Guitar Improvisations with Hexaphonic MultiEffect (GIHME) dataset and practice analysis

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ABSTRACT

This paper presents a novel guitar dataset made out of richtly annotated guitarist improvisations. The annotations gather notes, playing techniques, instrument tuning, audio effects configurations as well as transcription of post improvisation interviews. The dataset gathers ten hours of improvisations and around five hours of interviews. These accompanying data make this dataset suitable for a variety of different research domains : from MIR to musical improvisation analysis and musicology. The recordings that have yielded to this dataset were done in the context of an hexaphonic multieffect pratice study. This hexaphonic multieffect is meant to work with an hexaphonic guitar (one pickup per string guitar) and grants the player with independent audio effect configurations for each string. This paper presents the dataset and the experiments it has been gathered from. It also details, based on the transcriptions of the interviews, a first analysis of the specificities of an hexaphonic multieffect practice.

1. INTRODUCTION

An hexaphonic guitar is an electric (or acoustic) guitar equipped with an hexaphonic pickup. This device gathers six individual pickups, one per string. As a result, six audio signals are available for further processing [1]. With such system, different audio effects or analysis tools can be applied to each string independently. This type of pickups appeared in the late 1970s with guitar synthesizer which as its name implies corresponds to a guitar that can control a synthesizer. On this type of instrument, hexaphonic pickups are of great help in converting notes to control signals, because they narrow down the complexity of pitch detection from polyphonic to six monophonic algorithms running in parallel. Apart from that main commercially-developped use case, hexaphonic pickups can be use for independent-string audio processing. The first physical units integrating independent-string audio processing (either in synthesizer or in guitar pedal effects) appeared at the end of the 1970s but, despite the large amount of creative potential it seems to have, hexaphonic audio processing has never reach a larger audience and remained a niche. Interests in such approach have resurfaced in recent years with companies like Cycfi [2] and Synquanon [3]. The former manufactures the Nu Series pickups [4]. The Nu is a one string pickup active pickup which can be gathered in series of any number (i.e. it can be adapted to bass guitar, double bass, 6, 7 or 8 strings guitar, etc.). The latter develops hexaphonic aufio effects in the form of eurorack modules.

The series of experiments and the resulting dataset [5] presented here were made to try to understand how individual string processing affects the practice of guitarists. Five guitarists used the hexaphonic multieffect for three days to record improvisations based on pre-defined scenarios. The resulting dataset is made out of objective data (notes, playing techniques, effect configurations, etc.) which were collected automatically, semi-automatically or by hand, and subjective data (transcriptions of guitarist interviews). These different types of data make the dataset suitable for different research fields ranging from Music Information Retrieval (MIR) to Musicology as well as Music Improvisation Analysis. Ten hours of musical improvisations are being annotated and four and a half hour of interviews have been transcribed. As the amount of objective data is quite important (despite the limited number of guitarists), the first analysis presented here is based on interviews of guitarists. This analysis helps to highlight terms and notions describing different points of interest for the musicians of such a setup.

While section 2 will cover works related to our topic, sections 3, 4 and 5 will develop different points of the experiment. Section 6 will describe further the built dataset and section 7 will bring an analysis based on the interviews of the guitarists. Finally, section 8 will highlight future work before conclusion (section 9).

2. RELATED WORKS

Music datasets are mostly built and used in MIR-related contexts. Some contains multiple types of musical instruments [1], and some are oriented towards specific instrument such as the piano [2, 3] or the guitar [4, 5]. Most of these datasets are built for pitch and onset detection but

[1] As a comparison, on regular electric guitars, monophonic pickups mix the sound of all resonating strings down to one audio signal.

[2] https://www.cycfi.com/ (08/02/2022).
[3] https://www.synquanon.com/ (08/02/2022).
[4] https://www.cycfi.com/projects/nu-series/ (08/02/2022).
[5] https://github.com/numediart/GIHME (08/02/2022).

some of them are made for tasks such as guitar playing techniques [6], chords [7], effects [8] and playing modes detection [9]. Other approach such as non-negative matrix factorisation have been used with the hexaphonic guitar [10] to provide automatic transcription of the instrument.

