

CONSERVATORY OF MUSIC OF VERONA

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DEGREE IN COMPOSITION

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Master thesis

The Love which moves the Sun
and the other stars
(Mass for a symbol)

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*Music is a moral law:
It gives a soul to the Universe,
wings to the mind,
flight to the imagination,
a charm to sadness, and life to everything.
It is the essence of order,
and leads to all that is good,
just and beautiful,
of which it is the invisible,
but nevertheless dazzling,
passionate, and eternal form.*

Plato, 400 B.C. (from the Dialogues)

To all human beings of good will.

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Abstract

The aim of this thesis is to explain my composition for flute, soprano, live electronics and video. Such a composition is an interdisciplinary, multi-medial, multimodal and a real-time work creation. It has been inspired by a symbol, called Seed of Life, that is present all around the world and in particular in the land of the descendant of the Cathars, where I was born. This thesis is the fruit of work originating from years of research that I have carried out in various fields of human knowledge: history, philosophy, ancient traditions, quantum physics, ethnomusicology, esoterism, sacred geometry, ufology and, of course, arts, music and technology.

The thesis is divided in two parts. The first part illustrates the message I set out to convey. It begins illustrating where the symbol can be found: in Lessinia, in Northern Italy, in all Italy, in Europe and all around the world. Then the various meanings of the symbol are listed, including the main one: it represents the creation. Such a meaning is explained by means of the procedures of the Sacred geometry. Subsequently it is shown how some researches in the fields of quantum physics, ethnomusicology, and ufology are linked to the symbol.

The second part explains, in particular from a technological point of view, the composition I wrote. First of all the technologies involved in the composition are listed. Then the diffusion system of the sound, as well as the algorithms of sound spatialization I used in my composition, are described. Subsequently the theme of mapping sound-colour is faced, and the mappings I chose are illustrated. The thesis goes on showing how I reached the goal of having coherence between what happened at video and audio level. Finally the structure of the composition and that of the score are explained. An integral part of this thesis is the material in the attached cd: the score and its legend, the Max/Msp code, the Processing code, the leaflet to give to the audience, and the video-recording of its first performance.

The aim I set out to achieve with this work has been the representation of the symbol (and of all the meanings and the arguments to which it is related) by means of a multimedia composition that makes use of modern technologies for artistic creation.

My composition tried to represent through art, a content that by its own nature is very complex and difficult to communicate, but that is simultaneously wonderful and fascinating.

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Chapter 1

Introduction

*La gloria di colui che tutto move
per l'Universo penetra, e risplende
in una parte più e meno altrove.
Nel ciel che più de la sua luce prende
fu' io, e vidi cose che ridire
nè sa nè può chi di là sù discende;
perchè appressando sè al suo disire,
nostro intelletto si profonda tanto,
che dietro la memoria non può ire.
Veramente quant'io del regno santo
ne la mia mente potei far tesoro,
sarà ora materia del mio canto¹.*

Dante Alighieri, Divine Comedy - Paradise Canto I, verses 1-12
(Invocation).

This thesis is the fruit of work originating from years of research that I have carried out in various fields of human knowledge. This research began with an attempt to give a meaning to a symbol, known in Italy as “Sole delle Alpi” (meaning “Sun of the Alps”). This symbol is widely used in Lessinia²,

¹According to the Norton's Translation: *The glory of Him who moves everything penetrates through the universe, and shines in one part more and in another less. In the heaven that receives most of its light I have been, and have seen things which he who descends from thereabove neither knows how nor is able to recount; because, drawing near to its own desire, our understanding enters so deep, that the memory cannot follow. Truly whatever of the Holy Realm I could treasure up in my mind shall now be the theme of my song.*

²The Lessinia is a geographic zone mainly mountainous located predominantly in the Province of Verona and partially in that of Vicenza and Trento.

the land where I was born and grew up.

For example, it is depicted in many of the churches and engraved in many of the wooden tools. It can also be seen in the coats of arms of municipalities of the valleys, and also in the coats of arms of the cultural associations that aim to rediscover and enhance the traditions of the Cimbri people³, as in the association *Gruppo Etnico Musicale dei Panganoti-Cimbri*⁴ (fig. 1.1).



Figure 1.1: Coat of arms of the association Gruppo Etnico Musicale dei Panganoti-Cimbri.

Many recent studies carried out by this association confirm that the Cimbri people descends from the *Cathars*⁵. In the medieval epoch the Cathars were persecuted as heretics. They fled from France to find refuge in various parts of Europe, but mainly on the mountains of Verona and Vicenza⁶ after having spent some generations in Germany.

My research about this symbol lead me to discover that it is widespread not only in Lessinia but also throughout Europe and even all around the world. Driven on by curiosity I searched what meaning such a symbol could have. After having read lots of books and visited numerous web sites I

³The Cimbri people lives in Lessinia and still maintain its own traditions, tongue and culture.

⁴<http://www.cimbripan.org>

⁵One need only consider that the surnames of many Cimbric families refer to this origin. For example, the family name Albi derives from the Cathar French city of Albì, Bonomi derives from “bon homme” the term with which the Cathars were indicated, Consolati derives from “consolamentum”, the only sacrament practised from the Cathars.

⁶They also took refuge in other parts of the Italian regions of Piemonte, Veneto, Venezia-Giulia and Trentino Alto Adige, as well as in various zones of Europe.

concluded that the main thing it symbolizes is the Creation: this is the object of my thesis and of my composition.

1.1 Aesthetic choices and motivations

At the beginning of my research I was unaware that such a symbol could be so full of meaning, that to comprehend it I would have to make studies in various fields of human knowledge. To my amazement, I have ascertained that this symbol is indeed part of the culture and traditions of the people of my mountains.

Therefore, I have felt a strong necessity to disseminate, by means of an artistic composition, the result of my research in order to share this knowledge with other human beings interested in such arguments.

The aim I set out to achieve with this work is a representation of this symbol (and of its meanings) by means of a multimedia composition that makes use of modern technologies for artistic creation.

My composition thus tries to represent through art, a content that by its own nature is very complex and difficult to communicate, but that is simultaneously wonderful and fascinating.

I have always had great conviction that art is a medium with which to communicate a message. I have always disagreed with the school of thought that believes that art is an exclusive representation of itself. In my opinion, art is a language and as such, its main purpose is to convey a message.

After gathering all the background information and material about the message I wished to communicate, I wondered how I could express such a complex message through art, the message being full of meaning which appear to be so distant and unrelated to one another.

The first objective I set for myself was to find an effective method to convey the content, and this could not help but to include images, since we live in a culture heavily influenced by visual aspects.

The second way I chose to convey my message was to use the voice of a soprano in order to recite and sing a text. From the beginning I planned to include in such a text not only my words but also those of the people on whom my research was based (in particular Dante Alighieri, Drunvalo Melchizedek and Marius Schneider).

The third way I chose to express the content was to use symbolism. This has been realized not only at the level of the images projected on the screen, but also at level of movements of the singer who, as an actor, has to move on the

stage.

Furthermore I planned that the sounds and the images should have had a strong correlation with each other. I carried out that not only using continuous and discrete synchronizations but also describing at audio level, making use of complex spatializations of the sound, what was represented at video level (the goal here was to create *crossmodal interactions*⁷).

In addition was a strong conviction to make an “audience-centred” composition, trying to break the wall between the audience and the representation. I tried to carry out that designing a complex panning system, so that the audience was surrounded by the sound, which, furthermore, was not static but moving. The use of some technologies helped me in reaching such a goal that allowed to avoid the traditional case in which the sound comes from the stage in front of the audience.

Moreover to improve the audience’s awareness of the composition I planned to distribute a pamphlet with the recited and sung lyrics performed by the soprano. On this pamphlet a few lines would be written to introduce the audience to the composition, explaining in particular that it is a “mass for a symbol” in the sense that is a sacred, but not religious, representation.

Since the argument after all is about life, I decided to write a real-time composition, that made use of musicians and not exclusively of sounds and images created by a computer. Indeed, a similarity that life and art share is that life is never static but always changing, just as an artistic representation made by a human being is never equal to its previous iteration.

Furthermore, arising from the point that every performance of my composition should be slightly different from each other, I decided not to use any sampled sound but only sounds that can be obtained from a real-time execution.

The title of this thesis (and of the composition), “The Love which moves the Sun and the other stars”, is the translation⁸ of the last verse of the XXXIII

⁷Traditionally, each one of the five “classic” senses (vision, hearing, touch, smell and taste), has been studied in isolation. However, in the last few years, a variety of researchers in fields related to human perception, such as psychology, neuroscience, linguistics, and biology, have begun to investigate potential sensory interactions across the classic modalities. Indeed, carefully designed experiments have revealed the existence of many such “cross-sensory” interactions, with the most notable ones being auditory-visual, visual-tactile, auditory-tactile, and olfactory-gustatory. These experiments have emphatically shown that even early processing for a single sense is highly influenced by information in, and attention towards, other senses. Perceptual interactions of this kind are often called crossmodal, but the terms multimodal, multisensory, and supramodal are also used.

⁸According to the Norton’s translation.

Canto of the Paradise of the Divine Comedy of Dante Alighieri, “L’amor che move il sole e le altre stelle”. Many researchers are currently supporting the concept of the “Cathar” Dante. Their studies confirm that Dante advocated the Cathar doctrine. It seemed appropriate to me to choose a title that referred back to the Cathar culture, as the starting point for my research was a symbol found in the land of the descendants of the Cathars. Moreover, I chose this phrase for its elegance and musicality. As for the meaning it seems that with that last sentence Dante wants to suggest to us that the key to all is Love. In addition, he seems to indicate the stars quite persistently, since all the three parts of the Divine Comedy end with the word “stars”. Is it maybe a reference to a civilization coming from the stars? Maybe the same that creates the crop circles? Indeed there is the theory, supported by many researchers [1], that Dante had contact with space civilizations, but this is not an appropriate forum nor is it the message I want to represent in my composition.

I deem that the product of an artist should be fruit of his time, not only because of the artistic techniques and technologies used, but also due to the contents. For this reason I consider it appropriate to make reference to quantum physics and crop circles.

Finally I have always been fascinated by interdisciplinary operas and by the Gesamtkunstwerk (“total artwork”) of Richard Wagner, in which the various arts such as music, song, dance, poetry, visual arts, and stagecraft are unified. I tried to reach a similar goal: my composition is an interdisciplinary and multimedia representation of all that is written in the first eight chapters of this thesis.

1.2 Dissertation Outline

This thesis is structured in two parts. The first part (chapters 2 - 8) concerns the presentation and the explanation of the content I intend to represent with my composition.

The second part (chapters 9 - 15) explains, in particular from a technological point of view, the composition I wrote.

The chapter 2 illustrates where the symbol can be found: in Lessinia, in Northern Italy, in all Italy, in Europe and all around the world. The chapter two lists the various meanings of the symbol.

The chapter 3 explores the geometric procedures that lead to the construction of the symbol; it also explains the geometric derivations that from this

symbol lead to the Platonic solids, and to other figures of the Sacred Geometry.

The chapters from 4 to 8 show the relationships between the main meaning of the symbol, (i.e. the creation), and the quantum physics, the ethnomusicology, and the ufology.

The chapter 9 lists the technologies involved in the composition. In chapter 10 the diffusion system of the sound, as well as the algorithms of sound spatialization I created, are described.

Subsequently in chapter 11 the theme of the mapping sound-colour is faced, and the mappings I chose are illustrated. The following chapter goes on showing how I reached the goal of having a coherence between what happened at video and audio level.

Finally the chapters 13 and 14 explain how the composition and the related score, are structured.

The dissertation is complemented with an accompanying CD extra that includes the score and its legend, the Max/Msp code, the Processing code, the leaflet (with the recited and sung lyrics performed by the soprano) to give to audience, and the video-recording of its first performance.

Chapter 2

The Sun of the Alps

As far back as 10 thousand B.C. history is abundant with carvings and writings reflecting peoples respect and adoration for this object.

From the film “Zeitgeist”¹.

The Sun of the Alps is the current denomination, introduced in the 1990s by some intellectuals (in particular the Prof. Gilberto Oneto, [2]) of an archaic symbol widely spread in Celtic areas and especially in the Alpine region. The symbol is also known (in Italian) as *Hexamer sun*, *Celtic rose*, *six petals flower*, *seed of life*, *shepherds rose* and *Carolingian rose*.

It is a well wishing symbol that represents the sun; it is composed by six rays or petals, regularly radially spaced and generally inscribed in a circumference or in a circular decoration (some times in an hexagon) and not bound to specific colours.

As stated in the previous chapter, the Hexamer sun is a symbol widely spread in Lessinia. For example, it is possible to find it in churches, in the coats of arms of Lessinian municipalities, in coats of arms of the associations that deal with Cimbric traditions, in various wooden tools, in the oxen yokes, in the cheese stamps, and sculpted on many stones (fig. 2.1).

If we go out from the Lessinian boundaries, the zone of the world in which this symbol is most widespread, we discover that it is present in all Northern Italy and beyond. For example we can find it in the regions of Veneto (fig. 2.2(f)), Lombardia (fig. 2.2(b) and 2.2(a)), Liguria (fig. 2.2(c)), Piemonte (fig. 2.2(d)) or Sud Tirol (fig. 2.2(e)).

¹<http://www.zeitgeistmovie.com/>



(a) Hexamer Sun carved on a stone cross at Giare in Valpantena (Verona).



(b) Sun of the Alps on the front of the church of Roverè Veronese (Verona).



(c) Six petals flower on the (templar) church of San Giorgio di Valpolicella (Verona).



(d) Celtic rose in the San Fermo church in Verona.



(e) "Amulet" hanged to the neck of the animals, found in Valpantena (Verona).



(f) Two plate-pliers to cook big Hosts, found in Valpantena (Verona).



(g) Coat of arms of the 13 Cimbric municipalities.



(h) Hexamer suns on the San Floriano church (Verona).

Figure 2.1: Hexamer Suns in Lessinia.



(a) Sun of the Alps painted on the ceiling of the crypt of the Duomo of Lodi (XII cent.).



(b) One of the numerous Suns of the Alps present on the Gorzone castle in Val Camonica (Brescia).



(c) Lintel carved with Celtic Rose at Rezzo (Imperia).



(d) Hexamer sun on an house at Dorca in Valsesia (Vercelli).



(e) Sun of the Alps at Bolzano.



(f) Hexamer sun on the Palazzo della Ragione in Padova.

Figure 2.2: Sun of the Alps in north-Italy.

We can also find it in other parts of Italy, for example Lazio (fig. 2.3(a)), Abruzzo (fig. 2.3(b)) or Daunia, the north part of Puglia (fig. 2.3(c)) to cite a few (see fig. 2.3), and with smaller density not only elsewhere in Europe [3] (fig. 2.4) but also in other parts of the world (fig. 2.5).

In conclusion, the Hexamer Sun is a very ancient symbol that has been found in various parts of the world and in many ancient civilization as numerous archaeological finds show. It was known [4] by the ancient Egyptians, who carved it on the walls of the temple of the Osireion at Abydos (fig. 3.7(a)); by the Messapian and Etruscan who used the Hexamer sign as apotropaic protection of their tombstone (VII cent. B.C.)²; by the Chinese in the Forbidden City (fig. 3.7(c)); by the Jewish, that depicted it inside of the Jerusalem Temple.

The most substantial recurrences outside of the Alpine region are mostly in the Celtic, Celtic-Romance and Celtic-German regions (Galicia, Catalonia, Occitania, Bavaria, South Poland, Slovenia and Transylvania).

All the images previously shown (and there are thousands all around the world) and the cited archaeological finds, should be enough to make us notice the importance of this glyph throughout many ancient civilizations. However, it seems that the Cimbri have maintained with more awareness, their affection toward this symbol.

2.1 Various meanings of the Sun of the Alps

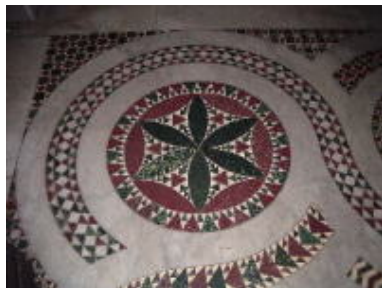
Graphically the symbol is composed of six petals (or rays) arranged inside a circle whose radius provides the cadence of the whole construction (fig. 2.6).

It is an authentic concentration of symbolologies endowed with great force: indeed, it is simultaneously a sun, wheel, flower, religious sign and, naturally, an intricate mixture and summation of meaning of all of these (fig. 2.7).

It indicates:

- the sun, that is the life, the warmth, the light and all that is beautiful and pleasant;
- the “wheel of life”, with the alternation of the seasons and events;
- the circle and therefore the Uroboros;

²Stele of Manfredonia Museum, n. 95, found at Siponto, see [5]; Stele of Aule Feluske n. 363, see [6].



(a) Hexamer Sun on the floor of the Basilica di S. Maria in Trastevere (Roma).



(b) Sun of the Alps on the main door of Abbazia di S. Clemente a Casauria (Pescara).



(c) Sun of the Alps on a church of Foggia.



(d) Celtic Rose in a oxen yoke, ethnographic museum of Garfagnana (Lucca).



(e) Six petals flower on a capital at Bagno Romagna, Valle di Pietrapazza (Forlì-Cesena).



(f) Sun of the Alps in the church of San Pietro in Valle at Ferentillo (Terni).

Figure 2.3: Sun of the Alps in Italy.



(a) Hexamer Sun on the Peak of Szekely at Szekelyko (Transylvania).



(b) Sun of the Alps sculpted on a stone wall of the ancient city of Preslav (Bulgaria, 893 B.C.).



(c) Hexamer Sun on a sidewalk of Tarragona in Catalonia.



(d) Celtic rose on the Gundestrup caldron (II cent. B.C.) in Copenhagen (Denmark).



(e) Sun of the Alps carved on a wooden lintel in a medieval house in Weitra (Austria).



(f) Hexamer Sun on the tombstone of the templar knights in the cathedral of St. Magnus at Kirkwall, Orkney Islands (Scotland).

Figure 2.4: Sun of the Alps in Europe.



(a) Sun of the Alps in Palestine.



(b) Hexamer Sun in Siria (Aleppo soap).



(c) Seed of life at one of the palaces of the king Erode, I cent. B.C. (Israel Museum, Israel).



(d) Sun of the Alps at Hampi (India).



(e) Celtic Rose at the Sultan's Bahia palace in Marrakesh (Morocco).

Figure 2.5: Suns of the Alps in the world.

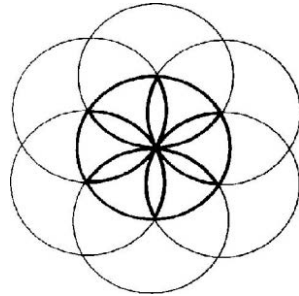


Figure 2.6: The six petals flower.

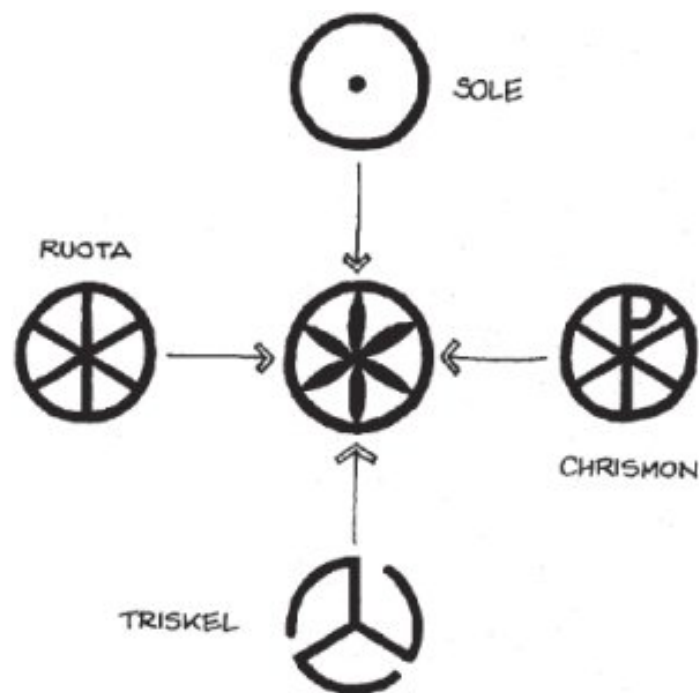


Figure 2.7: Various graphic meaning.

