ENHANCED PHENOTYPE

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ABSTRACT

Enhanced Phenotype (2012) is a composition with an interactive score on multiple computers designed for performance by a soloist or an open ensemble. In concert, the work comprises a real-time audiovisual environment controlled and performed by computer musicians. The premiere took place at the INTER/actions symposium in Bangor, Wales in April 2012 with the participation of an 'all stars' ensemble.

1. INTRODUCTION

iScore is an interactive generative score for multiple computers and audiovisual real-time composition for open ensemble and is programmed in Max/MSP/Jitter by the authors.

An interactive score turns the concert into a live-event of a very special kind: the score is assembled within an algorithmic real-time process on stage based mainly on graphic and figurative notation. The performers process an interactive score on multiple laptops (Apple preferable) and exert mutual influence on them.

2. CHARACTERISTICS OF ISCORE

Each performer or each group of performers has their own computer providing an interactive score on stage. Each computer can act independently or behave as part of a swarm led by an interactive conductor while the computers are automatically linked into a data exchange via local WLAN network. Each computer is equally cased and can send orders to all others to operate as a momentary conductor.

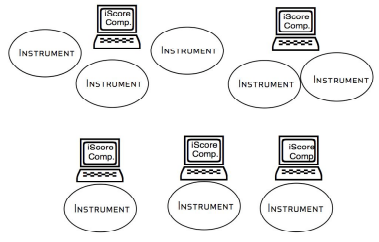

Figure 1. Performers use iScore in groups as well as individually

The iScore computer system chooses the pages from a collection of mainly graphical score elements. The musicians see this on their laptop or on the side screens and perform according to the interpretation of the pages agreed in the rehearsal. The graphic score is designed to encourage the performers to play in the style of contemporary composition/improvisation. At the rehearsals we work out a group improvisation according to 'sounding impressions' of the graphic score, which is randomly generated by the computer system and displayed on screens, or manually chosen by the composer/conductor. The piece is open to other joining musical instruments.

The musician can select pages of a graphic score collection (including traditional notes) by the gesture of turning a page in front of the built-in camera within a limited random function. In addition to this, a real-time composer/conductor can choose specific modules for the ensemble or soloist in real-time.

2.1. Modes

Individual mode:
The random selection of a new page is operated by „the wave of a hand" in front of the built-in camera in the manner of a traditional page turn. Each performer gets their individual module to perform and creates the timing for him-/herself.

Tutti mode and composed mode:
All computers show the same picture which is actuated by the conductor.

On cue mode:
This is a special form of the composed mode. Its purpose is to make sure the all performers execute a cue at the same time as a little virtual conductor appears in a video window. This generates a very surprising moment for the audience in the context of free improvisation and gives the impression of a real-time composition.

The dynamic level of the work can also be modified during the concert by the composer.

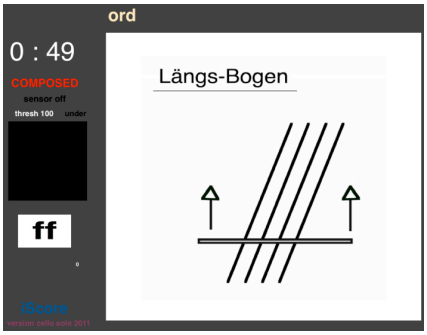

Figure 2. Mode composed

Figure 3. Mode individual

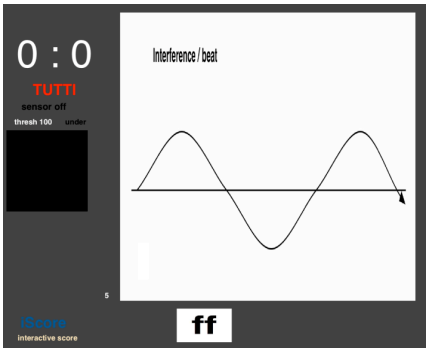

Figure 4. Mode tutti

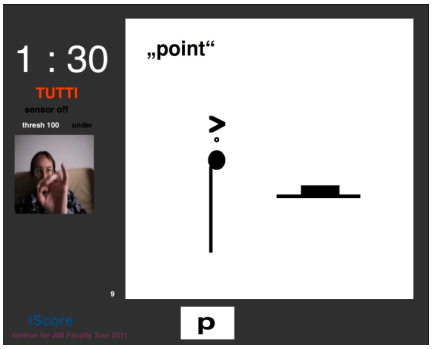

Figure 5. Mode on cue

3. THE PERFORMANCE

The author's speciality is in interactive performance, a skill which has developed as a result of many international concerts. The author's interactive performance practice is informed by contemporary instrumental composition, computer music, interactive improvisation and real-time score generation. By combining our computing procedures iScore, SpectraSonic, Multichannel Granular Synthesis and Sarcastic System, we achieve a synaesthetical effect in which the music of instruments and its electronic ambience come to mutually influence each other, blending to create a unique art work of real-time improvisation.

