated from function and, instead, focus on the maker's expressive need. In this pursuit, historic techniques and constructions are used in new configurations. These processes offer the artist new methods of effecting visual and physical form, scale and content. In the sixties, the results of these manipulations and interpretations were massive, excessive, and often three dimensional. In the late seventies and eighties, this unrestrained exuberance was modified. Concern was expended on the quality of the cloth as well as on the subtlety and specificity of the expressive content. More recently, the visual expressions of the portion of fiber artists who are weavers have been influenced by the possibilities inherent within computer technologies.

The link between the computer and the loom is specific. They are both based on binary principles. It is said that the Jacquard loom was inspiration for the invention of the first computer. As Emily DuBois points out, "Thousands of weave structures are derived from two simple positions of the warp - up and down. In the same way, the computer performs thousands of tasks based on two positions called 0 and 1." In weaving, these positions are notated on graph paper by a

filled-in or black square when the warp is up and a white one when it is down. The 0's and 1's become the machine language of the computer.

The textile industry almost immediately exploited the computer's uses in the designing and manufacturing processes. Soon, many weave programs for the personal computer were developed as well. They allowed the individual weaver to rapidly create and notate a multitude of weave structures, to change the path of individual or groups of warp or weft threads, to change the scale of parts or the whole, to change the color, the threading, the tie-up and treadling or chain sequence, to see different magnifications of the resulting drawdowns and repeats. These variations could be stored in a library or file, and parts of or the whole of each design could be called up for use, reinvention, or review at any time. All parts could be cut, copied, pasted, and restored as with any software. By the mid-eighties, there were so many programs that Lois Larsen compiled a book called SOFTWARE FOR WEAVERS, which listed and described the over two-hundred programs available for the various machines. A specific feature of these programs is that they all make extensive use of the handweaver's vocabulary, thus making them user friendly for those weavers who are not conversant with computers.

At this time, Rick Hart of the Macomber company and Ahrens and Violette of AVL developed systems that became the standards for personal computerized hand looms. For the Macomber loom, a specially designed microcomputer controlling the harness tie-up and treadling sequence of the weaving pattern could be added to their basic multi-harness handloom, a loom which had been designed over forty years ago. The idea was to computerize equipment the hand weaver already owned - thus making this technological upgrade more feasible economically. The basis of the first computerized system was an electronic single pedal which contained a bank of solenoids connecting it to specific hooks attached to the lams and, thus, to the shafts.. Individual shafts or combinations of shafts could be raised by keying in the desired connections and then raising and lowering the master pedal . This programmable feature relieved the weaver from crawling under the loom to manually connect pedal hooks.

A more recent innovation still operates on the same principle, but instead of using a single pedal it has an individual air cylinder and solenoid for each treadle. This system is more efficient, not as

physically taxing, and more easily repaired. Both mechanical versions can be connected either to the specially designed microcomputer or to the Atari, Macintosh, or IBM computer unit.

The AVL loom was conceived in the late 1970's. The loom was originally designed to have a dobby head controlling the shafts. As the dobby head is basically a primitive computer using a binary language, its replacement with a computer black box was a logical next step. The system operates with solenoids like the Macomber. It has no specifically designed microcomputer system but utilizes a cable hook-up to the software program run on an IBM or a Macintosh.

These innovations have allowed the artist/designer/handweaver a freedom of imagining and action that they previously did not have. The number of treadles contained on a loom, thus the number of options, were expanded electronically. Previously, a hand loom would have two more treadles than it had shafts. This allowed for a direct tie-up for each shaft as well as two treadles for plain weave. A thirty-two shaft loom would have thirty-four shafts. Now, on the computerized Macomber loom of this size there are sixty-four shafts. This allows the designer to employ weaves that have longer and more complex repeats. It also makes it possible to combine several weave structures on a single set of treadles. Before, the time-consuming and tedious job of changing tie-ups or the connections between the treadles and the shafts discouraged the contemporary handweaver from designing pieces that had many weave changes. These new systems also remember specific structural weft sequences or, in weavers' terms, the treadling sequences. The ease of using this feature encourages the weaver to change and modify the sequences during the course of weaving the cloth as well as use longer repeats. The warp can readily become an active component of the whole expression rather than having the more passive role it held in traditional tapestry. Thus, the physicality of the surfaces of various weave structures and the combinations and juxtapositions of these structures can have as essential a role in creating the visual effects of the artistic intent as color and image. The design potentials within the unique qualities of woven cloth can more readily be explored. In a sense, the use of computerized hand looms has made woven fiber art more directly connected to its textile heritage .

