Execution, Intuition and Chance:
Exploration and Interpretation of Musical Structures with Live Electronics

Peter Gahn
p.gahn@petergahn.de
http://www.petergahn.de

Proceedings of Korean Electro-Acoustic Music Society's 2011 Annual Conference (KEAMSAC2011)
Seoul, Korea, 22-23 October 2011

Presentation of a live electronic tool, written in SuperCollider, using a game joystick and MIDI controllers, for exploring and developing musical concepts and structures and performing as a member of chamber music ensemble and/or with other performing arts. Aesthetic and musical intentions for the development of the software environment and illustration with two compositions created and to be performed with this tool.

Improvisation and Interpretation

Improvisation during Musical Creation

Composing always means finding a concrete musical realization of one or more ideas – abstract, aesthetic, musical et al. – in processes taking part in the three-dimensional space of the execution of ideas, intuition and chance.

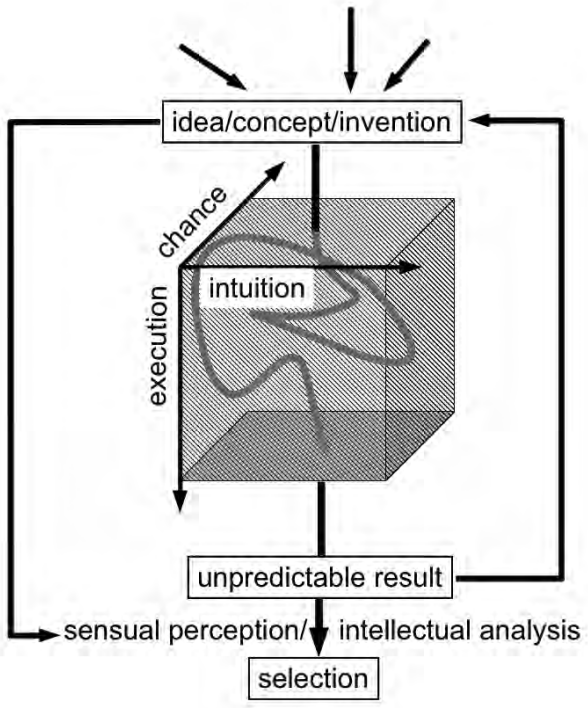

Figure 1. Process of creation.

Searching for structures which come close to a musical idea, deducting them as different realizations of one initial idea, trying out to play a new meta-instrument, finding the musical aspects of sound objects etc., every personal approach and method of composing contains these three aspects.

Improvisation with material and structures thus found or conceptionally created – alone or as a member of a team of musicians/performers – is an effective intuitional method (involving a certain degree of chance) to get new perspectives, new deductions of ideas, materials and structures. Intuition means highest mind control based on all personal musical and extra-musical experiences of senses and intellect, which is in its sum too complex to be present simultaneously in the intellectual mind. Direct control with the ears and spontaneous reactions – including moments of chance – lead to intellectually unpredictable results, which can be used in a composition directly, filtered, with more or less slight corrections, or as an inspiration to new intellectual ideas. Improvisation can be a part of the creation process, trying out, exploring found or constructed sounds and structures, slightly shifting, changing the parameters of one event or a group of events, exchanging order of events, erase events or continue the line of events and more. In some cases it can be one of the initial moments of the composition process like Stockhausen's improvisation with a musician at the beginning of the composition process of his work *Mikrophonie I*, or even creating almost the complete work ad hoc like Scelsi's composition method for the majority of his oeuvre.

Interpretation of Instrumental Music

According to these processes of composing, a musical work presents a selection of the infinite possibilities of perspectives of a musical idea, simultaneous and/or successive. The conditions of different concert halls, performance places, instruments, audiences and ensemble partner's physical and mental conditions – mostly dynamically changing during the performance time – result in the necessity of different interpretations aiming for the same musical meaning.

Even complex scores of contemporary music do never

contain complete information of sound result nor complete descriptions of actions to produce sound. For a distinctive realization the performer needs to take constant decisions during practice and performance, which are also processes taking part in the three-dimensional space of the execution of ideas, intuition and chance. Since the age of Romanticism the role of the performer of art music is clearly no longer just that of a fulfilling technician but rather that of a musical interpreter with responsibility for interpretation, performing a music with space for the personalities of the interpreter and the audience. This makes every music performance a singular event in time and space, a communication between a musical composition, the performer and the audience, and is one of the most significant qualities of music.

Interpretation of Electroacoustic Music

The awareness of the need for interpretation of electroacoustic music stills seems to be sometimes comparable to the Baroque idea of a musician, but is developing more and more.

Instruments used in the early days of electroacoustic music like ondes Martenot, Theremin were almost used like classical music instruments. During Serialism – the period of most precisely notated instrumental music in history, with an extreme focus towards the execution of intellectual ideas – the majority of electroacoustic music were completely fixed tape pieces, regardless of the very different production methods employed by, for example, the Parisian musique concréte, the electronic music in the Cologne studio or the computer music in Princeton. Aesthetic needs – probably pushed forward by the environment of broadcasting studios – led to production methods allowing for only a very small amount of improvisational elements during the creation (but maybe with still more intuitional decisions and moments of chance than intentionally done by the composers) and performance of the pieces. These pieces used tape as their original medium and were interpreted during performance with the mixer: slightly changing volume with faders to support the dynamic curve and spatialization, and adjusting sound quality with equalizers.

