La Otra Voz for flute, clarinet, violin, cello and piano with electronics and real-time visual image

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INTRODUCTION

La Otra Voz for ensemble, pre-recorded electronics and real-time visual image, takes its inspiration from Octavio Paz's *La Otra Voz* (1990). Following his poesy, we tried to search for invisible existence and inner voices by means of music and the visual image. This article describes the musical material and structure, as well as the technical system for the visual image and the interactivity between tha latter and the music.

La Otra Voz was premiered by the Onix Ensamble at the *Seminario de Música Contemporánea*, Escuela Nacional de Música UNAM, Mexico, in February 2010; supported by the Onix Ensamble, the CMMAS, and the Japan Foundation. It is a work for ensemble and prerecorded electronics, and real-time visual image. Software such as *Audio Sculpt*, *Open Music*, *Max/Msp* and *Jitter* were used as means of technological tools.

COMPOSITIONAL MATERIAL AND IDEA

The music is constructed as a multilayered complex sonority consisting of sounds of the ensemble, musicians' voices and pre-recorded electronics, which focus on diversity while remaining consistent. Translations of the word "voice", (*voz* in Spanish and *koe* in Japanese) are notated in the score to be spoken by the performers, which, when merged with breathing sounds and percussive sounds produced by instruments, is intended to produce a mysterious atmosphere pregnant with symbolic messages.

1. Ensemble Writing

The pitch materials are created from part of the harmonic series of the pitch *D*, its distortion – for instance, by multiplying each of the frequencies by a non-integer factor - and other pitched spectra. These were obtained using Open Music: the patch is shown in figure 1, and the musical results are shown in figures 2.1, 2.2, and 2.3.

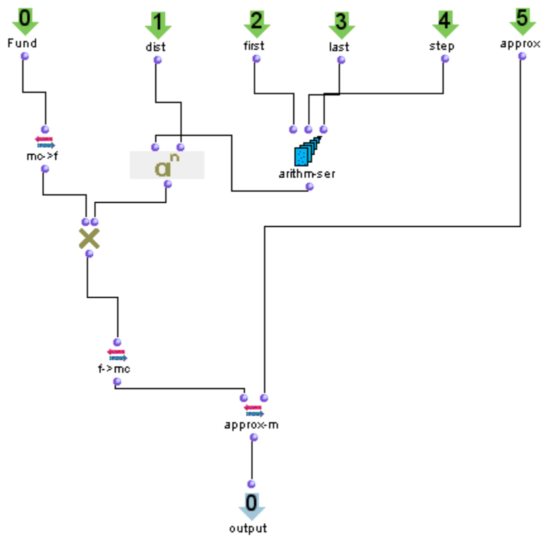

Fig. 1: Harmonic distortion in the Open Music patch

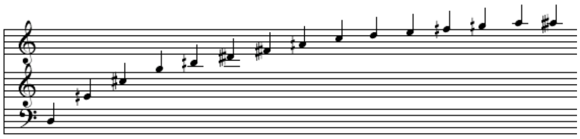

Fig. 2.1 Distortion of the harmonic series of *D* (146.83 Hz) using a factor n=1.2

Fig. 2.1 Distortion of the harmonic series of *D* (73.42 Hz) using a factor n=1.5

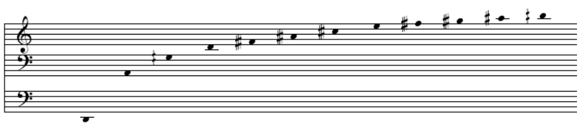

Fig. 2.3 Partials obtained by choosing harmonics of *D* (73.42 Hz) that are multiples of 5

In order to approximate the results of distortion as close as possible to the actual frequencies to the actual results generated by the computer, quarter tones are used (figure 3).

Fig. 3: Quarter tones used in the flute, clarinet, violin and cello parts

The first four bars in the piano part contain four patterns articulated in the lowest register (figure 4), which are used as a bass ostinato with different figurations throughout the whole piece. These piano patterns are also recorded for use in the electronics part.

