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Drum set sequencing: An approach to incorporate drummers' peculiarities in MIDI produced audio tracks

Secuenciación de batería: una aproximación para incorporar las peculiaridades de los bateristas en pistas de audio en formato MIDI

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ABSTRACT

With the release of the MIDI protocol, new resources and possibilities have been developed for musical performance, composition and editing. Due to the growing expansion of computers' storage and processing capacities, it has also been possible to increase the quality and specificity of sample libraries. In such a scenario, this mixed-methods research has as its main aim is to investigate drummers' performances focusing on developing pathways to incorporate their features into MIDI sequencing. Derived from it, four specific aims were established: 1) to present the basic elements of sampling and MIDI protocol; 2) To sequence the drummers' performances; 3) to apply quality-assessment questionnaires for the sequencing-generated audios; 4) to present the results' analysis. The inquiry's outcomes demonstrate that characteristics like timbre and dynamics' variation are determinants for the sequencing's acceptance by the audience.

Keywords: MIDI protocol, sequencing, drum set, electronic musical instrument, music production.

RESUMEN

Con el lanzamiento del protocolo MIDI, se han desarrollado nuevos recursos y posibilidades para la interpretación, composición y edición musical. Debido a la creciente expansión de las capacidades de almacenamiento y procesamiento de los ordenadores, también ha sido posible aumentar la calidad y la especificidad de las bibliotecas de muestras. En tal escenario, esta investigación de métodos mixtos tiene como objetivo principal investigar las actuaciones de los bateristas centrándose en desarrollar vías para incorporar sus características en la secuenciación MIDI. Derivado de ello, se establecieron cuatro objetivos específicos: 1) presentar los elementos básicos del muestreo y protocolo MIDI; 2) secuenciar las actuaciones de los bateristas; 3) aplicar cuestionarios de evaluación de la calidad de los audios generados en secuencia; 4) presentar el análisis de los resultados. Los resultados de la investigación demuestran que algunas características, como la variación del timbre y la dinámica, son determinantes para la aceptación de la secuencia por parte de la audiencia.

Palabras clave: protocolo MIDI, secuenciación, batería, instrumentos musicales electrónicos, producción musical.

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1. INTRODUCTION

Since the release of the MIDI protocol (Musical Instrument Digital Interface)[1] at the beginning of the 1980s, new possibilities were developed for musical performance, editing, composition and arrangement (Airy & Parr, 2001; Chattah, 2014; MMA, 2009; Pejrolo & Derosa, 2017). The development of these resources linked with the high-quality recording of musical instruments has significantly changed the music production scene. Due to the growing extension of Hard Drive's storage space and computer's processing power, it was also possible to increase the level of quality and specificity not only of synthesizers but also of sample libraries (Gilreath, 2004; Pejrolo & Derosa, 2017).

This work is based on the investigation of drummers' performances with the aim of understanding features related to sound quality, rhythmic construction and interpretation to its application in MIDI-oriented scenarios. It is proposed an active search for the closest possible correspondence between the original professional performances and the audio created by the association between the MIDI protocol and the acoustic drums' sample library. Therefore, this article's general aim is to examine drummers' performances seeking its reproduction, with the highest possible quality, using the functionalities offered by the MIDI protocol. Derived from this, we can delineate four specific aims: 1) To present the basic features of sampling and MIDI protocol; 2) To describe the process of sequencing of the chosen songs' excerpts; 3) To apply evaluative questionnaires that verify the quality of the audio tracks created by the MIDI sequencing procedures; 4) To present the results' analysis.

There is a goal of reflecting on the development of pathways that bring the MIDI-generated audio tracks closer to the "human-recorded live performances"[2] chosen as this investigation's reference, however, it is not expected that the MIDI generated tracks sounds the same, but rather that it incorporates some elements like interpretation, clarity and variation. It is expected that after developing all procedures, the MIDI-generated tracks make it difficult for the audience to distinguish between the human-recorded live performance and the sequenced ones, demonstrating that professional sequencing methods can simulate professional acoustic performances.

