論文の内容の要旨

Musical Instrument Identification Based on Weighted Timbre Features and Probabilistic Mode
（音色特徴重みづけと確率モデルに基づく楽器認識の研究）

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Music Information Retrieval (MIR) is one of the fast growing topic in which most of the research going on now is using signal processing method. The MIR research is an important and difficult problem in MIR. With this technique we will be able separate the music songs to be different instruments' performance, or make a live concert recording to be solo recordings of single instruments. It has both scientific and practical applications. However, this problem is yet far from being solved although some research about instrument recognition techniques in solos (monophonic or polyphonic recordings of single instruments) is going on. The recognition of musical instruments in multi-instrumental, polyphonic music has not been solved yet. A proper solution for this problem will be significant.

Polyphonic pitch estimation and musical instrument identification are some of the most challenging tasks in the field of Music Information Retrieval. While existing approaches have focused on the modeling of harmonic partials, we design a joint Gaussian mixture model of the harmonic partials and the inharmonic attack of each note. This model encodes the power of each partial over time as well as the spectral envelope of the attack part. We derive an Expectation-Maximization (EM) algorithm to estimate the pitch and the parameters of the notes. We then extract timbre features both from the harmonic and the attack part via Principal Component Analysis (PCA) over the estimated model parameters. However, there are often some cases that parts of the learning data are unreliable in real applications while no algorithm was proposed to solve this problem. In this

chapter, we applied a weighted PCA approach to deal with the unreliable features and build a consistent representation to cope with certain training data which contain noise, overlapped effect or other undesirable effects in musical instrument identification. Musical instrument recognition for each estimated note is finally carried out with a Support Vector Machine (SVM) classifier. Experiments conducted on mixtures of isolated notes as well as real-world polyphonic music show higher performance of the proposed algorithm than state-of-the-art approaches. To utilize the features and classifiers more efficiently, a new boosting algorithm based on probabilistic decisions is proposed for musical instrument identification. In contrast to the conventional boosting algorithm which uses a deterministic decision method during the iterations not considering the noise in the data set sufficiently, the new boosting algorithm is proposed to use probabilistic decisions for every hypothesis at the iterations of the boosting scheme, selecting the data events from a dataset, and then combines them. It improves the musical instrument classifier without using boosting approach and the conventional boosting algorithm significantly which was proved by the experiment.