- Jesus Christ, “true Sun”, “invincible Sun” and “Sun of justice”, represented with the Chrismon (superimposition of X and P, i.e. the first two Greek letters of the Greek word Christos);
- the flower, that is the beauty, the cleanliness, the life that is born again after the winter;
- the number six, which refers to an other symbol known as “Star of David”, and to the Creation; moreover the six is not only the double of the perfect number, but also the sum of the first three numbers.

2.1.1 Solar interpretation

Its most commonly used name suggests the most prominent of its meanings: the solar symbol. From time immemorial, the most common graphic representations of the sun more spread are a circle, a circle surrounded by rays, a circle with a central point and the so called “solar wheel”, a circle subdivided in four parts (“Celtic cross”), in six, eight or more parts (fig. 2.8).



Figure 2.8: Various graphic representations of the sun.

The sun’s most ancient mythological personification is Lug (“the luminous”), also called Grianainech (i.e. “face of sun”) whose image is the origin of all the representations of suns as human visages surrounded by rays that are common in the iconography of the Alpine region and beyond (fig. 2.9).

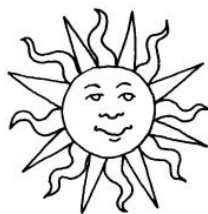


Figure 2.9: Personification of the sun.



(a) Altar of Lasargues, Gallic-Roman altar dedicated to Jupiter, that shows clearly the image of a wheel with six rays.



(b) The Chrismon, the monogram of Christ, Museum Pio Cristiano, Vatican.

Figure 2.10: The six rays wheel and the Chrismon.

2.1.2 Interpretation as a wheel

The representation of the wheel also comes from a solar derivation, being present in all the most ancient symbologies. It is linked to the world of “becoming” and to the continuous creation around a motionless centre. Its circular form remembers the Uroboros, symbol of eternal return or, in general, of eternity (fig. 2.1.4).

In particular the *six rays wheel* (fig. 2.10(a)), of which the Hexamer Sun is a floral stylization, is widespread in the Celtic tradition where it had mainly a solar meaning.

For the Celts, the sun not only represented the light and the shine, but also all that is beautiful, pleasant, and splendid [2]. This is a link that relates to an intriguing approach in the Christian symbology in which Christ is often indicated as “Sol justitiae” or as “Sol invictus”. Indeed the Christian tradition has assimilated the symbolism of the six rays wheel, slightly modifying the aspect in order to transform it in the monogram of Christ (obtained by overlapping the first two letters of the Greek name of Christ, χ (chi) and ρ (ro); the external circle is optional and often turn out to be absent), the Chrismon (fig. 2.10(b)).

Such an association has been obtained by transferring the ancient solar attribute to the emblem of Christ. It is not random, in fact the date of birth of Christ, historically unknown, has been symbolically fixed at 25th of December, near the winter solstice. On that date people celebrated the feast of

the Sol Invictus (Invincible Sun)³.

Other diffused symbols are linked to the wheel, as the “wheel of life” and of the “wheel of fortune” (always changeable), very often represented with six rays. Curiously we can find it in the tenth of the “Major Arcana” of the Tarot cards [7] that indicates the ups and downs of life, the destiny, the inevitability (fig. 2.11).

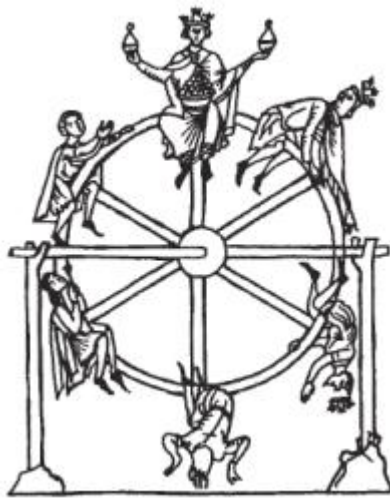


Figure 2.11: The wheel of fortune.

The meaning of rotation is linked to the wheel, and a very broad set of ancient signs has this in common, such as the triskel (fig. 2.12) or the swastika.



Figure 2.12: The Triskel.

³With regard to this it is recommended to see the film “Zeitgeist” <http://www.zeitgeistmovie.com/>

For the ancient Celts the Hexamer Sun was interpreted as a moving symbol and thus represented the vivifying and generative power of the sun. The star would convey to the sign its healing and protective power, and would make a birth lucky and life favourable. Thus it is not random, that this symbol is very frequently found in places in need of protection and defence, such as the doors of the houses and the cradles of newborns.

2.1.3 Floral interpretation

In some local Alpine cultures the Hexamer Sun is also called “Flower of the Alps” or “Six petal Daisy” for its appearance recalls stylized representation of chrysanthemums or lotus flowers which are themselves solar symbols. The flowers symbolize vital energy, joy of living and the end of the winter. Moreover, the flower version of the symbol, also called “star of the fortune”, is an ancient good luck charm that is widely spread in all the Alpine region. This sign was used with the aim of protection, in fact, as we have seen in the previous section, it is found very frequently in places in need of protection.

Finally, a link exists between the meaning of the wheel and the floral symbolism. If we consider some symbolic flower, such as the lotus or the lily, their blossoming represents, among other things, and taking into account the different meanings associated with such images, a manifestation of the perennial flowing of all the things. Traditionally the lily⁴ is depicted with six petals and the lotus with eight. Thus, the two forms correspond to the six and eight rays wheel respectively.

2.1.4 Geometric interpretation

Another interesting thing is the coincidence of one of the most common figurations of the sun, that is the circle with a point in the centre (fig. 2.8), with a sign of feminine representation (sign of female sex, fecundity, of the Mother Heart). This refers to the fact that the sun in the Celtic and Germanic tongues (and in all the ancient indoeuropean tongues) is of feminine gender.

The circle that includes the Hexamer Sun is another symbol and recalls the “Uroboros” (fig. 2.13), the snake that bites its tail creating a circle

⁴I would like point out that the lily was considered by the Cathars as symbol of purity (the Cathars, on the other hand, were called “the Pure” or “the good men”) and the paint of the white lily is often represented in the churches of Lessinia.

with its body. Such a symbol represents the cyclic nature of the things, the reincarnation, and all that is representable through a circle that restarts from the beginning after having reached its own end.



Figure 2.13: The Uroboros.

The triangle may also be represented by the Hexamer Sun, both with the tip turned on the bottom (feminine), and turned on the top (masculine), and horizontal and opposite (androgyny in the centre); the two triangles the one with the tip turned on the bottom and the other with the tip turned on the top, send back to the symbol known as “hexagram” or “Star of David” that represents the harmony of the Universe, since it is composed of two elements equal and opposite.

According to [8] the six petals clearly recall the number six and seven (six petals plus the centre). The number six is the sacred number for the Shaktism and for the Tantra, since there are the six Shakti, i.e the feminine forces that hold up the Universe, dating back to the matriarchal culture of the Indus Valley civilization, where we can find the hexamer symbol in archaeological finds. The Sun of the Alps may have arrived in the Alpine region from the Indo Valley first through the Chaldean, and secondly through the Celts and Cathars.

Finally another meaning can be found if we examine every petal that would symbolize the almond, which, in ancient cultures, is associated to “Yoni”, i.e. supreme feminine principle and door of passage between two existential levels, an inferior and a superior world in the evolutive sense.

2.2 Historical use of the symbol.

It is extremely interesting to consider the rather peculiar use that has been made of the symbol. It is present with considerable constancy during the time and in the various places. First of all we have to notice that the Sun of

the Alps has never had “noble” usages, in fact it does not exist in the noble or royal heraldry.

Its diffusion, instead, is incredibly widespread in popular art and iconography: it adorns modest edifices, decorates popular costumes and, above all, the tools and the objects of the everyday life.

The museums of the farmer’s tradition in the north-east of Italy are full of hexamer signs⁵ that focus on two fields of activities: the pastoral activity and the technology of wood.

It is possible to find it constantly, for example, on the stamps for butter, on furniture, on oxen yokes and on work equipment, all things that are *vital* for the life of the community⁶.

⁵For example the museum of the popular tradition of San Briccio and museum of the popular tradition of Udine

⁶Toschi Paolo, *Il folklore*, T.C.I., 1967, illustration n. 181; Gambiè G.M., *Tradizioni popolari veronesi*, E.V.Ver, 1967, fig. 22-23.

Chapter 3

The Flower of Life and the Sacred Geometry

The Flower of Life was and is known by all the Life. All the Life not only here but everywhere knew that it is the the creation pattern, the way of entrance and the way of exit. The Spirit created us in such a semblance. You know that it is true: it is written in your body, in all the bodies.

From *The ancient secret of the Flower of Life - Volume I* of Drunvalo Melchizedek [9].

This chapter explores the geometric procedures that lead to the construction of the Hexamer Sun; it also shows the geometric derivations that from this symbol lead to the Platonic solids, and to other figures of the Sacred Geometry.

The Sacred Geometry is the geometry used in the design of sacred architecture and sacred art. The basic belief is that geometry and mathematical ratios, harmonics and proportion are also found in music, light, cosmology¹.

As we will see, the Hexamer Sun (a very ancient symbol, as it has already been said) has a considerable importance in the Sacred Geometry since in its structure a perfect mathematics is recognized, with the presence of the *golden ratio* that is esoterically considered sacred as it is present in many natural forms.

¹For further details about the Sacred Geometry see [10].

According to the ancient connoisseurs of the Sacred Geometry [9], this design contains all knowledge, it contains in its proportions every single aspect of life that exists, every mathematical formula, every physical law, every harmony of music, every form of biological life including the smallest particles of our bodies. But, with regard to the true meaning we have to comprehend that some secrets were transmitted only orally and it was forbidden to speak about it to those not initiated. Often these secrets were not expressible in words, but they could only be experienced by the those initiated as something that radically changed their lives.

To this end in [11] it is said that the Sacred Geometry is a medium to transcend from our dimension and achieve superior levels of consciousness:

[...]The Sacred Geometry is not only a simple play of lines traced on a flat surface, but much more; if we want to fully enter in this type of teaching is good to bear in mind that we are speaking about movements and schemes considered as sacred.

Such movements and schemes have been to the base of the creation itself, they are the Creation, the Great Spirit or if you prefer, God created and still continues to create the Universe, in all its acting-out, through this basic scheme. The Sacred Geometry is a map of necessary movements for us that we find ourself to live the three-dimensional reality, since through the comprehension of the laws of the Universe, we can exit from the world of the illusion represented by the matter.

3.1 The Seed of Life

Another name used for the Hexamer Sun is *Seed of Life*, or also *sixth day of the Genesis* since it is obtained from the “rotation” of six circles or spheres, each one corresponding to a day of Creation².

The first three verses of the Genesis at the first chapter of the Holy Bible recite the following:

In the beginning God created the heaven and the earth. And the earth was without form and void; and darkness was upon the face of the deep. And the Spirit of God moved upon the face of the waters. And God said: “Let there be light”³; and there was light³.

²Note: this section is a summary of [11].

³King James Version.

Similarly to all other sacred texts, the Holy Bible gives a teaching that is not to be interpreted literally but rather symbolically. Therefore the phrase “*God created the heaven and the earth*” has to be more widely interpreted. Indeed it refers to the creation of the Universe in all its manifestations, from the physical universe to all the parallel universes (or ultra/extra dimensional, see [12] and [13]).

There is a concept about all this that the Bible omits, but that in a initiatic school of the ancient Egyptian culture is well explained and with extreme logic. The phrase to be analyzed is: “*And the Spirit of God moved upon the face of the waters*”.

God, or the Spirit, could move himself in the void. It had to shift close to something. Now, the Big Void is the total absence of matter. If all of what exists is the Spirit, and it moved without a datum point, how could the Spirit know that it had moved?

The ancient Egyptian initiatic school explains this as follows: the Spirit autoprojected itself outside in six directions (up and down, backwards and forwards, left and right) as represented in figure 3.1⁴.

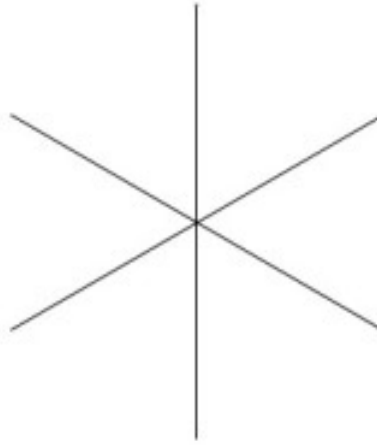
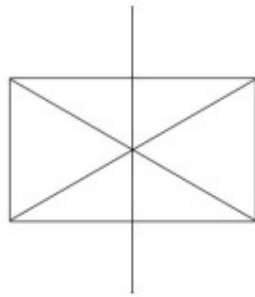


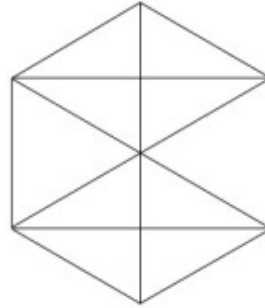
Figure 3.1: The six directions derived from the six Cartesian axes X, Y and Z (it needs to consider the image as three-dimensional).

The next step was to complete the projection by connecting and completing itself. Every point connected to every other line in the order shown

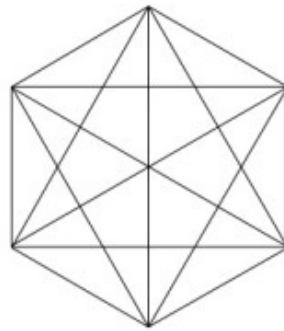
⁴In actuality, the sacred geometry derivations occur in the three dimensional space. However, for the sake of simplicity, we represent it in two dimensions as that is the form we are most comfortable with.



(a) The Spirit of God started to connect itself, first forming a rectangle.



(b) Then a pyramid at both ends.



(c) And finally all the lines to make an octahedron.

Figure 3.2: The octahedron resulting from the connections of the lines.

in figure 3.2.

At this point the Spirit had at it's disposal a reality located around itself. The movement was now possible as a perimeter was established. One could question why the Spirit decided to move in such a way, creating the six lines and connecting the points. It made the simplest thing. Indeed it is from here that all the other forms were generated. There is an ancient hermetic saying: "the simplicity is the seal of the truth".

Subsequently the Spirit started to spin the shape on its axes. In this way a sphere was formed. As a matter of fact, now that we have the lines connected, we can make a circle (in three dimensions a sphere) from the octahedron by using the middle point as the centre of the circle and any of the vertices of the octahedron as a measurement of the radius. Using these

two points, we get a very simple circle (fig. 3.3). It is important to note that for the Sacred Geometry the straight lines represent the masculine, while the curved the feminine. In this way, rotating on the three axes and generating the sphere from the octahedron, the Spirit passed from a male nature to a female one. The Bible itself narrates that the man was created first and the woman was originated from him. This symbolizes what happened, as we have seen from male straight lines it is arrived to the curved lines of the sphere. Now one may ask why the Spirit passed from straight to curved lines? From the Spirit's point of view the answer is very simple: the necessary progression for the creation is much more simple if it moves toward curved lines.

At this point the Spirit is inside the sphere. Let us come back to the Genesis: *"And the Spirit of God moved upon the face of the waters"*: what does this phrase mean? Now in the whole Universe, only a new place exists, that is, the sphere surface. It is taught that the Spirit moved on the sphere surface. Actually knowing from which point in particular does not matter, as on a sphere all the points are identical. The first movement that it made was to move from the inside of the great void to its surface (fig. 3.3). From this position it started to move, and after the first movement all was mathematically determined. Every movement from that point indicates exactly towards which point to make the next movement, until the creation of all the Universe.

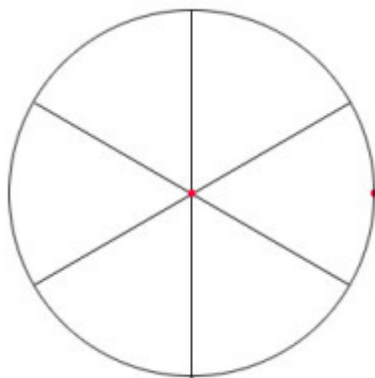


Figure 3.3: The Spirit began to rotate, forming in this way a sphere. After which the first movement was that of moving on the sphere surface itself.

After it moved on the sphere surface (i.e. the great void), only one thing was left to the Spirit: since it had already explored all that existed (that is

the sphere surface), the new thing it could create was another sphere (the first day of the Genesis, fig. 3.4(a)).

This determines the formation of a particular geometric figure in the intersection points. This figure has the form of a almond and it is called *Vesica Piscis* or *Mistic Almond* (see the final part of section 2.1.4).

In the Sacred Geometry this figure is linked to the formation of the light. Indeed such a figure, that recalls the form of the eyes, is the basic geometry of the electromagnetic field, which the photons are structured on. To reconnect to the Genesis the third verse says: “*And God said: "Let there be light"; and there was light.*”.

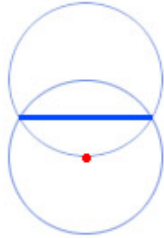
Now we have an arch of intersection between the two interlocking spheres, and this constitutes a novelty in the Creation. The Spirit then moves in any point of this circle and projects a new sphere (second day of the Genesis, fig. 3.4(b)). In fact considering the bidimensional case, the intersection points serve as the centre point for the next circle to form, again using the centre of the original circle as radius of the new circle. Similarly, we continue until we have drawn six circles (spheres) around the original. Indeed the Spirit does not do anything else but continues with the same schema, as this is the first thing it learnt. It stops only after completing all the turns around the first sphere, in this way they are quickly representing the third, the fourth, the fifth, and the sixth day of the Genesis (fig. 3.4). Having done this the Spirit stops and rests (seventh day), as the Genesis and all the laws of the Universe are now completed.

3.2 The Flower of Life

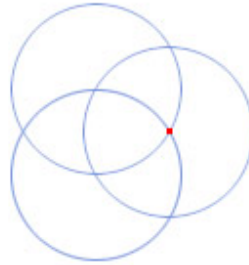
Once to the sixth day of the Genesis arrived, six spheres were obtained around the initial first, that fit together perfectly, without excluding anything. These six spheres plus the starting central one represent the totality of the Created.

If we make an other turn using this time the intersections of the external spheres we obtain six new spheres (it is simple to notice the necessary points to individuate the centre of every new sphere, fig. 3.5(a)). At this point if we take away some lines from the image we obtain a bidimensional representation of a three-dimensional figure, (fig. 3.5(b)). This figure is known as the *Egg of Life* and it is constituted by eight spheres that don't intersect.

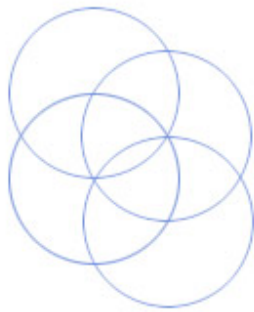
This structure forms the base of music since the distance between the spheres is identical to the distances between musical tones and semitones. Moreover it is identical to the cellular structure of the third embryonal division (the first cell divides in two cells, then in four and then in eight); thus in this



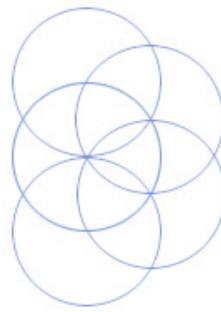
(a) The first day of Creation: the Vescica Piscis.



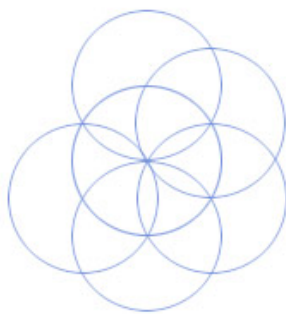
(b) The second day.



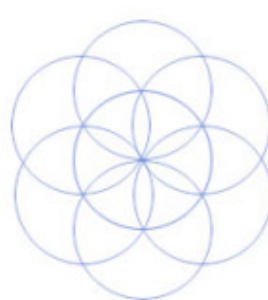
(c) The third day.



