

# Invention of Musical Notation

## Applying the Musical Notation to the Cinematic Art Language

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**Abstract**—This dissertation aims to expand existing cinematic expression by applying musical notation<sup>1</sup>, tonal systems, and the forms and structures of musical composition techniques to digital cinema. My objective is to apply the construction and techniques of music composition to the practice of digital cinema, to push the boundaries of story telling, rhythm and mise-en-scene structure in current cinematic conventions.

**Keywords**—*Music Composition; Cinema; Digital Media; Cinematography; Narrative*

### I. INTRODUCTION

How narrative is constructed in filmmaking closely resembles how music is written. But in music, the 11th-century invention of musical notation allowed composers to edit their musical ideas on parchment, producing sophisticated emotional effects when played. It greatly contributes to the ability to identify and visualize a system of patterned relationships: pitch and melody, major and minor scales, polyphony and counterpoint, meter and tempo, sonata form and symphony, motif and sequence, theme, variation and improvisation. However, there is no such a visual display method to express emotion and narrative in cinema that can be used as a composer does notation. As a result, my research is focused on other ways to conceptualize and apply the techniques of musical composition to filmmaking. Digital editing application layouts mirror how music is written. I suggest that the application of notation to digital editing allows one to structure and organize reality into a cinematic experience visually.

Painter Paul Klee and animator John Whitney derived their inspiration from music and its construction. Their visual and video artworks such as “Ancient Harmony” or “Digital Harmony” could be appreciated as the visualization of music. The film pioneer Sergei Eisenstein pioneered montage theory in silent films practice through films such as “Battleship Potemkin” and remarked that what connects music and narrative has to be the rhythm. Although we share a common engagement with music and visuals, my research

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<sup>1</sup> Musical notation presents a kind of graph of each sound's duration and pitch. Western music has been written with notation of pitch and notation of rhythm.

is neither a visualization of music, nor a revision of the montage theory, but with a focus to apply the music composition techniques in digital cinema production.

### II. DISCOVERY THROUGH INTERDISCIPLINARY COLLABORATION

My research plan and aims are based on my years of practice and interdisciplinary work in music, theater, dance and film. My responsibility has been to create scripts of both text and imagery, film, sound and music composition, and performance. All of these interdisciplinary collaborations have expanded my understanding as a filmmaker of how narrative functions in other art forms in resolving the puzzles of time and space.

#### A. Interdisciplinary Collaboration in USA

Making explorations into different media and artistic forms came naturally, and opportunities presented themselves as I worked along. One of my earlier films, KU “Fig. 1”, was a collaboration with New York University's Tisch School of the Arts and American University's Music and Audio Engineering program, exploiting minimalist music composition techniques and aesthetics in cinematic experimentation to tell a story about life after death.



Fig. 1. “Ku: Life After Death” – 14 minutes short film shot with 4 x 5 large format camera (Winner of Best Director at Georgetown International Film Festival USA , 2001.)

When I was a turner track asst. professor at DeSales University in America, the school's film program was under the wing of Performing and Fine Arts. I started to recognize the narrative approach in theater and dance performance. I therefore composed music and created sound design for a theater piece titled "The Trojan Women". Also, our annual ACT 1 film festival presented films with live band accompaniment (piano, drum and guitar).

### B. Interdisciplinary Collaboration in Singapore

When I was invited to co-establish a new school of Art, Design and Media at Nanyang Technological University, my research and collaboration with Singapore Odyssey Dance Theater was in demand in Singapore. I started to write poems, short stories, create visual sketches, compose and perform music, and make films for interactive performance art on stage, such as "The Story Begins", "White Shadow", "Black and White", and "Red Tears", which premiered at the Gallery Theater, National Museum of Singapore. "Fig. 2" This was quite an exploration for me to realize that an idea could be developed through rehearsals and that the source of inspiration could be a piece of music, a poem, or a drawing. I discovered that the process helps realize the work's form and structure, intuitively and systematically.



