Claims

1. Perceptual transform audio decoder comprising

a noise filler configured to perform noise filling on a spectrum (34) of an audio signal by filling the spectrum with noise so as to obtain a noise filled spectrum; and

a frequency domain noise shaper configured to subject the noise filled spectrum to spectral shaping using a spectral perceptual weighting function, wherein the frequency domain noise shaper is configured to determine the spectral perceptual weighting function from linear prediction coefficient information (162) signaled in a data stream into which the spectrum (34) is coded (164), or determine the spectral perceptual weighting function from scale factors (112) relating to scale factor bands (110), signaled in the data stream into which the spectrum (34) is coded,

wherein the noise filler is configured to

generate an intermediary noise signal;

identify contiguous spectral zero-portions of the audio signal's spectrum;

determine a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shape, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a negative slope.

2. Perceptual transform audio decoder according to claim 1, wherein the noise filler is configured to vary a steepness of the spectrally global tilt responsive to an implicit or explicit signaling in a data stream into which the spectrum (34) is coded (164).

3. Perceptual transform audio decoder according to claim 1 or 2, wherein the noise filler is configured to deduce a steepness of the spectrally global tilt from a portion of the data stream which signals the spectral perceptual weighting function or from a transform window length signaling in the data stream.

4. Perceptual transform audio decoder according to any of claim 1 to 3, further comprising

an inverse transformer configured to inversely transform the noise filled spectrum, spectrally shaped by the frequency domain noise shaper, to obtain an inverse transform, and subject the inverse transform to an overlap-add process.

5. Perceptual transform audio decoder according to any of claim 1 to 4, wherein the noise filler is configured such that the function (48, 50) assumes a maximum in an inner (52) of the contiguous spectral zero-portion (40), and has outwardly falling edges (58, 60) an absolute slope of which negatively depends on the tonality.

6. Perceptual transform audio decoder according to any of claim 1 to 5, wherein the noise filler is configured such that the function (48, 50) assumes a maximum in an inner (52) of the contiguous spectral zero-portion (40), and has outwardly falling edges (58, 60) a spectral width (54, 56) of which positively depends on the tonality.

7. Perceptual transform audio decoder according to any of claim 1 to 4, wherein the noise filler is further configured such that the function is 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.

8. Perceptual transform audio decoder according to any of claim 1 to 4, wherein the noise filler is further configured such that the function set (80) is dependent on the tonality of the audio signal so that, if the tonality of the audio signal increases, a function's mass 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.

9. Perceptual transform audio decoder according to any of claims 1 to 8, wherein the noise filler is further configured to scale the noise using a noise level parameter signaled in a data stream into which the spectrum is coded in a spectrally global manner.

10. Perceptual transform audio decoder according to any of claims 1 to 9, the noise filler is further configured to generate the noise using a random or pseudo-random process or using patching.

11. Perceptual transform audio decoder according to any of claims 5 to 7, wherein the noise filler is further configured to derive the tonality from a coding parameter using which the audio signal is coded.

12. Perceptual transform audio decoder according to claim 11, wherein the noise filler is further 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.

13. Perceptual transform audio decoder according to any of the previous claims wherein the noise filler is further configured to confine the noise filling onto a high-frequency spectral portion of the audio signal's spectrum.

14. Perceptual transform audio decoder according to claim 13, wherein the noise filler is further configured to set a low-frequency starting position of the high-frequency spectral portion corresponding to an explicit signaling in a data stream into which the spectrum of the audio signal is coded.

15. Perceptual transform audio encoder comprising

a pre-emphasis filter;

an LPC analyser configured to determine linear prediction coefficient information (162) by performing LP analysis on a version of the audio signal, subject to the pre-emphasis filter, the linear prediction coefficient information (162) representing an LPC spectral envelope of a spectrum of the pre-emphasized version of the audio signal;

a transformer configured to provide an original spectrum of the audio signal;

a spectrum weighter configured to spectrally weight an audio signal's original spectrum according to an inverse of a spectral perceptual weighting function so as to obtain a perceptually weighted spectrum, wherein the spectral weighter is configured to determine the spectral perceptual weighting function so as to follow the LPC spectral envelope;

a quantizer configured to quantize the perceptually weighted spectrum in a manner equal for spectral lines of the perceptually weighted spectrum so as to obtain a quantized spectrum, wherein the encoder is configured to code the quantized spectrum into a data stream to be output to a perceptual transform audio decoder according to any of the preceding claims, the linear prediction coefficient information also being signaled in the data stream;

a noise level computer configured to compute a noise level parameter by

identifying contiguous spectral zero-portions of the audio signal's spectrum;

determining a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shaping, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a positive slope.