In the theoretical background's development, it was found scientific publications which promoted reflections addressing this article's contents, such as: Phillips (2014), who explains about sample and sampling in MIDI context; Pejrolo (2011), which analyzes MIDI

[1] MIDI is a digital protocol that allows communication between electronic musical instruments, computers, interfaces, etc. Each MIDI link can have up to sixteen communication channels that can be assigned to different equipment. According to Pejrolo, "MIDI messages do not contain any audio information. MIDI and audio signals are always kept separately" (2011, p. 6).

[2] Even though a MIDI-sequence can be recorded live by a professional musician, in this article by "human-recorded live performance" we are referring to microphone-recorded performances of musical instruments, preferably (but not exclusively) acoustic instruments.

protocol procedures; and Carney (2015), who clarifies about contents related to commercial samplers, focusing on the application of the "Round Robin[3]" effect.

This research, with incorporate qualitative and quantitative approaches, was methodologically based on Cohen et al. (2007), Creswell (2010, 2012), Creswell & Creswell (2018), Silveira and Córdova (2009), Marconi and Lakatos (2003) and Moreira (2002). According to Silveira and Córdova "qualitative research is concerned [...] with aspects of reality that cannot be quantified, focusing on understanding and explaining the dynamics of social relations" [4] (2009, p. 32), while Creswell argues that such an approach is "a means to explore and understand the meaning that individuals or groups attribute to a social or human problem" [5] (2010, p. 43). Furthermore, the questionnaires will be applied as a quantitative instrument to gather data. By choosing narrow questions and focusing on methods that allow a carefully-conducted measurement based on the manipulation of a set of variables, quantitative inquires usually concentrate on collecting data by employing tools that pre-establish questions and their possible answers (Cohen et al., 2007; Creswell, 2012; Creswell & Creswell, 2018). As stated by Cohen et al., "quantitative research assumes the possibility of replication; if the same methods are used with the same sample then the results should be the same. Typically, quantitative methods require a degree of control and manipulation of phenomena" (2007, p. 148).

2. CHOOSING THE STUDY MATERIAL

As with the use of acoustic musical instruments, obtaining satisfactory artistic results using Electronic Musical Instruments (EMI) requires the adoption of specific techniques. Such techniques, in the digital environment, can be based not only on mechanical execution, rhythm, volume and timbre but also on the application of digital resources such as the ADSR envelope[6], sound layers, velocity[7] layers, audio samples, Round Robin effect, etc.

Focusing on the audio's generation, recording, storage and manipulation it is possible to identify two main groups among the range of possibilities achieved throughout the use of EMI: the "synthesized" and the "sampled" sounds. In the first group, the audios are created by synthesizers (hardware or software) that are able to "generate waveforms resembling

[3] In sampled EMI, Round Robin is a term used to address a function that commands the usage of different samples every time a note with the same parameter is triggered. For instance, based on this functionality, it is possible to set four different snare samples for a D1 with velocity 96. The employment of the chosen samples can be ordered (i.e. the sample 2 is used after the sample 1, the sample 3 is applied after the sample 2) or random. According to Carney (2015) "What the round robin effect does is allow us to take advantage of the fact that drum sample companies record the same sound several times [...], so we can switch samples".

[4] Here and ahead: authors' translation.

[5] Here and ahead: authors' translation.

[6] ADSR is an acronym of English origin that means Attack, Decay, Sustain, Release. Attack(A) refers to the time that an instrument, after being played, takes to reach its maximum volume; Decay (D) is the time it takes for the sound to go from its maximum volume to reach its stable sustain point. Sustain (S) is the intensity with which the sound remains stable. Release (R) is the time the sound takes, after the instrument is no longer played, to reach silence (Mathew, Abraham & Scaria, 2015).

