

Chromatic Fantasy: Music-inspired Weavings Lead to a Multitude of Mathematical Possibilities

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Abstract

As part of my thesis work for my MFA in Fibers at the University of Oregon, I wove five panels that were inspired by Johann Sebastian Bach's 'Chromatic Fantasy'. The many possible combinations of these weavings led me to create a flipbook of their images, as well as a computer-animated video of the weavings dancing to the music from which they were inspired.

Introduction

As a college student in the 1970's, I studied art, music and science. I was interested in finding ways that these fields connected to each other and looked to Leonardo da Vinci as a role model. When I signed up for a weaving class and sat down at a floor loom for the first time, it felt just like playing the pipe organ, except that the harmonies appeared in color instead of in musical tones. I became intrigued with the idea of finding relationships between weaving and music and expressing these relationships in my artwork.

A dozen years later I returned to graduate school at the University of Oregon to pursue a Master of Fine Arts in Fibers. When it came time to choose a topic to focus on for my thesis project, I decided to explore the relationships between weaving and music through their underlying mathematical structures. In my studies, I learned about the golden proportion and its relationship to musical frequencies. I also studied the movements of symmetry and found them to have wonderful correlations in musical compositions. In my weaving I work with many of the same elements found in music - rhythm, proportion, texture, harmonics - and strive to bring the beauty and order of music into visual form.

J. S. Bach's "Chromatic Fantasy"

Because I had worked extensively with the music of J. S. Bach as an organ student and was fascinated with the mathematical ideas and symbolism in his music, I chose to study it in more depth. As I read about Bach and his life, I became interested in a piece that he wrote for the harpsichord called "Chromatic Fantasy".

The word "chromatic" has both a musical and a visual meaning. In music, a chromatic scale contains twelve tones within an octave, as opposed to the seven-tone diatonic scale that we are accustomed to hearing in western music. Because of the inclusion of the half-tones in a chromatic scale, the harmonies can sometimes sound dissonant to our ears, but they also have a great richness and depth to them.

Visually, the word “chromatic” refers to color, and the full range of the color spectrum. As I thought about these two meanings of the word “chromatic”, I became intrigued by the analogies that I saw between them and decided that I wanted to weave a visual Chromatic Fantasy.

Making Music Visible

While I often use mathematical concepts such as harmonic proportions, symmetry patterns, tessellations and fractals in my weaving, my work is inspired by my interpretations of music, rather than attempting to be direct representations of specific pieces of music. I listened to a recording of Bach’s “Chromatic Fantasy” over and over and let the images come to me as I listened. This piece of music is a progression of single notes without any chords, but they are played so rapidly that the tones blur together like broad paint strokes of color. I imagined the notes flowing through space, with the fundamental tones grounding the piece, and the overtones floating up above them.

I work in a technique called doubleweave pick-up, in which two layers of fabric are woven simultaneously on the loom, one above the other. Individual threads are counted and exchanged between the two layers, enabling the weaver to create crisp design areas and to harmonize the colors of one layer against the other.

One of several significant differences between art and music is that art is experienced in space, while music is experienced in time. To incorporate an element of temporality into my piece, I decided to weave multiple panels that would fit together to make a larger composition and create a visual flow from one panel to the next. I ended up weaving a total of five panels using a full, rich spectrum of color against a black background.



Figure 1: ‘Chromatic Fantasy’ 44” x 168”

A Multitude of Possibilities

After I finished weaving the five panels, I stretched each one over foam-core board and framed them individually. Each panel measured 44” x 33”, so the entire composition ended up nearly four feet high and fourteen feet across. I laid them all out in the order that I had planned for the composition. Then I began to experiment with arranging the panels in different configurations. I discovered that because each

of the panels had a series of small diagonal lines going through the center of each of its sides, the panels could be placed in any order and any of them could be rotated 180 degrees, and the design would still fit together.

I quickly realized that there were quite a number of ways to arrange the five panels and that it would be difficult to keep track of which ways I had tried. Because there are five different panels and each one has two possible orientations, there are ten possible images for the first position. This leaves eight possible images for the second position, six images for the third position, four images for the fourth position and two possible images remaining for the last position. This leads to the equation: $10 \times 8 \times 6 \times 4 \times 2 = 3,840$ different ways of arranging the five panels in a line!

