PANORAMA

International Panorama Council Journal, Volume 4
Selected Proceedings from the 29th IPC Conference
2020

ISSN: 2571-7863
www.panoramacouncil.org

Where Islamic Visual Theory and Western Pictorial Tradition Meet: 360° Panoramic Photography's Two-Dimensional Image Projections and Sacred Spaces

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Abstract

Using this author's ongoing project Sacred Spaces of New England and Hans Belting's book *Florence and Baghdad: Renaissance Art and Arab Science* as starting points, this paper compares and contrasts Islamic visual theory with Western pictorial tradition and examines Islamic pattern design to root this author's 360° panoramic photography's two-dimensional geometric image projections of sacred spaces into an artistic tradition.

Keywords

360° Panoramic Imaging, Geometry, Islamic Geometric Pattern Design, Cultural Heritage, Mapping Projections

Introduction

Geometry and the sacred are often linked in most religions' manifestations of art and architecture, such as churches, temples, mosques, and religious monuments, as well as in designed natural spaces. Sacred geometry often refers to symbolic and sacred meanings assigned to certain geometric forms and proportions. [1] It is through the use of geometry as a cultural technique that one can in part understand the relationship between a religion and its philosophical expressions. In the book *Florence and Baghdad: Renaissance Art and Arab Science*, Hans Belting examines the notions of Islamic visual theory and Western pictorial tradition through the lens of geometry, comparing and contrasting represented geometry (geometric motifs) and representational geometry (applied linear perspective) to examine the philosophies associated with Islam and Christianity during the Renaissance.

360° panoramic imaging is the science, art, and practice of creating interactive and navigable immersive 360° screen-based images, which usually depict a place or event. A 360° panoramic image is built upon a geometric structure that produces the illusion of an immersive image space. This image data can also be output onto a two-dimensional surface using multiple projection variations. It can be argued that 360° panoramic photography's two-dimensional image projections mirror other geometry-based artistic practices such as Islamic pattern design. Using this author's ongoing project Sacred Spaces of New England and Hans Belting's book *Florence and Baghdad: Renaissance Art and Arab Science* as starting points, this paper compares and contrasts Islamic visual theory with Western pictorial tradition and examines Islamic pattern design drawing to root this author's 360° panoramic photography's two-dimensional image projections of sacred spaces into an artistic tradition, resulting in a body of work that is a conceptual hybrid of two seemingly disparate cultural techniques—represented geometry and representational geometry (figure 1).

Fig. 1. Stereographic Projection of Saint Anthony of Padua Church in New Bedford, Massachusetts. ©2020 Seth Thompson, Author.

Represented Geometry versus Representational Geometry

In the book *Florence and Baghdad: Renaissance Art and Arab Science*, Hans Belting argues his controversial theory of how the contributions of Islamic visual theory led to the development of linear perspective in Italian Renaissance painting. In this analysis, he compares and contrasts the cultural systems and practices of Islam with the West's in order to show that while mathematician and philosopher Abu Ali al-Hasan Ibn al-Haytham's (965–1040 AD) theory of optics may have been used for a different cultural purpose, his ideas would later influence the development of linear perspective used in Italian Renaissance painting, as well as Western concepts of human perception.

For the purposes of this paper, arguments about the use of linear perspective as a tool for colonization have been set aside in an effort to focus on the different philosophies associated with the use of *represented geometry* (motifs of geometry) found in Islamic Art and *representational geometry* (linear perspective) as it is used in Italian Renaissance painting to create three-dimensional space on a two-dimensional surface. [2]

Credited with inventing the camera obscura, Ibn al-Haytham (a.k.a. Alhazen) used this device and mirrors to test his theory that light moved in straight lines. While classical optical theory believed that the eye emitted energy to perceive objects, Ibn al-Haytham argued that physical light rays were reflected from a multitude of points on objects, and that these rays traveled in straight lines to the eye and were then transmitted to the brain. [3]

Linear perspective is a type of geometric projection system in which sightlines converge to a vanishing point(s) on a horizon line so that objects appear smaller as their distance from the observer increases. The sightlines are intercepted as if the viewer is looking through a window and seeing what intersects on the windowpane. While some may argue that linear perspective mimics optical reality, it is a technical construction and not an expression of natural vision.