16. Perceptual transform audio encoder according to claim 15, wherein the pre-emphasis filter is configured to high-pass filter the audio signal with a varying pre-emphasis amount so as to obtain the version of the audio signal, subject to a pre-emphasis filter, wherein the noise level computer is configured to set a slope of the spectrally global tilt depending on the pre-emphasis amount.

17. Perceptual transform audio encoder according to claim 16, configured to explicitly encode the amount of the spectrally global tilt or the pre-emphasis amount in the data stream into which the quantized spectrum (34) is coded (164).

18. Perceptual transform audio encoder according to claim 17, comprising

a scale factor determiner configured to, controlled via a perceptual model, determine scale factors (112) relating to scale factor bands (110) so as to follow a masking threshold, wherein the spectral weighter is configured to determine the spectral perceptual weighting function so as to follow the scale factors.

19. Perceptual transform audio encoder according to claim 15, wherein the noise level computer is configured to determine, for each contiguous spectral zero-portion, the function (48, 50) such that

same assumes a maximum in an inner (52) of the contiguous spectral zero-portion (40), and has outwardly falling edges (58, 60) an absolute slope of which negatively depends on the tonality,

same assumes a maximum in an inner (52) of the contiguous spectral zero-portion (40), and has outwardly falling edges (58, 60) a spectral width (54, 56) of which positively depends on the tonality, and/or

same is 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.

20. Perceptual transform audio encoder according to claim 19, wherein the noise level computer is configured to deduce the tonality from an LTP (long-term prediction) or TNS (temporal noise shaping) enablement flag or gain and/or a spectrum rearrangement enablement flag used by the perceptual transform audio encoder to encode the audio signal, 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.

21. Perceptual transform audio encoder according to any of the claims 15 to 20 wherein the noise filler is configured to confine the noise filling onto a high-frequency spectral portion of the audio signal's spectrum.

22. Perceptual transform audio encoder according to any of claims 15 to 21, wherein the noise level computer is configured to restrict the measuring to a high-frequency spectral portion with explicit signaling set a low-frequency starting position of the same in a data stream into which the audio signal is coded.

23. Method for perceptual transform audio decoding comprising

performing noise filling on a spectrum (34) of an audio signal by filling the spectrum with noise so as to obtain a noise filled spectrum; and

frequency domain noise shaping comprising subjecting the noise filled spectrum to spectral shaping using a spectral perceptual weighting function, wherein the frequency domain noise shaping comprises determining the spectral perceptual weighting function from linear prediction coefficient information (162) signaled in a data stream into which the spectrum (34) is coded (164), or determining the spectral perceptual weighting function from scale factors (112) relating to scale factor bands (110), signaled in the data stream into which the spectrum (34) is coded,

wherein the noise filling involves

generating an intermediary noise signal;

identifying contiguous spectral zero-portions of the audio signal's spectrum;

determining a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shaping, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a negative slope.

24. Method for perceptual transform audio encoding comprising

determining linear prediction coefficient information (162) by performing LP analysis on a version of the audio signal, subject to a pre-emphasis filter, the linear prediction coefficient information (162) representing an LPC spectral envelope of a spectrum of the pre-emphasized version of the audio signal;

provide an original spectrum of the audio signal by a transformer;

spectrally weighting the audio signal's original spectrum according to an inverse of a spectral perceptual weighting function so as to obtain a perceptually weighted spectrum, wherein the spectral weighting function is determined so as to follow the LPC spectral envelope;

quantizing the perceptually weighted spectrum in a manner equal for spectral lines of the perceptually weighted spectrum so as to obtain a quantized spectrum,

wherein the quantized spectrum is coded into a data stream to be output to a perceptual transform audio decoder according to any of claims 1 to 14, the linear prediction coefficient information also being signaled in the data stream;

computing a noise level parameter by

identifying contiguous spectral zero-portions of the audio signal's spectrum;

determining a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shaping, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a positive slope.

25. Computer program having a program code for performing, when running on a computer, a method according to claim 23 or 24.

