Awakening

Interactive harp quartet

Dedicated to the Adria Harp Quartet
First performance FORFEST,
Kromeritz (Czech Republic)
June 23rd 2014
Duration 10'

Video instructions at: https://www.dropbox.com/s/gcv3jjseuzetfu2/Awakening-instructions.mp4?dl=0
Studio recording at: https://soundcloud.com/nicola-baroni/awakening
Video recording at: https://youtu.be/gasFAG5QilY

PRESENTATION

CONCEPT

The idea of shaping music as if it were an organic form whose different articulations interleaves and grow similar to a living entity could be viewed as a post-romantic heritage. On the other hand this concept was traditionally related to the development of a drama, where the actions of imaginary or abstract characters are codified within a score.
These structural relationships should be eventually felt as evolving sounds recalling one another in the time domains of performance and attentive listening.

The interactive quartet Awakening is conceived as a concrete living organism, where there are no special focus points on its history and its future, and in fact no scores are fixed.
The living interaction is made of sounds, actions, functions and symbols seeking for balance and actual boundaries with respect to their environment.
The performers are the actors of this search for an identity of the **living sound system, which is driven by the music-social intentions of the ensemble.**

PRELIMINARY NOTE

Each harpist, specified as Harp_1, _2, _3 and _4, has a specific role inside the interaction. The detail of the following presentation is essential for the musician dealing with the overall setup, installation and concert location. This responsibility can be assumed by the composer, by an external sound engineer, or else by one or more members of the ensemble. Technical notes are given at page 24.

The conceptual involvement of Harp_1 and _2 requires the knowledge of this presentation, which could be in part skipped by Harp_3 and _4, going directly to the general and individual performance notes.

INSTRUMENTS

The harps are amplified and live processed. The position on stage requires Harp_1 and _2 to be **placed at a certain distance** from Harp_3 and _4 (4 meters approximately) in order to avoid the sound interference of the microphones coming from the opposite couples of players.

Three harps are required, since Harp_2 only interacts with the resonances of the neighbouring instrument (Harp_1).

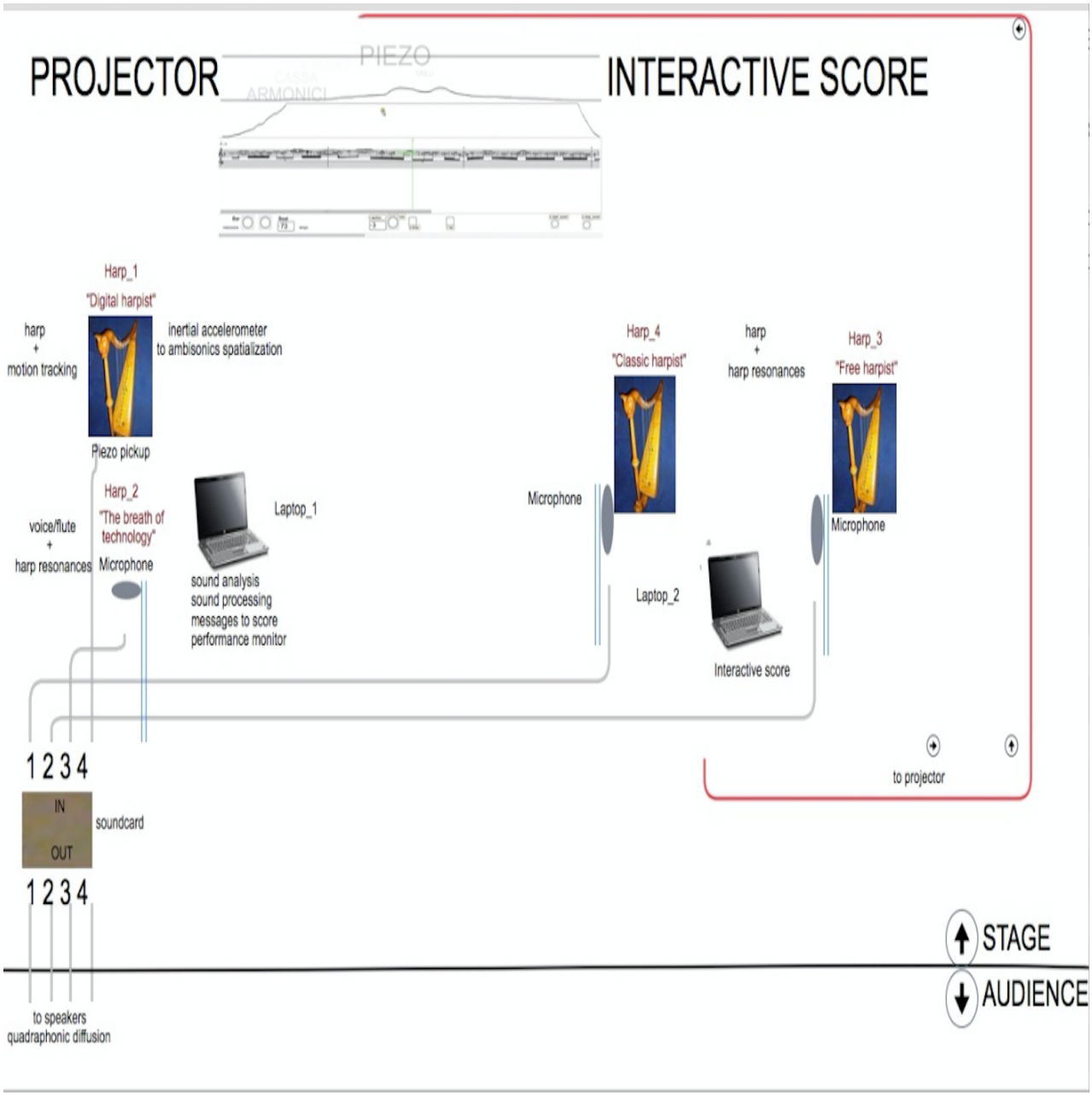

Fig.1 Arrangement on stage

COMPOSITION

ACTIONS
The piece is conceived as a harp quartet, but "Harp_2" doesn't need to be a harpist (in a sense she is more a composer rather than an instrumentalist) even if she interacts with the harp.
The composition could be seen as a harp trio plus flutist/vocalist.

Harp_1 ("Digital Harpist") plays**:**
-**single notes** in order to digitally select the sound effects of the live electronics.
-**soft passages** allowing for electronic depth to the sound, shaping electro-acoustic nuances.
-an IMU **sensor worn on the left hand** through which the electronic sounds are spatialised.
Harp_2 ("The Breath of Technology") never truly plays the harp:
-**initially she scans the harp resonances,** shifting the microphone near their nodes on the surface of the instrument body, producing modulated audio-feedback.
-during the following sections she **performs voiced/noisy sounds with her voice or any wind instrument** (with the exclusion of reed instruments), in order to shape the electronic timbres.
Harp_3 ("Free Harpist"):
receives an **animated graphic score** interactively upon which to improvise.
Harp_4 ("Classic Harpist"):
receives **interactive scores in pentagram** and common notation to sight-read.