The main difference between Ibn al-Haytham's theory of optics and linear perspective is that the former lacks the notion of a horizon line and vanishing point. Belting argues that Ibn al-Haytham's theory reveals a cultural difference between an Islamic approach to seeing and the Western approach to seeing developed in the Renaissance. Belting writes, "The vanishing point was first invented in Western art—because it makes sense only in a kind of picture that did not occur in [Islamic] art … Alhazen had no need of a vanishing point for his theory, which exists only in the gaze, the act of seeing, but not in the world of objects. Nevertheless the geometrical point through which the world transforms itself into a picture became possible only within the framework of a system that could be calculated mathematically." [4]

While linear perspective links the observer to the work of art by having the picture take on the person's gaze, Islamic visual theory addressed the notion of light and the laws associated with it. [5] Belting writes that Islam "drew back from the optical stimuli of the external world when it strove to protect the power of the imagination from the senses. A drawn or painted replica of internal images could only be an idol. … Paintings using perspective technique were thus necessarily regarded as idols when they became known in the Arab world. Such works could compete neither with the living creation in which people existed, nor with production of mental images, which remained a mystery of human nature." [6]

Islam's use of geometry is not related to pictorial space but rather is used to create complex mathematical patterns. Represented geometry in Islam is an expression of the divine and the cosmos. In the essay "A Hypothesis Concerning the Character of Islamic Art," Asli Gocer writes, "Like Plato, the Muslim sees geometry and exact proportion as a direct expression of the divine and takes mathematics to be the key to understanding the structure of the cosmos. For both, repetitive patterns, exactness of proportion, and symmetry are synonymous with God's perfect paradigm." [7]

In Islam, represented geometry is not just ornamentation but is rather a visual expression of meaning very different from Western pictorial tradition, which uses representational geometry as an underlay to depict the world in a mimetic manner. [8]

The differences between represented and representational geometries are best illustrated by examining the different intentions of the window and the mashrabiya. The window within linear perspective symbolizes the location of the observing subject who is looking out the window at the artist's constructed three-dimensional world. The idea of the window as it occurs in perspective is polar to the way the mashrabiya is intended in Arab-Islamic countries. [9] A mashrabiya is typically a protruding window screen found on the upper floors of a building that enables cool air to pass through. It usually has carved wood latticework consisting of elaborate geometric designs. A mashrabiya is porous to enable patterns of light to be cast on the floors and walls of the interior. Belting writes, "In Arabic living spaces we find a 'staging' or 'orchestration' of light that carries its own symbolism. The light always originates outside, but here it is directed inside in a particular way, where it draws the gaze of those inhabiting the space without their having to look outside. It is the *reflection* of the light that is staged, through the angle of incidence and the geometry of the screen." [10] Both cultural techniques—represented and representational geometries—reflect different philosophical intentions between Islamic and Western thought.

Islamic Geometric Pattern Design

Geometry has played an important role in Islam's material culture, not only structurally but also philosophically, since Islam's very beginning. Examples of the use of geometry can be found in some of the earliest Islamic monuments, including the Dome of the Rock (late seventh century) in Jerusalem and the Khirbat al Mafjar (early eighth century) in the West Bank. [11] In the essay "What Is Islamic Art?" Wijdan Ali defines Islamic art as "the artistic manifestation, created within a defined order and harmony by Muslim and non-Muslim artists, according to Islamic aesthetics, and within Islam's principles and concepts." [12] While Islamic art encompasses a broad span of geographic locations, time periods, and media including architecture, calligraphy, painting, glass, pottery, and textiles, the focus of this paper is on geometric design in Islamic art.

Islamic artists initially drew from classical tradition, early Christian art (particularly Byzantine art), and Sassanian art to create a new form of ornamentation that stressed unity, logic, and order. [13] Islamic art is indebted in part to the philosophies of the Athenian philosopher Plato. [14] Asli Gocer writes, "The most original Islamic contribution to art, geometrical design, arabesque, and patterned surface art often consist in the complex design of an interlocking system of rotating polygons and starts within circles. As it is for Plato, circle is the governing basis of all geometrical shapes for the Muslim, followed by hexagon, triangle, and square depicting the fundamental shapes of the geometric universe. Coupled with a sense of rhythm, these shapes are considered by some sects of Islam to evoke infinity, which is a symbol of divine presence." [15] Populating a space, area, or surface—whether spiritual or secular—with an uninterrupted, repetitious design using essential geometric forms as its basis is a significant quality of Islamic Art. In Islam, the circle relates to both God and the heavens; the square relates to the four directions of the earth as well as to earthly matters. Polygons and stars found within many Islamic geometric design patterns derive from the rotation of the square within the circle. [16]

