Claims

1. Apparatus configured to perform noise filling on a spectrum (34) of an audio signal in a manner dependent on a tonality of the audio signal, wherein the apparatus is configured to dequantize (132; 174) the spectrum (34), as derived after the noise-filling, using a spectrally varying and signal-adaptive quantization step size controlled via a linear prediction spectral envelope signaled via linear prediction coefficients (162) in a data stream into which the spectrum (34) is coded (164), or scale factors (112) relating to scale factor bands (110), signaled in the data stream into which the spectrum (34) is coded,

wherein the apparatus is configured to fill a contiguous spectral zero-portion (40) of the audio signal's spectrum (34) with noise spectrally shaped using

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) an absolute slope of which negatively depends on the tonality, or

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) a spectral width (54, 56) of which positively depends on the tonality, or

a constant or unimodal function (48, 50) an integral of which – normalized to an integral of 1 - over outer quarters (a, d) of the contiguous spectral zero-portion (40) negatively depends on the tonality.

2. Apparatus configured to perform noise filling on a spectrum (34) of an audio signal in a manner dependent on a tonality of the audio signal, wherein the apparatus is configured to

dequantize (132; 174) the spectrum (34), as derived after the noise-filling, using a spectrally varying and signal-adaptive quantization step size controlled via a linear prediction spectral envelope signaled via linear prediction coefficients (162) in a data stream into which the spectrum (34) is coded (164), or scale factors (112) relating to scale factor bands (110), signaled in the data stream into which the spectrum (34) is coded,

identify (70) contiguous spectral zero-portions of the audio signal's spectrum and to apply the noise filling onto the contiguous spectral zero-portions identified, and

respectively fill the contiguous spectral zero-portions of the audio signal's spectrum with noise spectrally shaped with a function set (80) dependent on a respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion, and dependent on the tonality of the audio signal so that, if the tonality of the audio signal increases, the function gets more compact in the inner of the respective contiguous spectral zero-portion and distanced from the respective contiguous spectral zero-portion's outer edges.

3. Apparatus according to claim 1 or 2, wherein the apparatus is configured to scale the noise with which the contiguous spectral zero-portions are filled using a scalar global noise level signaled in the data stream into which the spectrum is coded in a spectrally global manner.

4. Apparatus according to any of claims 1 to 3, wherein the apparatus is configured to generate the noise with which the contiguous spectral zero-portions are filled, using a random or pseudo-random process or using patching.

5. Apparatus according to any of the previous claims, wherein the apparatus is configured to derive the tonality from a coding parameter coded within the data stream.

6. Apparatus according to claim 5, wherein the apparatus is configured such that the coding parameter is an LTP (long-term prediction) or TNS (temporal noise shaping) enablement flag or gain and/or a spectrum rearrangement enablement flag, the spectral rearrangement enablement flag signalling a coding option according to which quantized spectral values are spectrally re-arranged with additionally transmitting within the data stream the rearrangement prescription.

7. Apparatus according to any of the previous claims, wherein the apparatus is configured to confine the performance of the noise filling onto a high-frequency spectral portion of the audio signal's spectrum.

8. Apparatus according to any of the previous claims

wherein the apparatus is configured to set a low-frequency starting position of the high-frequency spectral portion corresponding to an explicit signaling in the data stream.

9. Apparatus according to any of the previous claims, wherein the apparatus is configured to, in performing the noise filling, fill contiguous spectral zero-portions (40) of the spectrum (34) with noise a level of which exhibits a decrease from low to high frequencies, approximating a spectral low-pass filter's transfer function so as to counteract a spectral tilt caused by a pre-emphasis used to code the audio signal's spectrum.

10. Apparatus according to claim 9, wherein the apparatus is configured to adapt a steepness of the decrease to a pre-emphasis factor of the pre-emphasis.

11. Apparatus according to any of the previous claims, wherein the apparatus is configured to identify contiguous spectral zero-portions of the audio signal's spectrum and to fill the contiguous spectral zero-portions with functions set dependent on a respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion, and dependent on the tonality of the audio signal so that, if the tonality of the audio signal increases, the function gets increasingly more compact in the inner of the respective contiguous spectral zero-portion and distanced from the respective contiguous spectral zero-portion's edges and, additionally, dependent on the respective contiguous spectral zero-portion's spectral position so that a scaling of the function depends on the respective contiguous spectral zero-portion's spectral position.

