An agent for creative development in drum kit playing

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Abstract

The aim of this research is to design, implement and evaluate a conversational agent for drum kit players using a call and response model in order to develop their own drumming vocabulary and creativity. Evaluation of the system and analysis of resulting expert drummer behaviour will be used to illuminate various factors: the process of vocabulary development in drum kit players; ways in which technology can assist drum kit players to achieve their creative goals, and more broadly how this approach could support the practices of professional drummers. Although previous research has been conducted in music computing focusing on creativity development in melodic instruments, for example, electronic keyboard (Addessi, 2014) and guitar (Manaris et al., 2011), little is known whether this approach can be applied in rhythmic instruments such as the drum kit. Therefore, the main contribution to knowledge is exploring a gap in human-computer interaction tools for creativity development in drum kit playing.

1. Introduction

Bruford (2018) explains that a drum performance can be creative at different levels: i) by developing certain musical phrases ii) by gluing the performance together iii) and, most ambitiously, by redefining the possible future of the instrument. This research focuses on the first two of these: developing musical phrases and gluing the performance together. Both of these involve a process of fluid vocabulary expansion: learning new drumming vocabulary, combining new vocabulary with existing vocabulary, and using different applications of vocabulary. Leman (2016) refers to these transformations of vocabulary as an *enactment process,* which encourages music performers to experiment with transformations of intentions to sounds, and sounds to intentions, aiming to produce improvised, individual and novel work.

Drumming functions and develops in some of the ways that spoken language does. For example, when learning a spoken language, the focus may be vocabulary expansion through its use in various contexts. Practically, this is generally rehearsed in the form of a conversation, encouraging the learner to use the vocabulary in real-time interaction. Such a conversational learning process involves quick responses, appropriate use of vocabulary and adequate aural and auditory skills. Similarly, in a musical context, expanding drumming vocabulary and developing its practical use might be rehearsed with another drummer. However, in practice drummers have limited opportunities to play with other drummers. This is primarily because i) most musical groups have a single drummer ii) many drummers focus on serving a supportive role rather than developing their improvised vocabulary iii) on a practical level, it is more complicated to arrange a drumming interaction between two acoustic drummers, primarily because of the size of the drum kit and the amount of noise pollution two drum kits can create.

As previously outlined, this research aims to explore how conversational interactions with an agent can support creativity development in drum kit players. The research questions focus on: How can a drumming agent be designed to support drummers? What musical transformations are needed to support drummers? What user controls are required to support drummers? How can the drumming agent be adopted and potentially used in real-life scenarios of drummers? In order to understand which principles should guide the conversational design, to what extent can these principles be enacted by a system, and what effect do these principles have on drummers, we plan to collect quantitative and qualitative data from professional drum kit players who interact with a drumming agent. By collecting both types of data we hope to gain more understanding of improvised drumming conversations and explore the relationship between professional drummers and the drumming agent. Our methodology adopts a mixed methods approach (Tashakkori & Creswell, 2007) consisting of interviews, surveys, and audio data from the drumming interactions.

2. Related work

Computer technology can be used to enhance live performance (Tanaka et al., 2005) or offer support in the process of learning skills and developing creative aspects of musical performance (Pachet, 2004). Several systems designed to develop creativity in music have taken a conversational approach between the human and the system. For example, *Controlling Interactive Music* (Brown, 2018) focused on improvised piano conversations between a system and a human pianist. *Monterey Mirror* (Manaris et al., 2011) explored a conversational agent to support creativity in jazz guitarists. However, to our knowledge, there is currently no conversational interaction system to foster creativity in expert drum kit players.