(d) The fourth day.



(e) The fifth day.



(f) The sixth day: the Seed of Life.

Figure 3.4: The six days of the Genesis.

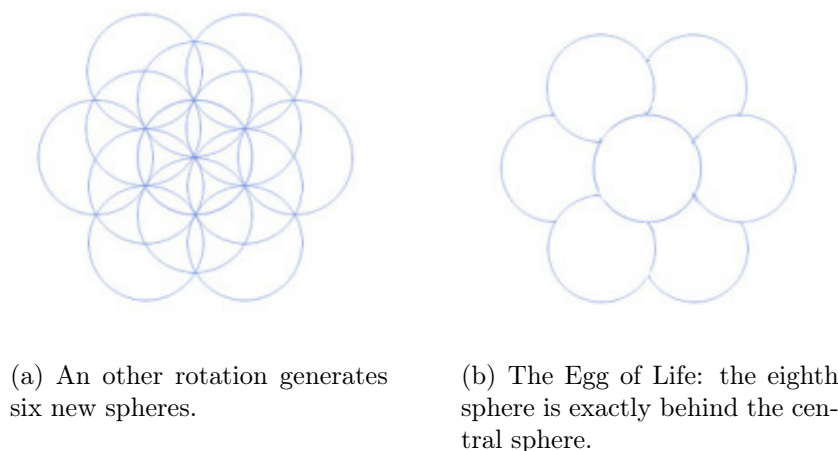


Figure 3.5: The Egg of Life.

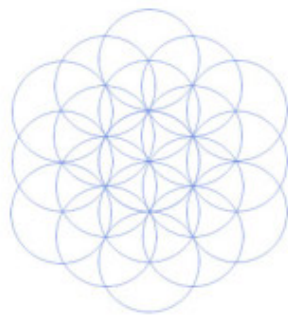
figure it is possible to see the embryonal state of the life.

Returning to the figure 3.5(a) and using the same principle to create a further rotation of the spheres around it, we obtain the most famous figure: the *Flower of Life* (fig. 3.6(a)). Generally this symbol is depicted completing with the “petals” the seven main circles (fig. 3.6(c)).

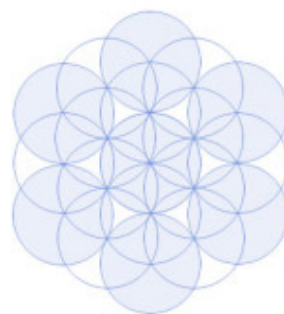
The Flower of Life perhaps constitutes the most important aspect of the Sacred Geometry. The meaning that has traditionally been attributed to it is that of representing the Creation.

Mysteriously, this symbol has been found in almost every culture and religion. The oldest Flower of Life has been retrieved at the Temple of Osiris at Abydos in Egypt (fig. 3.7(a)). Other Flowers of Life have been discovered in India in the Golden Temple, at Hampi and in some Temples at Ajanta; in the Middle East in some Islamic mosques; in Palestine at Masada and at Mount Sinai; in Turkey at ancient Roman settlements; in China at the Forbidden City; in Italy in art from the 13th century; and also in Spain, Austria, Morocco, Liban, Perù, Mexico, and Japan (fig. 3.7, [14, 15, 16, 17]).

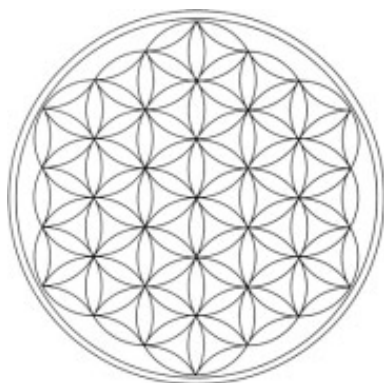
According to Drunvalo Melchizedek [9] the Flower of Life is the scheme par excellence of the Sacred Geometry, as it would contain all the information regarding life in the Universe. Also the synthesis of all the mathematical formulas and physical laws that regulate the Cosmos are included, as well as all small vibrational information. The whole Universe would have been created from this scheme, so in order to understand our biological, mental and spiritual nature we have to analyse its contents in depth.



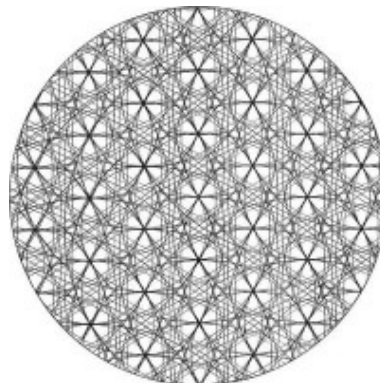
(a) The Flower of Life.



(b) The seven main circles of the Flower of Life.



(c) The most common representation of the Flower of Life.



(d) three-dimensional Flower of Life projected in two dimensions.

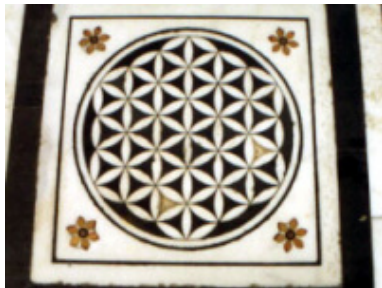
Figure 3.6: The Flower of Life.



(a) Flower of Life depicted on a wall of the Temple of Osiris at Abydos in Egypt.



(b) Flower of Life in a mosaic on the floor of an ancient roman house (I cent. B.C.) at Ephesus, Izmir (Turkey).



(c) Flower of Life at the Golden temple of the Sikh at Amritsar (state of Punjab, India).



(d) Flower of Life at a buddist temple in Ajanta (India).



(e) Spherically shaped Flower of Life under the paw of the guardian lion at the Forbidden City in Beijing (China).



(f) Flower of Life at the bud-dist temple of Goryo-Jinja at Kamakura (Giappone).

Figure 3.7: Flowers of Life representated in the world.

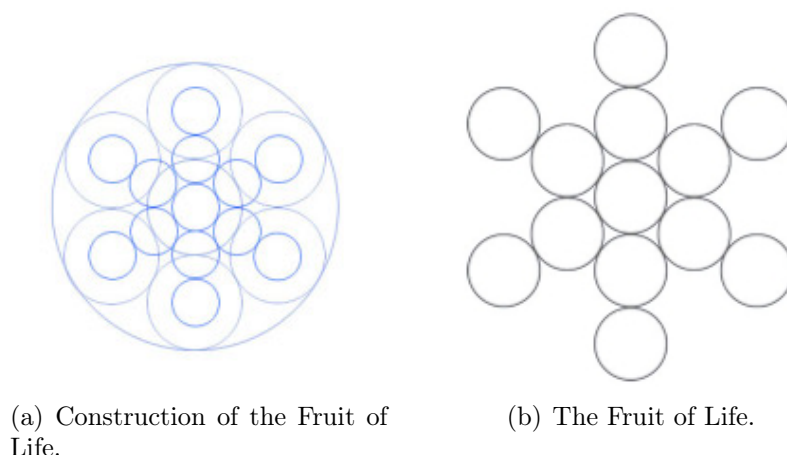


Figure 3.8: Construction of the Fruit of Life starting from the Flower of Life.

3.2.1 The Metatron's Cube and the Platonic solids

Starting from the Flower of Life it is possible obtain another figure, known in Sacred Geometry as the *Fruit of Life*, by adding circles with half radius of the existing circles (fig. 3.8).

At this point it is possible derive from the Fruit of Life (that, in turn, is a geometric derivation from the Hexamer Sun) the five Platonic solids⁵ (tetrahedron, cube, octahedron, icosahedron and dodecahedron) by means of an intermediate figure known as *Metatron's Cube*. As a matter of fact if we connect the centre of a circle with all the other centres of all the other circles, and if we reiterate this process for all the circles, we obtain a complex network of connections, the Metatron's Cube exactly (fig. 3.9).

This figure contains all the five Platonic solids (to obtain them it is necessary to eliminate opportunely some lines from the Metatron's Cube, fig. 3.10). Those polyhedrons, defined by Plato as “perfect solids” are characterized by the following property (there are many others, I describe only the most important ones herein [18]):

- all the faces are equal regular polygons
- all the vertices lie on a sphere
- the angles formed by adjacent faces are all equal

⁵Indeed, while in the plane we have a countable infinity of regular polygons, in the tridimensional space we can only make five regular polyhedrons. Those are traditionally called “Platonic solids” for the fundamental role they play in the cosmogony elaborated by Plato. Actually in the XIII book of the Elements of Euclide, it is clarified that the attribution to Plato of the discovery of these regular polyhedrons is not correct

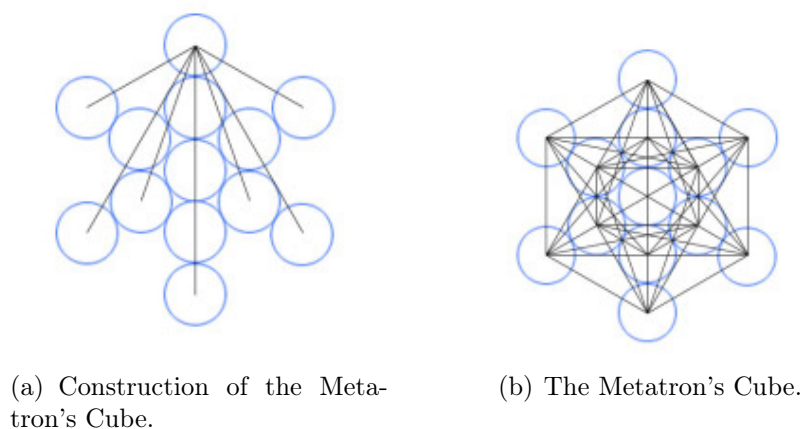


Figure 3.9: Construction of the Metatron's Cube starting from the Fruit of Life.

- all the vertices are rounded by the same number of faces

These five structures are present in minerals, in organic forms of life, in sound, in music and in language [14].

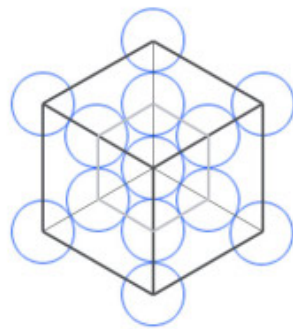
The Sacred Geometry was an integral part of the initiatic knowledge of the priestly class, in particular the Sumerian and Egyptian, and subsequently Templar⁶. They associated the Platonic solids with the four fundamental elements (as it is explained in the *Timaeus* of Plato): the tetrahedron, the octahedron, the cube, and the icosahedron were associated with fire, air, heart and water respectively. The dodecahedron, that has pentagonal faces and unlike all the other four polyhedrons can't be made into joining triangles, was associated to the image of the whole cosmos, making the so called "quintessence"⁷. Such an identification suggests an image of perfection that undoubtedly rises from the fact that the dodecahedron, in volume, approximates the sphere more than the other regular polyhedrons.

3.2.2 The Tree of Life

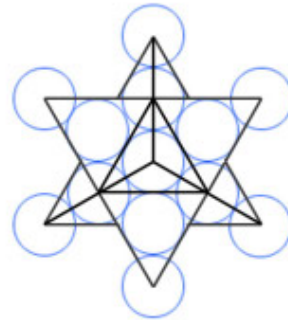
In addition to the Platonic solids it is possible derive from the Seed, Flower and Fruit of Life other figures, the most important of which is the *Tree of Life* (fig. 3.11). It constitutes a fundamental part of the Jewish Kabbalah

⁶To this end I would like to add that the majority of the Templar knights was Cathar [19].

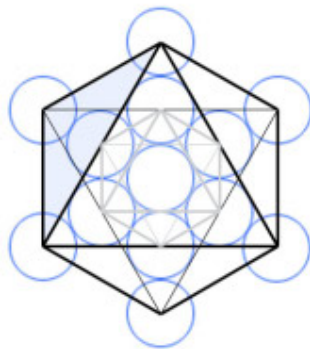
⁷According to the Corrado Malanga's interpretation based on the archetypes [20] the quintessence is the combination of the four fundamental elements.



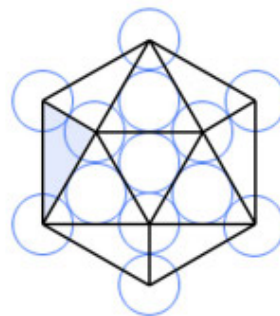
(a) Cube.



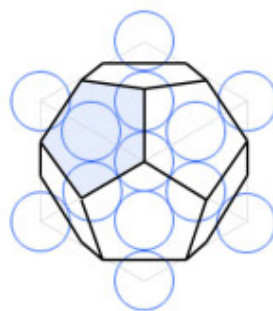
(b) Tetrahedron.



(c) Octahedron.

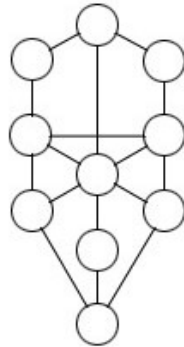


(d) Icosahedron.

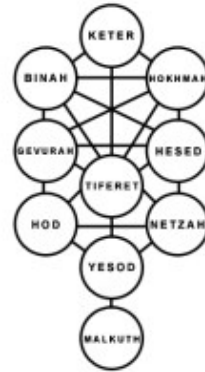


(e) Dodecahedron.

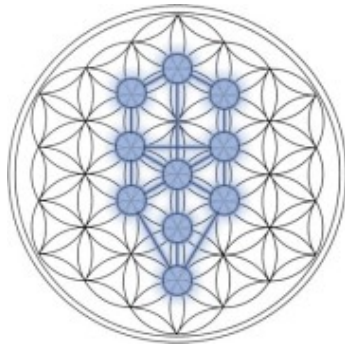
Figure 3.10: The five Platonic solids inscribed in the Metatron's Cube.



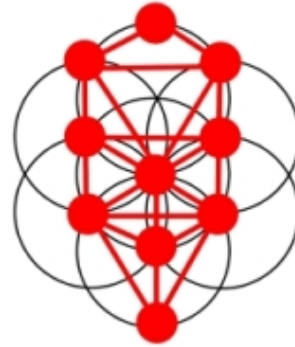
(a) The Tree of Life.



(b) The Tree of Life in the Kabbalah(Sephirot).



(c) The Tree of Life derived from the Flower of Life.



(d) The Tree of Life derived from the Seed of Life.

Figure 3.11: The Tree of Life.

at which it is known as Sephirotic Tree or Tree of Knowledge (but we have to notice that such a mystic concept is also present in many ancient cultures and religion, [21]).

Chapter 4

Sacred Geometry and physics

The most incomprehensible thing about the Universe is that it is comprehensible.

Albert Einstein.

This chapter substantially summarises the third chapter of the book *Divine Cosmos* of David Wilcock [22] in which it is proved, with a scientific approach ¹, that the Platonic solids are present at microcosmic level.

Wilcock explains that almost all sacred traditions, including those of the Vedas, insisted that there was a hidden order that unified all aspects of the Universe, and that with sufficient study and visualization of the underlying geometric forms of this order, the mind of the initiated could be connected with the Oneness of the Universe, enabling great feats of consciousness and mind-over-matter capability to occur.

Hence, the cornerstone of knowledge for secret mystery schools regarding this hidden order in the Universe has always been Sacred Geometry. In short, sacred geometry is simply another form of vibration, or “crystallized music”. To this end we can cite many physics experiments proving the vibrations are able to create geometric forms.

First, let’s consider the monodimensional case. Putting a guitar string in vibration creates “standing waves”, meaning waves that do not move back and forth across the string but remain stable in one place. We can see some areas where there is an extreme of vertical movement, representing the top

¹By means of the studies of cymatics and other experiments conducted in the field of the quantum physics.

and bottom of the wave, and other areas where there is no vertical movement, known as nodes. The nodes that are formed in any type of standing wave will always be spaced evenly apart from each other, and the speed of the vibration will determine how many nodes will appear. This means that the higher the vibration rises, the more nodes will appear.

In two dimensions, we can either use an oscilloscope or vibrate a flat circular “Chladni plate”² and see nodes develop that will produce common geometric forms when connected together. If the circle has three equally spaced nodes then they can connect to form a triangle, if it has four equally spaced nodes it can form a square, if five a pentagon, if six a hexagon, et cetera.

These and other physical experiments, conducted by Dr. Hans Jenny³, Gerald Hawkins⁴ and many others, are part of a branch of science called *cymatics* [24]. Cymatics studies the wave phenomena and has proved the strict relation existing between forms and acoustic wave frequency.

Quantum physics has explained that every structure of particles assumes a specific form as the result of ordered energetic links, following the frequency of basic energy. In this way every material subjected to a specific vibration assumes its peculiar form correlated to the frequency of the wave it has been subjected to. In other words *the form is the result of the wave frequency that generates it*.

It is possible to extend to three dimensions the experiments cited above for two dimensions and obtain the most deep and respected form of Sacred Geometry: the Platonic solids⁵ Indeed the students of Buckminster Fuller and the already cited Prof. Hans Jenny devised clever experiments that shown how the Platonic solids would form within a vibrating/pulsating sphere.

In the experiment conducted by Fuller’s students, a spherical balloon was dipped in dye and pulsed with “pure” sound frequencies, known as the “diatonic” sound ratios. A small number of evenly-distanced nodes would form across the surface of the sphere, as well as thin lines that connected them to

²Ernst Chladni was the inventor of a method to prove the various moods of vibration of a mechanic surface with regular or irregular form. He, in the last years of the 1700s, made some experiments on the effects of the vibrations imparted to glass plates covered with a very thin layers of sand. Exciting the plates with a fiddle bow, we can notice that the sand on the plates moves away from the major vibrations zones, grouping in curious figures (called *Chladni figures*) in proximity of the points of the plates touched by hands.

³See [23].

⁴Gerald Hawkins was the first to establish mathematically that such geometries inscribed within circles were indeed *musical relationships*.

⁵The Platonic solids have the property of being perfectly inscribed in a sphere.

each other. If there are four evenly spaced nodes, a tetrahedron will form. Six evenly spaced nodes form an octahedron. Eight evenly spaced nodes form a cube. Twenty evenly spaced nodes form the dodecahedron, and twelve evenly spaced nodes form the icosahedron.

The straight lines that we see on these geometric objects simply represent the stresses that are created by the “closest distance between two points” for each of the nodes as they distribute themselves across the entire surface of the sphere.

Prof. Hans Jenny conducted a similar experiment, wherein a droplet of water contained a very fine suspension of light-coloured particles. When this roughly spherical droplet of particle-filled water was vibrated at various “Diatonic” musical frequencies, the Platonic solids would appear inside, surrounded by elliptical curving lines that would connect their nodes together, as we see in the picture 4.1, where it is clear that there are two tetrahedrons in the central area.

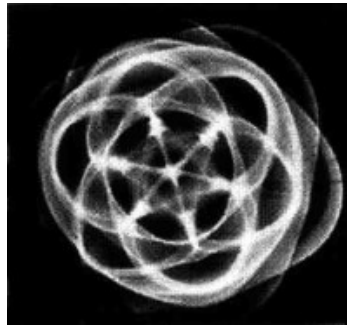


Figure 4.1: Prof. Hans Jenny’s platonic solid formation in spherical vibrating fluid.

Hence, similar to the two-dimensional cases involving the triangle, square, pentagon and hexagon inside the circle, the Platonic solids are simply representations of waveforms in three dimensions. Each tip or vertex of the platonic solids touches the surface of a sphere in an area where the vibrations have cancelled out to form a node. Thus, what we are seeing is a three-dimensional geometric image of vibration/pulsation.

Moreover we can’t but help mentioning the fact that some natural crystals assume the form of platonic solids⁶. For example sodium chloride forms in cubic crystals, while calcium fluoride forms in regular octahedrons. In addi-

⁶See [18].

tion there are many crystals that form following compositions and variations of the Platonic solids.

For more information on such arguments, and on the physics of the ether and of the microcluster, the reader can make reference to the scientific bibliography present in [22].