12. Audio decoder supporting noise filling comprising an apparatus according to any of the previous claims.

13. Perceptual transform audio decoder comprising

an apparatus configured to perform noise filling on a spectrum (34) of an audio signal according to any of claim 1 to 12; and

a frequency domain noise shaper configured to subject the noise filled spectrum to spectral shaping using a spectral perceptual weighting function.

14. Audio encoder supporting noise filling comprising an apparatus according to any of the claims 1 to 12, the encoder being configured to use a spectrum filled with noise by the apparatus, for analysis-by-synthesis.

15. Audio encoder supporting noise filling, configured to quantize and code a spectrum of an audio signal into a data stream and

set and code into the data stream, a spectrally global noise filling level for performing noise filling on the spectrum of the audio signal, in a manner dependent on a tonality of the audio signal,

wherein the encoder is configured to, in setting and coding the spectrally global noise filling level, measure of a level of the audio signal within contiguous spectral zero-portions (40) of the spectrum (34), spectrally shaped dependent on the tonality of the audio signal,

wherein the contiguous spectral zero-portions (40) of the audio signal's spectrum (34) are spectrally shaped using

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) an absolute slope of which negatively depends on the tonality, or

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) a spectral width (54, 56) of which positively depends on the tonality , or

a constant or unimodal function (48, 50) an integral of which – normalized to an integral of 1 - over outer quarters (a, d) of the contiguous spectral zero-portion (40) negatively depends on the tonality.

16. Audio encoder according to claim 15, wherein the measure is a root mean square.

17. Audio encoder according to claim 15 or 16, wherein the encoder is configured to quantize the spectrum (34) using a spectrally varying and signal-adaptive quantization step size according to a linear prediction spectral envelope, signal the linear prediction spectral envelope via linear prediction coefficients (162) in the data stream and encode the spectrum (34) into the data stream.

18. Audio encoder according to claim 15 or 16, wherein the encoder is configured to quantize the spectrum (34) using a spectrally varying and signal-adaptive quantization step size according to scale factors (112) relating to scale factor bands (110), signal the scale factors in the data stream and encode the spectrum (34) into the data stream.

19. Audio encoder according to any of claims 15 to 18, wherein the apparatus is configured to derive the tonality from a coding parameter used to code the audio signal's spectrum.

20. Method comprising performing noise filling on a spectrum (34) of an audio signal in a manner dependent on a tonality of the audio signal, wherein the method comprises dequantizing (132; 174) the spectrum (34), as derived after the noise-filling, using a spectrally varying and signal-adaptive quantization step size controlled via a linear prediction spectral envelope signaled via linear prediction coefficients (162) in a data stream into which the spectrum (34) is coded (164), or scale factors (112) relating to scale factor bands (110), signaled in the data stream into which the spectrum (34) is coded ,

wherein the method comprises filling a contiguous spectral zero-portion (40) of the audio signal's spectrum (34) with noise spectrally shaped using

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) an absolute slope of which negatively depends on the tonality, or

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) a spectral width (54, 56) of which positively depends on the tonality , or

a constant or unimodal function (48, 50) an integral of which – normalized to an integral of 1 - over outer quarters (a, d) of the contiguous spectral zero-portion (40) negatively depends on the tonality.

21. Method for audio encoding supporting noise filling, the method comprising quantizing and coding a spectrum of an audio signal into a data stream and setting and coding into the data stream, a spectrally global noise filling level for performing noise filling on the spectrum of the audio signal, in a manner dependent on a tonality of the audio signal, wherein the setting and coding the spectrally global noise filling level comprises measuring of a level of the audio signal within contiguous spectral zero-portions (40) of the spectrum (34), spectrally shaped dependent on the tonality of the audio signal,

wherein the contiguous spectral zero-portions (40) of the audio signal's spectrum (34) are spectrally shaped using

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) an absolute slope of which negatively depends on the tonality, or

a function (48, 50) assuming a maximum in an inner (52) of the contiguous spectral zero-portion (40), and having outwardly falling edges (58, 60) a spectral width (54, 56) of which positively depends on the tonality , or

a constant or unimodal function (48, 50) an integral of which – normalized to an integral of 1 - over outer quarters (a, d) of the contiguous spectral zero-portion (40) negatively depends on the tonality.

