EXPRESSIVE MUSICAL ICONS

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ABSTRACT

Recent research on the analysis and synthesis of music performance has resulted in tools for the control of the expressive content in automatic music performance [1]. These results can be relevant for applications other than performance of music by a computer. In this work it is presented how the techniques for enhancing the expressive character in music performance can be used also in the design of sound logos, in the control of synthesis algorithms, and for achieving better ringing tones in mobile phones.

1. INTRODUCTION

Music is today an important communication form that both expresses and elicits emotions in listeners. The emotional content of a music performance is not only dependent on the composition itself but is to a large extent also controlled by the performer. The same piece can be rendered "happy" or "sad" depending on performance variables, such as tempo dynamics and articulation [2]. These important performance-induced variations are in general lost when computers play music. For example, if a computer plays a melody exactly as written in the score the resulting performance is mechanic, dull and unmusical. On the other hand, if a computer has the tools for introducing the same variations as a real musician does, the resulting performance is much better.

Principles used in music communication have been investigated in our research group at KTH during the past 25 years. Together with leading musicians we investigated the basic principles in music performance and we are now able to, for example, instruct a computer to play the same score with different styles. A computer can play a melody in a musically enjoyable way as well as in a way expressing different emotions such as happiness and sadness [1].

2. UNDERSTANDING MUSIC PERFORMANCE

Our research resulted in a certain number of performance rules which describe different performance principles used by musicians. It includes how to render phrasing, repetitive patterns and grooves, harmonic and melodic tension, articulation, accents, intonation and ensemble timing. Most of these principles are coupled to the communication of the musical structure [3]. This can be compared with speech where marking the end of phrases and accents are useful for underlining the correct meaning. By varying *how* these rules for marking the structure can influence the music it is possible to obtain the individual variations applied by different musicians. Simulation of different emotions is also possible combining the rules and their set-up in the right way. It is now possible to automatically play any piece of music with happiness, sadness, solemnity, anger, fear or tenderness [1]. The performance rules are implemented in the computer program Director Musices (DM) [4] that is a PC program processing MIDI files (running under both Windows and MacOS systems).

3. APPLICATIONS

Traditionally research in automatic music performance has focused on the production of expressive rendering of mainly classical music by means of personal computers and MIDI devices. Our goal is to make use of the results from our research and extend them to non-specifically music-oriented applications such as computer games, virtual reality environments, electronic messaging systems, answering machines, telephones, and sound logos.

3.1. Controlling sound models

Sound synthesis algorithms typically involve numerous parameters, which often require a complex control. Sound models can be developed in such a way that respond to physical gestures, as could be a percussion instrument model. In this context, performance rules could be used to develop control models. These models would produce a musically expressive variation of the control parameters in accordance with the dynamics of the gestures. The sound models, specified by physical descriptions and control models, can be integrated into artifacts that interact with each other and that are accessed by direct manipulation, for instance in virtual reality (VR) applications.

In a first attempt to control sound models, performance rules have been recently applied for the control of step sounds. Analogies was found between gait patterns during walking and running and how *legato* and *staccato* are achieved in piano performance [5] [6]. The DM performance rules for *legato* articulation and for phrasing have been applied to the control of the sound of steps. This is illustrated in a short animation with sound examples that can be found at http://www.soundobject.org/Presentation/control.html [7].

3.2. Musical logos

The possibility of using performance rules for the design of emotionally different performances has been recently exploited for rendering the expressive character of short music excerpts associated to trademarks. The main idea is based on the assumption that a trademark is usually associated with a list of

specific keywords, which are related to the commercial target and/or to the mission of the manufacturer. Each keyword can be decomposed into one or more adjectives, which can be associated to a specific set of performance rules, called rule palette. Using the analysis-by-synthesis method, the successive application of more rule palettes can provide the desired musical logo.

3.3. Mobile phones

The ringing tones in mobile phones often appear somewhat irritating. The reason is not only their crude sound quality, but also the deadpan performance. Here, better performances would significantly increase the pleasantness of the signal. In particular, enjoyable applications could be developed by using emotionally colored ringing tones; ringing signals corresponding to different emotions could be associated to different telephone groups or numbers. Thus, when a call is arriving, the corresponding ringing tone is played. The possibility to control the ringing tone of the receiver's phone could be included in mobile phones of the next generation; when a person is calling, an emoticon[1] could be attached to number called, determining how the ringing tone is played in the receiver's mobile phone. The expressive performance of ringing tones will also include different spectral shapes of the signals, such as different attack times, as outlined in previous studies on expressive music performance [2]. In future phones embedded sensors could provide information about the emotional state of the caller and convey it to the receiver through the ringing tone.

At the present, the possibilities to change the expressiveness of a ring tone is rather limited in existing mobile phones, at least from a user point of view. The Smart Messaging format provided Nokia allows ring tones to be sent to a phone embedded in an SMS message. The specification has some nice features such as note-level control of dynamics and tempo [7]. However, only a limited subset of the specification seems to be implemented in the current phones. For example, in the model 7110 the control of dynamics is not possible.

