Claims

1. Apparatus for generating a frequency enhancement signal (130), comprising:

a signal generator (200) for generating an enhancement signal from a core signal (120, 110), the enhancement signal comprising an enhancement frequency range not included in the core signal, wherein a current time portion (320, 340) of the enhancement signal or the core signal comprises subband signals for a plurality of subbands;

a controller (800) for calculating the same smoothing information (802) for the plurality of subband signals of the enhancement frequency range or the core signal, and

wherein the signal generator (200) is configured for smoothing the plurality of subband signals of the enhancement frequency range or the core signal using the same smoothing information (802), wherein the controller (800) is configured to calculate the smoothing information (802) using a combined energy of the plurality of subband signals of the core signal and the frequency enhancement signal or using only the frequency enhancement signal of the current time portion, and

using an average energy of the plurality of subband signals of the core signal and the frequency enhancement signal or of the core signal only of one or more earlier time portions preceding the current time portion or one or more later time portions following the current time portion.

2. Apparatus of claim 1,

wherein the smoothing information 802 is a single correction factor (1402b, 1401b, 1400b) for the plurality of subband signals of the enhancement frequency range, and wherein the signal generator (200) is configured to apply the correction factor to the plurality of subband signals of the enhancement frequency range.

3. Apparatus in accordance with one of the preceding claims,

further comprising a filterbank or a provider (100) for providing the plurality of subband signals of the core signal for a plurality of time-subsequent filterbank slots (340),

wherein the signal generator (200) is configured to derive the plurality of subband signals of the enhancement frequency range for the plurality of time-subsequent filterbank slots (340) using the plurality of subband signals of the core signal (120), and

wherein the controller (800) is configured to calculate an individual smoothing information for each filterbank slot (340).

4. Apparatus in accordance with one of the preceding claims,

wherein the controller (800) is configured to calculate a smoothing intensity control value (1040) based on the core signal or the frequency enhancement signal of the current time portion and one or more preceding time portions, and

wherein the controller (800) is configured to calculate the smoothing information (802) using the smoothing control value (1060) in such a way that the smoothing intensity varies dependent on a difference between an energy of the core signal or the frequency enhancement signal in a current time portion and an average energy in the core signal or the frequency enhancement signal of one or more preceding time portions.

5. Apparatus in accordance with one of the preceding claims,

wherein the controller (800) is configured to calculate the smoothing information (802) based on the following equation:

$$currFac = \sqrt{\frac{a\,Ecurr_t + (1-a)Eavg_t}{Ecurr_t}}$$

wherein $Ecurr_t$ is an energy in the current time portion, wherein $Eavg_t$ is an average of one or more preceding or later time portions, and wherein a is a parameter controlling the smoothing intensity, and

wherein the signal generator is configured to apply the smoothing information on each subband sample of the plurality of subbands of the frequency enhanced signal.

6. Apparatus in accordance with one of the preceding claims, wherein the signal generator (200) is configured for shaping (204) the core signal or the enhancement signal in addition to smoothing.

7. Apparatus of claim 6,

wherein the current time portion and at least one further time portion form a frame (340),

wherein the signal generator (200) is configured for applying the same shaping information for a whole frame (340), and wherein the signal generator (200) is configured for smoothing using an individual smoothing information (802) for each time portion (340) within the frame (320).

8. Apparatus in accordance with one of the preceding claims,

wherein the signal generator (200) is configured for performing an energy limitation on the frequency enhancement signal or the core signal in order to make sure that a signal obtained by a synthesis filterbank (300) is so that an energy of a higher band is, at the most, equal to an energy in a lower band or greater than, at the most, by a predefined threshold of 3dB or less.

9. Apparatus of in accordance with one of the preceding claims,

wherein the signal generator (200) is configured for mirroring (202) a single subband signal of the core signal or the plurality of subband signals of the core signal when calculating the plurality of subband signals of the frequency enhancement signal.

10. Method of generating a frequency enhancement signal (130), comprising:

generating (200) an enhancement signal from a core signal (120, 110), the enhancement signal comprising an enhancement frequency range not included in the core signal, wherein a current time portion (320, 340) of the enhancement signal or the core signal comprises subband signals for a plurality of subbands;

calculating (800) the same smoothing information (802) for the plurality of subband signals of the enhancement frequency range or the core signal, and

wherein the generating (200) comprises smoothing the plurality of subband signals of the enhancement frequency range or the core signal using the same smoothing information (802),

wherein the calculating (800) comprises calculating the smoothing information (802) using a combined energy of the plurality of subband signals of the core signal and the frequency enhancement signal or using only the frequency enhancement signal of the current time portion, and

using an average energy of the plurality of subband signals of the core signal and the frequency enhancement signal or of the core signal only of one or more earlier time portions preceding the current time portion or one or more later time portions following the current time portion.

11. System for processing audio signals, comprising:

an encoder (1500) for generating an encoded core signal (110); and

an apparatus for generating a frequency enhancement signal of any one of claims 1 to 9.

