DIFFERENTIATING THE PITCH BEND FUNCTION BETWEEN THE SITAR AS A REAL & VIRTUAL INSTRUMENT

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ABSTRACT

The pitch bend is used as a tool in a virtual instrument/ synth that allows one to glide smoothly from one note to another. Almost all virtual instruments today employ the pitch bend joystick/wheel on a keyboard to solely manipulate the fundamental frequency or the pitch of the note being played. While this feature allows a perceptually realistic reproduction of slides in a few instruments (especially wind instruments), it largely fails to do so with plucked string instruments, especially non-Western traditional instruments. In this abstract, I chose to study the *meend* technique in Sitar performance in order to understand in finer detail the factors (including, but not limited to, the fundamental frequency) that characterize the glide between two notes.

1. INTRODUCTION

The sliding of one note to another is largely perceived as an ornamentation or a modulation in the field of music production. This is especially so in Western classical music; where slides are used sparingly. In Indian classical and folk music though, the slide is not seen as an ornamentation, but is essentially a part of the note itself. The way a note is (or is not) approached by a slide serves multiple purposes, including identifying the raag, or the sam, as well as establishing a *ras* or mood.

With the sitar, the process of sliding between notes is done in two ways. One is by sliding the hand along the string and across the frets from the starting fret to the final fret over a single pluck of the string. This technique is particularly used in faster passages of music and sparingly, when done so. The other way of sliding between notes is by using the meend technique, where the player pulls the string downward, while remaining on the same fret. The increased tension in the string due to the pulling action, increases the pitch of the note while the string is being pulled downwards, and reduces the pitch as the string returns to its resting position.

While the shift in the fundamental pitch is the most noticeable effect of the meend, there are various other factors that contribute to its perceived tonality. The aim of this abstract is to identify those factors.

2. METHODOLOGY

In order to study the difference in features of the meend between the real sitar and the virtual sitar, I chose to take samples of meends from a live, recorded sitar and classify them into 'bend up' (BU) or 'bend-down' (BD) samples. I further classified them into whole tone or semitone pitch bends. Each sample was labelled according to the note that the meend ended at. I then used these samples as references to record similarly labelled meend samples of a virtual sitar as played on a MIDI keyboard in Logic Pro X. The meend was performed on the MIDI keyboard to approximately replicate the length and level of the meend as was recorded by the real sitar. Thereafter, I computed the spectrograms of these samples to compare that of the real sitar against the virtual sitar, in terms of the corresponding time-frequency patterns.

The recording session of the real sitar was conducted in a studio using a Neumann U-87 microphone (with a cardioid microphone pattern selected). The samples were recorded in 24 bit, at a sampling rate of 48 khz.

The virtual instrument samples of the sitar are from the sampler in Apple's digital audio workstation, Logic Pro X. There was also a choice of using sitar samples from the SwarPlug plugin – a widely used virtual instrument plugin for playing Indian instruments on a MIDI keyboard – but the audibility of sympathetic strings in these samples was poor, if not non-existent. On the other hand, the audibility of the sympathetic strings in the samples from Logic Pro's sitar was better. This allowed us to make a fair comparison between the two samples.

2.1 Spectrogram of Real vs. Virtual Sitar Sample

The waveform and spectrogram analyses of a pitch bend down from *Shudh Dha* (major sixth on a scale) to *Pa* (perfect fifth) are illustrated in figures 1 & 2 and of a pitch bend up from *Shudh Ma* (major fourth) to *Pa* are illustrated in figures 3 & 4 respectively. I used the PRAAT speech analysis software [1] to compute the spectrograms with a window duration of 50 ms. Superposed on the spectrogram is a thin line indicating the detected pitch that varies across the sound.

Figure 1 corresponds to the pitch bend down from Dha to Pa in a real sitar. It indicates a secondary excitation after the initial one (which represents the plucking of the string). This secondary excitation appears to coincide with the sympathetic vibration of the Dha sympathetic string in response to the Dha on the main string as a result of the coupling effect through the primary and secondary bridges on the sitar [2]. This sympathetic vibration of the Dha string continues to ring even after the note on the main string has moved down to Pa at the end of the bend [3]. The reason for the longer decay time can be attributed to the sympathetic strings being made of ‘thin, lightweight steel’ material [2].

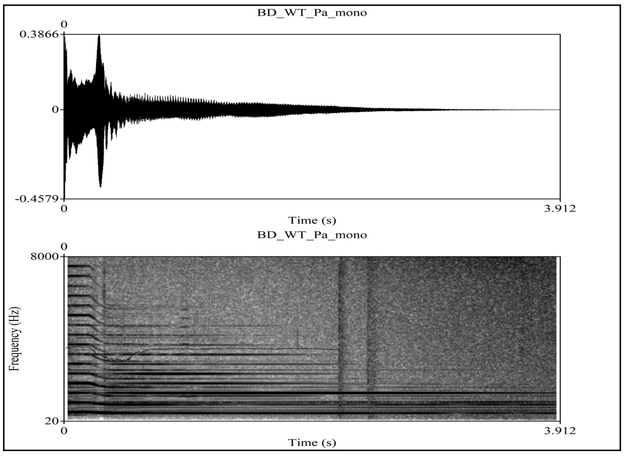

Figure 1. Waveform and spectrogram of a pitch bend down from note Dha to Pa on a real sitar.