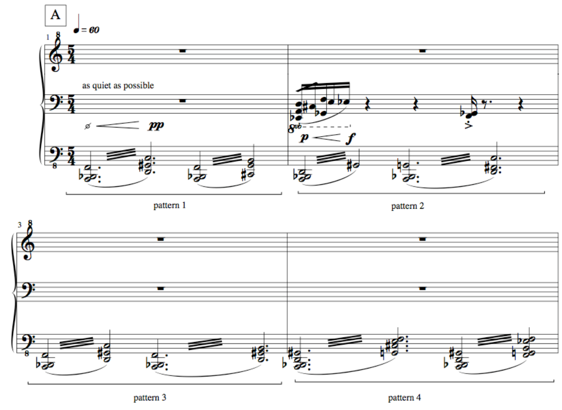

Fig. 4 Piano patterns

In the middle section (rehearsal letter G), noise based sounds are created by breathing through the flute and clarinet, knuckling on the body and bowing behind the bridge of the violin and cello, and striking the piano cross beams with the fingernails, knuckling on its cover, and repeatedly rubbing on the keyboard with flat fingers (figure 5). This is meant to express a chaotic moment, reinforced by a similar sonority that emerges from the electronics part. The resultant sounds are merged with electroacoustic part, which itself is derived from percussive piano sounds; reversing the relationship between the electronics and ensemble.

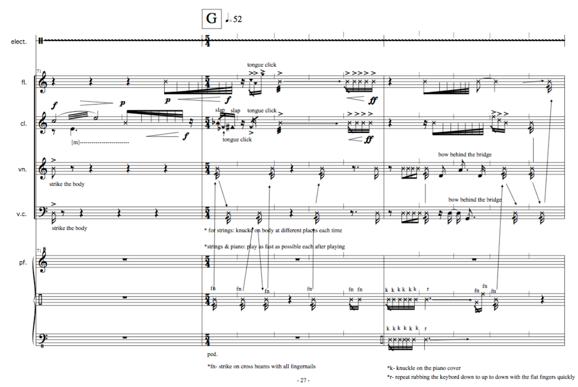

Fig. 5 Noise based sounds produced by the instruments in the middle section

2. Electroacoustics

There are fifteen soundfiles triggered by *Max/Msp* during the performance (the patch is shown in figure 6); each trigger point is precisely indicated in the score. The soundfiles are superimposed depending on the situation, and often correspond to the role of an on-stage instrument. These soundfiles were created using software processes (e.g. using *Audio Sculpt* and *Max/Msp*) applied to recordings of a piano, maracas and a rain stick; as well as white noise: just as the real, untransformed maracas are also used by players, the electroacoustic part uses similar, but transformed audio materials.

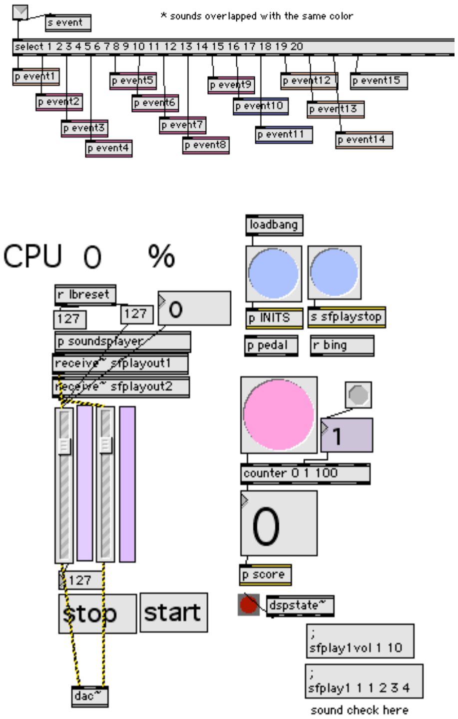

Fig. 6 Max/Msp concert patch

The recorded piano materials consist of the four patterns from the beginning of the piece (figure 4) and the percussive sounds in the middle section (figure 5): altogether, there are 79 excerpts that were recorded from the piano. These were all processed in *AudioSculpt* together with white noise, and eventually mixed in order to form the fifteen soundfiles. In total, 138 electronic sounds were processed by *Audio Sculpt* using the following treatments:

