A Tuning System Laboratory for the NeXT Computer

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Abstract: This paper describes a NeXT computer application allowing flexible interactive design and exploration of tuning systems. The program allows one to simultaneously fashion theoretically derived tunings, work with indigenous tuning practices, or create arbitrary tunings, while mixing and matching the results.

Introduction

One of the problems facing students, researchers, and composers interested in intonations other than 12-tone equal temperament is the special need for dynamically tunable instruments with which to explore this vast terrain. The computer has been used as such a tool serving both as user interface and computation engine for sound synthesis and calculation of all the various interval representations (Keitar 1987, Rich 1985). The NeXT computer features a flexible user interface and support for real-time sound synthesis, making it a suitable platform for such a tool. This paper describes a tuning system application for the NeXT computer.

Figure 1.
Overview

The objective of this application is to provide a means of exploring arbitrary tuning systems using standard representations (pitch, musical interval, cents, frequency, and ratio), as well as exploring theoretical systems such as Just Intonation and N-tone equal temperament. The application organizes these features into two main window styles and a few auxiliary panels. The two window styles: Keyboard and Ratio Matrix, contain keys that can be tuned and played with the mouse. A Tuning Panel provides controls that are used to tune, play, compare, or change the representation of selected keys.

Keyboard Windos

Keyboard windows (figure 1a & 1b) contain an arbitrary number of marimba style keys. Each key may be individually tuned in any of the standard representations. Each window has its own reference key from which base relative tunings are derived. Keys may also be tuned in sequential relations or absolute settings such as pitch or frequency. Each may use a different representation if desired. Keys are moved within or between keyboards with standard cut, copy, and paste operations. New keyboards of N-tone equal temperament or as220 may be requested in any size.

Ratio Matrix Windows

There are two types of Ratio Matrices available: Transpositional and Extended Just. Each presents a palette of ratios to be used in the formation of new keyboards.

A Transpositional matrix is formed by selecting two keyboards as axes, yielding a matrix of ratios that are reduced products of the two keyboards (cell $ij = cell_{10} * cell_{0j}$). This forms a set consisting of each keyboard transposed by each step of the other. Figure 1d shows a matrix with the "$Mlura" (1b) tuning in the vertical dimension and a Just tuning in the horizontal dimension. This technique can also be used to create "tonality diamonds" (Purch 1949).

An Extended Just matrix also provides a system of ratios. Here each axis represents powers of a specified ratio, reduced and brought within an octave of the origin (1/1), which is centered in this matrix. The axes display both positive and negative exponents of the ratios that generate them. Keys of the matrix not on an axis are multiplicative combinations of ratios at their axial coordinates. These matrices are formed by using the Ratio Layout Panel (figure 1b) to specify a ratio and power for each dimension. Figure 1c shows an order 2 matrix with 3/2 in the vertical dimension and 5/4 in the horizontal. By specifying Just ratios, these matrices can be used to create 2-D slices of Extended Just Intonation systems (Johnston 1964).

Tuning Panel

The Tuning Panel (figure 1e) is the mechanism used to tune a key or change its representation. Controls in the Tuning Panel are applied to the last key played. In the center is a tuning slider.
The user of change for the slider is selected and displayed with the "pop-up" list below it. The value of the key during tuning is shown in the panel's display, in the box above the slider. The representation used for this display is selected with the "pop-up" list below it. One can, for example, use the slider to tune a key in frequency, while viewing the result in cents relative to its neighbor. Tuning may also be achieved by entering values in the display field by hand.

The box at the bottom of the Tuning Panel contains buttons that reflect selected keys in the currently selected keyboard. Multiple keys may be selected at one time. This is useful for listening to harmonies, or examining relationships within a subset of a tuning. With multiple keys selected, the Compare button will show their relationship in any desired representation.

Summary & Future Directions
This tool is useful for gaining first-hand (listening) experience with extended JI intonation and other tuning systems. Using multiple windows allows comparison of different or alien scales and harmonies. The ability to fashion theoretically-derived systems, work with indigenous tuning practices, and explore arbitrary tunings all at the same time makes this program useful to students, researchers and composers.

To be more useful to composers, this application requires a richer compositional environment. Also, if currently only provides three synthesis methods: plucked string, gamelan, and piano. As soundpatch editing tools become available, their integration will also expand this program's usefulness. A sampling instrument would be useful, especially for chromaticological use.

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References