Aside from these datasets which were built to improve existing results on the MIR-related tasks, some are built to study musical and instrumental practices such as the Weimar Jazz Database from the Jazzomat project [11] which uses, as well as other tools, different MIR techniques to extract relevant information to describe and classify jazz improvisations. As mentioned above, the dataset presented in this paper goes a bit further by proposing recordings inprovisations of guitarists made using an hexaphonic multieffect and different types of annotations.

First hexaphonic effects appear in the late 1970s and beginning of the 1980s. The ARP Avatar [6] guitar synthesizer and the Roland GR-100 [7] both includes an hexaphonic distortion effects while the GR-300 [8] integrates an hexaphonic harmonizer. Apart from this already established companies, engineer Keith McMillen developed the PolyFuzz [9] guitar pedal (used by guitarist John Abercrombie) which integrates distortion, fuzz and suboctave effects. Swiss Luthier Matthias Grob buildt, under the brand Paradis and around the same period, its PolyDistortion [10] followed by a multieffect. He then went on developing the Polysubbass [11] (which octave down each string) and the Mathons VST plugins serie [12]. More recently, several scientific works deal with the development of hexaphonic audio processing tools [12] and their use in performance context [13–15] [13].

3. EXPERIMENT STRUCTURE

The experiment presented here was built up to investigate specific uses of hexaphonic pickup and multieffect, namely the distribution of audio effects on specific groups of strings and the control of individual bypasses of the audio effects. For this experiment, five guitarists have been recorded playing the hexaphonic multieffect on specific pre-defined scenarios. Four of them are professional guitarists and/or composers and/or improvisers and the last one is an amateur guitarist/composer [14]. The four professional guitarists are part of a collective of musicians [15] whose musical projects range from jazz and improvisation, to contemporary and prepared instruments while the amateur guitarist mostly evolves in rock style related music. While the practice of the professional guitarists can vary greatly from one guitarist to another, one could said that they mainly share the same modes of playing as a common ground. As one may have noticed, this dataset is clearly unbalanced in terms of professionnal vs. amateur. The point of this first analysis was not to compare guitarists in their use of the hexaphonic setup, but to try to understand how one guitarist practice is impacted (or not) by the use of this setup. In the rest of the paper we'll be referring to the guitarists using number from 1 to 5, 5 being the amateur guitarist.

3.1 Pre-defined scenarios

The whole process of this experiment go through the 3 following scenarios:

- The first scenario is a "discovery scenario" where the guitarist, with the aid of the researcher, tests each hexaphonic effects, builds presets and create a "main sound" (i.e. chain of chosen effects and presets) to start working on the next scenario. No improvisation was recorded during this scenario.
- The second scenario investigates the distribution of effects on specific guitar strings by applying the chosen "main sound" to different groups of strings while the remaining strings are left "dry" (i.e. without any effects).
- The third scenario studies how this setup can be controlled in a performance context. A generic MIDI foot controller (Behringer FCB1010 [16]) was used to control different granularities of individual audio effects bypass controls (e.g., global effect bypass versus string-independent bypass).

As a matter of clarity, the "discovery scenario" was named scenario 0 and the two remaining, respectively, scenario 1 and scenario 2.

3.2 Scenarios 1 and 2 protocol

Scenarios 1 and 2 follow the same protocol:

- They are made out of five sub-scenarios;
- Each sub-scenario are made of three steps:
  - Test : the guitarist plays with the proposed subscenario's configuration and tries to develop musical ideas that can be used during the improvisation;
  - Record : once the guitarist is satisfied with its findings, he records an improvisation of 3 to 4 minutes minimum (the longest being 18 minutes);

[6] http://www.vintagesynth.com/arp/avatar.php (08/02/2022).
[7] https://www.joness.com/gr300/GR-100.htm (08/02/2022).
[8] https://www.joness.com/gr300/GR-300.htm (08/02/2022).
[9] https://dokumen.tips/amp/documents/keith-mcmillen-timeline.html (08/02/2022).
[10] http://www.matthiasgrob.org/pEE/sndhist.htm (08/02/2022).
[11] http://www.polybass.com (08/02/2022).
[12] https://www.mathons.com/ (08/02/2022).
[13] Sound recordings of hexaphonic effects can be found online, https://soundcloud.com/medicationtime/sets/hexaphonic-effects (08/02/2022).
[14] https://www.youtube.com/channel/UCLHyrUsYR-gE5r_4Vs45xkQ (08/02/2022).
[15] https://muzzix.info/ (08/02/2022).

