MUSICAL DECONSTRUCTION / RECONSTRUCTION

Visualizing Architectonic Spaces Through Music

MAHMoud RIAD
School of Architecture, Planning, and Preservation, University of Maryland
theprogster@hotmail.com

Abstract. There is a common belief that music and architecture are connected through a hidden dimension. Both arts, when abstracted intellectually (through mathematics) or emotionally (through phenomenological experience), share a number of ordering principles, having the same notion of crescendo in sequence and progression. Many have sought to unlock this hidden dimension to create artwork that lets our souls transcend up to the heavens.

There are five different methods where architects have used music in their design approach: there are those who use harmonic proportions found in musical consonances as room dimensions to create harmonic spaces, flowing into each other like musical chords (Palladio, Steven Holl); those who believe that music is ‘design in time’ use rhythmic elements of music and apply it to their vertical surfaces and structural grids (Iannis Xenakis, Le Corbusier); those who use architecture as a musical instrument experiment with sound and acoustics to create a phenomenological environment (Bernhard Leitner, Peter Zumthor); those gifted with synesthesia (stimulating one sensory preceptor with another, e.g. seeing colors by listening to music, or vice versa) use certain musical pieces as an inspiration for form generation (Wassily Kandinsky, Steven Holl); and there are those who deconstruct an element in music and reconstruct it to architectural form, highlighting common themes between both arts (Iannis Xenakis, Daniel Libeskind).

These five different methods have been the topic of research of many architectural scholars using western music as reference. The question becomes what if the musical reference is changed? Classical, rock, pop, country, jazz, and blues music are very different from one another, yet they share similar foundational musical structures. One may go further and experiment with various world music as reference, which is very different than western music in terms of musical structure. Linguists and musicologists have discussed the origins of music in relation to language. They hypothesize that cognitive
elements found in language are somehow carried into the region's music.
This paper documents the research of the author in this topic, discussing the digital modeling applications adopted that make such an investigation possible. The interest here is exploring how the visual space is altered when the musical reference is changed, and whether properties of the musical reference are evident in the architectural visualization. The musical references will be limited to Western Classical and Arabic music.

1. Introduction

_Among the Jasmine Trees_ is an ethnomusicologist study of modern Syria in search of ‘authenticity of the oriental spirit and heritage’ that seems to have been long lost, where author Jonathan H. Shannon questions how does one achieve authenticity within modernity, not against it (Shannon, 2006). Many believe that cultural authenticity means adhering to cultural conceptions of their past - heritage. Heritage, to them, evokes images of customs, habits, and materials from their past. On the other hand, ethnomusicologist Barbra Kirshenblatt – Gimblet suggests that heritage usually features “the obsolete, the mistaken, the outmoded, and dead, and the defunct” within society (Kirshenblatt – Gimblet, 1993).

Janet Abu – Lughod asks “whose tradition?” when communities start “excavating the past to invent the new” (Abu – Lughod, 1992). What part of heritage or tradition is worth keeping, and how could it be utilized? This rationalization of tradition is the conceptual basis within which critical regionalist thinkers and architects work upon. The idea of “defamiliarization” is brought into play here, where traditional or regional elements are used slightly differently, to “make them strange”, so that the participators or observers would become more aware of them. The term is borrowed from artist Viktor Shklovsky in his essay “Art as a Device”, where defamiliarization (or ostranenie) is an artistic technique of forcing the audience to see common things in an unfamiliar or strange way, in order to enhance the perception of the familiar.