Chapter 5

The Sound as principle and origin of every thing

The fact that the “world is sound” isn’t just a widespread myth or legend. It is confirmed in the established findings of fundamental harmonic research and many other disciplines. We have found the world’s tonal character confirmed in DNA genes and electron spins, in the solar wind and geomagnetism, in the weather and in the “song” of flowers and plants.

Jocelyn Godwin.

According to the English physicist Stephen Hawking, our Universe originated from the void (quantum vacuum) for quantic fluctuation, generated from the vibration of the void itself.

Hence, quantum physics seems to be grounded today in the same conclusions that constituted the background of archaic knowledges of all primitive populations: they had expressed the concept of sound-substance, i.e. sound as living essence of the Universe.

As a fact of matter, as Marius Schneider¹ claims, in various cultures, from the Indian to the Chinese, to the Eskimo, to the Zulus at Africa, the belief exists that in the decisive act of Creation, a god emits a sound in the instant in which it gives life to itself or to another god, or to the cosmos, or to man. So from the primordial void, always as the first act of the life a blow, a sigh, a scream, a chant or, a sound rises; those are products of a thinking which, spreading, creates the space:

¹Schneider is considered the preeminent ethnomusicologist.

If we examine the sources that still now allow us to gain some understanding of the original meaning of music, we are stunned in front of the unity or to the very strict similarity of ideas developed around those fundamental thinkings. If we consult the documents of the ancient cultures or if we interrogate the population nowadays living according to lithic or metalic culture, we always find the same conceptions.

[...] It seems almost that elementary ideas burst forth from a very remote and common source, already in the so-called primitive cultures, to develop subsequently and to constitute the ticking of symbolic philosophy, destined to touch its apex in the late megalithic cultures and to survive in part, through the ancient world, until us.

From the book *Il significato della Musica* of Schneider, [25]².

To this end it is difficult to avoid referencing the prologue of John's Gospel (John 1:1-3):

*In the beginning was the Word,
and the Word was with God,
and the Word was God.
The same was in the beginning with God.
All things were made by him;
and without him was not any thing made that was made*³.

The term "Word" is the English translation of the Greek term *λογος* (logos), but this translation does not express everything that the term would have suggested to ancient readers. It should be intended as "*vibration*". That primordial vibration that the Veda call "Aum" and that according to their teaching permeates the Universe, existed before time and is to the base of all the Created⁴.

With regard to this Shneider writes [25]⁵:

The biblical phrase, *In the beginning was the Word*, is not a product of the advanced culture, but rather belongs to the most archaic conceptual heritage of humanity.

²Please note: translated from the italian version by the author of this thesis.

³King James Version.

⁴It is possible to draw a parallel between the sound "Om" of Hindu and Buddhist.

⁵Please note: translated from the italian version by the author of this thesis.

[...] The concept of “Word” only partially renders the original meaning, as here it is a matter of something that genetically precedes whichever determined form and every logically founded concept. Here it is a matter of something of primary and over-conceptual, and, for the logical thinking, it is indefinable and inconceivable.

The myths of primitive populations teach that the substrate of all phenomena in the Universe is a vibratory element and, specifically, acoustic. The first sensible manifestation of the creation is a sound that, according to the traditions, emanates from a primordial abyss, from a cavern, from a refulgent egg, from the tao, from the sun, from the mouth of a god opened wide or of a musical instrument that symbolizes the creator.

Hence, in the first stage of creation, the nature of the world is purely acoustic. The creator itself is nothing but a chant, a musical instrument or a resonating cavern, and it is very probable that the materialization of the idea of the creator as a musical instrument is a concession to the myth which gives more concrete character. In actuality the creator is a purely acoustic entity, a chant or a scream, that creates a world of sounds and lights. The apparition of matter is a posterior act very often considered a stage of decline⁶:

The world was created by an initial sound that, exiting from the primordial abyss, covered itself by light. Little by little a part of this sonorous light converted into matter. But the materialization never was completed, since in every object a more or less scarce residue of the sonorous substance from which it was created, continues to subsist.⁷

All in the Universe is vibration: such an affirmation is confirmed by the physics that has proved that all is energy (and we have to notice that all the forms of energy have movement in common). In fact the physicists, studying the phenomenal world, found themselves to break up matter into smaller and smaller elements, until arriving to the formulation of the Einstein’s now famous formula⁸

⁶A comparison can be drawn with the conception of the matter in the Cathars thinking [26, 19].

⁷Passage based on the book [25]. Please note: translated from the italian version by the author of this thesis.

⁸The formula $E = mc^2$ express in whatever reference system the total energy of a steady particle. If it is in movement, the correct formula is a little bit different (see the Restricted Theory of Relativity, [27]).

$$E = mc^2$$

i.e. the energy is equal to the mass (matter) multiplied per the squared speed of light. Thus it is simple to understand that mass and energy are equivalent and how they are two sides of the same coin: in short, the formula can be translated with the phrase “all is energy”.

Many types of energy exists, (thermal, electric, mechanic, nuclear, et cetera), each of which travel via a specific channel and answer to specific laws. But there is something that they all have in common: movement. In Universe immobility does not exist, all is in movement, in fact every energetic force is constituted by particles that move according to a some wave length and frequency.

Thus the reality is not as we commonly perceive, but rather it conceals in its interior a barely perceptible world, i.e. the energetic, or, to put it better, vibrational⁹. Therefore, the world is a dynamic woven of energy-movement wires that appears to us as solid objects and parts separated from each other only because our sensorial structure allows us to perceive this.

Indeed, the matter per se, is nothing but a concentration of vibrations kept in equilibrium by interactions acting in the form of atoms or molecules: every atom or molecule is the physical representation of a variety of complexities of a vibratory phenomenon¹⁰.

Hence, as quantum physics research confirms, matter is not the true reality but energy and its vibration¹¹. Energy is undulatory, with its own vibratory frequency and manifests itself at many levels according to the frequency of vibration: to the lowest frequency it thickens and becomes matter, as the frequency increases it becomes light, x ray, gamma ray, until the unknown infinite.

According to science it all began almost 15 billion years ago, with a huge explosion, the Big Bang, so violent to be still recognizable in the *Cosmic*

⁹Hence, the vibration is an unifying and regulating element as it joins all that vibrates. But this “enchantment” (as defined by Schneider in [25]) for the contemporary man is only a romantic fantasy since he has lost “in frightening measure” the faculty of vibrating and resonating with that nature from which he had originated.

¹⁰In this regard one cannot help but quote Alfred Tomatis: “Matter is a sonic material differently orchestrated”, [28].

¹¹Therefore matter is an illusion, as confirmed by the *holographic theory of the Universe* of the physicist David Bohm [29] and the *super spin theory* of the ufologist Corrado Malanga (see chapter 6): this fact has incalculable consequences on our life (to the reader I recommend to explore these themes).

microwave background radiation, [30]. There are recent recordings with scientific methods of such a background vibration, an inaudible and constant sound that is present in all the physical reality¹² that is explained by the scientists as an echo of the Big Bang.

So also a branch of the science agrees that all began from a primordial sound.

¹²This is a surprising scientific confirmation of the origin of the world from the *Om*, the sacred vibration of the ancient Hindu.

Chapter 6

The Super spin theory

The axe of Consciousness is real, while the algorithms are virtual, as well as the things that they describe, that is the space, the time and the energy.

From the book “Alien cicatrix” of Corrado Malanga.

More and more intrigued by what I was discovering about the creation, I continued my studies in the field of the quantum physics in order to try to understand what caused the Big Bang and, above all, the why.

Among all the physical theories I read, I was most convinced by the works of the Prof. Corrado Malanga (in collaboration with the Stargate Group Tuscany) [31, 32].

This ufologist, (and professor of organic chemistry at the University of Pisa), studying the alien abduction phenomena [33] with hypnosis techniques, has proved the true divine nature of the human being, since he found a method to communicate directly with the soul of the hypnotized person. Gathering informations from hundreds of hypnoses and from scientific background, he has been able to formulate the *Super Spin Theory* a general scheme of the structure of the Universe in its different manifestation [32].

According to such a theory the Universe can be described by four axes: the Time, the Space, the Potential Energy and the Consciousness (see fig. 6.1). In this environment any point of the Universe can be described by a mathematical operator called spin, in the form of magnetic, electric and gravitational field.

In outline, at the beginning there was only the Consciousness, which, at a certain point “woke up” and was aware of its existence: the Consciousness

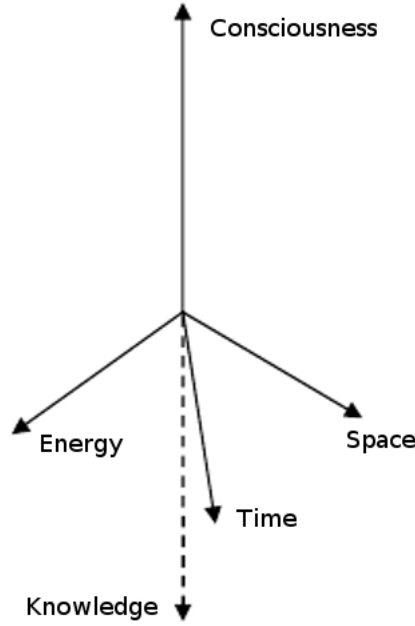


Figure 6.1: The Super Spin Theory.

got a sense of itself, but it had not knowledge of itself. In that moment there is not any mirror in which it can reflect itself, since nothing exists except it. So in order to know itself the Consciousness started to spin on itself creating, according to the three axes mentioned above¹, the Universe, that is the *virtual reality*². So the Universe would be the mirror inside which there are all the manifestations of the Consciousness divided in infinite parts, each one of whom can watch the other and can be watched and known by them.

In this way, from the initial moment in which nothing exists except a unique point of total consciousness, the maximum expansion of the Universe will be reached. That will be the moment in which the Primordial Being, (i.e. the Consciousness), will have divided itself in all it could divide itself, it will have experienced every its own manifestation, it will know completely itself but it will not get any sense of itself because of its complete subdivision.

¹These three axes can be correlated with the three axes shown in fig. 3.1 of section 3.1.

²This find a confirmation not only in the *holographic theory of the Universe* of the physicist David Bohm [29], but also in the thinking of ancient cultures (as the Indians, the ancient Chinese or the Maya), which believed that all we perceive is the outcome of a warped vision of the reality.

In this phase a centre of consciousness does not exist anymore, since every thing is separated and independent. The Universe, upon attaining the maximum of its expansion, will close on itself and will collapse and return to be a unique point, that at a certain moment will wake up fully aware of itself but without knowledge of itself and all will start again.

According to such a theory the Primordial Being or can be totally aware of itself, or can totally have knowledge of itself. This is a sort of Heisenberg's uncertainty principle³ applied at the level of cosmic interpretation.

³In quantum physics, the Heisenberg uncertainty principle [34] states that the values of certain pairs of conjugate variables (position and momentum, for instance) cannot both be known with arbitrary precision. That is, the more precisely one variable is known, the less precisely the other is known. This is not a statement about the limitations of a researcher's ability to measure particular quantities of a system, but rather about the nature of the system itself.

Chapter 7

Crop Circles, Sacred Geometry and music

The real voyage of discovery consists not in seeking new landscapes, but in having new eyes.

Marcel Proust

At this point the researches started from the Hexamer Sun had lead me to face the fields of Sacred Geometry, of cymatics, of quantum physics, of religions and mythologies of ancient populations and ufology. I now turn to another very fascinating argument strictly connected to all the themes exposed until now: the crop circles.

As a matter of fact in the wonderful designs of the crop circles it is possible to find many of the figures of Sacred Geometry encountered during this thesis (fig. 7.1 and 7.2).

Among all the theories gravitating around the origin of the phenomenon, it seems that researchers more and more agree on a common explanation considered the most plausible: the cymatic [35]. So, according to this hypothesis, the complex paintings would be visual geometric representations of audio frequencies, assuming that vibrations with more and more increasing frequencies could have produced more and more complex pictographs (as those similar to the mandala).

In support of such a theory we have to consider that the majority of crop circles appeared in zones in which the subsoil was rich with water, often in presence of well and ground waters. We also have to remember that in many cases, during the first 48-72 hours from the formation of the crop circle, a sound with the frequency of 5.2 Hz has been registered inside it.



(a) Crop circle with Hexamer Sun [Buckland (Oxfordshire, England), july 2008].



(b) Crop circle with Six petals flower [Ermreuth-Dachstadt, Markt Igendorf (Bavaria, Germany), august 2005].



(c) Crop circle with Seed of Life [Calcinaiia (Pisa, Italy), june 2006].



(d) Crop circle with Seed of Life [Broad Street, Maidstone (Kent, England), august 2000].



(e) Crop circle with Seed of Life [Brighton (England), july 2003].



(f) Crop circle with Seed of Life [Nursted, Devizes (Wiltshire, England), august 2002].



(g) Crop circle with six rays wheel [Monteu da Po, Mezzana (Torino, Italy), june 2007].



(h) Crop circle with Vescica Piscis [Ashbury (Oxfordshire, England), july 1996].

Figure 7.1: Crop Circles depicting some figures of the Sacred Geometry.



(a) Crop circle with Egg of Life [Littlebury Green (Essex, England), july 1996].



(b) Crop circle with Flower of Life pattern [Broad Hinton, Winterbourne Bassett (Wiltshire, England), july 2003].



(c) Crop circle with Flower of Life pattern [Nukerke south of Oudenaarde (Flanders, Belgium), july 2004].



(d) Crop circle with Fruit of Life and Metatron's Cube [Froxfield (Wiltshire, England), july 2003].



(e) Crop circle with octahedron projected in 2D [West Overton (England), june 1999].



(f) Crop circle with Tree of Life [Burderop Down, Barbury Castle (Wiltshire, England), may 1997].

Figure 7.2: Crop Circles depicting some figures of the Sacred Geometry.

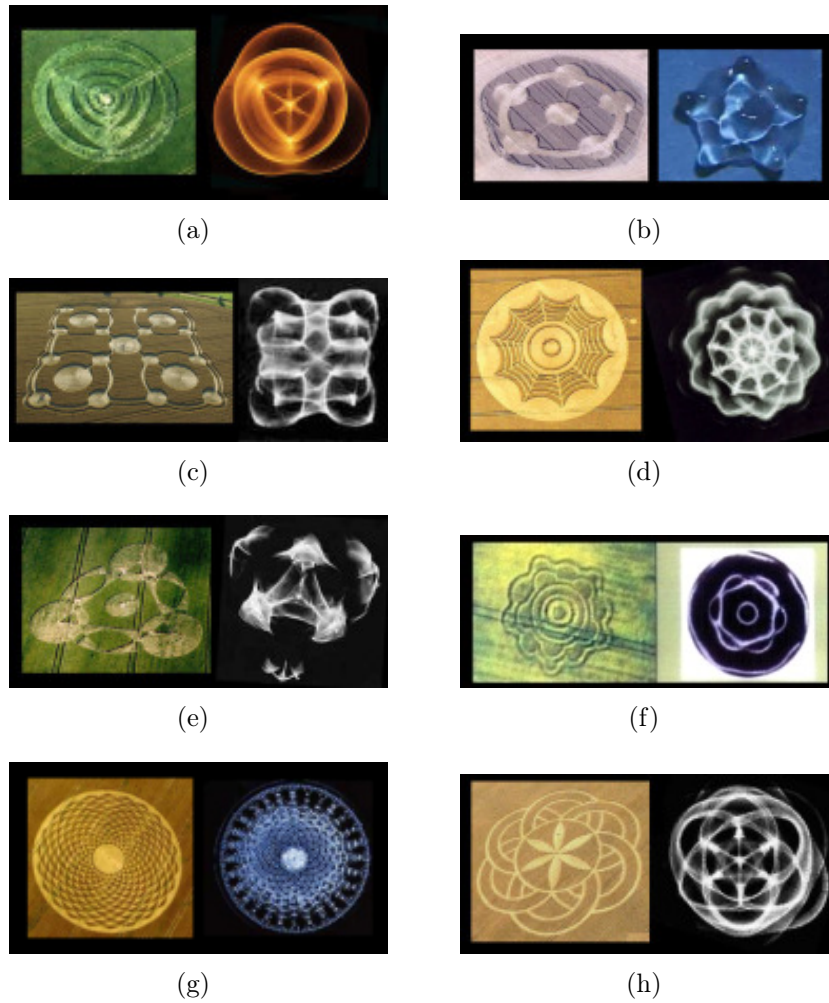


Figure 7.3: Crop Circles extraordinarily similar to the figures obtained with the cymatics.

As we have seen in chapter 4, cymatics is the study of geometric structures appearing when we stimulate some materials with some vibrations or with sounds. Some materials, submitted to acoustic waves of specific frequencies, react to the sound by generating some forms. The most surprising material from this point of view is water.

As we have already said, if we “bomb” a water drop with some sounds, it assumes some forms gradually more and more complex as the frequency increases: such forms are extraordinarily similar to the forms represented in some crop circles (fig. 7.3).

The ancient Greeks were in the habit of saying that the geometry was “solidified music” [36]¹. For their Egyptian teachers the Sacred Geometry and music were inextricably linked, as geometric laws govern the mathematical intervals forming notes of the occidental musical scale, the diatonic intervals². Now incidentally, the already cited Prof. Gerald Hawkins has found that the proportional dimensions of the extraordinarily complex geometries of the crop circles are also in direct correspondence with musical intervals of the white keys of a piano, i.e. the diatonic intervals (see for example the Euclidean theorems he has enunciated studying crop circles geometries, [35]). Therefore, geometric theorems and music have been correlated, proving that the crop circles “contain” musical notes.

Moreover using studies on cymatics, the already cited physic Prof. Hans Jenny has not only been able to solidify sound, but he has also allowed humanity to see the “frozen music” mentioned by the ancient Greeks. He has provided us a physical link with the creation of crop circles, since many of the vibrational forms founded in the photos of its studies coincide with the paintings appeared in the crop fields, as seen in fig. 7.3.

¹To this end we can't but help mentioning the quote of Pythagoras “A stone is frozen music”, and the quote of Johann Wolfgang von Goethe: “I call architecture frozen music”.

²After researching what notes sounded pleasant together, Pythagoras worked out the frequency ratios (or string length ratios with equal tension) and found that they had a particular mathematical relationship. The octave was found to be a 1:2 ratio and what we today call a fifth to be a 2:3 ratio. Pythagoras concluded that all the notes could be produced by these two ratios as $(3/2) \cdot (3/2) \cdot (1/2)$ gave $9/8$ which is a second and so on. Although Pythagoras did a wonderful job he did get it slightly wrong. The correct solution was worked out by Galilei (the father of the famous Galileo Galilei) who concluded that the best frequencies were in other proportions (the differences from Pythagoras are small). These proportions are called the Just Intonation music scale.

Pythagoras and his followers and later Kepler were to consider that these musical relations or harmonies had wider application in the universe. This idea was almost forgotten or dismissed for many centuries. However there are a lot of proofs that there is much evidence that the universe is completely organised on a system of mathematical harmony and that it shows up in every branch of scientific study, [37].

According to many researchers of this phenomenon, crop circles present a not random relationship with the esoteric symbologies of all the traditions. The message, readable in the light of such a relation, is a call from the divine world to a humanity now deaf to his deeper spirit. For example the researcher Adriano Forgione writes ([38]³):

Every great spiritual tradition of humanity has always been linked to the capacity of man to be able to communicate with what is often described “the place of the origins”. This is a desire based on the awakesness that between our reality level, and those superior and more “subtle”, there were bridges, from time immemorial associated to “the place of the origins” and to the divine. They were considered communication channels to which one could access through a course of knowledge that would have brought man to reconfigure himself inside a unique universal system. Such a system, present in the esoteric nucleus of all the great religions of humanity, was centred on the *vibration*, on the logos, on the energy that from a unique starting point, placed at higher vibrational levels, expands to the lowest level of frequency to embrace the whole creation.

According to such principles, the man that had been able to finish the Sacred Way, (its improvement course), would have been interrelated directly to the divinity and to those frequency levels, manifesting what is called “Ka” or “Merkabah”, the “Light Body”. So he would have reconquered the status of “solar” divinity among human beings. The Ancients, therefore, had codified such a status in the image of the Man-God, the Perfect, that not only becomes aware and an integral part of the whole energetic system, but he, in quality of mediator between the lowest level, the material one, and those put higher in the frequency scale, is able to show the divinity and its forces in Heart.