Smaller portable and less expensive synthesizers, computers and aesthetic needs later led to an environment allowing for more and more improvisational moments to play a part in production and performance as exemplified by the aleatoric instrumental music of the same period. The live electronic – first using analog techniques, later the computer – requests a performer or a group of performers at the electronics – mixer, computer with keyboard, mouse and other controllers – with much more possibilities of interpretation, yet still acting a little bit like an assistant of organ registration, changing patches and some parameters following the instrumentalists performance.

Nowadays new controllers like sensor gloves, sensor suites etc., or new techniques like live coding, use of analog circuits etc. allow to create the structures and sounds more or less predictably ad hoc, improvising or performing more or less predetermined pieces which are notated in scores, i.e. plans of execution or graphic representations of the sound result. The structures are mostly monophonic in a broader sense, have a more or less constant speed of the musical development, and are mainly influenced by the software/programming language used which can easily evoke a static set of so called patches, or let the music be trapped in loops.

Personal Ideas

Personal Interests

I am not interested in constructing/building sound or structure ad hoc. Me and the computer need more time than real time for creation. (The structures I realize with a mix of techniques like physical modeling, granular synthesis etc. at present still require plenty of computing time.) My aim is a technical environment with the possibilities to create complex structures, improvise with the material in micro and macro structures during the composition process and interpret electroacoustic music as a musician: stretching, crushing, shifting, mapping of micro and macro structure according to the performance circumstances, present situation and allowing the performer of the electroacoustic music to react as a partner within a musician's or other performer's ensemble.

I was never interested in using the live instrumental sound through electronics, even though I highly appreciate the musical quality of Nono's and other composers' live electronic works. I admire the different qualities of instrumental sound and performance action and electronic sound and don't see a necessity to melt it together in my music. The musical idea rather than the musical surface is responsible for the coherence, the causal relationship within my pieces. It is like in a classical violin & piano duo sonata, where neither the composer nor the interpreter try to let the violin sound like a piano or vice versa; the aim is a strong interaction in the aspect of sound quality, micro structure, musical intention and idea.

Personal Experiences

After creating tape pieces with analogue techniques, using recorded or synthesized sound, I worked several years

with the non real time algorithmic composition computer language Common Lisp Music which allowed me to realize sounds and structures which were at the time not possible to realize with real time techniques like analogue techniques, MIDI sampler techniques et. al. The music perspectives of the sounds I found or algorithmically calculated were explored with *snd*, a software allowing for filtering, pitch shifting etc. and playing with these methods simultaneously several sound files, starting and stopping them independently.

Structural Heterophony

At the same time – living in Japan and being highly impressed by Japanese traditional music like Gagaku or the structures and use of parallel perspectives in Japanese traditional paintings – I developed a method, a musical attitude I called *structural heterophony* for composing and performing instrumental music. I focused more on the linear musical meaning – allowing the performers to use as much of the individual potential of their own and their instruments to realize a music line, a musical idea – than on the momentary vertical sound result, but was always aware of the momentary field of possibilities of sound results and music interactions.

These techniques were also used for compositions for tape/CD and performers, playing together in a way of loosely coordinated karaoke. The interaction with instrumental and dance performers and the need for more flexibility of their performance were increased firstly with the use of two CD players with which I could start and stop two layers of electronic music independently.

Compositions, Soft- and Hardware

ink, colours and gold on paper II+III – surroundings 1+2 (2005/6)

The wish for more flexibility in the electronic part for interpretation as well as during the composition process, without giving up the quality of detailed work, of precise non real time computing, led me to the next step, realized in a work for several chamber music instruments and live electronics with a newly created computer language environment.

The general idea for this piece derived from my ensemble piece *ink, colours and gold on paper*, I composed in the idea of structural heterophony. While two instrumental groups interpret the same musical thread more or less simultaneously in two different ways, a third group realizes a very different layer. All three groups play musically together (listen to each other, coordinating and adjusting intonation, dynamics, relations of tempo, musical expression etc.), linked rhythmically in a more loose way.