Claims

1. Perceptual transform audio decoder comprising

a noise filler configured to perform noise filling on a spectrum of an audio signal by filling the spectrum with noise so as to obtain a noise filled spectrum; and

a frequency domain noise shaper configured to subject the noise filled spectrum to spectral shaping using a spectral perceptual weighting function, wherein the frequency domain noise shaper is configured to determine the spectral perceptual weighting function from linear prediction coefficient information signaled in a data stream into which the spectrum is coded, or determine the spectral perceptual weighting function from scale factors relating to scale factor bands, signaled in the data stream into which the spectrum is coded,

wherein the noise filler is configured to

generate an intermediary noise signal;

identify contiguous spectral zero-portions of the audio signal's spectrum;

determine a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shape, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a negative slope.

2. Perceptual transform audio decoder according to claim 1, wherein the noise filler is configured to vary a steepness of the spectrally global tilt responsive to an implicit or explicit signaling in a data stream into which the spectrum is coded.

3. Perceptual transform audio decoder according to claim 1 or 2, wherein the noise filler is configured to deduce a steepness of the spectrally global tilt from a portion of the data stream which signals the spectral perceptual weighting function or from a transform window length signaling in the data stream.

4. Perceptual transform audio decoder according to any of claim 1 to 3, further comprising

an inverse transformer configured to inversely transform the noise filled spectrum, spectrally shaped by the frequency domain noise shaper, to obtain an inverse transform, and subject the inverse transform to an overlap-add process.

5. Perceptual transform audio decoder according to any of claim 1 to 4, wherein the noise filler is configured such that the function assumes a maximum in an inner of the contiguous spectral zero-portion , and has outwardly falling edges an absolute slope of which negatively depends on the tonality.

6. Perceptual transform audio decoder according to any of claim 1 to 5, wherein the noise filler is configured such that the function assumes a maximum in an inner of the contiguous spectral zero-portion, and has outwardly falling edges a spectral width of which positively depends on the tonality.

7. Perceptual transform audio decoder according to any of claim 1 to 4, wherein the noise filler is further configured such that the function is 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.

8. Perceptual transform audio decoder according to any of claim 1 to 4, wherein the noise filler is further configured such that the function set is dependent on the tonality of the audio signal so that, if the tonality of the audio signal increases, a function's mass 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.

9. Perceptual transform audio decoder according to any of claims 1 to 8, wherein the noise filler is further configured to scale the noise using a noise level parameter signaled in a data stream into which the spectrum is coded in a spectrally global manner.

10. Perceptual transform audio decoder according to any of claims 1 to 9, the noise filler is further configured to generate the noise using a random or pseudo-random process or using patching.

11. Perceptual transform audio decoder according to any of claims 5 to 7, wherein the noise filler is further configured to derive the tonality from a coding parameter using which the audio signal is coded.

12. Perceptual transform audio decoder according to claim 11, wherein the noise filler is further 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.

13. Perceptual transform audio decoder according to any of the previous claims wherein the noise filler is further configured to confine the noise filling onto a high-frequency spectral portion of the audio signal's spectrum.

14. Perceptual transform audio decoder according to claim 13, wherein the noise filler is further configured to set a low-frequency starting position of the high-frequency spectral portion corresponding to an explicit signaling in a data stream into which the spectrum of the audio signal is coded.

15. Perceptual transform audio encoder comprising

a pre-emphasis filter;

an LPC analyser configured to determine linear prediction coefficient information by performing LP analysis on a version of the audio signal, subject to the pre-emphasis filter, the linear prediction coefficient information representing an LPC spectral envelope of a spectrum of the pre-emphasized version of the audio signal;

a transformer configured to provide an original spectrum of the audio signal;

a spectrum weighter configured to spectrally weight an audio signal's original spectrum according to an inverse of a spectral perceptual weighting function so as to obtain a perceptually weighted spectrum, wherein the spectral weighter is configured to determine the spectral perceptual weighting function so as to follow the LPC spectral envelope;

a quantizer configured to quantize the perceptually weighted spectrum in a manner equal for spectral lines of the perceptually weighted spectrum so as to obtain a quantized spectrum, wherein the encoder is configured to code the quantized spectrum into a data stream to be output to a perceptual transform audio decoder according to any of the preceding claims, the linear prediction coefficient information also being signaled in the data stream;

a noise level computer configured to compute a noise level parameter by

identifying contiguous spectral zero-portions of the audio signal's spectrum;

determining a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shaping, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a positive slope.