Fig. 2. "Black and White" 60 minutes full length theater play: Augmented Reality Theater collaboration with Odyssey Dance Theater Singapore

### C. Interdisciplinary Collaboration in Shanghai, China

My cooperation with Shanghai Music Conservatory in China on an interactive film-music-theater performance entitled "The Dialogue of Avant-Garde and Pure Entity" 《多媒体打击乐剧场——本真与前卫的对话》 premiered at the Shanghai Oriental Art Center Opera House on June 23, 2008. "Fig. 3" The performance resulted from my collaboration with the composer Zhang Chen Run. The source of inspiration was a composition with four movements; making film for an interactive musical performance was my task. It is not a music video, but the visualization of music for the opera house. The sensor for controlling the changes of the moving images depended on the beat of bass drum and the change of light. The drum beat on the score and the lighting diagram on the timeline were my cues for the suggested

duration of shots; that is to say that the rhythm of bass voice and light determined the cuts, the sequence, the narrative. I could only pre-edit the film, while the real outcome depended on the live performance. I participated in rehearsals during the entire process mainly in order to recognize the rhythm and pace of the music. I made notes on my scores and proposed visuals with a series of sketches and themes before production and post-production.

This series of full-length interdisciplinary time-space art collaborations led me to conclude that music is essential to all other media. I have been inspired and influenced by music in my making of moving images for film, theater, dance, and interactive performance arts. All the elements – setting, film, music, movement of figures are arranged through the use of light on stage to suggest the audio visual hierarchy. Theater, dance and cinema are moving arts; they can all aspire to music.

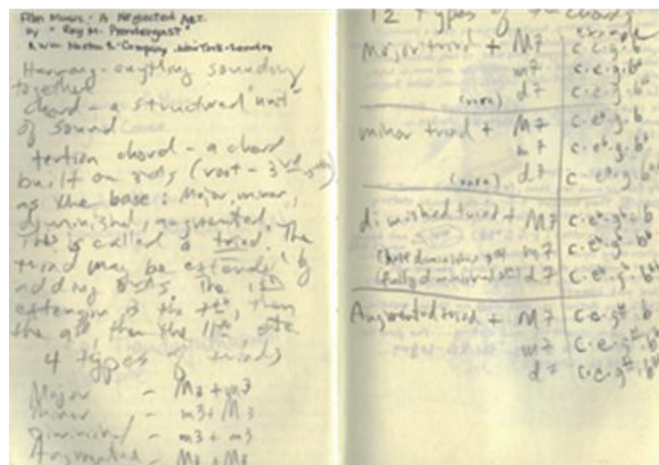


Fig. 3. Music Composition Sketch "The Dialogue of Avant-Garde and Pure Entity", collaboration with Shanghai Music Conservatory, 2008

## III. DIRECTORIAL CINEMATOGRAPHIC EXPERIMENTATION

The immediate transformation of music to visualizing time and space in filmmaking draws from still photography and the moving image. The camera is the greatest and most genuine invention, able to capture the existence of life. When I began to direct my films, I had trouble communicating my ideas with my cinematographer, and ended up deciding to shoot them myself. Whether this was due to weakness or enthusiasm, in this way I decided to prepare myself to be both director and cinematographer of my films, from preparing lighting diagrams and the gray scale of objects, the choreography between camera and actors, intimate space between camera and action, color and shape, harmony and perspective, processing, developing and printing techniques in the darkroom. I also searched for techniques and experiments from those filmmakers who both direct and operate camera for their films. Many of them are independent artists who make personal statements via filmmaking.

#### IV. MUSIC AND FILM: PARALLEL LANGUAGES

A composer uses notes to write music; a poet uses words to write poetry. I am a filmmaker, and similar to the composer and poet, who communicate their ideas through the languages of music and poetry, I convey my ideas using audio-visual content.

##### A. Melody and Harmony

In our time of digital cinema, filmmakers feel an urgency to develop or address the question of cinema as a language. From my perspective, cinema is a language because I choose to communicate through cinema. I simply cannot make a film without thinking of it as a language. Only consistent practice in a certain system of patterned relationships allows me to develop my language of cinema. “Fig. 4” I find music composition techniques to be useful tools.



Fig. 4. Musical Harmony in the progression of Cinematic Time

What generates music mathematically emotional is its tonal system. In Western classical music, what renders the complexity of music in melody and harmony has been the study of the tonal system, visually represented by the circle of fifths. In the beginning, harmony is formed from three tones, on every other degree of the scale, or in thirds: 1-3-5 (for example, C-E-G), 2-4-6- (D-F-A), and so on. It also employs four note combinations, with another third piled on top of the triad, known as seventh chords (1-3-5-7), or in the music of the Impressionists, five note combinations known as ninth chords (1-3-5-7-9). Twentieth century composers add more stories, or blocks, to such chords to form polychords of six and seven notes. The emergence of these complex “skyscraper” chords brought increased tension to music and allowed the composer to play two or more streams of harmony against each other, creating poly-harmony.