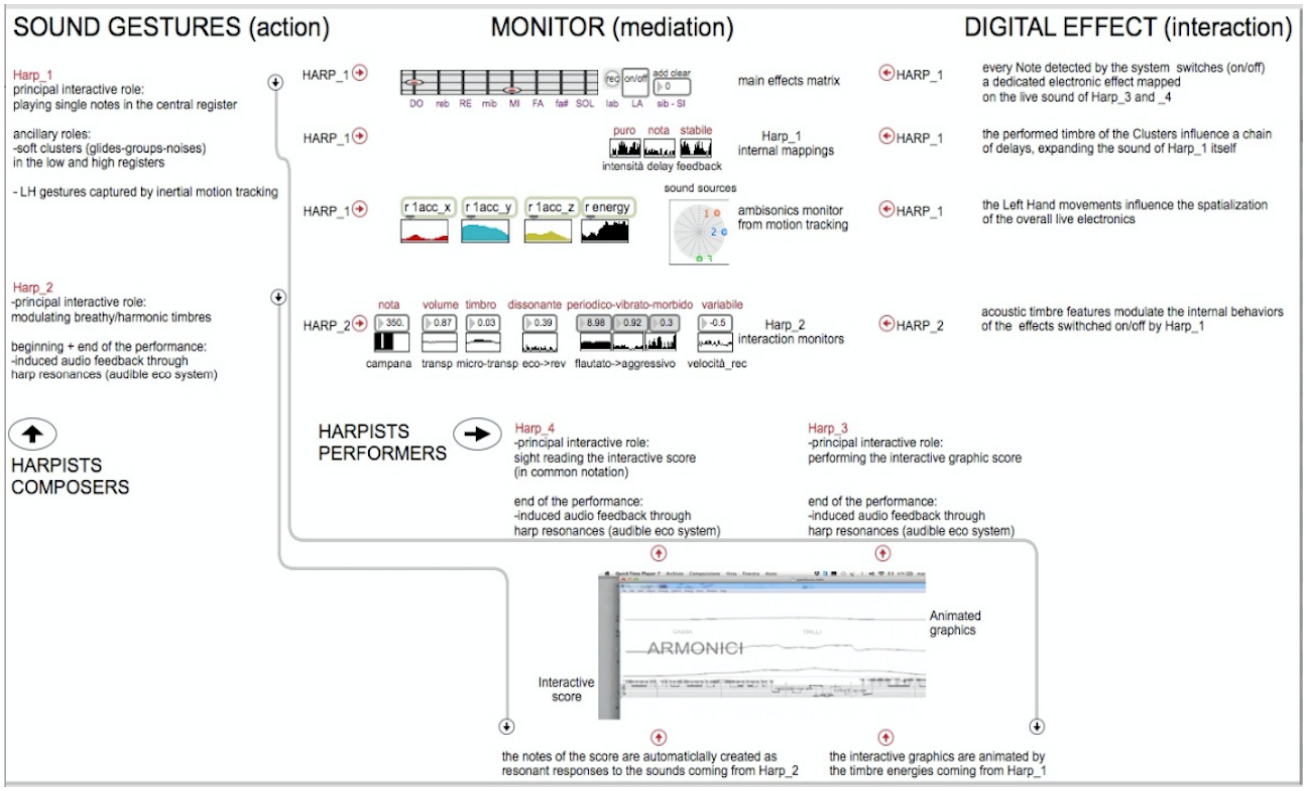

Fig.2 Schema of the interactions. On the left the actions performed by Harp_1 and _2 (composer-harpists).
The central part resumes the monitor interfaces and functions as they appear on the harp laptop screens.
On the right an essential description of the digital interactions connected to the relative actions.
The bottom part shows roles and scores of Harp_3 and _4 (performer harpists).

SCORES

Harp_1 and _2 share the graphic interface contained in Laptop_1.

The laptop has to be positioned in a music-stand fashion in order to be visualised by both players.

The upper part of the screen (monitors and annotations) only regards Harp_2.

The middle part of the graphic interface shows the actions performed by Harp_1: the actions called "points" (single notes) are especially in evidence as on/off functions relevant to both players.

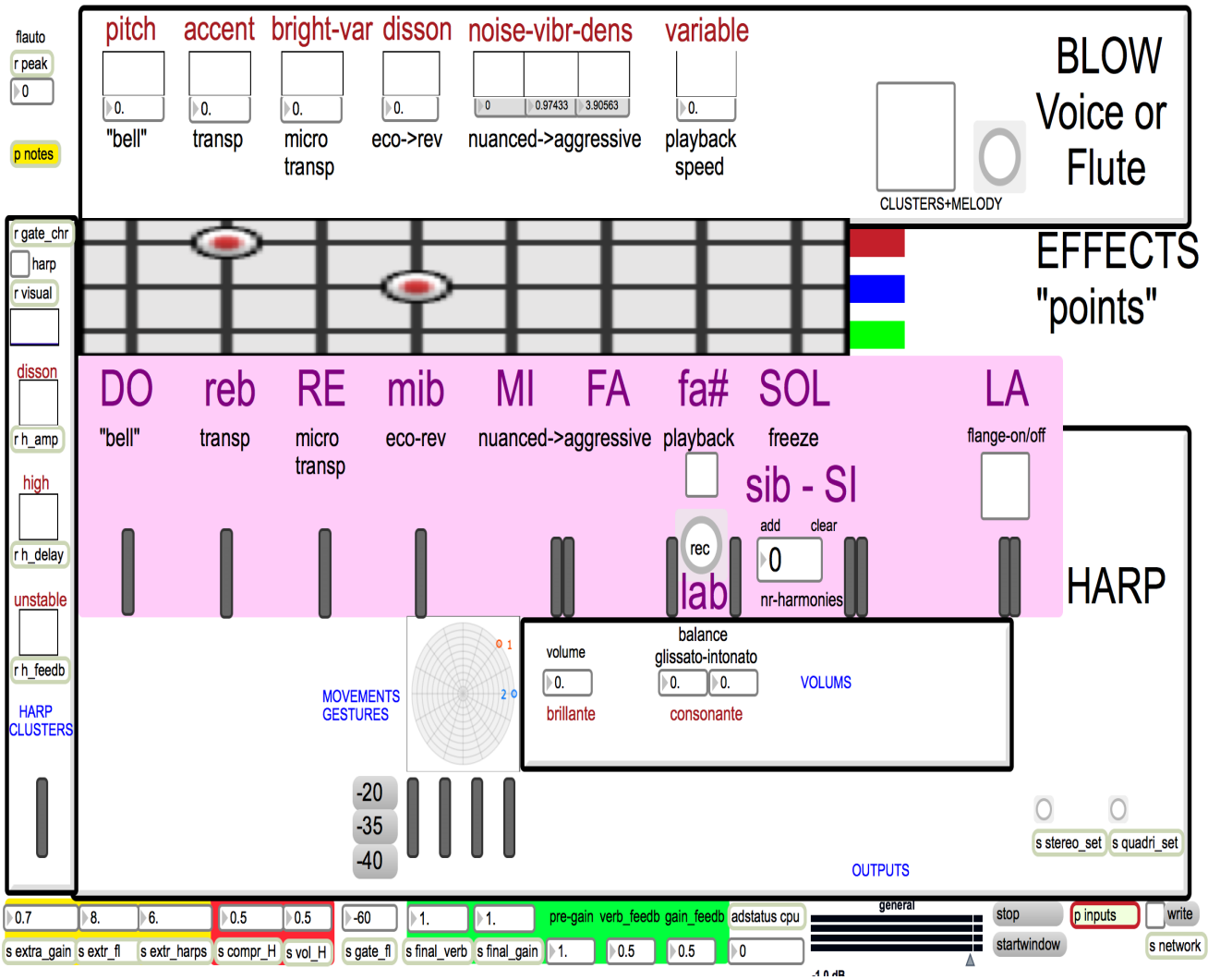

Fig.3 Screen interface as it appears on Laptop_1 (interactive monitor for Harp_1 and _2).
The upper part regards Harp_2 (voice/flute): it monitors the timbre analysis of the “blows”.
Just below is the matrix called “effects”, the mid-low part (“arpa”) is the interface of Harp_1.
At the bottom all the settings.

Harp_3 and _4 share the interactive screen of Laptop_2
(receiving messages from Laptop_1).
This laptop too has to be positioned and well visualised by the both players.
The upper part contains the graphic-verbal animated score for Harp_3.
The middle-lower portion contains a pentagram for Harp_4.