This concept of defamiliarization does not only address formal or visual characteristics in architecture. It is hypothesis of the author that defamiliarization of a visual symbol could sometimes spark negative reactions with the general public, and reduce the understanding of the architecture into a series of images as opposed to an experiential sequence. The architecture of Hassan Fathy is commonly understood as a visual recreation of Arab heritage and Egyptian farmer village life, as opposed to an architectural byproduct of using local materials and craftsmen while adhering to the region’s climate. The sad reaction towards Fathy’s New Gourna village (1946), where only his own house survives out of 70 dwellings that were built, is a product of public reaction and resentment against anything that looks Arab. The unfortunate sentiment of “west is best” allowed the New Gourna locals to tear down the village and replace it with, what they believe is western, concrete boxes.
Is quest then becomes defamiliarizing the invisible? This paper aims to discuss the use of this concept to defamiliarize music, removing it from its sonic context and placing it into an architectural setting. This method would be used to extrapolate conceptual ideas embedded in the music of a particular region, and apply it to the architecture, in hope to achieve authenticity within the architecture, without adhering to the common visual cues that architects seem to have been abusing. This is an ongoing research project, using Cairo and Egyptian music as a case study. Note that Egyptian pop music is not part of this research, as it blends a lot of western musical concepts, and has been argued by many scholars that it lost its “authentic oriental spirit”. Definitions of authenticity of the music are based upon the works of Al Farabi, Safi – el din, Owen Wright, Henry George Farmer, Scott Marcus, Jonathan Holt Shannon, and the proceedings of the Cairo Congress on Arab Music in 1932.

This paper addresses the different methods and theories of how music and architecture have been associated with one another, and how the author has been able to use digital modeling and animation tools to be able to explore the intersection between both arts and the design possibilities that stem from them.

2. Music and Architecture

Throughout history, music has been looked upon as either an intellectual body or an expression of emotion. These two different approaches can be traced back to Greek mythology. In a Homeric hymn to Hermes, the "lyre" is said to have been invented when Hermes proclaimed that a shell of the body could produce sound if its body was used as a resonator. This myth embarks on a discovery of sonic properties in materials of the universe. The lyre becomes the instrument of Apollo, and music is conceived as external sounds that God sent, reminding us of the harmony of the universe. Such music is serene, mathematically derived, and associated with transcendental views of Utopia along with the Harmony of the Spheres. This train of thought is evident in Pythagoras's teachings and it’s rebirth during the Renaissance, where music is a subject of the intellect belonging to the seven liberal arts (it belongs in the Quadrivium section, along with arithmetic, geometry, and astronomy, while the expression, Trivium, includes the arts of grammar, rhetoric, and logic). Arnold Schoenberg's music in the early twentieth century (twelve-tone method of composition) is a good example of such thought in music. The methods of expression are number theories, seeking to harmonize with the world through acoustic design.

On the other hand, Pindar's twelfth Pythian Ode tells the story of the beheading of Medusa, leading to the creation of the aulos. Athena, Goddess of strategic warfare and heroic endeavor, was touched by the cries of Medusa's sisters over her slaying, so she created a special nomos in their honor. In this myth, music arose as subjective emotion. The aulos is an instrument of exaltation and tragedy, and the instrument of Dionysian festivals. Such music is conceived as internal sounds, breaking through the human heart. The music produced is subjective and somewhat irrational (compared to the Apollonian view). It employs expressive devices such as tempo changes, dynamic progressions, and
tonal colorings. It is the music of opera, of Bach's passions, of Beethoven's symphonies, of Tchaikovsky's ballets. It is the music of the romantic artist, the music that we associated with 18th and 19th century classicism, and the music that most musicians are trained in today.

Music, as in any art form, is found to incorporate both views simultaneously. The Apollonian thought can be viewed as a left-brained mode of thinking, a rational view of the universe as it deals with issues in music theory like scales, rhythmic value, and acoustical design - the objective scientific aspects of music theory. The Dionysian thought can be viewed as a right-brained mode of thinking, a subjective emotive view dealing with how these scales, rhythms and acoustics properties can be used, altered, and manipulated to create such expressions of emotions.

Architecture theoreticians have talked about the intersection between music and architecture in both views. This paper identifies five methods that discuss such intersections:
1) Architecture as a Sequence of Harmonic Spaces
2) Architecture as a Stimulus for Movement
3) Architecture as a Musical Instrument
4) Music as an Inspiration for Architecture (irrational expression)
5) Music as an Inspiration for Architecture (rational expression)

The focus will be on both the “architecture as a stimulus for Movement” and “Music as an Inspiration for Architecture (rational expression)” methods, as their investigation relies heavily on digital modeling and animation, while the other methods will be briefly discussed.

3. Architecture as a Sequence of Harmonic Spaces

Pythagoras was the first to establish the musical proportions, believing that music could be represented as pure mathematical ratios - the ratios of the cosmos. Renaissance architects used these harmonic proportions in their architecture because they believed that “as man is the image of God and the proportions of his body are produced by divine will, so the proportions in architecture have to embrace and express the cosmic order.” This method belongs to the Apollonian view, as it is seen as an intellect rather than expression. The important factor in this method is proportion.