[16] This controller provides ten buttons (configured with on/off behaviours) which can be linked to different mapping configurations (also called pages or banks in this type of devices). The browsing (going up or down) of this list of configurations can be done by two other buttons. Two continuous foot controller are also present on the device but were not used in the context of these experiments.

Name	Strings with effects	Strings with no effect
1_1	E-A-D	G-B-e
1_2	G-B-e	E-A-D
1_3	E-D-B	A-G-e
1_4	A-G-e	E-D-B
1_5	Distribution (2_3 or 2_4) chosen by the guitarist and definition of recallable presets	

Table 1. Scenario 1 sub-scenarios [20] .

Name	Bypass controls mappings
2_1	1 button controls the bypass of 1 hexaphonic effect on all strings
2_2	1 button controls the bypass of the effects applied on 1 string
2_3	1 bank per effect and 1 button per string
2_4	1 bank per string and 1 button per effect
2_5	Distribution chosen by the guitarist

Table 2. Scenario 2 sub-scenarios.

  - Interview : the guitarist and the researcher talk about specific elements of the improvisation that was just recorded.

- The two last steps can be repeated any amount of times the guitarist feels like, leading to try out different presets (i.e., changing the "main sound" to fit one specific sub-scenario) and/or different modes of playing;

- While the four first sub-scenarios are pre-defined, the fifth one is created by the guitarist. In scenario 1, the guitarist can choose the group of strings on which the "main sound" can be applied. In scenario 2, the guitarist can decide which bypass control configuration he wants and create presets.

Table 1 and 2 summarize the different configurations of the sub-scenarios contained in each scenario. While sub-scenarios 1_1 and 1_2 uses separation between "low" and "high" strings which is already used by guitarists in different playing style [17] , scenarios 1_3 and 1_4 are relatively unatural for guitarists as effects are being applied on non adjacent strings. It has also to be noted that sub-scenarios 2_3 and 2_4 come out of the foot controller structure. Indeed, as only ten buttons [18] are available at once on the controller, mapping strategies needed to be defined in order to access the 36 individual bypasses of the multieffect (6 effects available on 6 strings). Another setup, e.g., with 2 Voes MX-18 (matrix of 6x3 footswitches) controllers [19] (which we didn't know of at the time of the experiment), may have only need one sub-scenario to access the 36 individual bypasses controls.

4. HEXAPHONIC MULTIEFFECT

The hexaphonic multieffect used in these experiments is depicted in figure 1. It has been developped using Cycling' 74 Max software. This patch is an adapted version of the one presented in [13]. The multieffect gathers four main elements: six hexaphonic audio effects, a bypass matrix grouping individual effects bypasses, a routing system to define effects order, an output mixer to adjust strings output levels individually. In order to help the guitarists focusing on the hexaphony pratice as much as possible, the six audio effects (overdrive, delay, ring modulation, flanger, tremolo, reverb) were chosen, arguably, among the most common for electric guitarists. Each of the effects integrates six instances (depicted by graphical colorful sliders) of each of its parameters, a preset system (with an interpolation option not used in these experiments) and individual bypasses. Those individual bypasses are gathered and developped graphically (bottom right part of the patch), forming a 6x6 graphical matrix that more easily gives visual feedback to the guitarist when using the foot controller in scenario 2. The default order of the effects routing system follows the graphical display of the patch (same as listed above). Only one of the guitarist changed this default setting by moving the delay just before the reverb effect. Lastly, an output mixer is used to balance the sound of each string. This mixer is particularly useful in the first scenario, where the difference in sound amplitude between the strings with effects and the strings without effects can be pretty significant.

