Claims

1. Apparatus for encoding an audio signal, comprising:

a converter for converting the audio signal into a spectral representation;

a scale parameter calculator for calculating a first set of scale parameters from the spectral representation:

a downsampler for downsampling the first set of scale parameters to obtain a second set of scale parameters, wherein a second number of scale parameters in the second set of scale parameters is lower than a first number of scale parameters in the first set of scale parameters;

a scale parameter encoder for generating an encoded representation of the second set of scale parameters;

a spectral processor for processing the spectral representation using a third set of scale parameters, the third set of scale parameters having a third number of scale parameters being greater than the second number of scale parameters, wherein the spectral processor is configured to use the first set of scale parameters or to derive the third set of scale parameters from the second set of scale parameters or from the encoded representation of the second set of scale parameters using an interpolation operation; and

an output interface for generating an encoded output signal comprising information on the encoded representation of the spectral representation and information on the encoded representation of the second set of scale parameters.

2. Apparatus of claim 1,

wherein the scale parameter calculator is configured to

calculate, for each band of a plurality of bands of the spectral representation, an amplitude-related measure in a linear domain to obtain a first set of linear domain measures;

to transform the first set of linear-domain measures into a log-like domain to obtain the first set of log-like domain measures; and

wherein the downsampler is configured to downsample the first set of scale factors in the log-like domain to obtain the second set of scale factors in the log-like domain.

3. Apparatus of claim 2,

wherein the spectral processor is configured to use the first set of scale parameters in the linear domain for processing the spectral representation or to interpolate the second set of scale parameters in the log-like domain to obtain interpolated log-like domain scale factors and to transform the log-like domain scale factors into a linear domain to obtain the third set of scale parameters.

4. Apparatus of one of the proceeding claims,

wherein the scale parameter calculator is configured to calculate the first set of scale parameters for non-uniform bands, and

wherein the downsampler is configured to downsample the first set of scale parameters to obtain a first scale factor of the second set by combining a first group having a first predefined number of frequency adjacent scale parameters of the first set, and wherein the downsampler is configured to downsample the first set of scale parameters to obtain a second scale parameter of the second set by combining a second group having a second predefined number of frequency adjacent scale parameters of the first set, wherein the second predefined number is equal to the first predefined number, and wherein the second group has members that are different from members of the first predefined group.

5. Apparatus of claim 4, wherein the first group of frequency adjacent scale parameters of the first set and the second group of frequency adjacent scale parameters

of the first set have at least one scale parameter of the first set in common, so that the first group and the second group overlap with each other.

6. Apparatus of one of the preceding claims, wherein the downsampler is configured to use an average operation among a group of first scale parameters, the group having two or more members.

7. Apparatus of claim 6,

wherein the average operation is a weighted average operation configured to weight a scale parameter in a middle of the group stronger than a scale parameter at an edge of the group.

8. Apparatus of one of the preceding claims,

wherein the downsampler is configured to perform a mean value removal so that the second set of scale parameters is mean free.

9. Apparatus of one of the preceding claims,

wherein the downsampler is configured to perform a scaling operation using a scaling factor lower than 1.0 and greater than 0.0 in a log-like domain.

10. Apparatus of one of the preceding claims,

wherein the scale parameter encoder is configured to quantize and encode the second set using a vector quantizer, wherein the encoded representation comprises one or more indices for one or more vector quantizer codebooks.

11. Apparatus of one of the preceding claims,

wherein the scale factor encoder is configured to provide a second set of quantized scale factors associated with the encoded representation, and

wherein the spectral processor is configured to derive the second set of scale factors from the second set of quantized scale factors.

12. Apparatus of one of the preceding claims,

wherein the spectral processor is configured to determine this third set of scale parameters so that the third number is equal to the first number.

13. Apparatus of one of the preceding claims,

wherein the spectral processor is configured to determine an interpolated scale factor based on a quantized scale factor and a difference between the quantized scale factor and a next quantized scale factor in an ascending sequence of quantized scale factors with respect to frequency.

14. Apparatus of claim 13,

wherein the spectral processor is configured to determine, from the quantized scale factor and the difference, at least two interpolated scale factors, wherein for each of the two interpolated scale factors, a different weighting factor is used.

15. Apparatus of claim 14,

wherein the weighting factors increase with increasing frequencies associated with the interpolated scale factors.

16. Apparatus of one of the preceding claims,

wherein the spectral processor is configured to perform the interpolation operation in a log-like domain, and

to convert interpolated scale factors into a linear domain to obtain the third set of scale parameters.

17. Apparatus of one of the preceding claims,

wherein the scale parameter calculator is configured to calculate an amplitude-related measure for each band to obtain a set of amplitude-related measures, and

to smooth, the energy-related measures to obtain a set of smoothed amplitude-related measures as the first set of scale factors.

18. Apparatus of one of the preceding claims,

wherein the scale parameter calculator is configured to calculate an amplitude-related measure for each band to obtain a set of amplitude-related measures, and

to perform a pre-emphasis operation to the set of amplitude-related measures, wherein the pre-emphasis operation is so that low frequency amplitudes are emphasized with respect to high frequency amplitudes.