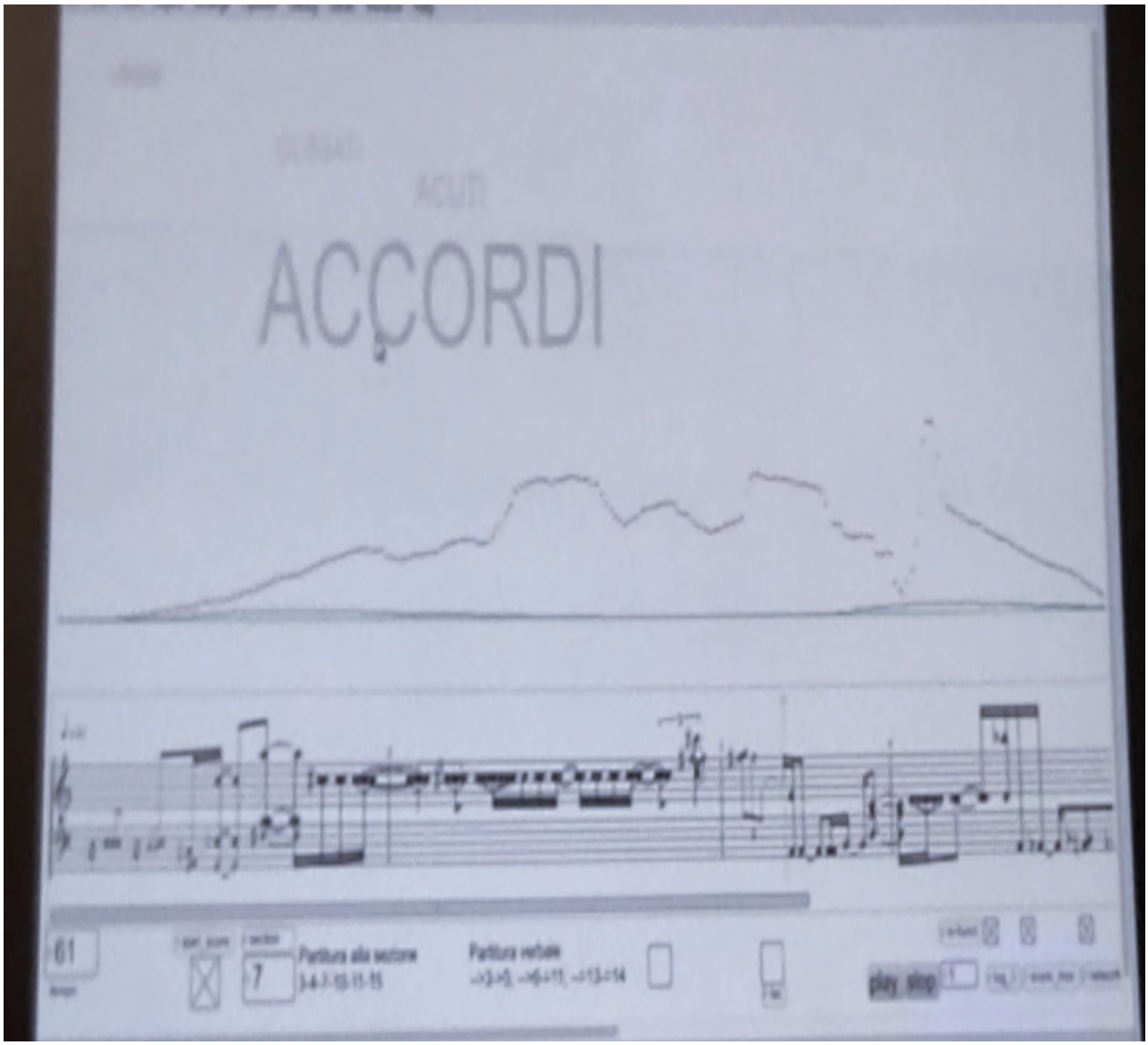

Fig.4 Screen of Laptop_2. At the top the verbal-graphic animated score for Harp_3, just below the interactive score for Harp_4. At the bottom variable BPM, number-section advance, various settings.

The lower part of both screens shows preliminary settings.

TIME DESIGN

Harp_1 and _2 (“Harpist-composers”) improvise, but strictly interacting with the software functions and monitors. Harp_3 and _4 (“Harpist-performers”) perform the interactive scores. A complex net of synchronised changes are automated inside the software.

These hidden agencies, coordinated with an internal timeline, show the performers the essential time-event-signals and interactive trajectories.

The composition, as if it were a sound installation, maintains an internal consistency upon which the performers build their own strategies of interaction.

The designed time segmentation of the music (**10’** as a default, but changeable inside the internal settings) produces **two complementary states**.

TIME-SPACE DEVELOPMENT

Beginning and conclusion (“peripheral body of interaction”).

Audible eco-system.

The performers reveal the natural resonances of the harps through microphone-scanning. The induced audio-feedback between instruments, technical equipment and room creates ghost-pitches showing that the audible space doesn’t correspond to the visual boundaries between stage and audience.

Central part (“central body of interaction”).

Social-digital composition.

The initial audio-feedback ostensibly grows and interleaves in a collective composition digitally mediated. The ensemble splits itself into two complementary entities of composers and performers. The combined musical actions of two harpists (Harp_1 and _2) generate and control the live electronics fed by the sound of the other two harpists (Harp_3 and _4).

In addition the sounds of the two harpist-composers are “interpreted” by the software and are sent as interactive scores to the couple of sight reading harpist-performers.

AUTOMATED PERFORMANCE

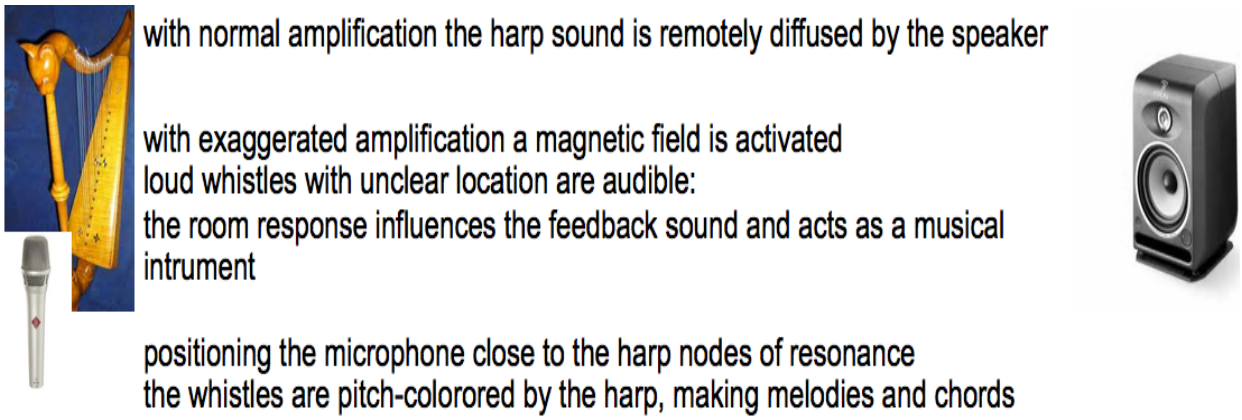

Fig.5 Performing the acoustic feedback

Beginning-conclusion.

The transitions between the two states of performance (the Audible eco-system and the Digital-social interaction) are technically realised through cross-fading amplitude gains of the input microphones.

The audio-feedback is obtained by a chain of variable exaggerated gains operating upon the single microphones (and compressed in order keep the whistling sounds inside a meaningful not disturbing range).

This extra-gain is synchronised with a message telling the interested performer to stand up, take off the microphone from the stand and start moving it around the harp. **By approaching with the microphone the main nodes of resonance inside the body of the instrument, the natural resonances of the harp are revealed, pitch-colouring the audio-feedback.** When the central digital interaction starts, the gains automatically return to their normal levels.

Central part

During the central digital interaction the software mediates the human actions through sound-analysis: it recognises and monitors features and patterns of the acoustic sounds of Harp_1 and _2.

These **two harpist-composers,** reading the monitor-analysis of their own sounds, are allowed to interact with the live electronics machine. In this way **they choose and influence the types and nuances of the sound treatments upon the live sound of Harp_3 and _4,** gaining the power to shape the overall performance.

In addition, by "listening" to the sounds of Harp_1 and _2, the software transforms their sounds into messages and symbols, sent as animated scores to Harp_3 and _4: a symbolic resonance of the sounds invented by Harp_1 and _2.

The composer tradition to codify on paper a successful improvisation is rendered in real-time on stage, allowing for a social creative interaction.

