specific, relying on characteristics of speech that are not suitable for music and other forms of audio, or require extensive computational resources that cannot be implemented economically.

DISCLOSURE OF INVENTION

Embodiments of the present invention seek to provide for the processing of audio signals to reduce the quantity of information required to represent a signal during transmission or storage while maintaining the perceived quality of the signal. Although embodiments of the present invention are particularly directed toward the reproduction of music signals, it is also applicable to a wide range of audio signals including voice.

According to one aspect of the present invention, there is provided a method for generating an electrical reconstructed signal that comprises: receiving from an electrical communication path an encoded electrical signal comprising baseband spectral components of an audio signal, a noise blending parameter and an estimated spectral envelope, wherein the number of baseband spectral components contained in the encoded signal may vary dynamically; decoding the encoded electrical signal to obtain the baseband spectral components, the noise blending parameter, and the estimated spectral envelope; generating a noise signal comprising noise-signal spectral components in an interval of frequencies above the baseband spectral components, wherein the noise-signal spectral components are weighted in amplitude by a noise blending function that is a function of frequency and the noise blending parameter and that gives greater weight to spectral components at higher frequencies; generating a regenerated signal comprising regenerated-signal spectral components in the interval of frequencies above the baseband spectral components, wherein the regenerated-signal components are copied from at least some of the baseband spectral components and weighted in amplitude by an inverse of the noise blending function; generating noisy regenerated spectral components from a combination of the noise-signal spectral components and the regenerated-signal spectral components, wherein amplitudes of the noisy regenerated spectral components are weighted according to the estimated spectral envelope; and generating along an electrical communication path the electrical reconstructed signal from a time-domain representation of the baseband spectral components combined with the noisy regenerated spectral components.

According to another aspect of the present invention, there is provided an apparatus for generating a reconstructed signal that comprises: means for receiving an encoded signal comprising baseband spectral components of an audio signal, a noise blending parameter and an estimated spectral envelope, wherein the number of baseband spectral components contained in the encoded signal may vary dynamically; means for decoding the encoded signal to obtain the baseband spectral components, the noise blending parameter, and the estimated spectral envelope; means for generating a noise signal comprising noise-signal spectral components in an interval of frequencies above the baseband spectral components, wherein the noise-signal spectral components are weighted in amplitude by a noise blending function that is a function of frequency and the noise blending parameter and that gives greater weight to spectral components at higher frequencies; means for generating a regenerated signal comprising regenerated-signal spectral components in the interval of frequencies above the baseband spectral components, wherein the regenerated-signal components are copied from at least some of the baseband spectral components and weighted in amplitude by an inverse of the noise blending function; means for generating noisy regenerated spectral components from a combination of the noise-signal spectral components and the regenerated-signal spectral components, wherein amplitudes of the noisy regenerated spectral components are weighted according to the estimated spectral envelope; and means for generating the reconstructed signal from a time-domain representation of the baseband spectral components combined with the noisy regenerated spectral components.

According to another aspect of the present invention, there is provided a non-transitory medium recording a program of instructions that is executable by a device to perform a method for generating a reconstructed signal, wherein the method comprises: receiving an encoded signal comprising baseband spectral components of an audio signal, a noise blending parameter and an estimated spectral envelope, wherein the number of baseband spectral components contained in the encoded signal may vary dynamically; decoding the encoded signal to obtain the baseband spectral components, the noise blending parameter, and the estimated spectral envelope; generating a noise signal comprising noise-signal spectral components in an interval of frequencies above the baseband spectral components, wherein the noise-signal spectral components are weighted in amplitude by a noise blending function that is a function of

frequency and the noise blending parameter and that gives greater weight to spectral components at higher frequencies; generating a regenerated signal comprising regenerated-signal spectral components in the interval of frequencies above the baseband spectral components, wherein the regenerated-signal components are copied from at least some of the baseband spectral components and weighted in amplitude by an inverse of the noise blending function; generating noisy regenerated spectral components from a combination of the noise-signal spectral components and the regenerated-signal spectral components, wherein amplitudes of the noisy regenerated spectral components are weighted according to the estimated spectral envelope; and generating the reconstructed signal from a time-domain representation of the baseband spectral components combined with the noisy regenerated spectral components.

Other aspects of the present invention are described below and set forth in the claims.

The various features of the present invention and its preferred implementations may be better understood by referring to the following discussion and the accompanying drawings in which like reference numerals refer to like elements in the several figures. The contents of the following discussion and the drawings are set forth as examples only and should not be understood to represent limitations upon the scope of the present invention.

BRIEF DESCRIPTION OF DRAWINGS

Fig. 1 illustrates major components in a communications system.

Fig. 2 is a block diagram of a transmitter.

Figs. 3 A and 3B are hypothetical graphical illustrations of an audio signal and a corresponding baseband signal.

Fig. 4 is a block diagram of a receiver.

Claims:

1. A method for generating an electrical reconstructed signal that comprises: receiving from an electrical communication path an encoded electrical signal comprising baseband spectral components of an audio signal, a noise blending parameter and an estimated spectral envelope, wherein the number of baseband spectral components contained in the encoded signal may vary dynamically; decoding the encoded electrical signal to obtain the baseband spectral components, the noise blending parameter, and the estimated spectral envelope; generating a noise signal comprising noise-signal spectral components in an interval of frequencies above the baseband spectral components, wherein the noise-signal spectral components are weighted in amplitude by a noise blending function that is a function of frequency and the noise blending parameter and that gives greater weight to spectral components at higher frequencies; generating a regenerated signal comprising regenerated-signal spectral components in the interval of frequencies above the baseband spectral components, wherein the regenerated-signal components are copied from at least some of the baseband spectral components and weighted in amplitude by an inverse of the noise blending function; generating noisy regenerated spectral components from a combination of the noise-signal spectral components and the regenerated-signal spectral components, wherein amplitudes of the noisy regenerated spectral components are weighted according to the estimated spectral envelope; and generating along an electrical communication path the electrical reconstructed signal from a time-domain representation of the baseband spectral components combined with the noisy regenerated spectral components.