1) Transposition: -1200 cents, -2400 cents, creating much lower register sounds.
2) Band-pass Filter
3) Dynamic Transposition: glissando effect.
4) Clipping Filter
5) Time Stretch: factors of 5 or 6.
6) Formant Filter: focused on both vowels 'o 'and 'e', which come from the words *koe* in Japanese and *voz* in Spanish.
7) Generalized Crass Synthesis: filtering with white noise.

Effects were carried out within *Max/Msp* using the sounds recorded from the piano, maracas and rain stick. Both the harmonizer object *harmv2b~* and the frequency shift object fshift1~ were used. Applying transposition smoothing to the harmonizer patch caused the glissando effect (figures 7 and 8).

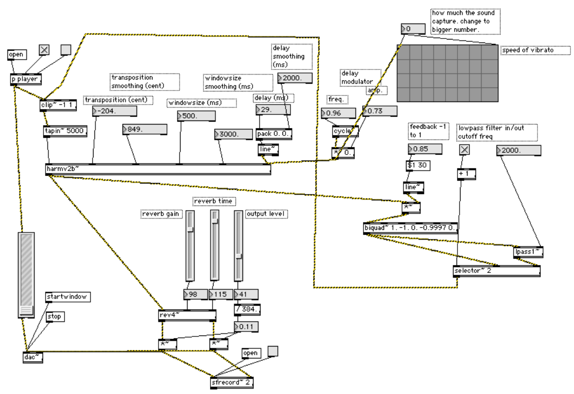

Figure 7: harmv2b~ in the *Max/Msp* patch

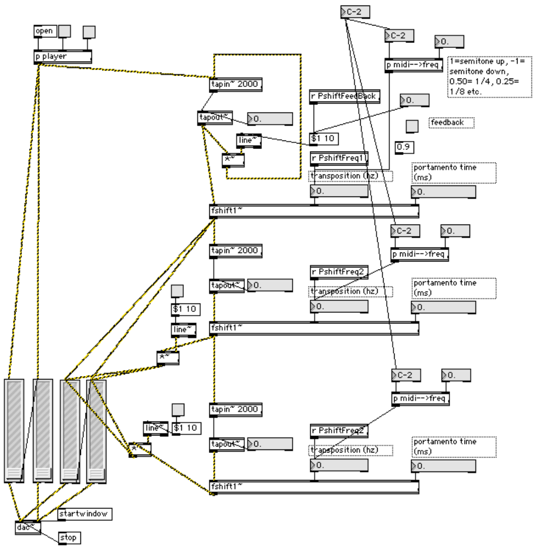

Figure 8: fshift1~ in the *Max/Msp* patch

The resulting processed sounds were mixed in Protools to produce the final fifteen soundfiles.

Real-Time Visual Image

The concept of the image is to visualize invisible phenomena like sounds. The visual image is transformed in terms of a performance each time, using the sound of the flute to create a real-time visual image during the latter (figure 9). The authors' collaboration began during a previous work, *The Sands of Time*, in which the sound of the bass flute was used to create a live visual image and a remix version. Different kinds of extended techniques such as multiphonics, distinct types of breathing sounds, sweeps through harmonics, tongue clicks and the use of the flutist's voice are employed in order to create mysterious textures, both as visuals and audio.

Figure 9: Real-time visual image

1. Hardware System

A microphone picks up flute sounds during a performance. *Jitter* samples the amplitudes of these captured sounds and then converts values of amplitude into a wave shape. The wave shape is then drawn on the screen.

2. Programming

This program is based on elemental geometry as follows:

1) Description of a wave shape.