Such development in music to create emotional tension and release through dissonant and consonant harmony has

been an inspiration. The system is logical and its sound is always there for experimentations like the patterns of words in poetry. I want to achieve a similar result. I have therefore looked first at music grammar and notes. I pay attention to two basics: the circle of fifths and the music notation of pitch and rhythm. I then apply the notation of music to cinematic space and time. Musical notation presents a kind of graph of each sound’s duration and pitch. These are indicated by symbols called notes, which are written on a staff, a series of five parallel lines separated by four spaces. Each note has its value proceeding in time. It is only natural for me to apply the language of cinema to these two factors, time and space, to start. Having said that, I am not the first person to apply this method.

##### B. Pictographic Languages

Filmmaker Martin Scorsese presented the 2013 Jefferson Lecture in Washington, DC, USA, entitled: “Persistence of Vision: Reading the Language of Cinema”. Scorsese takes the notion that cinema is a language as a given. In his lecture, he goes on to address the importance of literacy: “...the distinction between verbal and visual literacy needs to be done away with, along with the tired old arguments about the word and the image and which is more important. They’re both important. They’re both fundamental. Both take us back to the core of who we are. When you look at ancient writing, words and images are almost indistinguishable. In fact, words are images, they’re symbols. Written Chinese and Japanese still seem like pictographic languages ... But in the end, there really is only literacy.”

I propose that cinema is a language.(Fig.5) My brain easily organizes those cinematic patterns and pattern relations to one another like a language. In the Chinese language, our characters make up symbols such as the moon, the sun, the mountain, the river “月” “日” “山” “川”, or juxtapose two symbols to create meaning, such as rest “休”, which is the combination of person “人”, lying on the tree “木”. Thus, a person leaning on a tree means resting. Brightness “明” is made up of Sun “日” and Moon “月”. “Brightness” means that the sun and moon brighten up the day and the night, or we experience brightness through the source of light: the sun and the moon. We also have two characters together as a pair to create subtext. For example. The word crisis, in Chinese “危機”, is formed from the combination of “danger” = “危”, and opportunity “機”. The subtext is that crisis in life means both danger, and new opportunity.

Therefore, it is always more natural and more beneficial to make film with the idea of communication like a language with the arrangement of sound, imagery, light and movement in time and space, to create form and structure as if there is a grammar. Regardless of how other filmmakers see things, this approach simply makes it easier for me to make films. Music notation on pitch and rhythm are very useful tools functioning like a language – a set of scales with pitch and rhythm notation to indicate tone and duration. It is an organized system of time and space for expressing emotions and narrative.





Fig. 5. Symbol and Pattern Relations (stills from a 20 minutes short film “THE KING MY FATHER 2015)

## V. 20TH CENTURY PRECEDENTS: COMMON SOURCES

The paths that fish swim, birds fly, or a star travels are invisible to our physical eyes, yet they exist. There is a universal law that all natural phenomena follow. Likewise, in all art creation, inspired and influenced by the place in which we live, there must be a mysterious system or source that all arts share and follow, and that allows each to influence others. Although the invention of cinema as a medium occurred little over 100 years ago, it shares a kinship with literature, painting, drama, and music.

### A. Eurhythmics

In the early 20th century, Swiss musician and educator Émile Jaques-Dalcroze developed his music learning method “Eurhythmics”. He concluded that the best way for children to learn music is through physical body movement. The body movement affects the conception of music; musical consciousness is the result of this physical experience. Eurhythmics originates from the Greek, meaning beautiful, harmonious rhythm. Nevertheless, most of Dalcroze’s principles are centered on rhythm. The basic rhythmic impulses evolve from the specifics of certain musical patterns we are familiar with since birth (e.g. a mother’s lullaby and heartbeat, a bird singing in the morning or a cricket chirping at night). We manifest them physically in ways evolved directly from the nature of the music itself. The physical movement with the intention of music learning involves time and space, thus Dalcroze introduces the concepts of time and space into his theory. Time is a controllable factor and in many ways, is the basis of unification, whether of a physical movement to a musical idea, or a performer to a production concept.

