ZETA Violin Techniques: Limitations and Applications

Lilit Yoo and Ichiro Fujinaga
Peabody Institute of the Johns Hopkins University
1 E. Mt. Vernon Place
Baltimore, MD 21202
{lyoo|ich}@peabody.jhu.edu

Introduction

Given a new instrument, a basic understanding is required of its limitations, idiosyncrasies, and how the new instrument behaves to standard performance techniques. A player may have expectations that it will react the same way as a traditional instrument especially if it is closely modeled on one. One of the many concerns of performance practice, such as time delays, bears investigating for a number of reasons. First, the performer must understand how the instrument behaves given a stimulus. For example, the bowed or fingered articulations that creates an input signal on a ZETA instrument. Second, the performer must understand the limitations of the instrument. One of the most noticeable differences between the ZETA and the traditional instrument is the time delay which is caused by the Pitch-to-MIDI conversion (Roads 1996) of the pitch recognition algorithm (Kuhn 1990). This delay is investigated and possible solutions are offered. Last, one can expand the usage of the instrument as an effective teaching tool. Educational implementations of the ZETA interface using Opcode's MAX programming language will be discussed. One of the promising applications of the ZETA violin is its use in developing technical skills on the violin. Position shifting exercises can be monitored both visually and aurally using MAX. Other interactive exercises include maintaining evenness of bow strokes and controlling vibrato width and speed.

A major concern when performing on the ZETA violin is the perceptible time delay of triggering sound samples when using specific bowed articulations. Results in this study show that there is a much longer time delay when there are low-pitched sounds compared to higher-pitched ones. Articulations that have strong attack transients (e.g. pizzicato and martelé) have a much shorter time delay than other articulations such as détaché. Non-conventional techniques will be suggested to minimize delay and pitch detection errors.

ZETA RetroPak Instrument

Our ZETA RetroPak instrument comprises of a four-channel bridge electronic pick-up that sends the acoustical signal of each string into four separate preamplifiers in a beltpack, which can be attached to the performer's waist (*ZETA Owner's Manual* 1995). There are two separate outputs from the preamp: One is the direct audio mono out and the other goes into the ZETA VC-225 interface.

Features of ZETA VC-225 Interface

The ZETA VC-225 interface has a Pitch-to-MIDI converter which is essentially a five-channel IVL PitchRider (*ZETA Owner's Manual* 1995). MIDI messages from the interface can then be sent to a synthesizer or a computer.

To determine the pitch range of the interface, scordatura on the G string was tested and it was found that the interface could track notes a fifth below the open G string on our ZETA RetroPak-fitted violin. Also, the interface was able to track any playable high pitches.

The interface will trigger pitchbends depending on the pitchbend interval selected by the user between 0 to 12 semitones and can detect the pitchbend of vibrato and glissandi. This interval setting defines the range within which no NoteOn MIDI messages are generated but only PitchBend messages.

The interface can automatically transpose any note, even harmonics, between ± 3 octaves. We will come back to the usefulness of this feature when we discuss time delay issues. The interface also transmits bow pressure through aftertouch values that can be mapped by a specific Dynamic Mode.

Of all features, we found the Sensitivity setting to be most essential for pitch recognition. The general characteristic of this setting is that at lower levels it will not always trigger notes while at higher ones it will trigger harmonics and cause the ZETA interface to misfire unwanted note-ons (*ZETA: Suggested settings and equipment for ZETA instruments*, 1995). After much experimentation and practice, we were unable to find a setting where all intended attacks triggered MIDI NoteOns while no harmonics were picked up by the converter. A solution for this was to write a filter using MAX.

Time Delays

When playing note passages on the ZETA instrument, one can detect a perceptible time delay for low-pitched sounds and different bowed articulations. To the performer, this can be somewhat disconcerting. Although the delays may be minute, one may be thrown off-balance if one were to perform a work where synchronization is important.

To calculate the time delays for different bowed articulations (Pollard and Jansson, 1997), we have recorded both the MIDI output of a K2000 xylophone sample and the ZETA instrument audio output at the same time on two different channels. The MIDI output of the ZETA interface was connected directly to the K2000. These results can be viewed by looking at the following charts, Figures 1 to 3. In each figure, there are two charts. In each chart, the top waveform represents the audio output triggered by the connected MIDI device while the bottom waveform in each chart represents the audio output of the ZETA instrument. As illustrated in Fig. 1, to calculate the time delays, we have subtracted the time difference between the starting points of the initial attack transients of both audio outputs. It shows that détaché has a longer time delay than martelé.

As shown in Fig. 2, perceptual time delays can also be attributed to the range of pitches detected. Low-pitched sounds had longer time delays (30–70 ms) compared to high-pitched ones (15–45 ms). A solution to minimize this problem would be to transpose the ZETA an octave up and the connected MIDI device an octave down. Another interesting solution is to increase the sensitivity levels for lower strings while decreasing them for the upper strings. This was proposed by Mari Kimura and was found to be more effective in her patches when using her extended performance technique of playing subharmonics.

