CROSS-CULTURAL COMPARISONS OF EXPRESSIVITY IN RECORDED ERHU AND VIOLIN MUSIC: PERFORMER VIBRATO STYLES

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1. INTRODUCTION

Many traditional Chinese pieces have been transcribed for, and are frequently performed on, Western Classical instruments. Our study focuses on a cross-cultural comparison of erhu music performed on the violin and on the original instrument. Performances of erhu music on violin differ qualitatively, both in the pacing and sonic shaping of the music, from that on the original instrument. It is our goal to quantify this difference so as to create better models and representations for folk music analysis.

The use of vibrato in modern erhu playing can be traced back to the violin. Western Classical music played an important role in the development of erhu playing from the beginning of the twentieth century. Liu Tianhua (刘天华) (1895-1932), a Chinese musician, erhu teacher and composer, is especially noted for his innovative work on erhu. He studied violin, piano and Western music composition theory in his younger years, and adopted the violin vibrato and trills for erhu playing. He also introduced tremolo, spiccato, and pizzicato into erhu playing (Wang, 2002). These diverse playing styles gave a new life to erhu, and made it stand out in Chinese music. These techniques are now widespread and used extensively in erhu playing.

Our study of an erhu piece played on both erhu and violin seeks to measure playing styles when the violin may be emulating the erhu. In fact, the influence goes full circle and can be traced back to the violin because the vibrato techniques on erhu originated in erhu players borrowing from violinists. Nevertheless, the quantitative study of vibrato in these two instruments reveals interesting differences.

1.1 Motivation

Scientific study of expressivity in performances of Western Classical music has been a subject of study since the beginning of the twentieth century (Seashore, 1932, 1938). While music technology research focused on Chinese music has increased in recent years–for example, Yang & Hu (2012)'s work on automatic classification of Chinese and Western music instruments and Tian et al. (2013)'s work on emotion categorisation of singing in Chinese songs. However, studies on expressive features of non-Western music has received comparatively less attention, and the field is wide open for exploration. Ozaslan et al. (2012) has showed a pioneering coss-cultural comparative analysis between Turkey Mamkan music and Western Classical music.

As is true for transcription of music of diverse cultures (Ellingson, 1992), expressivity in the performance of Chinese music is poorly captured by Western common music notation (CMN). Chinese music was traditionally notated using *Gongche* (工尺谱) notation, which comprises of Chinese characters representing notes, and sparse rhythm signs to the right of these characters. Modern Chinese music notation borrows from CMN, and uses primarily numbers representing scale degrees, augmented by dots above or below the symbol denoting register, and lines and dots to represent note durations similar to that in CMN.

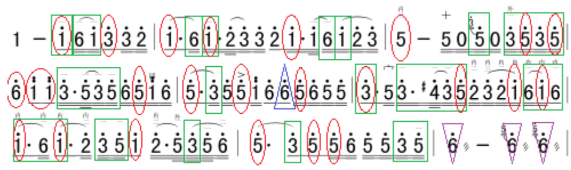

Figure 1: Modern Chinese music notation for first nine bars of *The Moon Reflected on the Second Spring*.

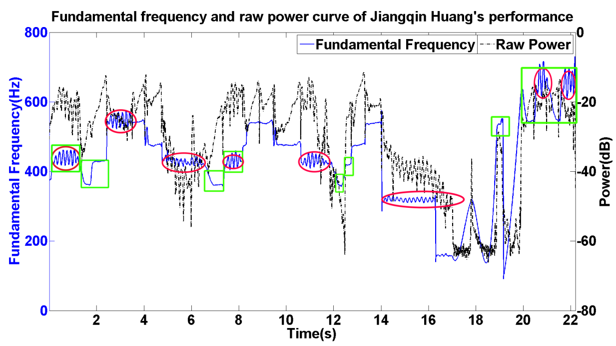

Figure 2: Fundamental frequency and raw power curve of Jiangqin Huang's performance of *The Moon Reflected on the Second Spring*.