Pythagoras found that if a piece of string, held at two points, producing a certain pitch (let us assume that it is the C tone for this example), is divided into two equal parts (ratio 1:2), the divided string would now produce the same note, an octave higher.
If the string is divided so that the ratio produced would be $2/3$ of the original length, the pitch produced from the longer part of the divided string is a perfect $5^{th}$, the fifth note of the scale (the G tone in this example).

If the string is divided so that the ratio produced would be $3/4$ of the original length, the pitch produced from the longer part of the divided string is a perfect $4^{th}$, the fourth note of the scale (the F tone in this example).

Each note in the Pythagorean scale has a different ratio in relationship to the original length of the string. The Renaissance saw a revival of these Pythagorean ideas in western
music theory under Zarlino, and in architecture, where these harmonic ratios were used in space making.

Figure 4. The ratios in the Pythagorean scale represented in 2D shapes.

4. Architecture as a Stimulus for Movement

Elizabeth Martin, editor of *Architecture as a Translation of Music*, notes that while "architecture represents the art of design in space; music is the art of design in time." Movement through architecture is what links both the units of time and space, leaving one to wonder, how architectural elements can be placed in space, to influence one’s movement patterns. This design approach belongs to the Apollonian view, as it is seen as an intellect rather than expression. The important factor in this method is rhythm.

Figure 5 diagrams the musical edifice "Canon in Dmaj", by seventeenth century composer Johan Pachelbell, as a generator of form. The diagram is primarily interested in the rhythmic notation of the piece. This particular edifice was chosen because of its simple, looping eight-chord progression, and a simple theme, that goes through numerous variations with each loop of the chord progression. The series of images are taken out of an animation the author composed, which imagines the music being transformed in a sea of vertical elements that one navigates through, with each row on the X-axis representing a different musical instrument, and the Y-axis representing time. It can also be understood as injecting form into sheet music. The heights correspond to the pitches that the instruments play, assigning the lowest pitch (the lowest pitch played by the double bass) to the lowest unit measurement. The sizes of each vertical element correspond to its rhythmical value, assigning the widest size to the whole note values (one note for every four beats) of the bass and the narrowest size to the thirty-second note values (eight notes for every beat) of the trills (found in the sixth window of Figure 7). This particular animation can be found on YouTube (http://www.youtube.com/watch?v=g1oSbOy0V9E) or on the author’s website (http://riadmusicarchitecture.blogspot.com/)

Figure 6 diagrams the musical edifice “Alf Leila we Leila”, by Egyptian composer
Baligh Hamdi, written for Egyptian crooner Um Kalthoum. The same algorithm in respect to form making used for the “Canon in Dmaj” example is also applied on this piece. The general differences between both musical genres can be clearly seen when pairing both animations together. The canon is cyclical in nature; with the main chord progression tying the whole piece together, while the theme and its variation are composed to link back to it. This cyclical composition style is common in western classical music, and gives birth to our modern song - the cyclical nature of the verse/chorus organization, everything referring back to the chorus. The images show the bass and pizzicato strings line acting like a module throughout the entire piece, where all the vertical elements are overlaid on top of it. The Arabic piece is much more episodical in nature, where 7 themes are clearly distinguishable, with no common thread linking them. These particular animations can be found on YouTube (http://www.youtube.com/watch?v=HASPZtftS68).

