

**Microtonal/spatial hybrid instruments - Application  
of microtonal and spatial composition with the new  
instrument "Octo"**

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## **Abstract**

Keywords/Subjects: Instrument Invention in the 21st Century, New perspectives in instrument luthiery, Microtonal Instruments, New realm of electro/acoustic instruments with new microtonal and spatial properties, Instrument remodeling, Instrument Design, Micro-intervals, Spatial, Acoustics, Musical Performance

## **Main questions**

How do we develop a hybrid spatial/microtonal instrument?

How the new instrument Octo affects microtonal/spatial/timbre notation?

How does the Octo advance instrument performance/technique?

How can we compose for the Octo?

Since the first “electrified” instruments in 1759 and the ongoing development through industrialization, the musical world has seen a rise in many spheres of instrument development and composition development as a cause/effect.

Areas of composition and compositional tools developed from the 20<sup>th</sup> century until present time like microtonality and spatialization are fields that have shown to be challenging to adapt technically and at the same time have expanded the horizons not only of composition but also perception and instrument invention itself.

The need for practical and user friendly microtonal instruments remains a challenge, whereas “spatialized” musical instruments apart from the Acousmonium, which is more of an output tool than an instrument, remain practically unexplored.

Through novel luthiery and new additions and technical implementations the project seeks to analyze 10 years of presence of the hybrid microtonal/spatial instrument “Octo” which I invented in 2010, in regards to a whole range of new instruments invented in the 20<sup>th</sup>-21<sup>st</sup> century and older versions of instruments from the medieval and baroque era.

Through analysis on the wide range of instruments, the project makes a parallel in how the invention affected compositional development and visa versa.

Through these 2 spheres we can try to understand the vast number of works and how the luthiery/composition relationship has developed, what are the remaining problems and what future possibilities lie within the field.

## **Introduction**

### **(The purpose of the study)**

The purpose of this study is to give an in depth view of technical aspects surrounding the prospective of building a new instrument, an instrument that embodies microtonal possibilities and spatialization possibilities. Besides the aspects of inventing and designing the Octo the study aims to show how these new aspects of the

Octo change and reinvent playing/performing stringed instruments, how it impacts notation and composition as a whole

Octo as a hybrid instrument, containing more than 10 instruments in one and also spatialization properties that are mainly found in electroacoustic music, necessitates also a brief examination of the different cultures of music making and musical tools which come as a synergy in the Octo.

As such in the background section i give an overview of instrument invention, 20th century musical notation, microtonality and new microtonal instruments, spatial music, spatial instruments all of which are important subjects and fields that consist the hybrid concept of the new instrument Octo.

### **(The Importance of the study)**

In the 20th century precisely with the works of microtonal composers and the development of spatial music in electroacoustic music, there is none or very few very practical applications of these concepts on a wider scale in one instrument altogether.

Existing microtonal instruments offer microtonal possibilities via specific fretting adhering to a specific microtonal scale, offering microtonal possibilities but omitting the use of diatonic semitone scale.

Spatial properties are very rarely present as a performance or general possibility in musical instruments, therefore most of instrumental music that

we hear comes via a uni directional or stereophonic form.

So it is necessary to give the possibility of spatial control of the sound to the instruments and the instrumentalist and to continue spatial sound research in parallel with other spatial developments in electroacoustic music.

Enabling the instrument spatial tools, gives rise to a new kind of spatial performer and the spatial tool enables also further detailed research in independent timbre exploration per string via different amplifiers and external effects.

In this case the construction of these new hybrid instruments is more than necessary in order to maintain these cultures and also develop further and expand notation, composition and performance technique. Several problems related to constructing such instruments arise in relation with playability and several ergonomic and technical load issues for the performer need to be addressed.

## **1. Background**

### **1.1. The development of instrument invention**

My musical upbringing has been always closely connected to different instruments, and my work in composition has led me to discover the world of instrument invention through the necessity to have instruments that can play the certain sounds that I need for my compositions, which not all the instruments can accommodate.

This is paired with my acoustic sense which has always been towards the idea of spatial treatment which is an issue that has preoccupied me since I was a child, when listening and having different acoustic uni-directional experiences in classical music concert halls.

The necessity of understanding instruments and instrument invention is natural in that it is an absolute integral part of music making and the possibilities of musical composition are completely conditioned by the possibilities that an instrument offers.

With that being said, musical composition and music instruments as two spheres develop co-dependently and influence one another accordingly.

Sometimes a new composition might call for a certain instrument advancement or new instrument altogether, and in the same vein a new advancement in technology can bring forth a new instrument with new sonoristic possibilities which can then advance musical composition.

I am particularly interested in the development of instruments with **microtonal properties** and **spatial properties**, also making instruments that can have these properties and be widely usable by all instrumentalists.