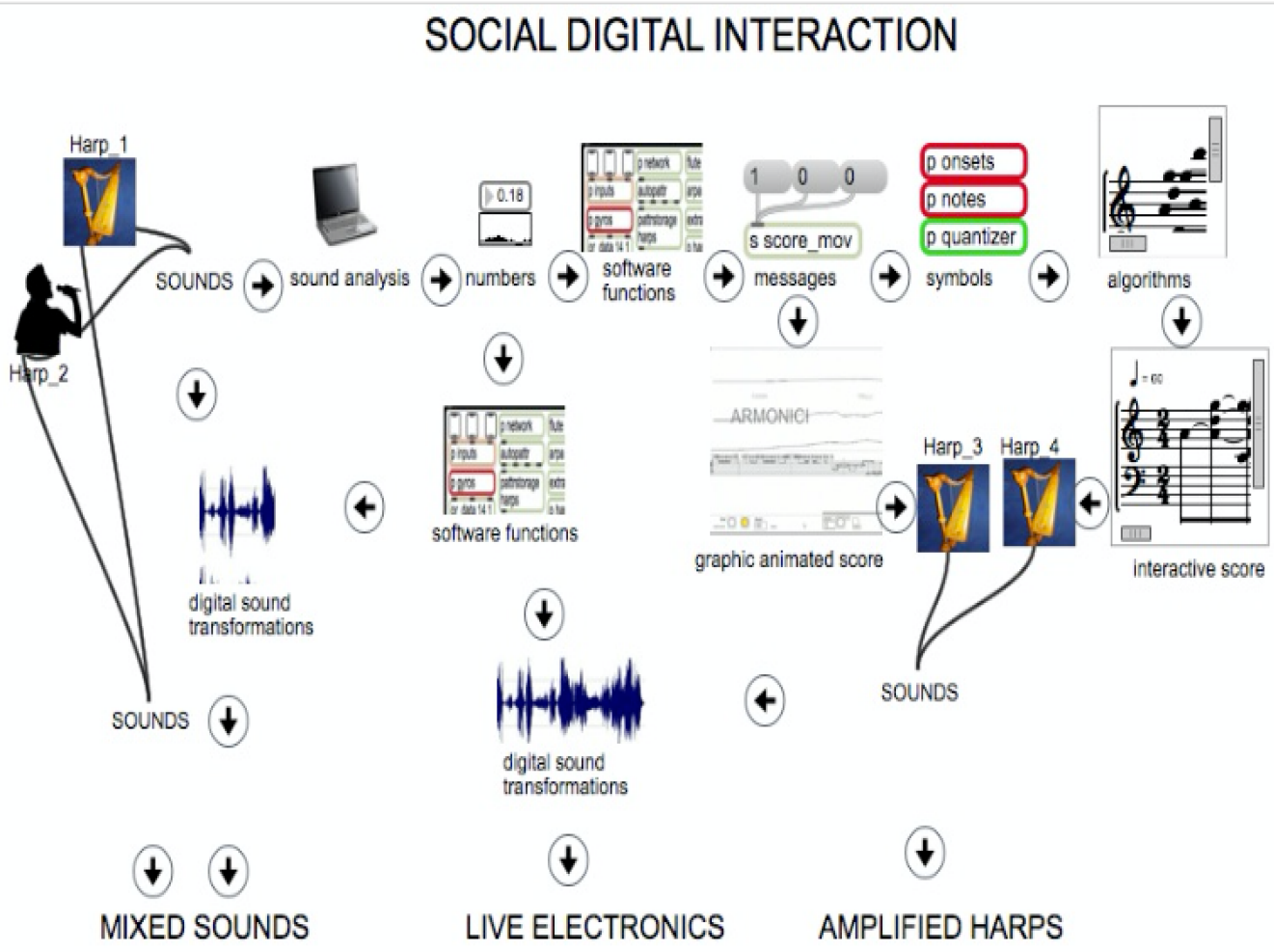

Fig.6 From sound to interactive functions, to scores, to digital processing, to socially mediated music

AWAKENING

Awakening is the process through which the subtle energies of life, present inside our body, empowers and harmonises our physical, mental and emotional dimensions through the spiritual practice of Yoga (whose meaning is union). The opening comparison of this harp quartet with a living organism is justified by its physical origin inside sound gestures and natural resonances. The performance arises from the extra-energy of the environmental audio-feedback. On the other hand the mental-symbolic dimension of the scores is treated as a dynamic part of a collective search for balance.

The non obvious boundaries of the interaction are performed through circles of opposites.

-Sound as it is perceived vs. Sound as it is computed through models of analysis
-Physical agency (sound gestures) vs. Symbolic resonance (scores)
-Musical gesture (instrumental note/timbre) vs. Electro-acoustic sound
-Technology vs. Environment
-Improvisation vs. Composition in real-time
-Concert-based music vs. Sound installation

TIME SEGMENTATION

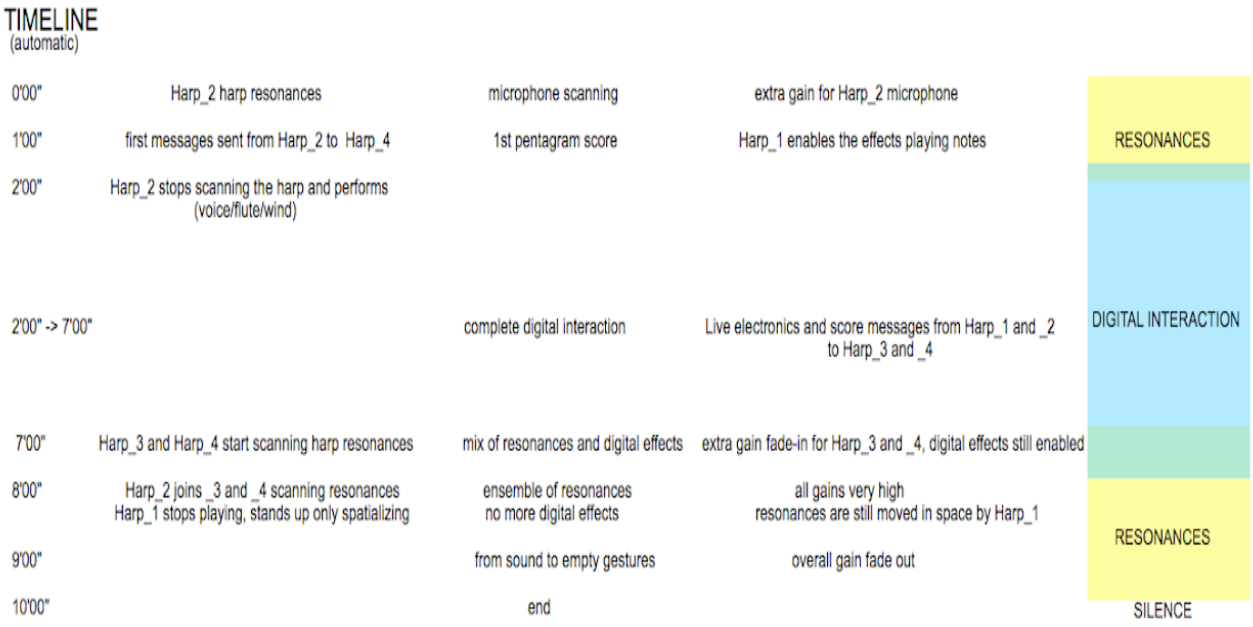

Fig.7 The piece starts with pure harp resonances, and gradually fades in the central digital interaction. From minute 7', at different times, the performers receive from their laptops a signal indicating the reprise of the resonance-scanning activity.

0''00" -> 1'00" Harp_2 starts to scan the harp resonances with the microphone; the other harpists are silent, with the microphones muted.

1'00" -> 2'00" Harp_4 receives a first score; when she starts playing, this is the signal to **begin the interaction of Harp_1;** when Harp_3 receives the first score and starts playing, **Harp_2 positions the microphone in the stand and proceeds with the central part of the interaction**[1].

2'00" -> 7'00" Central body of the digital interaction: **Harp_1 and _2 drive the composition in real-time, Harp_3 and _4 are receiving the scores.**

7'00" -> 10'0" Progression of fading out, gradual transition from the digital interaction to the **ensemble scanning of the harp resonances. Harp_3 starts,** then Harp _4, and finally Harp_2.

The action of leaving the previous position and grabbing the microphone for the scanning process is signalled by messages inside the laptop interface.
When everybody is scanning, Harp_1 stops playing and limits the activity only to spatialisation, until all the microphones fade out to silence.
The interaction finishes after a short time of silent gestures.

[1] The scores are received at fixed times, routed through an automatic timeline

GENERAL PERFORMANCE NOTES

PERFORMER ROLES
The production of the audible eco-system (harp resonances) involves Harp_2, _3 and _4 (see following performance notes).

The central digital interaction requires an amount of conceptual involvement by Harp_1 and _2 (the "Harpist-composers"): it justifies the dense detail of the following individual explanations.

The verbal notes for Harp_3 and _4 will be much lighter, since a great deal of the performance instructions is embedded inside their actual interactive scores: in this sense their performance styles are essentially those of classical players involved in contemporary music and graphic-score interpretation.

REHEARSALS
Some preliminary section rehearsals by Harp_1 and _2 are suggested before meeting the whole ensemble.
A previous individual training of Harp_1 and Harp_2 with the system is recommended (these "harpist-composers" should have an overall knowledge of the above presentation).

Load the patch "Awakening" in Laptop_1

1) Pressing the Spacebar the full rehearsal and performance starts
   (and Laptop_2, if connected by Ethernet, will react in its settings-mode).

2) When the piece is finished press Enter (close and reopen the patches before a new take).

3) Press the keyboard key A for "Section rehearsal", key B for "Harp_1 training", key C for "Harp_2 training", in the case of a study session.