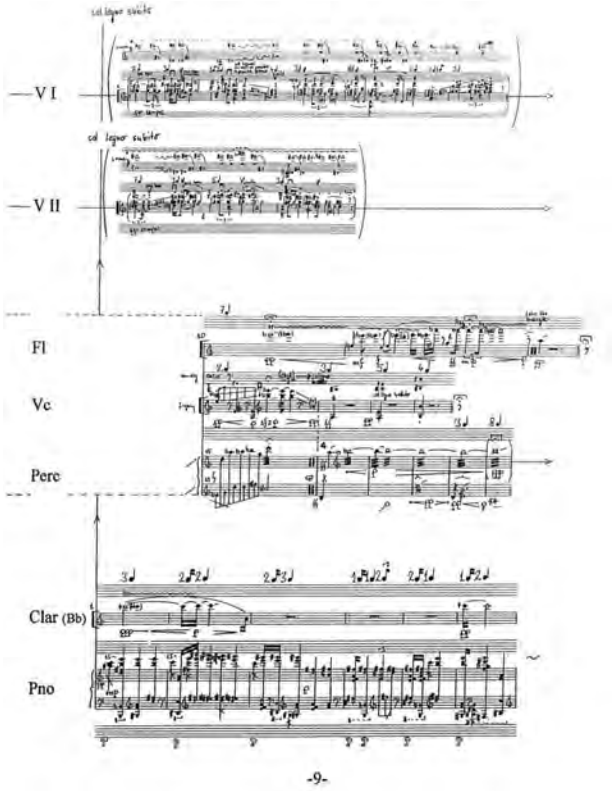

Figure 2. *ink, colours and gold on paper I*, p.9, © Edition Juliane Klein

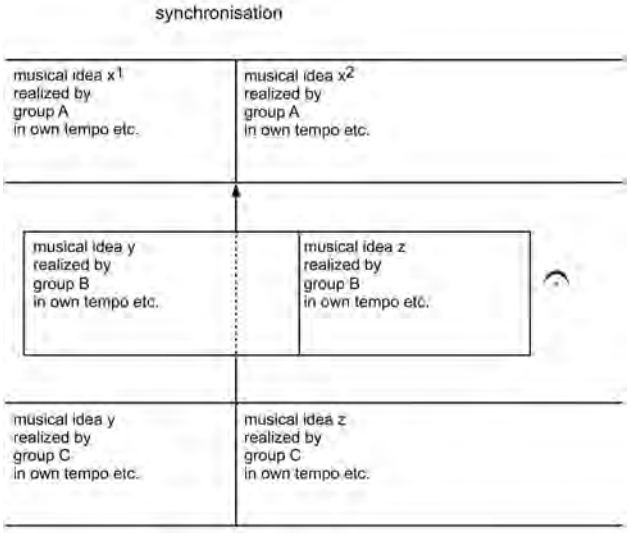

Figure 3. Time coordination of different instrumental groups in *ink, colours and gold on paper I*, p.9

The new piece, or better to say complex of pieces, exaggerates this idea in the way that the two solo instruments can play their parts (each of them containing both musical layers simultaneously) – *ink, colours and gold on paper II* for accordion and *ink, colours and gold on paper III* for percussion – as solo pieces or together as the duo piece *ink, colours and gold on paper II+III* in a broadly linked

rhythmic synchronization. These three different perspectives can be enlarged with one or both of two less dense, more transparent musical layers, *surroundings 1* for live electronics and *surroundings 2* for flute and violoncello.

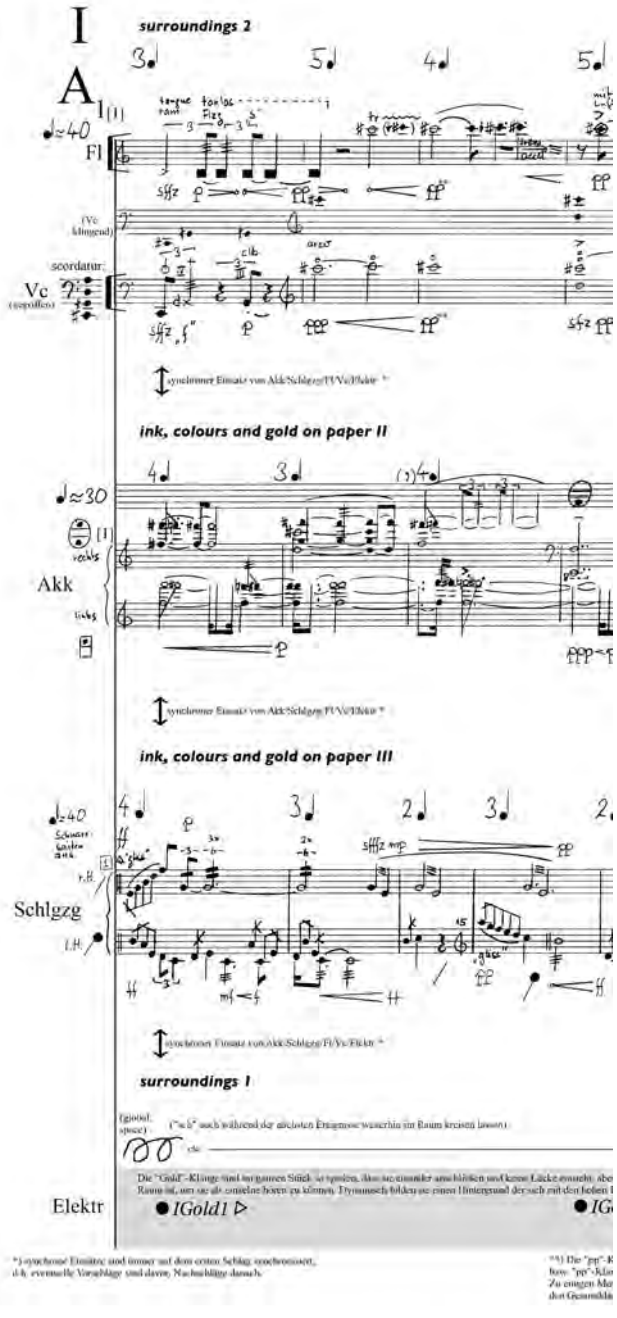

Figure 4. *ink, colours and gold on paper II+III - surroundings 1+2*, part of p.2 © Edition Juliane Klein

For *surroundings 1,* the live electronic part, I decided to use SuperCollider, an environment and programming language for real time audio synthesis and algorithmic composition, because like Common Lisp Music it is object-oriented and has also a single environment for micro and macro structures. SuperCollider adds the possibilities of a graphical user interface and real time live electronics. As a free and open source (GPL) software it continues to be developed by a huge community of programmers and composers and is easy to purchase and install for any musician for performing.

