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Math 005

Professor Barnett

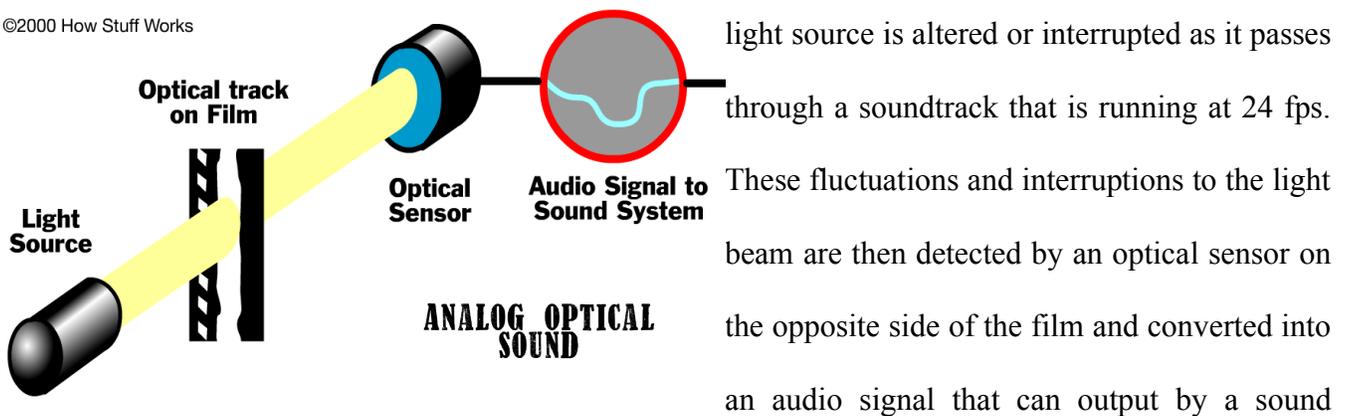
## Graphical Sound: Sound You Can See

I had before doing this project had some very brief and superficial experiences with graphical sound, but really had very little idea of how exactly sound film actually *worked*, how graphic sound worked, how to manipulate it, and how the guide I had been using was created and why it sounded wrong. The nature of my project was to investigate this more thoroughly with concepts and tools I learned in the duration of this course.

### How does film sound work?

One second of sound film essentially equals 24 frames of film. The soundtrack of a film runs along the far side of the film opposite the perforated side of the film. The way on-film-sound works is using a “variable-area” system, so that as the area of sound that is inscribed on the soundstrip widens and narrows as it runs through the camera. It is held in front of a light source and the beam from that

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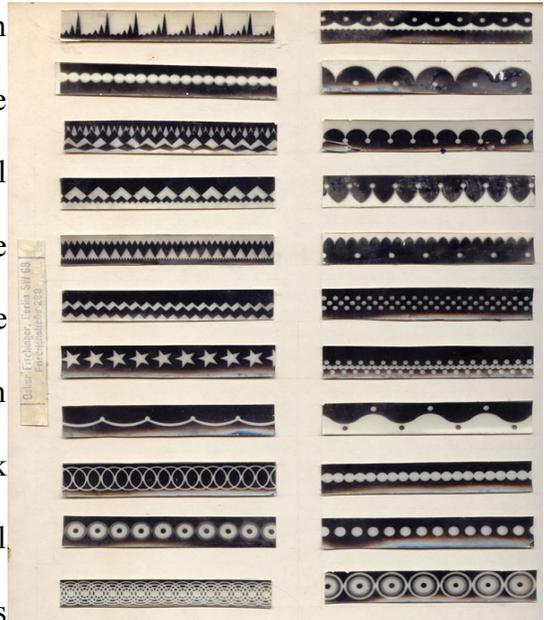
light source is altered or interrupted as it passes through a soundtrack that is running at 24 fps.

These fluctuations and interruptions to the light beam are then detected by an optical sensor on the opposite side of the film and converted into an audio signal that can output by a sound

system.

## What is graphical sound?

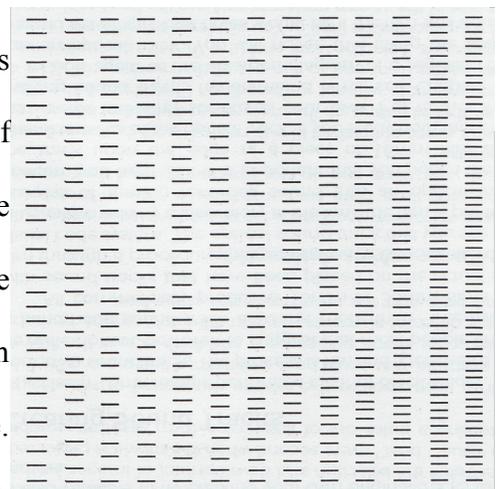
Graphical or animated or drawn sound essentially tries to do for the ear what conventional animation does for the eye: which is to create by hand an audio experience entirely designed by an artist without the use of sound recording equipment. Artists such as Normal McLaren used to physically draw on the sound strip while other artists like Rudolf Pfenninger film made elaborate drawings which could be as wide as a table and used an optical printer to “print” these drawings on the soundtrack of the film. They can be simple or elaborately ornamental like those pictured on the right. This methodology dates as



far back as the 1930s and is one of the precursors to synthetic sound with people like John and James Whitney, two pioneers of modern synthetic sound, being practitioners of it.

## Experiment 1

I had once used the guide at right from Helen Hill's *Recipes for Disaster* Booklet to create a sound piece of “Twinkle, Twinkle Little Star”. After creating the piece, the notes were lower than the guide had promised. Essentially the guide claimed that if you created these tick marks along the film strip, it would produce the sound of a certain musical note. This experiment set out to figure out what was going on with this.