Another distinguishing element in the Canon piece is the evidence of harmony; the vertical elements that are on the same coordinates on the Y-axis differ in height, as each row of vertical elements work in harmony with the next. The Arabic piece does not include any harmony at; all the vertical elements on the same coordinates are of the same height. Traditionally, Arabic music is devoid of harmony, yet it achieves its rich sound through a process of heterophony. This is possibly because Arabic music is of unequal temperament, while western music is of equal temperament. Equal temperament is a system of tuning in which every pair of adjacent notes has an identical frequency ratio, which makes harmony possible in western music. Heterophony, on the other hand, is a type of musical texture that refers to the practice of two or more musicians simultaneously performing slightly different versions of the same melody. Each version would be characterized as improvised or ornamented versions of the melody. This is evident in the animation as each row on the Y-axis, although more or less the same in height, have very slight variations of the same theme, giving the form its rich texture.
Figure 5. Visualization of Pachelbel's Canon in Dmaj. Each frame represents a beginning of a new theme added to the chord progression, starting from the initial bass line and main theme to the crescendo.
Figure 6. Visualization of "Alf Leila wa Leila". Each frame represents a different episode that occurs within the musical edifice.
A number of animations were composed for these two musical pieces, each one with a different navigation path through the vertical elements. One of the main differences between music and architecture when it comes to linear composition is where in architecture one walks forward from point A to B, in music one would walk backwards from point A to B, as there is no distinguishing what lies ahead in music, only what has been passed is being recollected in memory, while in architecture, one can distinguish what lies ahead through a strong visual axis. This notion leads the author to compose the backward navigating animations. Although the animations are true to the music, they seemed awkward in an architectural setting. The animations chosen to be presented in this paper (figures 5 and 6) have the camera navigate through the model so that the forms are seen in elevation. This allows for the element of surprise, akin to musical experience, without the need for backward navigation. This also allows the viewer to experience the Y-axis (time) in whole, as one walks outside the form as opposed to navigating through it. All said animations are available for viewing at http://riadmusicarchitecture.blogspot.com.

5. Architecture as a Musical Instrument

The architecture of musical instrument relies on both materiality and enclosure of a defined space for sound to be able to resonate throughout the body of the instrument. If architecture is seen as a musical instrument, then the sounds that are generated and manipulated within the space becomes a participant in the whole architectural experience. This method could be seen to belong to both the Apollonian or Dionysian view, depending on its use; acousticians would argue that the manipulation of sound and acoustics is an intellectual art, while Sound artists and architecture have used this manipulation to create expressionist spaces that aim to speak to the visitor’s emotions, rather than the normal noise control use of most acousticians. The important factor in this method is acoustics.

Rasmussen names three different musical movements that were a result of the acoustical conditions of the architecture. The Gregorian chant was developed due to the long reverberation times of the Roman Catholic Cathedral, where the acoustics made hearing speech difficult, yet the notes being sung resonated harmoniously throughout the space. Giovanni Gabrielli utilized the domes of St Marks in Venice to create a dynamic counterpoint between two orchestras in his piece Sonata Pian e Forte. Bach’s interventions were developed as a response to St. Thomas in Leipzig’s acoustical conditions, where the reverberation time was relatively short. The long bleeding notes that were considered spiritual in the Roman Catholic Cathedral dies out relatively quickly at St. Thomas, requiring Bach to invent a style of playing to create the same spiritual feel when listening to it.

While there have not been many published studies on the development of Arabic music due to acoustical conditions, it should be noted that the Islamic communities have traditionally been defined as “acoustic communities”, where the call to prayer (adhan) is audible from every part of the city.
6. Music as an Inspiration for Architecture (irrational expression)

Many artists, musicians, and writers have experienced sensations where sound triggers visual stimuli, like color or shapes. This phenomenon is called Synesthesia. It is irrational in a sense that the triggers are usually a reflex action that cannot be pre-rationalized. This method belongs to the Dionysian view, as it is an expression rather than intellect. The important factor in this method is Synesthesia.

It is difficult to affirm how Arabic music affects Synesthesia, or whether people react to it different than western music, or if Arabs are Synesthetes in the first place, or what kind of Synesthetes are they, as little research has been done on the subject according to region. Arab Musicologist Habib Hassan Touma discusses the emotional content of arabic maqams, stating that results of a survey among Arabian musicians show that maqam rast evokes a feeling of pride, power, soundess of mind, and masculinity; maqam bayati evokes feelings of vitality, joy, and femininity; maqam sikah evokes feelings of love; maqam saba evokes sadness and pain; while maqam hijaz conjures up the distant desert. These have yet to be tested on how they may relate to the built environment.

7. Music as an Inspiration for Architecture (rational expression)

To be able to translate one art form into another, a level of deconstruction is needed in order to understand the otherwise hidden abstract qualities that the original art form possesses in order to apply it to the other. An analysis is thus performed and rationalized. This method could be seen to belong to both the Apollonian or Dionysian view, depending on its use. The important factor in this method is deconstruction.