Instrument Invention is a field of music with several disciplines, that contributes to the development of music in those very same fields that it encompasses. [1]

It relates to the construction and building of all kinds of musical instruments/tools from traditional string instrument luthiery to the most advanced digital instruments.

## 1.1. Microtonality and new microtonal instruments

**Microtonality** is the concept of using microtones that are not part of the western diatonic scale.

In essence microintervals are named because of the “micro” distance between one note to the other so it generally relates to the idea of small note spaces between two notes, generally much smaller than a semitone. [15]

**Microtonal music** is music that utilizes intervals smaller than the half-tone, outside of the diatonic music scale in western Europe.

The microtonal work of Ivan Witchnegradsky, Harry Partch, Alois Haba, Alain Bancquart have expanded the harmonic world in Western European music, while at the same time the need of musical instruments that accommodate these microtones and that are playable is still to be standardized.

## 1.2. Spatial Music

Spatial music is music where the object of composition is the sounds position in space and the use of space is accentuated in regards to where we hear the sound source.

Spatial music is also considered music that is written to be played in specific space, where each sound has its own trajectory in space rather than coming from a uni-directional angle like in most acoustic music settings.

[20]

While Spatial music is made possible by the “Acousmonium” invented by Francois Bayle,

instruments that accommodate this property are almost non-existent. [21] [22]

### **1.3. Spatial Instruments**

The concept of spatial instruments comes as a continuation of music spatialization which is generally done through electroacoustic music which is then interpreted through an acousmonium.

Whereas traditional acoustic instruments and most of the music that is played live including music that is amplified comes through one direction or in stereo.

### **1.4. 20<sup>th</sup> century Musical notation**

**Musical notation** consists of the philosophy and structuralizing of the process of music writing.

Notation consists of several specific signs and symbols which aids the documentation process of music.

#### **1.5.1. Microtonal Notation**

**Microtonal Notation** developed in many different directions through the 20<sup>th</sup> century and onward in the 21<sup>st</sup> century. [42]

Because of the lack of an all encompassing microtonal structure which can unite the way we write microtone, we have an array of different symbols which have been added depending on the kind of microtones that the composer uses. [43]

#### **1.5.6. Spatial Notation**



Spatial notation refers to the idea of notating and documenting the position of sounds in space and their trajectory movement in space. [50] [51]

Spatial notation can refer either to the topographic description of where the instrumentalists should be, or move during a musical performance, or notate the position and the movement of sound through different speakers in a performance space.

## **1.6. Contributions**

In the interest of giving a background and understanding where the work for this thesis is based upon, we have gathered a bibliography related to the topics in regards to the new fields of music that are discussed.

Some of the contributions as seen in the “Spatial instruments” section, are the instrument Stragonaal, an instrument which is part of the 6 new instruments I have invented, and it is presented in this study briefly as one of the few instruments with spatial possibilities.

We compiled also a thorough list of microtonal, spatial compositions for each composer and also a detailed list of new instruments for each instrument family of the 20<sup>th</sup> and 21<sup>st</sup> Century.

For notation inquiries in relation to polychromatic music I have taken extra notes from contacts directly with Dolores Catherino, and have presented the brief information of Polychromatic notation in coordination with the information I have gotten from Ms.Catherino herself.

The Contributions in this Chapter present an amalgamation of concepts and a theoretical basis which don't often meet or interconnect, as they are part of a new instrument.

## **2. Octo-Developing a hybrid microtonal instrument**

### **2.1.1. Genesis and idea**

My work in regards to giving a new version and a new solution to playing microtonal music is my first instrument "Octo" made in 2010 in collaboration with the Finish/USA luthier Ari Lehtela. [52] [53]

After discovering microtonal music and spatialization as two distinct fields of study in music alongside a large number of composers and their works throughout the 20<sup>th</sup> and 21<sup>st</sup> century, I sought out to invent a multifaceted stringed instrument whereupon a wide range of all European Western and Eastern instruments could meet within different tonal ranges and spatialization possibilities all in a harmonious and playable instrument.

My aim was not only to give a solution in microtonal performance and possibility to compose for microtones in one large range(tone) instrument, but also to have one of the first of fully spatialized instruments, which meant addressing different technical issues in the realization of the instrument in coordination with playability and with compositional possibility factors related to the instrument.



*Fig.30.Octo – New Hybrid Microtonal/spatial hybrid instrument*

### **2.1.3. Realization**

I worked with the Finish/USA Luthier from North Carolina Ari Lehtela, in building and realizing all of these properties in one musical instrument.

My experience with composition since the age of 12 brought me in 2008-2009 to the discovery of several microtonal works and spatial electroacoustic concepts I had never heard of earlier.