The hardware consists of a computer with four-channel-audio-interface and 8 speakers (versions with fewer or more are possible). As controllers I decided to use a game joystick, computer keyboard and mouse, so everybody has access to the necessary hardware for performance.

The Software Environment

The software, a set of new SuperCollider classes developed during my residency at ZKM, Karlsruhe, Germany 2005/6, assists in producing the sound, starting and manipulating events. A score list of OSC-events can be played – automatically like playing a tape piece or starting individual events by playing like a classical composition from score. This list can be typed in as a list of time/events data or calculated by algorithms. In SuperCollider these events are OSC-messages, usually addressing the so called *server*, the part of SuperCollider which performs the sound synthesis, calculated by functions defined in *synth defs*. Two kinds of parameters can be changed by controllers (Joystick or mouse in the GUI):

The *static* parameters are a set of parameters – transposition, start/sample position, volume, filter/q, filter frequency, low pass/band pass/high pass, x,y and reverb – saved in global variables. They are used by a function which manipulates the values of the OSC-messages of the score list, adding or multiplying the values with the global variables before executing it as a OSC-message. (Values not described in the score list won't be manipulated and get as usual the default value or their synth def.) Synth defs values without these parameters would not be changed. A synth def with the value *pitch*, given a pitch-value in the score list and using it for the pitch, would not react to the *static*-parameter *transposition* because the name is different and won't be changed.

The *global* parameters contain the same set of parameters, but saved in control busses, being accessible at any time by the real time sound engine. Depending on the programming of the synth defs, some sound calculating functions read and use the bus parameters, others not. How they use these parameters is implied by their name, but completely undetermined. For example, a kind of sample player uses the parameter transposition to make glissandi, some random noise generators use this parameter for controlling the speed of LFOs, while others do

not react to transposition changes. This values are added to or multiply the values of the event given by the score list or default value.

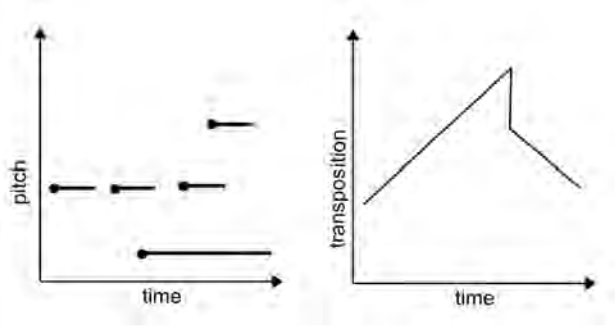

Figure 3 & 4. Events, change of parameter transposition

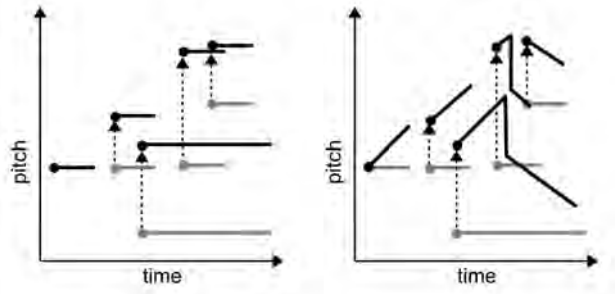

Figure 5 & 6. Events react to static (5) and bus (6) parameter.

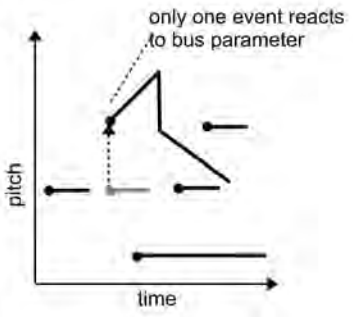

Figure 7. One event events reacts to bus parameters. Other events don't react to change

The Controller

A game joystick was selected as the main controller to manipulate parameters, start events and change play direction in score (forward, backward, repeat).

I decided to use a game joystick because it is inexpensive compared to a Wacom tablet or custom made interfaces etc. and easily accessible for anybody. Unlike a mouse or a smaller game controller (two little joysticks are controlled by the thumbs of the two hands), a game joystick can be controlled with just one hand, performing simultaneously the manipulation of parameters in three dimensions – x and y axis and torsion – in a single large scaled movement. The centre position is perceptible (unlike a mouse and Wacom tablet) through the tension of a spiral, several buttons can be switched with the fingers, a button at the so called hat can be set to five different positions, and still one hand is free to operate the computer keyboard etc.