Figure 1 shows the first nine bars of *The Moon Reflected on the Second Spring*(《二泉映月》), considered to be a traditional Chinese piece for erhu, composed by Abing (aka Hua Yanjun 华彦钧) (1893-1950). Figure 2 shows the fundamental frequency and the raw power curve of Jiangqin Huang's recorded performance of the first 3 bars of Figure 1. In both Figures 1 and 2, red ellipses mark vibratos, green boxes indicate portamentos, blue upright triangles mark notes elaborated with trills, and purple upside down triangles indicate tremolo notes. As can be seen by the dense markings, very little of these common expressive devices are indicated in the Modern Chinese music notation. But these expressive devices clearly stand out in the fundamental frequency and raw power curve.

1.2 Aim

The piece has been transcribed for violin and piano and is frequently performed throughout East Asia. The violin transcription closely mirrors the notes and structure of the original erhu composition. When performed on the violin, the music sounds different even when some violinists attempt to emulate idiomatic erhu expressive gestures. Our ultimate goals are: (1) to quantify the differences between erhu and violin playing of the same music; and, (2) to determine the expressive devices employed by erhu players.

We began our investigation into the differences between erhu and violin playing by first considering vibrato. In (Yang et al., 2013), we presented summary statistics for vibrato in erhu and violin playing focussing on the instrument. We found that the physical form of the instrument and how it is played may be the most dominant factors affecting the differences in vibrato style between erhu and violin playing.

In the present study, we delve deeper into the vibrato differences between individual erhu and violin players. The methodology also presents a way to perform cross-cultural vibrato analysis especially for world folk music.

2. METHODOLOGY

To compare the vibrato styles, we used the vibrato rate, extent, and sinusoid similarity as parameters. Details of how we extracted the vibratos and obtained these quantities are outlined below and can be found in (Yang et al., 2013).

2.1 Data

We collected twelve performances of *The Mood Reflected on the Second Spring*—six on erhu and six on violin—as shown in Table 1.

Erhu			Violin		
#	Performer	Nationality	#	Performer	Nationality
1	Guotong Wang	China	7	Laurel Pardue	U.S.A
2	Jiangqin Huang	China	8	Lina Yu	China
3	Wei Zhou	China	9	Baodi Tang	China
4	Jiemin Yan	China	10	Nishizaki Takako	Japan
5	Huifen Min	China	11	Yanling Zhang	China
6	Changyao Zhu	China	12	Yangkai Ou	China

Table 1: Selected performances

2.2 Vibrato rate and extent

The vibrato rate and extent are both calculated from he peaks and troughs of the vibrato fundamental frequency. We assume the interval between one peak and one trough is the half cycle of the vibrato period. The averaged inverse of the intervals for all half cycles results in the vibrato rate. Similarly, the extent for one half cycle is half the difference between the peak and the trough. The averaged extents for all half cycles is the vibrato extent.

2.3 Vibrato Sinusoid similarity

We use the normalised cross-correlation of the shape of f0 and the relevant sinusoid having the same frequency to determine the vibrato's similarity to a sinusoid. The procedures are:

1. Convert the f0 to a MIDI scale.
2. Apply smoothing to obtain the average f0.
3. Subtract the average f0 from the MIDI scale f0 to block the DC component.
4. Compute the FFT of the 0-centred f0.
5. Pick the peak from the spectrum to get the vibrato frequency.
6. Use this vibrato frequency to create a sine wave with amplitude 1.
7. Calculate the normalized cross-correlation between the 0-centred f0 and the sine wave.
8. Set the vibrato sinusoid similarity to the maximum of the normalized cross-correlation results.

3. RESULTS

Figure 3 shows the vibrato rate for each player. In general, violinists tended to apply faster vibratos. However, the Player 11 (a violinist) had vibrato rates similar to erhu players, and Player 12 (another violinist) had vibrato rates lower than all erhu performers. Thus, the violin vibrato rates varied more widely.

