# Kosmas Giannoutakis

## Attractive Correlations

Concert - Installation (2017)

# PROGRAM NOTE

## ATTRACTIVE CORRELATIONS

Concert installation for variable number of instrumentalists, microphonists, audience and computer music system (2017)

"Attractive Correlations" explores a connectionist paradigm for music creation through a hybrid presentation form combining concert and installation. The concert hall is transformed into an acoustic arena by a multi-loudspeaker setup, in which instrumentalists, microphonists and audience may move about and interact through the medium of sound. The computer music system dynamically generates unpredictable sonic streams and diffuses the sound of the instrumentalists by means of digital networks inspired by neuronal processing. The microphonists react to the sonic activities of the instrumentalists and the audience by approaching them and pointing their microphones towards the sound sources of interest. Sounds from audience members perturb the fragile and delicate equilibria in the generative local sub-networks, while the sounds of the instrumentalists modulate some plasticity parameters of these networks, modifying their generative character. The music emerges from the improvisatory interactions of all human agents, with the instrumentalists and adventurous audience members trying to win the favor of the microphonists and thus gain influence over the sound generation and diffusion by the computer music system.

# TECHNICAL REQUIRENMENTS

The concert-installation is adaptable to various venues and the technical requirements can vary. For a public presentation, a minimum technical setup is required which includes:

- Flat performance area of at least 100 square meters
- 16 full-range loudspeakers (no sub woofer)
- 2 condenser small-diaphragm microphones with super-cardioid polar pattern
- 2 clip instrument microphones
- Wireless audio system with 2 pocket transmitters
- Mixer which supports 16 outputs and 4 inputs
- Audio interface that supports 16 outputs and 4 inputs
- Computer with a quad-core processor, 2.5 GHz clock-speed, 4 GB RAM memory.
- Linux operating system, Pure Data (Vanilla version 0.47.1), iem_tab library, JACK Audio Connection Kit
- 20-40 Chairs, 2-4 small tables or stands
- 2 spotlights

This minimum setup applies for a performance with 2 microphonists and 2 instrumentalists. The 16 loudspeakers are divided into the "sky" and 2 "islands". The "sky" is consisted of 8 elevated speakers (more than 3.5 meter) and can have variable heights and directions. An "island" requires a hanged microphone (reaching 5 cm distance from floor) with a spot light and 4 circularly positioned loudspeakers (up to 2 meters height) directed to the microphone.