[...]Such fundamental principles of the great Primordial Traditions find today, in the crop circles phenomenon, not only an accomplishment, but also a spectacular confirmation.

The crop circles phenomenon represents, in fact, a door towards the infinite and the message concealed in it starts to reveal itself little by little, through a key represented by the esoteric symbology, confirming not only the big spiritual and solar principles of humanity, but also the existence itself of the “divine” dimension.

³Please note: translated from the italian version by the author of this thesis.

[...]It seems that the crop circle makers have wanted to communicate the necessity of Man to penetrate inside himself in order to comprehend his real divine nature.

[...]Therefore such symbols are representing a trace, a course, carrying and supporting a transformation that is in progress from time and that not only acts on the planet but also on the conscience of all the people observing them.

Finally, in light of the consideration made in chapter 5 about the vibratory nature of the created, one can deduce that the (tridimensional) figures of Sacred Geometry (in particular the Seed of Life) should be seen in vibratory movement, from the centre towards the exterior and vice versa: some in-movement figures (e.g. 7.1(g)) present in the crop circles seem suggest just this.

Chapter 8

Some considerations

A moment arrives in which all becomes clear.

From the book “La musica in testa” of Giovanni Allevi.

As we have seen, the symbol of an essentially mountain community (i.e. the Cimbri), that seemed to be very simple, revealed itself as a concentration of knowledge.

As discussed in previous chapters, the astonishing and wonderful thing is that the common thread is music. As did Schneider, I too cannot but express amazement when contemplating the fundamental unity of thinking among all peoples regarding the original meaning of music. Moreover the most interesting thing is that all such concepts, that at first sight seem esoteric or mystic, appear to be confirmed by science. For example, in the light of all the consideration made during the first part of this thesis, we can conclude that the physics (in particular the quantum physics) agrees with the philosophical which considers the sound as first principle, primary element and original substance present in every thing.

Throughout the last few millennia, dreamers, scientists, philosophers, and seekers of the patterns of creation have studied the movements of the cosmos and the mirroring of these cycles and proportions on Earth. The ancient Chinese, Egyptian, Sumerian, Druid, and Mayan cultures including great thinkers and pioneers such as Plato, Pythagoras, Copernicus, and Kepler, all discovered the interconnectedness of the planetary cycles, sacred geometry, and musical scales long before modern science began to confirm these connections.

It has to be said that in the exposition of the encountered themes, I tried to limit myself in order to not bore the reader. First of all I have deliberately avoid investigating in depth the historical and esoteric questions (in particular those regarding the Cathars), the philosophical, religious and ufological ones, but overall I have not expanded upon the physical arguments, that are very complex and need a considerable scientific background to be understood right to the end and appreciated¹.

The aim of such a thesis, indeed, is not to make a treatise, but to communicate, by means of art, a multidisciplinary content that other than being important is, in my opinion, very fascinating. All the material exposed until now, constitutes the base for my composition, that will be illustrated in next chapters.

I would like to conclude this first part by reading a passage from Drunvalo Melchizedek's book to sum up what we have seen so far:

Once, all life in the universe knew the Flower of Life as the creation pattern - the geometrical design leading us into and out of physical existence. Then from a very high state of consciousness we fell in darkness and forgot who we were. For thousands of years the secret was held in ancient artifacts and carvings around the world, and encoded in the cells of all life.

Now we are rising up from that sleep, shaking old, stale beliefs from our minds and glimpsing the golden light of this new dawn streaming through the windows of perception.

Sacred Geometry is the form beneath our being and points to a divine order in our reality. We can follow that order from the invisible atom to the infinite stars, finding ourselves at each step. The information here is one path, but between the lines and drawings lie the "feminine gems" of intuitive understanding.

In the following chapters the composition I wrote for this thesis will be explained, in particular from a technological point of view.

¹The reader can read further on such arguments by referring to works outlined in the bibliography of this thesis.

Chapter 9

The technology used

When asked what musical instrument they play, few computer musicians respond spontaneously with “I play the computer”. Why not?

Wessel & Wright, 2002.

My composition is an interdisciplinary, real-time and multimedia work. The media utilized are sounds and images. The audio part has been realized using a soprano, a flute and real-time sounds generated by a computer. The visual part has been realized by images on a screen generated by a computer, by the movements on the stage of the soprano, and by the pamphlet in which there is an introduction to the representation, as well as the lyrics sung by the soprano.

The composition makes use of software and hardware technologies. The software used consists of:

Max/Msp [39] is a graphical development environment for music and multimedia developed and maintained by San Francisco-based software company *Cycling '74*. It has been used for over fifteen years by composers, performers, software designers, researchers and artists interested in creating interactive software.

The Max/Msp program itself is highly modular, with most routines existing in the form of shared libraries. An API allows third-party development of new routines (called “external objects”). As a result, Max has a large userbase of programmers not affiliated with Cycling '74 who enhance the software with commercial and non-commercial extensions

to the program. Because of its extensible design and graphical interface (which in a novel way represents the program structure and the GUI as presented to the user simultaneously), Max/Msp is widely regarded as the lingua franca for developing interactive music performance software.

Max/Msp programs (called “patches”) are made by arranging and connecting building-blocks of “objects” within a “patcher”, or visual canvas. These objects act as self-contained programs (in reality, they are dynamically-linked libraries), each of which may receive input (through one or more visual “inlets”), generate output (through visual “outlets”), or both. The order-of-execution for messages traversing through the graph of objects is defined by the visual organization of the objects in the patcher itself. As a result of this organizing principle, Max/Msp is unusual in that the program logic and the interface as presented to the user are typically related, though newer versions of Max/Msp provide a number of technologies for more standard GUI design.

I used Max/Msp to create the patches used by the live electronics performer: the input sounds coming from the microphones are processed in several and different ways.

Processing [40] is an open source project initiated by Casey Reas and Benjamin Fry, both formerly of the Aesthetics and Computation Group at the MIT Media Lab. It is a programming language and integrated development environment built for the electronic arts and visual design communities, which aims to teach the basics of computer programming in a visual context, and to serve as the foundation for electronic sketchbooks. One of the stated aims of Processing is to act as a tool to get non-programmers started with programming, through the instant gratification of visual feedback. The language builds on the graphical capabilities of the Java programming language, simplifying features and creating a few new ones.

Processing is an alternative to proprietary software tools in the same domain: it is free to download and available for GNU/Linux, Mac OS X, and Windows. Its open source status encourages the community participation and collaboration that is vital to Processing’s growth. Contributors share programs, contribute code, answer questions in the discussion forum, and build libraries to extend the possibilities of the software. The Processing community has written over seventy libraries to facilitate computer vision, data visualization, music, networking, and electronics.

Tens of thousands of companies, artists, designers, architects, and researchers use Processing to create an incredibly diverse range of projects.

I used Processing to create the visual part of the composition. After I wrote the program in the Processing language I exported it in a java application thanks to the facilities provided by Processing itself.

Open sound control (OSC) [41] is a protocol for communication among computers, sound synthesizers, and other multimedia devices that is optimized for modern networking technology. Bringing the benefits of modern networking technology to the world of electronic musical instruments, OSC's advantages include interoperability, accuracy, flexibility, and enhanced organization and documentation.

This simple yet powerful protocol provides everything needed for real-time control of sound and other media processing while remaining flexible and easy to implement. There are dozens of implementations of OSC, including real-time sound and media processing environments, web interactivity tools, software synthesizers, a large variety programming languages, and hardware devices for sensor measurement. OSC has achieved wide use in fields including computer-based new interfaces for musical expression, wide-area and local-area networked distributed music systems, inter-process communication, and even within a single application.

OSC was originally developed, and continues to be a subject of ongoing research at UC Berkeley Center for New Music and Audio Technology (CNMAT¹)

I used the OSC protocol in order to put in communication Processing and Max/Msp to obtain synchronous events between video and audio (the libraries can be freely downloaded at [40] and at [42] respectively.)

The hardware used consists of:

a microphone used by the soprano

a contact microphone used by the flute player: the use of the contact microphone allows to pick up with great precision not only the sound of the flute but also the noise of the keys pressed by the flute player.

¹CNMAT is an interdisciplinary research center within the UC Berkeley Department of Music [42].

a sound card equipped with at least two input and six output

six loudspeakers placed according to the arrangement shown in section 10

four stands to place the loudspeakers at the heights explained in section 10

six cables to connect the six loudspeakers to the sound card

two computers configured in this way:

- computer 1 (OSC client): the operative system can be Windows or Mac, and the runtime of Max/Msp has to be installed. Moreover the sound card has to be linked to it.
- computer 2 (OSC server): the operative system can be Windows or Mac or linux, and the java software has to be installed, as this computer runs the java application.

a cable to connect the two computers in order to allow the OSC communication

a projector

a screen

Chapter 10

Sound spatialization

Music is the seat of secret forces or spirits which can be evoked by song in order to give a man a power which is either higher than himself or which allows him to rediscover the deeper self. The mystical sound substance inherent in all things manifesting itself now directly, now indirectly, exists everywhere, even beyond the range of the human ear.

Marius Schneider.

One of the aspects of my composition on which I concentrate more has been the sound spatialization. In this chapter some algorithms of sound spatialization are illustrated. Subsequently the diffusion system and the various algorithms of sound spatialization used in my composition are described.

10.1 VBAP and RVBAP: moving sound source

Vector Base Amplitude Panning (VBAP) is a method for positioning virtual sources to multiple loudspeakers developed by Ville Pulkki [43]. The number of loudspeakers can be varying and they can be placed in an arbitrary 2D or 3D positioning.

The goal of VBAP is to produce virtual sources that are as sharp as is possible with current loudspeaker configuration and amplitude panning methods. The idea behind VBAP is to extend the traditional panning techniques for two loudspeakers to a configuration of multiple loudspeaker. By using operations on vectors, VBAP allows to position a virtual sound source in any location in 2D or 3D space.

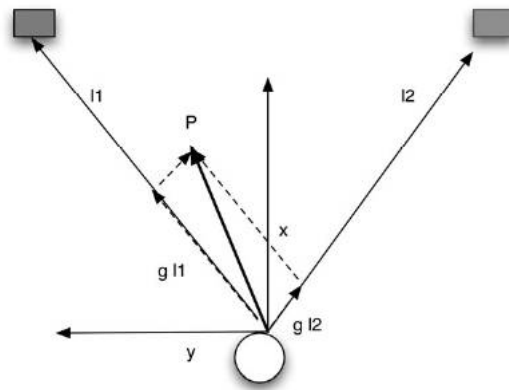


Figure 10.1: Vector based amplitude panning (VBAP) is a technique developed by Ville Pulkki to place sounds in a 3D space. The gray boxes represent two loudspeakers, while the circle represents the person standing in front of them.

For example, let us consider a configuration like the one shown in figure 10.1. In it, the virtual source vector p is set to be a sum of weighted loudspeaker vectors $l1$ and $l2$. After the weights $g1$ and $g2$ have been calculated and normalized they can be used as gain factors of each channel.

Extending this same idea to multiple dimensions, it is possible to use VBAP to position sounds in an arbitrary configuration of loudspeakers.

As seen in the Max/MSP patch of figure 10.2, the algorithm requires the user to specify the location of the loudspeakers in terms of azimuth (angle from the listener on the horizontal plane, typically clockwise) and elevation (angle from the listener going up/down, usually up from front-facing is positive). Once the task is established, it is necessary to specify the desired motion of the source in terms of elevation and angle. This means, for example, that if we want a sound source to move from left to right in front of us (no elevation) in one minute, this corresponds to creating a loop from -30° and 30° which lasts one minute. The same can be done for any configuration of moving sound sources, both for azimuth and elevation. By using VBAP it is possible to move sounds in a 3D space in an efficient way. The VBAP algorithm calculates the gain factors of all the loudspeaker using the specified angles, in such a way that the sound is perceived as if it is moving through space.

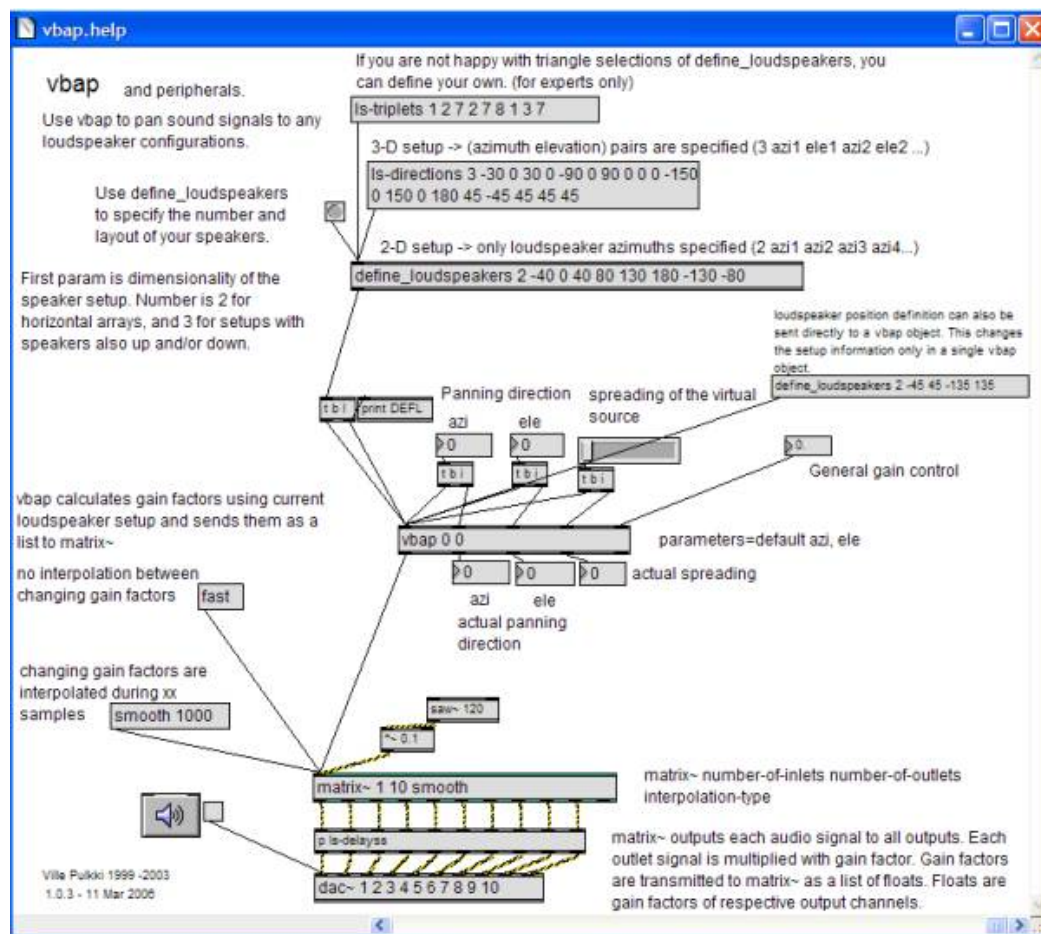


Figure 10.2: Max/MSP patch implementing the VBAP algorithm.

The Reverberated vector based amplitude panning (RVBAP¹) is an algorithm that improves VBAP. The latter allows to pan signals in a two or three dimensional acoustical space using any arbitrary setup of loudspeakers. However, it is only possible to pan the signal which appear at a fixed distance to the listener. This distance is usually the real distance speaker-listener. To extend the virtual acoustical room beyond the loudspeaker (and thus beyond the borders of the real space) a portion of reverberated signal can be added. RVABP, i.e. reverberated VBAP, tries to implement the usage of reverb to create a more realistic sense of acoustical space. To add a feeling of “distance” to amplitude panned signals a certain amount of reverb has to be added. There has to be one reverb per speaker/output channel. The final output signal consists of the following components:

- the “normal” VBAP signals representing the “dry part” of the signal with levels corresponding to the position in the room
- a “global reverb” part, i.e. reverb on all channels
- a “local reverb” part, i.e. reverb with different levels on different channels depending on position in room

Therefore, once the task is established, it is necessary to specify the desired motion of the source not only in terms of elevation and angle but also of distance.

10.2 Ambisonic

Ambisonics [44, 45, 46] is a series of recording and replay techniques using multichannel mixing technology that can be used live or in the studio. By encoding and decoding sound information on a number of channels, a 2-dimensional (“planar”, or horizontal-only) or 3-dimensional (“periphonic”, or full-sphere) sound field can be presented.

Ambisonics offers a number of advantages over other surround sound systems:

- It is isotropic in that sounds arriving from all directions are treated equally (as opposed to most other surround systems that assume that the main sources of sound are frontal and that rear channels are only for ambience or special effects).

¹As for VBAP, an external for Max/MSP (OS X/WinXP) is available to allow easy implementation of RVBAP (by Olaf Matthes, 2003).

- All loudspeaker are generally used to localise a sound in any direction (as opposed to conventional pan-potted (pair-wise mixing) techniques which use only two adjacent loudspeaker). This gives better localisation, particularly to the sides and rear.
- The stability and imaging of the reproduced soundfield vary less with listener position than with most other surround systems. The soundfield can even be appreciated by listeners outside the speaker array.
- A minimum of four channels of information are required for distribution and storage of a full-sphere soundfield, and three for a horizontal soundfield. (This is fewer than other surround systems). Full-sphere replay requires a minimum of six loudspeakers (a minimum of four for horizontal), the signal for each speaker position being derived using appropriate circuitry or software.
- The loudspeakers do not have to be positioned in a rigid setting; most regular polygons and (with somewhat more complex technology) a number of irregular figures can be accommodated. This allows the speaker configuration to be matched more closely to real listening environments, such as domestic living rooms.
- The Ambisonic signal is independent of the replay-system: the same signal can be decoded for varying numbers of loudspeakers (in general, the more loudspeaker, the higher the accuracy of the reconstructed soundfield). This allows flexibility for composers, performers and production teams to produce a “final” mix without worrying about how the mix will later be released and decoded.

Each source to be spatialized is passed to an encoder, along with a direction from the listener described as azimuth and elevation.

The ambisonic encoder then creates an intermediate representation of this sound source in the ambisonic domain. It's just a transform, in the same way that a spectral domain can be achieved by (some kind of) Fourier transform, however in this case it is based upon the math of spherical harmonics and captures polar orientations rather than frequencies².

²Ambisonic spatialization starts from the premise that the sound waves any source emits in space can be modelled using spherical harmonics. In order to obtain a precise decomposition of a sound wave, several passes with increasing numbers of spherical components in a Fourier series are used, corresponding to the increasing order of the harmonics. These components are obtained in the form of audio-streams which are grouped into a

There are different orders of ambisonics, and they can be done in 2D or 3D. Increasing the order is better if you want to expand your acceptable listening area, but requires more signals in the ambisonic domain. For an 8 channel surround in 2D, you would typically use 1st order (requires 3 channels) or 2nd order (requires 5 channels in the ambisonic domain). One of the nice things about the domain is that it is additive, you can encode lots of independent sources and add the domain signals together (assuming the domain orders and dimensions match).

The other nice thing is that the domain is portable; it can be easily “decoded” onto different arrays of loudspeaker, and the only additional information needed is the speaker arrangement (and that, again, the order/dimensions must match). The domain signals are passed to a decoder to do another spherical harmonic transform at each speaker location, and deduce the needed pressure waves from each speaker to try and reconstruct the spatial sound field in your listening area. That’s why the decoder also needs to know the azimuth and elevation of each speaker relative to the listener.

The great advantage of using Ambisonics is that it is not only a compact periphonic recording technique but also an intermediate carrier-format in which compositions can be stored and manipulated and then decoded to a specific speaker-array for each performance, for example in the concert hall.

10.2.1 Ambisonics Spatialization Tools for Max/MSP

The tools developed at the ICST [47] implement Ambisonics in the form of Max/MSP externals³ [48] and allow the encoding and decoding in three dimensions of up to third-order Ambisonics (see fig. 10.3). In addition they include a graphical control module for real-time manipulation of source placement and modules for algorithmic control of source motion in three-dimensional space.