The ensemble improvisation with real-time audio and video processes brings out the best skills of each performer whilst contributing to the agreed interpreation of materials during the rehearsal. The instrumental sounds are the source for the real-time audio signal processing.

3.1. Performers

The open scoring for the work includes the following elements:

- an open instrumental ensemble with laptops
- a real-time composition system, which can be operated by the composer, by the conductor or/and by the musician
- a real-time audio processing performer
- a real-time video processing performer

The performers of the world premiere at INTER/actions symposium, Bangor, UK, 12th of April at Powis Hall were:

Pierre Alexandre Tremblay, bass
Lauren Hayes, prepared piano
Xenia Pestova, toy piano
Karlheinz Essl, m@ze°2
Se-Lien Chuang, bass recorder, interactive visuals
Andreas Weixler, iScore, SpectraSonic
Faye Snowdon, flute
Sioned Roberts, clarinet
Richard Eigner, percussion

Figure 6. Stage setting and performers at the premiere - apple tree of 18 computers

4. AUDIOVISUAL INTERACTIVITY

In addition to the interactive score - iScore, a real-time audio computer system creates a constant stream of electroacoustic ambience; an abstract visual processing of live cameras; and prepared materials that interact with the music. This piece is an interactive composition using improvisational concepts and audiovisual real-time computer processes.

The live sound of acoustic instruments serves as an interface in an audiovisual interactive concert. To control the big bunch of possible interchangeable parameters within the computer systems we use limited random functions.

4.1. Audiovisual real-time computer system

The audiovisual real-time computer system consists of

- iScore – an interactive generative score on multiple laptops;
- SpectraSonic – a multichannel spectral delay;
- A multichannel granular synthesis with FFT filtering;
- Sarcastic System – an algorithmic sound spatialiser;
- AVI – an audiovisual interactive computer system that results in visual formations projected either on a single screen or on 3 individual screens using a Triptych device.

The system was programmed in Max/MSP/Jitter by the authors.

The sound distribution system can be in 2, 4, 8 or up to 16 channel surround. The duration of the performance was supposed to be 12 minutes, and is, however, variable.

4.2. RTA - real-time audio processing

4.2.1. SpectraSonic

A multichannel SpectralDelay sets an ambience sound out of 1024 frequency bands which are the result of 4-times 256 frequency bands. Each of these bands are delayed and fed back into the electroacoustic environment its own specific way.

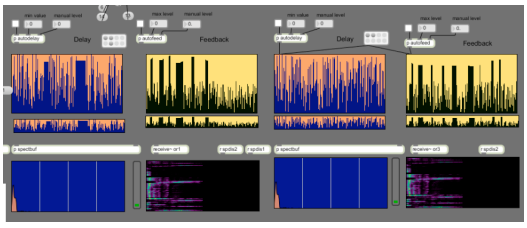

Figure 7. Algorithmic spectral delay

4.2.2. Multichannel Granular Synthesis

As with the SpectraSonic, the multichannel granular synthesis acts as an improvising musicial instrument as well. It consists of four layers of traditional granular synthesis (based on Richard Dudas) with sterero outputs, There are therefore eight generated channels of granluar synthesis with four independent pitches, grain lengths, sample positions and playback. The electronic and instrumental players feed off one another, meanwhile interactive visuals are generated by the AVI system to create a synaesthecial work of art.

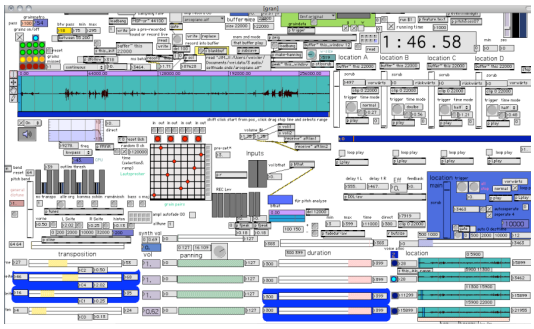

Figure 8. Granular synthesis patch

For each of the 8 channel audio matrices a 256 band FFT filter is applied to create a resonant sound, which can change dynamically. The filtered frequencies are the same, but the input of every channel is different, and because of 8 independent interferences the output gives a special jangling sonority. Also we implemented a continuous blending (a special multislider object by Emanuel Jordan) from one filter spectrum to the other to generate smooth changes in the performance.