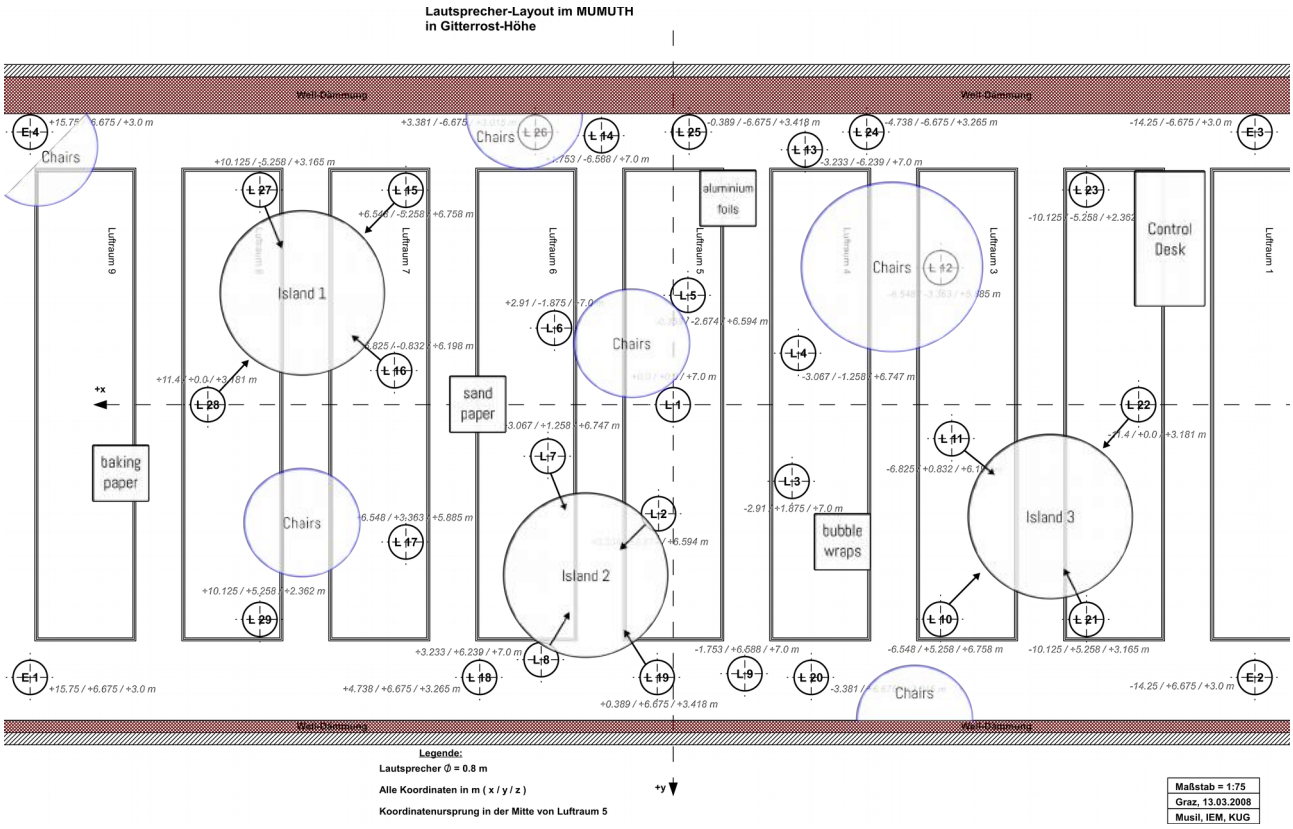
The concert installation can be extended with more loudspeakers for the "sky", more "islands" with microphonists and more instrumentalists. An additional "island" with a microphonist would require 4 more loudspeakers, 1 more microphone and spotlight. An additional instrumentalist would require 1 more clip instrument microphone and 1 more pocket transmitter. These three ways of expansion are not interdepended and there could be combinations of e.g. 2 instrumentalist, 2 "island" and a "sky" with 32 speakers or 5 instrumentalists, 2 "island" and a "sky" with 8 speakers or 2 instrumentalist, 4 "island" and a "sky" with 16 speakers. All these extensions should be supported by appropriate mixer, audio interface, computer and wireless audio system.

An "island" with a microphonist.

## Space Setup

The loudspeakers of the "sky" as well as the "islands" are positioned in a way that cover all the performance area and if possible not by forming any perfect shapes or symmetries. The chairs are positioned in circular or semicircular arrangements, facing the exterior of the circle. The tables-stands with sounding objects for the audience are positioned also in a nonuniform way. The concert-installation could be adapted also for non open halls, having the "islands" installed in various rooms and the "sky" in corridors or different rooms.

A presentation of the concert-installation took place at 3rd of March 2017 as part of the Junge Signale festival in MUMUTH György-Ligeti-Saal in Graz. The 32 loudspeaker system of the hall were divided into a "sky" with 20 speakers and 3 "islands" with 4 speakers each. The presentation included 3 instrumentalists performing the violin, alto saxophone and bass clarinet.

