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 set of scale parameters based on the audio signal;

a spectral processor for processing the spectral representation, or at least part thereof, using the set of scale parameters, or a modified version thereof;

a scale parameter encoder for generating an encoded representation of the scale parameters, or of the modified version of the scale parameters, wherein the scale parameter calculator is configured to calculate an amplitude-related measure for each band of a plurality of bands to obtain a set of amplitude-related measures, the scale parameter calculator being configured to perform a pre-emphasis operation, for each band of the plurality of bands, to the amplitude-related measure, so that low frequency amplitudes are emphasized with respect to high frequency amplitudes according to a tilt value, or according to a pre-emphasis factor, wherein the scale parameter calculator is configured to control the tilt value, or to control the pre-emphasis factor, based on a harmonicity measure of the audio signal, to thereby obtain the set of scale parameters; and

an output interface to generate an encoded audio signal comprising information on an encoded representation of the spectral representation and information on the encoded representation of the scale parameters or of the modified version of the scale parameters.

2. The apparatus of claim 1, configured to obtain the harmonicity measure of the audio signal using an autocorrelation measurement or a normalized autocorrelation of the audio signal.

3. The apparatus of any of the preceding claims, configured to perform the pre-emphasis operation by scaling the tilt value g' by a tilt factor g_{tilt} which is predefined and/or based on the bandwidth.

4. The apparatus of any of the preceding claims, wherein the harmonicity measure of the audio signal is a value between 0 and a value different from zero, so that a lower harmonicity is closer to 0 than a higher harmonicity.

5. The audio encoder of any of the preceding claims, wherein the scale parameter calculator is configured so that a comparatively higher value of the harmonicity measure of the audio signal causes a higher tilt value, or a higher pre-emphasis factor, than a comparatively lower value of the harmonicity measure.

6. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to process the amplitude-related measures:

$$\mathrm{E_p(b)} = \mathrm{E_s(b)} \cdot \mathrm{d}^{\left(\frac{\mathrm{b} \cdot \mathrm{g_{tilt}} \cdot \mathrm{g'}}{\mathrm{h} \cdot \mathrm{nb}}\right)},$$

where $\frac{\mathrm{b} \cdot \mathrm{g_{tilt}} \cdot \mathrm{g'}}{\mathrm{h} \cdot \mathrm{nb}}$ is the tilt value, which is an exponent applied to d, where h is fixed, $\mathrm{g'} \geq 0$ is, or is derived from, the harmonicity measure, $\mathrm{g_{tilt}}$ is pre-defined, b is an index indicating the band out of nb+1 bands in such a way that a higher frequency band has a higher index than a lower frequency band, $\mathrm{E_s(b)}$ is the set of amplitude-related measures and $\mathrm{E_p(b)}$ is a pre-emphasized energy per band.

7. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to process the amplitude-related measures by applying the tilt value to be proportional with at least the harmonicity measure, or the pre-emphasis factor to be obtained by raising a constant number with an exponent proportional with at least the harmonicity measure.

8. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to process the amplitude-related measures by applying the tilt value to be proportional with at least an index which increases with higher bands, or the pre-emphasis factor obtained by raising a constant number with an exponent proportional with at least an index which increases with higher bands.

9. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to process the amplitude-related measures by applying the tilt value, or the pre-emphasis factor, to be dependent on the bandwidth of the spectral representation.

10. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to process the amplitude-related measures by applying the tilt value to be linear with the harmonicity measure, or pre-emphasis factor to be obtained by raising a constant number with an exponent which is linear with the harmonicity measure.

11. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to obtain the amplitude-related measures from a squared magnitude spectrum of the audio signal.

12. The apparatus of claim 11, wherein each amplitude-related measure is obtained as an integral, or a sum, of squared magnitude values of a spectrum of the audio signal.

13. The apparatus of claim 12, wherein the integral, or sum, of the squared magnitude values of the spectrum of the audio signal is not normalized using the width of each band.

14. The apparatus of claim 12 or 13, wherein the integral, or sum, of the squared magnitude values of the spectrum of the audio signal is obtained, for each index, by a sum of a squared modified discrete cosine transform, MDCT, coefficient and a squared modified discrete sine transform, MDST, coefficient.

15. The apparatus of any of the preceding claims, wherein the converter is configured to perform an MDCT transformation and an MDST transformation, to provide MDCT coefficients and MDST coefficients, wherein the amplitude-related measure for each band is obtained as sum of magnitudes of the MDCT coefficients, or a squared version(s) thereof, and magnitudes of the MDST coefficients, or a squared version(s) thereof.

16. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to control the tilt value or the pre-emphasis factor based on a long term predictor, LTP, parameter or on a long term post-filter LTPF parameter as the harmonicity measure of the audio signal.

17. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to control the tilt value or the pre-emphasis factor based on a spectral flatness measure as the harmonicity measure of the audio signal.

