Claims

1. An apparatus for encoding audio information, comprising:

a selector for selecting a comfort noise generation mode from two or more comfort noise generation modes depending on a background noise characteristic of an audio input signal, and

an encoding unit for encoding the audio information, wherein the audio information comprises mode information indicating the selected comfort noise generation mode,

wherein a first one of the two or more comfort noise generation modes is a frequency-domain comfort noise generation mode, and wherein the frequency-domain comfort noise generation mode indicates that the comfort noise shall be generated in a frequency domain and that the comfort noise being generated in the frequency domain shall be frequency-to-time converted.

2. An apparatus according to claim 1,

wherein the selector is configured to determine a tilt of a background noise of the audio input signal as the background noise characteristic, and

wherein the selector is configured to select said comfort noise generation mode from two or more comfort noise generation modes depending on the determined tilt.

3. An apparatus according to claim 2,

wherein the apparatus further comprises a noise estimator for estimating a per-band estimate of the background noise for each of a plurality of frequency bands, and

wherein the selector is configured to determine the tilt depending on the estimated background noise of the plurality of frequency bands.

4. An apparatus according to claim 3,

wherein, the noise estimator is configured to determine a low-frequency background noise value indicating a first background noise energy for a first group of the plurality of frequency bands depending on the per-band estimate of the background noise of each frequency band of the first group of the plurality of frequency bands,

wherein the noise estimator is configured to determine a high-frequency background noise value indicating a second background noise energy for a second group of the plurality of frequency bands depending on the per-band estimate of the background noise of each frequency band of the second group of the plurality of frequency bands, wherein at least one frequency band of the first group has a lower centre-frequency than a centre-frequency of at least one frequency band of the second group, and

wherein the selector is configured to determine the tilt depending on the low-frequency background noise value and depending on the high-frequency background noise value.

5. An apparatus according to claim 4,

wherein the noise estimator is configured to determine the low-frequency background noise value L according to

$$L = \frac{1}{I_2 - I_1} \sum_{i=I_1}^{i<I_2} N[i]$$

wherein i indicates an i-th frequency band of the first group of frequency bands, wherein I_1 indicates a first one of the plurality of frequency bands, wherein I_2 indicates a second one of the plurality of frequency bands, and wherein $N[i]$ indicates the energy estimate of the background noise energy of the i-th frequency band,

wherein the noise estimator is configured to determine the high-frequency background noise value H according to

$$H = \frac{1}{I_4 - I_3} \sum_{i=I_3}^{i<I_4} N[i]$$

wherein i indicates an i-th frequency band of the second group of frequency bands, wherein I_3 indicates a third one of the plurality of frequency bands, wherein I_4 indicates a fourth one of the plurality of frequency bands, and wherein $N[i]$ indicates the energy estimate of the background noise energy of the i-th frequency band.

6. An apparatus according to claim 4 or 5,

wherein the selector is configured to determine the tilt T depending on the low frequency background noise value L and depending on the high frequency background noise value H according to the formula

$$T = \frac{L}{H},$$

or according to the formula

$$T = \frac{H}{L},$$

or according to the formula

$$T = L - H,$$

or according to the formula

$$T = H - L.$$

7. An apparatus according to one of claims 2 to 6,

wherein the selector (is configured to determine the tilt as a current short-term tilt value,

wherein the selector is configured to determine a current long-term tilt value depending on the current short-term tilt value and depending on a previous long-term tilt value,

wherein the selector is configured to select one of two or more comfort noise generation modes depending on the current long-term tilt value.

8. An apparatus according to claim 7,

wherein the selector is configured to determine the current long-term tilt value T_{cLT} according to the formula:

$$T_{cLT} = \alpha\, T_{pLT} + (1 - \alpha)\, T\ ,$$

wherein T is the current short-term tilt value,

wherein T_{pLT} is said previous long-term tilt value, and

wherein α is a real number with $0 < \alpha < 1$.

9. An apparatus according to claim 7 or 8,

wherein a first one of the two or more comfort noise generation modes is a frequency-domain comfort noise generation mode,

wherein a second one of the two or more comfort noise generation modes is a linear-prediction-domain comfort noise generation mode,

wherein the selector is configured to select the frequency-domain comfort noise generation mode, if a previously selected generation mode, being previously selected by the selector, is the linear-prediction-domain comfort noise generation mode and if the current long-term tilt value is greater than a first threshold value, and

wherein the selector is configured to select the linear-prediction-domain comfort noise generation mode, if the previously selected generation mode, being previously selected by the selector, is the frequency-domain comfort noise generation mode and if the current long-term tilt value is smaller than a second threshold value.

10. An apparatus for generating an audio output signal based on received encoded audio information, comprising:

a decoding unit for decoding encoded audio information to obtain mode information being encoded within the encoded audio information, wherein the mode information indicates an indicated comfort noise generation mode of two or more comfort noise generation modes, and

a signal processor for generating the audio output signal by generating, depending on the indicated comfort noise generation mode, comfort noise,

wherein a first one of the two or more comfort noise generation modes is a frequency-domain comfort noise generation mode, and

wherein the signal processor is configured, if the indicated comfort noise generation mode is the frequency-domain comfort noise generation mode, to generate the comfort noise in a frequency domain and by conducting a frequency-to-time conversion of the comfort noise being generated in the frequency domain.