I used the joystick to simultaneously modify a set of three parameters with x and y axis and torsion, selecting the set and change between *static* and *global* parameter, using the button at the hat and three additional buttons to set these parameters. The possibility to set the parameters – same like a mouse click – allows for both parameter jumps and continuous glissandos, and set only one or two of the three parameters. Two other buttons were used to start the events and change the direction of score reading, if necessary.

Several musicians played the piece and all, including myself, required mental and physical training for the use of the joystick, looking at the score, playing together with the instrumentalists and occasionally checking the graphical user interface for the actual values.

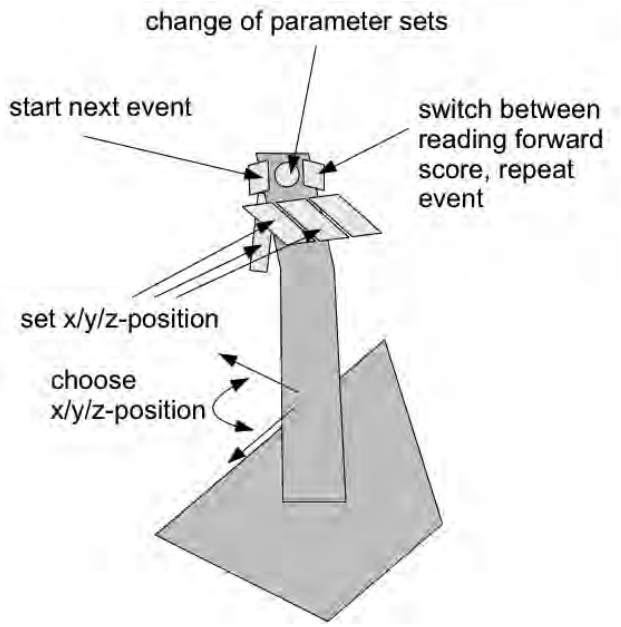

Figure 8. Usage of the joystick

A computer keyboard was used together with the mouse, originally only for the substitution of the joystick or in the case of an emergency to jump inside the score if any problem arises during a performance. The events can be started, the reading direction in the score can be changed, numbered keys allow to jump to predefined events in the score etc. Mouse actions in the graphical user interface can set fader, start recording, automatic playing, rendering the score to a sound file etc. The graphic user interface shows the value of the parameters and the position of the joystick, for coordinate jumps or smooth changes of parameters without a value jump.

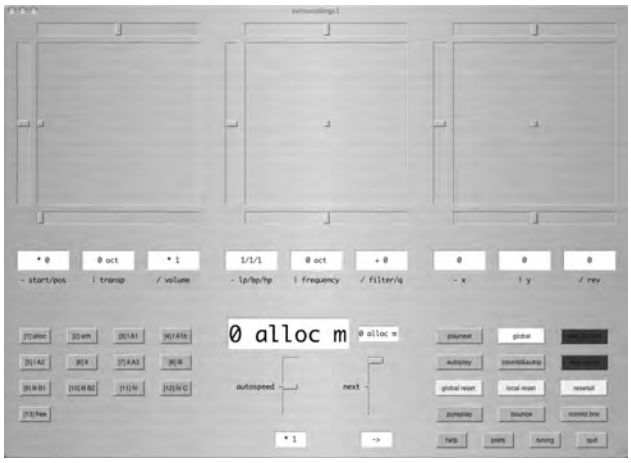

Figure 9. Graphical user interface, first version

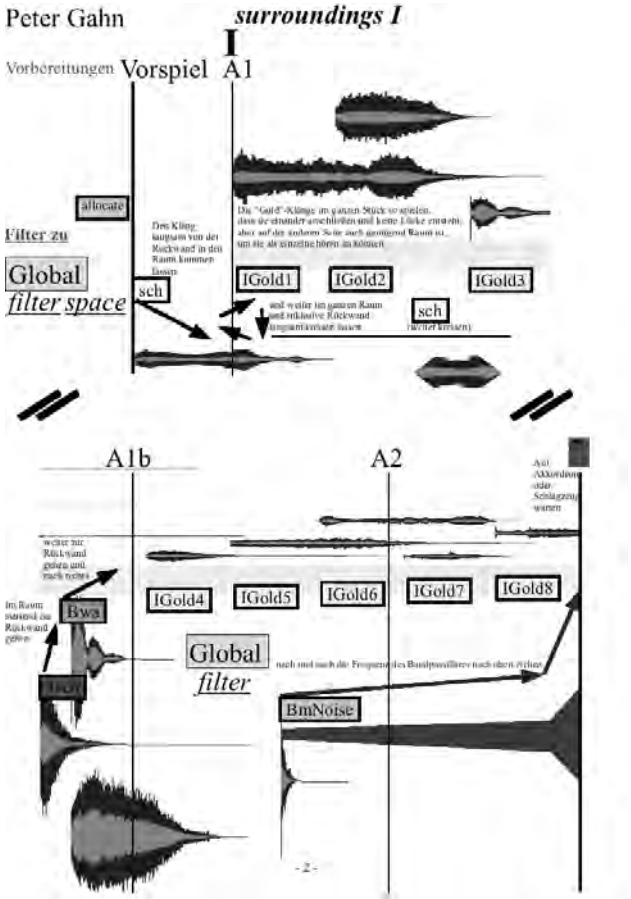

Figure 10. Score of *surroundings 1, © Edition Juliane Klein*

Process of Composing

The Sound material was produced, using recordings of Peking opera gongs, shō (a mouthorgan of the Japanese traditional orchestral music Gagaku), simulated sound of large thin gold walls, beaten or crashing together (calculated with physical modeling software Modalys), synthesized white noise and more.