These new paradigms of musical activity intrigued me greatly and I immediately wanted to know how one writes and also how does this music gets performed. I realized fast that there are several types of instruments either traditional or new that contained some elements of microtonal possibilities of performance and almost practically no instruments that had the possibility for spatial treatment.

So I aimed for a all encompassing system of microtonal possibilities and spatial system with as much tonal range as possible.

My goal was to create a hybrid instrument that was:

- Approachable by all instrumentalists
- Fused the east and the west tonal possibilities
- Have microtonal range from 6<sup>th</sup> of a tone to 4<sup>th</sup> of a tone and semitones in one instrument
- Able to play/switch/combine microtonal and semitone possibilities from medieval western music, Asian music, modern contemporary hybrids
- Easy(relatively/learnable) to use
- Contained as much as 5 octaves and a half of tonal range
- Create timbre control for each string
- separate each string with a designated output, giving 8.0 spatialization properties
- enable through the 8.1 output separation the extensive use of external effects

In order to fulfill these properties, I followed a very dense and rigorous process for almost 1 year, in close connection with Ari Lehtela and constructed the following properties to be implemented in the Octo.

## **2.2. Tuning system**

The tuning has two facets:

- One that combines bass and guitar in only 8 strings, in 4ths going up, with the exception of the 6<sup>th</sup> string – E – A – D – G – C – E – A – D –
- One which reflects the exact intervallic distance as a classical guitar, only tuned a 5<sup>th</sup> lower – A – D – G – C – E – A –

The second system can be found in the “middle” of the string setup, from the 7<sup>th</sup> to the 2<sup>nd</sup> string.

### **2.3. Neck design**

Neck design for the Octo takes in to consideration the application of 5 and a half octaves of tonal range with the least left hand stretch through the fretboard.

The neck is with the length of a classical guitar, expanding gradually through the lower end of the neck to the magnetic pickup.

While this is true for these cases, having a fixed thumb “standard” position might help the performance of close spaced microintervals.

### **2.4. Fretboard - reverse fretboard concept**

The reverse fretboard constitutes of a fretting system which is the opposite of a standard diatonic system.

Guitars and most diatonically fretted stringed instruments have a system that minimizes fret distance per semitone going upwards the octave. [44]

With the objective of maintaining as much playable microtones and a balance of playability, I arrived at this construction which more or less resembles a “reversed

fretting” system where the fret distance increases slightly while moving upwards the octave.

## **2.6. Octo Body**

The Octo’s body is made generally from swamp ash, a type of wood which is much lighter.

This type of wood was necessary in order to lessen the weight on the instrument, as the heavy electronics for the 8 outputs give a considerable addition to the overall instruments weight. It is done in a natural-black finish in a non-gloss color.

### **2.6.1. Pickup Design and 8 Output System**

Most stringed instruments have one output, from which the whole sound of the guitar is connected to an amplifier or through a mixer to a sound system.

Any external effect pedal that will be used and any aspect of how the sound is emitted in the speakers will affect the whole strings altogether.

In comparison one of the main concepts which embody Octo is the possibility to offer stringed instruments spatialization properties.

This was achieved through the idea of separating each string through a special magnetic pickup. The pickups were made especially by Kent Armstrong in California [54]

The special pickup separates the sound signals in 8 parts, which are controlled through separate potentiometer setups.

## 2.7. Contributions

The process of constructing the Octo has taken 8 months divided in 2 parts. I have also done extensive research to refine my ideas on what the Octo should contain 4 months beforehand, and have spent 2 other months after I established my ideas on research for a Luthier to collaborate with. My preliminary work in instrument invention had started one year earlier with a “prosthesis” for the piano that could enable the performance of prepared piano sounds for the whole keyboard with separate pedals, and this experience combined with the discovery of microtonal music and spatialization started this journey and helped me to understand how I can combine these elements.

After finding many searches in Balkans and Europe I found Ari Lehtela and his Lehtela Guitar Craft Factory in Charlotte where we started the Octo process.

The first 2 months we had extensive work in clearly defining in strict detail each part of the Octo and worked extensively in conceiving all the parts that you see in this chapter.

Then we proceeded with the process of construction which took 6 months, combined with the long days each part needs in order to have a good finished product. Within this process each section that you see in the chapter was monitored closely by me with daily and weekly updates through pictures and analysis by Ari and me.

When the Octo was finished it was sent from Charlotte, North Carolina to Prishtina, Kosovo where I proceeded

to use but also analyze very closely on how each detail was done.

For this chapter the contributions also include a compilation of all the experience with all the aforementioned and described parts of the Octo with the 10 years of practice with it in the studio and live.

