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REVIEW ARTICLE

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A SURVEY ON SEPARATION OF HARMONIC AND PERCUSSIVE SOUND

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ABSTRACT

This survey paper is based on musical classification using various techniques. Music signal consist of two components harmonic and percussive. It provides knowledge to identify advantages and to choose correct method for musical separation.

Index words: Harmonic components, Percussive components, audio signal.

I. INTRODUCTION

Audio classification is a part of the larger problem of audio visual data handling with important applications in education, digital libraries, entertainment, professional media production, and surveillance.Speaker recognition and speech can be considered classic problems in audio retrieval and have received decades of research attention.

The separation of harmonic and percussive sources from mixed audio signals has numerous applications, both as an audio effect for the purposes of remixing and DJing, and as a preprocessing stage for other purposes. It includes the automatic transcription of key signature detection, pitched instruments and chord detection, where elimination of the effects of the percussion sources can help improve results. Similarly, eliminating the effects of pitched instruments will help to improve the results for automatic transcription of drum instruments and rhythm analysis beat tracking.

Western music can be described as a collection of note events, each defined by several attributes: onset time, duration, pitch, instrument, playing style, loudness, vibrato rate, etc. Polyphonic pitch transcription consists of estimating the first three of these attributes. This task lies at the core of many applications, including content-based retrieval and source separation.

II. Literature Survey

Separation of a monaural audio signal into harmonic/percussive components by complementary diffusion on spectrogram

Nobutaka Ono, Kenichi Miyamoto, Jonathan Le Roux, Hirokazu Kameoka and Shigeki Sagayama proposed a simple method for monaural audio signal into harmonic and percussive components using complementary diffusion on spectrogram. It derived the fast iterative solution by auxiliary function approach.

Harmonic/Percussive separation using median filtering.

Derry Fitgerald describesan approach for musical classification using median filter to remove denoising resulted in enhanced harmonic/percussive spectrograms. Median filter is used across successive frames to suppress percussive events and enhance harmonic components andalso performed across frequency bins to enhance percussive events. It is then used to generate masks and applied to original spectrogram to separate the signal.

Multichannel harmonic and percussive component separation by joint modelling of spatial and spectral continuity

NgocQ.K.Duong,HideyukiTachibana,EmmanuelVincent,NobutakaOna,RemiGribonval and Shigeki Sagayama proposed a multichannel approach by joint modelling of spatial and spectral continuity for the separation of harmonic/percussive component.The spatial and spectral parameters are estimated using expectation-maximization (EM) algorithm.

Table:1 :Average harmonic/percussive component separation performance

		SDR	SIR	SAR	ISR
Original	HPSS	3.8	5.2	7.6	8.7
	$HPSS_{IG}$	4.8	7.9	8.0	10.7
	M-HPSS	5.0	7.2	8.6	10.1
Pan+	HPSS	3.8	5.1	7.5	8.6
	$HPSS_{IG}$	4.7	7.7	8.2	10.4
	M-HPSS	5.3	7.4	8.8	10.3

Beyond timbralstatistics: Improving Music Classification using percussive patterns and bass lines

Emiru Tsunoo, George Tzanetak is, NobutakaOno, Shigeki Sagayama discussed an approach for extracting feature vectors for classification. The new feature vectors were pattern occurrence histograms for percussive patterns and averaged distances from each template for base-line patterns.This improved the accuracy of classification system based on timbral information.

Table:2: Audio mood classification and the comparison to one using only timbral features

Features	Accuracy
Existing (timbre, 68 dim.)	53.5%
Timbre + Rhythm/Bass (152 dim.)	55.9%

Unsupervised single-channel music source separation by average harmonic structure modeling

ZhiyaoDuan,YungangZhang,ChangshuiZhang,ZhenweiShi proposed an unsupervised model based music source separation.It is tested on several mixed signal, including synthesized and real harmonic instrument signals and singing voices. AHS models are used to extract their corresponding sources from the mixed signal. The proposed system cannot handle a mixed signal with more than one inharmonic or noisy source because it cannot be represented by AHS model.

Table: 1: Performance measurement of separating two synthesized harmonic instrument and a singing voice

	Piccolo			Oboe			Voice		
	AHS	NMF	Oracle	AHS	NMF	Oracle	AHS	NMF	Oracle
SDR	11.2	13.7	19.4	10.1	12.9	17.3	7.6	6.2	16.9
SIR	23.1	22.5	34.4	33.1	26.6	31.1	23.1	28.6	30.9
SAR	11.5	14.4	19.5	10.2	13.1	17.5	7.7	6.2	17.1

Separation of harmonic sound sources using sinusoidal modelling

TuomasVirtanen,AnssiKlapuri proposed a method to separate harmonic sounds.It is done by using harmonic relations of sinusoidal spectral components and synchronicity. Sinusoidal modelling is used to represent the sinusoidal trajectories. From this trajectories determine the colliding harmonics and split the trajectories into two. Finally synthesize the sounds separately. The disadvantage is, it is difficult to determine the harmonic partials.

Algorithm for the separation of harmonic sounds with time-frequency smoothness constraint

Tuomas Virtanen describes an algorithm for the estimation of amplitude of harmonic partials with interframe dependency. By modelling the components as a sum of pre-defined basis functions are used for dependency. From each frame harmonic components are estimated and synthesize the sounds separately. From frame to frame amplitude, frequency and phases are interpolated. From each sound, time domain signal is obtained by summing up the harmonic component and sound parameter can be analysed further. It shows improvement in quality.

Table:3: Simulation Result

time model	mean of log(noise disturbance)		percentage of notes with log(noise disturbance) < 0	
	MPE	MIDI	MPE	MIDI
constant-interval	0.311	0.301	18.2	23.5
exponen-tially spaced	0.285	0.278	21.4	25.4
no time model	0.030	0.030	45.3	51.7

III. Conclusion

In this paper various methods are used for the music classification. Some of the methods make use of spectrograms, medianfilter, spectral parameters. These techniques has unique characteristic for separation of musical signal but some drawbacks also present in this technique. Selection of time-frequency distribution will lead to better result in separation.

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