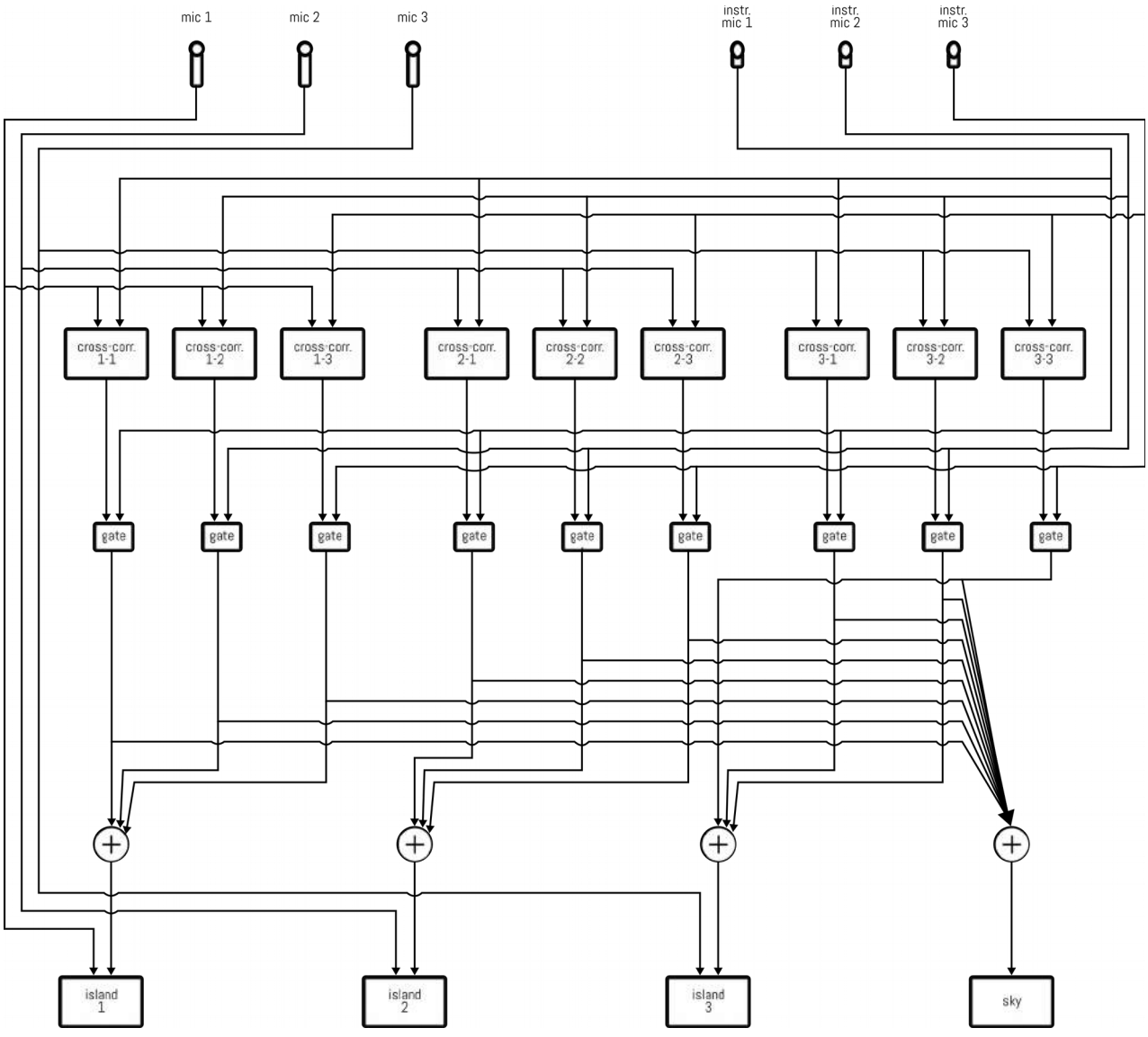



Floor plan of the György-Ligeti-Saal with the loudspeakers, “islands”, chairs and tables outlined.

Sitting audience members.

