# *Wires's*

## PRESENTATION

Studio recordings at: https://soundcloud.com/nicola-baroni/wires
https://soundcloud.com/nicola-baroni/shamans-wires
Live video at: http://www.youtube.com/watch?v=-E1B0DQmNFA
Performance instructions at: https://www.dropbox.com/s/evxyhf1obs487qx/Shaman-instructions.mp4?dl=0

*SHAMAN'S WIRE*

*Shaman's Wires* is a collaborative project involving the composer-vocalist Angelina Yershova and the cellist-composer Nicola Baroni.
The project, in its concert based facet, develops a 50' lasting macro-form, whose narrative unfolds through improvisation.
The stage setup is arranged as 2 parallel extended instrument assemblages:
-female voice and ethnic percussions *(Bodran)* embedded in a live electronic environment
-prepared cello, augmented through interactive live electronics equipment.
The 2 personal stage equipments are independent augmented instruments partially interfacing through technology.

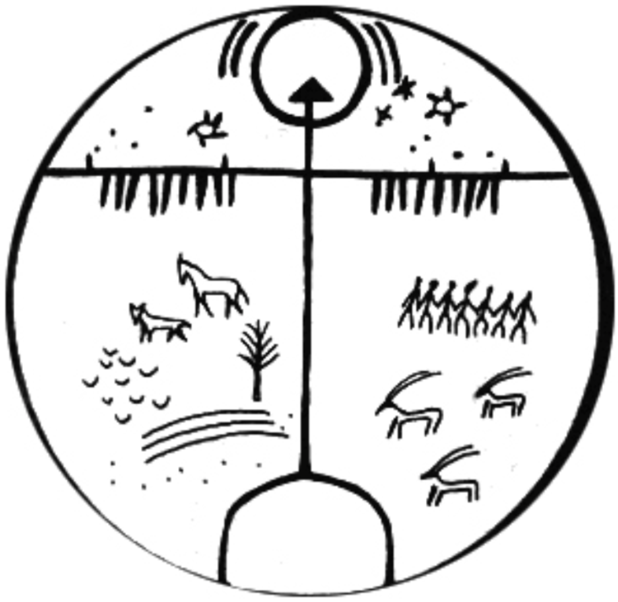


Fig.1 Shaman's wire

Fig. 2 Angelina and Nicola

Yershova's background as a native Kazakh contemporary composer, and Baroni's position as a cellist involved in computer interactive composition, fashion a cross-cultural project based on ethnic composition, cello extended techniques and Live Electronics.

The performative role of the cello is centred upon new sound vocabularies absorbing Kazakh sounds and techniques. The actions of the electronics disembody, helping to reformulate the sounds of the cello with respect to its native Western practices, and the same happens on the other side for the Asian ethnic instruments.
Live Electronics, being unconventional in terms of practice and music "grammars", act as a mediating open space between Western and Central Asian approaches to contemporary music.

SHAMAN'S SOUNDS

Syncretism, the state of "being both", is treated as an action of preserving traditions (Eastern and Western as well), putting into question, whilst developing, their native motivations to make music.

On the other hand the electronics allow the mutation of the acoustic sounds onto imaginary soundscapes, moving towards the shared compositional contexts animating the concert.

"Being both" is an actual shamanic state, and in fact the animistic Kazakh conception of music maps sounds onto a transcendent and therapeutic space by which physical energy is charged: in a word, music is more a spiritual practice than a form of "Art".

Inside our project the Western concert-based rite meets the Central Asian dimension of sound as meditation, soundscape and self-emergence, through the mediation of the electronics.

The storytelling macro-form of the whole concert is traced upon the metaphor of the shamanic harmony with the energies of the upper world, giving power to transform lower energies.

Originally the word *Shaman* (from the sanskrit S*aman*) means chant, which is a primary healing practice; and our music is in fact a broad exploration of the harmonic chant techniques, through acoustic and electroacoustic instruments.

SOUNDS

The sweeping overtones emanating from extremely low pitches which distinguish the Kazakh-Mongolian singing practice, are boundaries of a corporeal resonance where sound meets mantra.