The work of four weavers illustrates the use of this new technology within the artistic expression of the fiber artist. All four use the computerized loom and software as tools to design weaves

and to create flexibility in generating, modifying, and combining them. Presently, they do not use any computer capabilities to draw or design the overall images or create compositions, although it is conceivable that that might evolve in the future.

EMILY DU BOIS lives and works in California. As she states, " For twenty years, my work in visual art has developed along with my practice of Tai Chi.....In Taoism's naturalistic, relativist world view, we are constantly engaged in a complex process created by the continual modulations of Yin and Yang, representing the polar extremes of any given principle........In my work with computer generated textiles, Yin and Yang manifest themselves as the computer's 0 AND 1, the loom's warp up or down, the intersection between dyed surface and woven structure." She visually varies the structures obtainable on a sixteen-harness loom by using the effects of color and weave principles, by juxtaposing blocks of twill weaves in such a way that they form moiré effects, and by discharging parts of the warp before weaving as well as discharging the finished cloth and overdyeing. These actions build change and randomness into a constant known and thus advance her idea. She weaves fast, using production-weaving techniques, and does not depend on hand-manipulated weaves, such as pick-up or inlay. She feels that if a maneuver is too cumbersome, too difficult, then one tends to avoid it. Thus, the computer frees up her imagining and allows for more creativity.

BHAKTI ZIEK works and teaches in Philadelphia. Years ago she co-authored a book on backstrap weaving. In her travels throughout the world she has studied textiles. Her fiberwork reflects her particular interest in the fabrics and culture of the less industrialized societies. In creating it, she combines the technology of a sixteen-harness computerized AVL loom with hand techniques that were used to pattern the fabrics on backstrap looms. Generally she employs a compound triple warp for the hand pick-up. This is combined with weft brocade. She also uses lampas techniques. The complexity of the weave structures modulates the surface of the various forms and adds a dimension to the visualization of her ideas.

LIA COOK's unique work exists somewhere between painting and textiles. Her intent is to imbed images of textiles - such as the drapery depicted on the figures and within the settings of old masterpieces - into actual textiles that she has woven. This play of a textile about a textile makes a comment on the hierarchy of subjects,

processes, and materials in fine art. To do this she first makes a painting on canvas or on sheets of abaca .After cutting the painted image into narrow strips, she inserts each strip successively into a warp to act as weft. A large diameter rayon warp is painted with dyes before weaving. The painted forms and shapes are related to the weft image. The complex woven structure, with few exceptions, is continuous throughout the piece and is designed to interlock visually with the weft images to create an illusionary and shifting surface. This illusion is heightened by passing the entire piece through an etching press after it is woven. Cook uses the weave software program SWIFTWEAVE to design a weave that will specifically enhance the particular image she is using. The memory within the computerized Macomber thirty-two-harness loom facilitates her use of the complex treadling sequence.

My own weaving focuses on the integration of structure and image so as to render them physically and visually inseparable: the unique characteristics of the textile are intimately linked to formal aesthetic aspects such as line, form, color, and image. To achieve this I use three separate warps, each of a different size or material and each painted with different designs. Each warp has as well its specific weave structure, but instead of being woven with three different wefts to make three cloths, one on top of the other, the weaves are integrated and woven with one weft to form a single layer. The relationship between the three different weaves determines which of the layers comes more dominantly to the surface of the cloth. As all layers are weaving, there is always at least a trace of each layer of warp on the surface. To further complicate the process, I employ tapestry or sectional wefts, that is, wefts that transverse limited areas specified by the design and link together to weave the width of the cloth. The color, size, and texture of these various wefts combine visually with the warps.