[7] As with all MIDI parameters, velocity has a scale ranging from zero to one hundred and twenty-seven or one to one hundred and twenty-eight (MMA, 2009). Although commonly used for this purpose, velocities are not necessarily related to sample playback volume.

original acoustic sonorities or create completely new waveforms such as pads and leads" (Pejrolo & Derosa, 2017, p. 60). In the second group, instead of being created electronically by waveform manipulation, the initial material comes from recordings (samples) that are stored, accessed and processed by the virtual instruments. Phillips (2014) affirms that "sample" is a portion of audio that, for commercially-oriented applications, are saved in high-quality formats (e.g. WAVE, AIFF, etc.). According to the author,

> in the case of a musical instrument, a sample is usually a recording that captures the performance of a single note. Every note of an instrument can be recorded separately, and those notes can then be spread across the controller keyboard. This process, known as "multi-sampling", renders the musical instrument playable through the MIDI controller (Phillips, 2014, p. 200).

Both methods of audio generation have their own particular set of challenges and advantages, however, due to the very nature of its initial material, "sampling" usually achieves better results when there is a wish to simulate acoustic instruments (Pejrolo & Derosa, 2017). In addition, due to the notes' short time length and the rapid attack and release in their "natural envelopes", percussive instruments are usually more easily captured and reproduced by "samplers" (Gilreath, 2004). These characteristics allow percussive sound libraries to store lighter samples than libraries dedicated to musical instruments from other families, making it possible to catalog a large number of variations and inflections in a relatively small storage space. In this way, the following criteria were considered to choose the sample library: 1) quality of the samples; 2) quantity of samples in the same velocity range ("Round Robin" effect); 3) quantity and quality of velocity layers[8]; 4) number and quality of samples related to the drumstick's attack location (i.e. center, edge, bell, etc.); 5) relationships between velocity, volume and samples; 6) variety of Kits and drum parts; and 7) possibility of exchanging drum parts within and outside the kits. By analyzing these criteria, the library named EZdrummer 2 - ToonTrack[9] was chosen to develop the research project.

Regarding the human-recorded live performances used as reference to conduct the sequencing procedures, the following elements were considered to select the audiovisual materials: 1) recording quality; 2) different characteristics between excerpts like tempo, groove, genre, etc.; and 3) the existence of a video with reasonable quality that provides different viewpoints for the performance examination. Based on these elements, the following video's excerpts were chosen:

[8] It is a sampler setting that controls the use of different samples based on the velocity informed via MIDI. Through this configuration, we seek to simulate different timbres achieved by an instrument based on the strength applied during the performance (Carney, 2015).
[9] Library's official website: https://www.toontrack.com/product/ezdrummer-2/.

1. *"Gaguinho" (Só Bateria) – Ramon Pika – Pau – HD* – between 00'28" and 01'34"[10].
2. *"Eye of the Tiger" – Drums ONLY Cover – Drum Cover* – between 00'14" and 01'48"[11].
3. *Metallica – Drum Cover – "Enter Sandman" (Drums Only)* – between 00'01" and 01'47"[12].

3. THE SEQUENCING PROCESSES

The sequencing processes had as main aim to reach the maximum possible similarity between the original audio (human-recorded live performance) and the audio track created using the MIDI protocol's functionalities accessed via Digital Audio Workstation (DAW). Since a DAW is typically a very complex software that offers a high range of music-oriented tools, it demands a long process of searching, exploring, learning and familiarizing with its interface. Thereby, the Logic Pro X (version 10.4.6) was chosen as this project's Digital Audio Workstation due to the researchers' previous professional experiences.

The investigation processes were based on learning, selecting, applying and connecting the MIDI protocol's functions with the Sample library's sounds and possibilities through the Digital Audio Workstation's interface and tools. In this way, despite the procedures described below having not been used in every sequencing section, they were considered the most effective procedures in terms of quality and agility. After the auditions, the programming was carried out respecting the following steps: 1- sequencing, by playing a MIDI controller[13], the section's main rhythm using only two of the most important drum parts for that section's rhythm construction (the parts were usually chosen between snare drum, bass drum, ride and hi-hat); 2- individual sequencing of the remaining drum parts to complete the main rhythm (preferably playing a MIDI controller); 3 – In small excerpts, sequencing and editing[14] the presented variations (still disregarding the drum fills); 4 - Sequencing the fills' basis using two or three drum parts; and 5 – Sequencing the remaining drum parts to complete the fills.