The tension between these simultaneous vibrations, obtained through special body techniques (the shaman voice, or its corresponding instrumental sounds) reveal different corporeal energy states, tuned to existential dimensions intertwined with health, balance, ethics, esoteric knowledge, relationships with nature and ancestors.

Raucous vocalisations, besides any music representations, are symptoms and means to dissolve energy blockages and trauma, breaking up dense energies through sound rattles.

On the other hand the music interrelation with tunes, melodies and note-scale systems are not primarily viewed as means for composition nor perfect imitation, but as sound links with universals resonating within our energy-body. In this context rhythmic patterns show the emergence of interior motions (leading to focussed textural densities), rather than being a form of metered time division.

CELLO AND *KYL KOBIZ*

*Kyl Kobiz* is the principal bowed string instrument of Kazakhstan: generally it is not bought from a luthier, but it is assigned to the musician by a shaman, as a sounding entity tuned to the inner personal qualities and relationships with the environment and the ancestors. Being more than a tradition, these cultural aspects persist inside the Kazakh classical and contemporary music community.

http://www.bukhara-carpets.com/kazakh-musical-instruments.html

The role of the *Kyl Kobiz* is represented inside this project by the cello through a specialised research involving extended techniques and interactive live electronics.

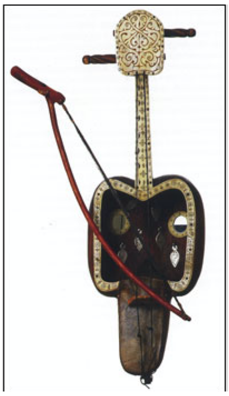


Fig.3 *Kyl Kobiz*

*WIRE'S*

The interactive system here proposed has been natively built as the central part of the whole duo *Shaman's Wires*. The composed interactions called *Wire's* behave musically in a hyper-cello fashion, and can be considered both as an autonomous solo, as well as a prominent cello section maybe accompanied or dialoguing in duo.

Any further performance of *Wire's* could be independent of this original program, developing totally free and autonomous choices by the cellist.

The interactive system *Wire's* "listens to" and interprets the cello timbre as it is played inside the performance, and sensitively responds with electronic sounds shaping different levels of attunement, abstraction and energetic intensity with respect to the cello sound. **The cellist structurally and interactively organises and influences the electronic evolutions of the solo through music segmentations and timbre** (whose features feed the composition algorithms, operatively following the intentions of the cellist).

The electronic sounds have a perceptual (as well imaginary) connection with the Kazakh music styles, and their characters are musical resonances responding with their own qualities and autonomy to the cello input. The electronic system is organised as a subliminal self-organising sound entity. Its junctions cross-resonate with the energetic and reflexive music intentions of the cellist, as if they were arousing *chakra* vortexes.

The performance develops as a **free improvisation**.
No playing instructions are given, the laptop screen application is displayed for settings, the electronic interaction will be conducted by listening.

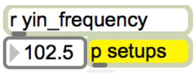
The following performance explanations are structured as:
-Ethnic sounds and cello extended techniques
-Software composed interactions
-Augmented cello improvisation and performance

# ETHNIC SOUNDS

Even if each performance of *Wire's* could be independent of this program, the following notes offer guidelines for a faithful performance with respect to the native Western-Kazakh electroacoustic interaction. The notes regard styles and cello extended techniques, in accordance with the performative analysis here documenting possible symmetries between cello and K*yl Kobiz*, as they were found through music rehearsals.

1) The cello will be tuned:

A flat - slightly lowered = frequency 206<br>
A flat - slightly lowered (1 octave below) = frequency 103<br>
G - 1/6 of tone higher = frequency 100<br>
C sharp - slightly lowered = frequency 69




Tuning can be afforded through the fundamental frequency monitor located inside the the bottom left section of the laptop screen (turning on the DSP).

Fig.4 Tuning monitor

This tuning permits:
- A more relaxed and edgeless timbre throughout the high ranges (the upper strings are lowered).
- A more pushing sound in the low ranges (the lowest string is higher).
- A middle range mainly producing faint resonances, giving rise to microtonal beats.