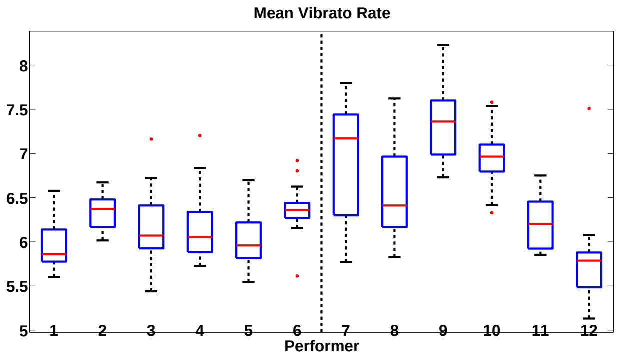

Figure 3: Box plots of vibrato rates for all performers.

Figure 4 presents the vibrato extent for each player. The results show that erhu performers' vibratos had much greater extents than that of violinists. The standard deviation of the erhu vibratos were also markedly larger than that for violin. The 2nd erhu player showed the largest vibrato extent, almost 1 semitone, which is twice that of the 3rd erhu player. In contrast, all violinists maintained relatively small vibrato extents, with low standard deviations.

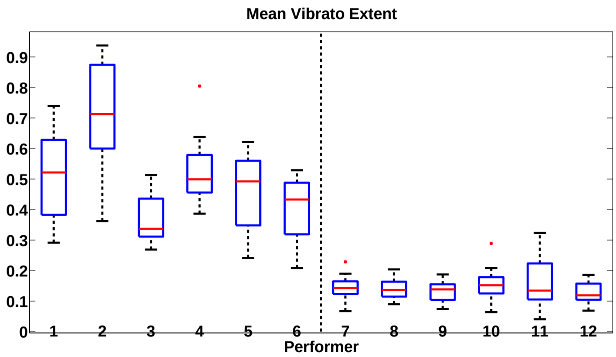

Figure 4: Box plots of vibrato extents for all performers.

The vibrato sinusoid similarity for all performers is represented by Figure 5. All erhu vibratos have greater sinusoid similarity than that of the violins. Player 7 (the US violinist) showed the widest sinusoid similarity range, and lowest sinusoid similarity values.

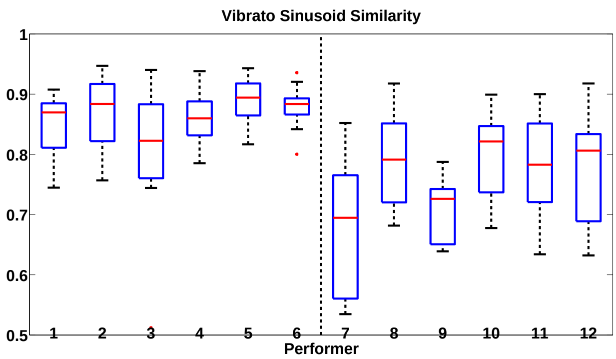

Figure 5: Box plots of vibrato sinusoid similarity values for all performers.

4. CONCLUSIONS

In general, violin performers had marginally higher vibrato rates, and varied the vibrato rate more widely than erhu performers, but the differences are not significant. All erhu performers had significant larger vibrato extents than violin performers. Furthermore, the erhu players also varied the vibrato extents more widely than violin players. The shape of the erhu vibrato samples was closer to that of a sinusoid than the violin samples.

Thus, even though the erhu borrowed vibrato techniques from violin, and the violin may be emulating the erhu in playing an erhu piece, the differences between their vibrato styles can still be identified quantitatively; this is especially true for the vibrato extents.

To determine if the only factor leading to this difference in vibrato styles is the instrument, the ideal experiment would analyze the vibratos of the same performer playing both the erhu and violin. This represents future work as and when such a player can be found. A carefully designed experiment will be required to obtain a systematic analysis of vibrato performance style that eliminates the effect of habit or practice.

5. ACKNOWLEDGEMENTS

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