To control the encoder, the position information (azimuth, elevation and distance) is input for each source. The input channel gets placed at the specified position in the soundfield as if it were a virtual microphone.

To give the user an intuitive access to positions of the source-sounds the multi-channel format called the B-Format. It contains one channel of omni-directional signal (the monophonic signal or the zeroth order), and three channels for the “figure-of-eight” pressure responses along the three Cartesian axes, encoding a full sphere, using only three directional components.

³The ICST Ambisonics Tools are free software distributed under GNU Lesser General Public License (LGPL).

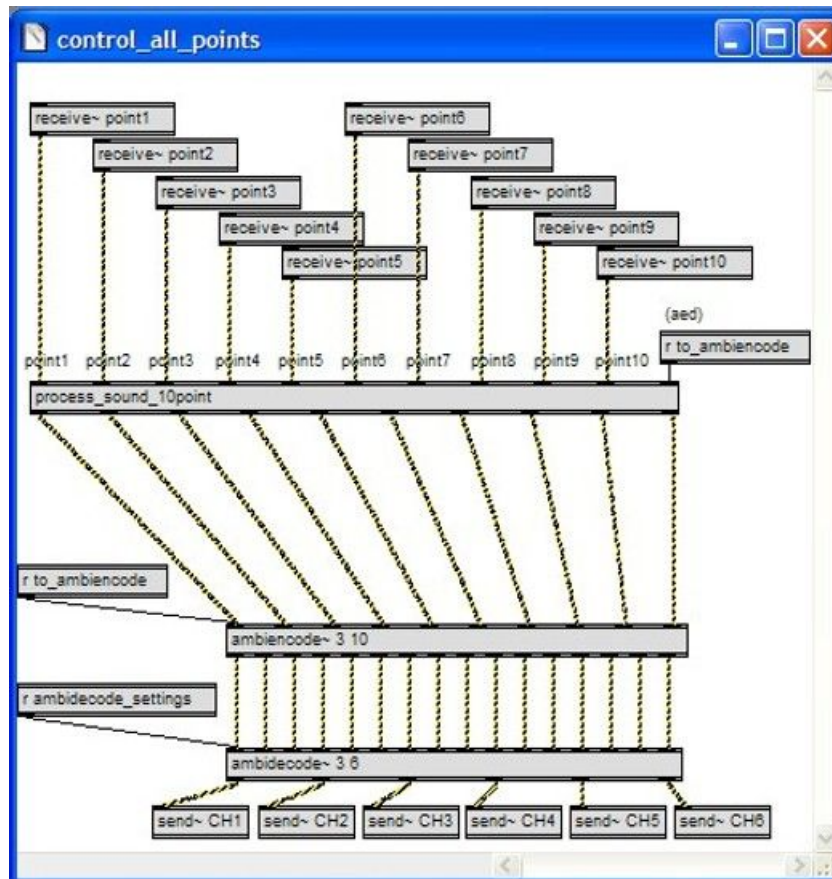


Figure 10.3: Ambisonic encoder and decoder in the patch for the control of the sources movements utilized in my composition (using ten sources, six loudspeaker and transcoding in third order B-format).

GUI-object “ambimonitor” was developed (see fig. 10.4). It integrates seamlessly with the encoder, transmitting the correctly formatted indexed lists containing the position information for each point. The graphic display is used to visualize positions on a two-dimensional surface or with half- or full-sphere three-dimensional display using two views (top and front). Sources are displayed as dots and are labeled either with symbolic names or their indices. If desired, the coordinates for each point can be displayed in Cartesian or polar form (see fig. 10.5).

Furthermore, points can be selected and moved with the mouse and a variety of key commands gives easy access to the points, allowing their creation and erasure and the control of a few basic motion types.

A companion-class called “ambicontrol” (see fig. 10.4) connects to the data-structure containing the source-points and performs motion behaviours and transformations such as rotation, translation and random walks within boundaries. User-defined trajectories given in a breakpoint format (time, coordinates) are executed as well.

Finally, the efficiency of this technique in terms of computing power makes the use of complex spatialization algorithms on one portable computer an attractive option, be it in a studio as a modelling tool or on a stage in a portable setup. Contrary to other higher level spatialization tools, in Ambisonics a large number of sources can be treated in real-time while leaving a considerable amount of headroom for other types of signal-processing.

10.3 The diffusion system used

At the end the technique of spatialization I choose has been the ambisonic. I took such a decision after having ascertained that all I could do with RVBAP could be made by ambisonic. Moreover ambisonic allowed a more efficient management of the virtual sound sources both in polar and Cartesian coordinates, and above all it allowed till to 16 virtual sound sources placed in 16 independent tridimensional trajectories.

The diffusion system I used in my composition constitutes six loudspeakers placed on the vertices of an hexagon (as regular as possible) as shown in figure 10.6.

The six loudspeakers must be identical (i.e. same dimensions, same frequency response, same features, etc.) and they must be positioned as follows:

- loudspeaker 2 and 5: at the bottom

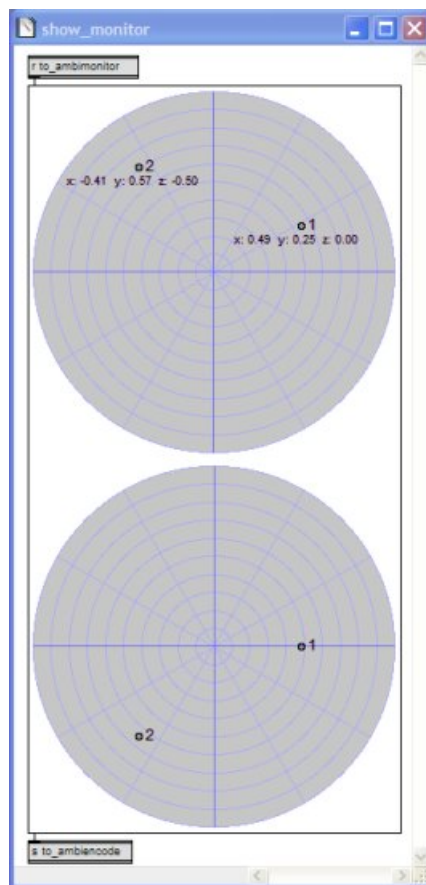


Figure 10.4: Ambimonitor's full-sphere display with two points and their coordinates.

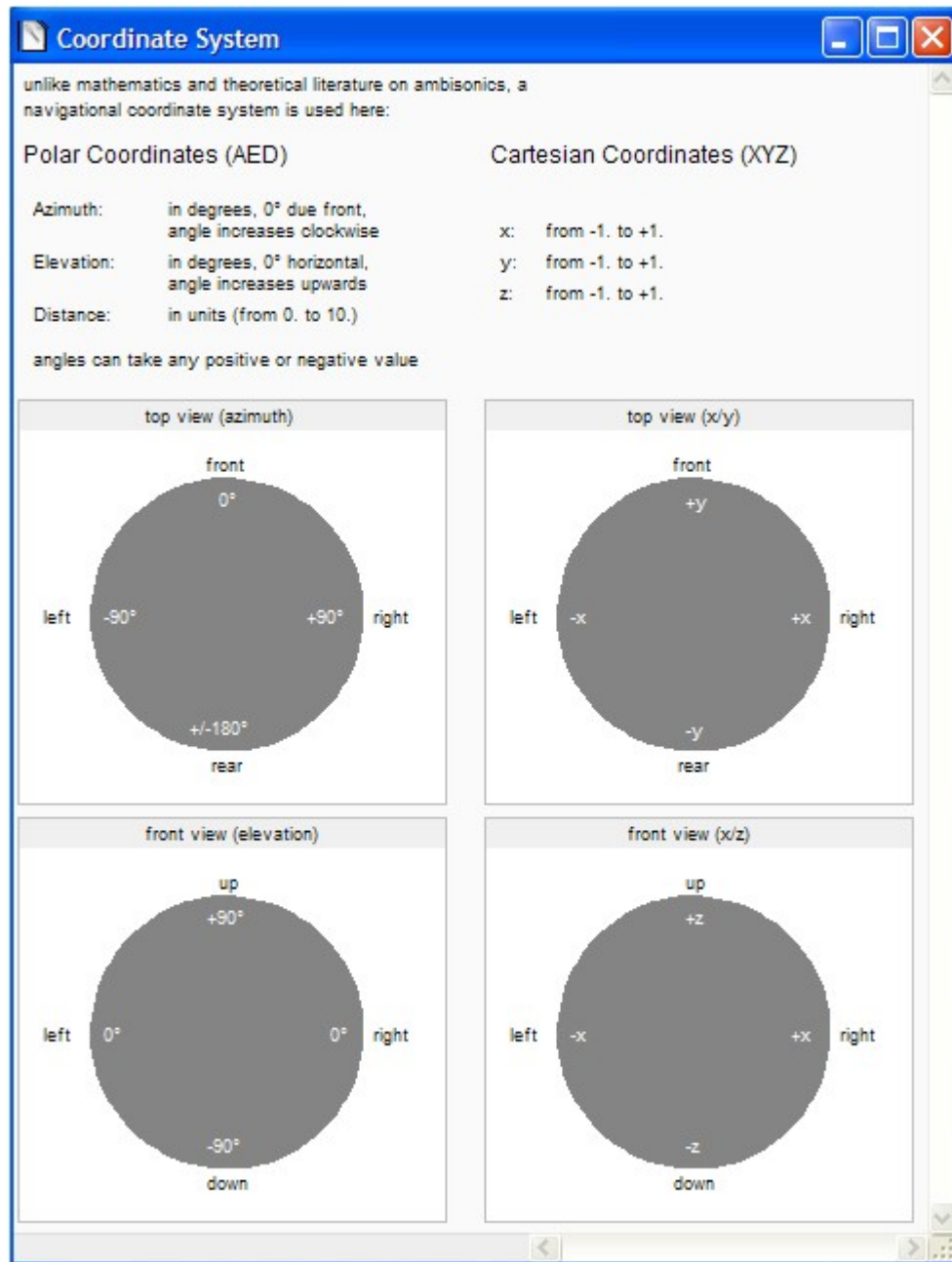


Figure 10.5: Coordinates system of the ambisonics spatialization tools for Max/MSP.

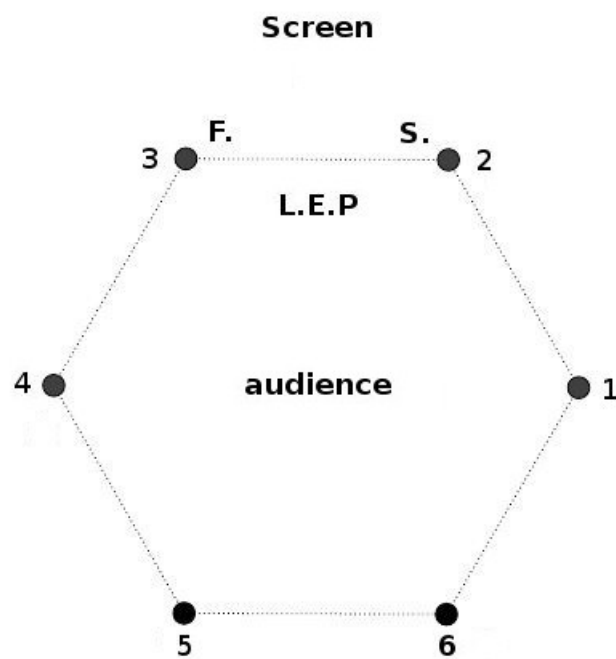


Figure 10.6: Arrangement of the six loudspeakers in an hexagonal pattern (they are indicated with numbers following the counter-clockwise order).

- loudspeaker 3 and 6: at the top
- loudspeaker 1 and 4: at the middle (half height between the top and the bottom)

The pairs azimuth-elevation that identifies the six loudspeakers in the ambisonic domain should be chosen in relation to the hall dimension and to the heights of the stands. Indeed the positions of the six loudspeakers are defined on the surface of an imaginary sphere, thus the greater the radius of the sphere the more the elevation parameter is affected.

For instance, with reference to fig. 10.5, the ambisonic parameters I used for the first representation of my work were:

- loudspeaker 1: (90,0)
- loudspeaker 2: (30,-45)
- loudspeaker 3: (-30,45)
- loudspeaker 4: (-90,0)
- loudspeaker 5: (-150,-45)
- loudspeaker 6: (150,45)

10.4 Algorithms to place virtual sound sources along a trajectory

Various kind of trajectories have been algorithmically defined to place one or more virtual sound sources in the three-dimensional space delimited by the six loudspeakers.

All the following trajectories are defined on the geometrical forms suggested by the symbol.

Circular pattern: the virtual source moves along a circumference. The parameters that can be controlled are radius, position of the centre, clock/counter-clockwise, elevation, speed.

Stereo circular pattern: two virtual sources move along the same circumference, with the same speed but with a distance of 180° from each other. The control parameters are the same of the previous one but are shared by both the virtual sources.

Arch pattern: the virtual source moves along an arch half a circumference long. Once it reaches an extremity come back in the inverse sense.

Hexagonal pattern: the virtual source moves along the perimeter of an hexagon. The parameters that can be controlled are radius and position of the centre of the hexagon, clock/counter-clockwise, elevation, speed.

SOL formation pattern: seven virtual sources move along the seven circumferences forming the Seed of Life symbol. The seven trajectories share the same values for the control parameters radius, clock/counter-clockwise, elevation and speed, but change the positions of the centres.

Redhae formation pattern: seven virtual sources move along the curves defining the Seed of Life symbol. The first one moves along a circumference, the other six move along six archs according to the arch pattern spatialization. The seven trajectories share the same values for the control parameters radius, clock/counter-clockwise, elevation and speed, but change the positions of the centres.

10.4.1 An example of definition of a trajectory: the hexagonal pattern

This algorithm allows the movement of a virtual sound source along the perimeter of an hexagon, in both clockwise and counter-clockwise and with a certain speed. The trajectory has been defined as the values of the distance from the centre of the hexagon in function of the azimuth angle in a polar coordinates system (the elevation parameter has been set to 0).

In reference to figure 10.7, let us consider only the portion of the hexagon included in the OAD triangle, that is the line we want the sound move along between the vertex positioned at 30° and the vertex positioned at 30° . To calculate the distance at the point B (the segment OB) we have to use a formula of trigonometry called “law of sines”. It states that:

$$\frac{a}{\sin(\alpha)} = \frac{b}{\sin(\beta)} = \frac{c}{\sin(\gamma)}$$

where the sides of the triangle are a , b and c and the angles opposite those sides are α , β and γ . So the segment b (i.e. OB) is calculated as:

$$b = \frac{a}{\sin(\alpha)} \sin(\beta)$$

If we define a as 1, that is the distance between the centre of the hexagon and each vertex (i.e. the ray of the circumscribed circumference), we have all

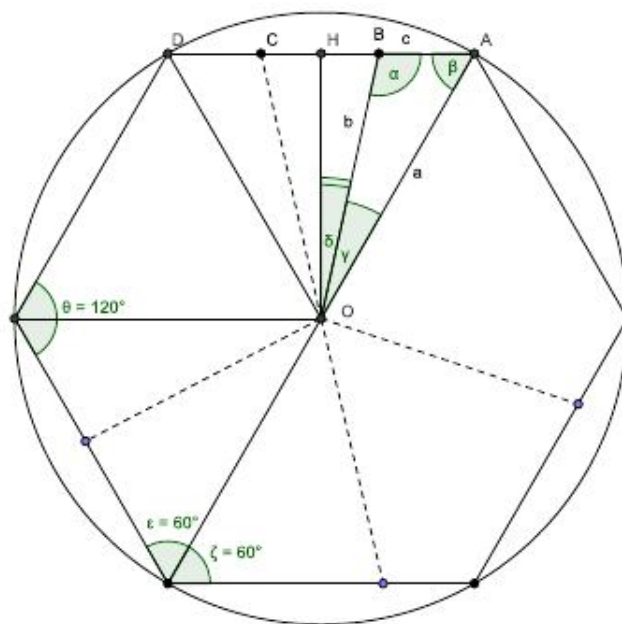


Figure 10.7: Spatialization along a hexagonal pattern. The dashed segments represent the vector distance that moves in clock or counter-clockwise along the perimeter of the hexagon.

the information to calculate b (a will be subsequently scaled to the wanted distance in the control the algorithm). In fact β is equal to 60° since it is the half of each internal angle of the hexagon (i.e. 120°) and α is

$$\alpha = 180 - \beta - \gamma = 180 - \beta - (30 - |\delta|)$$

Indeed we know that the sum of the internal angles of a triangle is 180° , so the angle α can be calculated as the difference between 180° and the sum of the other two angles. Moreover we know the value of γ as the difference between 30° and the value of the angle δ . In this way we have expressed α , and so the distance, as a function of δ (i.e. the azimuth).

In calculating γ we have to consider the absolute value of δ since when the azimuth assumes negative values we have to assure a symmetrical behavior. The next step in the formulation of the algorithm is to adapt the calculation of the distance in the range $[30^\circ, -30^\circ]$ to the other five ranges (each one 60° large): this can be simply do with some appropriate subtractions.

10.5 Not ambisonic spatializations

Besides the trajectories defined using the ambisonic technique, various kind of spatialization of the sound through the six loudspeakers has been used:

Single channel: the sound is totally diffused on a single channel.

All equal: the sound is diffused on all six channels with equal volume.

Left: the sound is diffused on channels 3, 4 and 5 with equal volume.

Right: the sound is diffused on channels 1, 2 and 6 with equal volume.

2, 3, 4 and 5 delays: a unique sound is delayed 2, 3, 4 or 5 times, at distance of 1 second and with the same volume. Each delay is diffused on a different channel.

6 reverbered delays: first of all the sound is reverberated with a long stereo-reverber. Then the left (L) and the right (R) outputs of the stereo reverber are delayed six times (at distance of 1 second and with decreasing volume) sending the sound to pairs of channels in the following order: (L,R) = (1,4), (2,5), (3,6), (4,1), (5,2), (6,3). The pairs of channels have been chosen following the diagonals of the hexagons that connect pairs of vertices (i.e. [1,4],[2,5],[3,6]) in counter-clockwise.

Chapter 11

Sound-colour relationship

Colour is the keyboard, the eyes are the hammers, the soul is the piano with many strings. The artist is the hands which plays touching one key or another purposively to cause vibrations in the Soul.

Wassily Kandinsky.

At the beginning of my work I planned to use a mapping between sounds and colours in order to create a stronger relationship between what could happen at audio and video level.

The theme of the correspondences and analogies between music and painting fascinates all of the people that approach its study. In the past great musicians and great painters faced, with a more or less scientific attitude, the problem of finding mappings between sound and colour. One should bear in mind the literary works of Kandinsky or the Prometheus of Skrjabin.

Both sound and light are vibratory phenomenon and are measured as frequencies in cycles per second. Sound is measured from the ten's to the ten of thousand's of cycles per second. Light manifests as billions of cycles per second. Therefore, one way of viewing the relationship between sound and light is to assume that light is speeded up sound, or conversely, that sound is slowed down light.

The ancient Hermetic principle of "as above, so below" is often quoted in regard to the relationship between sound and light. Mathematically, if you speed up a sound's frequency by doubling it forty times, you come up with a frequency that is within the parameters of light. Conversely, if you slow down light's frequency forty times, you have a frequency within the parameters of

sound [49].

For example the frequency of 518.7 cycles per second, which creates a note somewhat near what we call a “C”, when speeded up in this manner, falls within the range of what we see as a green. Or, when slowed down, this greenish coloured light that vibrates at approximately 570 billion cycles per second, becomes that note “C”, at least mathematically. Very dark red vibrates at a frequency of approximately 430 billion cycles per second, which when reduced by 40 octaves becomes 391.3 cycles per second., creating the note of “G”. The spectrum of violet goes from light violet at around 690 billion cycles per second (which equates to 627.8 cycles per second, creating a note somewhere around a Eb) to very dark violet at about 750 billion cycles per second (which when reduced 40 octaves manifests as 682.4 cycles per second, creating a note close to an F).

