

# Algorithmic process for time-based arts

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## Abstract

In this paper, we investigate an algorithmic method of producing animation using mathematically generated images with electroacoustic sound. The basic model consists of several key frames of geometrically generated images, and interpolated frames calculated by blending functions. The sound was intended to reflect the way a composer interprets the images. Methods of algorithm-based image and sound collaboration will be discussed.

## 1. Introduction

Editing sequences in film making is very important and it is almost a kind of craftsmanship. Rich experience is required for the editor to reflect the style of the director properly. Subtle difference in timing, or temporal distance between image and sound can provide different messages or meanings to the audience. The fact that this critical manipulation is inherited by many digital animation artists who generate images by algorithmic processes indicates that editing is not easily done solely by an algorithm. Actually, in making animation with an algorithmic scheme, we use one algorithm to generate key-frame images, and another one for generating interpolations, but the temporal distances between key frames are decided by hands or on a trial and error basis.

In feature films, cuts make a scene and scenes make a story and the continuity is an important element for the total impression of the work. You can say that film making starts from the storyboard and ends with the editor's job of realising its continuity. Therefore, editorship was established in the early days of the film history and its technique and experience have been piled up in film-maker's professionalism. In contrast with traditional film making, algorithm based works want another skill in making sequence of cuts and scenes. Our interest was in taking advantage of algorithmic processes in this kind of time based manipulation and we tried to realize a short clip with algorithm based imaging, editing, and sound design.

We employed the method of making sound after the image in this project. The image was created by Abe, and Ishijima designed the sound based on the impression she got from the image.

## 2. Animation

We created a basic animation clip with images of three objects made of geometric surfaces in



### 3. Sound

In this experimental animation, the role of sound is somewhat different from that of conventional films, in which sound tracks are categorized in three ways: voice, music, sound effect. Since there is no actor, no real-world landscape, or no written story in this animation, composer has more freedom to explore the sound world. Not only forming a cause and effect relationship with the image, sound can at times be an independent character, or an object, which has certain behaviour of its own. The audio tracks contain the work of the composer, effect designer and sound editor.

#### 3.1 Sound and Moving Image

In feature films, conversational voice and sound effects are situational. They have direct connection to the event happening in the scene. The link between music and image on the other hand is metaphorical. Music creates atmosphere, drama, suspense, etc. but often it has no physical connection to the event in the scene. In the post-production of film making, balance and timing among these three sound tracks are very important and it is the job of the sound editor to co-ordinate all the sound elements to suit the theme of the film.

In this experimental animation which consists only of geometric figures, the role of sound is different from conventional films. However, I would like to point out that whatever the style of production; fundamental functions of sound in moving image are the same. Sounds can be situational or metaphorical.

##### Situational Sound

Sound which has direct connection (cause-effect) to the event.

1. Triggering sound
2. Triggered sound
3. Room acoustics

##### Metaphorical Sound

Sound which has metaphorical connection to the imaginative faculty of a viewer.

There is no clear boundary between the two. In the case of this animation, since the image itself does not necessarily project a real world event, it is difficult for the viewer to logically distinguish whether the sound is situational or metaphorical. Meanings emerge at stages of production, but final meaning is not established until interpretation of the viewer joins in. Nonetheless, careful sound design and timing are crucial, especially in cases of 1 and 2 of the situational sound, as we make sense of audio-visual events according to our real-world terms. Unless we make a very conscious adjustment, or receive physically manipulative stimuli to our sensory systems our sensory convention is hard to break.

One universal principle of our perception, which is very useful for designing sound for moving image, is our frequency-related association. High-pitched sound is often associated with small objects. Compared to low-pitched sound it also sounds physically high in the air. Low-pitched sound, on the other hand, is associated with an object of larger volume and weight; and it sounds as if it is near the ground. This principle is used in the process of designing the animation sound.

### 3.2 Sound Design

In designing the sound for this animation, attention was paid to the following visual objects and events.

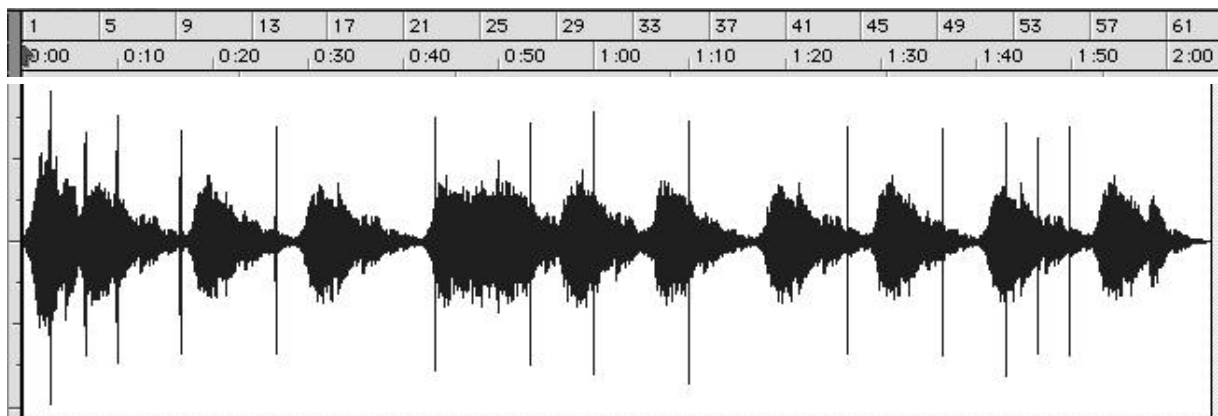
Objects:  
Rings and Strips

Events:  
Rotation of the rings  
Movement of view points  
Changing colours of the rings

Now to turn the way of connecting sound of these objects and events.