Groups of events, set manually or calculated by algorithms performing complex mixing, transposition, filtering and granular synthesis are the main techniques used for sound manipulation.

The automatic play and rendering function was used to listen to the parts without personal interpretation, playing with or without the percussionist. Playing parts of the pieces, repeating events with slightly or roughly changed parameters and changing the play direction and jumping around in score led to the revision or affirmation of values.

Smaller parts were created, changed, combined and rendered to bigger parts, resulting in a musically meaningful structure.

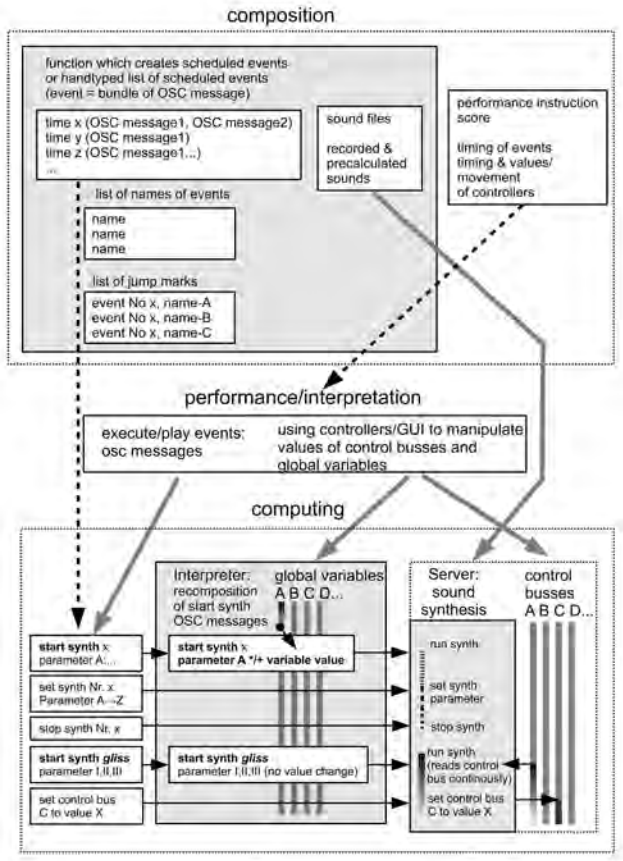

Figure 11. The parts of composition (SuperCollider data, sound files, performance instructions), interpretation and computing.

Revision of Software and New Composition

Nachtsicht (2010/11)

Already during the production and performances of *Gewölle* – a composition for dance, voice, violoncello, live electronics and rope jumpers – the software reached its borders and narrowed the possibilities of the performance and process of composition. The impossibility of reorder the events freely in time (jumping was possible only to some marked positions, scrolling was to slow and risky), technical (fingering) performing problems changing several parameters simultaneously, jumping between *static* and *bus* (former called *global*) parameter and difficulties in playing polyphonically forced me to completely revise the software during the process of work on my piece/complex of pieces *Nachtsicht* for live electronics, optional narrator, optional percussion or piano.

The first realized versions of *Nachtsicht* saw two channel electronics installed at exhibitions together with oil paintings. These versions were interpreted by myself at each of the exhibition spaces, recorded and played as a 10 min long loop. Later developed versions are live electronic performances together with narrator and/or percussion or piano. Improvisations with the material (recordings of painting sessions, traffic sounds of cities at night and with the software Modalys virtually calculated sounds like hit and brushed giant canvases, footsteps and brush strokes applied to bridges etc.) alone and later together with the narrator/poet developed a music, coming close and closer to my musical intentions, showing ever clearer musical structures.

Originally composed in the first version of my software which easily allows to create complex structures, these structures were transcribed into performing prescriptions, allowing to start every single event with a specific key.

The new software uses now as an event any SuperCollider function, instead of OSC-messages or the formerly used function for manipulating OSC-messages, but can contain them too. It allows for functions to changes global variables, start algorithms, open windows, do anything possible in SuperCollider. These sets of functions are bundled in scenes. Each scene starts with a function itself, e.g. starts synthesizers for effects, reorganizes sound buffer, resets or sets counters of events of each function, and activates a set of functions which can be started with a MIDI-keyboard (or at the graphical user interface).

The graphical user interface shows now *static* and *bus* parameter at the same time which can be set with mouse, joystick and/or MIDI-controllers. This allows for a flexible fingering, finding best combinations for changing the parameters.