The division of the open cello strings in these 3 pitch regions engages with:
-strong sustained low drone tones expanding to a preferential detuned 5th double-stop
-higher melody ranges springing from the low *bordone*, but passing through the deconstructing resonance of the middle strings
-higher tones show a heterophonic attitude because of the role of the middle strings
-middle strings in addition help to create a secondary higher drone, or a secondary inner voice (more or less centred one octave below)

2) Low sustained tones are central to the performance and they can be:
- modulated in timbre (full tones, sweeping-sibling bowing conductions, harsh vs. slow-increasing modes of attack, gradations of grattato styles, sul-tasto -> ponticello zooms)
- enhanced through low double-steps
- the 3rd string allows for natural harmonic sweepings recalling the Asian harmonic chant
- the ordinary open-string style can occasionally be alternated with different sustained pitches (by left hand fingering)
- implicit rhythmic patterns vs. drones are means to structure the improvisation

3) Higher melodic sketches can be designed through short intervallic fragments and ornamentations around few selected pitches
-melody should be highly fragmented, and interleaving with low and middle open string resonances
-melodic fragments are often performed through left finger half-pressure, quick glides, nail lateral contact with the high string
-ornamentation is microtonal, gliding with the same finger, occasionally extending to larger pitch-tremolos up to a minor third
-the middle strings offer the opportunity for secondary voices, intermediate drones, scraping accompaniments, differentiated *bariolages*

4) Bow-string noises are more important than melodic fragments:
-extreme bow pressure, pitch-timbre clusters, fast-extended left hand glides and sweeping harmonics through different bow pressures
-timbre shaped through a rich vocabulary of bow roughness (half-pitches, fast tense tremolos, small pressure distortions, unstable bow-bridge distance)
-the rotational bow activity through the strings increases beats, rough note attacks, collateral bow-noises, re-bouncing resonances

5) The irregular melodic trend does not preclude occasionally developing a tune-like melody, or shaping implicit rhythmic divisions
-a free unmetered performance can alternate with background rhythms conceived in an additive fashion (similarly to the Indian *Tala*)
-rhythms can be freely chosen within slow or faster motion, strictly mingling binary and ternary impulses in cyclic patterns (i.e. 4-4-2-3-2, 3-2-3-4, etc.)
-the additive rhythmic conduction frees the performer from the need to follow a fixed meter, the rhythmic patterns can be dynamically changed during the performance

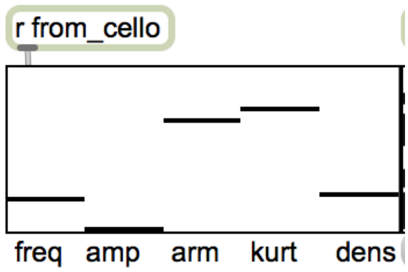
6) A small set of external objects preparing the cello is recommended
-copper thin wires (wearing low or/and high strings) for rumbling effects (raising intermodulations and detuning the cello spectrum)
-small metal rings (such as key rings) fixed around the low string, rhythmically rattling against the cello bridge
-small clips attached to mid portions of the strings in order to block the string vibration at special nodes: the clip positions can be modified during the performance
These objects need to be easily fixed/removed during the performance

A sequence of predefined time segments needs to be planned in advance, at least for the initial 2'-3' in order to shape an organised sound interaction with the electronics.

# SOFTWARE INTERACTIONS

The electronic system develops music by means of a Self Organising Map. SOM is an unsupervised Machine Learning technique based on the Adaptive Resonance Theory (ART)[1].
The software program reads the continuous stream of **5 cello timbre descriptors,** and consequently behaves in response of how and when the music created by the cellist is performed.
At the beginning the SOM progressively expands its mapping space from an initial point zero.
Subsequently the SOM automatically fixes some nodes (relative to the cello input articulations and time evolutions), until it fills its mapping space.
The self organised mapping, even if apparently abstract, hence depends on the cello timbre and the music segmentations as they are performed during the initial phrases of the solo.