Clearly, if I wanted to explore working with all these possibilities, I would have to come up with a less cumbersome way than moving five large panels around.

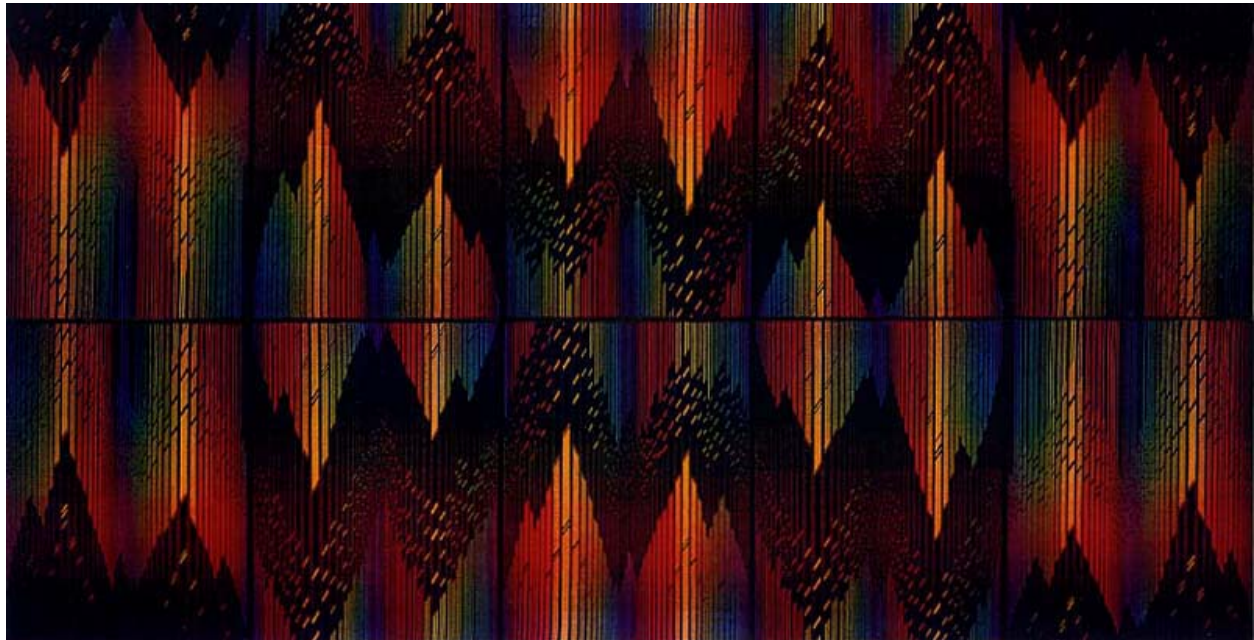


Figure 2: The five ‘Chromatic Fantasy’ panels in each of two orientations

Chromatic Fantasy Flipbook

I took a photograph of the woven panels and made a color photocopy of it. Then I cut apart the images of the individual panels, which allowed me to lay out the images and move them around freely. As I experimented with this, an idea came to me of a flipbook in which stacks of the different images could be hinged and flipped over to create new compositions.

I made numerous copies of the photograph of the weavings, cut apart the individual images, and mounted them on card stock to make them sturdier. Since there were a total of ten different images (the five original weavings each in two different orientations), I created two rows of five stacks of images.

Each of the stacks contained all ten of the different images. I punched holes along the outside edges of each of the stacks so that they could be hinged and flipped over. I attached all of this to a backing board that holds everything together and made a pair of covers for the top.

In this configuration of ten stacks with ten images in each stack, there are 10^{10} , or 10 billion possible combinations. I think of it as being something like a visual abacus.

