PITCH DETECTION BASED MONOPHONIC PIANO TRANSCRIPTION

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ABSTRACT

In order to make creation of music score easier, music transcription walks into the engineering field.

Music transcription is designed to generate music scores from simple audio recordings. The goal of this paper is to design a project to complete the entire transformation, which included in multiple processing steps.

INTRODUCTION

In old ages, musicians usually used pens to make notes of a music piece while playing along with the instrument. Although transcribing music pieces into music scores is not hard for professional musicians right now, an automatic music transcription system can still save a lot of work. The appearance of new technology like computers makes music transcription possible.

Because piano produces sound by the hit on the string, which makes piano the instrument with less change on pitch. Taking the stability of piano into consideration, it is chosen to be the instrument used for this music transcription system.

MODEL STRUCTURE

Figure 1 Structure of the music transcription system

YIN

YIN algorithm is designed for the estimation of the fundamental frequency (F0) of sounds. For pitch detection, taking the detection of fundamental frequency of music recording as the target, YIN is perfectly suitable for the work.

Step 1. The autocorrelation method: This step separates the entire wave data into multiple windows and calculate autocorrelation value of each frame.

Step 2. Use difference function to search for the values of time for which the difference is zero.

Step 3. Cumulative mean normalized difference function.

Step 4. Set an absolute threshold and choose the smallest value of time that gives a minimum of difference deeper than that threshold.

Step 5. Parabolic interpolation: Each local minimum of difference and its immediate neighbors is fit by a parabola. The abscissa of the selected minimum then serves as a period estimate.

Step 6. Best local estimate: Repeat detecting around the vicinity of each analysis point for a better estimate.

PITCH DETECTION

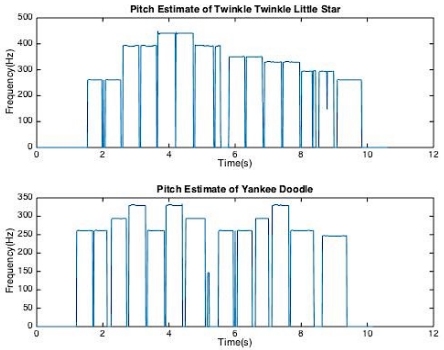


Figure 2 Pitch estimation result of YIN algorithm

ONSET DETECTION

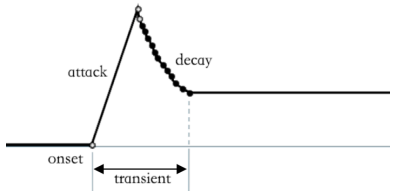


Figure 3 Definition of different parts in a note

MIDI INFORMATION

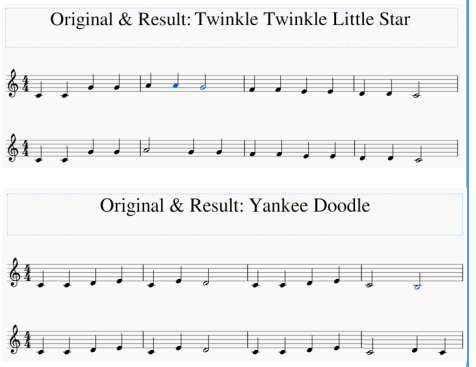
Twinkle Twinkle Little Star			
Onset Time	MIDI Number	Note Name	Beat (duration)
0.00	60	C4	1
0.50	60	C4	1
1.00	67	G5	1
1.50	67	G5	1
2.00	69	A5	2
3.00	67	G5	1
3.50	67	G5	1
4.00	65	F5	1
4.50	65	F5	1
5.00	64	E5	1
5.50	64	E5	1
6.00	62	D4	1
6.50	62	D4	1
7.00	60	C4	1

Table 1(a) MIDI information results of Twinkle Twinkle Litter Star

Yankee Doodle			
Onset Time	MIDI Number	Note Name	Beat (duration)
0.00	60	C4	1
0.50	60	C4	1
1.00	62	D4	1
1.50	64	E5	1
2.00	60	C4	1
2.50	64	E5	1
3.00	62	D4	2
4.00	60	C4	1
4.50	60	C4	1
5.00	62	D4	1
5.50	64	E5	1
6.00	60	C4	2
7.00	62	D4	1
7.50	60	C4	1

Table 1(b) MIDI information results of Yankee Doodle

TRANSCRIPTION



CONCLUSION & FUTURE WORK

Piano Piece	Note Accuracy	Beat Accuracy	Onset Accuracy	Offset Accuracy
Twinkle	96.88%	90.63%	100%	50%
Yankee	91.67%	95.83%	100%	66.67%

Table 2 Average detection accuracy of different music recordings

- Noise Reduction
- Polyphonic Music
- Other Instruments
- Changed Tempo

REFERENCE

[1] Alain de Cheveigne, Hideki Kawahara: "YIN, a fundamental frequency estimator for speech and music", *Acoustical Society of America*, Vol. 111, No.4, 2002.

[2] Juan P. Bello, Laurent Daudet and Mark B. Sandler: "Automatic Piano Transcription Using Frequency and Time-Domain Information", *IEEE Transactions on Audio, Speech, and Language Processing*, Vol.14, No.6, 2006.

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