Automatic tone identification in continuously played music

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8:13

UU2. Perception of crescendos as a function of duration. M. V. Mathews (Bell Laboratories, Murray Hill, NJ 07974)

A theory is proposed that the perceived strength of a crescendo depends on its duration and that very short and very long crescendos will seem weaker than crescendos of moderate duration. Crescendos of varying durations and equal intensity change in decibels were generated with a computer and were rated by a group of listeners on a one-to-ten scale. The perceived strength of otherwise equal crescendos increased steadily as the duration increased from 0.04 to 10 s. Thus short crescendos were weak, but long crescendos were not. Crescendos with equal decibel change but with various average intensities were generated. The crescendos with greater average intensity were judged to be stronger. This interaction between average intensity and duration may explain why long crescendos do not seem weak.

8:26

UU3. Perception of musical styles. K. T. Marcus and G. W. Mathews (Bell Laboratories, Murray Hill, NJ 07974)

We carried out an experiment to determine a multidimensional scaling of music styles. A set of short examples of pieces for solo piano were chosen, two each from five style periods: Baroque, Classic, Romantic, 20th Century Modern, and Jazz. The durations of each piece ranged from 1 to 3 min. We played these pieces to 40 subjects ranging from professional musicians to naive listeners. After an initial exposure to the ten pieces, the subjects were asked to listen to and to make 45 similarity ratings on all possible pairs of pieces. The subjects were also asked to rate each piece on 19 bipolar scales. Both data sets were run through the INSCAL program which constructed a two-dimensional similarity space to represent the subjects' judgments. We interpreted the dimensions as a Romantic–Baroque dimension and a Modern–Old dimension. A correlation was noted between musical expertise and the importance the subject attached to the dimensions. The Modern–Old dimension was more important to musicians; the Romantic–Baroque dimension was more important to nonmusicians.

8:39

UU4. Prestimulus perceptual activity in perception of tone in musical sequences. Paul C. Boomsliter (Capital Area Speech Center, 525 Washington Ave., Albany, NY 12206) and Warren Creel (Albany Medical College, Albany, NY 12208)

Acoustical concepts of tone were formed in an age when psychologists thought of a perceiver as responding directly to a stimulus. Psychological thinking has shifted in recent decades; in many cases now, a stimulus is thought of as modifying a complex of interacting processes that were already in progress before the stimulus arrived. Short tone experiments show that an unprepared listener requires observable time to achieve tonal sensation, and yet more time to achieve appropriate pitch sensation. Abnormal cases throw light on the normal; findings before and after surgery to improve brain stem function on 55 patients are presented. Within musical sequences we experience tone and proper pitch without any such delay, indicating that each stimulus has been preceded by prestimulus perceptual activity. The fact that composers of tonal music tend to use only limited combinations, and the fact that variation from desired pitch is experienced as change in tone quality rather than in pitch, support this interpretation. [Supported in part by Public Health Service Grants HE-08179 and 5M01FR0094 from the National Institutes of Health and by the Danforth Foundation.]

8:52

UU5. Automatic tone identification in continuously played music. M. B. Piszczalski and B. A. Galler (Department of Computer and Communication Sciences, University of Michigan, Ann Arbor, MI 48109)

Successive short-time (32 ms) spectra are calculated either with the FFT or, experimentally, with the CCD to yield the digitized spectra. Pattern matching on the resulting digital spectrogram is done to detect the sharply emerging spectral peaks that often indicate tone beginnings. A check is made for the overlap of previous partials onto the hypothesized new tone at such points and these past partials are filtered out (over time) until they disappear or a new tone is suggested by another emerging spectral peak condition. A pitch and amplitude estimate is then made for each short-time section (described in "Predicting musical pitch from component ratios" available from the authors). The resulting pitch versus time contour is first smoothed and then tone segmentation is performed by seeking tone-transition patterns indicated by abrupt jumps in pitch or associated amplitude crossings over a minimum amplitude threshold. Single notes probably fragmented by spurious octave jumps are compacted and other very short tone-segment fragments are merged into the preceding longer tone. The melodic sequence has been well captured (less than 10% gross errors) with no external modifications required for a variety of instrumental music of varying styles we have processed. Better time resolution and use of context appears necessary for further improvements. [Work supported by NSF.]

9:05

UU6. Fusion and consonance relations for tones with inharmonic partials. Elizabeth Cohen (Graduate Special Studies: Acoustics. Room R123, Stanford Medical Center, Stanford, CA 14305)

Tones with inharmonic partials were generated on the Sampson Digital Synthesizer according to the algorithm. $Fn = F_1 a^{\log 2n}$, where Fn is the frequency of the nth partial and a determines the degree of stretching/shrinking of the octave. Subjects noted a bell or gonglike quality for stretched and shrunk tones. Subjects were asked to make judgments on the degree of fusion (unitary sensation of pitch). For individual tones a "pulling apart" of tones as a function of increasing a was discovered. Dyads, triads, melodic, and harmonic passages were also presented. Melodic relationships seem to hold throughout the range of 60% shrunk to 200% stretched ($a = 1.2 \rightarrow a = 4$), whereas certain harmonic relationships break down. Preliminary results indicate that this harmonic breakdown is due to context and is not an individual property of the chord.

9:18

UU7. Stretched tones with only octave partials: The unsanctified octave. Elizabeth Cohen (Graduate Special Studies: Acoustics, Room R123, Stanford Medical Center, Stanford, CA 94305)

Stretched-octave tones whose only partials are stretched octave partials were generated on the Sampson Digital Synthesizer according to the relation $Fn = a^n Fo$, where $n = 1,2,4. \ldots$ These partials are separated by distances greater than a critical band yet subject reports of difference in tone quality suggest an interaction among the partials. For $a = 2$, a tone with octave partials only has been traditionally perceived as thin and clear. [J. R. Pierce, J. Acoust. Soc. Am. **40**, 249 (1966); IRCAM communication, April 1976]. Departures from $a = 2$ show progressively greater variance from this percept. The expected beats of mistuned octaves are heard in these tones only with great difficulty and under special conditions. An explanation for the change in tone quality was sought by looking