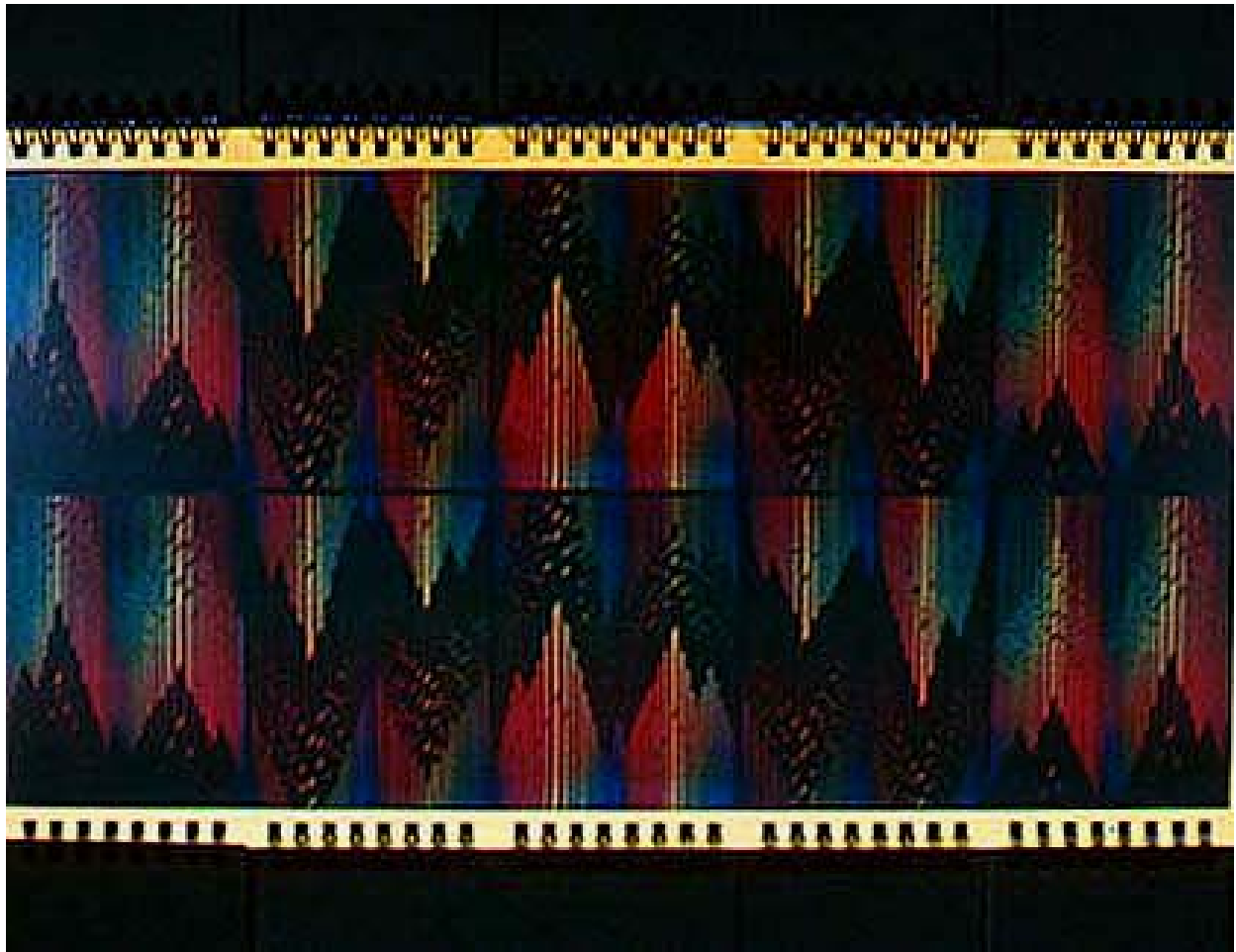


Figure 3: Chromatic Fantasy Flipbook

Chromatic Fantasy Video

After making the flipbook, which is a manual way of animating the images, the next step was to bring it into the world of technology by making a computer-animated video of the weavings dancing to Bach's 'Chromatic Fantasy'. I spent the last several months of my time in graduate school working in the computer graphics lab bringing this idea to life.