After trying different types of bows, it was found that the heavier the bow, the shorter the time delay, which is illustrated below in Figure 3. Heavier bows, compared to the standard violin bow, were found to be more effective for bowed articulations. One does not have to work as hard to consciously get a clean attack for each bowstroke by allowing the natural weight of the bow to be pulled by gravity.

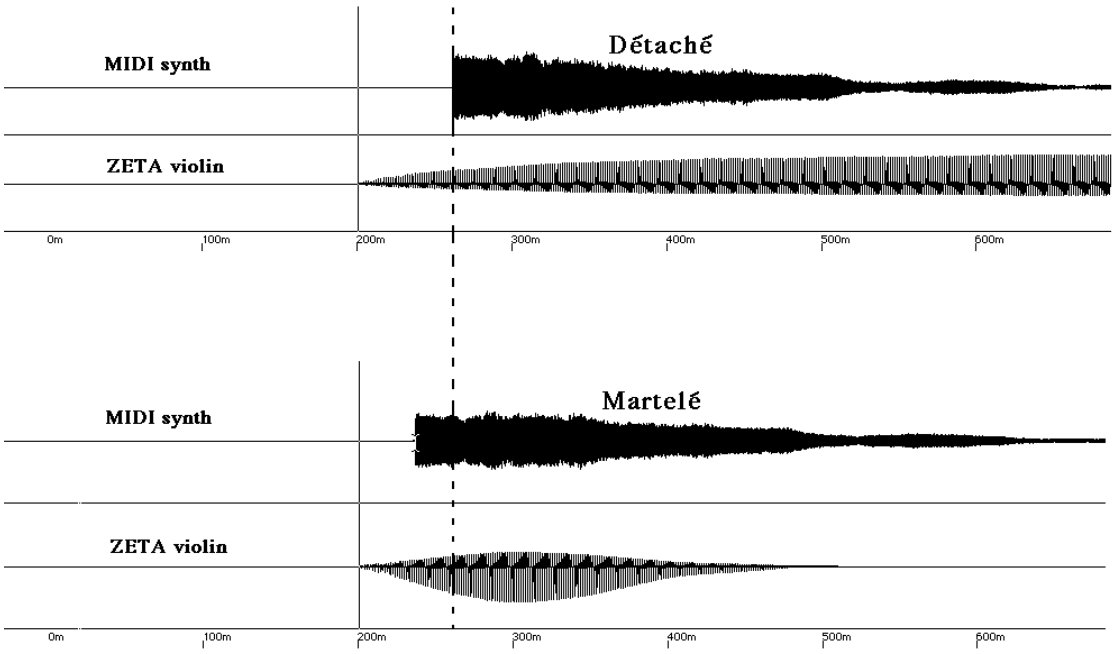

Figure 1 This chart demonstrates the time delay difference of the initial attack transients of two bowed articulations, martelé and détaché of open E string.

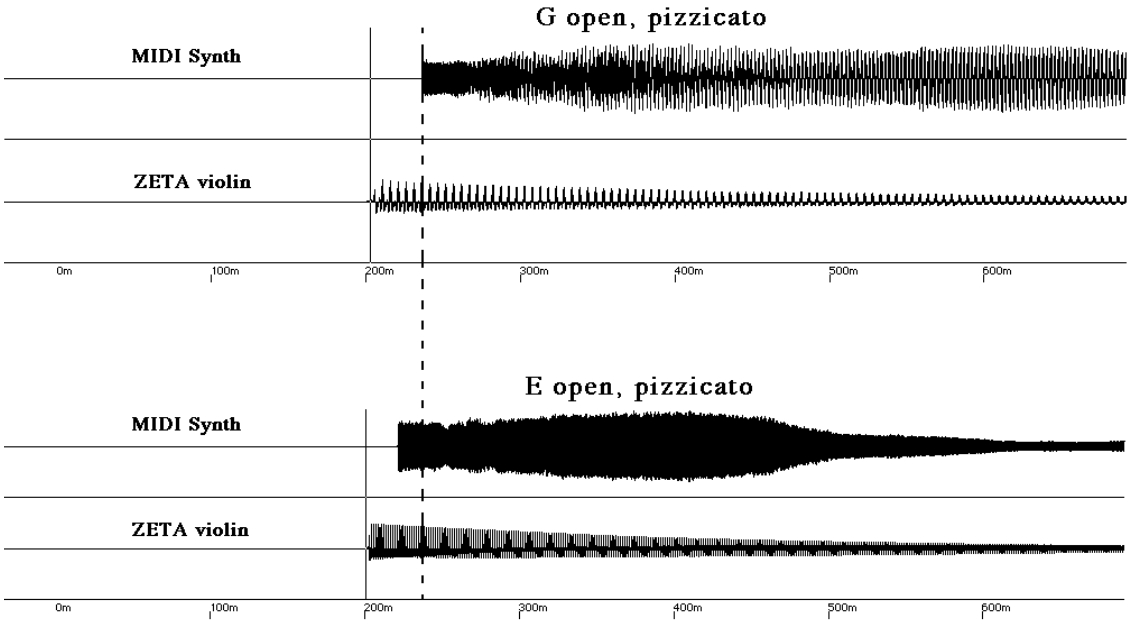

Figure 2 Time delay difference of the initial attack transients of pizzicato between two different pitches, open G string and open E string.