A common method of deconstruction would be assigning a form to each different musical instrument. Steven Holl used Bella Bartok's Music for Strings, Percussion and Celesta as his inspiration for the Stretto House. Both the piece and the building are formed in four sections, consisting of two modes: heavy orthogonal masonry representing the percussion, and light curvilinear metal roofing representing the strings. Using the same two musical pieces as in the “Music as a Stimulus for Movement” section, similar animations were explored that attempts to address the sensual experience of the pieces. Wireframe animations were created to study the general linear form (Figure 7 and 9), while light study animations were generated to attempt to replicate the crescendo in the music using light as a medium (Figure 8).
Figure 7. Wireframe deconstruction of Pachelbel's canon in Dmaj.
Figure 8, Light study / deconstruction of Pachelbel’s canon in Dmaj.
In the Canon example, imagining that one is moving through a linear procession, each threshold corresponds to a chord in the piece - making the distance between each threshold and the other equivalent to a bar of music. The pizzicato strings are translated into small little light spots (seen on the roof on the wireframe model and as small spot lights in the light model), while the starting violin theme is seen as long light lines cutting through the model. With each theme being added to the canon, one of the planes on the hall starts to take a curvilinear form emulating the flow of the piece, until the piece reaches the crescendo main theme, where the form explodes with light.

In the Arabic piece example (Figure 9), also imagining that one is moving through a long linear procession, there is a lack of threshold like that of the Canon piece, because there are no chord progressions in the piece. The threshold is achieved by moving from one theme to the other, where the form abruptly changes as a response. Each plane corresponds to a different musical instrument – the oud for the right wall, the violin for the left wall, the bass for the ground plane, and the ney (wind instrument) for the roof plane, while the percussion is laid out in the center (The decision to layout the instruments that way was due to the mixing of the Jesse Manno recording of the piece, where the oud and bass were more noticeable on the right channel, and the ney and violin were more noticeable on the left channel). Heterophony is evident throughout the piece, which explains the need to model each of the instruments slightly different, where sometimes one instrument would reach a note faster than the other, or include minor improvisations in the piece, adding more texture and variation to the animation. Modeling each instrument the same way, although the pitch and rhythmic input of all instruments are all the same, would produce a monotonous experience, and would not be true to the piece, which is filled with these colors of variation and rich melodic texture.
8. Conclusions

Both animations seem to favor the linear understanding of space, which limits the possibilities of how one could relate both music and architecture. This very well could be due to the difficulty the author had trying to visualize these sequences in anything but linear form. It seems that once a musical piece is picked, the linear composition becomes inevitable. However, if one models ideas from the music, as opposed to the music itself, other possibilities may emerge. On the other hand, since time, and thus architecture, is experienced in a linear motion, the relationship between both may be strictly seen as an experiential movement and crescendo through space, where the second series of animations (Music as an Inspiration for Architecture – Rational Expression) provides more fruitful results.

The series of animations were very helpful to visualize different conceptual composition agendas that can be argued have stemmed from the culture in general. The animations highlighted certain attributes in the musical form that was previously taken for granted, like the cyclical nature of the canon and the episodical nature of the Arabic piece. This is where the defamiliarization process is effective – by translating the music from the aural arena into the visual, one starts to become more aware of these specific attributes, and how they may be related to existing architecture. The rhythmical animation of the Arabic piece (figure 6) is full with heterophony, and reminds the observer of the streetscapes in Islamic streets.

What is surprising is that the expected conclusions were very different than the actual conclusions. Since both Arabic and Western music have different attitudes towards musical scales and rhythms, it was expected that these attributes would manifest in the animations. On the contrary, these become very difficult to see or grasp through what has been produced, as the differences between both seem to be very minute to distinguish by the naked eye. This led the author to conclude that the differences between both rely more heavily on attitudes toward music in general, and less about these technical aspects. More animations are expected to be composed that deal with proportion, acoustics, and synesthesia.

References

Shannon, J.H., Among the Jasmine Trees: Music and Modernity in Contemporary Syria, Wesleyan University Press, Middletown, CT 06459, 2006
Wittkower, R., Architecture Principles in the Age of Humanism, 1971, New York: W.W. Norton & Company