The use of Islamic pattern design in religious spaces has not been exclusive to the Muslim faith alone. For example, in Coptic Cairo, which is part of the Old Cairo district in Cairo, Egypt, Islamic pattern design may be found in such places as the Ben Ezra Synagogue and Saint Virgin Mary's Coptic Orthodox Church (a.k.a. Hanging Church or al-Mu'allaqa). In the Ben Ezra Synagogue, Islamic pattern ornamentation is prominently found on the Torah Ark or hekhal as well as throughout the synagogue's interior. Similarly, throughout the nave of Saint Virgin Mary's Coptic Orthodox Church and on the entrance portal and iconostas, Islamic pattern design ornamentation plays a predominate role in the design of the space. Integrated within this ornamentation is the symbol of the cross, which is found in many Coptic churches in Egypt. [17]

While there is no definitive answer as to why Islamic geometric pattern was incorporated into the interiors of the Ben Ezra Synagogue and Saint Virgin Mary's Coptic Orthodox Church, Ann Shafer offers a plausible theory, arguing that "while it is possible that the choice of Islamic-style geometric decoration was a politically motivated one … it may instead be interpreted as reflecting an environment of acculturation, wherein Christian and Muslim artists, patrons and congregations alike shared a social and cultural heritage taken from a common frame of visual reference. Likewise, the hekhal decoration in the Ben Ezra Synagogue indicates that a strong element in early modern Jewish identity in Cairo was its connection to the surrounding visual cultures." [18] Islamic art craftsmen in Egypt were not exclusive to the Muslim faith but also included Jews and Christians. Within a broader context, religious influences may be found in seemingly disparate faiths throughout the world, manifested in their art and architecture as the result of shared cultural experiences.

Sacred Spaces of New England and Stereographic Image Projections

Sacred Spaces of New England is an online artistic research platform developed to document, map, and archive sacred spaces of New England using 360° panoramic photography, hypermedia systems, and related technologies (https://seththompson.info/sacredspacesne/). The purpose of this project is to record and re-present New England's religious and secular places that elicit contemplation, reflection, and inspiration. Rather than to be a comprehensive survey, the intent of this long-term project is to be a personal exploration of sacred spaces within New England, showcasing the region's diversity and its rich heritage. [19]

Using the 360° panoramic photography data from the Sacred Spaces of New England project, the panoramic images can be digitally redrawn with a number of different mapping projections (e.g., equirectangular, stereographic, cylindrical, mercator) onto a two-dimensional flat surface, creating what appears to be a hybrid between represented geometry and representational geometry. For this investigation, the author has predominantly used the stereographic projection, which may also involve additional transformation adjustment operations of the image, including yaw, pitch, and roll, as well as adjusting the field of view of the spherical projection to create the final image. Involving these operations is similar in a sense to developing an Islamic pattern design, as one manipulates the image within a set of geometric-based rules to create the formal outcome (figures 2, 3, 4, 5, 6, 7, 8). Interestingly, the

stereographic projection is attributed to Claudius Ptolemy, a mathematician, astronomer, geographer, and astrologer who lived in Alexandria, Egypt, in the second century CE; he referred to it as a *planisphere projection*. Ptolemy's *Planisphaerium* is the oldest surviving document that describes the stereographic projection. [20] By combining such notions as represented geometry and representational geometry, this author's work hopes to inspire an interfaith dialogue between religions by exploring religious philosophies through geometry while documenting sacred spaces.

Fig. 2. Stereographic Projection of Saint Mary–Saint Catherine of Siena Parish in Charlestown, Massachusetts. ©2020 Seth Thompson, Author.

Fig. 3. Stereographic Projection of First Congregational Church of Madison in Madison, Connecticut. ©2020 Seth Thompson, Author.

Fig. 4. Stereographic Projection of St. Andrew's Episcopal Church in Newcastle, Maine. ©2020 Seth Thompson, Author.

