

APPENDIX C

Pitch and Frequency

Pitch is the sensation or perception of a musical note by the listener, while frequency is a physically measurable quantity. Although it is generally assumed that pitch and frequency are identical, and the terms are used interchangeably, enough evidence exists that sounds of the same frequency may be felt to be in different pitches under certain circumstances.

An increase in intensity of high frequency sounds (over 2000 Hz) is *perceived* as an increase in pitch even when the frequency remains constant, while for sounds in a lower frequency range, the increase in intensity is *perceived* as a decrease in pitch. (Rossing, Thomas D., *The Science of Sound*, 2nd ed., Chapter 7, Addison-Wesley, 1990). Terhardt (Terhardt, E., 'Calculating Virtual Pitch', *Hearing Research* 1, 155, 1979) found that a 200-Hz tone was perceived as 20 cents lower when its intensity was raised from 60 to 90 decibels, while for a 6000-Hz tone, the same had the effect of increasing the pitch by 30 cents. A decaying tone is perceived to be at a higher pitch than a pulse tone of steady amplitude. Harmonic composition also seems to affect the pitch sensation ('Pitch Shifts and Pitch Deviations', Ernest Terhardt: "The perception of the pitch of short pulses differs from that of sustained sounds of the same measured frequency. If a short pulse of a pure tone is decaying in amplitude, it will be perceived to be higher in pitch than an identical pulse which has steady amplitude.")

Piano notes in higher octaves are 'stretched' up to 2% from the theoretical values: due to the stiffness of the strings, the higher harmonics are not perfect multiples of the fundamental, and such stretched tuning is found to be more acceptable than theoretically correct tuning.

These were studies on steady notes. Some studies have been made on perception of pitches of notes in vibrato (steady up-and-down variations in pitch around the basic note), and the results appear to indicate that the perceived pitch is the geometric mean of the frequencies. However, vibrato is also described as a "rapid alteration of correct and flattened pitch . . . a correct vibrato go[es] from pitch to below and backup." by Ichiro Fujinaga)

While trying to analyse musical intonation by ascertaining the frequencies using gadgets, it has to be remembered that the musician and the listener are interested in the pitch of the notes and that the performer has to be judged on the musical quality of the intonation rather than measured frequencies.