In the DM program it is possible to save the performances of a melody in the Smart Messaging format. So far only the control of tone duration has been possible. Therefore it is not possible to use other important cues for expressing emotions such as differences in sound level, different levels of vibrato, different attack times. Nevertheless, the control of note duration helps in improving the musicality of ringing tones by acting on the musical structure producing *accelerandi*, *rallentandi*, increasing or decreasing the contrast between durations, changing the articulation, grouping and separating musical events. Furthermore, the overall mean tempo can be controlled. For example, by only changing the duration contrast and the mean tempo the expressive character of a music excerpt can be significantly changed. For instance a happy performance can be obtained with a faster tempo, a *staccato* articulation and an increased contrast between durations; symmetrically a sad performance can be obtained with a slower tempo, a *legato* articulation and decreasing the contrast between durations [1].
A more complex model of mobile phone has been simulated using a software sampler. The starting point was to see how much the performance of a melody could be modeled without changing the original sound source of the existing hardware, i.e. by using only software changes. The sound used was a sampling of an Ericsson phone. The input variables to this model were overall tempo, overall sound level, tone IOI (tone onset to onset duration), tone duration (giving the articulation), tone sound level, and tone attack time. Thus, it gives the possibility to produce ringing tones that can vary in tone attack time as well

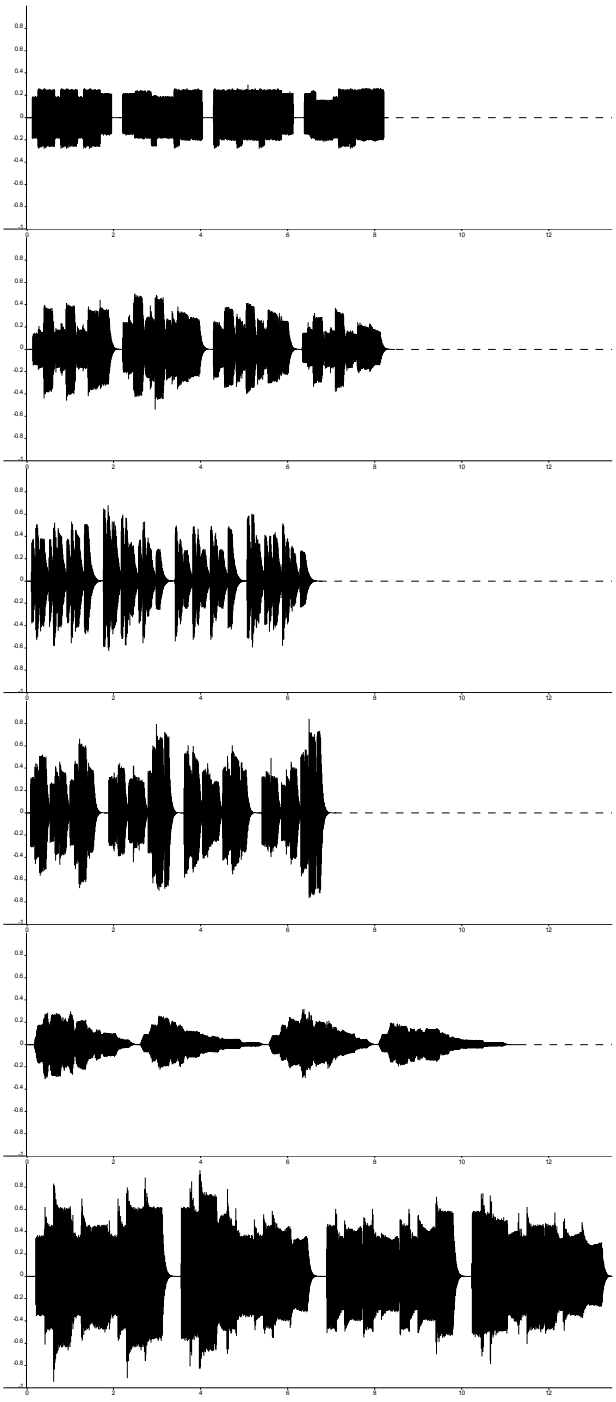

Figure 1. An excerpt from Mozart's G minor symphony performed on the ring tone simulator emulating different emotions. The graphs show a display of the sound wave. From the top: (1) dead-pan version, (2) natural version, i.e. the piece was performed in the way preferred by the authors, (3) happy version, (4) angry version, (5) sad version, and (6) solemn version.

[1] Emoticon: emotional icon. It is used to indicate emotional icons generally used in e-mail messages or in chat systems; :-) and :-(are the most used emoticons.

as in the intensity of each tone. Both are important characteristics in the communication of emotionally expressive music performances. An example is given in Figure 1 where the sound wave is displayed for different performances of the same piece, including three performances expressing emotional characters.

4. CONCLUSIONS

The understanding of the process of music performance can open new possibilities in the design of everyday life sound icons. Ringing tones, alert sounds in computer programs, musical logos can acquire pleasantness and reality by applying performance rules. Furthermore, embedded performance rules will allow a real time control of sound icons by changing their expressive character according to the actual situation and/or to the emotional state of the user.

5. LINKS

A list of our publications, several sound examples, and free software for expressive music performance can be found at the following link:

http://www.speech.kth.se/music/performance.

6. ACKNOWLEDGMENTS

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