Also a large part of this section contains the parallels that are made in relation to existing instruments in regards to the process of construction the hybrid that is Octo, also parallels which were added and made after the Octo was constructed and the period where it has been played and analyzed by several encounters with performers, composers and scientists around the world.

### **3.Octo Notation and Scale possibilities**

After many forms of experimentation with notation I decided upon 3 sets of symbols related to each tonal structure.

These 3 ways to notate Octo are very simplistic and use already existing symbols, only difference is they are brought together or used separately depending on which of the 3 tonal systems that are chosen to be written for or performed.

Microtonality has underwent and still continues to have new sets of symbols for notating microtones, each one differing in the Western European scales, Middle eastern scales, Asian scales, and many others in between, like the Dolores Catherino polychromatic concept which goes completely in another direction for the Octo.



### **3.1. Microtonal Notation for Liburn Jupolli 3-part system**

Octo contains the 3 part tonal systems which can be used in different ways, the name of this chapter indicates that there are only 31 tones in a octave, but the fact is that depending on the approach the Octo can generate up until 36 equal temperament scales if only the first tonal system is used.

Here we can observe the tonal possibilities offered by the upper fretboard 6<sup>th</sup> tone microtonal separation, which has a 3 octave and a perfect fourth tonal range of writing and performing possibilities.

The example below represents the complete range for each string beginning from the open string continuing through the perfect fifth.

The second fret separation system is organized in equal separations of quarter notes per each semitone from the fifth interval per each string going through the second octave.

In the example below we can see the range per each string which is of a perfect fourth.

The Lower fretboard 3<sup>rd</sup> tonal separation system is in a semitone structure and starts from the second octave.

Each string has the prospect of one octave from the middle of the second octave to the 3<sup>rd</sup> octave.

### **3.2. Scale creation possibilities with the Liburn Jupolli 3-part system**

Composers and performers can create a variety of scales with the 3 tonal systems and combine them. The scales

can be combinations of existing Western or Eastern scales, they can be modifications of Arabic Maqam scales [55] [56] [57] or South Indian Melakarta scales [58] etc., or they can be completely new types of scales utilizing all or parts of the 3 tonal systems in the Octo.

### **3.3. Scale Replication in the Octo**

The Octo can replicate a variety of Microtonal scales, in this way emulating the different western and Eastern instruments alongside with the sonorities that the instruments have.

All the scales that can be replicated in a fixed fret position can go to a 6<sup>th</sup> of a tone separation, and if necessary the 8<sup>th</sup> of the tone can be replicated with additional glissando.

#### **3.3.5. Spatial notation for the Octo**

Notation for the Octo, extends to writing for space, as it is one of its main additions.

The 8 output system requires a new form of notating each string and its timbre and space qualities depending on each performance and composition.

Firstly, the correct arrangement of the speaker setup has to be defined in the legend of each composition for performance instruction purposes.

This is of course indicated correctly with the specific choice of speaker and mixer setting or with separate amplifier setup.

Notating each strings timbre is done by adding one or two lines per string under the Octo staff structure, which is usually made of a treble and bass stave together like writing for a Piano, because of the 5 and a half octave range of the Octo.

### **3.4. Contributions**

The third chapter represents the work related to assembling a practical hybrid notation system for the Octo.

Many composers who have written for the Octo have used different types of notation for the 3 tonal systems, but I have unified the notation in one system which I have distributed to the different composers that I have commissioned work for the Octo.

As presented in this chapter I use 3 types of notation 6<sup>th</sup> tone, quarter tone and diatonic which can overlap in one composition.

In this chapter we also present the possibilities of creating new scales for the 31 ton in one octave possibility.

We also present the different scales that can be emulated and the different tonal structures of other instruments which can be replicated in the Octo, like several Balkan and Asian instruments like Saz, Oud, Baglama, Çifteli, etc.

The different Maqams and other Asian scales are examined and shown how they are possible to be reproduced in the Octo.

## **4. Octo performance technique**

Playing the Octo varies for different performers. In order to achieve good levels of performance and control over the various elements that are present in the instrument the best profile to perform on the Octo is a multi-instrumentalist of strummed stringed instruments. Such a performer plays actively guitar, bass, classical/acoustic/electric, plays mandolin, various African and Asian instruments, and could potentially have knowledge or play other bowed string instrument. Other types of performers will have a hard time grasping the different concepts that are intertwined within the Octo's structure and have a difficult time performing or executing any kind of musical pattern correctly in the Octo.

### **4.1. Octo vs other instruments – comparative technique**

Here is an example of the of the 9 different stringed/strummed instruments in one and separately, that are present in the Octo, and that can be replicated identically with every tonal and sound quality element.

### **4.2. Finger technique**

Techniques of performance in the Octo vary from each performer and what part of the Octo they wish to use, and also vary from how a composer sets up the use of the Octo and the demands of the composition.