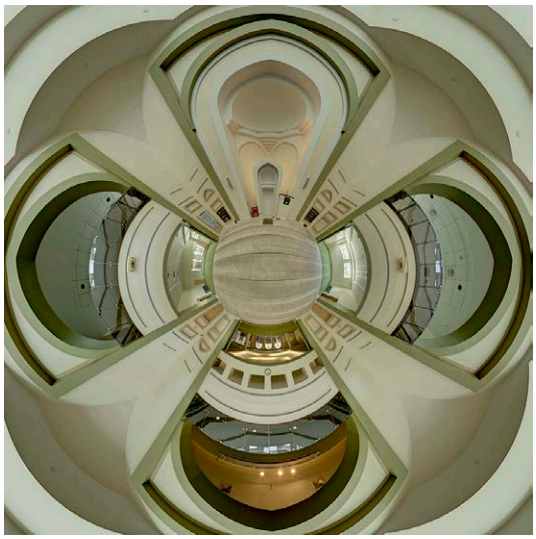

Fig. 5. Stereographic Projection of Islamic Society of Boston Cultural Center in Roxbury, Massachusetts. ©2017 Seth Thompson, Author.

Fig. 6. Stereographic Projection of St. John's Episcopal Church in Portsmouth, New Hampshire. ©2020 Seth Thompson, Author.

Fig. 7. Stereographic Projection of First Presbyterian Church in Stamford, Connecticut. ©2020 Seth Thompson, Author.

Fig. 8. Stereographic Projection of Saint Catherine Greek Orthodox Church in Braintree, Massachusetts. ©2017 Seth Thompson, Author.

Concluding Remarks

Hans Belting writes that mathematics in Islamic culture "do not link abstract with figurative but rather abstract with abstract. Geometry in [Islamic] culture has become a symbolic form in the same sense that pictorial perspective was in the Renaissance. It does not depict the world in a mimetic manner, and it is a symbolic form in the way it raises mathematics to a cosmic law." [21] While the notions of represented geometry and representational geometry as cultural techniques seem to be philosophically polar at a glance, the ends appear to be the same—to create vehicles for reflection and contemplation.

With the ability to digitally redraw 360° panoramic photography data onto a two-dimensional flat surface using different mapping projections, a conceptual hybrid between the two cultural techniques—represented geometry and representational geometry—can be made. For this investigation, the stereographic projection of sacred spaces has been used; not only does it make references to Islamic and Western geometric uses, but viewers sometimes equate the images to the mandala, a geometric configuration of symbols found in some Eastern religions, such as Hinduism and Buddhism.

This paper acts as a trajectory for future work by this author in the form of artistic production that examines geometry, spirituality, and religion. This author also hopes to document sacred spaces outside the context of New England to broaden the understanding of *sacred geometry* through practical and theoretical investigations, as geometry is manifested in almost all religions; this study seeks to explore the interrelationship of religion and geometry.

Notes

1. Strachan, *Chartres: Sacred Geometry, Sacred Space*, 35.
2. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 14–15.
3. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 29–30.
4. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 10–11.
5. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 9, 11.
6. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 30–31.
7. Gocer, "A Hypothesis Concerning the Character of Islamic Art," 691.
8. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 30–33.
9. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 252.
10. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 253.
11. Bier, "Geometry in Islamic Art," 1–2.
12. Ali, *What Is Islamic Art?*, 55.
13. Metropolitan Museum of Art, *Islamic Art and Geometric Design: Activities for Learning*, 11.
14. Gocer, "A Hypothesis Concerning the Character of Islamic Art."
15. Gocer, "A Hypothesis Concerning the Character of Islamic Art," 691.

16. Erzen, "Reading Mosques: Meaning and Architecture in Islam," 125–131.
17. Mahmoud, "Geometric Patterns in Egyptian Architecture & Interior Design," 1–11.
18. Shafer, "Sacred Geometries: The Dynamics of 'Islamic' Ornament in Jewish and Coptic Old Cairo," 158–177.
19. Thompson, "Sacred Spaces of New England: Artistic Research, Cultural Heritage, and Virtual Reality Panoramic Photography."
20. Swart and Torrence, "Mathematics Meets Photography Part I," 14–17; Snyder, "Map Projections—A Working Manual."
21. Belting, *Florence and Baghdad: Renaissance Art and Arab Science*, 33–34.

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