4.2.3. Sarcastic System Audio Distribution

An audio diffusion system distributes sound sources algorithmically in a multichannel periphonic audio system. Granular synthesis and spectral delay also have their own internal spectral movement in conjunction with the SARCastic System creat complex spatial movements.

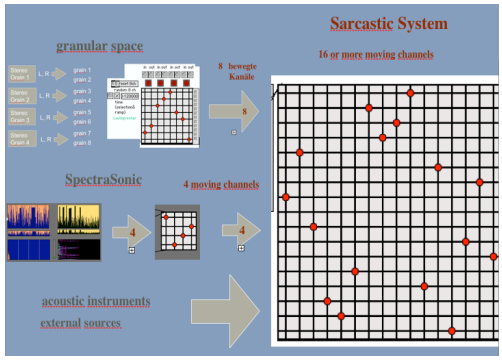

Figure 9. SARCastic system audio flow

4.2.3.1. The granular space

Each granular synthesizer creates a pair of audio channels. For the build-up of sonic environments the granular space supplies four times stereo channels with limited random panning. These 8 granular channels are fed into a matrix of 8x8 and distributed in random movements. Thus each channel has its own unique position and movement.

4.2.3.2. The spectra sonic space

As the granular spaces, the spectra sonic space is fulfilled with 4 channels (quad) with limited random panning,

and the 4 SpectraSonic channels are moved by a matrix of 4x4.

4.2.3.3. The SARCastic system

The SARCastic system is a multichannel audio distribution system which drives groups of audio channels within the electroacoustic space. We developed this during a composers residency for and at the Sonic Arts Research Centre at Queen´s University in Belfast.

The annotation of the whole structure can be described in the following:

The Granular Synthesis and the Spectral Delay are operated through controller hardware devices.

For time based media and in real-time performance the 32 channel dynamic matrix has an audio driven function, i.e the speed of random functions, are mapped to the dynamics, and can drift motion in motion, i.e. in the granular and simultenously in the spectra sonic space)

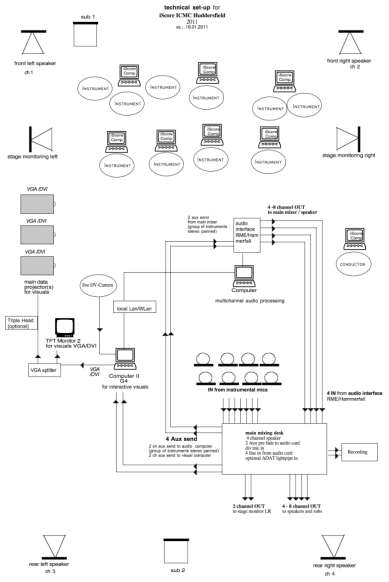

Figure 10. Technical setup

5. INTERACTIVE VISUALS

Se-Lien Chuang controls the interactive visuals within the group. The visuals are triggerd by the analysis of the pitch and dynamics of the acoustic instrument, and is linked to the parameters of the live processing of the granular synthesis. This process is achieved by data mapping.

The purpose of the data mapping is to select parameters from the audio and visual input, to scale them, to link them and to output the visual results in relation to a randomly determined timeline or predetermined series of moments.

The association between the audio and visual components is artistically determined. Though the data mapping is predictable, the result is different in each instance. In our data mapping we distinguish between different organization levels: parameter, module, script

5.1 Parameters of granular synthesis

On the audio side we have the following parameters linked to the visual processes: transposition, panning, duration and location. All parameters exist four times in each of the layers A, B, C and D.

5.2 Parameters of visual processing

On the video computer we link parameters such as zoom, rotate, scale, saturation, fade etc.

5.3 Module

This is a central idea of ModularFilter. A main patch handles the visual source, i.e. a live camera or the initial materials, the exchange of the filters, effects and scripts in a modular system.

5.4 Script

The script is the artistic decision of what will happen, similar to that of a storyteller. It contains for example, the reaction of the visual system according to a trigger from the audio analysis module.