5. AUDIO SETUP AND RECORDING PROCESS

The audio processing setup is made out of several components:

- Two Godin guitars equipped with RMC hexaphonic piezoelectric pickups were at the disposal of the guitarists. The first one, a Godin Multiac, is a nylon-string guitar whereas the second one, a Godin LGXT, is a steel-string guitar. Only one of the guitarist tried the first one, but eventually felt more at ease with the second one;

- A homemade breakout box is used to power pickup electronics and to convert the standard 13-pin din connector used for the hexaphonic pickup [21] to six standard monophonic 6.35mm female jack cable;

- The breakout box is connected to an RME Fireface UCX soundcard throught six mono Jack cables. Sampling rate was set to 44100 Hz and 16 bits of precision were used;

- The computer used is running Max software and the hexaphonic multieffect patch described in section 4;

[17] We can think, e.g., of acoustic blues style where guitarists often plays the accompaniement part on the low strings (often with alternating bass technique) and the melody on the high strings.

[18] See footnote 16 .

[19] `https://www.voes.be/mx18.html` (08/02/2022).

[20] The standard tuning of a six-string guitar is E-A-D-G-B-e, the **E** string being the 6th string and the **e** string, the 1st string.

[21] This "standard" connector is mainly used by Roland which has been the main company developing guitar synthesizers.

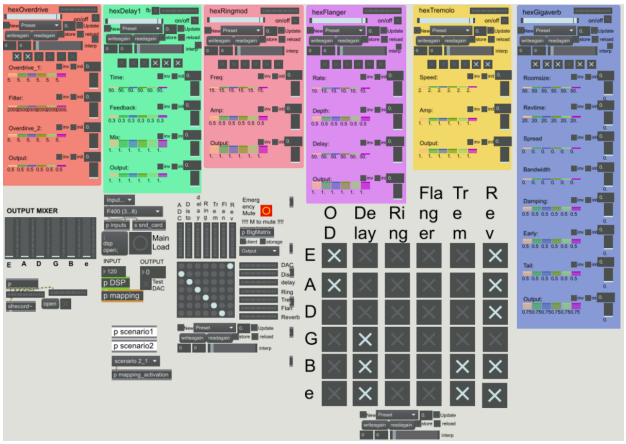

Figure 1. Hexaphonic Multi-Effects used for the experiments.

- Hexaphonic outputs are then connected to a mixing desk and to a quadriphonic Genelec speaker system (completed by a subwoofer). This diffusion system was the one present in the recording room and couldn't be moved. No specific spatialisation was used as it was not the subject of this experiment. The resulting sounds of the six strings were all equally broadcast on each speaker.

Multiple audio and video files were recorded during the experiment. On the audio side, the hexaphonic audio signals were recorded before ("dry" or "clean") and after ("wet" [22]) the chosen audio effects. As the result, the clean hexaphonic signals enable to easily use any type of algorithm detection to ease the annotation part and the wet hexaphonic signals give a detailed look at the produced sound. A monophonic reduction of the hexaphonic wet signals was also recorded in order to have a low quality format easier to work with (only the two first channels of hexaphonic audio files can be heard when listen to through audio player software). Moreover, the guitarist was asked to start (when ready) a mono mix recording of its improvisation. On the video side, a Nikon 5D mark IV camera was used to capture the guitarists while the were playing (during test, improvisation or interview parts). Video files were recorded with a resolution of 1920x1080 at 25 fps. The screen of the computer, on which the audio program ran, was also recorded in order to keep track of the user changes to the program GUI. The video conference software Zoom was used for that purpose so that recordings could be launched remotely without having the guitarist to do it.

All recorded signals were synced by sound. The guitarist was asked to pluck the lowest string with a palm-muting technique in order to record on each media a sharp event that can easily be detected and refered to.

[22] The "wet" term is often present in effects like reverb for example where levels of modified signals and non modified signals can be modified. In this context, this term refers to the level of the modified signal.

6. DATASET

Once all those raw signals are recorded, several steps are necessary in order to obtain a useable dataset.