16. Perceptual transform audio encoder according to claim 15, wherein the pre-emphasis filter is configured to high-pass filter the audio signal with a varying pre-emphasis amount so as to obtain the version of the audio signal, subject to a pre-emphasis filter, wherein the noise level computer is configured to set a slope of the spectrally global tilt depending on the pre-emphasis amount.

17. Perceptual transform audio encoder according to claim 16, configured to explicitly encode the amount of the spectrally global tilt or the pre-emphasis amount in the data stream into which the quantized spectrum is coded.

18. Perceptual transform audio encoder according to claim 17, comprising

a scale factor determiner configured to, controlled via a perceptual model, determine scale factors relating to scale factor bands so as to follow a masking threshold, wherein the spectral weighter is configured to determine the spectral perceptual weighting function so as to follow the scale factors.

19. Perceptual transform audio encoder according to claim 15, wherein the noise level computer is configured to determine, for each contiguous spectral zero-portion, the function such that

same assumes a maximum in an inner of the contiguous spectral zero-portion, and has outwardly falling edges an absolute slope of which negatively depends on the tonality,

same assumes a maximum in an inner of the contiguous spectral zero-portion, and has outwardly falling edges a spectral width of which positively depends on the tonality, and/or

same is 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.

20. Perceptual transform audio encoder according to claim 19, wherein the noise level computer is configured to deduce the tonality from an LTP (long-term prediction) or TNS (temporal noise shaping) enablement flag or gain and/or a spectrum rearrangement enablement flag used by the perceptual transform audio encoder to encode the audio signal, 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.

21. Perceptual transform audio encoder according to any of the claims 15 to 20 wherein the noise filler is configured to confine the noise filling onto a high-frequency spectral portion of the audio signal's spectrum.

22. Perceptual transform audio encoder according to any of claims 15 to 21, wherein the noise level computer is configured to restrict the measuring to a high-frequency spectral portion with explicit signaling set a low-frequency starting position of the same in a data stream into which the audio signal is coded.

23. Method for perceptual transform audio decoding comprising

performing noise filling on a spectrum of an audio signal by filling the spectrum with noise so as to obtain a noise filled spectrum; and

frequency domain noise shaping comprising subjecting the noise filled spectrum to spectral shaping using a spectral perceptual weighting function, wherein the frequency domain noise shaping comprises determining the spectral perceptual weighting function from linear prediction coefficient information signaled in a data stream into which the spectrum is coded, or determining the spectral perceptual weighting function from scale factors relating to scale factor bands, signaled in the data stream into which the spectrum is coded,

wherein the noise filling involves

generating an intermediary noise signal;

identifying contiguous spectral zero-portions of the audio signal's spectrum;

determining a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shaping, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a negative slope.

24. Method for perceptual transform audio encoding comprising

determining linear prediction coefficient information by performing LP analysis on a version of the audio signal, subject to a pre-emphasis filter, the linear prediction coefficient information representing an LPC spectral envelope of a spectrum of the pre-emphasized version of the audio signal;

provide an original spectrum of the audio signal by a transformer;

spectrally weighting the audio signal's original spectrum according to an inverse of a spectral perceptual weighting function so as to obtain a perceptually weighted spectrum, wherein the spectral weighting function is determined so as to follow the LPC spectral envelope;

quantizing the perceptually weighted spectrum in a manner equal for spectral lines of the perceptually weighted spectrum so as to obtain a quantized spectrum, wherein the quantized spectrum is coded into a data stream to be output to a

perceptual transform audio decoder according to any of claims 1 to 14, the linear prediction coefficient information also being signaled in the data stream;

computing a noise level parameter by

identifying contiguous spectral zero-portions of the audio signal's spectrum;

determining a function for each contiguous spectral zero-portion depending on

the respective contiguous spectral zero-portion's width so that the function is confined to the respective contiguous spectral zero-portion,

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 such that an amount of the scaling monotonically increases or decreases with increasing frequency of the respective contiguous spectral zero-portion's spectral position; and

spectrally shaping, for each contiguous spectral zero-portion, the intermediary noise signal using the function determined for the respective contiguous spectral zero-portion such that the noise exhibits a spectrally global tilt having a positive slope.

25. Computer program having a program code for performing, when running on a computer, a method according to claim 23 or 24.