The first step was to record the music into the computer. By bringing the music into the program Macromind SoundEdit, I was able to see the music on the screen in wavelength form. I adjusted the size so that I could see two seconds of the music on the screen at a time, and then divided that up into fifteen partitions per second. I printed out the piece of music in this form, and then taped all of the pages together into one long wavelength pattern.

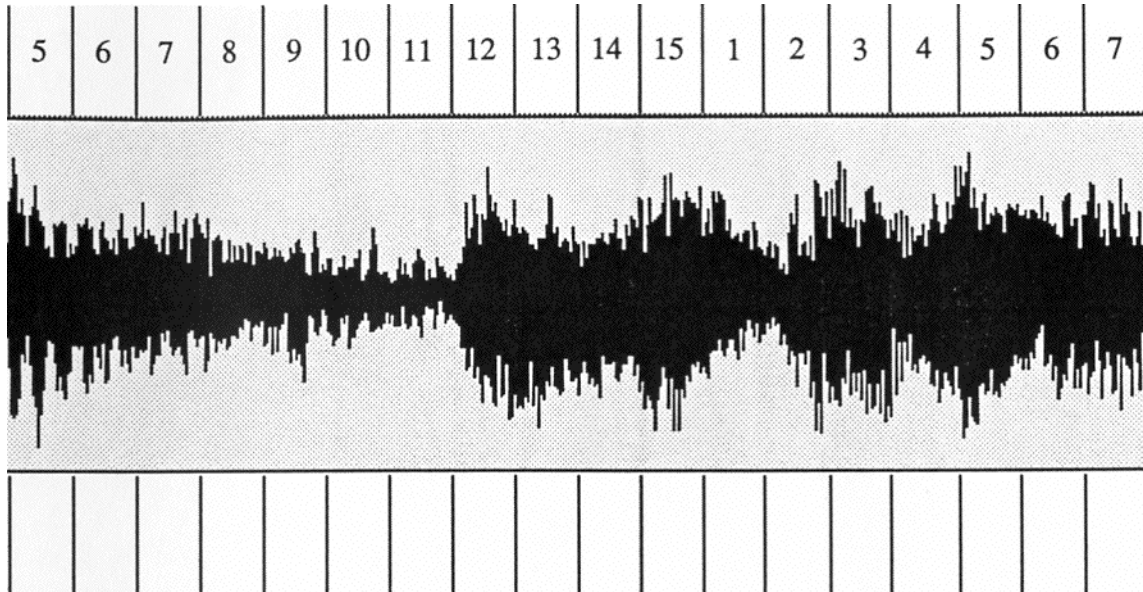


Figure 4: “Chromatic Fantasy” music shown in Macromind SoundEdit

Next I scanned the photograph of my woven panels into the computer and worked with the program Macromind Director to create the video. I entered each of the ten possible images of the weavings as individual cast members, along with a plain black background screen. The proportions of a computer screen allowed for three rows of five images in each row.

Using the pages I had printed out of the wavelength patterns of the music, I began to work out a screenplay of actions for the visual images. The fifteen partitions per second in the music corresponded to fifteen frame changes per second in the animation. By listening to the music while comparing the written score with the wavelength patterns, I could pinpoint where specific changes in the music were happening. While listening to the music I visualized the movements of the images and wrote down the sequences of actions I wanted them to take.

Returning to the computer, I placed the individual images on the screen in their chosen positions for each frame change. With the configuration on the computer screen of three rows of five images, I had one quadrillion possible combinations to choose from. In order to make the project manageable in the time frame I had available, I ended up working with the first two and a half minutes of the musical composition, which meant creating slightly over 2200 different frames. I used various special effects that were available in the animation program for transitions between different sections of the music. After all

the frames were in place, quite a bit of fine-tuning was required to get the musical track and visual track running in synch with each other.

The end result was an animation of the images of the woven panels dancing around on the screen to the music of Bach which originally inspired their creation. The project came to a full circle with the completion of the video.

In the year 2000 the five woven panels were purchased along with a copy of the flipbook and the video by the Alberta Kimball Auditorium in Oshkosh, Wisconsin. People can view the woven panels and the flipbook in the lobby as they arrive to attend concerts.

References

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