3.1. REMARKS REGARDING THE BASS DRUM SEQUENCING PROCESS

The bass drum's sound quality was identified as an extremely important element to be considered during the sequencing process. A characteristic of the chosen sample library is that there are velocity ranges that trigger very clear sample exchanges. When the velocity is set higher than a certain threshold, the activated sample presents an intense kick-pedal stroking sound and loses clarity in the lowest frequencies, misrepresenting the desired bass

[10] Fernandez, R. (2014). *"Gaguinho" (Só Bateria)*. Retrieved from https://www.youtube.com/watch?v=8bI_4f6DFn0

[11] Cooper, C. (2017). *"Eye of the Tiger" – Drums ONLY Cover – Drum Cover*. Retrieved from https://www.youtube.com/watch?v=7D_DHn7HT20

[12] Cooper, C. (2015). *Metallica – Drum Cover – "Enter Sandman" (Drums Only)*. Retrieved from https://www.youtube.com/watch?v=26IaOLJoMe4

[13] Considering the researcher's professional connection with keyboard instruments (e.g. accordion and piano), a keyboard controller was employed to conduct the initial phase of the project's sequencing processes.

[14] Editing in this context refers to the employment of tools for creating, editing and excluding MIDI events and their attributes without a MIDI controller.

drum sound. Therefore, when this effect was not welcome, velocities were kept below 97, on a 0-127 scale[15].

3.2. REMARKS REGARDING THE HI-HAT SEQUENCING PROCESS

As any acoustic instrument, the hi-hat is capable of producing countless different sound inflections. By analyzing the visual resources, it is possible to notice that variations in the place stroked by the drum stick, the hits between the pair of cymbals and pressure applied to the pedal during the drumstick hit are some of the parameters that enable the variety of sound characteristics. It was noticeable that in the reference material, the hi-hat produced a myriad of different sounds based on these types of nuances.

By classifying, categorizing and naming samples recorded with very specific settings (e.g. hi-hat ¼ open played by the edge, hi-hat ½ opened played by the bell), the sample mapping information offered by the EZdrummer 2 was particularly important for the Hi-Hat sequencing procedures. Interpreting the available samples without the provided mapping information would be extremely complex for someone that is not a professional drummer or a drums specialist.

In order to simulate the hi-hat's countless variations, after the initial sequencing process using a MIDI controller, all notes had some of their parameters edited (e.g. velocity, length, position, the note itself) to trigger different samples and make the whole audio track more similar to a performance recorded in an acoustic set.

3.3. REMARKS REGARDING THE SNARE DRUM SEQUENCING PROCESS

Variation, in different elements, was identified as a remarkably relevant characteristic of human performances. Accordingly, a professional sequencer needs to listen carefully to the variation in timbre between samples, especially among certain velocity ranges. In some cases, a small velocity alteration provokes a sample change (activation of a different velocity layer) without affecting the volume level. This feature must be widely explored in order to make a MIDI sequence more realistic, especially in sample libraries with few samples devoted to the round-robin effect.

Starting from the 27th bar of "Enter Sandman" (Cooper, 2015), the drummer performs a particularly interesting interpretative *crescendo* with the snare drum and floor tom. Cooper manages to execute this fill so skillfully that at the beginning it seems that there is no snare drum and at the end it seems that there is no floor tom. This fill, which lasts for one and a half bars, is performed so steadily and gradually that the presented effect becomes natural and organic. As shown in Figure 1, to incorporate these features into the MIDI file, it was necessary to set growing velocities for both drums' parts. However, to achieve the desired

[15] It is important to mention that that, in the mentioned scale, the velocity "0 (zero)" means note off. Additionally, it is relevant to point that some manufacturers use the scale 1-128 but in both cases there are 128 possible values (MMA, 2009).

result, the range of velocities used for the snare drum was significantly wider than the devoted to the floor tom.

