MIREX 2014: MULTI FEATURE BEAT TRACKER (INF AND REG)

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ABSTRACT

The Multi-feature Beat tracker [16] 2014 uses seven different onset detection functions to estimate the beats of a musical audio signal using only one beat tracker algorithm, finally the beat tracker output is selected using a committee technique presented in previous works. This is a new version of the algorithm ZDG1 and ZD2, which uses five onset detection function, submitted to MIREX 2012 audio beat tracking task.

1. INTRODUCTION

Based in the beat tracking selection from a committee of state of the art algorithms presented in [16] [15] [11], This Beat tracker uses seven different onset detection functions as input signal to the Degara Beat Tracker [6]. Each output is considered as a committee member and in each case the beat tracker output chosen to represent the committee is selected automatically as the one which most agrees with the remainder of the committee (Maximum Mutual Agreement, MaxMA).

2. BEAT TRACKING SYSTEM

The Beat tracking estimation is computed seven times, each time with a different onset detection function. the output is selected using the Maximum Mutual Agreement method. This Beat tracker was presented in [16] and implemented in the essentia framework, http://essentia.upf.edu/

2.1 Onset Detection Function

The onset detections used are:

- Complex Spectral Difference [7]
- Energy Flux [12]
- Harmonic Function [9]
- Sub Bands weight [5]
- Phase Slope Function [13]
- Spectral Flux Log Filtered [1]
- Mel Auditory Feature [8]

2.2 Period Estimation

The beat tracking system estimates the beat period and phases independently. To extract the sequence of periods from the beat period salience observation signal. The beat period is estimated by passing the autocorrelation function of the onset detection function through a shift invariant comb filterbank matrix. Then the information of the beat period is used to recover the beat alignment by passing the onset detection function through a comb filter matrix. The system assumes the beat period like a slowly varying process and the transition probabilities are modeled using a Gaussian distribution of fixed standard deviation. For a complete description of the beat period estimation method see [2, 6].

2.3 Beat Tracking

The Degara Beat tracking probabilistic model [6] takes as input parameters the phase observation signal and the beat period estimation, returning the set of beat time estimates.

2.4 Output Selection with Maximum Mutual Agreement (MaxMA)

The Mean Mutual Agreement (MMA) follows the Query by Committee concept [14] which selects the most informative set of samples from a database based on the mutual (dis-)agreement between a designated committee of learners. Given a committee of beat trackers, the low MMA between their estimated beat sequences (see Figure 1) on a music database was shown to indicate difficult samples for beat tracking, by being strongly correlated with low performance against the ground truth of this data [11].

As depicted in Figure 1 and proposed in [11], the MMA of a sample is computed by using the beat estimations of N beat trackers on a musical piece, measuring the mutual agreement (MA) among their estimated beat sequences, and retrieving the mean of all $N(N-1)/2$ mutual agreements:

$$MMA = \frac{1}{N(N-1)/2} * \sum_{i=1}^{N-1} \sum_{j=i+1}^{N} MA_{i,j}. \quad (1)$$

The Maximum Mutual Agreement (MaxMA) refer to the MA of the beat sequence that highly agrees with the others:

$$MaxMA = max_i \left(\sum_{j=1, j \neq i}^{N} MA_{i,j} \right), i = 1, \ldots, N. \quad (2)$$

In order to measure the MA between each pair of estimated beat sequences a beat tracking evaluation criteria was selected. A combination of Information Gain measure [4] for Multi feature beat tracker information gain (ZDG1) and Regularity Function [10] for Multi feature beat tracker information gain (ZDG2). The output selection is done using the Maximum mutual agreement presented in [15] [11].

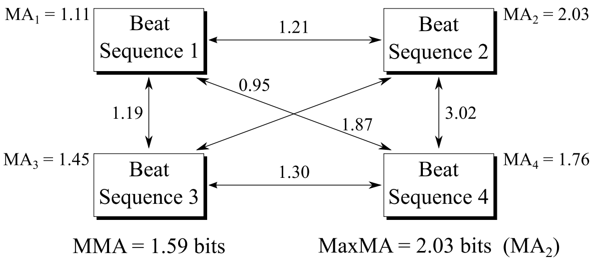

Figure 1. Example calculation of the MMA and MaxMA for a musical piece with the beat sequences estimated from a committee of four beat trackers.

3. RESULTS

4. ACKNOWLEDGEMENTS

We would like to thank all the authors (N.Degara, D.Ellis, A. Holzapfel, S. Böck, F. Krebs and M. Schedl) of the available matlab code for their support. Universidad Pontificia Bolivariana (Colombia) and Colciencias.

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