The first step was to extract from recorded audio and video files, the media corresponding to each specific sub-scenario recordings. Syncing points (made by plucking the palm-muted lowest string), as well as timings of sub-scenarios parts (test, recordings or interviews) were annotated by hand in order to automatically trim and export files corresponding to each sub-scenario. The trim and export steps were done using `ffmpeg` [23] and `sox` [24] softwares, respectively for dealing with video and audio files. Each part of each sub-scenario is then made out of 5 files:

- 2 video files: one from the camera, one from the computer screen;
- 3 audio files: clean and wet hexaphonic signals as well as monophonic mix down of wet hexaphonic signals.

The second step was to annotate each sub-scenario. Different types of annotations were used for different types of collected data:

- Global information, such as scenario and sub-scenario number, instrument tuning (and its evolution if necessary), duration of the specific part, used audio effects and presets, were collected;
- Played notes have been retrieved by using a semi-automatic method similar to the one used in [5]. Six automatic pitch extractions were performed in parallel, on the hexaphonic clean signals. As tuning (i.e., pitches of the strings when no notes are fretted) of the guitar was known, fret number was inferred from pitch extraction result and string number. `Aubio` library's [25] implementation of `yin-fft` algorithm [16] has been used to perform this task [26] . The data generated by the algorithm have then been manually verified in order to consolidate notes and frets information;
- The activation periods of each individual effects from scenario 2 have been automatically extracted from computer screen videos. A computer vision algorithm has been built to track the changes in the indivual bypasses of hexaphonic effects of the graphical user interface (thoses changes have then been computed as time segments). Moreover, in order to be able to easily visualize those changes with the improvisation, the global bypass matrix from the computer screen videos has been cropped and overlayed on top of the camera video;
- Common guitar playing techniques, such as bend, harmonics, hammer-on, pull-off, etc. (see, e.g [6],

[23] `https://www.ffmpeg.org/` (08/02/2022).
[24] `http://sox.sourceforge.net/` (08/02/2022).
[25] `https://aubio.org/` (08/02/2022).
[26] It has to be noticed that different pitch detection algorithms were tested inside of Sonic Visualizer software and that the `yin-fft` algorithm appeared to give the best results.

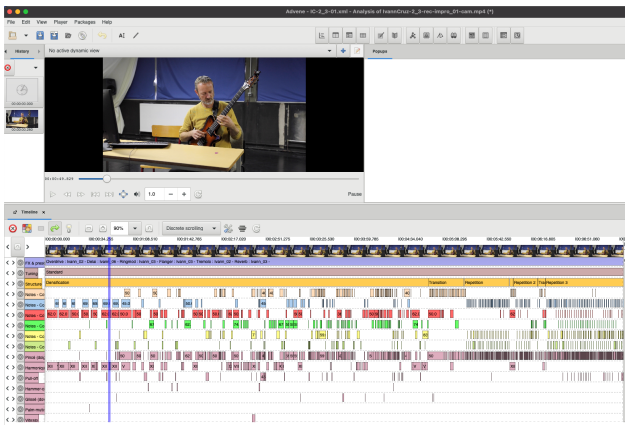

Figure 2. GIHME annotations integration example in Advene software.

> for details on such techniques), have been manually annotated. Extended playing techniques like use of a bow,objects or preparations as well as more advanced techniques like *scordatura* [27] are also including in the annotations. Definitions and explanations of those kind of extended or advanced techniques can be found in [17], [18] and [19] or [20]. To the best of our knowledge, these kind of techniques are most often not present in litterature's datasets.

All the data detailed above are stored in various file formats (`json`, `txt` or `csv`) in order to be compatible with different visualisation software like Sonic Visualizer [28] or Advene [29] . An exemple of the collected data integrated in Advene software can be seen on Figure 2.

To complete the objective collected data, interviews made after each improvisations have been transcribed. The method used for the transcription is the one of the verbatim. The use of the verbatim here is made so that researchers from other fields willing to analyze those texts can access the data in minimally modified form. Only some common french oral language words or expressions have been rewritten with more readable terms. The analysis that we are making in next section is specifically based on those transcriptions.