22. Computer program having a program code for performing, when running on a computer, a method according to claims 20 or 21.

Claims

1. Apparatus configured to perform noise filling on a spectrum of an audio signal in a manner dependent on a tonality of the audio signal, wherein the apparatus is configured to dequantize the spectrum, as derived after the noise-filling, using a spectrally varying and signal-adaptive quantization step size controlled via a linear prediction spectral envelope signaled via linear prediction coefficients in a data stream into which the spectrum is coded, or scale factors relating to scale factor bands, signaled in the data stream into which the spectrum is coded,

wherein the apparatus is configured to fill a contiguous spectral zero-portion of the audio signal's spectrum with noise spectrally shaped using

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges an absolute slope of which negatively depends on the tonality, or

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges a spectral width of which positively depends on the tonality, or

a constant or unimodal function an integral of which – normalized to an integral of 1 - over outer quarters of the contiguous spectral zero-portion negatively depends on the tonality.

2. Apparatus configured to perform noise filling on a spectrum of an audio signal in a manner dependent on a tonality of the audio signal, wherein the apparatus is configured to

dequantize the spectrum, as derived after the noise-filling, using a spectrally varying and signal-adaptive quantization step size controlled via a linear prediction spectral envelope signaled via linear prediction coefficients in a data stream into which the spectrum is coded, or scale factors relating to scale factor bands, signaled in the data stream into which the spectrum is coded,

identify contiguous spectral zero-portions of the audio signal's spectrum and to apply the noise filling onto the contiguous spectral zero-portions identified, and

respectively fill the contiguous spectral zero-portions of the audio signal's spectrum with noise spectrally shaped with a function set dependent on a respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion, and dependent on the tonality of the audio signal so that, if the tonality of the

audio signal increases, the function gets more compact in the inner of the respective contiguous spectral zero-portion and distanced from the respective contiguous spectral zero-portion's outer edges.

3. Apparatus according to claim 1 or 2, wherein the apparatus is configured to scale the noise with which the contiguous spectral zero-portions are filled using a scalar global noise level signaled in the data stream into which the spectrum is coded in a spectrally global manner.

4. Apparatus according to any of claims 1 to 3, wherein the apparatus is configured to generate the noise with which the contiguous spectral zero-portions are filled, using a random or pseudo-random process or using patching.

5. Apparatus according to any of the previous claims, wherein the apparatus is configured to derive the tonality from a coding parameter coded within the data stream.

6. Apparatus according to claim 5, wherein the apparatus is configured such that the coding parameter is an LTP (long-term prediction) or TNS (temporal noise shaping) enablement flag or gain and/or a spectrum rearrangement enablement flag, the spectral rearrangement enablement flag signalling a coding option according to which quantized spectral values are spectrally re-arranged with additionally transmitting within the data stream the rearrangement prescription.

7. Apparatus according to any of the previous claims, wherein the apparatus is configured to confine the performance of the noise filling onto a high-frequency spectral portion of the audio signal's spectrum.

8. Apparatus according to any of the previous claims

wherein the apparatus is configured to set a low-frequency starting position of the high-frequency spectral portion corresponding to an explicit signaling in the data stream.

9. Apparatus according to any of the previous claims, wherein the apparatus is configured to, in performing the noise filling, fill contiguous spectral zero-portions of the spectrum with noise a level of which exhibits a decrease from low to high frequencies, approximating a spectral low-pass filter's transfer function so as to counteract a spectral tilt caused by a pre-emphasis used to code the audio signal's spectrum.

10. Apparatus according to claim 9, wherein the apparatus is configured to adapt a steepness of the decrease to a pre-emphasis factor of the pre-emphasis.

11. Apparatus according to any of the previous claims, wherein the apparatus is configured to identify contiguous spectral zero-portions of the audio signal's spectrum and to fill the contiguous spectral zero-portions with functions set dependent on a respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion, and dependent on the tonality of the audio signal so that, if the tonality of the audio signal increases, the function gets increasingly more compact in the inner of the respective contiguous spectral zero-portion and distanced from the respective contiguous spectral zero-portion's edges and, additionally, dependent on the respective contiguous spectral zero-portion's spectral position so that a scaling of the function depends on the respective contiguous spectral zero-portion's spectral position.