Dalcroze wrote that at the end point of the evolution of dance there would be dance without music: “The final culmination of studies in moving plastic is certainly the direct expression of aesthetic feelings and emotion without the aid of music or even of speech”. It was undignified for dance to be an interpretation of music; instead, the dance should aspire to be music. And so Dalcroze hypothesized that dance would some day have its own diatonic scale. “The plastic artist will construct for himself a scale of gestures corresponding to that of sounds”. If sound were to occur at the same time as this plastic music, Dalcroze hoped that the two musics would be in counterpoint, not in unison.

20 some years after publishing “Eurhythmics,” Dalcroze wrote an article on cinema and music. It is a prophetic work considering what was later to occur musically in the sound film. The chart below shows Dalcroze’s “moving plastic”<sup>2</sup> equivalencies.

TABLE I. MOVING PLASTIC EQUIVALENCIES

Film	Music
Film Style	Musical Environment – Historical
Nature/A action	Chord sequences/less the third
Pace/Tempo	Tempo
Gradations of Light and Shade	Dynamics
Space (open-closed)	Chords (complete-imperfect)
Character	Tonal System (major-minor)
Emotion	Special Rhythms
Continuous Action	Continuous Sounds
Sudden Action	Staccato
Hesitation	Syncopation
Sequence of Gesture	Sequence of Phrases
Intensity of Gesture (visual breadth or intensity)	Dynamics
Gestation of Gesture	Musical Rests

Music in film performs a certain function -- to establish time and space, to heighten or relax dramatic tension, to re-enforce the emotive qualities of a character, to heighten action, or to give a scene shape and direction. These musical functions are clues to a deeper musical structure in film. Dalcroze’s equivalents test the boundary of moving visual arts and music.

2. In 1922, Émile Jaques-Dalcroze published “The Techniques of Moving Plastic”. All the masterpieces of Doric sculpture prove the existence of rhythmic laws that regulate the relations of individuals with one another and the contrasts between various human groupings. All this presupposes on the part of the complete athlete a capacity for adapting himself to every physical rhythm in time and space. “Moving plastic” is to try to create a system by turning the relationship of music to the visual arts that move such as dance and cinema.

## B. Sergei Eisenstein

Sergei Eisenstein discovers a unit of measurement and then, builds on that; the attempt to allow musical, physical and narrative motifs to be developed simultaneously without one of them controlling position. Eisenstein creates rhythmic patterns, evolved through montage and subject motion, which are identical to music. In some cases, it is the narrative that determines the nature of the rhythmic pattern. Schematically, the system looks as follows “Fig. 6”.

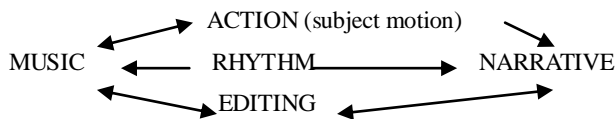


Fig. 6. Synthetic Link: Music and Narrative

Eisenstein makes a quite extraordinary statement that the primary synthetic link exists between music and narrative through rhythm. I would have to agree with this statement when studying Maurice Ravel’s music composition “Pavane pour une Infante Defunte.” Eisenstein manifested this link primarily through his rhythmic use of either subject motion or montage on editing, or both. The arrows are two-way in the chart only because it is practically impossible to discern which element is the actual origin of a scene, except to say that a rhythmic pattern seems to have been established “Fig. 7”.

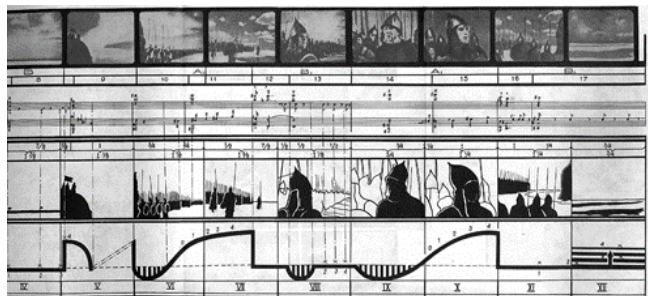


Fig. 7. Eisenstein’s Temporal Structure “Montage”. 3 The vertical elements from top to bottom are the picture frame, the music phrases, music length, diagram of pictorial composition, and diagram of movement.

## VI. THE ART OF TIME AND SPACE WHEN MUSIC MEETS DIGITAL CINEMA

In the history of late twentieth-century media art, we are introduced to a new way of visualizing time and space. With photography and cinematography, humans began to manipulate time itself: capturing it with various speeds (slow motion, fast forward, variation on time-lapse), reconfiguring it, completely collapsing the barriers of past, present and future. Although there have been many existing theories and practices over the past century, I still have many questions and cannot help conducting further film experimentation. I

am curious to discover whatever works for me to evolve the complexities of various elements in cinema.