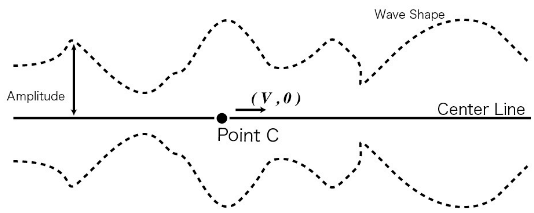

Fig. 10. Description of a wave shape

Point C in figure 10 is moving along the centre line at a velocity V. This is described as

$$\textbf{Point C : (} Xc(t)\textbf{ , } Yc(t)\textbf{)}$$

$$\vec{v} = (V , 0)$$

$$\begin{bmatrix} Xc\ (t+\Delta t) \\ Yc \end{bmatrix} = \begin{bmatrix} Xc(t)+\Delta t \cdot V \\ 0 \end{bmatrix} .$$

1) Rotation of the direction of the centre point.

The direction of Point C is controlled in real-time by a rotary controller, shown in figure 11.

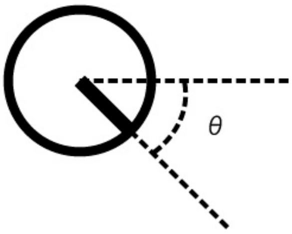

Fig. 11: Rotary controller

The velocity vector of point C is shown in figure 12 and can be written as
v =(v cos (θ), v sin (θ)).
Therefore, the centre point is

$$\begin{bmatrix} Xc\ (t+\Delta t) \\ Yc\ (t+\Delta t) \end{bmatrix} = \begin{bmatrix} Xc(t)+\Delta t\cdot Vcos\ (\theta) \\ Yc(t)+\Delta t\cdot Vsin\ (\theta) \end{bmatrix}$$

The *MAX/MSP* implementation of the centre point is shown in figure 14.

1) Calculation of the borders of the wave shape.

First, we need to calculate the vector P, orthogonal to the velocity vector.

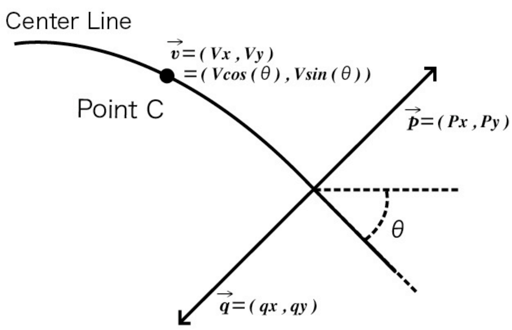

Fig. 12 Velocity vector of point C

From figure 12, this is

$$\begin{bmatrix} \vec{p}x \\ \vec{p}y \end{bmatrix} = \begin{bmatrix} cos\ (90)Vx + sin\ (90)Vy \\ -\ sin\ (90)Vx + cos\ (90)Vy \end{bmatrix}$$

$$\begin{bmatrix} \vec{p}x \\ \vec{p}y \end{bmatrix} = \begin{bmatrix} cos\ (90)V\cdot cos\ (\theta) + sin\ (90)V\cdot sin\ (\theta) \\ -\ sin\ (90)V\cdot cos\ (\theta) + cos\ (90)V\cdot sin\ (\theta) \end{bmatrix}$$

$$\begin{bmatrix} \vec{p}x \\ \vec{p}y \end{bmatrix} = \begin{bmatrix} Vsin\ (\theta) \\ -\ Vcos\ (\theta) \end{bmatrix}$$

$$\vec{p} = (\ Vsin\ (\theta)\ ,\ -\ Vcos\ (\theta)\ )$$

Its MAX/MSP implementation is shown in figure 15.
Now, we can calculate the boundaries of the wave shape, shown as points S and Q in figure 13. If A denotes amplitude of sound, point S is calculated as

Point S : (Xs (t) , Ys (t))

$$\begin{bmatrix} Xs\ (t) \\ Ys\ (t) \end{bmatrix} = \begin{bmatrix} Xc(t)+AVsin\ (\theta) \\ Yc(t)-\ AVcos\ (\theta) \end{bmatrix}$$