4) During a full rehearsal, you can press the keyboard 2 for "Start from min2" or key 7 for "Start from min7", if you want to rehearse only a part of the composition.

HARP RESONANCES

A too high amplitude of a microphone can instantiate a magnetic field involving proximate loudspeakers, and creating an audio-feedback effect. As a result some standing waves (whose frequency depends on distance, angle, room response and equipment specs) form a generally disappointing group of fixed whistles. This effect is exploited in a controlled fashion, through a chain of variable extra-amplitude and compressors: positioning the microphone close to special nodes of the harp surface (or inside the holes of its body), specific harp modes of resonance start to influence the pitch and the amplitude of the audio-feedback. This effect, when hybridised by digital processing, was called audible eco-system[2], since it involves the natural interferences of technology and environment, in our case with the contribution of the resonant body of the harp. During the normal setup your microphone is positioned on its stand and the sound gain is at a neutral level. When you are requested to produce the eco-system, the software automatically raises the input amplitude of your mike, and you should be able to feel a sort of sound-magnetic field. After the start signal, grab the microphone in your hands, approach it to the harp, and perform creatively following these general suggestions.

1) **Find the most interesting pitched nodes of resonance of your harp,** generally the result is more effective near to the curved shapes of the body (see video instructions).
2) **By positioning the mike closed and towards the base,** near the lower strings, and **very slowly moving it** towards the middle part of the strings and/or towards the low-middle pitch register of the instrument, some chords can be produced.
3) By **scanning with the microphone the holes** in the back part of the column, or inside the pedal holes, you can gain powerful sounds, but there is a possibility of exaggerated and distorted effects, here the performance has to be extremely careful.
4) You are advised not to hold the microphone too far from the harp, otherwise the effect could interfere with the noisy components of the environment and fall out of control.
5) It is important to **intuitively find the true boundary of the magnetic field**: if the mike is removed too quickly from the harp proximity, the wave could disappear, but moving it one millimetre too close the sound could be distorted: find a good feeling and balance in your gestures.
6) The audio-feedback standing wave takes time to emerge and stabilise: sometimes you have to wait for it, with the mike still and close to the chosen nodal point (maybe you have to wait longer than you could expect). When the whistle begins, it is better to immediately distance it by about 1 cm. in order to avoid an uncontrolled sharpening of the effect: the movements around the sound boundaries should be characterised by **specific patterns of acceleration/deceleration,** you can "tune" your gestures by listening after some rehearsals.
7) When you decide to reach a different node (searching for a different pitch), **move the mike slowly** and keep it inside the boundary of resonance (a correct distance, which you feel by careful listening and soft airy gestures), otherwise the resonance disappears and you miss the opportunity to shift the pitch.

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[2] Agostino Di Scipio, Contemporary Music Review, 33:1, 2014.

DIGITAL INTERACTION_INDIVIDUAL NOTES

HARP_1

The contribution of Harp_1 is crucial in designing the macro-form of the music.
During the time of the performance Harp_1 chooses which effects are acting and in which sequence. The density of the electronics (the kinds and the number of effects working in parallel) are extremely important for shaping the music well in terms of variety, tension and interest.

Harp_1 is a hyper-harp: the way she makes music is sensed by the software (through sound analysis), and directly affects the live electronics.
In addition one accelerometer is fastened to the left hand in order to drive the spatialisation.

Vocabulary
1) POINTS (single detached notes);
2) CLUSTERS (soft glides and note-groups);
3) GESTURES (rotational movements in the air with the left hand wearing an accelerometer)

-1) Points: every note clearly detected by the system has the role to open and close a single attached effect of the live electronics (transforming the sound of Harp_3 and _4).
-2) Clusters: improvised patterns of soft and continuous timbre commentaries performed in contrasting pitch registers: they diffuse electronic sound-copies of what Harp_1 is playing (*delays* effect)
-3) **Gestures:** orientation and speed of the left hand affect the **final spatialisation.**

Time
0'00" -> 1'00" No sound, only spatialisation through **Left Hand rotations**

1'00" (Harp_4 starts playing)

1'30" **The "Points-matrix" is enabled:**
play *Points*, not yet *Clusters*

2'00" -> 7'00" (Harp_2 take place in front of the microphone): **full interaction.**

7'00 -> 8'00" (Harp_3 and _4 start scanning the resonances):
play *Points*, no more *Clusters*.

8'00 -> end (everybody is scanning the resonances),
stand up, stop playing, only spatialisation through Left Hand rotations.

Points

The central part of Laptop_1 is the graphic monitor of the sound actions called *Points*. You can see on the screen many virtual buttons (red points and crossed buttons mean that the effect is turned on).

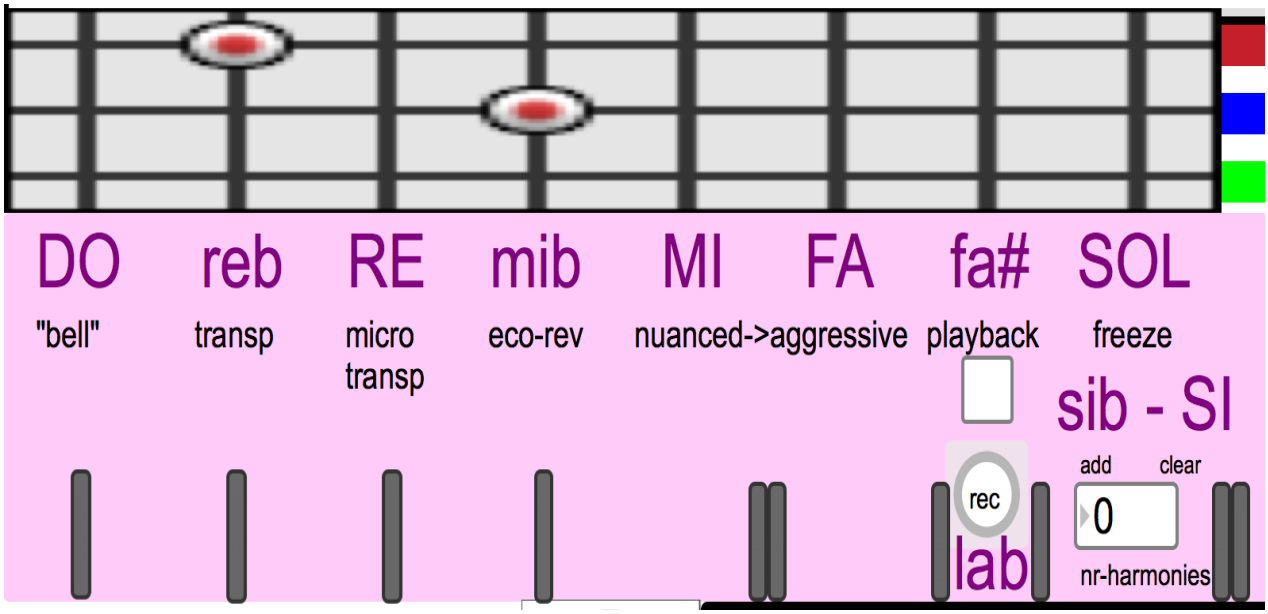


Fig.8 The “Points-matrix”: the effects-console of Harp_1

-Any note you perform, if played alone and detached, can be clearly detected by the system, which activates a related sound effect.

-The notes are intended as pitch classes, therefore tracked independently by their octave: generally they have the function to open or close one effect.

-When you play a note the effect is opened, on repeating the same note the effect is closed (the note B is the only exception).

-It is possible to open many effects together in order to increase the density of the live electronics; when all the effects are closed, only the acoustic sound of the harps will be heard.

-The notes are better detected if they are **in the mid register:** avoid high and low pitches if you need a precise control.

- The name of each note is present on the screen near to the on/off monitor and the name of the related sound transformation (which affects the sound of Harp_3 and _4).

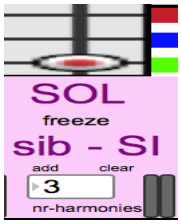
Even if the machine note detection is quite responsive and accurate, it can happen that some unwanted notes ("false positives") are captured by the system (especially in the middle part of the performance, when many notes are performed by the other players!), in this case probably some efforts will be needed in closing unwanted effects.

A sort of tolerance towards this independent behaviour of the machine makes the interaction more interesting, obviously if the false positives are not in excess. In this sense the computer is more a "composer assistant in real time" rather than a strict instrument.

It is extremely important that Harp_1 reaches a clear perception of the difference between every sound effect, as shown by the video instructions.