Digital cinema has provided me with tools to visualize time and space in a way similar to how music has been written since the 11th century. In most western art music, the main factors are rhythm, harmony and melody. We hear music through patterns in rhythm, phase, form, and structure. In cinema, you hear and see time. Most techniques and grammar for use of time in music could directly apply to the use of audio. Cinema is an audio-visual phenomenon or content. While it might be logical to call it 50 percent visual and 50 percent sound, Jean-Luc Godard argued that cinema is 51 percent sound. Before a person appears, the presence of his or her sound has already arrived and been recognized. Being Chinese, I can recognize the truth in Godard’s statement. In editing, sound in most cases is the impetus for the shot, the sequence to form the narrative.

My theory and practice will not focus only on the visualization of time, but will also present how audio counterpoints or harmonizes the visual elements, and how I create emotional tension with the aid of notated music and digital application.

For those who read western classical music, this score “Fig. 8” is the recording of the music’s rhythm, harmony and melody. It also indicates the finger positions on the piano. A pianist could visualize its positions and movements and the chord progressions in time, how he/she would prepare their physical body to project the sound of the composition. However, for a filmmaker, it might still be too foreign, because there is no piano for them to imagine and hear the rhythm, the harmony and melody. I therefore introduce the piano graphic score in the following figure to support my hypothesis.



Fig. 8. Ravel’s Piano Score Pavane pour une Infante Defunte. This music has been composed for both piano and orchestra. This copy is from my study and practice with Dr. John Sharpley.

3 Eisenstein, Sergei (1942) *The Film Sense*, New York: Hartcourt; translated by Jay Leyda. Appendix.

The piano graphic roll “Fig. 9” was originally designed for the player piano, which was invented in the early 20th century -- the result of translating a score onto a roll of paper or recording a great pianist’s interpretation onto the roll for playback. The roll of paper moves from left to right. When a key is played, there is a hole and line, indicating on the paper the position of the key and how long this key should be sustained. The movement of the line horizontally shows the melody. The melody is how one remembers a piece of music, in most cases. Vertically, we can see that there are other lines placed on other piano keys that are played at the same time. In a song, we can hear a main melody sung with accompaniment. In a symphony, we can hear the main melody sung together with many other lines, all the melodic lines are in counterpoint to one another. The idea of key signature, its chords and scales gives a piece of music its own distinguished color and texture.

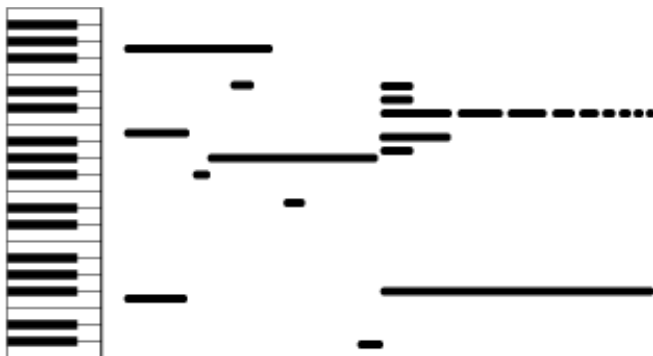


Fig. 9. The Piano Graphic Score - visualization of music on the axis of time and space. We call it the piano graphic score, invented in the early 20th century. Its representation looks like the layout for digital cinema editing. This is a simplified version, to help demonstrate my point.

The timeline indicates the axis of time (duration, speed, rhythm, sequences, form and structure) and space (layers of moving images, paintings, animation and text as well as shots, location sound, Foley, SFX, dialogue, music). This development in digital cinema as illustrated is a merit and benefit to most independent filmmakers.

Space, in my case, has often resulted in 1 to 6 channels of video and 2-24 audio channels. If you compare “Fig. 4” to “Fig. 5”, you can understand that notated music in pitch and rhythm is very much related to the instruments of digital cinema. Especially in the case of cinema, half of its elements are already music and a “symphony of sound.”

