Audio Tempo Extraction Algorithm for MIREX 2006

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Abstract

This paper describes an audio tempo extraction algorithm submitted to the MIREX 2006 contest. The algorithm is identical to the one submitted to MIREX contest in 2004, and has been described in detail in the article "Analysis of the Meter of Acoustic Musical Signals" published in IEEE Trans. Audio, Speech and Language Processing, 14(1), 2006. In summary, the method analyses musical meter jointly at three time scales, of which only the tactus (beat) level is used here. The output tempo is obtained as the median inter-beat-interval during the latter half of the analysed signal.

Keywords: Tempo estimation, musical meter analysis, beat tracking.

1. Introduction

The tempo extraction algorithm described here is identical to that submitted to MIREX contest in 2004. It is based on the meter analysis method originally described in [1]. [1]

The employed algorithm estimates only one tempo value for the analysed signal. This is calculated as a median of the inter-beat-intervals during the latter half of the analysed signal. In order to conform to the task description in MIREX 2006 contest, another tempo value is obtained by doubling or halving the first estimate towards the mean tempo of 109 beats per minute (BPM). The latter estimate is assigned a small weight value.

2. The underlying meter analysis algorithm

The aim of the method proposed in [1] is to estimate the meter of acoustic musical signals at three levels: at the tactus, tatum, and measure-pulse levels. An overview of the method is shown in Fig. 1.

For the time-frequency analysis part, a technique is employed which aims at measuring the degree of spectral change, or, "accent" in music signals. In brief, preliminary time-frequency analysis is conducted using a quite large number of subbands and by measuring the degree of spectral change at these channels. Then, adjacent bands are combined to arrive at four bandwise accent signals, for which periodicity analysis is carried out.

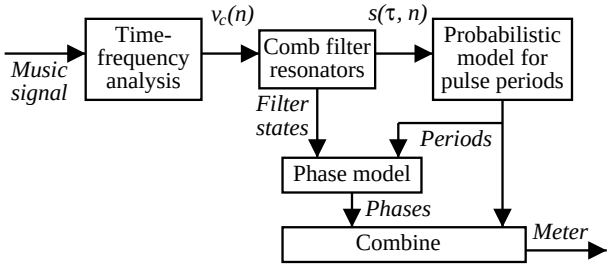

Figure 1. Overview of the meter analysis method, on which the tempo extraction algorithm is based.

Periodicity analysis of the bandwise accent signals is performed using a bank of comb filter resonators very similar to those used by Scheirer in [2]. Before we ended up using comb filters, four different period estimation algorithms were evaluated. A bank of comb filter resonators was chosen because it was the least complex among the three best-performing algorithms.

The comb filters serve as feature extractors for two probabilistic models. One model is used to estimate the period-lengths of metrical pulses at different levels. The other model is used to estimate the corresponding phases (see Fig. 1). The probabilistic models encode prior musical knowledge regarding well-formed musical meters. In brief, the models take into account the dependencies between different pulse levels (tatum, tactus, and measure) and, additionally, implement temporal tying between successive meter estimates.

3. Acknowledgements

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References

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