I set out and recorded several of these notes and noticed that the recordings of the tick marks were each about 30 Hz below the expected Hz that the guide had promised. On my own, I started

increasing the number of tick marks per section of film and noticed that the Hz was rising with each tick mark:

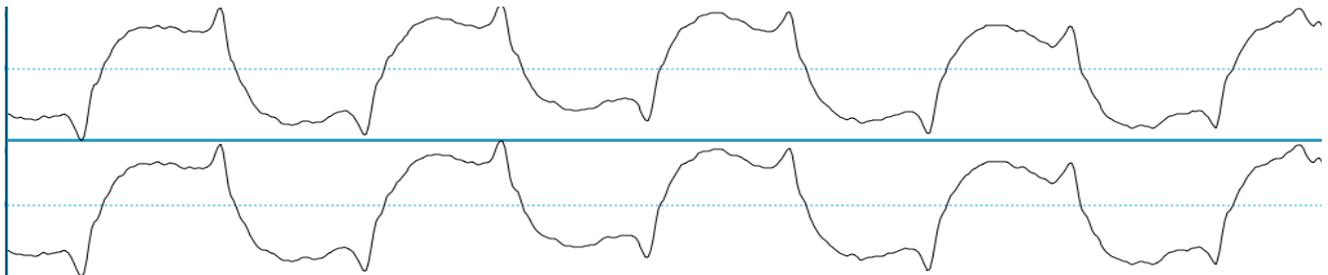
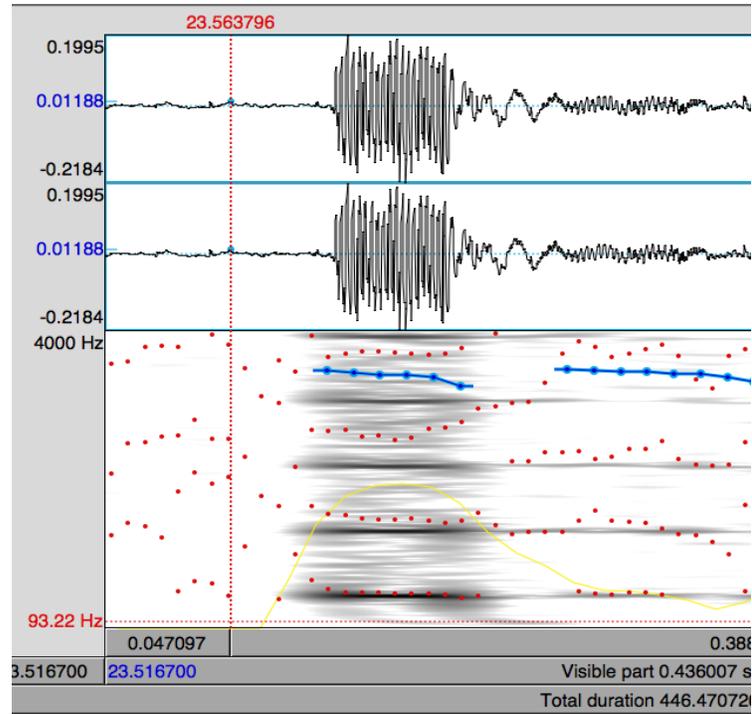
<b>Note</b>	<b>Claim</b>	<b>Actual</b>	<b>Mine</b>
<b>C3</b>	128 Hz	93 Hz	127 Hz
<b>B2</b>	120 Hz	88 Hz	121 Hz
<b>A#2</b>	112 Hz	80 Hz	110 Hz
<b>A2</b>	106 Hz	77 Hz	104 Hz
<b>G#2</b>	100 Hz	73 Hz	99 Hz
<b>G2</b>	96 Hz	67 Hz	94 Hz

I noticed that when the number of tick marks in 24 frames of film equals the number of Hz of a given note, the perceived pitch is much closer to a note. Because there are 24 frames per second, the number of interruptions or ticks in those 24 frames of film in turn cause the same number of interruptions in the beam of light being perceived by the optical sensor of the projector, and this should be equal to the desired frequency in Hertz of a note. I believe that because the chart claimed to be “actual size” and that this is the key to why the guide is out of tune. The scale of the guide must have increased over the past years, throwing it respectively off. This is further supported by the fact that my recordings of each note from the guide seemed to be spaced relatively similar to how notes lower on a diatonic scale might be.

### **Experiment 2:**

Because my skill with graphical sound is limited, I decided to analyze the soundtrack of Norman McLaren's *Synchrony* (1971). I chose this film because in addition to being a wonderful film, the piece also not only uses graphical sound techniques but it as well shows what exactly the audience is hearing when it is hearing. Norman McLaren essentially optically printed the soundtrack onto the visual part of the film strip so that it could be see in synchronization with the sound.

The following is of the first sound in the film:



I repeated this experiment several times with the McLaren piece as well as a few graphical pieces of my own. I compared each analysis to the quality of its visual counterparts and observed the following sets of relationships.

**Results:**

- \*The number of strokes controls the pitch of the note
- \*The greater the width of the stroke, the greater the intensity.
- \*The darker the stroke, the greater the intensity of the sound as well
- \*Rounded forms give smooth sounds.
- \*Sharper or angular forms give harder, harsher sounds.

**Conclusions:**

The number of strikes seems to be indicative how many times the light beam is interrupted, which was more deeply explained in Experiment 1. The way intensity is affected seems to be by controlling the amount of light that is actually let in regardless of how many “interruptions” or the pitch, the less light that is let in seem to correlate with a higher intensity. Rounded versus sharper forms seems to be related to how the form of the light is changed from one frame to the next, rounded seem to soften the interruption while more angular forms seem to sharpen or create a more dynamic interruption to the beam.

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