## Computer Music System

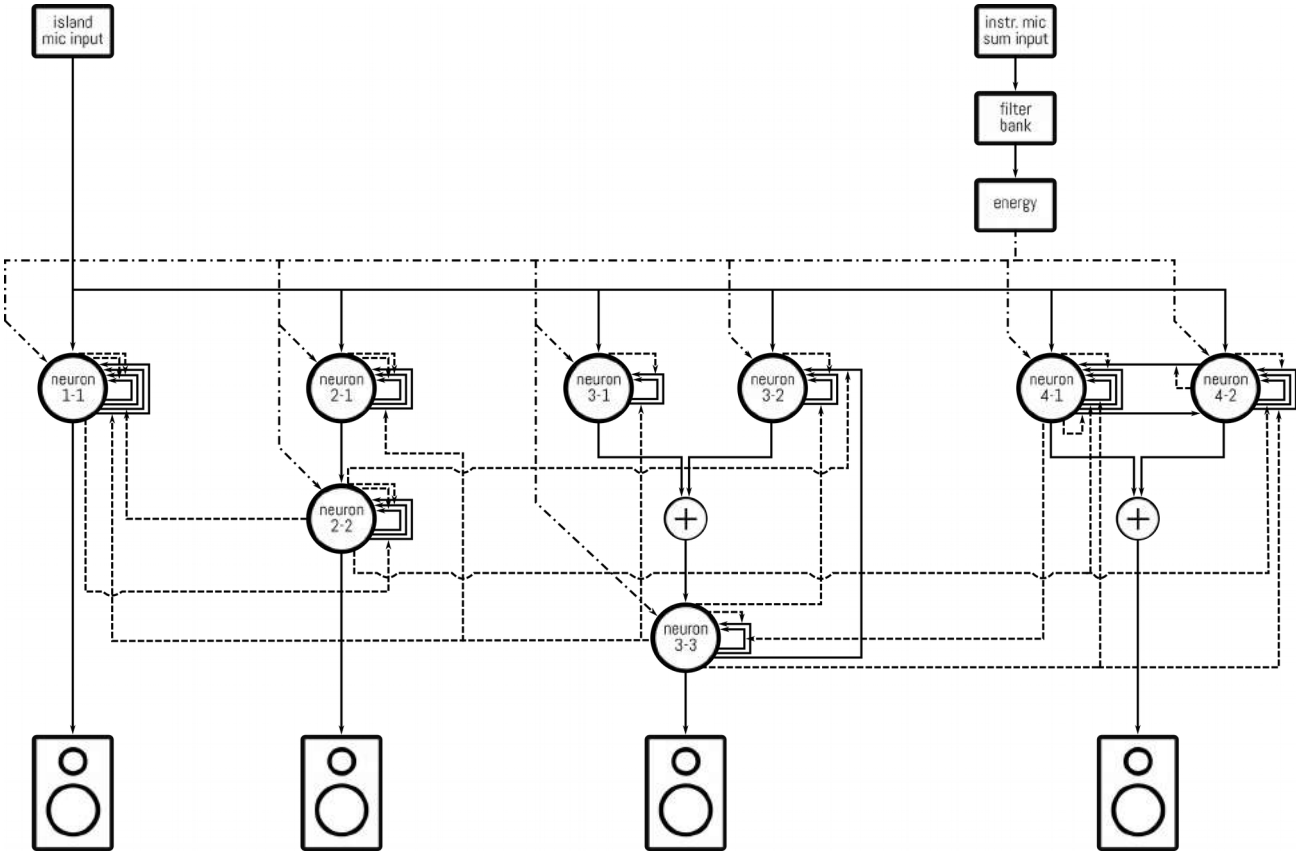
A central function the computer music system continuously performs, is a windowed real-time cross-correlation between the audio signals of the "island's" microphones and the instrumentalist's microphones. The low-pass filtered energies of the cross-correlated signals modulate the amplitude of the corresponding instrument microphone signals, working as a sort of continuous gate. The software module for each "island", receives the audio signals from the corresponding microphones and the sum of the respectively amplitude-modulated instrument microphones signals. The software module for the "sky", receives the sum of all amplitude-modulated instrument microphones signals




Flow diagram for the cross-correlation operations and routings.