7. INTERVIEWS ANALYSIS

This analysis of the words of the guitarists is a first step towards understanding and characterizing their practices have been altered by the use of the hexaphonic multieffect. The different points presented below give good hints about the impact of hexaphonic multieffect on practices of guitarists, but, for now, it cannot be easily generalizable as the number of guitarists who participate in that experiment is pretty small.

7.1 Constraints and limitations

Before talking about the impact of the hexaphonic multieffect itself, one common element to all guitarists is that, at some point, they felt constrained. The limitations they endured were most of the time either due to the configurations of scenarios or to the technical elements used for the experiment.

It has to be noticed that the scenarios and sub-scenarios configurations do act as constraints already, as they put all the guitarists in unusual situations, but most of the time the guitarists have managed to work with them and felt stimulated by them. The constraints listed below are the ones where guitarists had a hard-time integrating those configuration in their improvisations.

Regarding to the hexaphonic, multieffect several constraints were mentioned : the balance between the volume of dry strings and strings on which effects were applied in scenario 1 was, for example, mentioned by guitarists 1 and 3 as being problematic (the issue was resolved by adding the output mixer mentioned in Section 4). Some effects configurations were felt uneasy : guitarist 1 had trouble playing with different delay times when those were not rhythmically related and guitarist 5 felt that applying distortion only on specific strings was not a natural fit for him.

On the scenario level, all the manipulations needed to access the different individual bypasses in scenarios 2_3, 2_4 and 2_5 (due to the use a foot controller FCB1010 as mentioned above) was mentioned by guitarists 1, 4 and 5 as being not intuitive and adding a strong inertia to the whole process. Guitarist 2 felt a strong constraint with effects distribution in scenario1_3 and 1_4:

> I was a bit helpless in fact with a setup like this one. [...] I have my guitarist's reflexes that try to find something but which is not there anymore. So, yeah it tries [...], but it doesn't work. (Guitarist 2, extract of post improvisation interview, scenario1_3-02, pers. comm.).

One last type of constraint is due to acoustic and electric behavior of the piezoelectric hexaphonic pickup. Indeed cross-talk [30] and transfer of a played string's vibrations to other pickups through the bridge create resonances on non-played strings. These two phenomena are particularly significant in scenario 1, where notes played on strings without effects would trigger low volume modified sounds on strings with effects. This is especially true when the distortion is used on the string with effects as it increases the volume of the strings. However, these constraints were used by guitarist 2, 3 and 4 as a mode of playing in itself.

7.2 Appropriation of the system

In spite of the constraints brought by the scenarios and by the technical system, the guitarists have, for the great majority, succeeded in appropriating and integrating the complexity of the system. They have, for the most part, put in place various strategies to reduce this complexity.

[27] The *scordatura* is the action of strongly detuning the strings in order to be able to play with the timbres generated in part by the softness of the relaxed strings.

[28] `https://www.sonicvisualiser.org/` (08/02/2022).

[29] `https://www.advene.org/` (08/02/2022).

[30] A small amount of the sound of a vibrating string is picked up by adjacent pickups.

Guitarist 3, for example, played several improvisations using only a limited amount of prepared strings [31] (scenario 1_2) or a limited way to attack the strings (scenarios 2_1, 2_2, 2_3). In scenario 1_2, guitarist 4 used preparation (a small bar of metal inserted in between the strings close to the bridge) [32] on the three dry strings in order to bring their timbre closer to the ones of the strings with effects. The same guitarist used *scordatura* right from the beginning (scenario 1_1) to limit the harmonic range of the guitar [33] :

> It appeared to me as a way, in this chaos of the low strings [strings with effects, editor's note], to try to find an organization clearer for me. (Guitarist 4, extract of post improvisation interview, scenario1_1, pers. comm.).

In this improvisation, the standard tuning of the guitar, E-A-D-G-B-e, evolved to E-A-D-A-A-e (the D string was left unused during all the improvisation).

During scenario's test step, guitarist 5 played pieces of his repertoire while applying effects in a random manner. Both of these actions (know pieces playing and randomness) helped him to dig directly into hexaphonic effects timbre without overthinking too much. From there he narrowed down to specific choice of effects and presets as well as specific directions for his improvisations (most of the time inspired by the pieces he just played).

