Claims

1. A decoder for generating a frequency enhanced audio signal (120), comprising:

a feature extractor (104) for extracting a feature from a core signal (100);

a side information extractor (110) for extracting a selection side information associated with the core signal;

a parameter generator (108) for generating a parametric representation for estimating a spectral range of the frequency enhanced audio signal (120) not defined by the core signal (100), wherein the parameter generator (108) is configured to provide a number of parametric representation alternatives (702, 704, 706, 708) in response to the feature (112), and wherein the parameter generator (108) is configured to select one of the parametric representation alternatives as the parametric representation in response to the selection side information (712 to 718); and

a signal estimator (118) for estimating the frequency enhanced audio signal (120) using the parametric representation selected.

2. Decoder of claim 1, further comprising:

an input interface (110) for receiving an encoded input signal (200) comprising an encoded core signal (201) and the selection side information (114); and

a core decoder (124) for decoding the encoded core signal to obtain the core signal (100).

3. Decoder of one of claims 1 or 2,

wherein the selection side information (712, 714, 716, 718) comprises a number N of bits per frame (800, 806, 812) of the core signal (100),

wherein the parameter generator (108) is configured to provide, at the most, an amount of parametric representation alternatives (702 to 708) being equal to 2^N.

4. Decoder of one of the preceding claims, wherein the parameter generator (108) is configured to use, when selecting one of the parametric representation alternatives, a predefined order of the parametric representation alternatives or an encoder-signaled order of the parametric representation alternatives.

5. Decoder of one of the preceding claims, wherein the parameter generator (108) is configured to provide an envelope representation as the parametric representation,

wherein the selection side information (114) indicates one of a plurality of different sibilants or fricatives, and

wherein the parameter generator (108) is configured for providing the envelope representation identified by the selection side information.

6. Decoder of one of the preceding claims,

in which the signal estimator (118) comprises an interpolator (900) for interpolating the core signal (100), and

wherein the feature extractor (104) is configured to extract the feature from the core signal (100) not being interpolated.

7. Decoder of one of the preceding claims,

wherein the signal estimator (118) comprises:

an analysis filter (910) for analyzing the core signal or an interpolated core signal to obtain an excitation signal;

an excitation extension block (912) for generating an enhanced excitation signal having the spectral range not included in the core signal (100); and

a synthesis filter (914) for filtering the extended excitation signal;

wherein the analysis filter (910) or the synthesis filter (914) are determined by the parametric representation selected.

8. Decoder of one of the preceding claims,

wherein the signal estimator (118) comprises a spectral bandwidth extension processor for generating an extended spectral band corresponding to the spectral range not included in the core signal using at least a spectral band of the core signal and the parametric representation,

wherein the parametric representation comprises parameters for at least one of a spectral envelope adjustment (1060), a noise floor addition (1020), an inverse filter (1040) and an addition of missing tones 1080),

wherein the parameter generator is configured to provide, for a feature, a plurality of parametric representation alternatives, each parametric representation alternative having parameters for at least one of a spectral envelope adjustment (1060), a noise floor addition (1020), an inverse filtering (1040), and addition of missing tones (1080).

9. Decoder of one of the preceding claims, further comprising:

a voice activity detector or a speech/non-speech discriminator (500),

wherein the signal estimator (118) is configured to estimate the frequency enhanced signal using the parametric representation only when the voice activity detector or the speech/non-speech detector (500) indicates a voice activity or a speech signal.

10. Decoder of claim 9,

wherein the signal estimator (118) is configured to switch (502, 504) from one frequency enhancement procedure (511) to a different frequency enhancement procedure (513) or to use different parameters (514) extracted from an encoded signal, when the voice activity detector or speech/non-speech detector (500) indicates a non-speech signal or a signal not having a voice activity.

11. Decoder of one of the preceding claims, further comprising:

a signal classifier (606) for classifying a frame of the core signal (100),

wherein the parameter generator (108) is configured to use a first statistical model (600), when a signal frame is classified to belong to a first class of signals and to use a second different statistical model (602), when the frame is classified into a second different class of signals.