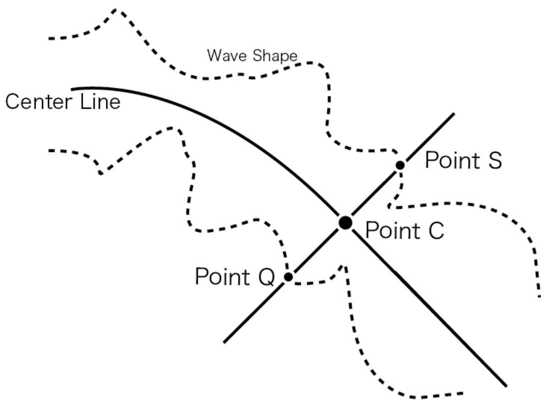

Figure 13 Boundaries of the wave shape (points S and Q)

Similarly we can calculate a vector q, also orthogonal to the velocity vector but in the opposite direction to a vector p.

$$\begin{bmatrix} \vec{q}x \\ \vec{q}y \end{bmatrix} = \begin{bmatrix} cos\ (270)V\cdot cos\ (\theta) + sin\ (270)V\cdot sin\ (\theta) \\ -\ sin\ (270)V\cdot cos\ (\theta) + cos\ (270)V\cdot sin\ (\theta) \end{bmatrix}$$

$$\begin{bmatrix} \vec{q}x \\ \vec{q}y \end{bmatrix} = \begin{bmatrix} -\ V\cdot sin\ (\theta) \\ V\cdot cos\ (\theta) \end{bmatrix}$$

And from here, point Q is

Point Q : (Xq (t) , Yq(t))

$$\begin{bmatrix} Xq\,(t) \\ Yq\,(t) \end{bmatrix} = \begin{bmatrix} Xc(t) - AV\sin\,(\theta) \\ Yc(t) + AV\cos\,(\theta) \end{bmatrix}$$

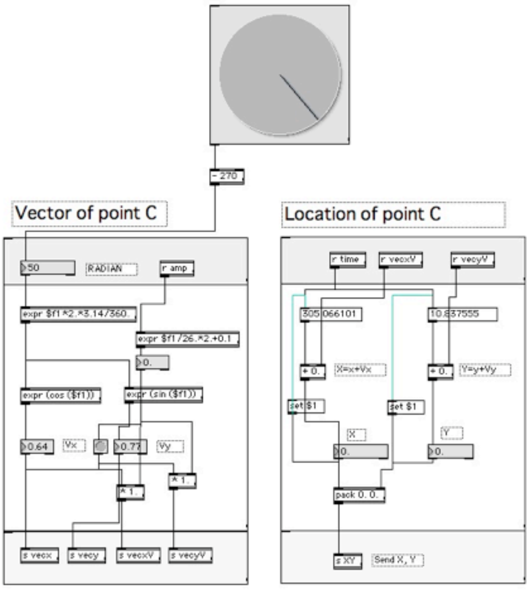

Fig. 14: Center Point on the Max/Jitter patch

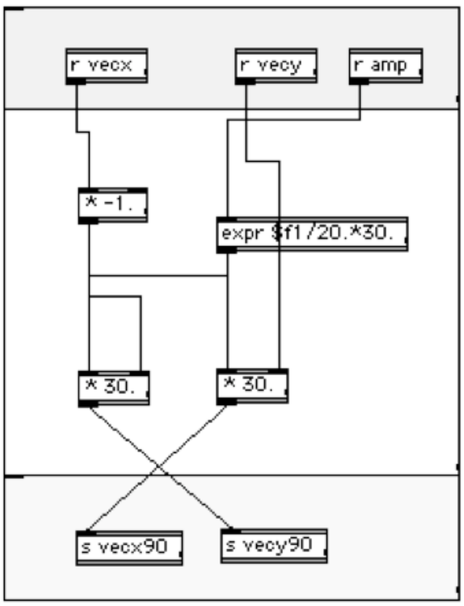

Fig. 15: Orthogonal Vector on the Max/Jitter patch

Images created during the concert using the method described above are shown in figures 16.1 to 16.5.