Figure 2 corresponds to the pitch bend down across the same two notes but as played in the virtual sitar instrument. In contrast to figure 1, the spectrogram in figure 2 does not indicate a second excitation after the initiation of the impulse. As the pitch bend function in a virtual instrument affects the whole sample, both the main string and the sympathetic string slide down in pitch. This presents a different result to that of the real sitar, as the sympathetic strings on a real sitar are fixed pitch strings, and only resonate in response to one of the main strings vibrating at their fundamental frequency. Additionally, in the virtual sitar’s example, as the pitch of the sympathetic string has also moved down to Pa, there is a clear absence of the residual Dha as had been observed in the real sitar sample (which in turn had resulted in a brighter timbre).

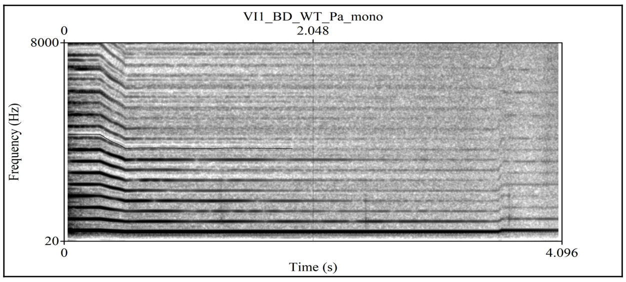

Figure 2. Spectrogram of a pitch bend down from note Dha to Pa on a virtual sitar.

Correspondingly, figures 3 & 4 show spectrograms of a pitch bend up from note Ma to Pa in a real sitar and a virtual sitar instrument respectively. Here too, the presence of the residual sympathetic vibration of the starting note of the meend is audible in the real sitar, while it is absent in the virtual sitar instrument. An interesting characteristic of the pitch bend up in the real sitar is the diminishing of high frequency content post bend. This could be attributed to the loss of amplitude due to the increase in tension of the string as it bends.

One caveat that needs to be considered is that every sitar’s construction is slightly different from the other, resulting in differences in amplitude of the sympathetic strings with respect to others. Thus, a recording of a different sitar might show slightly larger or smaller amplitudes in the second excitation, and these too might vary according to the note being played.

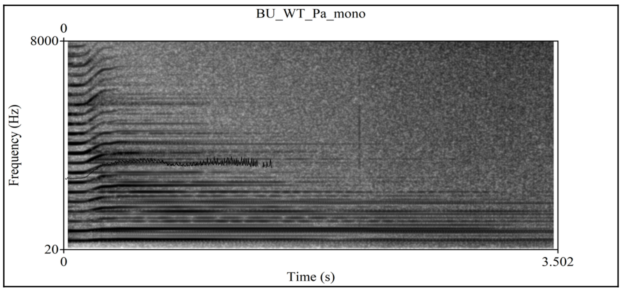

Figure 3. Spectrogram of a pitch bend up from note Ma to Pa on a real sitar.

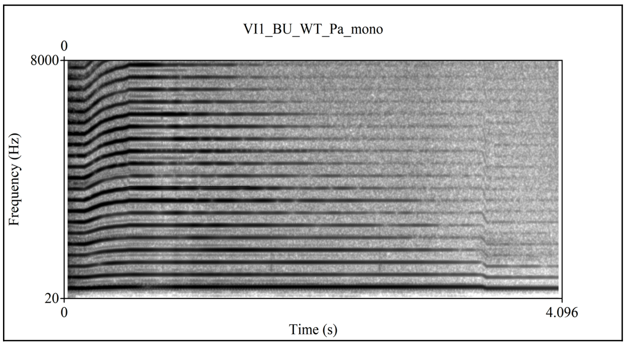

Figure 4. Spectrogram of a pitch bend up from note Ma to Pa on a virtual sitar.

3. CONCLUSION

From the brief study of the audio samples and the spectrograms, it is possible to consider that the absence of the role and complexities of the sympathetic strings, as well as the acoustics of string tension and mass density, contribute to the differences in tonality of the meend between a real and virtual sitar.

One way for virtual instruments to implement these differences is to treat the sitar as a multi-sample instrument, one corresponding to the main string, and another corresponding to the sympathetic strings. Additionally, the application of a high-shelf filter can be added to the signal chain following a pitch bend control, in order to subdue the higher frequencies corresponding to the upward movement of the pitch bend control.

4. ACKNOWLEDGEMENT

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5. REFERENCES

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