19. Apparatus of one of the preceding claims,

wherein the scale parameter calculator is configured to calculate an amplitude-related measure for each band to obtain a set of amplitude-related measures, and

to perform a noise-floor addition operation, wherein a noise floor is calculated from an amplitude-related measure derived as a mean value from two or more frequency bands of the spectral representation.

20. Apparatus of one of the preceding claims, wherein the scale factor calculator is configured to perform at least one of a group of operations, the group of operations comprising calculating amplitude-related measures for a plurality of bands, performing a smoothing operation, performing a pre-emphasis operation, performing a noise-floor addition operation, and performing a log-like domain conversion operation to obtain the first set of scale parameters.

21. Apparatus of one of the preceding claims,

wherein the spectral processor is configured to weight spectral values in the spectral representation using the third set of scale factors to obtain a weighted spectral representation and to apply a temporal noise shaping (TNS) operation onto the weighted spectral representation, and

wherein the spectral processor is configured to quantize and encode a result of the temporal noise shaping operation to obtain the encoded representation of the spectral representation.

22. Apparatus of one of the preceding claims,

wherein the converter comprises an analysis windower to generate a sequence of blocks of windowed audio samples, and a time-spectrum converter for converting the blocks of windowed audio samples into a sequence of spectral representations, a spectral representation being a spectral frame.

23. Apparatus of one of the preceding claims,

wherein the converter is configured to apply an MDCT (modified discrete cosine transform) operation to obtain an MDCT spectrum from a block of time domain samples, or

wherein the scale factor calculator is configured to calculate, for each band, an energy of the band, the calculation comprising squaring spectral lines, adding squared spectral lines and dividing the squared spectral lines by a number of lines in the band, or

wherein the spectral processor is configured to weight spectral values of the spectral representation or to weight spectral values derived from the spectral representation in accordance with a band scheme, the band scheme being identical to the band scheme used in calculating the first set of scale factors by the scale factor calculator, or

wherein a number of bands is 64, the first number is 64, the second number is 16, and third number is 64, or

wherein the spectral processor is configured to calculate a global gain for all bands and to quantize the spectral values subsequent to a scaling involving the third number of scale factors using a scalar quantizer, wherein the spectral processor is configured to control a step size of the scalar quantizer dependent on the global gain.

24. A method for encoding an audio signal, comprising:

converting the audio signal into a spectral representation;

calculating a first set of scale parameters from the spectral representation:

downsampling the first set of scale parameters to obtain a second set of scale parameters, wherein a second number of scale parameters in the second set of scale parameters is lower than a first number of scale parameters in the first set of scale parameters;

generating an encoded representation of the second set of scale parameters;

processing the spectral representation using a third set of scale parameters, the third set of scale parameters having a third number of scale parameters being greater than the second number of scale parameters, wherein the processing uses the first set of scale parameters or derives the third set of scale parameters from the second set of scale parameters or from the encoded representation of the second set of scale parameters using an interpolation operation; and

generating an encoded output signal comprising information on the encoded representation of the spectral representation and information on the encoded representation of the second set of scale parameters.

25. Apparatus for decoding an encoded audio signal comprising information on an encoded spectral representation and information on an encoded representation of a second set of scale parameters, comprising:

an input interface for receiving the encoded signal and extracting the encoded spectral representation and the encoded representation of the second set of scale parameters;

a spectrum decoder for decoding the encoded spectral representation to obtain a decoded spectral representation;

a scale parameter decoder for decoding the encoded second set of scale parameters to obtain a first set of scale parameters, wherein the number of scale parameters of the second set is smaller than a number of scale parameters of the first set;

a spectral processor for processing the decoded spectral representation using the first set of scale parameters to obtain a scaled spectral representation; and

a converter for converting the scaled spectral representation to obtain a decoded audio signal.

26. Apparatus of claim 25,

wherein the spectral scale parameter decoder is configured to interpolate the second set of scale parameters in a log-like domain to obtain interpolated log-like domain scale parameters.

27. Apparatus of claim 25 or 26,

wherein the scale parameter decoder is configured to decode the encoded spectral representation using a vector dequantizer providing, for one or more quantization indices, the second set of decoded scale parameters, and

wherein the scale parameter decoder is configured to interpolate the second set of decoded scale parameters to obtain the first set of scale parameters.

28. Apparatus of one of claims 25 to 27,

wherein the scale parameter decoder is configured to determine an interpolated scale parameter based on the quantized scale parameter and a difference between the quantized scale parameter and a next quantized scale parameter in an ascending sequence of quantized scale parameters with respect to frequency.

29. Apparatus of claim 28,

wherein the scale parameter decoder is configured to determine, from the quantized scale parameter and the difference at least two interpolated scale parameters, wherein for the generation of each of the two interpolated scale parameters a different weighting factor is used.