Many different people have expressed very different understandings about the relationship between light and sound. Within the last twenty years, the most common relationship found between musical notes and their colours matches the notes of one octave with the colours of the electromagnetic spectrum, starting with the note C (see table 11.1) [50, 49]. This is a very different relationship than the octave doubling relationship discussed previously.

Colour	Note
Red	C
Orange	D
Yellow	E
Green	F
Blue	G
Indigo	A
Violet	B

Table 11.1: The mapping between the colours of the electromagnetic spectrum and notes.

To my knowledge, no one has ever succeeded in turning a sound wave into a light colour finding the relationship between sound and light by having specific colours assigned to specific notes. This does not mean there is not a direct relationship between sound and light, but thus far, no one has figured out exactly what it is.

It may be that colour and sound are two very different energy forms or it

may be that there is a direct relationship of colour to sound. But it may be that this relationship is much more complicated than simply taking a note and bringing it up 40 octaves to the bandwidth of light. It may be that as sound goes up the electromagnetic spectrum, that as it changes energy, the mathematics become more complicated and different than simple doubling.

11.1 A different approach

Maurice Touzé in the article [51] faced with a predominantly scientific attitude the matter in hand. First of all he highlighted the two most common mistakes of all have proposed correspondences and analogies between sounds and colours.

The first error is to compare the seven colours of the visible spectrum¹ to the seven notes of the diatonic scale. Such things are not comparable because while the spectrum contains all the colours used in painting, the diatonic scale contains only seven of the twelve notes. Moreover the diatonic scale is characterized by the irregularity of tones and semitones. So, comparing the sound of the diatonic scale to the colour of the spectrum is equivalent to comparing the half of the sonour phenomena to all the colour phenomena, and an irregular sequence of sounds to a regular sequence of colours.

The second error is to juxtapose the colours of the spectrum to all the series of the perceivable sounds, from the most high-pitched to the most low-pitched, disregarding the fact that the sonorous phenomena recur periodically among the octaves while this does not happens for the colours. The ears perceive various octaves in the range of the audible frequencies while the eyes perceive a unique set of colours in the range of the visible frequencies. For this reason comparing all the series of the audible sound to the series of the visible colours means comparing many times the same thing to a unique thing.

After having analyzed these two kinds of mistakes, Touzé proposed a comparison method founded on deducible relationships between the spectrum of colours and the spectrum of sounds.

Let's put the three colours called primaries (red, blue, yellow) [52] at the vertices of an equilateral triangle². Now, let's place between two near colours

¹Note: the seven colour of the rainbow constitute the "base spectrum" from which all the light we see is formed. Even if the various colours mix without discontinuity, generally it is in the habit to subdivide them in red, orange, yellow, green, blue, indigo, and violet. Isaac Newton studied the decomposition of the white light: he shown that not only a triangular prism split a ray of solar light in the seven colours of the rainbow, but also that a second prism put again together all the seven colours, reforming the white light.

²Note: Touzé refers to the RYB colour model (an abbreviation of red-yellow-blue),

the colour resulting from their mixture. So between the blue and the yellow will result the green, between the yellow and the red the orange, and between the red and the blue the violet. They are called the secondary colours [54]. Let's repeat the same operation: we obtain the so called tertiary colours [55]. For example between the blue and the green we obtain the blue-green (or aquamarine), between the orange and the yellow the orange-yellow (or amber). In this way we have obtained a series of twelve colours (see fig.11.1(a)).

At this point Touzé shows that it is possible to compare such a series of twelve colours with a series of twelve notes arranged according the so called circle of the fifths (see fig 11.1(b)). Along this circle if we start from a arbitrary note and make twelve traspositions of fifths, we come back to the starting note, having identified all the twelve notes of the equal temperament (which divides the octave into twelve equal parts). Note that in such a method there is not an unique and unambiguous mapping between sounds and colours. As a fact of matter Touzé states:

A sound per se does not evoke any specific colour and a colour per se does not evoke any specific sound, we can overlap the two spectra³ does not matter how in rapport each other. We do not have to try to know if a certain sound is blue or yellow, but rather if the colours behave between each other as the sounds.

Such an association shows some interesting properties that allow to define the five following analogies between sounds and colours.

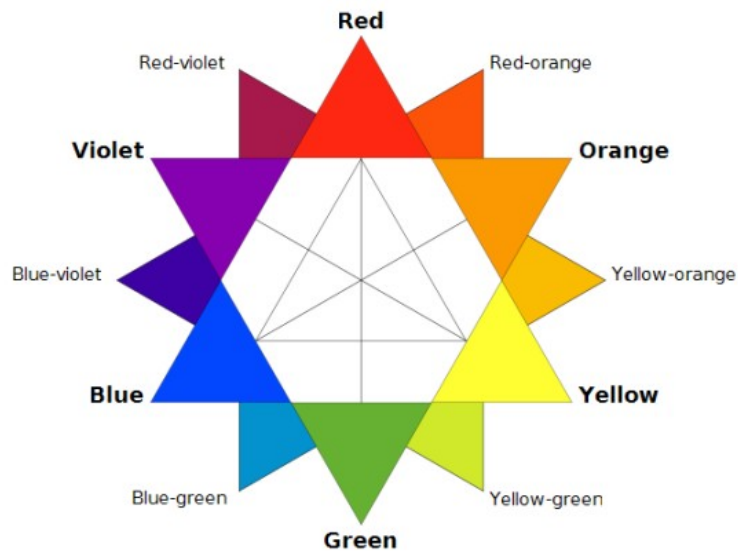
The simplest way to obtain a grey in painting, consists in the mixing two colours called complementary colours [56] (for example red and green). We can find them at the extremities of any diameter of the circles of the colours above defined. Such a property never verify between two colours chosen in another way.

Now, if we consider two sounds taken at the extremities of any diameter of the circle of the sounds above defined (for example C and F#) we obtain a bichord called tritone. Such bichord presents an indeterminate character, it is neutral.

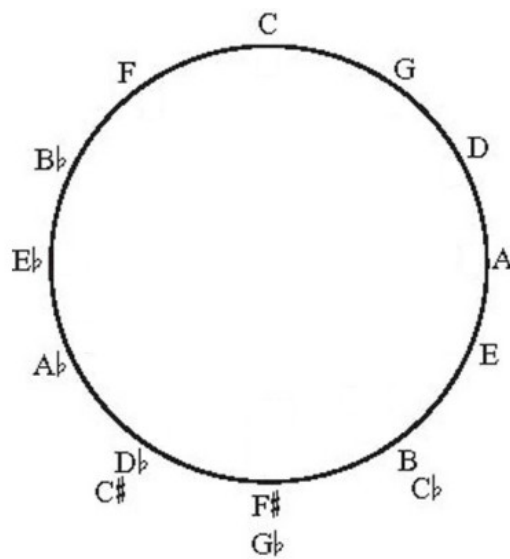
First analogy: To obtain the grey with two colours or a neutral chord with two sounds it is necessary and sufficient to take them at the extremities of any diameter of the circle of the colours or of the circle of the sounds.

a historical set of subtractive primary colours. It is primarily used in art and design education, particularly painting [53].

³The two spectra mentioned here are the twelve sounds and the twelve colours arranged in circles, fig. 11.1.



(a) Primary, secondary and tertiary colours in the RYB colour model.



(b) The twelve notes disposed according to the circle of the fifths.

Figure 11.1: The spectrum of the twelve colours and the spectrum of the twelve sounds according to Touzé.

But the painter can obtain the grey in several other ways. If we consider three colours, the only way to obtain the grey is to mix the colours taken at the vertices of any equilateral triangle (for example red, yellow and blue). Now if for analogy we consider three sounds taken at the vertices of any equilateral triangle (for example C, E, G \sharp) we have the so called augmented fifth chord. This chord, composed by three notes regularly placed in the sonorous domain (at distance of two tones), does not appertain to any tonality and gives an atonal and neutral sensation. Moreover does not matter the position of the notes in the chord: every inversions is always in equilibrium.

Second analogy: To obtain the grey with three colours or a neutral chord with three sounds it is necessary and sufficient to take them at the vertices of any equilateral triangle inscribed in the circle of the colours or in the circle of the sounds.

To obtain the grey with four colours the painter can choose the colours at the vertices of any square inscribed in the circle of the colours (for example red-violet, orange, yellow-green and blue). Similarly if we take in consideration the sounds placed at the vertices of any square inscribed in the circle of the sounds we have the so called seventh diminished chord (for example B, D, F, Ab). It maintains its indefinite sonority in any inversion and it does not appertain to a unique tonality.

Third analogy: To obtain the grey with four colours or a neutral chord with four sounds it is necessary and sufficient to take them at the vertices of any square inscribed in the circle of the colours or in the circle of the sounds.

With six elements we can do the same considerations. The grey is obtained choosing the six colours at the vertices of any regular hexagon (for example red, orange, yellow, green, blue and violet). Following the circle of the sounds in the same manner (for example C, D, E, F \sharp , G \sharp , A \sharp), we find a chord that has not a name but which is based on the whole tone scale of Deboussy. Its sonority is vague and enigmatic.

Fourth analogy: To obtain the grey with six colours or a neutral chord with six sounds it is necessary and sufficient to take them at the vertices of any regular hexagon inscribed in the circle of the colours or in the circle of the sounds.

Finally, with twelve colours and twelve sounds:

Fifth analogy: with the mixture of all the colours we obtain the grey, and with the mixture of all the sounds we obtain a neutral chord.

In conclusion we can summarize all above said in the following proposition: *in music and in painting the neutral is obtained with the mixture of sounds or colours regularly arranged in the circle of the colours or in the circle of the sounds.*

11.2 The mappings used in my composition

After analysing all the mappings I found during my research and taking into consideration the various meanings of what had to be represented on the screen, I developed various mappings for my composition.

As a matter of fact I changed the initial idea of creating with a unique mapping a strong relationship between what could happen at audio and video level. This decision was dictated by several reasons. First of all I had understood that a unique general mapping did not exist. Secondly it would not have made sense in the structure of my composition because it would not have been suitable for every part of it.

Thirdly the impression that a more correct (but however not general) mapping could be found at emotional level came to me. Indeed studying the colours I noticed that they can be classified as cold or warm (plus all their graduated shadings). In my opinion this classification could be put in relation with the emotions that the music can evoke (for example a sensation of disquiet could be put in relation with a certain shading of grey).

Fourthly the sound is alive, so in my opinion also the texture, as well as the level of saturation and brightness of the colour, of the coloured shapes should change in relation to the changes in the sound.

So I have to conclude that there are not general guidelines suitable for every case. I think that each composer can choose its own mapping or mappings between colours and sounds inside its multimedia work. In such a vision the mapping is a parameter of the composition like the others.

I put side by side different mappings in different contexts inside the composition (everyone of these has been chosen in relation to the meaning of what was represented):

No mapping: not everything has a mapping.

Dynamics-brightness: the brightness of a colour is associated to the volume of a sound.

3 colours-3 chords: the red, the green, the blue, (the fundamental colours in the RGB space) are associated to the chords D minor, G major and C major respectively.

Rainbow colours-7 chords: the seven colours of the rainbow with the exception of the indigo (which has been substituted by the white) have been associated to the seven triads chords that can be built on the scale of C major (see table 11.2).

Colour	Triads
White	(C,E,G)
Blue	(D,F,A)
Violet	(E,G,B)
Red	(F,A,C)
Orange	(G,B,D)
Yellow	(A,C,E)
Green	(B,D,F)

Table 11.2: The mapping “Rainbow colours-7 chords”.

12 colours-12 dominant seventh chords: taking the cue from the Touzé’s method, I developed a similar mapping.

First of all I change the RYB model used by Touzé to use the RGB model⁴, since it preserves the same properties of the RYB model discussed in the previous section. To prove this let’s consider the figure 11.2 as the new the circle of the colours. Taking the three RGB coordinates of three colours placed at the vertices of any equilateral triangle, summing and normalizing⁵ them, we obtain the colour gray (see table 11.4). The same thing happens with two colors taken at any diameter (see table 11.3), with four (see table 11.5) and six colours taken at the

⁴The RGB colour model is an additive colour model in which red, green, and blue light are added together in various ways to reproduce a broad array of colours. The name of the model comes from the initials of the three additive primary colours, red, green, and blue. The main purpose of the RGB colour model is for the sensing, representation, and display of images in electronic systems, such as televisions and computers [57].

⁵Such a normalization is needed in order to bring each sum of the three coordinates inside a correct RGB-coordinates range (precisely inside the range $[0, 127]$), and to compare such sums with the gray color. In the RGB model the gray is identified by the same value for the three R, G, and B coordinates; the difference between triplets is in the degree of white and black present in the gray. Knowing that $(0,0,0)$ = black and $(255,255,255)$ = white, I chose one of the possible grays identified by thee coordinates $(127, 127, 127)$.

vertices of any square and any regular hexagon respectively, as well as with all the colors, exactly in the same shown RGB colour model.

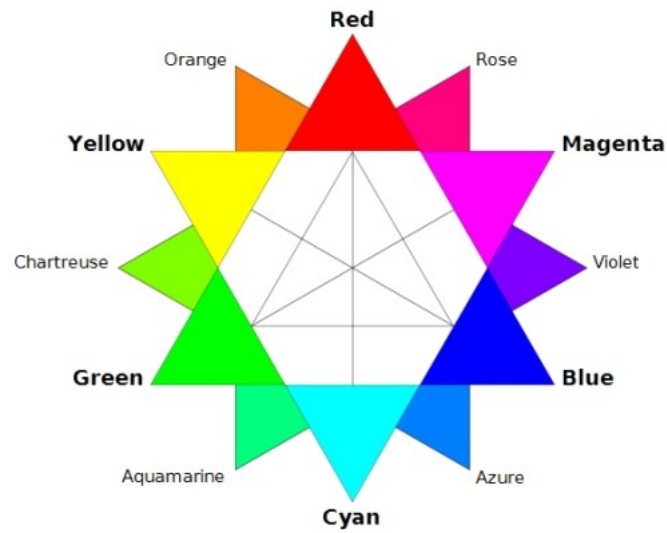


Figure 11.2: Primary, secondary and tertiary colours in the RGB colour model.

Colour	R	G	B
Red	255	0	0
Cyan	0	255	255
Sum	255	255	255
Normalization	127	127	127

Table 11.3: Red and Cyan.

Colour	R	G	B
Red	255	0	0
Green	0	255	0
Blue	0	0	255
Sum	255	255	255
Normalization	127	127	127

Table 11.4: Red, Green and Blue.

Colour	R	G	B
Yellow	255	255	0
Rose	255	0	127
Blue	0	0	255
Spring green	0	255	127
Sum	510	510	509
Normalization	127	127	127

Table 11.5: Yellow, Rose, Blue and Spring green.

At this point having the circle of the colours and the circle of the sounds I chose one of the possible one-to-one mapping. My mapping, however, was not intended colour-note but colour-root note of a dominant seventh chord. The mapping chosen is shown in table 11.6.

Note	Colour	RGB coordinate
C	Blue	(0, 0, 255)
G	Azure	(0, 127, 255)
D	Cyan	(0, 255, 255)
A	Spring green	(0, 255, 127)
E	Green	(0, 255, 0)
B	Chartreuse	(127, 255, 0)
F#	Yellow	(255, 255, 0)
C#	Orange	(255, 127, 0)
Ab	Red	(255, 0, 0)
Eb	Rose	(255, 0, 127)
Bb	Magenta	(255, 0, 255)
F	Violet	(127, 0, 255)

Table 11.6: Mapping “12 colours-12 dominant seventh chords”.

Chapter 12

Audio-video coherence

The ability to perceive or think differently is more important than the knowledge gained.

David Bohm.

As I anticipated in chapter 1, one of my goals was to have coherence between what happened at video and audio level. This has been carried out in various ways. Using various kinds of relationship between sound and images I tried to achieve the purpose of making the whole composition crossmodal.

First of all the images and the sounds has been synchronized, both with discrete and continuous controls. To this purpose the OSC protocol illustrated in chapter 9 has been the right choice.

Such a protocol, as well as the Max/Msp and Processing libraries to manage it, have never given me any problems of package loss, nor latency. In particular I used the UDP protocol to make the OSC information travel between the two computers, instead of the TCP/IP protocol. This choice was made due to the fact that UDP is faster than TCP/IP, even if the latter is safer in case of package loss. However the probability of package loss is very low when the communication happens between two close computers, joined only by a simple cable.

The synchronization has been carried out by means of OSC messages from Max/Msp to Processing, but not vice versa: in such a way Max/Msp controls both the audio and the video events. The actions to control Processing are hidden to the user of the Max/Msp patches, with the exception of few actions that need to be enabled on purpose because they have not a counterpart in the control of the audio. In this way the live electronics performer mostly

has to take care of the audio events, because the control of the video is quasi-totally transparent.

Discrete Max/Msp events can control both discrete and continuous events of Processing, while continuous Max/Msp events can control only continuous events of Processing. For example the activation of a patch, or pressing a button inside a patch can make an object appear or disappear on the screen. As regards the continuous control, an example is the velocity of the virtual sound sources along the trajectories that is associated with the velocity of some objects in the screen.

The second way I used to create consistency between sounds and images has been the use of a spatialization of the sounds, strongly related to the images appearing on the screen. For example in the presence of an object on the screen moving along a direction (through the three-dimensional space), the synchronized virtual sound source moves along the same direction. Or when the Seed of Life appears on the screen, the spatialization used is the “Redhae formation pattern” of section 10.4. Similarly when the formation of the symbol is represented on the screen by the juxtaposition of seven circles, the “Sol formation pattern” spatialization is used. Moreover in the presence of a sphere I tried to represent at audio level such a three-dimensional shape using three virtual sound sources moving along three circular trajectories sharing the same centre and radius, but lying in three different planes. To choose the slopes of such planes I was influenced by the positions of the orbits of the figure 4.1.

Finally another way I created the coherence between what happened at video and audio level was the use of appropriate sounds for the images. Indeed I tried to describe with the sounds what happened at the screen, not only by means of the various spatializations as illustrated above, but also with harmonies and melodies, in particular using the mapping sounds-colours explained in section 11.2.

Chapter 13

Structure of the Composition

I've always felt that there's a point where a piece seems to be alive, that is, living. And that's the point where I know the composition is finished.

David Tudor.

The composition, both in its macro- and micro-structure, has been written by taking cue from the features of the symbol. The symbol indeed suggests a lot of ideas that can be applied to a musical work (and, of course, to many other works in different areas).

For example it suggests the numbers six and seven, the ideas of symmetry, specularity, and dualism, the circular and hexagonal forms, the idea of six equal things, the idea of six different things, and of course the idea of vibration if we consider the symbol as moving.

I tried to apply such features both at a macro- and micro-level, dealing with them as compositional parameters to follow during the compositional act. Such a choice allowed me to unify the various parts of the composition and to give solidity to the whole structure.

With regards to the form, I chose to define it as a “mass for a symbol”. Of course it is not a mass in the sense of traditional masses used during the centuries by composers. For my purpose, this denomination suggests the idea of a sacred representation: indeed the whole piece is permeated by a kind of sacrality and such a feature gives coherence to the whole structure.

13.1 Macro-level

The ideas suggested by the features of the symbol have been applied at macro-level in the following ways:

Number six: the composition is structured in six uninterrupted parts, each one, in turn, is divided in six subparts.

Idea of dualism: the parts I, II, III are characterized by the use of photographs, on the contrary the parts IV, V, VI are characterized by images created at computer.

Idea of six different things: the six parts have different characters: part I: meditative; part II: tonal; part III: atonal; part IV: chromatic; part V: diatonic; part VI: sacred. At this level there is also the idea of dualism between the pairs II-III and IV-V (chromatic vs. diatonic, tonal vs. atonal).

In addition I felt free to approach six different languages: part I: new-age like; part II: (a kind of) folkloristic¹; part III: serialistic; part IV: chromatic in a tonal context; part V: modal; part VI: an evolution of the language of the part I (in addition the elements of part I have been placed in the inverse order).