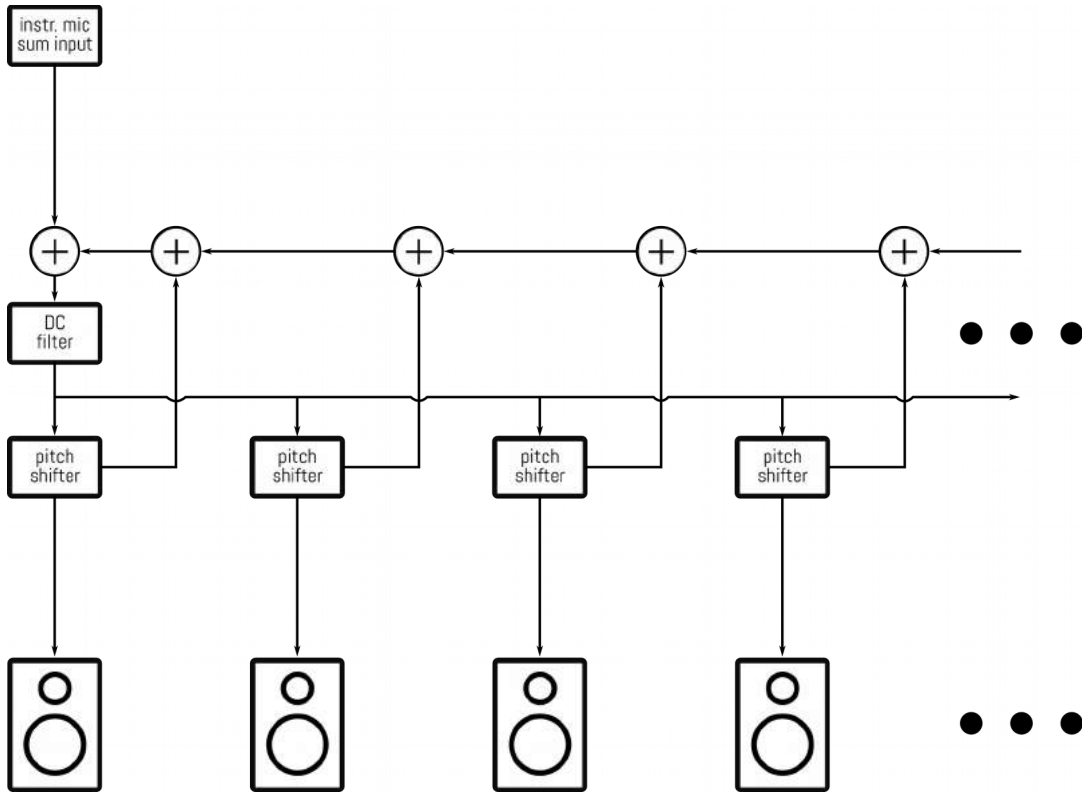
The software module for each "island", is an interconnected network inspired by neuronal processing. The incoming signals in a digital neuron are mixed, passed through a DC-filter and compressed through a look-ahead RMS detector. The output is fed back to the same neuron or to other neurons, forming recurrent network topologies. The connections or digital synapses, are time-varying delay lines, implemented as all-pass fractional filters. The low-pass filtered energy is extracted from the neurons and mapped to the delay-times in the digital synapses (dashed lines in the diagram). The neurons modulate their own synapses (self-modulation) or other synapses in the network (neuromodulation). This technique is inspired by biological neuromodulation which is the physiological process by which neurons use chemicals to regulate diverse populations of other neurons, in order to achieve lifetime learning abilities.

The incoming sum of the modulated instrument microphone signals is analyzed by a filter bank, and the low-pass filtered energy is extracted for various frequencies. These energies modulate some neuron parameters and some second-order synaptic plasticity parameters of the synapses in the network (dash-doted lines in the diagram).




Flow diagram of "island" digital network topology used for the Mumuth performance.

The software module for the "sky" is a modified feedback delay network. Each delay line is implemented as a classic rotating-tape-head style pitch shifter. The pitch shifted signals are routed to the loudspeakers and fed back, mixed with the incoming signal and pass through a DC filter. This modified feedback delay network uniquely expands every incoming sound in time, space and frequency. The transpositions and maximum delay time of the pitch shifter can be arbitrarily composed for every performance. The maximum delay time should be at least 30 seconds. For the performance in Mumuth, equidistant intervals of perfect fifths (ratio 3/2) for both time and transposition were used.