2. The method of claim 1, wherein the time-domain representation of the baseband spectral components is obtained to represent segments of the reconstructed signal that vary in length.

3. The method of claim 1 that comprises applying a time-domain aliasing cancellation synthesis transform to obtain the time-domain representation of the baseband spectral components.

4. The method of claim 1 that comprises adapting the generating of the regenerated signal by changing which baseband spectral components are copied or by changing the frequency amount by which baseband spectral components are copied.

5. The method of claim 1, wherein: the data also represents one or more additional noise blending parameters; and the noise blending function is also a function of the one or more additional noise blending parameters.

6. The method of claim 1, wherein the regenerated signal comprises regenerated-signal spectral components copied from the baseband spectral components in a circular manner into one or more additional intervals of frequencies.

7. An apparatus for generating a reconstructed signal that comprises: means for receiving an encoded signal comprising baseband spectral components of an audio signal, a noise blending parameter and an estimated spectral envelope, wherein the number of baseband spectral components contained in the encoded signal may vary dynamically; means for decoding the encoded signal to obtain the baseband spectral components, the noise blending parameter, and the estimated spectral envelope; means for generating a noise signal comprising noise-signal spectral components in an interval of frequencies above the baseband spectral components, wherein the noise-signal spectral components are weighted in amplitude by a noise blending function that is a function of frequency and the noise blending parameter and that gives greater weight to spectral components at higher frequencies; means for generating a regenerated signal comprising regenerated-signal spectral components in the interval of frequencies above the baseband spectral components, wherein the regenerated-signal components are copied from at least some of the baseband spectral components and weighted in amplitude by an inverse of the noise blending function; means for generating noisy regenerated spectral components from a combination of the noise-signal spectral components and the regenerated-signal spectral components, wherein amplitudes of the noisy regenerated spectral components are weighted according to the estimated spectral envelope; and means for generating the reconstructed signal from a time-domain representation of the baseband spectral components combined with the noisy regenerated spectral components.

8. The apparatus of claim 7, wherein the time-domain representation of the baseband spectral components is obtained to represent segments of the reconstructed signal that vary in length.

time-domain aliasing cancellation synthesis transform to obtain the time-domain representation of the baseband spectral components.

9. The apparatus of claim 7 that comprises means for applying a time-domain aliasing cancellation synthesis transform to obtain the time-domain representation of the baseband spectral components.

10. The apparatus of claim 7 that comprises means for adapting the generating of the regenerated signal by changing which baseband spectral components are copied or by changing the frequency amount by which baseband spectral components are copied.

11. The apparatus of claim 7, wherein: the data also represents one or more additional noise blending parameters; and the noise blending function is also a function of the one or more additional noise blending parameters.

12. The apparatus of claim 7, wherein the regenerated signal comprises regenerated-signal spectral components copied from the baseband spectral components in a circular manner into one or more additional intervals of frequencies.

13. A non-transitory medium recording a program of instructions that is executable by a device to perform a method for generating a reconstructed signal, wherein the method comprises: receiving an encoded signal comprising baseband spectral components of an audio signal, a noise blending parameter and an estimated spectral envelope, wherein the number of baseband spectral components contained in the encoded signal may vary dynamically; decoding the encoded signal to obtain the baseband spectral components, the noise blending parameter, and the estimated spectral envelope; generating a noise signal comprising noise-signal spectral components in an interval of frequencies above the baseband spectral components, wherein the noise-signal spectral components are weighted in amplitude by a noise blending function that is a function of frequency and the noise blending parameter and that gives greater weight to spectral components at higher frequencies; generating a regenerated signal comprising regenerated-signal spectral

components in the interval of frequencies above the baseband spectral components, wherein the regenerated-signal components are copied from at least some of the baseband spectral components and weighted in amplitude by an inverse of the noise blending function; generating noisy regenerated spectral components from a combination of the noise-signal spectral components and the regenerated-signal spectral components, wherein amplitudes of the noisy regenerated spectral components are weighted according to the estimated spectral envelope; and generating the reconstructed signal from a time-domain representation of the baseband spectral components combined with the noisy regenerated spectral components.

14. The medium of claim 13, wherein the time-domain representation of the baseband spectral components is obtained to represent segments of the reconstructed signal that vary in length.

15. The medium of claim 13, wherein the method comprises applying a time-domain aliasing cancellation synthesis transform to obtain the time-domain representation of the baseband spectral components.

16. The medium of claim 13, wherein the method comprises adapting the generating of the regenerated signal by changing which baseband spectral components are copied or by changing the frequency amount by which baseband spectral components are copied.

17. The medium of claim 13, wherein: the data also represents one or more additional noise blending parameters; and the noise blending function is also a function of the one or more additional noise blending parameters.

18. The medium of claim 13, wherein the regenerated signal comprises regenerated-signal spectral components copied from the baseband spectral components in a circular manner into one or more additional intervals of frequencies.