CELLO TIMBRE
The system extracts the real-time analysis of the following cello features:
**frequency, amplitude, periodicity, spectral kurtosis, timbre density.**
-frequency individuates the pitch registers
-amplitude tracks the sound global volume intensity
-periodicity regards pure vs. noisy sounds
-kurtosis reveals if the timbre is resonant vs. *ordinario* vs. compressed
-density tracks timbre intensity (full tone) vs. airy timbre (i.e. sul tasto, light bowing, pizzicato)




The fluctuations of these 5 sound qualities are tracked in order to detect their evolutions along a time span of 2.5 seconds.
They are computed as continuous values between 0. and 1.
Their streaming values are sent to the SOM.

Fig.5 Timbre cello descriptors

If the cellist plays contrasting episodes at the beginning of the solo, the SOM will be faster to organise its mapping space. On the contrary, slow initial cello transitions showing longer music segmentations of similar timbre contents will slow down the Machine Learning phase.
Slower initial transitions will be beneficial to the consistency of the automatic mapping process.
The cellist cannot control the detail and the timings of the SOM, as the system is self-regulating.
The cello improvisation therefore creates an indirect remote dialogue with the system. Rather than a strict instrumental loop of control-reaction upon each effect, the cellist will be focussing on high-level decisions involving the global music behaviour of the interaction.
In a sense the electronics behave more as an “alter-ego” than an objective instrument.

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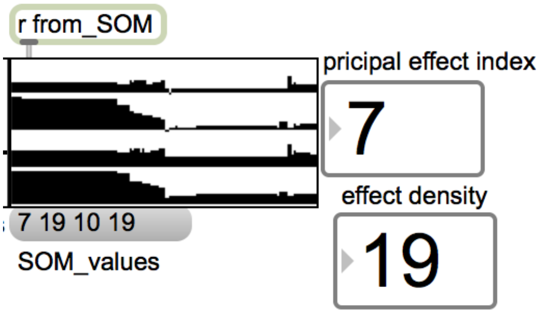
[1] B.D.Smith, G.E.Garrett, 2012
http://www.nime.org/proceedings/2012/nime2012_68.pdf

SELF ORGANISING MAP

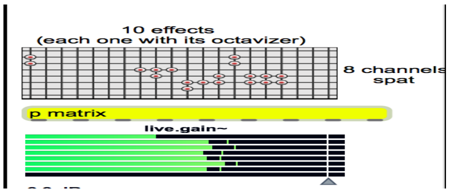
The SOM, taking as input the stream of the 5 cello timbre descriptors, creates **nodes of cello-timbre similarity**. The system organises its mapping space by identifying cello timbre characters (as inputs), and creating (as output) a code related to the **sequence of occurrence of these timbres,** as they were performed by the cellist during the initial part of the solo.




*Wire's* is structured in order to make the SOM progressively generate output numbers from 0 to 19 in 2 x/y dimensions during the initial part of the solo performance (the Machine Learning phase). **The output numbers X are mapped to the electronic effects, the output numbers Y are mapped to the density of the electronics** (how many effects are running in parallel).

Fig.6. Self organised mapping outputs

The figure above shows, as an example, a situation in which the mapping space Y (density of effects) was filled quite briefly, reaching its maximum of density in a short time.
A smoother process would be preferable.




Two further SOM output dimensions are mapped to the spatialisation.

Fig. 7 Output display monitor

ELECTRONIC RESPONSE

As listed below, there are 20 electronic effects in all, **the electronic sounds with a low index number are lighter in character**. The more the index number rises, the more the referenced effect will be intense and abstract.

Your laptop screen (as in Fig.5) shows the currently active **"principal effect index" and the "effect density"** (when more effects are active in parallel they are neighbours of the principal effect). When the cellist performs timbres very similar to those played at the beginning, the machine should output very low output numbers: the output numbers increase when the cellist performs timbres previously played, but during subsequent music segmentations. In this way the machine shifts from light, middle and stronger effects, and with a narrow or larger band of effects density.

The cellist can monitor the mapping numbers as output by the SOM, as shown in figure 5. But the true effective monitor (consistent with the audible response) is afforded through the colour changes of the sound modules appearing on the laptop screen. But it is not necessary to exploit the laptop as if it were a graphic score (looking at it exaggeratedly), since *Wire's* is an improvised interaction.