Flow diagram of the modified feedback delay network used for the "sky".

Each "island" and the "sky" software module run in different Pd instances, utilizing a different processing core. They receive the audio inputs from the cross-correlation patch, which runs also in a different Pd instance, through the Jack server audio kit. With more powerful computers, more complex topologies may be implemented for the "island" software modules, resulting to more variable behavior. Different network topologies can be implemented for each "island". For the Mumuth performance, the same network topologies for all "island" was implemented, having different loudspeaker routings.

## Performance Rules

The performative agencies that can interact with the spatialized computer music system, are the microphonists, the instrumentalists and the audience. The microphonists and instrumentalists learn and practice their performance rules in the rehearsals, while the audience members discover their role in the public performances.

### Microphonists

The microphonists are responsible for the musical behavior of their "island". They are considered as special "musical neurons" that modulate the position and direction of the microphones, which are considered also as special "musical neurons". A change in position and direction of the microphone alters all the weight, time-delay and filter parameters in the local network. The microphonists can move freely about their responsible "island" and improvise gestures that provoke musical responses. Some position/direction spots, drive the generative network to recognizable audible states. The microphonists

have to find and learn where such spots can be located and revisit them freely in their improvisation in the public performances with audience.

Microphonists performing in their “islands”.

If audience members produce sounds near an “island” with the exhibited sounding objects, the responsible for this “island” microphonist can go nearby and point the microphone towards this external sound source. The incoming sound will perturb any dynamic behavior of the generative network, while it will be amplified and filtered at the same time. The microphonists can also ignore external sounds from audience member if they find them musically inappropriate at the specific moment.

The same situation can occur with the instrumentalists. The difference is that the instrumentalists carry microphones in their instruments, which allows the cross-correlation algorithm of the computer music system to be performed. If a microphonist approaches the instrumentalist(s), then the incoming signal(s) will get access to the diffuse network of the “sky”. At the same time it will modulate some second-order plasticity parameters of the generative network, modifying its generative character and changing the recognizable audible spots. Multiple instrumentalists can approach an “island” at the same time and the microphonist have to decide which incoming sound sources are musically more relevant for their “island”, in order to point at the proper direction. The microphonist can improvise freely with the instrumentalist(s), going very close to the instrument (e.g. inside a bell of a wind instrument), moving the microphone in various speeds across the instrument(s) or alternate microphone positions/directions between different instruments or loudspeakers.

The microphonists can perform two types of symbolic gestures for the instrumentalists. When they are alone in their "islands", they can let the hanged microphone swing freely while they stay in a close distance. This sign is an invitation for the instrumentalists to come and interact with the "island". The microphonists can perform this sign if they feel that their networks need some character modification, so that they can attempt new improvisatory actions. The second sign can be performed when instrumentalists are inside the islands and the microphonist wants them to leave. The instrumentalist can point the microphone very close to a loudspeaker for a prolonged time. This gesture will cause a characteristic audible stability in the generative flow.

There will be situations where the "sky" will be very loud, so that the generative streams in the "islands" are not audible anymore. When such situation occur, the microphonists can abandon their "islands" for a while and turn themselves into listening agents (like audience members). They can return to their "islands" when the "sky" calms down the the generative streams become audible again.

Instrumentalists

The instrumentalists are considered as special "musical neurons" that can move around the hall (self-modulate), integrate the incoming sonic activity (listen) and activate their dynamic response (play their instruments). Only the transportable musical instruments can be used and the non-transportable (piano, harp, etc.) are not eligible for this concert-installation.

The instrumentalists try to play musically in every position they are situated in. They move around in order to find suitable spaces that musically fit their improvisation. All other agencies ("island", "sky", audience members, other instrumentalists) offer possible spaces for musical interaction. If the musical activity of the instrumentalists attracts the microphonists, their gestures will be diffused by the "sky" and spread through the concert hall.