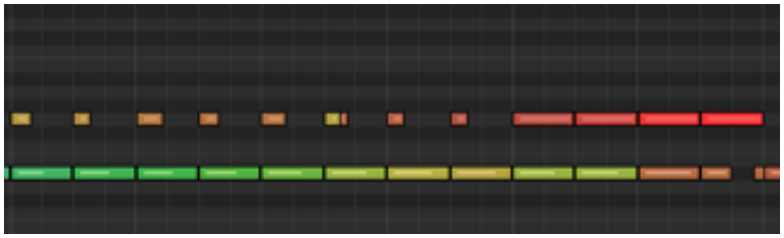


Figure 1. Crescendo of the snare drum and floor tom in "Enter Sandman"[16].

(Source: the authors).

As can be noticed at 01m26s of the video "Eye of the Tiger" (Cooper, 2017), the drumstick may eventually hit the drum part more times than it seems on a first audition. It is recommended that a sequencing-generated audio track that aims to simulate a human-recorded live performance reproduces these nuances. The number of rebounds is not fixed, the important feature is that the volume of each rebound (usually linked to velocity) be smaller than its predecessor.

3.4. Remarks Regarding the Toms Sequencing Process

Selecting the kit and setting the drum parts for the song "Gaguinho" (Fernandes, 2014) was especially challenging due to the toms' high tuning. First, there was an unsuccessful search for parts with timbre and tuning compatible with the reference audio. Later, we tried to adjust the pieces' tuning: it worked well for the first two tons (high and mid), but to reach the desired pitch in the other toms it was necessary to alter too much the original sample, mischaracterizing the tom's sonority. As a third possibility, drum parts with the same diameters were chosen to occupy different parts of the drum kit; for example: employing a 10-inches tom as a high and mid toms. This procedure, aligned with the pitch manipulation, granted satisfactory results and proved to be effective in this scenario.

It was possible to notice that to reach a good audio quality during repeated toms' strokes (particularly if the strokes happen in a short period of time), it is recommendable to increase the velocity parameter every time there are changes in the hit part; otherwise, the note will lose clarity, especially when the new stroke is in a drum part with lower frequencies than the previous one.

[16] The events below refer to the snare and the upper ones to the tones - The colors closer to green correspond to lower velocities and the ones closer to red to higher velocities.

3.5. REMARKS REGARDING THE CYMBALS SEQUENCING PROCESS

Since the chosen Sample library does not offer a "stopping function" for the cymbals (similar to grabbing it to make it quiet), it was possible to realize the relevance of having at least one short-time-sound crash cymbal in the kit. The smaller cymbals were the best-found option to fulfill this function.

Sample libraries usually offer at least three types of samples for each ride: stroking the bell, the bow and the edge. By analyzing the videos and the sample library it was possible to notice the clear differentiation regarding the intentions of using each ride's part: 1) the bell presents the biggest impact sound, the shorter time length and it emphasizes the higher frequencies – in the referential videos it was mainly used during aggressive and loud excerpts; 2) the bow produce an intermediary sound, more low frequencies and a satisfactory impact sound – used by the investigated drummers to create a continuous high-pitch sound and to conduct some rhythmic variations; 3) the edge produces the lowest frequencies with less impact sound – mainly used to create ambiance and effects.

After performing the sequencing procedures considering the aforementioned remarks related to each drum part it was possible to create satisfying audio tracks in terms of similarities with the selected human-recorded live performances. With the MIDI-created audio track, this research carried out questionnaires among different groups to assess the tracks' quality and applicability. The next session will be dedicated to present and reflecting on this process.

4. EVALUATIVE QUESTIONNAIRE

The application of questionnaires aimed to verify the effectiveness of using MIDI sequencing procedures to reproduce human-recorded live performances. By choosing this quantitative approach, this investigation assumes a potential for replication and, possibly, generalization. Therefore, it is expected that if the same samples are used and the same methods are applied, the same results can be found (Cohen et al., 2007).

