Modes of vibration of tuned bars in percussion instruments

Calvin Rose; Thomas D. Rossing


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tension when a string is stopped, the effective string length
to stop more than one string. To compensate for the increased
electronics, Massachusetts Institute of Technology, Cambridge,
nylon and steel guitar strings and results were compared with
ically coupled to the sound chamber. The model assumes
flat bridge on which the strings terminate and which is acous-
tically coupled to the sound chamber. The model assumes
force on the bridge is at all times given by its instant elonga-
tion and angie at the bridge. The force transformation is non-
linear because (1) for any simple mode the string elongation is
proportional to that of the fundamental. Synthetic
fundamental decreases as the amplitude of vibration of the
membrane decreases, finally approaching a constant at low
frequencies, amplitudes, and decay rates taken from the
analysis of the real tones. A listening test was performed us-
ing 25 subjects. Each was presented a series of 30 tones con-
taining 25 subjects tested were 56% right.

KKK3. Analysis and synthesis of oboe tones by the linear
prediction method. J. D. Dudley and W. J. Strong (Department
of Physics and Astronomy, Brigham Young University, Provo, UT 84602)

The linear prediction method has recently been used with
considerable success in the analysis and synthesis of speech
sounds. The purpose of this paper is to describe its applica-
tion to musical tones in general, and to the analysis and syn-
thesis of oboe tones in particular. Preliminary indications
are that five predictor coefficients are adequate for the syn-
thesis of good oboe tones, and in some ways are better than
12. Adaptation of the analysis--synthesis algorithms and
determination of the optimum number of predictor coefficients
for various pitches and tone dynamics is discussed. Tones
synthesized with various numbers of predictors coefficients
are demonstrated.

KKK4. Modes of vibration of tuned bars in percussion instru-
ments. Calvin Rose and Thomas D. Rossing (Department of
Physics, Northern Illinois University, DeKalb, IL 60115)

The modes of vibration and sound spectra of tuned marimba,
xylophone and vibraphone bars have been studied. The modes
of vibration are determined by driving the bars electromagneti-
cally, whereas the spectra are determined with a real-time
spectrum analyzer while striking the bars in the conventional
manner. The tuning of bars by undercutting is discussed.

KKK5. Analysis and synthesis of bass drum tones. Harvey
Fletcher and Irvin G. Bassett (Department of Physics,
Brigham Young University, Provo, UT 84602)

Tones from a bass drum were recorded and played repeatedly
through a 3-Hz bandpass filter. With each pass, the center
frequency of the filter was increased 1 Hz. From this analysis
the frequency, intensity, and decay rates of the most prominent
components of the tone were determined. A reasonably close
relationship was found to exist between these components and
the ones predicted from the Bessel functions for a stretched
membrane. Up to 200 components have been identified in this
manner. These components vary in intensity according to
where and how hard the drum is struck. The frequency of the
fundamental decreases as the amplitude of vibration of the
membrane decreases, finally approaching a constant at low
amplitudes. Each of the components has a changing frequency
that remains proportional to that of the fundamental. Synthetic
drum tones were computed by adding a series of sine waves
with frequencies, amplitudes, and decay rates taken from the
analysis. Tones thus synthesized were compared with the re-
cording of the real tones. A listening test was performed us-
ing 25 subjects. Each was presented a series of 30 tones con-
sisting of three real and three synthetic sounds repeated five
times in random sequence. The subjects were asked to decide
whether each tone seemed real or synthetic. Overall results
for the 25 subjects tested were 56% right.