Strategy

1. Creating situational sound for some significant rotation movements of the rings. Sound can be cause or effect of a visual event. If some causes seem missing from the visual event, sound representing that can be created, and vice versa.
2. Sequencing the sounds according to the rotation chart; then examining the sequence with the 2 min. base animation which has only one fixed view point.



[Fig 4] Spiky peaks at 3.3, 6.6, 10.0, 16.6, 26.6 sec. show the sound designed for the fast spins of ring 2 synchronized with the event.

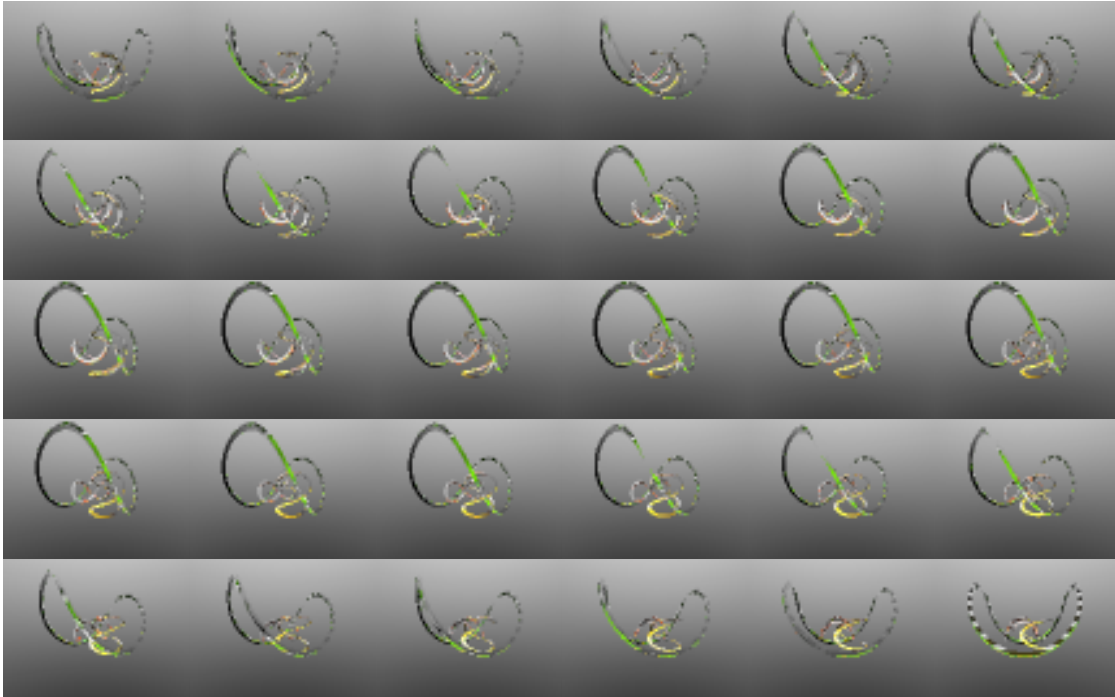
### 3. Transformations

Transformation of the rings into strips is ostensible. It occurs as a result of sweeping view positions, and the rings never actually (mathematically) break into strips. Nonetheless, the sensation of transformation would be quite significant for the viewers. It might be felt as if entering another world etc. In order to reflect that, some pitch elements of the sounds representing movements of the rings were transposed according to the distance of the rings from the view point, and x-y-z chart of the movement of the view point. The change in the harmonic or timbral structure creates corresponding and contrasting sound events with the visual events.

### 4. Space

One of the significant features of this geometric image is that there seems to be no gravity. The view point sweeps freely in the three dimensional space. The feel of this is reflected in the

acoustics timbre and the musical structure. This is to say designing partly situational partly metaphoric sound. To sum up, sound design is a matter of connecting visual objects and events with metaphoric and situational sound.



**[Fig 5]** Sample animation.

## 4. Conclusion

The algorithmic process is not only useful as a method to control and join the audio and visual elements in an animation, but also becomes a fascinating guide to an unknown world. When artists use algorithms in the creative process, the primary interest is often in getting into the new world the algorithm provides. On one hand, algorithms are the creation of the artist, yet on the other hand, they provide previously never-experienced phenomena for the artist.

When you think about the fact that the artist exists before the art, how to reflect the artist's style on the work is the most important thing in any kind of art medium. Whether an algorithm reflects the artist's style or not is the key question. We believe that the algorithm does reflect the artist's style.

## Notes

[1] Aitken's interpolation scheme. p.387B, Encyclopedic Dictionary of Mathematics, 3rd edition by Mathematical Society of Japan. in Japanese. Iwanami publishing co. ltd. 1985

[2] We used a math formula to define the distance between key frames for the base animation. Other clips used different algorithm.