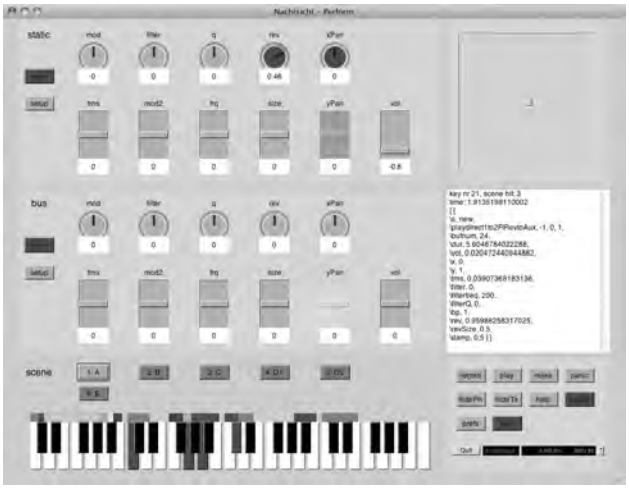

Figure 12. *Graphical user interface, second version, for more flexible performance*

The design of the score: After creating a score representing the sound – with beautiful images, but almost impossible to play from it – an action score was developed, showing the keys triggering the functions in a chromatic system, the rhythm (with a main pulse of 7 secs, derived from the brush stroke rhythm of a recording of a oil painting session) notated in slightly modified traditional rhythm notation, with some newly added symbols for fader movement, spatialization etc.

The performance of the live electronics results in a quite virtuosic use of the joystick (right hand), the MIDI-keyboard (right and/or left hand) and the MIDI-controllers (right and/or left hand) of very slow but polyphonic structures.

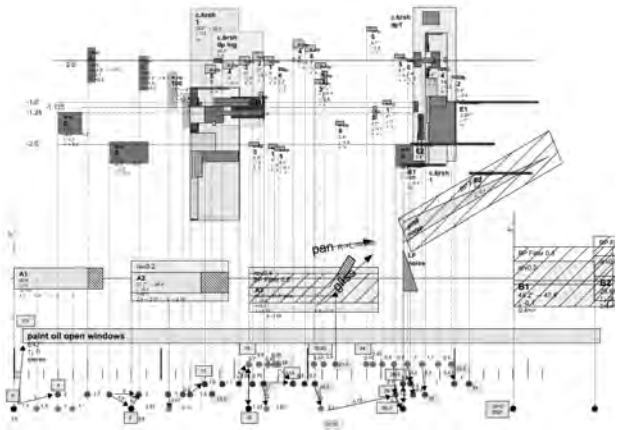

Figure 13. Sound score of live electronic part of *Nachtsicht © Edition Juliane Klein*

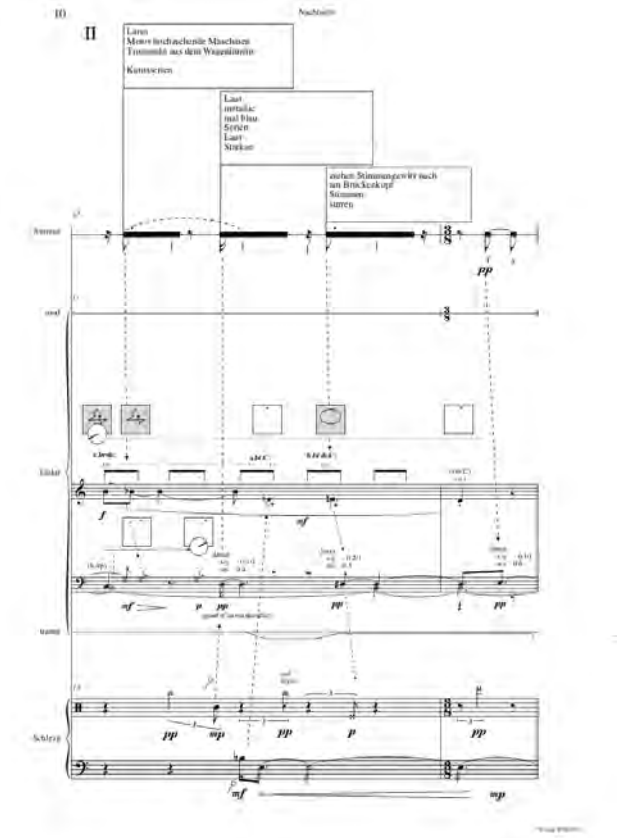

Figure 14. *Nachtsicht – version for live electronics, speaker and percussion, p.6 © Edition Juliane Klein*

The Controller

A 49-key MIDI keyboard was chosen as a trigger for the functions, because a musician can easily jump between the keys and not only switch them on, but also control the velocity parameter which is used in most cases to control the volume of the event. A keyboard is a versatile controller, easily to understand for almost every musician and, like the joystick, easily to purchase.

MIDI-controller, slider, knobs are very useful to manipulate several parameters simultaneously. They allow in combination with the joystick – used for more sensitive settings and spatialization – several possibilities of fingering. To perform this piece, several ways of fingering should be tried out to find the most suitable combination for each part.

The joystick is used as in the first version of the software with all its buttons etc.