List of the connections

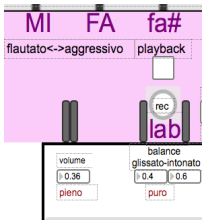
Note C	ring modulation	bell-like effect
Note C sharp	transposition	pitch glides, inside the range of a major third
Note D	micro-transposition	microtonal glides and beats
Note E flat	delays	effect of multiplying the most recent sounds
Note E	spectral decomposition 1	split the sound in its noisy vs. pure components
Note F	spectral decomposition 2	similar, but more harmonic effect
Note F sharp	playback	playback of a live recorded fragment (A flat -> record)
Note G	spectrum-freeze	enables freezing the sound (as it is at that moment)
Note A flat	recording	records the last 2 and ½" of sound (F sharp -> playback)
Note A	flanger	extreme artificial vibrato modulation (electric-guitar effect)
Note B flat	add-harmony	adds one layer of freezing, a new fixed harmony
Note B	clear harmony	clear the all freezes harmonies



On playing G the freeze is only enabled.
After enabling, play B flat when you want make a sound, every new B flat adds one more sound creating a fixed harmony.
Play B when you want to silence the harmonies (a small number tells you how many harmonies are playing).

Fig.9 Freeze

A few more interactions (less important to be fine-controlled)
Notice that Harp_1 only activates the effects, which are instead internally modulated by Harp_2. The only exception is the Flanger (activated by the note A), which is modulated by you: take it easy and be intuitive!
But you may notice that:
-the brightness of your sound adds artificial pitched-colour to the flanging,
-when your sound is very resonant, it increases the presence of the effect,
-your high pitches increase the flanger vibrato-reactivity,
-impulsive quick movements of the left hand dramatically increase the reverb of the effect.



The effects called "spectral decomposition", activated by E and F note detection, can sound extremely harsh (noisy) or very subtle (pan-flute-like) depending on the performance of Harp_2. You can influence the volume of these effects (if you feel the need to better balance these sounds):

Fig.10 Volumes

-Low volume <- soft/touching sounds in the middle of the string,
or leaving the harp free to resonate.
-High volume <- aggressive/brilliant sounds.

You can also influence the playback module (effected by the F sharp): the more your sound is consonant ("puro"), the less the playback will be transposed (probably the *Clusters*, since dissonance will produce many pitch transpositions in the playback).
It is not necessary to pay close attention to the fact that your sound creates the graphic score of Harp_3, just note that:
- the more numerous the effects opened by your notes (the *Points*), the greater the quantity of overlapping instructions to Harp_3 (no *Points* opened, no verbal instructions to Harp_3).
-the energy of your sounds impact the dynamic animation of the score.

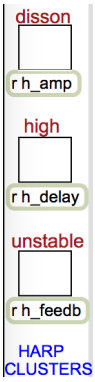
Clusters

Harp_1 alternates the single-note performance with some improvised passages, characterised by timbre density, very soft intensity, blurred pitch contents, and very low, or by contrast, very high pitch registers (they shouldn't affect the note detection):
-soft glides inside narrow-band pitch contours,
-trills,
-soft scale-like passages with grace notes,
-slow nail vertical scratches,
-any other sound characterised by softness and timbre density.

***Clusters* transform only your sound,** through a chain of delays adding depth to your amplification.
Clusters* are never to be performed during the *Harp-resonances (beginning-end of the piece).

An increasing requirement of *Clusters* is signalled by recurrent yellow flashes in the upper right part of the screen, which suggests also Harp_2 to increase melodic variety.

Fig.11 Increasing Clusters



The choice of producing *Clusters* is left to your feeling of adding "fatness" to your amplification.
This added fatness/depth to your sound is obtained by a delay-system (you will hear many echoes of your sound). You can influence the echoes in this way, just playing the harp:
-high pitches -> distant echoes (low pitches -> close echoes, similar to a reverb)
-dissonant/rough sounds (opposite to sound "puro" -> more amplitude
-unstable timbre -> increasing of the effect (feedback)
Noisy or dissonant passages and groupings should increase the overall echo density.

Fig.12 Delays

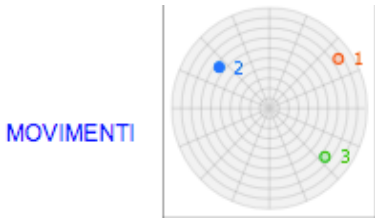
But the way a machine detects timbre is not exactly the same as that of our ears, therefore some previous study and experiments should be individually done in order to reach a fine-tuned control of the effect[3].

Gestures

A three axis accelerometer is fastened to your left hand[4].

The direction and the velocity of your movement in the air are tracked, in order to move the electronic sound sources around the space of the audience.

During the beginning and the end of the piece you can focus only on spatialisation, but when you are concentrated on the harp sounds, even your involuntary hand movements are still tracked and spatialised, it is a good idea to give some attention to this during the pauses of your sound, while it resonates.



Inside the spatial monitor (called "movements") the three sound sources are coloured, and their colour corresponds to the colours besides the main graphic called "effects" (the effects appearing in the first column are marked as red, in the second column as blue, in the third as green, and they correspond to the digital sound effects described above).

Fig.13 Spatial interface

The first part of the performance involves only one sound (the sounds of resonance extracted by Harp_2) therefore only one coloured source will appear in the spatial monitor.

An intuitive approach to this kind of interaction is advised, but remember that your hand can have three straight positions corresponding to the high, horizontal and lateral axis, which displace the three sound sources in the space positions shown here on the left. Any intermediate position of the hand will move the sound sources accordingly.
The overall velocity of the hand affects the velocity of shifting of the electronic sounds. In addition the hand velocity strongly increases the reverb of the *flanger* effect, when it is active.

These three methods of performance show an unconventional, gestural and highly conceptual way to play the harp. Maybe not many notes are performed, but each sound is charged with a strong compositional influence, and intriguing gestural aspect.
Sometimes you will be less focused on the "logic and beauty" of the music coming from your harp, and much more on the sensitivity towards the interaction.

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[3] Stable/unstable timbre is technically detected as “spectral flux”: sharp attacks, noise and pitch variability will show more unstable values. Dissonance is computed through “roughness” (timbre dissonance): melodic/harmonic dissonance, scraping sounds, but also very low resonant notes create the sensation of timbre dissonance.

[4] A simplified tracking could be exploited by a mobile or an iPod tied around the right forearm.

HARP_2

Modes of performance

1) 0'00" -> 2'00" Resonances (on Harp_1)

2) 2'00" -> 8'00" Breaths/Voices/Blows – Digital Interaction (on your microphone)

3) 8'00 ->10'00" Resonances (on Harp_1 again)

Shift between "resonances" and "blows" without any hurry or strict sense of time.

Your resonances are **the opening event of the music, the first sound will not appear immediately,** wait patiently for it and then start to very gently modulate and harmonise it.

Approximately you go in front of your microphone when Harp_3 starts playing, and you return to scan the harp resonances after both Harp_3 and _4 have begun the activity in the last part of the music.

These **two opposite performance modes** have in common an airy and wireless relation with the sounds of technology, in both cases the pitches emerge as byproducts of scratch and noise. Resonances are sounds of the environment, in the mid part of the performance the "resonance" becomes more conceptual, since your voice (or flute) timbre has the power to electronically transform the sound of the harps: in other words it is a hyper-instrument.

"Resonances" are explained above, **"Digital Interaction"** on the next page.

Your sounds are also feeding the pentagram score of Harp_4 during time-defined moments of the performance.

The yellow button flashes during the times of the score-feeding of Harp_1: if you wish, you can be more active and harmonic during these moments, in this way putting some melody inside the score.