11. An apparatus according to claim 10,

wherein a second one of the two or more comfort noise generation modes is a linear-prediction-domain comfort noise generation mode, and

wherein the signal processor is configured, if the indicated comfort noise generation mode is the linear-prediction-domain comfort noise generation mode, to generate the comfort noise by employing a linear prediction filter.

12. A system comprising:

an apparatus according to one of claims 1 to 9 for encoding audio information, and

an apparatus according to claim 10 or 11 for generating an audio output signal based on received encoded audio information,

wherein the selector of the apparatus according to one of claims 1 to 9 is configured to select a comfort noise generation mode from two or more comfort noise generation modes depending on a background noise characteristic of an audio input signal,

wherein the encoding unit of the apparatus according to one of claims 1 to 9 is configured to encode the audio information, comprising mode information indicating the selected comfort noise generation mode as an indicated comfort noise generation mode, to obtain encoded audio information,

wherein the decoding unit of the apparatus according to claim 10 or 11 is configured to receive the encoded audio information, and is furthermore configured to decode the encoded audio information to obtain the mode information being encoded within the encoded audio information, and

wherein the signal processor of the apparatus according to claim 10 or 11 is configured to generate the audio output signal by generating, depending on the indicated comfort noise generation mode, comfort noise.

13. A method for encoding audio information, comprising:

selecting a comfort noise generation mode from two or more comfort noise generation modes depending on a background noise characteristic of an audio input signal, and

encoding the audio information, wherein the audio information comprises mode information indicating the selected comfort noise generation mode,

wherein a first one of the two or more comfort noise generation modes is a frequency-domain comfort noise generation mode, and wherein the frequency-domain comfort noise generation mode indicates that the comfort noise shall be generated in a frequency domain and that the comfort noise being generated in the frequency domain shall be frequency-to-time converted.

14. A method for generating an audio output signal based on received encoded audio information, comprising:

decoding encoded audio information to obtain mode information being encoded within the encoded audio information, wherein the mode information indicates an indicated comfort noise generation mode of two or more comfort noise generation modes, and

generating the audio output signal by generating, depending on the indicated comfort noise generation mode, comfort noise,

wherein a first one of the two or more comfort noise generation modes is a frequency-domain comfort noise generation mode, and

wherein, if the indicated comfort noise generation mode is the frequency-domain comfort noise generation mode, the comfort noise is generated in a frequency domain and a frequency-to-time conversion of the comfort noise being generated in the frequency domain is conducted.

15. A computer program for implementing the method of claim 13 or 14 when being executed on a computer or signal processor.

Claims

1. An apparatus for encoding audio information, comprising:

a selector (110) for selecting a comfort noise generation mode from two or more comfort noise generation modes depending on a background noise characteristic of an audio input signal, and

an encoding unit (120) for encoding the audio information, wherein the audio information comprises mode information indicating the selected comfort noise generation mode.

2. An apparatus according to claim 1,

wherein the selector (110) is configured to determine a tilt of a background noise of the audio input signal as the background noise characteristic, and

wherein the selector (110) is configured to select said comfort noise generation mode from two or more comfort noise generation modes depending on the determined tilt.

3. An apparatus according to claim 2,

wherein the apparatus further comprises a noise estimator (105) for estimating a per-band estimate of the background noise for each of a plurality of frequency bands, and

wherein the selector (110) is configured to determine the tilt depending on the estimated background noise of the plurality of frequency bands.

4. An apparatus according to claim 3,

wherein, the noise estimator (105) is configured to determine a low-frequency background noise value indicating a first background noise energy for a first group of the plurality of frequency bands depending on the per-band estimate of the background noise of each frequency band of the first group of the plurality of frequency bands,

wherein the noise estimator (105) is configured to determine a high-frequency background noise value indicating a second background noise energy for a second group of the plurality of frequency bands depending on the per-band estimate of the background noise of each frequency band of the second group of the plurality of frequency bands, wherein at least one frequency band of the first group has a lower centre-frequency than a centre-frequency of at least one frequency band of the second group, and

wherein the selector (110) is configured to determine the tilt depending on the low-frequency background noise value and depending on the high-frequency background noise value.

5. An apparatus according to claim 4,

wherein the noise estimator (105) is configured to determine the low-frequency background noise value L according to

$$L = \frac{1}{I_2 - I_1} \sum_{i=I_1}^{i<I_2} N[i]$$

wherein i indicates an i-th frequency band of the first group of frequency bands, wherein I_1 indicates a first one of the plurality of frequency bands, wherein I_2 indicates a second one of the plurality of frequency bands, and wherein $N[i]$ indicates the energy estimate of the background noise energy of the i-th frequency band,

wherein the noise estimator (105) is configured to determine the high-frequency background noise value H according to

$$H = \frac{1}{I_4 - I_3} \sum_{i=I_3}^{i<I_4} N[i]$$

wherein i indicates an i-th frequency band of the second group of frequency bands, wherein I_3 indicates a third one of the plurality of frequency bands, wherein I_4 indicates a fourth one of the plurality of frequency bands, and wherein $N[i]$ indicates the energy estimate of the background noise energy of the i-th frequency band.