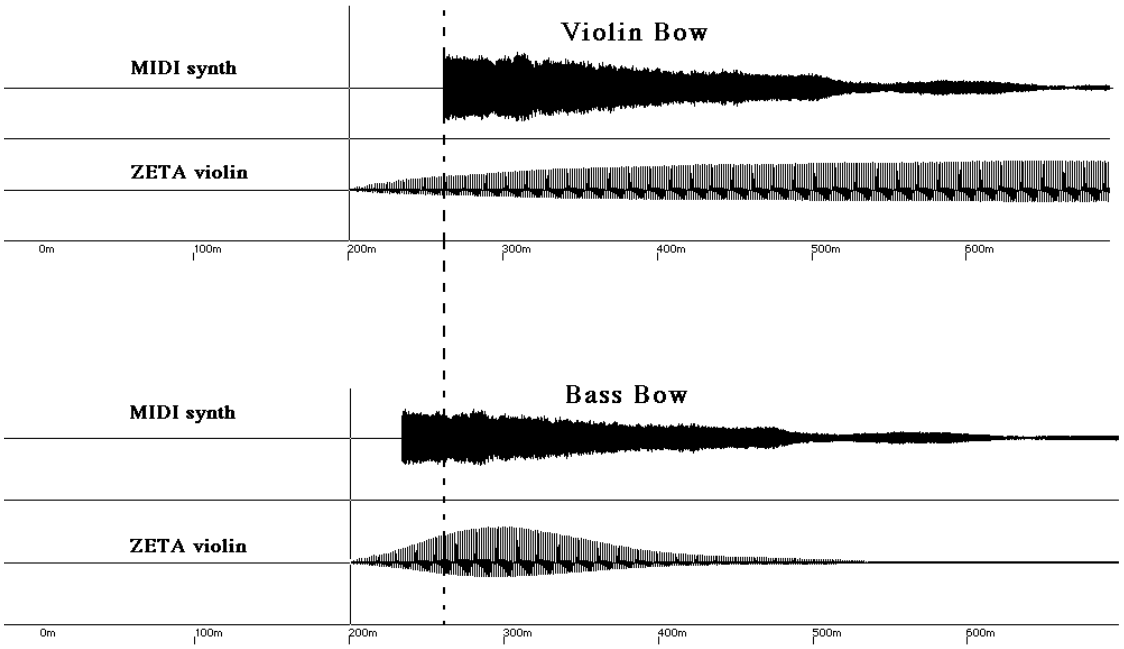

Figure 3 Time delay difference of the initial attack transients between a violin bow and a bass bow using the same bowed articulation on open E string.

Technique

Position shifting, intonation, vibrato width and speed control, and maintaining consistent bow pressure are skills that every conservatory-level string player vigilantly practices. Any weakness in one of these skills will undoubtedly be exposed in a note passage of a given piece and will compromise overall sound quality and musicianship. With MAX, one can use the ZETA to help performers improve their skills and make them more consciously aware of what is happening when they apply the same skills on their own traditional instruments.

Learning how to shift into different positions start early in a string player's career. Shifting, basically, is the linear movement of the left hand from a starting pitch to end at the resulting pitch. For beginners, learning to maintain correct left-hand posture while shifting is crucial. Often, beginners will take off their left-hand from the fingerboard and them place it back onto the fingerboard in hopes of getting the right pitch after shifting. Therefore playing glissandis, while performing shifting exercises, are encouraged to ensure greater success in maintaining correct left-hand posture. As students gets better, the same shifting exercises are performed but instead of playing glissandis, students are now required to lightly touch the strings without making a sound while the bow is moving. Speed is also a factor in affecting the accuracy of the resulting pitch. By hearing some discrete pitches when playing shifting exercises on the ZETA instrument, it is suggested that perhaps by hearing them, one can better track the speed required to make a clean shift and get a more accurate intonation feedback.

Other implementations of using the ZETA instrument are that one can also use the real-time graphics in MAX (e.g., table object) to practice vibrato width and speed. Also, by viewing the AfterTouch messages in MAX, one can use the ZETA to make the performer more

aware of how to control and maintain consistent bow pressure. Due to the construction and inherent nature of the bow, every string player must learn to compensate for the unequal weight distribution of the bow by applying varying amounts of pressure. Learning proper bow control for different articulations will aid the performer to achieve better overall sound quality and sound projection.

Conclusion

In the process of analyzing the ZETA interface, we found a number of parameters and its settings limiting to the performer in terms of expressivity. If sensitivity levels are too high, unwanted misfirings and other extraneous information are picked up, necessitating in writing external software filters. Otherwise, if some parameters are set at low levels, such as the dynamics range, the interface is unable to detect minute changes in velocity values. Thus, initially, conservatory-level trained performers may experience difficulty in adapting their playing techniques to the ZETA instrument. By understanding how this instrument behaves, the performer and composer will achieve a greater understanding of the capabilities and limitations of the instrument in order to exploit them to advantage. Future studies and experiments will be explored on the ZETA instrument for improving standard violin techniques.

References

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