Fig. 16.1 Excerpt from the live visual images in the concert

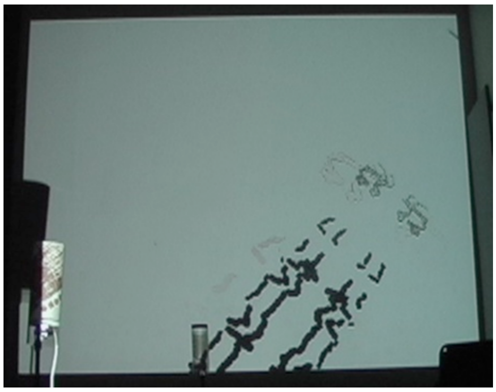

Fig. 16.2 Excerpt from the live visual images in the concert

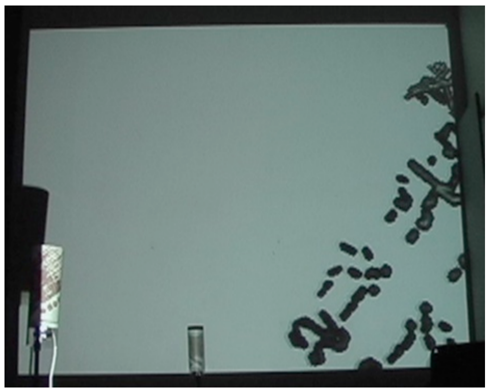

Fig. 16.3 Excerpt from the live visual images in the concert

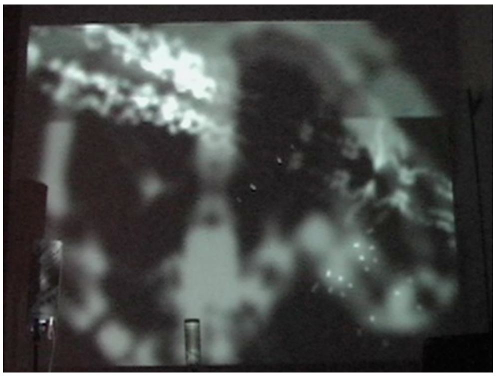

Fig. 16.4 Excerpt from the live visual images in the concert

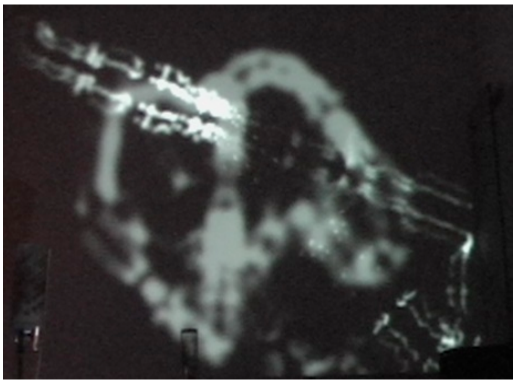

Fig. 16.5 Excerpt from the live visual images in the concert

CONCLUSIONS

As a result of this project, our recent interest has focused on imagining "invisible things", which acts as a pivotal energy in our creativity. In addition, Japanese sensibility and aesthetics are always present in our works, consciously and unconsciously woven into its very fabric.

Because of the technical limitations of the performance venue for the premier concert in Mexico, it was risky to use live electronics with *Max/Msp*, as well as to use multiple microphones for each instrument in order to create complicated visual images. However, it will be possible in the future to achieve more diversity of visualised sounds with a live electronics version and multilayered complex live visual images.

Computer technology enhances our creativity and lets us think of new possibilities. Therefore we try to explore a comprehensive approach in order to give advanced technology a new meaning. Furthermore, we believe that the most important issue is precisely those "invisible phenomena", which the computer cannot calculate but human beings can feel. This is the invisible we incarnate using computer technology, which in turn can generate multidimensional images in the listener/viewer.

ACKNOWLEDGEMENTS

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References

Paz O (1990). *La Otra Voz*. Seix Barral: Barcelona.