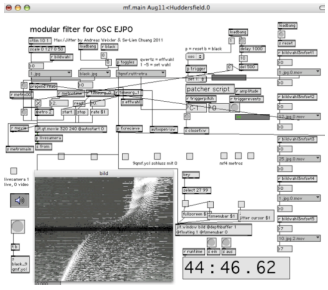

Figure 11. The interactive visuals patch

The modules of the visual treatments are:

- 3D-Tools within OpenGL environment;
- Modules of filter effects;
- Rutt/Etra scan processo;r
- Inspired by the work of Woody Vasulka in the mid-1970s, this patch displaces a 3D plane based on the luminance of a video signal;
- Ycl;
- Plane geometry transformed to a cylinder;
- Others.

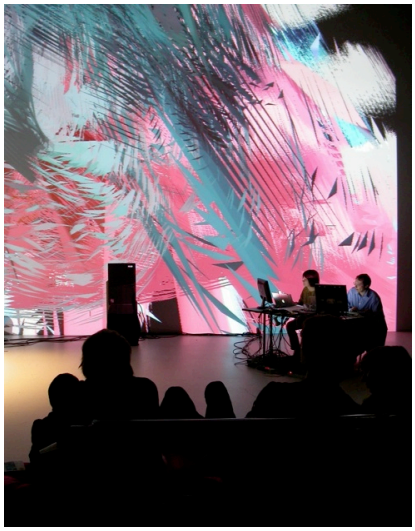

Figure 12. Immersive visuals in the Deep Space, Ars Electroncia Center, Linz

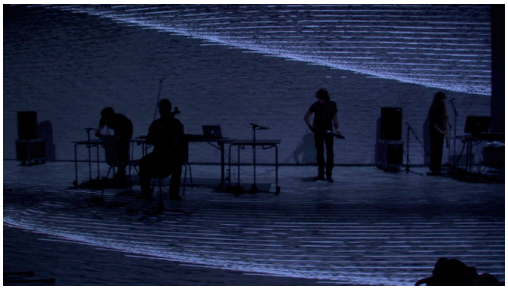

Figure 13. Immersive visuals in the Deep Space, Ars Electroncia Center, Linz

6. INTERACTION

Interaction is the core of the piece *Enhanced Phenotype*, and takes place in a multiple ways between:

- instrumental player and personal iScore computer on stage;
- iConductor performer and the ensemble;
- acoustic instrumental player(s);
- machine musician (granular player) and the ensemble;

and within the AVI system between audio and video computing, i.e. data mapping, which happens via LAN/OSC.

6.1. Audio analysis

Basic audio data comprises is pitch and dynamic from the acoustic instrument(s). The system comunicates via OSC - Open Sound Control.

6.2. Grain data

This step selects parameters for granular systhesis, and scales these before the data flow goes from the multichannel granular synthesis to the visual computing environment.

6.3. Visual data

To select visual input as well as parameters for effect modules and to scale it are the essential tasks. Within the granular synthesis patch the parameters of audio processing, which are executed to the visual computing, are indicated in real-time so that the musical performer knows which audio parameters influence visual interaction.

6.4. Data flow

The implementation of a dynamic threshold for the flow of data is technically important for avoiding CPU crashes.

7. ISCORE PAGES

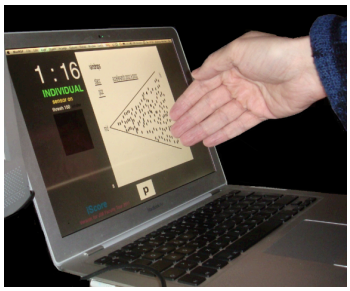

Figure 14. A new module is selected by the wave of a hand gesture for turning a page

There are different fields of iScore pages and modules: accents, gesture, pictures, instrument specific, traditional notation and et al.

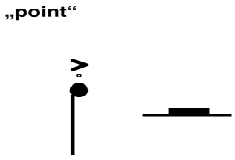

Figure 15. iScore “point”

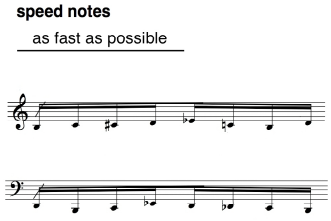

Figure 16. iScore “speed notes”

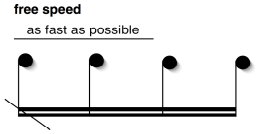

Figure 17. iScore “free speed”

7.1. Fluctuation

The phrasing of a musical statement is essential for constructing the form of a memorable piece.