7.3 Guitarist practice

The playing of an electric guitar is necessarily modified by the addition of an hexaphonic microphone and of an string-individualized sound processing system. The gestures made by the guitarists no longer have the same scope, the same impact, which leads him to reexamine his relationship with his instrument and therefore his practice. However hexaphonic multieffect practice was not considered by the guitarists as something radically new. As guitarist 2 stated: "it's another instrument, but at the same time, it's a familiar one" [34] .

Guitarist 4 notes the sensitivity of the hexaphonic pickup "regarding the reactivity [...], it's very sensistive [he plucks the strings very slighlty with his nails, editor's note]" [35] . The hexaphonic pickup on this guitar are piezoelectric ones. Those type of pickups sense a broader frequency spectrum [21] than most of the regular electromagnetic pickups found on electric guitars. But what this very technical remark highlights is that this kind of pickup is very good at sensing all subtleties of guitarist's playing. This element is very important in terms of respect of practice and acceptance of hexaphony by guitarists.

Guitarist 1 develops the same idea :

> [...] because there's also the habit of linking instrumental gesture with foot gestures on the pedals. So there you have it, it seems to me to fit more into the same logic, but at a higher level we'll say. (Additional interview, Guitarist 1, pers.comm).

With this quote, guitarist 1 emphasizes that working with the foot controller in scenario 2 is pretty close to its practice of monophonic guitar effect pedals but it adds more relief or details to it. This idea of being part of a known and familiar practice which goes further and needs to adpat is developped by guitarist 2 :

> It doesn't question the pratice. The practice, it stays, it exists. However, it reconsiders it, in the sense where, as new things happen, you have to adapt. [...] It's a system who forces you to look deeply at the instrument for ways to adapt, even if it is a material that I know. I mean, all this effects, I've already used them in my life. They are part of the guitarist's landscape. And despite all that, the fact to use them in hexaphony, you rethink the effects differently too. You rethink, you adapt your playing, an interaction takes place. (Guitarist 2, extract of post improvisation interview, scenario2_5, pers. comm.).

The same guitarist sums up this idea in a pretty concise and concrete way when he mentions "with this system, you have to redraw the geographical relationship with your instrument" [36] . This "geographical relationship" is close to the notion of "mapping" often used in NIME (New Interface for Musical Expression) context. Using an hexaphonic multieffect pushes the guitarist to modify the relationship, one could say the "inner mapping", he has built between his gesture and the produced sound.

From these few excerpts, it appears that this hexaphonic setup can easily integrate into practices of guitarists as it uses the same elements as their regular pratices, but they also need to adapt this practice in terms of relationship between the gesture and the produced sound.

7.4 Hexaphonic specificities

Regarding the produced sounds, several comments develop the idea of this setup having a rich palette of sounds. Guitarists 1 and 4 both make the parallel with the organ. This metaphor derives direclty from the use of the foot controller in the second scenario but also from the vast amount of sounds accessible through this controller and through the playing. Let's remember that scenario 2_5 gives access to individual bypass control of individual effects as well as to presets of the whole bypass matrix. These options gives the musicians the ability to change completely configurations or just to make tiny adjustments, these abilities being modulated by guitarist's playing which itself acts as a "selection gesture" [22] inside of the defined timbre

[31] Instrument's preparation is the process by which object are added or fixed on the strings in order to modify its original timbre.

[32] See video recording at `https://vimeo.com/639069813` (08/02/2022).

[33] See video recordings at `https://vimeo.com/639069333` (08/02/2022).

[34] Guitarist 2, extract of post improvisation interview, scenario 2_5, pers.comm

[35] Guitarist 4, extract of post improvisation interview, scenario 1_5, pers.comm

[36] Additional interview, Guitarist 1, pers. comm.

palette. Guitarist 2 develops this idea by comparing the sound possibilities to the ones given by digital audio workstation (DAW) :

> Precisely, it helps going into fields that could be covered by the digital world and all that. I find that we come close to things like that, while respecting the instrumental practice. [...] I'm not saying that it's like MIDI [...], it's a kind of in-between. (Guitarist 2, extract of post improvisation interview, scenario2_5, pers. comm.)