12. Decoder of one of the preceding claims,

wherein the statistical model is configured to provide, in response to a feature, a plurality of alternative of parametric representations (702 to 708),

wherein each alternative parametric representation has a probability being identical to a probability of a different alternative parametric representation or being different from the probability of the alternative parametric representation by less than 10 % of the highest probability.

13. Decoder of one of the preceding claims,

wherein the selection side information is only included in a frame (800) of the encoded signal, when the parameter generator (108) provides a plurality of parametric representation alternatives, and

wherein the selection side information is not included in a different frame (812) of the encoded audio signal in which the parameter generator (108) provides only a single parametric representation alternative in response to the feature (112).

14. Decoder of one of the preceding claims,

wherein the parameter generator (108) is configured to receive parametric frequency enhancement information (1100) associated with the core signal (100), the parametric frequency enhancement information comprising a group of individual parameters,

wherein the parameter generator (108) is configured to provide the selected parametric representation in addition to the parametric frequency enhancement information,

wherein the selected parametric representation comprises a parameter not included in the group of individual parameters or a parameter change value for changing a parameter in the group of individual parameters, and

wherein the signal estimator (118) is configured for estimating the frequency enhanced audio signal using the selected parametric representation and the parametric frequency enhancement information (1100).

15. Encoder for generating an encoded signal (1212), comprising:

a core encoder (1200) for encoding an original signal (1206) to obtain an encoded audio signal (1208) having information on a smaller number of frequency bands compared to an original signal (1206);

a selection side information generator (1202) for generating selection side information (1210) indicating a defined parametric representation alternative (702-708) provided by a statistical model in response to a feature (112) extracted from the original signal (1206) or from the encoded audio signal (1208) or from a decoded version of the encoded audio signal (1208); and

an output interface (1204) for outputting the encoded signal (1212), the encoded signal comprising the encoded audio signal (1208) and the selection side information (1210).

16. Encoder of claim 15, further comprising:

a core decoder (1300) for decoding the encoded audio signal (1208) to obtain a decoded core signal,

wherein the selection side information generator (1202) comprises:

a feature extractor (1302) for extracting a feature from the decoded core signal;

a statistical model processor (1304) for generating a number of parametric representation alternatives (702 to 708) for estimating a spectral range of a frequency enhanced signal not defined by the decoded core signal;

a signal estimator (1306) for estimating frequency enhanced audio signals for the parametric representation alternatives (1305); and

a comparator (1308) for comparing the frequency enhanced audio signals (1307) to the original signal (1206),

wherein the selection side information generator (1202) is configured to set the selection side information (1210) such that the selection side information uniquely defines the parametric representation alternative resulting in a frequency enhanced audio signal best matching with the original signal (1206) under an optimization criterion.

17. Encoder of claim 15,

wherein the original signal comprises associated meta information describing a sequence of acoustical information for a sequence of samples of the original audio signal,

wherein the selection side information generator (1202) comprises a metadata extractor (1400) for extracting the sequence of meta information; and

a metadata translator (1402) for translating the sequence of meta information into a sequence of the selection side information (1210).

18. Encoder of claim 15 or 16,

wherein the selection side information generator (1202) is configured to generate a selection side information comprising a number N of bits per frame (800, 806, 812) of the encoded audio signal,

wherein the statistical model is so that, at the most, an amount of parametric representation alternatives being equal to 2^N is provided.

19. Encoder of one of claims 15 to 17,

wherein the output interface (1204) is configured to only include the selection side information (1210) into the encoded signal (1212), when a plurality of parametric representation alternatives are provided by the statistical model and to not include any selection side information into a frame for the encoded audio signal (1208), in which the statistical model is operative to only provide a single parametric representation in response to the feature.