Fig.14 Melody enhancer

Digital Interaction

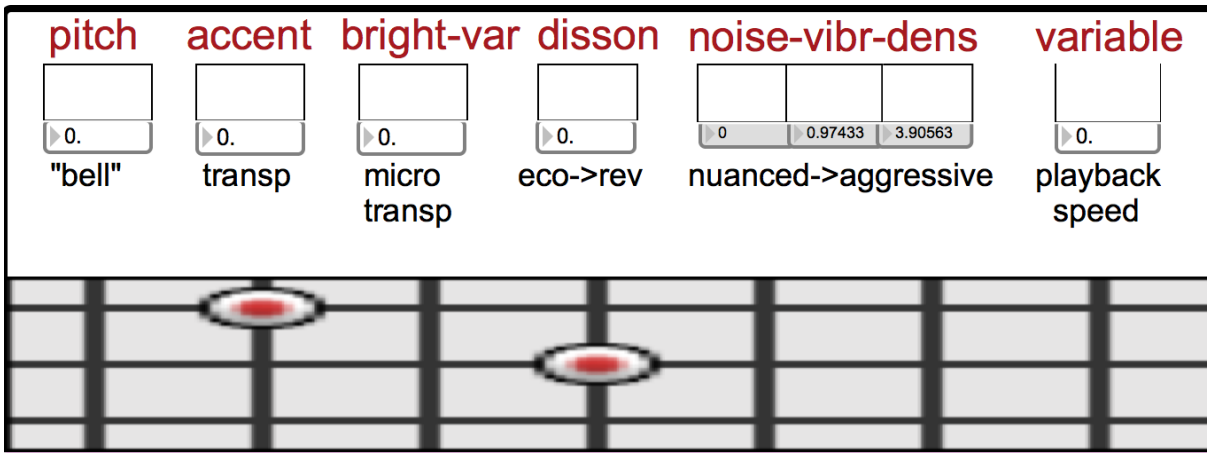


Fig.15 Hyper-instrument console

During the Digital Interaction you have the power **to modulate the electronic sounds coming from Harp_3 and _4. Your timbre micro-shapes directly affect the live electronics.** In the upper part of the laptop-screen you can monitor your timbre shapes, which share the same curves affecting the electronic effects.

These modulations operate only inside the currently active effects, if more effects are opened in parallel your timbre will be transforming many different effects at the same time.
The effects are opened by Harp_1 and you can see which ones are working by looking at the matrix called "effects" below your monitors (red points mean open effects).

Sound analysis is active only when the intensity of your sound is not too low.

Description of the input sounds

The music is improvised, but the acoustic sound is only a partial focus, since **any sound inflection is finalised to shape the live electronics of the harps.**
The performance is conceived for voice or/and any kind of flute.
Your music shifts between sound/noise, pitch/breath, voiced/unvoiced.

Schema of the effects

Played feature	Transforming technology	Heard effect upon the amplified harps
-1) PITCH	-> ring-modulation	(large bell -> medium bell -> small bell)
-2) VOLUME	-> melodic glissando	(sitar -> harp -> sitar)
-3) BRIGHTNESS	-> beats	(normal -> dissonant -> detuned)
-4) DISSONANCE	-> delays	(eco -> multiplication -> resonance)
-5-6)PERIODICITY+DENSITY	->spectral-decomposition	(pan-flute -> artificial harp ->aggressive)
-7) VARIABILITY	-> playback-rate	(accordion -> normal speed ->fast harp)

Explanation of the effects

-1) Pitch to ring modulation

-ring modulation detunes the spectrum of the harps through a sound frequency that modulates them

-the result is **a hybrid bell-like sound**

-the machine detects your pitch in real-time and continuously tunes it to the modulating frequency

-you have control over the hybridising frequency, affecting the sensation of width of the imaged harp-bell (low pitch = large bell).

-2) **"Volume" to melodic glissando**

-variable pitch transpositions are applied to the harps (within a major 3rd range)

-the result is a **continuous glide** up and down **(sitar-like effect)**

-the machine doesn't exactly detect your sound amplitude ("Volume" is here only a conventional name), instead it detects how much your crescendo/decrescendo is intensifying or relaxing. Notice that the resulting value is not the intensity of your de/crescendo, but how much it "accelerates": in this way your "effort" is active, rather than your sound intensity

-if your crescendo is increasing in a linear proportion (or the decrescendo linearly decreasing) the harp sounds will be in tune, if you impulsively accentuate your crescendo (or refrain the decrescendo) the harps make an upward glissando, if you release the push of your crescendo (or immediately drop with decrescendo) the harp make a downward glissando (sitar-like effect).

-3) **Brightness to beats/detuning**

-microtonal pitch transpositions are applied to the harps

-extremely subtle glides give the impression of a rough beating timbre, if they increase beyond the range of (approximately) 1-2 eighths of a tone, they are audible as detuned sounds

-brightness is enhanced by the high-frequency components of a sound and it is connected with the impression of its "brilliancy": a noisy or hybrid sound is extremely bright, a tense timbre is brighter than a relaxed or resonant one. This system detects the variation in brightness: if you start a soft sound and increase its tension, you should gain a positive value; the transition from a voiced sound to a breathy/noisy one also returns a positive value, and the opposite

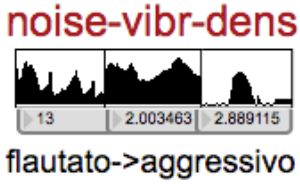
-you can detune the harp sounds by navigating between contrasting timbres, or keep them tuned by holding onto the same kind of sonority in terms of its brightness.

-4) **Dissonance** to *delays*

-artificial echoes (more or less repeating themselves) are applied to the harps -1 distant echo is 1 repetition of the sound, more repetitions at a short time distance (i.e. half of quarters of a second) result in a dense overlapping sound texture, numerous echo repetitions in the range of 20/50 milliseconds create a sensation similar to reverb - roughness is a method of computing how "dissonant" the timbre is. Effects involving pitched noise (such as jet whistles, rumbles) or small spectral shifts (i.e. exaggerated vibrato, or detuned low pitches) sound more "dissonant" than pure noise, pure harmonic tones are not at all dissonant, but they could increase their dissonance in the case of quick melodic passages

-The more you are "pure" and the more 1 single detached echo is discernible; dissonant sounds multiply and approach echoes in time, pitched noises (very rough) simulate reverb.

-5-6) **Periodicity/density** to spectral decomposition



-these effects called "spectral decomposition" (more confidentially "pan-flute effect") perform a splitting process between the sinusoidal (harmonic) and the noisy (high frequency) components of the harp sound

Fig.16 The "pan-flute effect"

-in this way it is possible to output only the sinusoidal part of the sound **("pan-flute effect"),** only the noisy part ("aggressive" effect) or some mixes of the two. Take into account that the reconstruction of the sound can be reduced to its most prominent components (resulting in an effect perceivable as "artificial"), or expanded to a broad palette of partial components (allowing from "realistic" to "hyper-real or exaggerated effects)

–your interaction mixes periodic vs. noisy sounds, static vs. vibrato-like sounds, light vs. dense timbre

–density and noisiness make the electronics aggressive, lightness (and pure high pitches) create the "pan-flute" effect (enhanced when the sound is pure and periodic), trills, vibrato and breaths enhance the artificiality of the effect.

7) Spectral flux to **playback speed**

-short chunks (2 ½ ") of harp sound are live recorded and played back as loops at variable speeds

-high speed increases the density of the loop, low speed stretches the sound giving more focus to the timbre, negative speed reverses the sound which resembles an accordion rather than a harp

-the spectral flux detects how variable the sound spectrum is (i.e impulsive attacks, noisy contents, complex-discontinuous timbres)

-therefore **through high timbre variability you increase the velocity of the harp playback, but through a very static sound the accordion-effect is discernible.**

Timbre analysis remarks

You will easily notice that the mapping-effects connected with pitch and “volume” are more natural as controllers of the electronic sounds, but the other timbre mappings can be quite complex and elusive.

Timbre is almost impossible to be fully defined by numbers. Machine sound analysis is often modelled upon the patterns of human perception, but the two “languages” are not the same. Timbre qualities are generally codified in our brain as music concepts (i.e. bright, expressive, nasal etc.) or as instrumental techniques (i.e. vibrato, flageolet etc.).

The physical qualities of sound vibration, detected in your monitor by the analysis machine, are only traces of your timbre, a sort of interactive score, upon which to find creative and meaningful solutions for shaping the sounds of the electronic harps.

Towards a vocabulary

Harp_2 shapes the electronics through 8 sound descriptors (3 of which are variable quantities). Below is a short vocabulary of instrumental techniques apparently influencing the 4 fixed descriptors: Dissonance, Noisiness, Vibrato, Density. As observed above, there is no straight correspondence between one technique and a reciprocal analysis feature, only an influence happening under different sound conditions.