Idea of circularity: part I opens in the same way as part VI closes, that is with the same image on the screen and with the same sound. In this way I created a circular opera, and moreover I was able to give the idea of the eternal return suggested by the symbol Uroboros (see fig. 2.13). In addition the image shown and the sound diffused are the white pulsing sphere and the breath. It was my intention to represent with those elements the Consciousness (the Primordial Vibration), that is the beginning and the end, the alpha and the omega.

Idea of specularity: at video level the six parts can be related for the use of images bi- and three-dimensional: part I: 2D + 3D; part II: 2D; part III: 2D; part IV: 3D; part V: 3D; part VI: 2D + 3D. So the specularity at this level is between the parts I, II, III and the parts IV, V, VI, according to the pairs I-VI, II-V, III-IV.

¹I used (modifying them) some parts of a traditional folk song of Lessinia in the repertoire of the association Panganoti Cimbri (see chapter 1). This, in the will of the author, wants to be also a quote of the works of Luciano Berio and Béla Bartók.

13.2 Micro-level

The ideas suggested by the features of the symbol have been applied at micro-level in the following ways:

Number seven: in part V, I used the seven musical modes (Ionian, Dorian, Phrygian, Lydian, Mixolydian, Aeolian, and Locrian) applied to the diatonic scale of C major, in relation to the seven circles of the formation of the Seed of Life. Moreover such circles have been coloured with the seven colours of the rainbow (see the relative mapping explained in section 11.2).

Number six: first of all, this number suggested to use the hexagonal spatialization illustrated in section 10.4 and the six delays spatialization of section 10.5.

Secondly in part III, the series has been chosen combining two esatonal scales: such scales have the property that they divide the octave in six equal parts, so the distance between a note and the successive note is identical (as the distances between the petals of the Seed of Life). The first scale was composed by the notes *C, D, E, F#, G#, A#*; the second scale by the notes *B, A, G, F, D#, C#*; their combination gave origin to the series *C, B, D, A, E, G, F#, F, G#, D#, A#, C#*. Such a twelve note series has then to be processed by means of the four standard techniques of the serialism: transposition, retrograde (i.e. reverse in time), inversion (i.e. reverse in pitch), retrograde-inverse (combination of retrograde and inversion). The way I used these techniques follows the scheme illustrated in table 13.1.

As you can see the eleven transpositions follow the same order of the notes in the series: in this way this order controls the micro- and the macro-structure of the series itself. The twelve series are shown in figure 13.1.

I used each series as a melody above a pedal. The succession of the notes of the pedal follows the same order of the original series (*C, B, D, A, E, G, F#, F, G#, D#, A#, C#*) and can be considered a kind of “cantus firmus” at macro-structure level. Moreover in this way the twelve series, grouped in two groups, present two properties that could be exploited:

- the first note of the series 1, 3, 5, 7, 9 and 11 is the same note of the relative pedal



Figure 13.1: The twelve series derived from the original one.

Series	Serialistic techniques applied
series 1	original series (unchanged)
series 2	retrograde plus transposition to B
series 3	inversion plus transposition to D
series 4	retrograde-inverse plus transposition to A
series 5	original series transposed to E
series 6	retrograde plus transposition to G
series 7	inversion plus transposition to F \sharp
series 8	retrograde-inverse plus transposition to F
series 9	original series transposed to G \sharp
series 10	retrograde plus transposition to D \sharp
series 11	inversion plus transposition to A \sharp
series 12	retrograde-inverse plus transposition to C \sharp

Table 13.1: The serialistic techniques applied to the original series.

- the last note of the series 2, 4, 6, 8, 10 and 12 is the same note of the relative pedal

One of the problems associated with writing for voice (especially in the context of contemporary music with live electronics), is that the singer needs a definite pitch reference. So the odd series have been assigned to the soprano, while the even ones to the flute.

However it is very important to notice that such a mathematical scheme rules only the order of the notes. All the other parameters (octaves, dynamics, effects, etc.) have been left free.

In addition I used long durations for the notes in correspondence of consonance with the pedal, and short durations in correspondence of dissonance. The goal indeed was to create a melody that had the flavour of the contemporary music but not too much dissonant, emphasizing in particular the various timbres of the voice and of the flute.

Idea of vibration: this idea has been carried out using the sound “Om”, a clear reference not only to the meditative and sacred character beneath the whole composition and to the Tibetan monks mantras, but also to the cosmic microwave background radiation discussed in chapter 5. In addition the spatialization of the sound along the trajectories gives the impression of a vibration, because the sound moves from and to the listener in a repetitive way.

Finally also the effect of holding the sound creates the feeling of vibration: the incoming sound of the flute or of the soprano is passed to a trapezoidal envelope and then looped.

Idea of dualism: this has been created by arrangement of the notes or of the dynamics in many parts of the score.

In addition, in part IV, I tried to describe with the sounds the Heisenberg's uncertainty principle applied to the Consciousness (as discussed in chapter 6) using between the flute and the soprano various kinds of crossing²:

- crossing timbres: the sound varies from pure to affected with various effects and vice versa. When the flute has a pure sound the soprano has a not pure one and vice versa.
- crossing dynamics: the sum of the dynamics of the flute and of the soprano is always constant, i.e. $(ff + pp) = (f + p) = (mf + mp)$.
- crossing rhythmical patterns: the duration of the notes is switched; when the soprano has long durations the flute has short ones and vice versa.
- pitch: also the pitch of the notes is switched; when the soprano sings low pitches the flute plays high pitches and vice versa.

²In the will of the author this is also a quote of the Stockhausen's Kreuzspiel.

Chapter 14

The score

Music is a higher revelation than all wisdom and philosophy.

Ludwig van Beethoven

As the figure 14.1 shows, the score is organized in:

- one line for the soprano
- one line for the flute
- two lines for the control and the generation of sounds obtained from the soprano
- two lines for the control and the generation of sounds obtained from the soprano
- one line for the control of Processing

All the control by the live electronics performer is by means of the interface of Max/Msp, using a simple mouse to enable and disable buttons and toggles, and to move sliders. Any external MIDI device is used.

The control of the Max/Msp patches is strongly optimized. Such an optimization manifests itself not only in the quasi-total non-existence of the control of Processing (as already explained in section 12), but also in a one-to-many mapping of the actions. Indeed an action can control various patches, decreasing or increasing their volumes, or activating their buttons, or enabling or disabling them. The behaviour of each action is described in the comments near the action itself. An example could be the following:

The Love which moves the sun and the other stars
(Mass for a symbol)

Luca Turchet (2009)

Processing Timeline

START & OPEN MAIN_CONTROL

START DSP

/ Automatically the two microphones are enabled and their sounds are diffused according to the default settings*/*

Sound from Soprano

START & OPEN PART 1

MAX/MSP Timeline

START & OPEN control_breath

Sound from Flute

START & OPEN part 1_3_directions

Soprano

Flauto

Breathe through the embouchure hole

mf

mp

ppp

Press various times the "Hold" button until a complex soundscape of crossing breaths is created. [Increase the octaves volumes until the maximum is reached].

Then press the "Record in the buffer" button and do not change any parameter of this patch for 10 seconds (the sound recorded in the buffer will be filtered in several ways by the various effects used).

Breathe in and out in different ways (changing speed and depth) and several times until the live electronics effects create a state of chaos. Do not press any key. Start with deep and calm breaths and get faster. Be careful, do not produce any tone and any extra noise.

This action causes the stop of the patch “Hold2PitchShifterRevLR” after its volume decreases linearly to 0 over 60 seconds. It also stops the patch “control_Redhae_Formation” after each sinusoid at a time decrease linearly to 0 over 5 seconds. Moreover this action starts the patch “reverber+ 6delays” for the flute.

The patches have been organized in order to be executed in a simple way by any live electronics performer. Indeed my aim was to create a software user-centred, to be used in a real-time context, where the live electronics performer could concentrate on the synchronizations with the other two performers and on the handling of the dynamics.

The management of the patches consists of the actions shown in table 14.1¹:

Action	Explanation
START	Switch on the toggle to activate the patch.
STOP	Switch off the toggle to deactivate the patch.
OPEN	Open the patch.
CLOSE	Close the patch.
START & OPEN	Switch on the toggle to activate the patch and then open it ² .

Table 14.1: Actions to manage the patches.

The toggle mentioned that enables or disables the patches, allows one to optimize the whole computational load. Indeed by means of the polyobject it has been possible to create a strong optimization, since such an object allows to turn signal processing on and off using a simple message.

I paid a lot of attention to the optimization of the code in its every stage, not only with regard to Max/Msp but also to Processing. Moreover a substantial part of my work has been the meticulous testing of the algorithms (I followed the methodology “Agile software development” as concerns the software life cycle), and a lot of importance has been given to the documentation.

14.1 Audio effects explanation

In what follows the Max/Msp patches with which the performer interacts are explained. For more specific details about them and about the numer-

¹For all the details please see, in the attached CD, the score and the legend.

ous subpatches they are based on, please see the code of each patch in the attached CD.

default settings: the sound of the soprano and of the flute player are reverberated with a short stereo reverber. Then the left and the right part of the reverberated sound are spatialized on channels (1,2,6) and (3,4,5).

control_breath: allows to create a complex soundscape of crossing breaths holding the sound (coming both from the flute player and the soprano) various times with a trapezoidal envelope of 4 seconds. The sound held is summed to its transpositions (using FFT) at 8 octaves (4 superior and 4 inferior) for which is possible the control of the volumes at pairs of octaves. This patch also allows to record on a buffer the sound processed: such a buffer will be filtered in various ways by the different algorithms (the sound in the buffer has a large spectrum due to the 8 transpositions).

part_I_3_directions: allows to spatialize in 3 ways the sound resulting from the sum of 4 FFT-based bandpass which select from the buffer a frequency plus its 3 superior octaves (the bandwidth increases with the octave):

part_I_directionT-D: the sound is spatialized along a linear trajectory from top to bottom. When it reaches the bottom it restarts from the top.

part_I_directionF-B: the sound is spatialized along a linear trajectory from front to back. When it reaches the back it restarts from the front.

part_I_directionL-R: the sound is spatialized along a linear trajectory from left to right. When it reaches the right it restarts from the left.

The velocity at which the 3 virtual sources move is identical.

Hold2PitchShifterRevLR: the incoming sound is held (with a trapezoidal envelope of 4 seconds), pitch-shifted (using FFT) to the two inferior octaves and reverbered with a long stereo reverber. Then the left and the right part of the reverbered sound are spatialized on channels (1,2,6) and (3,4,5).

control_Redhae_formation: seven sinusoids (starting automatically one at a time) are spatialized along trajectories that follow the curves of the Seed of Life symbol. The first sinusoid moves along the exterior circle, the other six sinusoids move along the six interior arcs (half a circle). The frequency of each sinusoid is a note of the triad of C major.

reverb+6delays: first of all the sound is reverberated with a long stereo-reverb. Then the left (L) and the right (R) part of the reverberated sound are delayed six times (at distance of 1 second and with decreasing volume) on the six channels in the following order: (L,R) = (1,4), (2,5), (3,6), (4,1), (5,2), (6,3).

Hold_stereo_circular: the incoming sound is held (with a trapezoidal envelope of 4 seconds) and spatialized along a circular trajectory having the radius of the hexagon on which vertices the speakers are placed. The patch has two buttons to hold the sound in two different ways: the button “Hold1” holds the incoming sound, sums it to its transpositions at 8 octaves (4 superior and 4 inferior), reverbers it with a long (mono) reverb and spatializes it to the circular trajectory the button “Hold2” holds the incoming sound, reverbers it with a long (mono) reverb and spatializes it to the circular trajectory. The two virtual sources move along the same circular trajectory, with the same velocity but with a distance of 180 degree from each other.

Lessinia: six images of the symbol found in various parts of Lessinia are presented. Each time a new image appears on the screen the voice of the soprano is spatialized in a different channel. The images appear (and disappear) at the centre of the screen.

Northern_Italy: twelve images of the symbol found in various part of Northern Italy are presented. Each time a new image appears on the screen the voice of the soprano is diffused on a different channel, and delayed one time on the channel at the opposite vertex of the hexagon (i.e. direct sound on channel 1 and delayed sound on channel 4). The position of the images follows the channel spatialization of the direct sound.

Italy: six images of the symbol found in various part of Italy are presented. Each time a new image appears on the screen the voice of the soprano is diffused on a different channel, and delayed two times on other channels. The order follows the hexagon vertices counter-clockwise, according to the following pattern: e.g. direct sound on channel 1 and first and

second delays on channel 3 and 5 respectively. The position of the images follows the channel spatialization of the direct sound.

Europe: twelve images of the symbol found in various part of Europe are presented. Each time a new image appears on the screen the voice of the soprano is diffused on a different channel, and delayed three times on other channels. The order follows the hexagon vertices counter-clockwise, according to the following pattern: e.g. direct sound on channel 1 and first, second and third delay on channel 4, 6 and 3 respectively. The movement of the images follows the channel spatialization of the direct sound.

World: twelve images of the symbol found in various parts of the World are presented. Each time a new image appears on the screen the voice of the soprano is diffused on a different channel, and delayed four times on other channels. The order follows the hexagon vertices counter-clockwise, according to the following pattern: e.g. direct sound on channel 1 and first, second, third and fourth delay on channel 4, 6, 3 and 5 respectively. The movement of the images follows the channel spatialization of the direct sound.

Crop_Circles: six images of the symbol depicted in various Crop Circles are presented. The images appears (and disappears) simultaneously. The direct sound is delayed 6 times according to the “reverb+6delays” spatialization.

control_pedal_fifth: two low frequency notes (the root and its fifth) are filtered (with a FFT-based bandpass) from the buffer and are spatialized along two hexagonal trajectories creating a pedal effect. The root note moves in clockwise with a small radius (so the sound is loud), the fifth moves in counter-clockwise with a big radius (so its sound is not loud).

Hold8PitchShifterRevLR: the incoming sound is held (with a trapezoidal envelope of 4 seconds), pitch-shifted (using FFT) to 8 octaves (4 superior and 4 inferior) and reverbered with a long stereo reverber. Then the left and the right part of the reverbered sound are spatialized on channels (1,2,6) and (3,4,5). The resulting effect of the filter applied to a voice or a flute (both without vibrato) is that of an organ.

control_InharmonicFilter: the buffer is filtered (using FFT) with 17 bandpass whose central frequencies are placed at not harmonic distances.

control_6directions : allows to spatialize in 6 different ways the incoming sound recorded in 6 buffers:

direction_1_T-D: the sound is spatialized along a linear trajectory from top to down. When it reaches the bottom it restarts from the top.

direction_2_R-L: the sound is spatialized along a linear trajectory from left to right. When it reaches the right it restarts from the left.

direction_3_F-B: the sound is spatialized along a linear trajectory from front to back. When it reaches the back it restarts from the front.

direction_4_D-T: the sound is spatialized along a linear trajectory from down to top. When it reaches the top it restarts from the bottom.

direction_5_L-R: the sound is spatialized along a linear trajectory from left to right. When it reaches the right it restarts from the left.

direction_6_B-F: the sound is spatialized along a linear trajectory from back to front. When it reaches the front it restarts from the back.

The velocity at which the 6 virtual sources move is identical.

pedal: a low frequency note is filtered (with a FFT-based bandpass) from the buffer and spatialized along two hexagonal trajectories creating a pedal effect. The first trajectory is clockwise with a small radius (so the sound is loud), the second one moves in counter-clockwise with a big radius (so its sound is not loud) and a bigger speed.

12lines: this patch allows to play 12 dominant seventh chord. Each one of the 4 notes forming each chord is the sound resulting from the sum of 4 FFT-based bandpass which select from the buffer a frequency plus its 3 superior octaves (the bandwidth increases with the octave).

sphere_formation: this patch generates a sound composed by a (major or minor) triad chord equally spatialized in all the 6 channel, plus 3 sinusoids spatialized along 3 circular trajectories with equal centre but orientated in different ways in the three-dimensional space (this to reach the purpose of representing a sphere at audio level). The frequencies of the sinusoids are the root note, its third and its fifth and changes

with the chord played (the default chord is G major). Moreover the velocity of each sinusoids along the circular trajectories changes with the button pressed.

control_Sol_Formation: seven sounds (starting one at a time), composed by the sum of a sinusoid and a FFT-based bandpass with a very thin bandwidth, are spatialized along trajectories following the circles that forms the Seed of Life symbol. The first sound moves along the interior circle, the other six sounds move along the six exterior circles. The frequency of each sound changes each time a new sound is activated. On the screen seven points moving around seven circles of different colours appear. As each circle appears, the velocity of the points moving on the screen gradually increments, as well as the velocity of the seven virtual sources along the trajectories.

part_VI_3_directions: allows to spatialize in 3 ways the sound resulting from the sum of 4 FFT-based bandpass which select from the buffer a frequency plus its 3 superior octaves (the bandwidth increases with the octave):

part_I_directionR-L: the sound is spatialized along a linear trajectory from left to right. When it reaches the right it restarts from the left.

part_I_directionB-F: the sound is spatialized along a linear trajectory from back to front. When it reaches the front it restarts from the back.

part_I_directionD-T: the sound is spatialized along a linear trajectory from down to top. When it reaches the top it restarts from the bottom.

The velocity at which the 3 virtual sources move is identical.

Chapter 15

Conclusions

All truth passes through three stages. First, it is ridiculed. Second, it is violently opposed. Third, it is accepted as being self-evident.

Arthur Schopenhauer.

This thesis has tried to explain both the fundamental aspects of my composition and the material from which the composition itself is inspired. As we have seen, the nature of this work is interdisciplinary.

Indeed in carrying out this composition I got a sense of all the aspects implicated by a real-time piece which involves compositional paradigms applied not only to the instruments and to the voices, but also to a digital art involving both sounds and images.

First of all I have to say that this work would not have been possible without a previous study of some important operas of composers of the 19th century. It also would not have been possible without strong knowledge of both audio and video technologies, and in general of computer science.

This has been my first work of this kind. Before I was unaware of the many problems involved in a real-time and multimedia work making use of performers, electronic music, and video.

Apart from the initial difficulties of choosing the appropriate technologies (in particular for the technique of sound spatialization, for the video, and for the communication protocol.) and of reducing to the minimum both the hardware and software latency, the main difficulty has been to have, during the compositional act, a long range sight. Such a sight had to consider various and concomitant aspects, which had to be related in the function of the

message to be represented.

In the first place, the computational load of the Max/Msp patches played a relevant role in the choice of the combination of the effects processing the sounds. Indeed many of the patches I created make use of quite heavy FFT computations, and, in addition, some of the algorithms explained in section 10.4 require quite a high amount of CPU resources to move several virtual sources at the same time. As a consequence, in many parts the structure of the composition was dictated by the limits due to the computational load and many ideas were not realizable.

Secondly an aspect kept in great consideration was the control of the patches on the part of the live electronic performer: the score had to be intuitive and the actions had to be simple to execute.

Thirdly one of the problems associated with writing for voice (especially in the context of contemporary music with live electronics), is that the singer needs a definite pitch reference. So the structure of the composition was influenced by this aspect too.

Fourthly one of the principles which had to be respected was the coherence between what happened at video and audio level as illustrated in section 12. Finally one had to ponder on the relationships between the various spatializations used.

However I had not a work of reference to see and from which to take cue. Also, at the moment, I don't know if similar compositions, taking into account all the aspects listed above, have been written before.

With this composition I brought myself closer to a methodology of composing in which the composer is also luthier (he has to build the Max/Msp patches), and where among the most important compositional parameters there are the spatialization of the sound and the audio-video synchronization.

I conclude by saying that I considered the composition finished only after its first representation. From the feedback of the audience I could deduce that I was able to reach my initial goal of conveying, by means of a multimedia work, the message I wanted. This is for me cause for great satisfaction.

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*A l'alta fantasia qui mancò possa;
ma già volgeva il mio disio e 'l velle,
sì come rota ch'igualmente è mossa,
l'amor che move il sole e l'altre stelle*¹.

Dante Alighieri, Divine Comedy - Paradise Canto XXXIII,
verses 142-145.

¹According to the Norton's Translation: *To my high fantasy here power failed; but now my desire and my will, like a wheel which evenly is moved, the Love was turning which moves the Sun and the other stars.*