What I am doing would be wholly impractical without the aid of the computer. It would take hours to continually change the tie-ups of the integrated triple weave structures I use on my thirty-two-harness Macomber loom. Generally I work with three or four structures simultaneously. Without the additional treadles afforded by the electronic solenoids, it would be extraordinarily difficult to accomplish this. I utilize long and complex treadling sequences or chain plans to mesh the successive weft shots specific to each design area. The whole width, woven weft shot by weft shot, often utilizes at least four sheds. The time-consuming effort of setting up such a sequence either for treadles or a dobby head would be

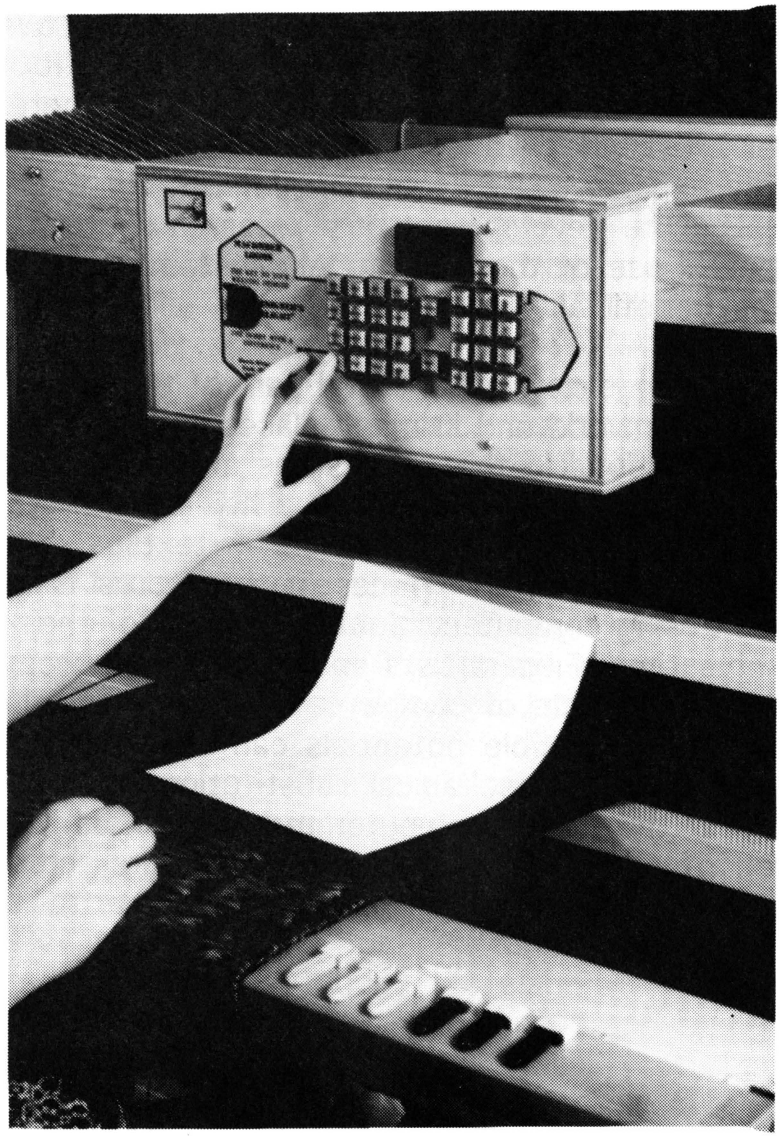
impractical, especially as I often change the sequence after one or two inches. The flexibility contained within the essence of a computerized hand loom and the accompanying software programs is what prompted me to conceive of my present cycle of work.

Another aspect of the effects of computer technology on fiber art is demonstrated by THE JACQUARD PROJECT, which took place at the Muller Zell mill in Zell, Germany. The project was conceived by Beatrijs Sterk, editor of Textilforum and Director of the new European Textile Network. It was sponsored by Werner and Regina Henschell, owners and directors of the mill, and by the Nurnberg Academy of Fine Arts. The intent was to make available to an international group of fiber artists the latest CAD/CAM (computer aided design/computer aided manufacturing) technology, technology used commercially in industry. The resulting documentation was to be widely disseminated. The interest was in exploring the potentials for new paths or directions in textile design for both industry and the individual artist. Lia Cook and I participated in the project. Continuing in that vein is the two-year project, involving twelve artists, directed by Bhakti Ziek at the Philadelphia College of Textiles and Science. All four artists discussed in this paper will participate in that project. In both cases the computerized Jacquard loom is the basis of the experimentation.