The interaction with other instrumentalists can have a cooperative or competitive character. In the cooperative mode, two or more instrumentalists approach each other and form a small ensemble that can be approached by the microphonists. These ensembles have more chances to be picked up, modulate an "island" and grant access to the "sky". In the competitive mode, two or more instrumentalists approach an "island" from different directions. They keep their distances and try to win the favor of the microphonist with their improvisatory skills. In these case the instrumentalists have less chances to be picked up but exclusiveness if they succeed in winning the microphonist.

Another interesting side-effect the computer music system allows, is that instrumentalists can grant access to the "islands" and the "sky" from distance. This is possible because the cross-correlation algorithm runs continuously for all "island" and instrument microphones. If a microphonist and an instrumentalist are engaged in an close interaction, another instrumentalists outside the "island" can try to pitch-follow the improvisation of the instrumentalist inside the "island". The "island" microphone signal and the instrument microphone signal inside the "island" will correlate in a high degree, since they are very close. The instrument microphone signal outside the "island" will correlate also in some degree because of the pitch proximity. This situation is referred as "hacking". It is even possible for the instrumentalists to "hack" in some degree the generative stream of the "islands" alone.

Saxophone player picked up by a microphonist.

Violinist and clarinetist playing competitive.

Saxophonist, violinist and clarinetist playing cooperatively.

Sounds from audience members picked up by the microphonists can only perturb the generative stream. If the instrumentalists approach such interactions without or with very subtle playing, then these sounds will be recorded by both microphones and get cross-correlated. This is the only way of letting sounds from audience members to modulate an "island" and get diffused into the "sky".

At any moment, the instrumentalists can switch to a listening mode and behave like a listening audience member. These listening intervals can be as long as the instrumentalist finds appropriate, until a suitable space for improvisation is found.

Audience members picked up by microphonists. In the second picture the saxophonist help the sound of an audience member to be entered into the "sky".

Audience

The audience members are considered as special "musical neurons" that can sit in the chairs and listen (non-self-modulation, non-activation), move around and listen (self-modulation, non-activation), move around, listen and make sounds with the exhibited objects (self-modulation, activation) or stay in a fixed position and make sounds (non-self-modulation, activation). Their role is uncommon for a concert situation and the following text is provided together with the program note at their entry to the concert hall, in order to introduce their new role:

*From this moment, you are part of a sonic ecosystem. Feel free to move about, find captivating listening spots and conduct your own listening expeditions. You can contribute to the sonic discourse with sounds that you can produce with the exhibited materials. You can rip apart baking papers, crumple aluminum foils, brake bubble wraps or rub sand papers. Do that in your favorite listening spots or while moving. If the microphonists and instrumentalists realize your creative contribution, they will come close to and play with you. This will allow your sounds to enter the computer music system and affect the dynamic generation and diffusion of sound. Try to discern the global sonic tendencies of the ecosystem and act according to them or against them. Give space to other performers for their actions and listen or infiltrate in current interactions and play along with or disturb them.*

Audience member disturb the generative stream in an abandoned "island".

## General Remarks

For the rehearsals, isolated scenarios should be tried out (e.g. rejected pick up, cooperative/competitive play, "hacking" etc). The final and general rehearsals should be free, letting the agents acting on their own will. Any planning of the dramaturgy should be avoided, although it could be applied in the case of short performances (up to 30 minutes).

The concert-installation should be ideally presented as a non-stop installation throughout the whole duration of a festival. It should be accessible 24 hours a day by audience members and musicians who would like to interact and play with the system. At specific announced dates and times, performances as concerts should be scheduled. These concerts can take place at any time of the day and night. They should be rehearsed performances with experienced microphonists and instrumentalists. The performers should enter the hall, start the performance and after reaching a planned situation, leave the concert hall. The planned situation can be a time interval or performative situations (e.g. when 3 competitive/cooperative interactions occur, or 5 "hackings", or when the audience members are not interacting for 10 minutes etc.). There should not be any applause events from the audience for the beginning or the end of a performance.

Performers and audience member exiting the hall without an applause event, with the computer music system running.

http://www.kosmasgiannoutakis.eu/attractive-correlations/