"Respect of instrumental practice" referred by guitarist 2 echoes remarks from the previous part, but also comes in opposition to MIDI control of instruments. With the hexaphonic system, the guitarist uses the professionnal practice he spent years to develop to access all these sound possibilities.

The specificities of the practices used during this experiments are also the center of the last hexaphonic specificity developed here. Indeed, it appears that practices that already made use of techniques to develop polyphonic or multitimbral approaches of the guitar were enhanced by this system. Guitarist 3 who extensively used preparations during its improvisation points out at several moments the gain of clarity due to the hexaphony :

> [...] one can add a tremolo or a delay on just one string, it's really nice. Or a reverb on one string, it brings a bit of depth and it won't impact everything. On a classic annalog effect, it necessarily take huge proportion. Here, one can add a huge reverb, but just on one string, it's very convenient yeah. (Guitarist 4, extract of post improvisation interview, scenario2_4-01, pers. comm.).

Despite being obvious when said out loud, this remark brings to the fore the idea that monophonic effect pedals are not that well-suited for prepared guitar practice. Indeed, added preparations can be string specific (as well as applied to multiple strings) whereas monophonic effects do apply to all the strings at the same time. In such a context, string specific effect system (aka hexaphonic multieffect) brings a natural continuity to preparations. Guitarist 4 whose practice fals into classical, contemporary and flamenca styles tends to formulate the same kind of idea:

> With a classical guitar, we work with the aim of being able to have an action as independent as possible from each finger and therefore potentially also differentiated regarding the strings. (Guitarist 4, complementary interview, pers. comm.).

This quote comes as a justification of the idea brings by guitarist 4 that the hexaphonic multieffect setup could be of interest of classical guitarists who would want to move on electric guitar. As he mentions, the independence of the finger from each other seems to find a continuity in a string specific audio effects system. This point (that wasn't expected in the first place) and the example of the prepared guitar practice seems to highlight that this kind of system is a good fit for practices that seeks for independance in terms of gestures, of strings or of preparations.

8. FUTURE WORK

While bringing some important notions, this first analysis and this dataset could definitely be improved. Recordings coming from more guitarists with more different styles of music would help broaden the results. The different styles seem pretty important as other music styles come with specific modes of playing, which were not represented in this dataset. These different modes of playing could adapt differentely to hexaphonic effects. We showed a data visualization test in Advene software, but this software, while being able to show all the data (except audio signals) at once, is not optimum to run a study with such a number of different types of data. Being able to switch between audio signals (clean or wet hexaphonic, monophonic or sound from video) while looking at the same video or to summarize relevant data for specific parts of an improvisation are some of the features which would be really useful for this kind of study. Lastly, the first insights gained by the anaysis of the interviews could be broadened by the addition of the objective data and their analysis. The use of a fretboard patterns analysis tool such as the model developed in [23] could help in finding a common ground to the different practices analysis. Further, in order to really understand the impact of the hexaphonic setup on the practice of one specific guitarist, an analysis of its regular practice (i.e. without hexpahonic setup) should be done so as to enable a "before/after" comparison.

9. CONCLUSION

This paper presents a novel dataset including improvisations of 5 different guitarists using hexaphonic guitar and multieffect. Such a system enables them to apply string-independent effects. This dataset gathers 10 hours of improvisations and transcription of 4.5 hours of interviews. Each sub-scenario's improvisation is annotated with pitch, string/fret, playing techniques (including extended techniques), effects configuration and effects activation timings. As these annotations represent a large amount of data, the first analysis given in this paper is based on the different interviews. According to the guitarists, this system, while new, appears to be familiar: effects are a well-known paradigm for electric guitarists and there's no need to learn new gestures; the guitarists' practices can be used as is. What requires a new approach from the guitarists, though, is the impact the instrumental gestures have on the generated sound, what one could call "inner mapping". Indeed by being string-specific, hexaphonic effects add another level to the impact the gestures can have. As a wrap-up, guitarists make several remarks that tends to emphasize that this system is particularly relevant with practices that already use extensively the independance of fingers and strings, such as prepared or classical guitare practices.

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