In the case where a performer wants to use the microintervals and specific microtonal scale the finger technique should be specific.

The finger technique has to be adapted depending on what instrument it emulates, for example when playing scales relative to Asian instruments with a specific hand position or as called in the Oriental fashion “düzen”. [73] This has to be done for all chosen microtonal scales that wish to be used by the performer, as this helps them to adjust a specifying finger movement within the scale and to position their playing in respect to the chosen scale, also help eliminate the possibility of mixing the small frets that don't belong to the scale.

#### **4.5. Octo hybrid instrument technique**

As mentioned above in the Octo we find bass, guitar, oud, saz, çifteli, classical medieval guitar, etc. In many ways if necessary there will be a call in a piece of music for combining the elements of these instruments in one, or the full range of the Octo will be used by the composer, in which case the performer will need to be prepared to use all the different techniques of the aforementioned instruments and prepare for combining them in one technique.

#### **4.8. Contributions**

Within the prospect of understanding the technical possibilities of the Octo, from a performers standpoint I gathered a bibliography and analyzed segments of

technical skill in a number of Western and Eastern stringed/strummed instruments.

Taking apart elements of technique from the Saz, Oud, Cifteli, Bouzuki, Mandolin, Sharki, Llaud, Guitar, Bass Guitar, Baritone Guitar, together with analysis with my colleague and the primary performer of the Octo in Kosovo, MA. Astrit Stafai.

We did thorough analysis of how these techniques apply to the Octo and very specifically how to adapt them in a new modern Octo technique.

We realized how the Octo can educate the young string performer, and we created separately to the study a booklet on the Octo technique which can be found in the Appendix.

## **5.Spatial and timbre control**

Spatial and Timbre control with the Octo is done through the manipulation of the onboard volume and tone features and with external amplification and other timbre manipulation external equipment.

Such equipment as analog pedals, synthesizers, computers and other external tools which can enhance or color the sound of each string in the Octo separately and in combination.

### **5.1. Spatial performance**

Treating the space as a performance tool is not attributed to instrumentalists. This is apparent by the mere fact that instruments do not have this possibility to begin with, this goes for all types of instruments acoustic and

electronic, even so that the electronic instruments have the capacity to adopt this within their expressive range.

## **5.2. Amplifier setups**

Octo in its standard form has the possibility to separate its signal individually from 8 outputs 1 per each string that is then amplified through 8 separate speakers. Usually an amplifier setup for the Octo will accommodate the different strings with specific frequency response amplifiers, for example 4 guitar amplifiers for the high pitch strings and 4 bass amplifiers for the low pitch strings.

### **5.2.1. Separate speaker setup – surround sound**

Each speaker is chosen in relation to its frequency range. Amplifying the high pitch strings E – A –D requires guitar amplifiers. Lower pitch sounding strings are amplified through bass guitar amplifiers

## **5.3. Timbre Control**

The 8 output possibility opens up the all new ways to treat each strings timbre separately.

The Octo compared to the Kramer Ripley guitar can use each string separately and have up to 36 effects all separated according to the ideas of the composer for specific pieces.

The Octo's timbre can also be colored while playing only clean sound without external effects, the Strings

volume and tone potentiometers and the separate outputs can be defined specially and have their own clean sound, amounting to a special sounding clean setup which has each string toned separately and mixed live per each string, which can have special effect especially while playing chords.

### **5.3.2 Solo or “isolated” setups – one effects combinations**

The Octo can be used also in a kind of “isolated” effect manor. In this case only one type of pedal is used per each string, but the characteristics of each pedal are changed creating a kind of richer version of the same effect, with different settings per string.

This form of usage of the 8 outputs mirrors the standard guitar effect use, where all the strings are affected by the pedal that is used, in this case with the Octo a richer and varied effect is achieved, especially when different pedals of the same effect are used.

### **5.3.3. Delay – all delay, different delay setup per 8 outputs**

Using delay with the Octo just like another external effect, through the connection of the same pedal or same pedal type for each string, can have very rich results and detailed structures especially of the rhythmic nature with delay.

Each string can be setup with a specific delay time and other delay specifics which is heard separately when



playing each string separately, it can also have very specific effect when using chords, where one chord in this case will contain different delays giving complex varied rhythmic delays in one chord strike. [74]

### **5.3.8. The effector – live electronics performance support**

In the case of electroacoustic music, with acousmonium setting there is the necessity for an acousmatic interpret, in to control and perform the electroacoustic works. [77 ] [78]

The case is similar with the Octo when the setting of external effects and other tools of amplification are to large to be handled by the actual performer of the Octo. In cases where the amount of the external effects or other setups for each string is more complex, there needs to be another one or two performers specifically for controlling the external effect station.