Since the early 19th century, there have been concertgoers who favored soloists in Paris. Composers are often the performers of their own compositions. Under such circumstances, a pianist is said to be equipped with great tools to be a composer not only of piano work but also the symphony. As mentioned earlier, Ravel’s “Pavane pour une Infante Defunte” has two types of scores: one for piano and the other for symphony orchestra. This is why I have introduced music to digital cinema through the piano score, then the symphony.

To conclude, the pianist interpreted the full sound of an orchestra on the piano, with complete scales of keys, and can transform and indicate the pitch and timbre of their sound for the selected musical instruments. For example, the soprano could be sung by a violin or flute; the bass could be sung by a cello or contrabass, and so on. Each instrument is powerful and they all sing beautifully, yet the music is played fully not by its powerful sound but by the strength that has been properly arranged in harmony. There is always a hierarchy. The conductor helps the performers of each instrument work on details without losing balance in a symphony. Therefore, symphony orchestration presents me with unlimited guidelines and principles for shooting and editing my films. Music is the arrangement of sound, cinematography is the arrangement of light, and the filmmaker composes and conducts a symphony of music and cinematography.

The Circle of fifths was conceived as a tool to aid musicians in manipulating or expressing their ideas. It is a visual presentation of the major and minor chromatic tonal scale.

Layout of Digital Cinema Editing Application “Fig.10” is a screenshot taken of Final Cut Pro while editing the feature-length film “TAKAO DANCER.”<sup>4</sup> The timeline indicates the axis of time (duration, speed, rhythm, sequences, form and structure) and space (layers of moving images, paintings, animation and text as well as shots, location sound, Foley, SFX, dialogue, music.)

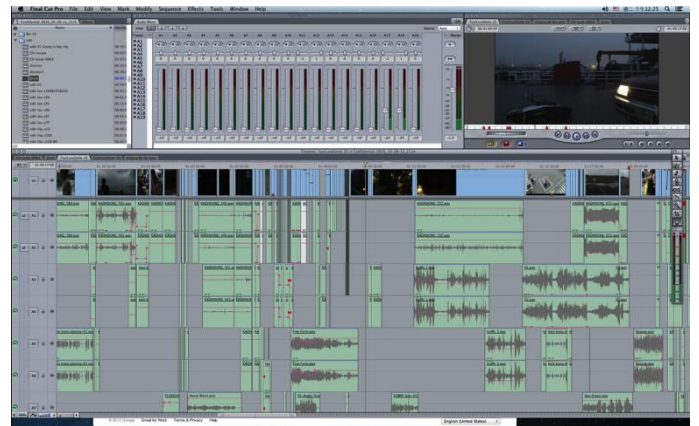


Fig. 10. Layout of Digital Cinema Editing Application

Score for Symphony Orchestration “Fig.11” Indicates Time (Horizontal Elements with Notation) and Space (Harmony, Vertical Elements – Musical Instruments).

<sup>4</sup> “TAKAO DANCER” directed by the author Dr. Wen-Shing Ho, premiered at 26th Tokyo International Film Festival.





Fig. 11. Score for Symphony Orchestration

The Circle of fifths “Fig. 12” is a visual presentation of the major and minor chromatic tonal scale. Each major key has its relative minor

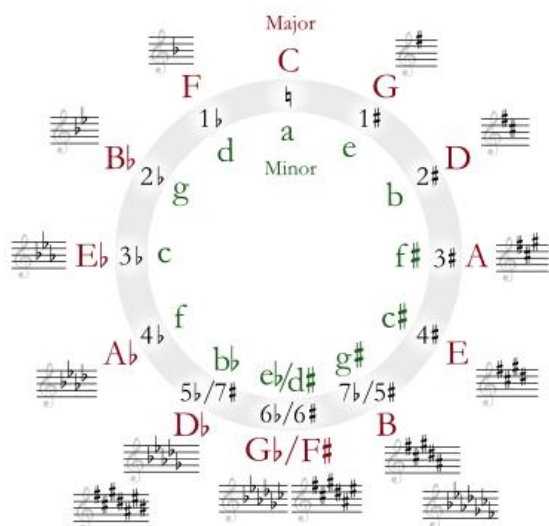


Fig. 12. The Circle of fifths

The Circle of Fifths is a tool for music composition and a guide for its analysis. I would like to develop a similar visual presentation of the concept on which my work is based, to build emotional tension and reflect the order of heaven and earth. I will do so through the use of the harmonic tools that I present as cinematic experiments in most of my films such as “WATER”<sup>5</sup>, “THIEF”, and “TAKAO DANCER”.

