HzpiralVR

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HzpiralVR is a musical instrument for HTC Vive based on a polar-coordinate pitch-space. Built in Unity, HzpiralVR uses the Chunity (ChucK for Unity) package, developed at CCRMA, for real-time sound synthesis. HzpiralVR provides a novel interface for creating music that incorporates immediate visual feedback of mathematical harmonic relationships as well as spectral representation as music is played. It also allows creation of recorded loops combined with real-time performance to offer a wide range of musical exploration and discovery.

Goal:

To create a novel musical instrument that capitalizes on the unique visualization and interactive capabilities of VR.

Features:

Polar-coordinate pitch-space
The playing areas in Hzpiral map constant chroma, or pitch identity (e.g. C, F#, Bb, etc.) to constant angle from a center origin; and pitch height (what octave a note sounds in) to radial distance from the origin. This paradigm essentially maps what is customarily thought of as a one-dimensional pitch axis (like a piano keyboard) to a log base two spiral, such that perceptually related pitches, those sharing the same note identity, are quantifiably related. Thus, any musical interval can be represented as fixed angle that remains constant regardless of the specific frequencies that comprise the
interval. For example, any two notes that form an interval of a perfect fifth will always be separated by 210 degrees. Besides allowing the player to easily find interval relationships in any musical key, eliminating the need to learn physical key patterns required to proficiently play traditional musical instruments, the Hzpiral format visualizes the pure math behind musically harmonic relationships. As such, it can be used as a tool for developing a deeper understanding of music theory in addition to providing an intuitive and engaging instrument for musical expression.

Each hand controls an independent pitch-space
Hzpiral VR provides two independent pitch-spaces, one per Vive controller. Pull the trigger to play a note. Trigger depth controls note volume. Hold the grip button to reposition and/or rotate either of the identical playing areas for each controller to customize the combined playing area. Each pitch space has separate controls for overall volume, pitch octave range, and waveform, indicated by a simple GUI. The controller application button toggles the controls available on the touchpad.

Multiple preset and custom waveforms
The player can select one of several preset (Triangle, Sawtooth, Square) waveforms, built from integer-multiple harmonics at given relative intensities above the played fundamental frequency. When a note is played, sphere objects representing the fundamental and harmonic frequencies appear at corresponding locations in the pitch-space, at relative sizes representing their relative volume levels. This allows the player to visualize the mathematical relationship between these harmonics as well as choose the next note to play based on where these harmonics occur. The player can also create custom waveforms by setting specific interval angles for harmonic or inharmonic relationships between sounding overtones (currently only available from within the Unity editor).

Quantize notes to the semitone
The default play mode quantizes pitch values to the half-step, corresponding to a 30 degree angle. Any note played within each 30 degree arc will sound the same, corresponding to a note in a chromatic tempered scale (comparable to keys on a piano) for ease of playing. Disabling the quantize feature allows for smooth continuous movement through the pitch space, allowing for more specific or alternate tunings. Future versions with also include dividing the pitch-space into traditional Western diatonic scales as well as alternate tunings (such as Shruti scale tuning).

Different interaction volumes
Play in real-time within one 3D area. In the 3D area directly above the playing area, record looped sequences of notes that fall into the play area, sounding when they enter. Vary the tempo at which notes fall, changing the speed of the recorded loop. Separate play and record areas for each controller with independent tempo control.

Real-time spectral analysis of frequency content
Colored representation of real-time magnitude spectrum is shown in a cascading display that visualizes playing notes and harmonics.