Pandeiro Funk: Experiments on Rhythm-Based Interaction

Sergio Krakowski IMPA
Luiz Velho IMPA
Francois Pachet Sony CSL - Paris

1 The Problem

In this work, we address to the problem of making the machine listen and react to the musician in an improvisation situation with the purpose of generating high-quality music.

Nowadays, on the shelf technology directed to live performance is still very limited with respect to the potential modern computers offer in terms of processing power. The great majority of equipments designed for musicians allows them to loop live recorded samples or filter theirs sounds. On the other hand, DJ's have access to CD players and Drum Machines (e.g. MPC-2000) but the functionalities offered by these tools are not in the hand of musicians, in a live context and many times are shown to be inflexible.

Playing over a fixed-tempo pre-recorded loop in an improvisation context is one of the most unpleasant situation a professional musician can go through. For this reason we developed methods that make the communication between musician and machine more natural during the improvisation experience.

With respect to Rowe's classification, we could define our research as a Performance-Driven, Instrument-Driven approach.

We can find many examples of performance-driven systems in computer music literature such as Francois Pachet's Continuator. Usually, these systems provide one or more *modes of interaction*. Simply speaking, we could see these modes as games the musician play with the computer.

In general, a limitation to these systems is the fact that the musician don't have the choice to change the mode of interaction she/he is using during the interaction experience without interrupting the music flow.

2 In Music

During a performance, players have to communicate to each other for many reasons. In a Jazz context, e.g., a musical phrase can be used to point out the end of a piece or the restart of the tune's theme.

A more complex example of "musical command" are the phrases used by the saxophone player Steve Coleman to give orders to his band. This incredible musician developed with his group a vocabulary of some phrase-orders that, when played, change the behaviour his band interacts with him.

Another example are the Bata drum's music. This drum ensemble is composed by a hierarchy of three drums, the okonkolo (smaller drum), itotele (medium drum) and the yia (biggest leading drum). The yia drum leads the other two drums by play one of the possible "calls", rhythmic phrases that are interpreted by the other players as a sign to switch to another rhythmic pattern.

3 Our main contribution

We now propose the main innovation of our approach: The use of *rhythmic phrases* as commands to control the computer. By *rhythmic phrases* we mean the rhythmic content of a musical phrase which can be extracted directly from the audio signal captured by a microphone.

The advantages of this approach are many:

1. Is based in real life experience.
2. The musician can concentrate only in the music and not on pedals or other interfaces.
3. Let the musician control the machine without stopping the music flow.
4. Low computational cost and fast results.
5. As it is audio-based, can be applied to many sorts of instruments.
6. A rhythmic phrase carries several informations that can be used as parameters during the interaction. In this way, the commands carry more information and the interaction becomes richer and more natural.

4 The research

What we present here is part of a PhD research of the first author of the abstract. In the thesis currently being written we give a mathematical formalization to the concept of *modes of interaction* using the synchronized automata theory which was found to be the best suited considering our instrument-driven approach.

In the thesis, among other things, we rigorously define what are the *rhythmic phrases*, and propose they can be seen as actions in the synchronized automata context. We also propose a robust method for detection of rhythmic phrases.

5 Case Study and Conclusion

As a case study, we implemented this method in a system adapted to work with a percussion instrument called Pandeiro. This Brazilian tambourine is the instrument played professionally by the first author of the abstract.

The low level analysis and the detection of *rhythmic phrases* were all implemented in C language as *externals* in the Pure Data framework. This analysis can be easily adapted to other instruments.

The system has some modes of interaction and to each one, a different *rhythmic phrase* associated to it, used to enter or leave that mode. We strongly encourage the reader to watch the Supplementary Video to see an explanation about how the system works and a demonstration of the system in action.

Our hypotheses of a multi-modal system with a natural switching-mode strategy has shown to be very efficient during the experimenting phase and has been used in real life during a series of performances that took place in Rio de Janeiro in the month January 2009.

These performances were part of a musical project done by the first author of this abstract in which he mixed two different Brazilian genres, the traditional "Choro" (where we find the Pandeiro) and the first Brazilian electronic style called "Funk Carioca". In these concerts, the system had an important artistic function of blending the traditional Pandeiro playing to resources that, up to now, were exclusive to DJ's and VJ's. This can be seen in the Supplementary Video.