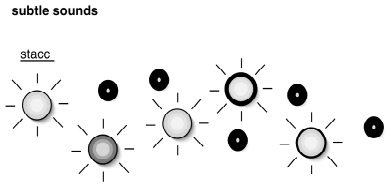

Figure 18. iScore "subtle sounds"

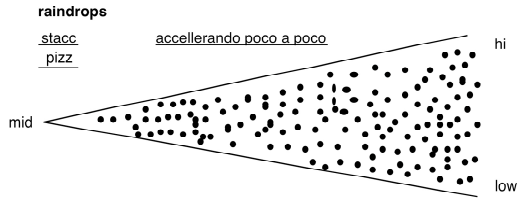

Figure 19. iScore "raindrops"

7.2. Pitch

Beyond the traditional tonality, scales and atonality, we are also interested in a way of contemporary and experimental expression.

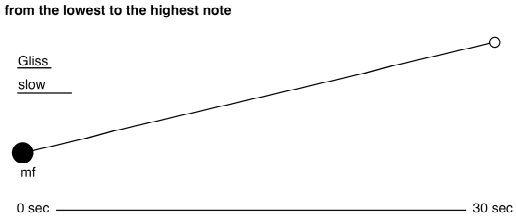

Figure 20. iScore "the range"

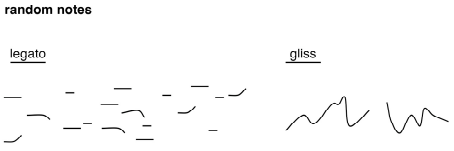

Figure 21. iScore "random notes"

7.3. Gestural structure

We are beset with a sound landscape of commonplace objects. How can we make senses out of the environment and contrast it in an instrumental musical context? The definition of gestural structure in this section points to a way toward the path of imitating the acoustic surroundings by practicing the objective sounds through the instruments.

An impressive illustration stimulates the visible expression of the gesture to be played on the instrument.

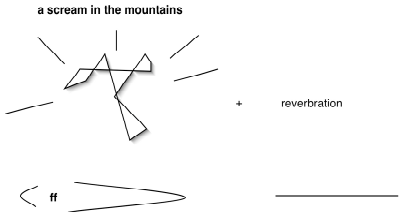

Figure 22. iScore "scream in the mountain"

Figure 23. iScore "reverse"

7.4. Image

Here is the further step to draw the expressive connotation of the trope.

Figure 24. iScore "the purring of a cat"

(Max/MSP/Jitter startup pict [1])

7.5. Instrument specific

Many instrumental performers have developed their own skills in contemporary playing techniques. In this field iScore refers to the very individual artistic skills of the cooperating performer, especially for soloists.

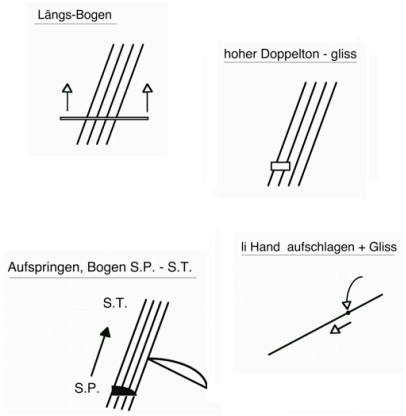

Figure 25. Instrument specific module

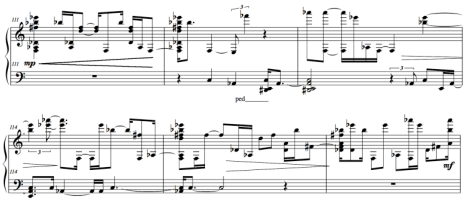

Figure 26. Traditional notation module

8. CONCLUSIONS AND OUTLOOK

The goal of this project is to create computer music with an emphasis on live score generation. The score provides an interface for contemporary instrumental playing and its music computing within an associated graphical environment along with audiovisual composition/ improvisation, and to create a performance that balances interpretation, reaction and interaction.

To achieve this we combine iScore with improvised music and real-time computer processes into an audiovisual real-time composition, learning from each other, in both a technical and artistic way.

Currently we are working on generalizing the representation of the graphic score whilst developing more instrumental specificity for performance by a chamber ensemble or a group of solo instruments with different supposition and varied playing techniques. We plan to separate the granular synthesis, the SpectraSonic and the SARCastic system as well as the analysis along with each instrument so that each instrument will have its own iScore electronic interpretation for the real-time sonic ambience. A further extension is a method for generating new pages in real-time.

9. REFERENCES

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