6. An apparatus according to claim 4 or 5,

wherein the selector (110) is configured to determine the tilt T depending on the low frequency background noise value L and depending on the high frequency background noise value H according to the formula

$$T = \frac{L}{H} \quad ,$$

or according to the formula

$$T = \frac{H}{L} \quad ,$$

or according to the formula

$$T = L - H \quad ,$$

or according to the formula

$$T = H - L \quad .$$

7. An apparatus according to one of claims 2 to 6,

wherein the selector (110) is configured to determine the tilt as a current short-term tilt value (T),

wherein the selector (110) is configured to determine a current long-term tilt value depending on the current short-term tilt value and depending on a previous long-term tilt value,

wherein the selector (110) is configured to select one of two or more comfort noise generation modes depending on the current long-term tilt value.

8. An apparatus according to claim 7,

wherein the selector (110) is configured to determine the current long-term tilt value T_{cLT} according to the formula:

$$T_{cLT} = \alpha\, T_{pLT} + (1 - \alpha)\, T \ ,$$

wherein T is the current short-term tilt value,

wherein T_{pLT} is said previous long-term tilt value, and

wherein α is a real number with $0 < \alpha < 1$.

9. An apparatus according to claim 7 or 8,

wherein a first one of the two or more comfort noise generation modes is a frequency-domain comfort noise generation mode,

wherein a second one of the two or more comfort noise generation modes is a linear-prediction-domain comfort noise generation mode,

wherein the selector (110) is configured to select the frequency-domain comfort noise generation mode, if a previously selected generation mode, being previously selected by the selector (110), is the linear-prediction-domain comfort noise generation mode and if the current long-term tilt value is greater than a first threshold value, and

wherein the selector (110) is configured to select the linear-prediction-domain comfort noise generation mode, if the previously selected generation mode, being previously selected by the selector (110), is the frequency-domain comfort noise generation mode and if the current long-term tilt value is smaller than a second threshold value.

10. An apparatus for generating an audio output signal based on received encoded audio information, comprising:

a decoding unit (210) for decoding encoded audio information to obtain mode information being encoded within the encoded audio information, wherein the mode information indicates an indicated comfort noise generation mode of two or more comfort noise generation modes, and

a signal processor (220) for generating the audio output signal by generating, depending on the indicated comfort noise generation mode, comfort noise.

11. An apparatus according to claim 10,

wherein a first one of the two or more comfort noise generation modes is a frequency-domain comfort noise generation mode, and

wherein the signal processor is configured, if the indicated comfort noise generation mode is the frequency-domain comfort noise generation mode, to generate the comfort noise in a frequency domain and by conducting a frequency-to-time conversion of the comfort noise being generated in the frequency domain.

12. An apparatus according to claim 10 or 11,

wherein a second one of the two or more comfort noise generation modes is a linear-prediction-domain comfort noise generation mode, and

wherein the signal processor (220) is configured, if the indicated comfort noise generation mode is the linear-prediction-domain comfort noise generation mode, to generate the comfort noise by employing a linear prediction filter.

13. A system comprising:

an apparatus (100) according to one of claims 1 to 9 for encoding audio information, and

an apparatus (200) according to one of claims 10 to 12 for generating an audio output signal based on received encoded audio information,

wherein the selector (110) of the apparatus (100) according to one of claims 1 to 9 is configured to select a comfort noise generation mode from two or more comfort noise generation modes depending on a background noise characteristic of an audio input signal,

wherein the encoding unit (120) of the apparatus (100) according to one of claims 1 to 9 is configured to encode the audio information, comprising mode information

indicating the selected comfort noise generation mode as an indicated comfort noise generation mode, to obtain encoded audio information,

wherein the decoding unit (210) of the apparatus (200) according to one of claims 10 to 12 is configured to receive the encoded audio information, and is furthermore configured to decode the encoded audio information to obtain the mode information being encoded within the encoded audio information, and

wherein the signal processor (220) of the apparatus (200) according to one of claims 10 to 12 is configured to generate the audio output signal by generating, depending on the indicated comfort noise generation mode, comfort noise.

14. A method for encoding audio information, comprising:

selecting a comfort noise generation mode from two or more comfort noise generation modes depending on a background noise characteristic of an audio input signal, and

encoding the audio information, wherein the audio information comprises mode information indicating the selected comfort noise generation mode.

15. A method for generating an audio output signal based on received encoded audio information, comprising:

decoding encoded audio information to obtain mode information being encoded within the encoded audio information, wherein the mode information indicates an indicated comfort noise generation mode of two or more comfort noise generation modes, and

generating the audio output signal by generating, depending on the indicated comfort noise generation mode, comfort noise.

16. A computer program for implementing the method of claim 14 or 15 when being executed on a computer or signal processor.