18. The apparatus of any of the preceding claims, configured to quantize the harmonicity measure of the audio signal, so as to control the tilt value or the pre-emphasis factor based on quantized version of the harmonicity measure of the audio signal.

19. The apparatus of any of the preceding claims, further comprising a downsampler to downsample the set of scale parameters, which is a first set of scale parameters, to obtain a second set of scale parameters, which is, or is comprised in, the modified version of the first set of scale parameters, the second set of scale parameters having a second number of scale parameters which is lower than a first number of scale parameters of the first set of scale parameters, wherein the scale parameter encoder is configured to generate the encoded representation of the second set of scale parameters as the encoded representation of the modified version of the scale parameters.

20. The apparatus of any of the preceding claims, further comprising a downsampler to downsample the set of scale parameters, which is a first set of scale parameters, to obtain a second set of scale parameters, the second set of scale parameters having a second number of scale parameters which is lower than a first number of scale parameters of the first set of scale parameters,

wherein the spectral processor is configured to process the spectral representation using a third set of scale parameters, which is, or is comprised in, the modified version of scale parameters.

21. The apparatus of claim 20,

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.

22. The apparatus of any of claims 19-21,

wherein the scale parameter calculator is configured to

calculate, for each band of the plurality of bands of the spectral representation, the amplitude-related measures 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.

23. The apparatus of any of claims 19-22,

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.

24. The apparatus of any of claims 19-23, wherein the downsampler is configured to use an average operation among a group of first scale parameters, the group having two or more members.

25. The apparatus of any of claims 19-24,

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

26. The apparatus of any of claims 19-25,

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.

27. The apparatus of any of claims 19-26,

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 third set of scale factors from the second set of quantized scale factors.

28. The apparatus of any of claims 19-27,

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.

29. The apparatus of any of the preceding claims,

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

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

30. The apparatus of any 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 set of scale factors.

31. The apparatus of any of the preceding claims,

wherein the spectral processor is configured to weight spectral values in the spectral representation using the set of scale factors, or modified version thereof, 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.

32. The apparatus of any of the preceding claims,

wherein the converter uses an analysis window 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 or a spectrum of the audio signal.

33. The apparatus of any of the preceding claims,

wherein the converter is configured to apply a modified discrete cosine transform, MDCT, 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 of the plurality of bands, an energy of the band, the calculation comprising squaring spectral lines, adding squared spectral lines, or

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

34. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to obtain the set of amplitude-related measures as a set of energies per bands.

35. The apparatus of any of the preceding claims, wherein the converter is configured to perform a first conversion to obtain a first part of the spectral representation and a second conversion to obtain a second part of the spectral representation, or wherein the converter is configured to perform a single conversion to obtain the spectral representation that has a first part of the spectral representation and a second part of the spectral representation, wherein the first part of the spectral representation is provided to the spectral processor, and the second part of the spectral representation is not processed by the spectral processor, and both the first part of the spectral representation and the second part of the spectral representation are provided to the scale parameter calculator to calculate the set of scale parameters based on both the first part of the spectral representation and the second part of the spectral representation.

36. The apparatus of claim 35, wherein the first part of the spectral representation is formed by MDCT coefficients and the second part of the spectral representation is formed by MDST coefficients, or the first part of the spectral representation is formed by MDST coefficients and the second part of the spectral representation is formed by MDCT coefficients.

37. The apparatus of claim 35 or 36, wherein the scale parameter calculator is configured to obtain the amplitude-related measures from the first part of the spectral representation, squared, summed to the second part of the spectral representation, squared.

38. The apparatus of any of the preceding claims, wherein the scale parameter calculator is configured to obtain the amplitude-related measures from the spectral representation.

39. Method for encoding an audio signal, comprising:

converting the audio signal into a spectral representation;

calculating a set of scale parameters based on the audio signal;

processing the spectral representation, or at least part thereof, using the set of scale parameters, or a modified version thereof;

generating an encoded representation of the scale parameters, or of the modified version of the scale parameters,

wherein calculating includes calculating an amplitude-related measure for each band of a plurality of bands to obtain a set of amplitude-related measures, wherein calculating comprises performing a pre-emphasis operation, for each band of the plurality of bands, to the amplitude-related measure, so that low frequency amplitudes are emphasized with respect to high frequency amplitudes according to a tilt value, or according to a pre-emphasis factor, wherein calculating comprises controlling the tilt value or controlling the pre-emphasis factor based on a harmonicity measure of the audio signal, to thereby obtain the set of scale parameters;

the method comprising generating an encoded audio signal comprising information on an encoded representation of the spectral representation and information on the encoded representation of the scale parameters or of the modified version of the scale parameters.

40. A non-transitory storage unit storing instruction which, when executed by a processor, cause the processor to control or perform the method of claim 39.