Perspectives

Apart from looking forward to rehearsals and performances of *Nachtsicht* with several musicians performing the live electronics and learning from their experiences, several steps are planned to add and revise in the third version of the software environment:

Extension of the Graphical User Interface:

- Easy Registration of Controllers (MIDI, Joystick etc.) and assignment to the parameters within the GUI in combination with the Controllers.
- Input of the function/bundles of function and assignment to keys/bundle of keys within the GUI in combination with the controller keyboard.

Including time factor - like in the first version, without loosing the flexibility of the second version:

- Adding the possibility of scheduling of the functions. Assignment of the time data to them manually, algorithmically calculated, or recorded during playing/improvising.
- Automatically playing and rendering to sound files of the scheduled functions.

Enable cross-platform OSC messaging.

Create of a new score format including more sound information in the performance score.

Once the revision of the software is finished and a detailed documentation available, every composer could use this environment to create and improvise an electronic composition fixed in performance descriptions and a list of SuperCollider functions and/or OSC-messages - using his own SuperCollider libraries, synth defs and functions and/or controlling other OSC capable applications. Every musician can use this environment to perform these compositions.

References

Adorno, Theodor W. (1984). Wilhelm Furtwängler. *Musikalische Schriften VI*. Frankfurt am Main: Suhrkamp, pp. 468-469

Adorno, Theodor W. (1984). Zum Problem der Reproduktion. *Musikalische Schriften VI*. Frankfurt am Main: Suhrkamp, pp. 440-444

Adorno, Theodor W. (2001). *Zu einer Theorie der musikalischen Reproduktion*. Frankfurt am Main: Suhrkamp

Benford, Steve. (2010). Performing Musical Interaction: Lessons from the Study of Extended Theatrical Performances. *Computer Music Journal*, 34:4, pp. 49–61, Posted Online November 30, 2010, Cambridge: Massachusetts Institute of Technology. Retrieved from http://www.mitpressjournals.org

Boulez, Pierre. (2000). *Leitlinien: Gedankengänge eines Komponisten*. Kassel: Bärenreiter

Cage, John. (1997). *Dear Pierre - cher John: Pierre Boulez und John Cage; der Briefwechsel*. Hamburg: Europäische Verlagsanstalt

Danuser, Hermann., Mauser, Siegfried., et. al. (1992). *Musikalische Interpretation*, (Neues Handbuch der Musikwissenschaft 11). Laaber: Laaber

Essl, Karlheinz. (2007). Wandlungen der elektroakustischen Musik. *Zwischen Experiment und Kommerz. Zur Ästhetik elektronischer Musik,* (ANKLAENGE. Wiener Jahrbuch für Musikwissenschaft 2), Wien: Mille Tre. Retrieved from http://www.essl.at/bibliogr/wandlungen-elak.html

Lachenmann, Helmut. (1996). *Musik als existentielle Erfahrung: Schriften 1966-1995*. Wiesbaden: Breitkopf & Härtel

Schaeffer, Pierre. (1967). *Solfège de l'objet sonore*, Nouvelle Édition 1998-2005, Paris: Institut national de l'audiovisuel

Stockhausen, Karlheinz. (1964). *Mikrophonie I*. Wien: Universal Edition

Varga, Bálint András. (1996). *Conversations with Iannis Xenakis*. London: Faber and Faber

Wagner, Richard. (1869). *Über das Dirigieren*. Leipzig: Insel, digitized by the Internet Archive in 2010 with funding from University of Toronto, copy of University of Toronto, Retrieved from http://www.fullbooks.com

Wilson, S., Cottle, D., & Collins, N. (eds). (2011). *The SuperCollider Book*. Cambridge, MA: MIT Press

Xenakis, Iannis. (1992). *Formalized Music*. Hillsdale, NY: Pendragon Press

[Abstract in Korean | 국문 요약]

실행과 직관, 우연성: 라이브 전자음악의 음악적 구조에 대한 탐구와 해석

페터 간

이 글에서 독일 작곡가 페터 간Peter Gahn은 그가 개발한 실시간 전자 음악을 위한 도구를 발표하고자 한다. 이것은 수퍼콜라이더SuperCollider를 이용하여 만들어졌으며, 게임용 조이스틱과 미디 콘트롤러를 사용하여 앙상블의 단원이나 하나의 연주 주체로서 음악의 개념, 짜임새 및 연주에 대해 탐구하고 이를 발전시키기 위해 만들어졌다. 예컨대, 작곡과 그 해석 과정에 있어서 구조적 헤테로포니의 개념과 직관 및 우연성의 측면과 같은 미적, 음악적 이유들은 OSC-message 목록과 수퍼콜라이더 기능들의 처리를 기반으로 하는 기술적 환경의 창출로 이어지게 된다. 이 도구는 복잡한 구조를 생성하기 위한, 작곡 과정의 미시적 또는 거시적 즉흥 연주를 위한, 그리고 음악가로서 또는 앙상블의 일원으로서 주어진 상황에 유연하게 대처하고 전자음악을 해석하기 위한 가능성들을 제시한다. 이 도구의 개발과 그 사용은 페터 간의 2005/2006년작 ≪ink, colours and gold on paper Ⅱ+Ⅲ – surroundings 1+2≫와 2010/2011년작 ≪Nachtsicht≫에 잘 나타나 있다.