

Fractional Fourier Transform Based Features for Musical Instrument Recognition Using Machine Learning Techniques

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Abstract. This paper reports the result of Musical instrument recognition using fractional fourier transform (FRFT) based features. The FRFT features are computed by replacing conventional Fourier transform in Mel Frequency Cepstral coefficient (MFCC) with FRFT. The result of the system using FRFT is compared with the result of the system using Mel Frequency Cepstral Coefficients (MFCC), Wavelet and Timbrel features with different machine learning algorithms. The experimentation is performed on isolated musical sounds of 19 musical instruments covering four different instrument families. The system using FRFT features outperforms over MFCC, Wavelet and Timbrel features with 91.84% recognition accuracy for individual instruments. The system is tested on benchmarked McGill University musical sound database. The experimental result shows that musical sound signals can be better represented using FRFT.

Keywords: Musical instrument recognition, Mel Frequency Cepstral Coefficient (MFCC), Fractional Fourier transform (FRFT).

1 Introduction

Recognizing the objects in the environment from the sound they produce is primary function of auditory system. The aim of Musical instrument recognition is to identify the name and family of musical instrument from the sound they produce. So far many attempts were made for musical instrument recognition and classification. The statistical pattern-recognition technique for classification of 15 musical instrument tones with 31 features based on log-lag correlogram was discussed in Martin and Kin [2]. A study on pitch independent musical instrument recognition for 30 musical instruments with 43 features based on spectral, cepstral and temporal properties of sounds was described by Eronen and Klapuri [4].

Comparison of features for Musical Instrument recognition was discussed and used large set of features including MFCC, delta MFCC, Linear prediction cepstral coefficients, temporal feature, spectral features and modulation features for 16 orchestral instruments were used for experimentation by Eronen [1]. A work on

instrument recognition for isolated monophonic notes using six features: cepstral coefficients, constant Q transform frequency spectrum, multidimensional scaling analysis trajectories, RMS amplitude envelope, spectral centroid and vibrato for 19 Instruments was described by Kaminskyj and Czaszejko [5]. Essid et al. performed study on use of hierarchical taxonomies for 20 musical instruments with wide set of 540 feature covering Temporal, Cepstral, spectral, wavelet and perceptual features [7]. Deng et al. [3] compared performance musical instrument recognition with work of [1], [2], [5], [6], [12], [13]. A study on feature analysis for recognition of classical instruments, using machine learning techniques to select and evaluate features extracted from a number of different feature schemes was described by Deng et al. [3]. The performance of Instrument recognition was analyzed using selected features with different feature selection and ranking algorithms.

Review of earlier work shows that, developing compact and efficient feature set for Musical Instrument Recognition has become challenging task and attracted the attention of researchers. Earlier work shows that number of features and recognition accuracy are main issues in Musical instrument recognition and classification.

This paper presents comparison of FRFT based features with MFCC, Timbrel and wavelet for Musical Instrument Recognition and classification using different machine learning algorithms.

The paper is organized as follows. Feature extraction and proposed features along with different machine learning algorithms is described in section 2. Database details and performance evolution is presented in section 3. Conclusion is summarized in section 4.

2 Feature Extraction and Proposed Features

Musical instrument recognition was tested using four different feature set as follows.

1. MFCC, 2. Wavelettes, 3. Timbrel 4. FRFT (proposed).

The block schematic for musical instrument recognition system is shown in figure 1.

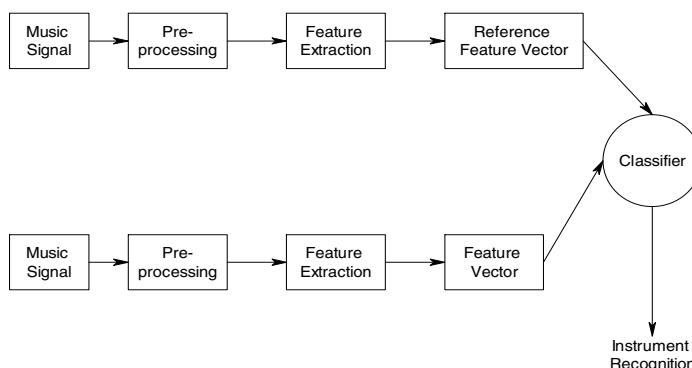


Fig. 1. Musical Instrument Recognition system