The Whitney Music Box

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Abstract

I describe my musical realization of the motion graphics of experimental animation pioneer John Whitney. The Whitney Music Box casts John Whitney's visual idea of "incremental drift" into musical form.

About John Whitney

John Whitney (1917-1995) was an innovative filmmaker who pioneered a number of methods for producing experimental animations based on precisely defined motions. All his life, perhaps beginning with his youthful obsession with the Mount Palomar telescope, Whitney was especially interested in the mathematics of circles, including polar coodinates and sine waves. Whitney's earliest films, made with his brother James during the 1940s, used a pendulum device to produce music and graphics simultaneously.

In the 1950s, Whitney converted a surplus World War II analog computer, originally used in the sighting mechanism of an anti aircraft gun into a versatile and accurate motion control rig, the first of its kind. This "cam machine," was used by the Whitney brothers to realize a series of commercial film effects as well as more personal experimental films all featuring elaborate and fluid abstract motions. In their films, they used multiple exposures while rotating both the camera and a variety of photographed objects and light sources, all moving in complex paths, such as nested arcs. The striking spiraling figures in the Saul Bass designed opening credits of *Vertigo*, were animated by Whitney on this equipment, as well as James' most successful movie, the mandala-like *Lapis*.

In the early 1960s, Whitney changed his medium from analog to digital, and began making a series of pioneering computer graphics shorts, including his 1968 film, "Permutations". Whitney continued working in the computer graphics field until his death in 1995, making the film *Arabesque* and the film series *Moon Drum*.

Whitney's films were highly geometrical in nature, often consisting of nothing more than colored points of light, moving over mathematically defined paths, such as sine waves, controlled by either electro-mechnical or digital computation. Whitney was principally interested in the cumulative effect of these motions on the viewer.

Incremental Drift. The motions of the objects in Whitney's mid to later films often were based around a type of mathematically choreographed motion Whitney called "incremental drift." Whitney described incremental drift in his 1980 book, *Digital Harmony*, in which he elaborated on his belief that the the mathematical properties of music could be applied to motion graphics on a computer.

An early intuition about how to control total dynamics led me to activate all graphics elements through a motion function that advances each element differentially. For example, if one element were set to move at a given rate, the next element might be moved two times that rate. Then the third would move at three times that rate and so on. Each element would move at a different rate and in a different direction within the field of action. So long as all elements obey a rule of direction and rate, and none drifts about aimlessly or randomly, then pattern configurations form and reform. This is harmonic resonance and it echoes musical harmony, stated in explicit terms. I tried this procedure in several films, and was gratified by the consistency of the confirmation it demonstrated.

– John Whitney, *Digital Harmony*, pp. 38

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In the book, Whitney goes on to describe a few simple examples of this type of motion. The book contains sample code in the back, in the BASIC programming language. One of those examples is constructed of points moving around a series of increasingly wider concentric circlular paths.

I noticed the resemblence of the circular paths to the dots on the disc of a music box, and thought it would be interesting to use Whitney's dots to trigger a series of notes on a chromatic scale. Although this arrangement is very similar to a regular music box equipped with chromatically tuned tines, the rotational speed of the dots differs in a way that can't be produced with a single disc - rather such a music box would require a single disc or cylindar for each dot, each moving at a slightly faster speed.

Much like Whitney, I was "gratified" by the quality of the music this system generated, and even more so by the effect of listening to the music while watching the animation that triggered it [Figure 1]. What to the ear sounds like a complex piece of music becomes more lucid when the eyes are confronted with the evidence of a relatively simple and predictable system of motions triggering those sounds. The overall effect can produce a strong sense of wonderment in the listener / viewer, which I found pleasing.

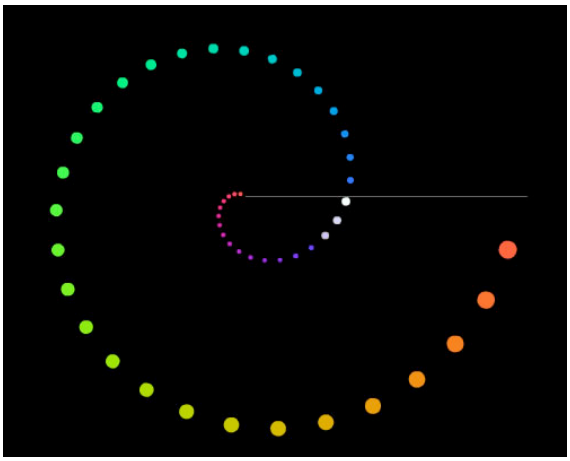

Figure 1 :
The Whitney Music Box

I went on to produce a series of variations of this basic experiment, using different numbers of dots, tunings (both chromatic, harmonic, and modal, with forward and retrograde assignments) as well as a few different methods of sound production.

A close inspection of Whitney's writings reveals that he was much more of an artist than a mathematician. The mathematics of Whitney's movies can be quite simple, based on nothing more than the simple integer ratios of Pythagoras. Like medieval music theorists, Whitney believed that the appeal of his animations, like the appeal of tonal music, was based on these simple ratios.

For the casual mathematician, and casual listener, the Whitney Music Box provides a beautiful and fascinating introduction to some elementary and beautiful mathematical ideas.

For more information about this project, including an online Flash demonstration, visit
http://www.coverpop.com/whitney/