After the start the laptop screen can be considered nothing more than a global monitor of the electronic densities and directions, and it should not disturb the listening priority of the interaction (previous setup and calibration maybe requiring the help of an assistant).

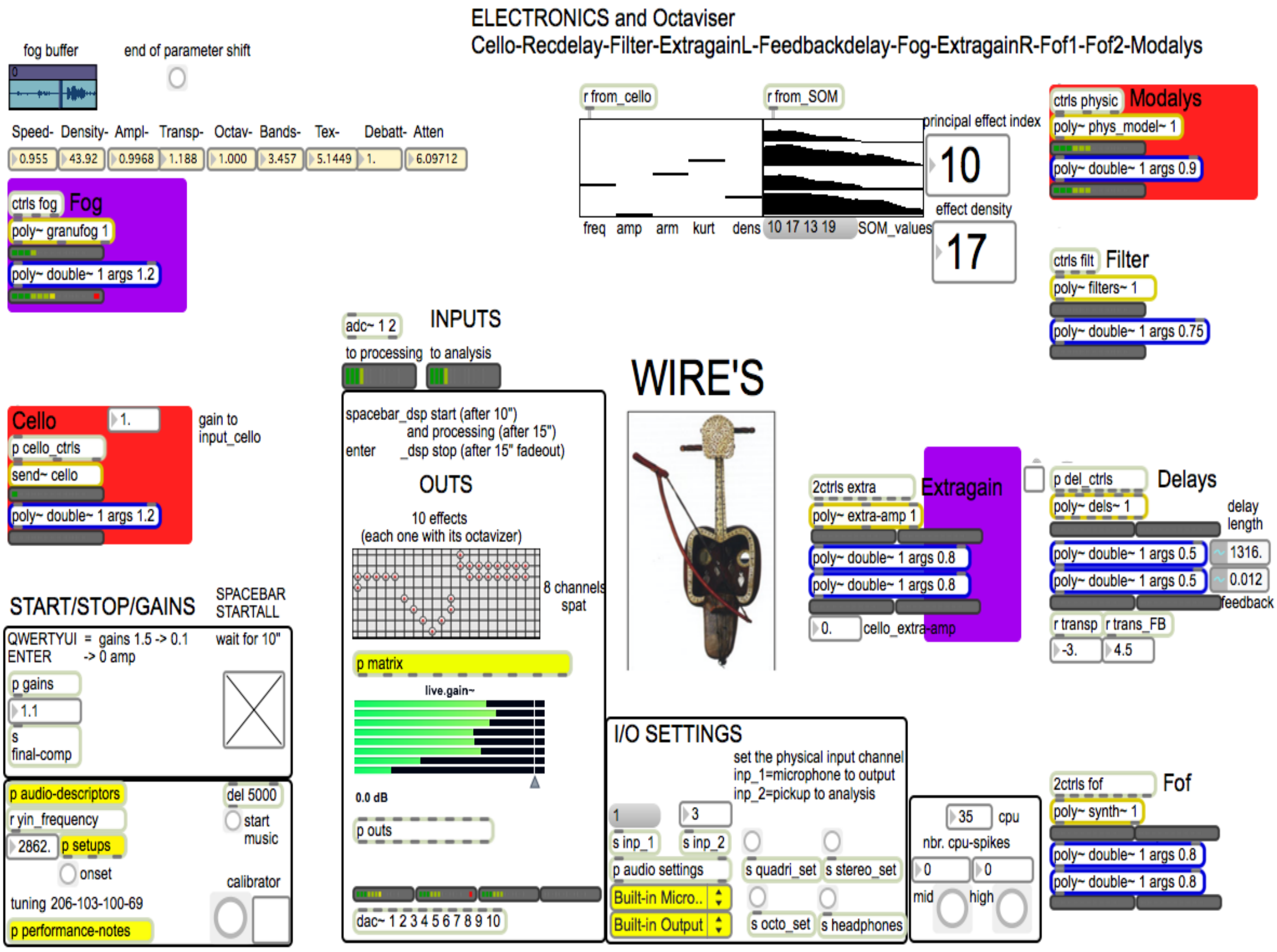



Fig.8 Main “Wire’s” MAX patch

The previous image shows an example of your laptop screen in action. The SOM monitors are in the upper portion. The lower left part contains the start/stop/gain settings.

