Wobble Strings: Spatially Divided Stroboscopic Effect for Augmenting Wobbly Motion of Stringed Instruments

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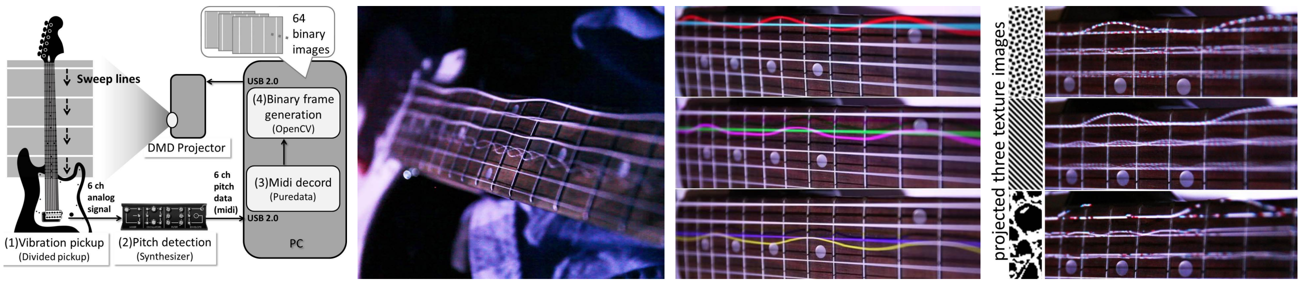

Figure 1: *(a) System Configuration, (b) Wobbly motion result, (c) Results using color sweep lines, (d) Results using texture sweep lines*

1 Introduction

When we snap strings playing with a CMOS camera, the strings seems to vibrate in a wobbly slow motion pattern. Because a CMOS sensor scans one line of video in sequence, fast moving objects are distorted during the scanning sequence. The morphing and distorting are called a rolling shutter effect, which is considered to be an artistic photographic techniques like strip photography and slit-scan photography. However, the effect can only be seen on a camera finder or a PC screen; the guitar player and audience are quite unlikely to notice it by the naked eye.

To cope with this limitation, we developed Wobble Strings, a system that allows for the rolling shutter effect to be observed by naked-eye in real time using spatially divided stroboscopic projection. The system can produce wobbly slow motion effect in real time by generating the animation of sweep lines using a projector in accordance with the pitch of strings. Furthermore, our system can also alter the color and texture of strings using a projection of the color and texture sweep lines. Thanks to our system, the guitar player can monitor the strings' oscillation and, the audience can experience an artistic visual effect with the guitar sound.

The stroboscopic effect is a temporal aliasing with a spatially uniform flashing light, and it can create stop-motion and slow-motion effects. In addition, we opened up a novel spatially divided stroboscopic system that has feedback from musical instruments, and we also developed a method to create new visual effects like wobbly motion distortion and color and texture coating. In addition to our system, Morphovision can distort a 3D object into various shapes observable by the naked-eye with a moving line projection in accordance with the rotation of the object[Fukaya et al. 2006]. However, the developer have not consider a system with musical instruments and musical applications. Some musical instrument products illuminate the chassis using LEDs, but it is not an approach that alters the motion and texture of periodic moving objects.

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2 Technical Contributions and Applications

To achieve the projection of the sweep lines in accordance with stringed instruments, we utilize a color high speed DMD projector (V7000, ViALUX), a PC, a synthesizer (GR-55, Roland) and a vibration sensor (GK-3 pickup, Roland). The information flow of the system is as follows (Fig. 1 (a)). (1) The sensor picks up each stringfs vibration. (2)The synthesizer calculates the pitch of vibrations and sends the data using midi format to the PC. (3) The PC decodes the midi data to frequency. (4) In parallel with that, the PC generates 64 binary images that have 1024*768 pixel resolution of one color, and it determines the sweep speed of the binary images. The DMD repeatedly projects the 64 images at this sweep speed until the pitch of the strings changes.

In case of a single sweep line, if the sweep period T rises above 16.6 ms (which means 1/60 Hz), people perceive a flicker. Thus, if the T goes over 16.6 ms, the system adds a line at the T/N interval (N means the number of sweep lines). By controlling the T/N so that it does not go above 16.6 ms, all of the pixels can brighten at above 60 Hz while keeping the same seep speed of the lines. Fig. 1 (b) is a result for a projection of 4 white lines. By increasing the N, the visualized wavenumber of wobbly motion increases.

The system can project not only a pattern of white lines, but also ones of various color and texture on the strings. However, in this implementation, the texture pattern is also projected on another region like the chassis and the background. Thus, we add a complementary binary image into the 64 binary images. A complementary image was projected on whole pixels, so for human eyes, the chassis and the background look grey. Fig. 1 (c) (d) show the wobbly motion results when 4 sweep color or texture lines were projected. The color phase is shifted from red to purple in tone.

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