3. Conceptual design

In the preliminary phase of this research, an initial conceptual design of a drumming agent was created. Under this design model, the system generates new phrases in the conversation by applying *transformations* of a given *core phrase.* The core phrase is a rhythmic phrase of accented and unaccented notes which forms the starting point for a particular drumming interaction. The transformations involve adapting the core phrase in various ways, for example, by making changes to the rhythms or drum voices used. However, before we explain what each transformation means within our conceptual design, it is important to clarify the origin of the transformations we chose. The drumming language can be learnt by listening, copying, and developing grooves, fills and other rhythmic patterns around the drum kit. Once a certain rhythmic phrase is learnt, there are clear methods for expanding this vocabulary. Although the methods of expanding drumming vocabulary can differ according to the drumming style, there are generic methods that can be used effectively in many styles as well as in our design. The first transformation is *reduction*, which leads to a drumming phrase where only some of the notes are played. This will be useful for drummers who want to create more space in the interaction or simplify the core phrase. The next transformation relates to the drum voices that are used. Therefore, we will refer to this transformation as *orchestration*, where vocabulary expansion is supported by alternating the drum voices. For example, changing the accented notes from the snare drum to the floor tom. The next transformation involves changes in *rhythm*, more specifically, the agent generates subdivisions for some of the notes. This will support and challenge the technical abilities of the human drummers. The final transformation involves a *groove* based on a specific core phrase by using these drum voices: snare drum, bass drum and hi-hat. Practically, the agent will use one of these three voices to play the accented notes while maintaining a consistent groove pattern with the other two voices. This basic architecture aims to offer system prompts which are relevant, varied and sufficiently convincing in the *conceptual space* (Boden, 2009) of professional drummers. This provisional design was tested with seven professional drummers, using pre-recorded system phrases sequenced by the author. The participants of the preliminary study responded positively to the drumming interaction suggesting that the system offers a good basis for exploring our research questions outlined above. Following the analysis of the data from the preliminary study, we progressed with software implementation of this drum-specific system design. Supercollider was chosen due to the extensive facilities for representation and manipulation of musical patterns (Harkins, 2009).

4. Implementation

There are three consecutive phases to the process of implementing our drumming agent design in Supercollider. Phase 1, which has already been achieved, is discussed immediately below, while phases 2 and 3 are discussed in the *Future Work* section. In phase 1, a drumming agent was created based on our conceptual design. At this phase the agent was able to generate phrases in real-time based on a database of core phrases and the following transformations: *reduction* plays only the accented notes; *orchestration* alternates the drum voices used for the accented or unaccented notes; *rhythm* subdivides every unaccented note to two even notes; *Groove* focuses on the snare, bass drum and hi-hat, transforms the core phrase into a groove. To facilitate the interaction, we created a framework of common time, i.e. 4/4, where the agent continuously generates one bar of drumming and schedules a one-bar gap between its generated transformations for the human drummer to respond. Following the data from the preliminary study, we added three additional elements to our design. These include rhythmic rotations, randomised rests, and a *human* variable. The rhythmic rotations assist the agent in generating more interesting phrases by changing the starting point of the core phrase. The randomised rests schedule occasional rests within the transformations and the *human* variable offers a subtle element of playing some notes slightly ahead or behind the beat. Both the rests and *human* variable assist the agent transformations sound more fluid. In the next section, we present our future work plans which include adding user controls and machine listening elements so the agent can adapt to each individual drummer and provide better long-term support for their development as well as evaluating the drumming agent with professional drummers in real-life scenarios.

5. Future work

Phase 2 will focus on adding user controls so the human drummer can adapt the behaviour of the agent during real-time interaction. This phase will build on the prototype developed in phase 1, implement some of the cues detected in the analysis from phase 1 and give the tool steerable capabilities. The user controls will give drummers the ability: (i) to focus on specific transformations and explore certain areas of their playing (ii) to record the interactions in order to listen back and evaluate (iii) to adapt the agent volume (iv) to adapt the tempo (v) to add or remove a metronome. In addition, we will explore integrating machine listening elements in Supercollider with BeatTrack, DrumTrack or Onsets (Wilson et al, 2011).

Phase 3 will focus on refining the user controls and machine listening elements. In addition, we will evaluate the agent in real-life scenarios with professional drummers. Likely scenarios include: the practice room, education settings such as lessons or masterclasses, recordings, and live performances. The participants will maintain a documented log of the drumming interactions. The evaluation process will involve thematic analysis (Braun & Clarke, 2012) of the logs, interviews and surveys from all phases aiming to understand the potential of this type of tool in drum kit playing practices. The focus on creativity in drum kit playing, vocabulary expansion, user controls and use of the technology in real-life scenarios might provide opportunities for future research and interest not only in the music computing community but also for music educators, music performers and human-computer interaction researchers designing for support of real-time interactions with an agent.

6. References

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