The effector is the performer of the effect and spatial station of the Octo external timbre and spatial possibilities.

## **5.4. Contributions**

The Octo is one of the first 8 output instruments.8 outputs give the possibility to separate each string in separate amplifiers. I have extended this into the idea of more extensive timbre exploration, which you see in this chapter through the use of separate effects per each string.

## **6.Composing for Octo**

### **6.1. New compositional tools**

With the creation of the Octo we have new compositional tools that expand in the 2 aforementioned fields.

The new compositional tools include all the elements of microtonal composition, which can be elaborated in many different ways, either by emulating certain types of scales and harmonic qualities of existing instruments and musical cultures, either by defining a personal compositional language through the use of the vast microtonal possibilities of the Octo.

#### **6.1.1. New spatial writing possibilities**

With the 8 output system we have the chance to treat each instrument separately.

We can use one or more effects in one string, making more complex sound effect combinations within one interval or more also chords.

### **6.2. Solo**

Writing for solo Octo can be approached in several forms, some of which I will mention in the following and ones which have proved usability through these 10 years.

- Writing for the instrument in a “partialised manor” or “instrument emulation” mode

- Writing for the Octo using all the tonal range
- Writing for all the components and especially
- Writing with a spatial usage focus with the 8 outputs
- Writing for partial or all components in chamber setting
- Writing for Octo in large scale work compositions

### **6.2.1. Notation and staff structure for the Octo**

In this example you can see how the addition of the output separation per string augments the number of staves, in this case each one corresponding to one string.

### **6.3. Chamber formations**

The Octo can be used in various chamber formations. Until now it has been tested with up to 8 different instruments.

It can be a accompaniment either for treble, bass or mid-range sounding instruments.

As it has a range of 5 octaves and a half, it can represent any given counter range of the instrument and accommodate the needed tonal capacity within any chamber formation.

Of course as one might assume it will go well with all its “cousins”, having the possibility to mirror the tonal qualities of almost all stringed instruments, especially from the West to the East. I have experimented with various formations, and in the more recent times I have tested the instruments compatibility with ethnic Albanian instruments which are shown below.

I have also tested the Octo's more extreme range with the use of 34 different effects, in combination with a fretless guitar and a standard 6 string electric guitar, in a trio formation.

The experiments I did involved the usage of Octo's extreme possibilities of external effects, in combination with its microtonal possibilities, that were mirrored and made a dialogue with the two other instruments.

#### **6.4. Opera Gof – using the Octo in a large scale composition**

One of the large scale works in which I worked with the Octo is the Opera "GOF".

"GOF" is a post-modern chamber opera written for tenor, baritone, virtual singer (pre-recorded, flute, ocarina, 4 synthesizers, Octo, electronics, film world and dance. It is one of my first attempts at writing an Opera, also at organizing and structuring a Libretto. [84]

In the Opera electronics play a large part in coordination with the video and the Octo is combined in various parts with the electronics. [85] [86]

#### **6.5. Contributions**

In the 6<sup>th</sup> Chapter there is a presentation of 3 main works that I have written for the Octo utilizing the different aspects that I show in the previous chapters, and also show how other composers use the Octo.

The 3 main works are my first Opera "Gof" where the Octo is shown as a chamber ensemble instrument, the Octo as a solo instrument with electronics and the Octo

as a solo instrument only with external effects, other examples include different commissioned works, whereupon I take excerpts in regards to the novelty they bring in the way the use musical material in regards to the new compositional tools that the Octo offers.

The chapter also contains examples of writing for the Octo for not only the microtonal possibilities but also the added aspect of writing for external effects, as a solo performer with feet or with one or two other effect performers.

The aspects of topographic placement writing are also treated and discussed together with the newest ideas of using spatialization with more than one amplifier per string.

Aspects of the topographic writing are also shown with a mixer and separate speaker setups as with separate amplifier setups.

## **7. Conclusions**

In the 20<sup>th</sup> century and through the 21<sup>st</sup> century we see the rise of many new fields in instrument invention and diverse structures and methods created specially to enable new forms of music and help reinforce and implement musical paradigms that are not possible to be performed or emulated in anyway without the invention of these instruments.

With this massive production output the musical world faces several problems and obstacles relate the correct implementation of these technological advancements in coordination with performance and the development of notation.

Notation, instruments and performance are intertwined with one another and microtonality in general as a growing field faces many different challenges in creating a balance between new forms of expression, the effective and practical notation of these new musical tools and availability of instruments with universal microtonal possibilities as for those diatonic.

The “lack” of universal microtonal instruments is evident, especially stringed and wind instruments, of course the comparison being the vast amount of instruments in the semitone diatonic system, not disregarding instruments which contain some microtones within their tonal range and instruments which have microtonal possibilities and “omit” semitone properties within their tonal range, rendering these instruments as “exclusively” microtonal.