30. Apparatus of claim 29,

wherein the scale parameter decoder is configured to use the weighting factors, wherein the weighting factors increase with increasing frequencies associated with the interpolated scale parameters.

31. Apparatus of one of claims 25 to 30, wherein the scale parameter decoder is configured to perform the interpolation operation in a log-like domain, and

to convert interpolated scale parameters into a linear domain to obtain the first set of scale parameters, wherein the log-like domain is a log domain with a base of 10 or with a base of 2.

32. Apparatus of one of claims 25 to 31,

wherein the spectral processor is configured

to apply a temporal noise shaping (TNS) decoder operation to the decoded spectral representation to obtain a TNS decoded spectral representation, and

to weight the TNS decoded spectral representation using the first set of scale parameters.

33. Apparatus of one of claims 25 to 32,

wherein the scale parameter decoder is configured to interpolate quantized scale parameters so that interpolated quantized scale parameters have values being in a range of ± 20% of values obtained using the following equations:

$$scfQint(0) = scfQ(0)$$
$$scfQint(1) = scfQ(0)$$
$$scfQint(4n+2) = scfQ(n) + \frac{1}{8}\big(scfQ(n+1) - scfQ(n)\big) \quad for\ n = 0..14$$
$$scfQint(4n+3) = scfQ(n) + \frac{3}{8}\big(scfQ(n+1) - scfQ(n)\big) \quad for\ n = 0..14$$
$$scfQint(4n+4) = scfQ(n) + \frac{5}{8}\big(scfQ(n+1) - scfQ(n)\big) \quad for\ n = 0..14$$
$$scfQint(4n+5) = scfQ(n) + \frac{7}{8}\big(scfQ(n+1) - scfQ(n)\big) \quad for\ n = 0..14$$
$$scfQint(62) = scfQ(15) + \frac{1}{8}\big(scfQ(15) - scfQ(14)\big)$$
$$scfQint(63) = scfQ(15) + \frac{3}{8}\big(scfQ(15) - scfQ(14)\big)$$

wherein scfQ(n) is the quantized scale parameter for an index n, and wherein scfQint(k) is the interpolated scale parameter for an index k.

34. Apparatus of one of claims 25-33,

wherein the scale parameter decoder is configured to perform an interpolation to obtain scale parameters within, with respect to frequency, the first set of scale parameters and to perform an extrapolation operation to obtain scale parameters at edges, with respect to frequency, of the first set of scale parameters.

35. Apparatus of claim 34,

wherein the scale parameter decoder is configured to determine at least a first scale parameter and a last scale parameter of the first set of scale parameters with respect to ascending frequency bands by an extrapolation operation.

36. Apparatus of one of claims 25 to 35,

wherein the scale parameter decoder is configured to perform an interpolation and a subsequent transform from a log-like domain into a linear domain, wherein the log-like domain is a log 2 domain and wherein the linear domain values are calculated using an exponentiation with a base of two.

37. Apparatus of one of claims 25 to 36,

wherein the encoded audio signal comprises information on a global gain for the encoded spectral representation,

wherein the spectrum decoder is configured to dequantize the encoded spectral representation using the global gain, and

wherein the spectral processor is configured to process the dequantized spectral representation or values derived from the dequantized spectral representation by weighting each dequantized spectral value or each value derived from the dequantized spectral representation of a band using the same scale parameter of the first set of scale parameters for the band.

38. Apparatus of one of claims 25 to 37,

wherein the converter is configured

to convert time-subsequent scaled spectral representations;

to synthesis window converted time-subsequent scaled spectral representations, and

to overlap-and-add windowed converted representations to obtain a decoded audio signal.

39. Apparatus of one of claims 25 to 38,

wherein the converter comprises an inverse modified discrete cosine transform (MDCT) converter, or

wherein the spectral processor is configured to multiply spectral values by corresponding scale parameters of the first set of scale parameters, or

wherein the second number is 16 and the first number is 64, or

wherein each scale parameter of the first set is associated with a band, wherein bands corresponding to higher frequencies are broader than bands associated with lower frequencies, so that a scale parameter of the first set of scale parameters associated with a high frequency band is used for weighting a higher number of spectral values compared to a scale parameter associated with a lower frequency band, where the scale parameter associated with the lower frequency band is used for weighting a lower number of spectral values in the low frequency band.

40. Method for decoding an encoded audio signal comprising information on an encoded spectral representation and information on an encoded representation of a second set of scale parameters, comprising:

receiving the encoded signal and extracting the encoded spectral representation and the encoded representation of the second set of scale parameters;

decoding the encoded spectral representation to obtain a decoded spectral representation;

decoding the encoded second set of scale parameters to obtain a first set of scale parameters, wherein the number of scale parameters of the second set is smaller than a number of scale parameters of the first set;

processing the decoded spectral representation using the first set of scale parameters to obtain a scaled spectral representation; and

converting the scaled spectral representation to obtain a decoded audio signal.

41. Computer program for performing, when running a computer or a processor, the method of claim 24 or the method of claim 40.