12. Method of processing audio signals, comprising:

generating (1500) an encoded core signal (110); and

generating a frequency enhancement signal using a method of claim 10.

13. Computer program for performing, when running on a computer or a processor, the method of claim 10 or claim 12.

Claims

1. Apparatus for generating a frequency enhancement signal, comprising:

a signal generator for generating an enhancement signal from a core signal, the enhancement signal comprising an enhancement frequency range not included in the core signal, wherein a current time portion of the enhancement signal or the core signal comprises subband signals for a plurality of subbands;

a controller for calculating the same smoothing information for the plurality of subband signals of the enhancement frequency range or the core signal, and

wherein the signal generator is configured for smoothing the plurality of subband signals of the enhancement frequency range or the core signal using the same smoothing information, wherein the controller is configured to calculate the smoothing information using a combined energy of the plurality of subband signals of the core signal and the frequency enhancement signal or using only the frequency enhancement signal of the current time portion, and

using an average energy of the plurality of subband signals of the core signal and the frequency enhancement signal or of the core signal only of one or more earlier time portions preceding the current time portion or one or more later time portions following the current time portion.

2. Apparatus of claim 1,

wherein the smoothing information is a single correction factor for the plurality of subband signals of the enhancement frequency range, and wherein the signal generator is configured to apply the correction factor to the plurality of subband signals of the enhancement frequency range.

3. Apparatus in accordance with one of the preceding claims,

further comprising a filterbank or a provider for providing the plurality of subband signals of the core signal for a plurality of time-subsequent filterbank slots,

wherein the signal generator is configured to derive the plurality of subband signals of the enhancement frequency range for the plurality of time-subsequent filterbank slots using the plurality of subband signals of the core signal, and

wherein the controller is configured to calculate an individual smoothing information for each filterbank slot.

4. Apparatus in accordance with one of the preceding claims,

wherein the controller is configured to calculate a smoothing intensity control value based on the core signal or the frequency enhancement signal of the current time portion and one or more preceding time portions, and

wherein the controller is configured to calculate the smoothing information using the smoothing control value in such a way that the smoothing intensity varies dependent on a difference between an energy of the core signal or the frequency enhancement signal in a current time portion and an average energy in the core signal or the frequency enhancement signal of one or more preceding time portions.

5. Apparatus in accordance with one of the preceding claims,

wherein the controller is configured to calculate the smoothing information based on the following equation:

$$currFac = \sqrt{\frac{a\ Ecurr_t + (1-a) Eavg_t}{Ecurr_t}},$$

wherein $Ecurr_t$ is an energy in the current time portion, wherein $Eavg_t$ is an average of one or more preceding or later time portions, and wherein a is a parameter controlling the smoothing intensity, and

wherein the signal generator is configured to apply the smoothing information on each subband sample of the plurality of subbands of the frequency enhanced signal.

6. Apparatus in accordance with one of the preceding claims, wherein the signal generator is configured for shaping the core signal or the enhancement signal in addition to smoothing.

7. Apparatus of claim 6,

wherein the current time portion and at least one further time portion form a frame,

wherein the signal generator is configured for applying the same shaping information for a whole frame, and wherein the signal generator is configured for smoothing using an individual smoothing information for each time portion within the frame.

8. Apparatus in accordance with one of the preceding claims,

wherein the signal generator is configured for performing an energy limitation on the frequency enhancement signal or the core signal in order to make sure that a signal obtained by a synthesis filterbank is so that an energy of a higher band is, at the most, equal to an energy in a lower band or greater than, at the most, by a predefined threshold of 3dB or less.

9. Apparatus of in accordance with one of the preceding claims,

wherein the signal generator is configured for mirroring a single subband signal of the core signal or the plurality of subband signals of the core signal when calculating the plurality of subband signals of the frequency enhancement signal.

10. Method of generating a frequency enhancement signal, comprising:

generating an enhancement signal from a core signal, the enhancement signal comprising an enhancement frequency range not included in the core signal, wherein a current time portion of the enhancement signal or the core signal comprises subband signals for a plurality of subbands;

calculating the same smoothing information for the plurality of subband signals of the enhancement frequency range or the core signal, and

wherein the generating comprises smoothing the plurality of subband signals of the enhancement frequency range or the core signal using the same smoothing information,

wherein the calculating comprises calculating the smoothing information using a combined energy of the plurality of subband signals of the core signal and the frequency enhancement signal or using only the frequency enhancement signal of the current time portion, and

using an average energy of the plurality of subband signals of the core signal and the frequency enhancement signal or of the core signal only of one or more earlier time portions preceding the current time portion or one or more later time portions following the current time portion.

11. System for processing audio signals, comprising:

an encoder for generating an encoded core signal; and

an apparatus for generating a frequency enhancement signal of any one of claims 1 to 9.

12. Method of processing audio signals, comprising:

generating an encoded core signal; and

generating a frequency enhancement signal using a method of claim 10.

13. Computer program for performing, when running on a computer or a processor, the method of claim 10 or claim 12.