The most prevalent and widely used existing instruments for microtonal music, that seem to make this performance/sound balance better are various synthesizers, microtonal and semitone with pitch modulation.

These of course come in hardware and software formats and have made the use of microtonality much more widespread in all kinds of genres.

This is seen in more popular genres and especially in electronic music with “microtonal champions” like Boards of Canada, Tycho etc., and a whole range of new musicians which aim for a more wavery/unstable microtonal movement emulation from and like old analogue synthesizers and a kind of old tape like sound mix of their music, which deeply accentuates the use of

microtonality within the diatonic chromatic diatonic system.

I mention in particular the effects on popular culture, not understating the work in the classical contemporary music, in part because it is one of the times in history where microtonal music elements become part of popular culture in a kind of integrative fashion, helping expand the use of microtonality and the general understanding and opportunity to listen to microtonal music elements.

It is important to mention the work in stringed and strummed instruments has made an impact in the more global use of microtonal music.

The development of space as a compositional tool and as an integral part of electronic instruments is still vastly overlooked and is a field which needs to develop.

In the 21<sup>st</sup> century instrument invention has broadened its developmental spectrum, continuing traditions such as DIY instruments, Hybrid Instruments,

A big problem in the field of instrument invention is the fact that many new instruments have a lifespan that is connected to their extravagancy, with limited presentations and the overall use and view of these instruments as novelties objects, rather than usable instruments within a larger ensemble frame and new compositions.

Many of these instruments are also only played by the inventor and do not receive more than a few concerts in line with presentations of the instruments, only a small number of these new instruments become a household name, one of the examples being the Theremin, Ondes Martenot, etc.

The most extensively developed field in instrument invention in the last 2 decades since 2000s is the development of musical controllers.

In parallel with the development of Digital Instruments and various Digital sound tools its only logical to assume that the development of musical controllers is very necessary.

Constructing an instrument like the Octo came from the necessity to fulfill microtonal and spatial compositional tools, but as it proves the addition of these elements within a string/strummed instrument has a certain level of limitations technically.

This is relevant for most new instruments, it is evident that in order to build certain instruments with new tonal possibilities, devising new playable scales or tonal structures requires a combination of knowledge in composition and luthiery.

The knowledge of the most recent and older version of the instrument or instruments of kin, an extensive knowledge of the history of the type of instrument that you want to invent,

Issues of notating microtones, spatial possibilities and other new compositional tools are presented in the other chapters, much if the solutions can be personal but also can derive from similar ways to notate the sounds that are possible in the Octo.

Notating microtones also depends on the type of approach to the microtones, so composers are invited to also to personalize their microtonal writing often, and they often derive the symbols from other musical reference.



Nonetheless the system that is put in place which I have made known to other composers who write for the Octo, proves to be clear and easy to use, although it requires some assessment before and during writing especially when hand positions are concerned in relation to the 3 tonal structures that are present in the Octo.

This is solved easily through writing down the actual position as when writing for other stringed/bowed or other instruments.

Performance technique

After careful assessment and 10 years of experience in writing and playing the Octo, I have noted the many problems and needs in developing such a system within a hybrid instrument such as the Octo.

The Octo's microtonal range proves playable to many instrumentalists, though the training takes sometime and a necessity for a manual and a information on microintervals is necessary.

Besides the successful leveling of the different microtonal scales on the neck, which are playable for any finger type of players, the positioning and harmonic structure with a microtonal range of this kind is relatively unknown so a manual and a tutorial can help guide the performer in their finger and hand positioning and movement and at the same time give them ideas on how to use the different possible scales within the movement properties of the hand in rapport with the neck.

When external effect performance is concerned, effects chains with more than 2 units need to have gate effects or noise suppression effects to stabilize and control parasite sounds.

Application of a lot of effects also requires the use of buffers for stability which if not applied will create muddy and unstable sound, while a lot of effects are connected in one effect chain each group for a separate string.

Effects have to be studied in advance separately, and the combinations of effects that are close to one another have to be assessed because of the slight interpolation between the strings.

The effects that are closer to each other can affect the other neighboring string with the effect that is used in the other string and most importantly the volume capacity can be transferred from one string's effect to the other and in many cases especially when distortion is used can double the volume of the other string, and this is something to be taken care of very delicately as it can disturb and complicate the volume balance between all the strings.

When using effects with rhythmical qualities, it is best to put the effects with a bigger rhythmic difference close to each other and the ones that are slightly different further, in order to have the best rhythmic complexity and clarity between the strings.

