Session 7MU

Musical Acoustics: The Singing Voice

Contributed Papers

3:45

7MU5. Making and hearing the vocal trill: An acoustical study. Michèle Castellengo and Damien Colas (Lab. d'Acoust. Musicale, Univ. Paris 6 et CNRS URA 868, Tour 66, 4 Place Jussieu, 75005 Paris, France)

Among vocal ornaments trill is the least well known. Several records of trills done by great singers have been analyzed in order to define and measure relevant characteristics for this ornament: the amplitude of the vibrato during the preparation, the extension and speed of the trill itself, the termination pattern. The importance of the accompanying amplitude modulation has also been investigated. An hypothesis for the particular vocal technique of bass singers is proposed. These various acoustical parameters are used as data for digital synthesis based on formant-waveform algorithm. Artificial vocal sequences are tested by subjects in order to evaluate the perceptual effect of the variations of the acoustical parameters and to appreciate the relative importance of the different elements of a trill. These experiments have pointed out the great importance of the preparation phase for perceiving a trill, and appreciating its interval (major or minor).

4:00

7MU6. A parametric study on pitch of short vocal vibrato tones. Christophe d'Alessandro (LIMSI-CNRS, BP 133-91403 Orsay-Cedex, France) and Michèle Castellengo (LAM, Univ. of Paris, VI, 4 Place Jussieu 75005 Paris, France)

The pitch perceived for short vocal vibrato tones was measured using a method of adjustment. The stimuli were synthetic vocal tones, produced by a formant synthesizer. The main parameter under study was the tone duration, as a function of the fractional number of vibrato cycles. This parameter was examined in relation to: (1) the vibrato extent (0, 50, 100, and 200 cents); (2) the vibrato rate (4, 6, and 8 Hz); (3) the tone frequency (220, 440, 880, and 1500 Hz). Durations from $\frac{1}{2}$ cycle to 5 cycles were studied. Part of the results were obtained for a relatively large group of musically educated subjects (20 subjects), and another part for a small group of selected subjects. Our results show that: (a) for short tones, the pitch does correspond to a weighted time average of the $F0$ pattern (a numerical model of which is in accordance with this data); (b) the pitch mean between the extreme frequencies as the duration increases; (c) the overall pattern of $F0$ has an influence on perception, and some simple patterns seem to behave better perceptually; (d) perception may be ambiguous above a threshold of duration, which is related to the absolute threshold of pitch change and to the trill threshold.

4:15

7MU7. Advanced methods for voice analysis. Yingyong Qi (Dept. of Speech and Hear. Sci. and Dept. of Elec. and Comput. Eng., 106 Speech Bldg., Univ. of Arizona, Tucson, AZ 85721)

The harmonics-to-noise ratio (HNR) has been widely accepted as a measure for quantifying the irregular or noise component of voice. The use of the HNR assumes that: (1) the noise or irregularity in voice is a stationary process, and (2) errors introduced by the cycle-to-cycle pitch period variations are trivial. When either of these assumptions is violated, the HNR is inappropriate for estimating irregularities in the shape of acoustic wavelets. Methods for eliminating these assumptions (or limitations) of the original HNR have been developed based on advanced techniques of signal processing. In these methods, nonstationary irregularities in voice are identified using an adaptive Wiener filter. The effects of pitch period perturbations on the measurement of wavelet irregularities are minimized by optimal time normalization of wavelet assemble using procedures of dynamic time warping. These methods have been evaluated using natural and synthetic voices and results have indicated that they significantly increase the accuracy and reliability of voice analysis.