tion of one-dimensional signals. In this paper, wavelet transforms are used as the basis for an algorithm that represents an audio signal as a sum of "spectral components" (contributions obtained by amplitude modulation and slow frequency modulation around a frequency). A central role in this construction is played by the phase of the (complex-valued) wavelet transform; the interpretation of this phase is particularly simple and intuitive if the analyzing wavelet is chosen as an analytic signal (progressive wavelet). The parameters determined by the algorithm allow an additive reconstruction of the signal, as well as a variety of nonlinear modifications. These possibilities will be illustrated by several audio examples.
[a] Current address: Stanford Univ., CCRMA Dept. of Music, Stanford, CA 94305-8180.

4:15

9MU11. Computer processing of audio signals by exclusion filters. Robert C. Maher (Dept. of Elec. Eng., Univ. of Nebraska-Lincoln, 209N WSEC, Lincoln, NE 68588-0511)

A common task in computer music and electroacoustic signal processing is additive *mixing* of two audio signals. If the two input signals contain discrete spectral components, their sum will typically contain amplitude beating and other interactions between pairs of components with similar frequencies. A new method is described that suppresses spectral interactions during mixing by deriving a time variant "exclusion filter" from the short-time spectrum of one of the signals in order to prefilter the other signal. This technique allows one of the signals (dominant) to pass through the mixing process with little modification, while the other signal (secondary) is prevented from interaction by attenuation of its conflicting spectral components. The exclusion filter is specified in a flexible manner, which can include such psychoacoustic criteria as critical bands. Audio examples will be presented.

4:30

9MU12. A discrete model for synthesizing guitar sounds. Antoine Chaigne (TELECOM Paris, 46 Rue Barrault, 75634 Paris Cedex 13, France and KTH, Dept. of Speech Commun. and Music Acoust., Box 70014, S-100 44 Stockholm, Sweden)

In an attempt to simulate guitar sounds, a discrete model was developed that consisted of real strings with stiffness and internal damping, the player's finger, the resonance box, and the modelization of the sound pressure. The vibrating string equation was solved in the time domain using the finite-difference method. The player's figure was modeled as a force density term in the string equation, which accounted for the initial plucking conditions. The resonance box was modeled as impedancelike boundary conditions at one end of the string. These end conditions were obtained under the assumption that the driving force exerted by the string at its ends excites a set of second-order resonances in parallel, the first resonance of the plate being coupled with the air resonance of the box. Finally, the sound pressure was modeled as the contribution of a set of monopoles, where each monopole corresponds to one given resonance. The radiation efficiency of each monopole was derived from a curve fitting on a guitar sound-pressure spectrum measured in an anechoic chamber. The waveforms obtained are in good agreement with experimental waveforms measured on real guitars. Sound examples will be presented highlighting the realism of the simulation.

4:45

9MU13. Statistical analysis of old Serbian music. Milan J. Merkle and Miomir Mijic (Univ. of Belgrade, Faculty of Elec. Eng., P.O. Box 816, 11001 Belgrade, Yugoslavia)

Being a link between mathematical scrutiny and a fuzziness of the real world, statistics is often used to help investigate relations between objects or phenomena that are intuitively similar (or dissimilar). In these problems, statistical methods set objective criteria of similarity, thus reducing the human proneness to errors. This work is an attempt to make a contribution to an objective analysis of music. It is not quite clear what are the main objective characteristics of a musical work, and much less is known about how to translate them to a mathematical writing such that when two songs sound similar, one gets two numbers that are close to each other. This is a problem of coding. In this work, the problem of coding is investigated, and the power of various statistical methods in comparison of songs is demonstrated. This is done using samples of an old Serbian chant from the 15th century. This kind of music is used because of its relative simplicity.

FRIDAY AFTERNOON, 30 NOVEMBER 1990 COUNCIL–CHAMBER ROOM, 1:00 TO 2:40 P.M.

Session 9PAa

Physical Acoustics: Use of Acoustics in Electronics

Yves H. Berthelot, Chair
Georgia Institute of Technology, School of Mechanical Engineering, Atlanta, Georgia 30332

Invited Papers

1:00

9PAa1. Acoustic aspects of acoustic charge transport devices. William D. Hunt (School of Elec. Eng., Georgia Inst. of Technol., Atlanta, GA 30332)

The Gallium Arsenide(GaAs) acoustic charge transport (ACT) device was first reported in 1982 [M. J. Hoskins and B. J. Hunsinger, *1982 IEEE Ultrasonics Symposium Proceedings*, IEEE Catalog No. 82CH1823-4 (IEEE, New York, 1982), pp. 456–460] and has been subsequently developed for a variety of analog signal