US006298322B1

(12) **United States Patent**
Lindemann

(10) **Patent No.: US 6,298,322 B1**
(45) **Date of Patent: Oct. 2, 2001**

(54) **ENCODING AND SYNTHESIS OF TONAL AUDIO SIGNALS USING DOMINANT SINUSOIDS AND A VECTOR-QUANTIZED RESIDUAL TONAL SIGNAL**

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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/306,256**

(22) Filed: **May 6, 1999**

(51) **Int. Cl.**[7] **G10L 19/02**

(52) **U.S. Cl.** **704/222**; 704/200.1; 704/209; 704/220

(58) **Field of Search** 704/200.1, 206, 704/207, 209, 220, 222

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(57) **ABSTRACT**

Tonal audio signals can be modeled as a sum of sinusoids with time-varying frequencies, amplitudes, and phases. An efficient encoder and synthesizer of tonal audio signals is disclosed. The encoder determines time-varying frequencies, amplitudes, and, optionally, phases for a restricted number of dominant sinusoid components of the tonal audio signal to form a dominant sinusoid parameter sequence. These components are removed from the tonal audio signal to form a residual tonal signal. The residual tonal signal is encoded using a residual tonal signal encoder (RTSE). In one embodiment, the RTSE generates a vector quantization codebook (VQC) and residual codebook sequence (RCS). The VQC may contain time-domain residual waveforms selected from the residual tonal signal, synthetic time-domain residual waveforms with magnitude spectra related to the residual tonal signal, magnitude spectrum encoding vectors, or a combination of time-domain waveforms and magnitude spectrum encoding vectors. The tonal audio signal synthesizer uses a sinusoidal oscillator bank to synthesize a set of dominant sinusoid components from the dominant sinusoid parameter sequence generated during encoding. In one embodiment, a residual tonal signal is synthesized using a VQC and RCS generated by the RTSE during encoding. If the VQC includes time-domain waveforms, an interpolating residual waveform oscillator may be used to synthesize the residual tonal signal. The synthesized dominant sinusoids and synthesized residual tonal signal are summed to form the synthesized tonal audio signal.

42 Claims, 26 Drawing Sheets