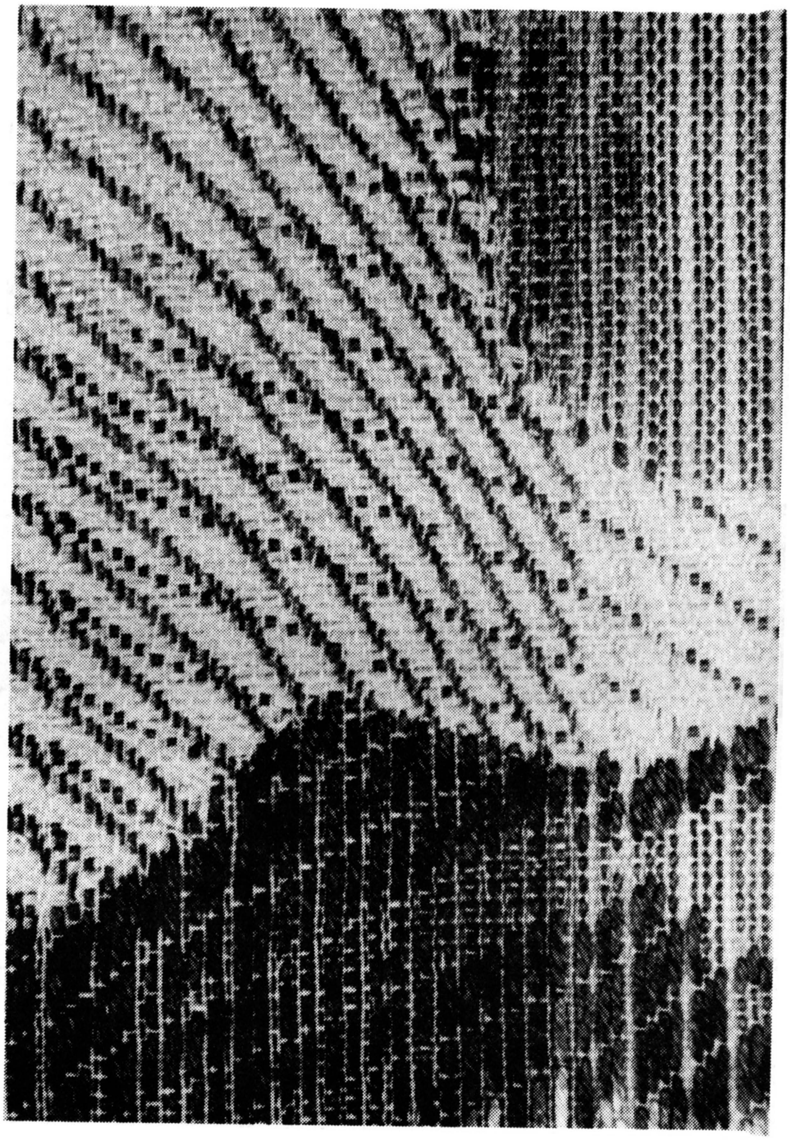
This loom differs dramatically from the standard hand loom. The principle is that of defining each and every intersection of warp and weft. In a standard loom, warp ends are controlled by groups, through the use of shafts, rather than singly. While much larger and more intricate patterns or images can be obtained through the loom-controlled processes of a Jacquard loom, the elaborate and time-consuming steps of making the point paper, cutting and lacing the cards, and preparing the loom restrict the practicality of change within the design. The tediousness of the process discourages design modifications. In opposition to this, the Grosse CAD/CAM system used at Muller Zell allows a design to be scanned in or even developed directly within the system and modified as with any paint/draw computer program. It can then be shifted to point paper to be flipped and magnified for accurate repeats and clean up. In addition, the system prepares the technical instructions and calculations. All this is put on a computer disc which is inserted into the computerized loom for weaving. The design is called up and woven as continuous yardage. Modifications can be made by returning to the design computer, making whatever changes are desired, and cutting a second disc so there are two versions. The loom would weave whichever one

was inserted into it. The looms (Dornier) can weave at the rate of about one meter, one hundred and forty centimeters wide, every six minutes. When I returned to Zell last spring, I spent three days at the computer making my designs and their variations and determining the structural information. On the fourth day I wove twenty-four meters of design variations. The ease, speed, and flexibility of the system promote artistic investigations. The potentials are extraordinary for the fiber artist who weaves. The drawback is that the system is extremely expensive, its acquisition far beyond the means of most individuals. The development of a research center for the experimental use of these CAD/CAM systems by artists and designers would be beneficial.