The selection of participants aimed to include representatives of groups that could hold different quality standards for drums' recordings. Aiming to achieve an appropriate "representativeness of the sample" (Cohen et al., 2007), the respondents' selection was guided by the procedures advocated by the "maximum variation sampling". Creswell (2013) asserts that this approach suggests the determination of some criteria that will distinguish groups of participants before the selection per se. As stated by the author, "this approach is often selected because when a researcher maximizes differences at the beginning of the study, it increases the likelihood that the findings will reflect differences or different perspectives". (Creswell, 2013, p. 157). Thereby, the respondents were selected to cover four main sampling

groups: 1) Musicians; 2) Non-musician; 3) Drummers; and 4) Sequencers[17]. The participants' placement in these categories was based on the respondent's self-identification.

To carry out the questionnaires, the sequencing-generated audios and the original performances were mixed with other instruments in order to portray the scenario where this kind of track is more commonly listened to. Therefore, six audio tracks were developed: three mixed with the original human-recorded performances and three with the MIDI-based audios. Without knowing if they were MIDI-created or traditionally recorded, each participant was asked to listen to three performances, one of each song. The questionnaire was composed of only two questions that were repeated after each audition: 1) Is the audio of the drums in this song midi-generated or acoustically-performed? 2) What led you to conclude this? The questionnaires were carried out in person using the researcher's headset. The participants could repeat the audio as many times as they wish.

5. THE DATA ANALYSIS PROCESS

As a suitable procedure for quantitative analysis, the data provided by the questionnaire application was interpreted based on statistical comparisons between the participants' answers regarding the presented audio tracks. As posited by Creswell (2012, p. 15), to examine quantitative data "you analyze the data using mathematical procedures, called statistics […] statistical procedures such as comparing groups or relating scores for individuals provide information to address the research questions or hypotheses". Likewise, the following sections will be devoted to presenting the questionnaires' analysis, one excerpt at the time.

5.1. "GAGUINHO".

Among the audience of drummers, the MIDI-generated audio had great results: 100% of the interviewees believed that it had been played live by a professional drummer. The drummers accepted the sequencing better than the original performance. Among non-musicians, the track with MIDI audio did not acquire good results, satisfying only 33% of respondents. Among the musician's audience, the sequenced audio performed relatively well: in spite of its 25% success rate, it obtained better results than the human-recorded live performance, which satisfied only 20% of this respondents' group. Among sequencers, neither the MIDI audio nor the human recording convinced the participants: no respondent (0%) believed that the audio was acoustically performed by a professional drummer.

5.2. "ENTER SANDMAN".

Since all respondents believed that the drums in the presented audio track were played by a professional drummer, the sequencing achieved a 100% success rate among the non-

[17] For the purposes of this research, a sequencer will be understood as a person with expertise in sequencing or sampling processes

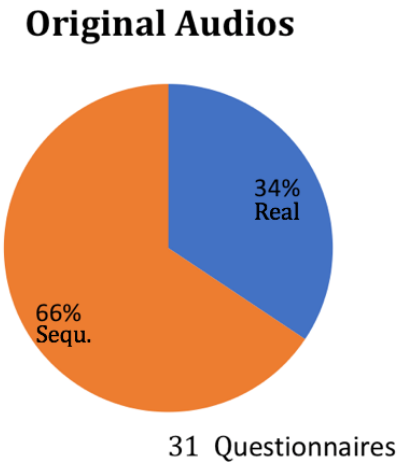
musicians. Among the musicians, the MIDI-generated audio reached a 62% of success rate against the 100% success rate of the original audio. Among the drummers, only one questionnaire was carried out using the original performance (that acquired 0% of success rate), not providing reliable information for a direct comparison between the original and MIDI-produced audios. However, comparing the 75% success rate with the results of the other audio tracks (including original and sequenced), it can be affirmed that the sequencing-produced track performed well. Among the sequencers, neither the MIDI-produced audio nor the human-recorded audio granted a good success rate: both with 25%. However, taking into account a comparison between the two audios, the sequencing can be considered well rated.