Seven modules arranged on the screen contain the electronic effects: the coloured interfaces show you dynamically which sound effects are currently active.
Three of the modules are actually double-modules, and each module can play one octave lower.

Red squared module means “the effect is active and playing”
Blue means “the effect is performing one octave lower”
Violet means “the effect is performing at normal pitch plus its low-octave”

ELECTRONIC SOUNDS
Taking into account all the internal variants, **the system provides 20 sound effects. Each effect is tagged as an index to the SOM output maps.** Starting from a "point zero" mapping, represented by the amplified cello alone, **the most artificial effects are located as the most distant points from the origin of the self-growing mapping space.**

The effects are ordered by surrogacy, that is timbral abstractedness and distance from the cello

| | |
|---|---|
| **1 amplified cello** | **2 amplified cello low octave** |
| **3 live recorded cello** | **4 live recorded cello low octave** |
| **5 filtered cello** | **6 filtered cello low octave** |
| **7 very amplified cello (ch1)** | **8 very amplified cello (ch1) low octave** |
| **9 cello with delay-feedback** | **10 cello with delay-feedback low octave** |
| **11 FOG cello granulator** | **12 FOG cello granulator low octave** |
| **13 very amplified cello (ch2)** | **14 very amplified cello (ch2) low octave** |
| **15 FOF synthesis 1 - artificial voice** | **16 FOFsynthesis 1 - artificial voice low octave** |
| **17 FOF synthesis 2 - artificial voice** | **18 FOF synthesis 2 - artificial voice low octave** |
| **19 Modalys physical model** | **20 Modalys physical model low octave** |

INTERACTION
The more the cello performance is varied and contrasting, the richer the electronic performance will be. The more the cello performance is slow pacing and reflexive, the lighter, more controlled and slowly evolving will be the electronic result. Maybe it is not necessary to exploit the full range of the electronics, and a climax could be an isolated event.

The internal response of each effect is quite complex and should be performed intuitively, but **the internal local mappings are detailed inside each module (by double-clicking the labels** inside the main app you access mappings and explanations).

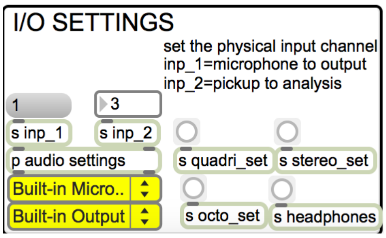
Each electronic response, even the most subtle, depends on the cello timbre as you are performing it. In other words you sonify the timbre analysis of yourself. The most important thing is to keep a clear connection with the conceptual aspects of the mappings:
**-the initial sound characters building the overall system response,**
**-the kind and density of the effects during the middle part of the performance,**
**-how and when to create points of climax.**

You can also individuate at your choice a few elements out of the complex detail of all the mapping parameters, upon which to interplay giving nuance to the improvisation. Since timbre is complex and multidimensional it will be impossible to force the machine into deterministic responses in terms of a precise chain of cause and effect: the electronics will be a further sound dimension coupled with the music and the intentions coming out of the cello performance.

More details are contained inside the module “performance-notes” inside the main app.
-the module “setups” contains the messages for calibration,
-“audio-descriptors” shows the sound analysis functions,
-inside the module “matrix” all the internals of the system are running.

# PERFORMANCE

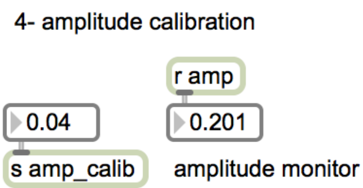
SETUP




"I/O settings" section allows to **set:**
**-the sound card and the logical input channels,**
-the outputs (**by default the system is quadraphonic,** press the relative button for a different option).

