MIREX 2009 AUDIO BEAT TRACKING EVALUATION: DAVIES, ROBERTSON AND PLUMBLEY

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ABSTRACT

We provide a description of four beat tracking algorithms submitted to the MIREX 2009 Audio Beat Tracking Evaluation. We include our standard beat tracking algorithm and then a modified version better able to deal with tracking beats in more expressively performed music. Of the remaining two submissions the first is formulated as simple as possible, with the final beat tracker assigning beats at regular intervals without any information about the input signal.

1. ALGORITHMS

1.1 Standard Tracker

The standard beat tracking algorithm is a hybrid model based on the beat period tracking stage in [3] and the dynamic programming algorithm in [4].

The input to the beat tracking system is the complex spectral difference onset detection function [1] calculated with a temporal resolution of 11.6ms per detection function sample. The two-state model for tracking the beat period in [3] which uses the output of a comb filterbank applied to an autocorrelation function (ACF) is replaced by a Viterbi decoding stage to find a path of beat period through time.

Once we have an estimate of the beat period path, the beats are found by applying the dynamic programming algorithm from [4], which has been modified to deal with multiple estimates of periodicity rather than a single value as initially published. A pre-compiled version of this beat tracking algorithm is available as a plugin [1] for Sonic Visualiser [2].

1.2 Flexible Tracker

The flexible beat tracker is identical to the standard beat tracking algorithm but with a modification to the parameters used in the dynamic programming stage. We alter the properties of the dynamic program to investigate the trade off between flexibility and inertia in beat tracking systems. For this beat tracker we tip the balance in the favour of flexibility by giving greater influence to the instantaneous value of the onset detection function rather than the momentum built up by the recursion in the dynamic program. The input onset detection function and the periodicity tracking stages are left unchanged.

1.3 Dumb Tracker

We formulate the third beat tracker from the perspective of making the algorithm *as simple as possible*. Instead of the complex spectral difference onset detection function we employ a simple energy based approach. From this energy based detection function we take we find the autocorrelation function (ACF) and extract a single estimate of the beat period by finding the index of the maximum value of the element-wise product of the ACF and a Gaussian weighting curve centred on 0.5 seconds. To find the beat locations we partition the detection function into windows equal to the beat period. These are weighted by a different Gaussian centred on half the beat period. To find an individual beat location, we take the the index of the maximum value of the Gaussian-weighted analysis frame. Once each beat has been recovered, we shift the start of the next analysis frame to half the beat period beyond the last detected beat and proceed in this manner to the end of the file. No higher level processing to incorporate temporal continuity between beats or any musical knowledge is included.

1.4 Deterministic Tracker

To provide a baseline for the evaluation we create a set of beat locations where no effort is made to look at the structure of the input. We find the length of the audio file and place beats at 0.5 second intervals.

[1] http://www.vamp-plugins.org/download.html

2. REFERENCES

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