

KEY DETECTION USING BIGRAM BAYESIAN ANALYSIS

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ABSTRACT

In this submission we present a method for automatically estimating the key of a musical piece in a digital audio format.

The proposed method is an evolution of the CG1 submitted on Mirex2019 and it is based on three main aspects, first, the generation of a spectrogram using the CQT; second, the generation of a chromagram. Finally, a probabilistic analysis of the chromagram, so that the probability bigram sequences of major and minor triad chords is taking into account to determine the estimated global key.

1. INTRODUCTION

This work represents some progress in the scope of the previous efforts from the members of the team to implement an Automated Piano Music Transcription System [1] [2] [3]. Some of the technical decisions must be understood in this context.

The present contribution corresponds to the second contribution on the MIREX contest by the authors. Followed by the 2018 [4][5] and 2019 submissions .

The automated Key Detection Algorithm has been developed and implemented in Python.

2. PROPOSED ALGORITHM

The proposed algorithm is based on the classification of local key estimations that are created from chromagrams after CQT spectrograms. The depicted diagram is displayed in Figure 1.

First, a Spectrogram is generated using a technique similar to the Constant Q Transform (CQT). We select 73 frequency bins with a logarithmic spacing starting with the A0 frequency and covering all the standard piano frequencies up to A8.

We use the standard CQT implementation from scipy package.

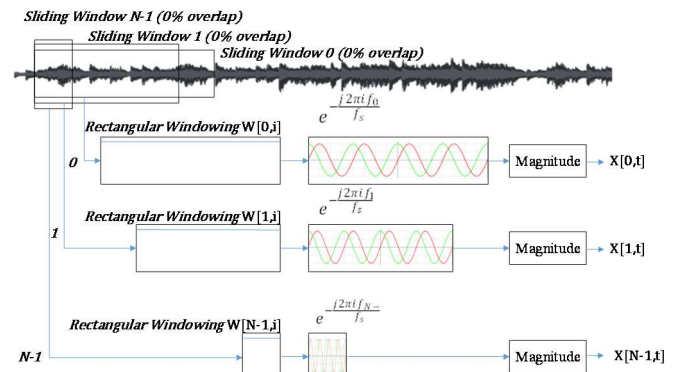


Figure 2 Block Diagram of CQT with number of cycles $Q=4$.

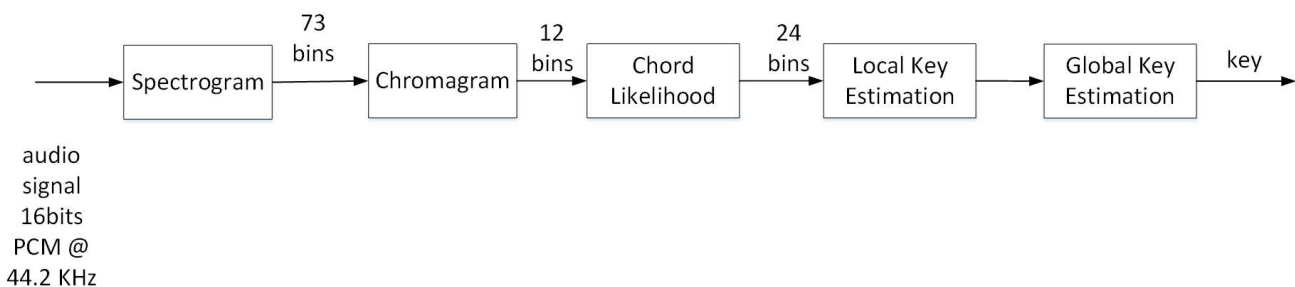


Figure 1. Block Diagram of Key Detection Algorithm

The resulting spectrogram is further processed to obtain a chromagram. This is a sequence of chroma vectors from a temporal windows from the spectrogram. Chromagram windows are not overlapped and integrate the spectrogram components for a period of 0.5 seconds. This value has been found empirically after testing with different values.

For every chromagram frame we compute the probability of having all major and minor chords. This results on a vector of 24 dimensions.

For every frame we select the most probable chord, and build bigrams and trigrams of chords that are used to create a local key estimation.

We do a bayesian analysis of the conditional probability of having a bigram for a key.

$$P(key|bigram) = \frac{P(bigram|key)P(key)}{P(bigram)}$$

Initially all keys are equally probable. After some frames, the key probability depends on the previous frames estimated keys.

The local key estimation is then a problem of obtaining the maximum of a posteriori estimation (MAP) considering all the possible keys.

The global key estimation is obtained from the local key estimations applying some weighting with respect frame position. Initial frames have more contribution than later ones.

3. RESULTS

The preliminary results show a significant improvement in classical music (which is the genre of the MIREX2005 dataset), scoring around 90%.

The observed results in electronic dance music from Giant-Steps database is significantly lower than classical music.

4. REFERENCES

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