All these elements have shown that the use of separate effects per string needs a special attention and is a field in itself that needs to be explored, either with strings that are complexly separated like in cases of midi guitar setups, or like in the case of the Octo where the strings sound interpolates slightly between neighboring strings. A further analysis and further tests need to be done in order to have new and better ideas how to develop this form of timbre modification with new hybrid

electroacoustic instruments, we will consider also making a booklet especially on how to use external effects for the Octo, with several examples and experiments.

It is very important to note that in the Octo, because of the harmonic interpolation the user will learn and will be subjected to not only staking up different effects for one string in order to model the timbre of one string, the interpolation will necessitate for another level of timbre exploration and how it effects the neighboring string, which in essence is also a chance to learn how to combine timbres between strings, an endeavor which needs to be developed with special dedication separately from the actual performance in the neck of the Octo.

This exploration can also be done in collaboration with the effect performer which can be in charge of creating the effect chain and can be the one to identify the desires of the composer or the performer, that is why also a booklet with clues and hints to already tested setups can also benefit the effect performer and the composer besides the actual performer of the Octo.

solo

The Octo as a solo instrument in itself has the capacity to perform as a very potent instrument, encompassing a 5 and a half octave range, a limitless possibility of timbre definition, spatial properties and microtonal tones that are not found in other instruments as compact and as versatile as in the Octo.

By all the performances since 10 years of Octo's construction a 50% of the performances were solo, and they have proved that the Octo as a solo instrument can be very adequate and to be able to stand on its on in

various settings, with various approaches and various settings either with external effect use and spatialized setups or just as a solo “clean” instrument.

Bringing the capacities of the Octo to fruition takes knowledge and research of the instrument itself, as much as it has taken to create an instrument like the Octo it also takes a considerable amount of research and exploration in order to write for it and to perform it as mentioned above.

Composing for the Octo varies by the ensemble formation that is chosen to be written.

The versatility of the Octo to blend, replicate instruments, dominate as a all instruments in one, or trigger other musical actions demands for the composers clear choice in the use of the Octo’s possibilities, each element should be tested well, especially when using a lot of effects per output.

Volume should be a primary element of composition to be taken care of and carefully written, for each timbre, to note well and test how volume changes with timbre when an external effect is triggered.

Seems that volume can be negligible, but as a 10-year test has shown volume is a key component that when not noted by the composer and likewise not checked properly at least 2 different times by the performer, can create performance problems that inhibit sometimes almost all performance of the strings that have this volume problem, problems which cant be fixed ad hoc while the performance ensues.

ensemble

When playing in ensembles Octo has the capacity to overshadow other instruments, especially if they are

acoustic, in this case there is need to balance the volume and the external effects in relation to the instruments and the acoustics of the hall.

Large scale

The Octo in a larger scale setting can play different roles. It can be part of a larger body of stringed instruments, combined with all of the different instruments of a larger ensemble or orchestra.

As it has shown in many occasions in concerts and especially in the Opera "Gof", it can be part of a larger body of instruments and play a role of accompaniment, with acoustic instruments and also electronic and pre-recorded material.

As much as the invention of a type of instrument like the Octo comes from hybrids of concepts in composition, as much as it has proved to bring new forms of expression for composers and performers.

Many new possibilities have been discovered beyond the primary ideas I had when conceiving the Octo, and many more arise each day as the instrument is used and is exposed to different composing and performance settings and as many researchers and musicians see it and analyze its capacities.

In a way like in many cases necessity drove invention, but the fruition of invention also drove into new necessity and into invention itself, for we realize only when the new instrument is in place and we use it how great was the necessity.

Invention therefore proves to be very important in this field in music, together with an ongoing analysis and experimentation with the new tools that these new

instruments bring to our catalogue of expression in the 21<sup>st</sup> century.

Only when the Octo was ready to use did we realize the educative quality that a hybrid West/East instrument has.

In most presentations the Octo offers the possibility to describe and encompass almost all the

stringed/strummed instruments, because it has the capacity to emulate them within its tonal structure.

The 3 tonal structures also have shown to offer to the performer, the composer and the public a chance to see also how microtonal and semitone scales of different places of the world can coexist and be used to form new combinations of scales.

There needs to be a parallel between the development of interfaces and new electroacoustic/spatialized/microtonal instruments in order to study more closely specialization with the performer and in order to study microtonal performance in a much wider more popularized scale.

Future directions in this type of work entails the close analysis of all the elements of the Octo performance, detailing the further research from the perspective of composers also and the further documentation of all the experiments.

In conclusion a newer version of the Octo can be possible to be created with new or less features depending on the parts that need to be modified, and a continuation of the similar types of instruments in soprano or other type of form within a similar construction framework can benefit the testing of the similar elements as the Octo and the overall development of this type of Luthiery in correlation with the

advancements of the new expressive compositional tools  
that these instruments offer.