12. Audio decoder supporting noise filling comprising an apparatus according to any of the previous claims.

13. Perceptual transform audio decoder comprising

an apparatus configured to perform noise filling on a spectrum of an audio signal according to any of claim 1 to 12; and
a frequency domain noise shaper configured to subject the noise filled spectrum to spectral shaping using a spectral perceptual weighting function.

14. Audio encoder supporting noise filling comprising an apparatus according to any of the claims 1 to 12, the encoder being configured to use a spectrum filled with noise by the apparatus, for analysis-by-synthesis.

15. Audio encoder supporting noise filling, configured to quantize and code a spectrum of an audio signal into a data stream and

set and code into the data stream, a spectrally global noise filling level for performing noise filling on the spectrum of the audio signal, in a manner dependent on a tonality of the audio signal,

wherein the encoder is configured to, in setting and coding the spectrally global noise filling level, measure of a level of the audio signal within contiguous spectral zero-portions of the spectrum, spectrally shaped dependent on the tonality of the audio signal,

wherein the contiguous spectral zero-portions of the audio signal's spectrum are spectrally shaped using

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges an absolute slope of which negatively depends on the tonality, or

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges a spectral width of which positively depends on the tonality , or

a constant or unimodal function an integral of which – normalized to an integral of 1 - over outer quarters of the contiguous spectral zero-portion negatively depends on the tonality.

16. Audio encoder according to claim 15, wherein the measure is a root mean square.

17. Audio encoder according to claim 15 or 16, wherein the encoder is configured to quantize the spectrum using a spectrally varying and signal-adaptive quantization step size according to a linear prediction spectral envelope, signal the linear prediction spectral envelope via linear prediction coefficients in the data stream and encode the spectrum into the data stream.

18. Audio encoder according to claim 15 or 16, wherein the encoder is configured to quantize the spectrum using a spectrally varying and signal-adaptive quantization step size according to scale factors relating to scale factor bands, signal the scale factors in the data stream and encode the spectrum into the data stream.

19. Audio encoder according to any of claims 15 to 18, wherein the apparatus is configured to derive the tonality from a coding parameter used to code the audio signal's spectrum.

20. Method comprising performing noise filling on a spectrum of an audio signal in a manner dependent on a tonality of the audio signal, wherein the method comprises dequantizing the spectrum, as derived after the noise-filling, using a spectrally varying and signal-adaptive quantization step size controlled via a linear prediction spectral envelope signaled via linear prediction coefficients in a data stream into which the spectrum is coded, or scale factors relating to scale factor bands, signaled in the data stream into which the spectrum is coded ,

wherein the method comprises filling a contiguous spectral zero-portion of the audio signal's spectrum with noise spectrally shaped using

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges an absolute slope of which negatively depends on the tonality, or

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges a spectral width of which positively depends on the tonality , or

a constant or unimodal function an integral of which – normalized to an integral of 1 - over outer quarters of the contiguous spectral zero-portion negatively depends on the tonality.

21. Method for audio encoding supporting noise filling, the method comprising quantizing and coding a spectrum of an audio signal into a data stream and setting and coding into the data stream, a spectrally global noise filling level for performing noise filling on the spectrum of the audio signal, in a manner dependent on a tonality of the audio signal, wherein the setting and coding the spectrally global noise filling level comprises measuring of a level of the audio signal within contiguous spectral zero-portions of the spectrum, spectrally shaped dependent on the tonality of the audio signal,

wherein the contiguous spectral zero-portions of the audio signal's spectrum are spectrally shaped using

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges an absolute slope of which negatively depends on the tonality, or

a function assuming a maximum in an inner of the contiguous spectral zero-portion, and having outwardly falling edges a spectral width of which positively depends on the tonality , or

a constant or unimodal function an integral of which – normalized to an integral of 1 - over outer quarters of the contiguous spectral zero-portion negatively depends on the tonality.

22. Computer program having a program code for performing, when running on a computer, a method according to claims 20 or 21.