Fig. 9 I/O section

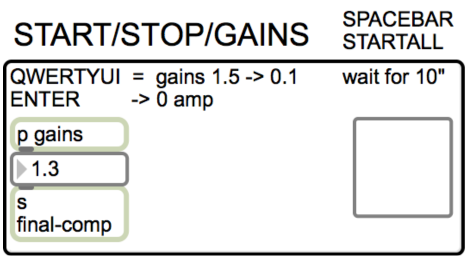
At the bottom left of the screen, the module "Setups" contains the calibration system:
-the inside section 5 involves the optional advanced option (requiring direct experimentation) of setting the parameters of the SOM (plasticity, learning rate, neighbourhood).




**-the amplitude calibration of section 4 is necessary:**
by pressing "Tab" (with DSP on, and before starting the piece) you have 10" time to play the loudest cello sound as possible (2 flashes signal the beginning and the end of the calibration time window)[2].

Fig.10 Amplitude calibration

START




Optionally you can set the final gain (0.9 by default) by pressing one of the laptop keys QWERTYUI.
**By pressing the Spacebar you start the music: after 10" the sounds will be coming out, after 15" the full interaction will be running. At the end, by pressing Enter, a long fadeout steers the music to its conclusion.**

Fig.11 Start-stop interface

More details can be found inside the module "laptop-controls" (double-click " performance-notes") inside the main app. The start and stop functions are the only physical interaction that the cellist has to perform with respect to the computer. **All the interactive music information is sent to the system exclusively by means of the cello sound.**

[2] The system automatically sets the number box "amp_calib" to the value as returning inside its neighbour number box "amplitude monitor". After that press the message "write", the application should remember your levels at the next use, until a new calibration is stored again.

FORM BUILDING
The music interaction develops as a consequence of the sound choices of the cellist.
From the beginning the SOM observes the cello sound as it develops during the performance and automatically builds its self-growing and abstract mapping space.
**The cellist has to improvise a music characterised by different time regions (formal segments, music phrases, contrasting timbral zones) possessing specific pitch-ranges (static or evolving), mean volumes (i.e. piano, mezzo-forte, fortissimo), and timbres (pure vs. noisy, light vs dense, resonant vs. intense).**

Similar timbre cello inputs will move the system towards similar electronic outputs. The consistency between cello timbres and electronic outputs is a result of the initial part of the solo: the time development of the initial timbre characters (from the point of view of the cellist), Machine Learning from the point of view of the computer.
Depending on the cello improvisation, *Wire's* grows differently in terms of sound abstractness (orders of sound surrogacy), density and spatialisation.
If the cellist during the initial 2'-3' of performance creates well shaped differentiated sound regions (i.e. very low pitches / pianissimo / sul-tasto, after ca. 10" to 20" medium-low pitches / mezzo forte / dense bowing, after ca. 10" to 20" high pitches / forte /noise-distorted etc.) the system should couple the initial region with low-surrogacy effects, few effects active, and involving speaker 1.
As the system detects new sound characters it will start to progressively activate higher surrogacy effects, a higher number of effects working in parallel and more dynamic spatial movements.
Similar cello sounds will always recall similar electronic situations.

If the cello improvisation develops through stable and slowly evolving music sounds the system response will be smoother, more cello contrast will recall degrees of electroacoustic entropy.

ARTIFICIAL SOUNDS
Inside each of the effect modules you can find the description of the internal mappings.
The electronic effects are built in order to recreate concrete or imaginary features recalling Kazakh sounds and techniques: enhancing, mimicking or estranging timbre qualities.
Starting from the simpler effects, towards the last more abstract ones it can be noticed that:
**A) <u>Cello treatments</u>**
-all the effects are provided with a low octave doubler, mimicking the deep throat voiced Central Asian style.
-filtering allows for a pseudo harmonic chant result
Quick and nervous loudness variations by the cello increase the filter sweeps into different harmonic frequencies; a bright timbre (i.e. sul ponticello) increasing the effect.
-the intricate delay system suggests multiple heterophonic textures
You amplify this effect by decreasing your cello volume
-the extra-gain effect fits for grungy subtle noises
It is very sensitive to soft and very noisy sounds
B) **<u>Synthetic sounds</u>**
-FOG enacts overtones/irregular-granulations/sound-distortions
-FOF modulates voiced/guttural/rumbling sounds
-physical models (*Modalys*) produce rumbles/percussions/abstract-bow-scrapings

Augmented interaction
Each internal modulation of these artificial effects responds to the cello timbre in a consistent way, but the more abstract the effects are, the less predictable will be their response.
The cello improvisation, through its non obvious association with the electronics, acts as a timbre based corporeal meta-language accessing different levels of remoteness and energy response.