5.3. "EYE OF THE TIGER".

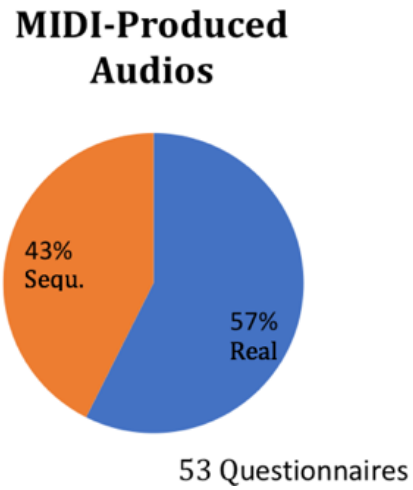
The sequencing had great results among the musical audience: 87% of respondents supposed that it had been played by a drummer. The sequencing was better accepted than the original performance, which only achieved a 43% of success rate. Unfortunately, no questionnaire was applied among the "non-musician" using the MIDI-created audio; the original audio reached a 100% success rate within these participants. Among the drummers, the sequencing convinced 100% of the respondents: an extremely good result, especially when compared with the original performance's total rejection (0% success rate). In the group of sequencers, the MIDI-produced audio got a relatively good assessment: whilst it achieved a 50% of success rate, the human-recorded live performance was totally rejected by the sequencers (0% success rate).

5.4. GENERAL VIEW (ALL EXCERPTS)

An overview of the questionnaire application process can be seen in the two graphics presented below. The blue color represents the percentage of times a respondent understood that the drums in the listened audio track were performed by a professional musician in an acoustic instrument (considered a good result for the purposes of this article) and the orange color describes the percentage of times the participants understood that the drums' performance was developed from sequencing processes (considered a bad result). By examining the totality of the data collected during the questionnaires' application, it can be noted that the MIDI-generated audios granted excellent results, managing not only to acquire a good success rate but also to overcome the results achieved by the actual human-recorded live performances.



Graphic 1. Evaluation of all human-recorded live performances.
(Source: the authors)



Graphic 2. Evaluation of all audios produced by sequencing processes.
(Source: the authors).

6. CONCLUSIONS

Due to the need of listening carefully to drummers' performances, it was possible to notice frequently used principles such as using the bass drum to reinforce strokes on crash cymbals or employing an open hi-hat as crash cymbal in moments where there is a wish for greater control over cymbals' sound length. The recognition of these principles can be beneficial not only for the professional sequencer but also for the arranger, songwriter or composer, who can become more mindful about the drums' role in their artistic initiatives.

By analyzing this research's results, it is possible to perceive that the acceptance of the MIDI-generated audio was satisfying in all the studied groups. Due to the approach adopted by this inquiry (requesting the distinction of audios between "real" and MIDI), a relevant

portion of the participants faced the questionnaire as a "quiz game", which enhanced their commitment to the process by adding a wish to find the "right answers" for the questions. However, despite this perceived extra effort, in the majority of the excerpts the sequencing audio-tracks achieved better success rates than the original performances. Examining the participants' decision criteria, characteristics like timbre, dynamics, groove, fills and rhythmic variation were found as fundamentally important to guide respondents' answers.

The sequencing process was motivated by the assumption that, in certain contexts, the audio produced from MIDI files can be used as an alternative to the human-recorded live performances and this research was conducted to test and evaluate this hypothesis. Despite the good results, it is believed that there are huge differences between professional sequencing and professional human performances. Certain elements that are distinctive of individual professional performances are impossible to be reproduced by MIDI events. Ultimately, every performance is unique and unrepeatable, even by the performer himself. Due to the immense amount of sounds that can be produced by each of the drum parts, it would be impossible for sample libraries to provide every possible drum sound and, even if they did, it would be impracticable for a professional sequencer to employ every offered resource.

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