Dissonance
High value: Singing into the flute (detuned), jet whistle, breathy attack
Mid value: Breathy-sound, chromatic quick passage, deep low pitch

Noisiness
High value: Breath
Mid value: Breathy attack, trill, multiphonic

Vibrato
High value: Trill
Mid value: Vibrato, flatterzeug, flageolet, breath

Density
High value: Low tense pitch,
Mid value: Pitched noise, multiphonics, crescendo

HARP_3
1) 0’00” -> 2’00” Silence

2) 2’00” -> 7’00” Sound gestures (Improvised harp effects)

3) 7’00 ->10’00” Resonances (see section above)

You receive a graphic-verbal animated score.
You are the last performer starting to play: when the screen is empty it means silence.
The performance happens when one or more verbal labels appear indicating sound effects upon which to freely improvise:
-trills,
-arpeggios,
-nails (vertical scratch),
-pedals (sounds of just the pedals in this case),
-harmonics,
-claps (hand percussion on the instrument body),
-glides,
- high-pitches (extremely high passages).

The width and the position of the labels (sometimes moving) suggest modes of performance. Sometimes the labels are numerous (their number is related to the overall density of the electronics), in this case the performance has to be more intense until agitation, or even emotional explosion.
On the contrary one or two single labels, their smaller dimensions, and slow/absent movements suggest a reduced energy.
Some moving waves appear on the screen intersecting the written labels: feel and invent the appropriate sounds.

The time occurrence of the animation is fixed, not the contents since they are shaped by the sound of Harp_1.

When the background becomes black it is the signal to stand up, grab the microphone from the stand and start to scan the resonances: the other players eventually will be joining you in the same activity.

At the very end, fading out the sound, maintain the movement for a while, as an empty gesture.

HARP_4

1) 0’00” -> 1’00” Silence

2) 1’00” -> 7’30” Phrases (sight reading the interactive score)

3) 7’30 ->10’00” Resonances (see section above)

The score appears at fixed times (as indicated in the bottom part of the screen).
A couple of times the note sequences are the exact repetition of the previous one.

When the score appears you have 30" to mentally read it, after that, a green pointer starts to shift from left to right and you follow its position by playing.

Grey notes are to be played softer.

Don't accentuate the rhythmic values; the flowing time relationships are often underlined by grace notes and sequences of re-bounced notes.

Play with intensity.

Your score is a symbolic resonance of the sounds coming from Harp_2.

When the background becomes black, take the time to finish your score sequence: Harp_3 will be already beginning to scan the harp resonances. Without any hurry join her in the same activity.

At the very end, fading out the sound, keep the movement for a while, as an empty gesture.

TECHNICAL NOTES

HARDWARE EQUIPMENT AND SETUP

-2 laptops positioned in front of the two couples of performers, connected by one Ethernet cable (1000Mbit/s, 3 meters long at least).

-Laptop_1 is concerned with interaction and sound processes, it must be a Mac.

2,4 Ghz double processor, 4 GB RAM, as minimum requirement, more power is advised.

Laptop_2 receives data without processing audio, and sends the screen (scores) to a projector: it can be Mac or Windows.

-Sound card at least 4 inputs (3 microphone inputs + 1 line input) and 4 outputs, connected to laptop_1. Optional mixer.

-Quadraphonic PA

-2 small audio monitors positioned on stage, near to the opposite couples of performers, in order to increase and modulate the audio-feedback

-1 triaxial accelerometer for Harp_1 (mobile accelerometers could be a reduced option).

-Projector for video streaming of the animated scores of laptop_2

MICROPHONES (minimal requirements):

-1 specifically designed harp-pickup (or a piezoelectric pickup positioned inside the back column facing the string joints) for Harp_1: the pickup should be positioned in the middle part of the soundboard in order to offer a middle-register sweet-spot

-1 condenser microphone for Harp_2

-2 high quality dynamic, or directional condenser microphones for Harp_3 and _4 (one for each harp).

MOTION TRACKING

Inertial Motion Tracking is tested with the Orients_15 System, developed by the Centre for Speckled Computing of the University of Edinburgh, [5] running through the orientMac application. This application and the related Readme.txt document are contained in the main folder of this software.

The system needs a native Bluetooth 4 Mac version as minimal requirement.

A different Motion Tracking system is allowed by substituting the abstracion “or_data” with a different OSC udpreceive module, which must contain proper scaling and normalisation. Details are given inside the module “or_data” and in the Readme text file.

[5] www.specknet.org

AUDIO SETTINGS

The option to output portions of direct amplified sound from the instruments (through audio card or mixer) is to be carefully balanced before the concert depending on the audio-feedback response.

Sound setting before the concert is crucial, and the dedicated software section is visible in Laptop_1

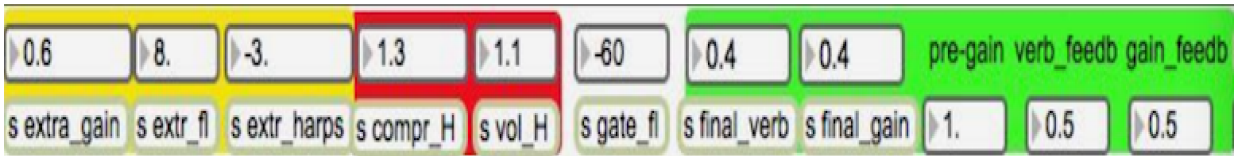


Fig.17 Setting section in Laptop_1

Feedback extra-gains

-“s extra_gain” enhances the global feedback from 0.5 upwards
-“s extra_fl” and “s extra_harps” sets the extra gain in Db
(separately for Harp_2 and Harp_3 _4)

Harp inputs

Sometimes the levels of the live processed instruments (Harp_3 and _4) are not sufficiently high. Pre-DSP software gains are necessary: they affect both harps
-“s vol_H” sets the initial input amplitude (pre high-pass filtering)
-“s compr_H” sets the final input amplitude (post high-pass and pre-DSP)

Threshold of analysis

-“s gain_fl” set the minimum signal level in Db, sent to the analysis module, in order to allow just the analysis of instrumental sounds, cutting the environmental noise

Final mix

-“pre-gain” sets the final amplitude of the processed harps (Harp_1 excluded)
-“gain_feedb” sets the final amplitude of the audio feedback
- “verb_feedb” sets the final amplitude of the reverb applied on audio feedback
-“s final_gain” sets the final amplitude of the overall electronics
-“s final_verb” sets the final amplitude of the overall reverb

Dry and reverbed outputs are independent signals mixed up.

After the last saved setting, press “write” (right bottom of the patch)

SOFTWARE

The interaction is designed in MAX/Msp (6.1.10).
Laptop_1 exploits some externals specific for Mac, Laptop_2 can be Mac or Windows.
Every laptop exploits a different patch, talking through Ethernet.

Requirements: MAX/Msp 6.1, or *Awakening,* plus *Awakscore* standalone applications.
Python plus the dedicated python folder installed in Laptop_1
(or otherwise a different Motion Tracking system, not excluding a simple mobile setup).

In case of a different MT system, replace the “rec_orient” abstraction and “p gyros” patcher with a fitting module. In case of mobile MT the “mobile_data” abstraction is given inside the main folder.
See the Readme.txt, for details on Motion Tracking installations.

LIST OF EXTERNALS AND ABSTRACTIONS
LAPTOP_1-Awakening

ambiencode~, ambidecode~, ambimonitor (Jan Schacher)
http://trondlossius.no/articles/743-ambisonics-externals-for-maxmsp-and-pd

chroma~ (Adam Stark)
http://c4dm.eecs.qmul.ac.uk/people/adams/chordrec/

contrast-enhancement (Michael Edwards)

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

ej.line (Emmanuel Jourdan)
http://www.e--j.com

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

ftm, ftm.copy, ftm.list2col, ftm.mess, ftm.object,
gbr:fft, gbr.slice~, gbr.wind=, gbr.yin,
mnm.delta, mnm.moments, mnm.onepole
FMAT and Gabor library (Norbert Schnell et al.)
http://ftm.ircam.fr/index.php/Download

jfc-spectral-tutorial3, melody2harmony (Jean Francois Charles)
https://cycling74.com/toolbox/live-spectral-processing-patches-for-expo-74-nyc-2011/#.Vh0sE2A-BE4

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

newverb~ (freedistribution)

OSC-route (Matt Wright)
roughness (John MacCallum)
http://www.cnmat.berkeley.edu/MAX

SpT.analsynth, SpT.makeharm (abstractions)
Spectral Toolbox (William A. Sethares et.al)
http://www.dynamictonality.com/spectools.htm

zsa.easy_flux (Mikhail Malt, Emmanuel Jourdan)
http://www.e--j.com/index.php/download-zsa/

LAPTOP_2-Awakscore

bach.roll, bach.score, bach.transcribe (Andrea Agostini, Daniele Ghisi)
http://www.bachproject.net

o.route (Adrian Freed)
http://cnmat.berkeley.edu/downloads

INDEX

LIST OF FIGURES