Sebastian Streich
Research proposal

Estimating the Perceived Complexity of Music

Due to the massive growth of web catalogs offering digital music files, and also of private music collections on home computers it is nowadays becoming a problem to navigate through these collections and to retrieve the music one is interested in.
One possible approach to this problem consists in providing semantic descriptors of the musical content in order to enable enhanced ways of displaying, querying, or even automated recommendation [1]. However, the manual annotation of such descriptors for large collections is a hardly feasible way. A reliable automated computation would therefore be desirable.

Our research proposal addresses exactly this issue, focusing in particular on the aspects of perceived musical complexity. Former studies indicate that musical complexity is related with general and individual preference for music ([2],[3],[4]), thus making it a valuable descriptor for the desired applications (music recommendation; visualization and browsing of music databases).

The concept of complexity in general is not very precisely defined, because it can capture very different aspects in different contexts. The definition of musical complexity we want to use consists in a criterion for the effort a listener has to put into analyzing the music in order to capture what is going on [5]. It can be seen in equivalence to the *arousal potential* in psychophysics, first mentioned by Wundt and later used by Berlyne [6] in his theory.

Since a musical performance comprises a variety of aspects, a multidimensional layout of the complexity descriptor is reasonable. We propose a set of six dimensions to be addressed individually. These are *melody, harmony, rhythm, timbre, structure*, and *acoustic properties*. The latter are meant to incorporate aspects of the spatial and dynamical comprehensiveness, which are, strictly speaking, not so much attributes of the music as of the recording.

Some research has been carried out to find models for musical complexity. Shmulevich and Povel developed the PS-Measure for rhythmic complexity [7]. For melodic complexity Eerola and Krumhansl [8] among others conducted several experiments based on a model originally developed by Narmour [9]. Yet, all these approaches work on representations of the music on symbolic level rather than on the audio signal itself. While this gap should be relatively easy to bridge in the case of rhythm, for melodies it is much harder. Our resaerch will consist in exploring the suitability of existing models to be applied to musical audio signals as well as the search for alternatives in order to avoid transcription as a preprocessing step.
For the other proposed dimensions of complexity so far no approved models exist. Nevertheless, we will start our research based on related findings like the preference rule system for harmonies proposed by Temperley [10] or algorithms used in room acoustics to estimate spaciousness [11]. We will also conduct experiments with listeners in order to verify the validity of the computed values.

References

[1] http://www.semanticaudio.org

[2] R. M. Parry, "Musical Complexity and Top 40 Chart Performance", Technical Report, College of Computing, Georgia Institute of Technology (2004).

[3] D. K. Simonton, "Drawing inferences from symphonic programs: Musical attributes versus listener attributions," *Music Perception* no. 12, pp. 307—322 (1995).

[4] A. C. North, D. J. Hargreaves, "Experimental aesthetics and everyday music listening," *The social psychology of music* pp. 84—103, Oxford University Press (1997).

[5] S. Streich, P. Herrera, "Towards describing perceived complexity of songs: Computational methods and implementation," to appear in *Proc. of AES 25th Int. Conf. on Metadata for Audio* (2004).

[6] D. E. Berlyne, *Aesthetics and psychobiology,* Appleton-Century-Crofts (1971).

[7] I. Shmulevich, D. J. Povel, "Measures of temporal pattern complexity," *Journal of New Music Research* vol. 29, no. 1 (2000).

[8] T. Eerola, P. Toiviainen, C. L. Krumhansl, "Real-time predictions of melody: continuous predictability judgements and dynamic models," *Proc. of the 7th International Conference on Music Perception and Cognition* (2002).

[9] E. Narmour, *The Analysis and Cognition of Basic Melodic Structures,* The University of Chicago Press (1990).

[10] D. Temperley, *The cognition of basic musical structures*, The MIT Press (2001).

[11] R. Mason, *Elicitation and measurement of auditory spatial attributes in reproduced sound*, PhD Thesis, University of Surrey (2002).