In the 20th century, the violist and painter Paul Klee drew much of the inspiration for his abstract art from musical rhythms and structures, lines and textures, such as “Neighborhood of the Florentine Villas” (1926). Animator and composer John Whitney spent a year in Paris studying twelve-tone composition under Rene Leibowitz and applied it in the creation of his abstract films such as “Digital Harmony.” Such paintings and motion graphics succeed in achieving an abstract quality that had previously belonged to music, and now to the visual arts.

Using the guideline of the proposed diagram “Fig. 9,” comparing musical factors to film elements, I create a film form that reflects a system of patterned relationships, as the circle of fifths does for a composer.

Musical Orchestration “Fig.13” serves as an organizational guideline for images and sound editing. (Stills from 100 minutes feature length film “TAKAO DANCER” during the post-production digital editing process.)

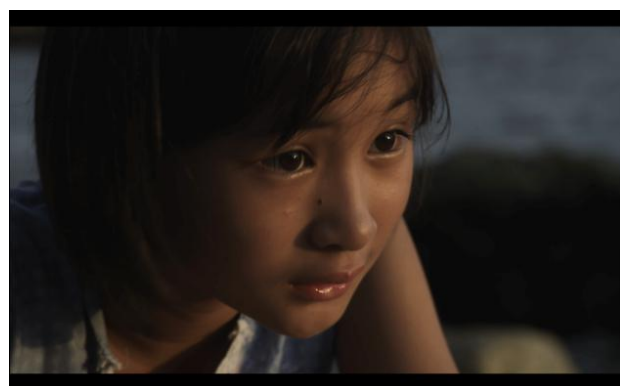


Fig. 13. Musical Orchestration

<sup>5</sup> “WATER” 15 minutes short film, world premiered at 35th Hong Kong International Film Festival. Water is the application of Maurice Ravel’s music to its direction of Digital Film Experiment.

Correlations in film and cinema need not be viewed simply as an imposed system. Rather, because of their similar outlines, there are common structures in artistic forms. Such correlations in musical composition and cinematic assembly on a timeline are not imposed. Musical composition in many cases serves as a guideline or grammar that I can utilize during editing. The sense of musical rhythm and its sonic expression communicates to me in the composition of light and movement for camera.

Film and music are two elements already in a synthetic situation. There is already a conscious recognition of the other form. The relationship suggested here is not arbitrary, but is to inspire the creation of a form not in an abstract sense, but in an extended musical sense, in hearing and sight through the characters, landscape, behaviors, dialogues, narration, cinematography, sound and music.

*1) An analysis of characteristics of musical ideas in the creation of film (see Table II)*

TABLE II. THE PROPOSED DIAGRAM: COMPARING MUSICAL FACTORS TO FILM ELEMENTS ANALYSIS OF CHARACTERISTICS OF MUSICAL IDEAS IN THE CREATION OF FILM

Elements	Music	Film
TIME  Horizontal Dimension	Time: Rhythm; Motive; Form and Structure; Rhythmic Motif and Sequence, Meter and Tempo, Duple, Triple, quadruple meter and polyrhythm, Sonata form and Symphony	Time: 24 frames per second; Motion, Spiritual, Physical time-measurement; Shot duration; Montage, the sequence, plot development, the story structure
SPACE  Vertical Dimension	Harmony: Dissonance and Consonance , Texture: dissonant Counterpoint Tonal: Chords in major and minor, Triad, fifth, 7th, 9th, poly-tonal, Poly chords and Poly-harmony Theme, Variation and Improvisation, The Circle of Fifth	Space: Elements of Cinematic Harmony: Characters and settings; Mise-en-scene, Staging Compositing : Audio and Visual
Lines	Pitch and Melody: Major and minor scales, Dynamic, Theme(s) Motive and Sequence, Theme, Variation and Improvisation, Polyphony and Counterpoint Tonal music – singing in major or minor, The Circle of Fifths	As the motion of time and space, we realize a shot, a sequence, a form, a structure, and possibly a metaphorical narrative. it is the composition of light in association with Emotion, History, Memory, Desire, Dream. Light is the original source of color, hue, saturation, and movement. Light represents life with direction, intensity, and movement; Contrast: The ratio of light and shadow

*a) Cinematic Time - Musical Time: Rhythm, Motive, Form and Structure*

*b) Cinematic Space - Musical Space: Harmony, Dissonance and Consonance*

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