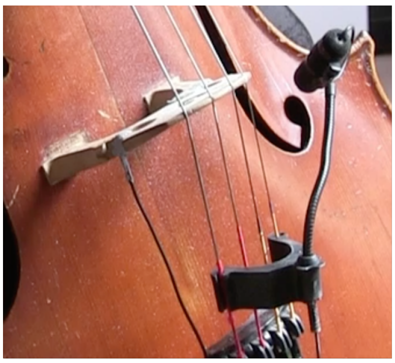
The cellist has an indirect access to the means of electronic control, which are not in fact controls at the low level of analytic instrument parameters. Especially at the level of macro-form, the cellist, preserving his/her traditional instrument holistic approach to performance gains the power to influence the compositional behaviours. But these compositional behaviours are the result of a mediation between the musician's choice and the mirroring autonomous behaviour of the self-organising abstract machine. Both the cellist and the system have a strict relation with their past choices which influence the present music events. The continuous negotiations between the cellist, his/her mirroring self-organising alter-ego and the past of both, suggested the creation of such a system as a means to convey the idea of energy exchanges through different spiritual dimensions.
In this sense the electronic sounds can be viewed as extra corporeal extensions, localised and accessed through a "shamanic" body-based, but multi-dominant and interdependent balance.

# PREPARED CELLO

-Copper wires and small mutes
-Rattling metal rings
-Clips

Fig.12 Modulating objects

# HARDWARE EQUIPMENT



-1 Microphone (phantom powered) for the audio, possibly DPA (adc~1)
-1 Bridge-contact pickup for the sound analysis, possibly Fishmann (adc~2)
-1 Audio card (minimum 4 outputs)
-1 Mac laptop (minimum dual core, 2.4 GHz), running MAX/Msp (some externals requiring IRCAM authorisation) or otherwise the *Wire's* standalone
-PA quadraphonic at least

Fig.13 Cello microphones

# SOFTWARE

MAX/Msp 6.1, or *Wire's* standalone application

LIST OF EXTERNALS AND ABSTRACTIONS

banger (Peter Elsea)
http://peterelsea.com/lobjects.html

contrast-enhancement (Michael Edwards)

dot.smooth, dot.std (Joseph Malloch et al.)
http://idmil.org/software/digital_orchestra_toolbox

f0.fold, f0.line_log, f0.round (Fredrik Olofsson)
http://www.fredrikolofsson.com/pages/code-max.html

fiddle~ (Millar Puckette et al.)
http://vud.org/max/

fof~ (Michael Clarke and Xavier Rodet)
http://eprints.hud.ac.uk/2331/

fog~ (Michael Clarke and Xavier Rodet)
http://eprints.hud.ac.uk/2331/

ftm, ftm.copy, ftm.mess, ftm.object,
gbr:fft, gbr.resample, gbr.slice~, gbr.wind=, gbr.yin
FTM gabor library (Norbert Schnell et al.)
http://ftm.ircam.fr/index.php/Download

ml.som (Benjamin Smith, Guy Garnett)
http:/nime.org/proceedings/2012/2012_68.pdf

modalys~, mlys.bi-string, mlys.bi-two-mass, mlys.bow, mlys.point-input, mlys.point-output, mlys.position, mlys.signal, mlys.speed (IRCAM Instrumental Acoustic Team)
http://forumnet.ircam.fr/product/modalys-en/

multiconvolve~ (Alex Harker and Pierre Alexandre Tremblay)
http://www.thehiss.org/

roughness (John MacCallum)
http://cnmat.berkeley.edu/downloads

sadam.stat (Ádám Siska)
http://www.sadam.hu/en/software

zsa.flux~ (zsa.easy_flux) (Mikhail Malt, Emmanuel Jourdan)
readaptation of the abstraction zsa.consonant tracking
http://www.e--j.com/index.php/download-zsa/

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*LIST OF FIGURES*