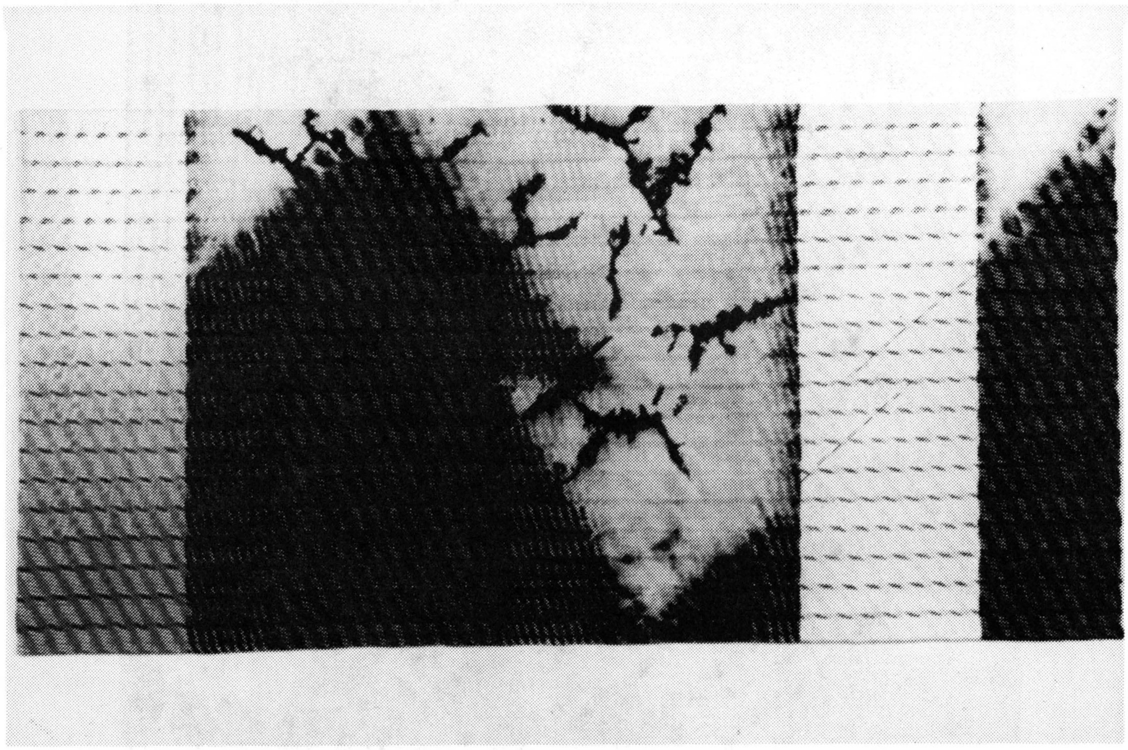
Computers are now an integral part of the technology of weaving in the western world and in many places in the east. They are used in teaching situations in the universities and art schools as well as by independent weavers and industry. Their effects are evident in the complexity of imagery and structure in textiles that are readily available at relatively low prices in the stores today. Textile mills have been using computers in many aspects of their production for quite some time. Fiber artists and independent weavers have utilized various basic aspects of computer technology for almost a decade Its time-saving and flexible potentials can be a powerful creative tool rather than a poor mechanical substitution for artistic sensibility. I believe that the use of computer technology has had and will continue to have a fundamental effect on the structure and design of functional fabrics as well as on woven fiber art.



The keyboard and memory disc keys of a computerized thirty-two harness Macomber handloom.



An example of an integrated triple weave structure woven on a Macomber thirty-two harness handloom.



PINE BARK by Emily DuBois - 1990 - The size of the weaving is 31" in height and 64" in width. The material is mercerized cotton. It is woven on an AVL computerized sixteen harness loom. Ikat techniques are employed before and shibori techniques after the weaving process.

A print out of Cynthia Schira's double weave design on the **Grosse Jac-Design** computer program used at the Muller Zell Textile Co., in Zell, Germany. The print out shows the graphic tools available to the designer at the right of the image. These include pens and brushes and erasers, rotation devices, cut and paste as well as enlarging and reducing tools. Below the toolbox is a palette of available colors for use in the design. The number of weft shots employed for the design is on the left of the image, the number of warps across the bottom. The band across the top has the pull down menus for the more elaborate functions such as moving the design to electronic graph paper,adding the technical information and doing the final structural clean ups before the design is transferred to the disc that will be used for weaving the fabric on the Dornier Jacquard loom.