20. A method for generating a frequency enhanced audio signal (120), comprising:

extracting (104) a feature from a core signal (100);

extracting (110) a selection side information associated with the core signal;

generating (108) a parametric representation for estimating a spectral range of the frequency enhanced audio signal (120) not defined by the core signal (100), wherein a number of parametric representation alternatives (702, 704, 706, 708) is provided in response to the feature (112), and wherein one of the parametric representation alternatives is selected as the parametric representation in response to the selection side information (712 to 718); and

estimating (118) the frequency enhanced audio signal (120) using the parametric representation selected.

21. Method of generating an encoded signal (1212), comprising:

encoding (1200) an original signal (1206) to obtain an encoded audio signal (1208) having information on a smaller number of frequency bands compared to an original signal (1206);

generating (1202) selection side information (1210) indicating a defined parametric representation alternative (702-708) provided by a statistical model in response to

a feature (112) extracted from the original signal (1206) or from the encoded audio signal (1208) or from a decoded version of the encoded audio signal (1208); and

outputting (1204) the encoded signal (1212), the encoded signal comprising the encoded audio signal (1208) and the selection side information (1210).

22. Computer program for performing, when running on a computer or a processor, the method of claim 20 or the method of claim 21.

23. Encoded signal (1212) comprising:

an encoded audio signal (1208); and

selection side information (1210) indicating a defined parametric representation alternative provided by a statistical model in response to a feature extracted from an original signal or from the encoded audio signal or from a decoded version of the encoded audio signal.

Claims

1. A decoder for generating a frequency enhanced audio signal, comprising:

a feature extractor for extracting a feature from a core signal;

a side information extractor for extracting a selection side information associated with the core signal;

a parameter generator for generating a parametric representation for estimating a spectral range of the frequency enhanced audio signal not defined by the core signal, wherein the parameter generator is configured to provide a number of parametric representation alternatives in response to the feature, and wherein the parameter generator is configured to select one of the parametric representation alternatives as the parametric representation in response to the selection side information; and

a signal estimator for estimating the frequency enhanced audio signal using the parametric representation selected.

2. Decoder of claim 1, further comprising:

an input interface for receiving an encoded input signal comprising an encoded core signal and the selection side information; and

a core decoder for decoding the encoded core signal to obtain the core signal.

3. Decoder of one of claims 1 or 2,

wherein the selection side information comprises a number N of bits per frame of the core signal,

wherein the parameter generator is configured to provide, at the most, an amount of parametric representation alternatives being equal to 2^N.

4. Decoder of one of the preceding claims, wherein the parameter generator is configured to use, when selecting one of the parametric representation alternatives, a predefined order of the parametric representation alternatives or an encoder-signaled order of the parametric representation alternatives.

5. Decoder of one of the preceding claims, wherein the parameter generator is configured to provide an envelope representation as the parametric representation,

wherein the selection side information indicates one of a plurality of different sibilants or fricatives, and

wherein the parameter generator is configured for providing the envelope representation identified by the selection side information.

6. Decoder of one of the preceding claims,

in which the signal estimator comprises an interpolator for interpolating the core signal, and

wherein the feature extractor is configured to extract the feature from the core signal not being interpolated.

7. Decoder of one of the preceding claims,

wherein the signal estimator comprises:

an analysis filter for analyzing the core signal or an interpolated core signal to obtain an excitation signal;

an excitation extension block for generating an enhanced excitation signal having the spectral range not included in the core signal; and

a synthesis filter for filtering the extended excitation signal;

wherein the analysis filter or the synthesis filter are determined by the parametric representation selected.

8. Decoder of one of the preceding claims,

wherein the signal estimator comprises a spectral bandwidth extension processor for generating an extended spectral band corresponding to the spectral range not included in the core signal using at least a spectral band of the core signal and the parametric representation,

wherein the parametric representation comprises parameters for at least one of a spectral envelope adjustment, a noise floor addition, an inverse filter and an addition of missing tones,

wherein the parameter generator is configured to provide, for a feature, a plurality of parametric representation alternatives, each parametric representation alternative having parameters for at least one of a spectral envelope adjustment, a noise floor addition, an inverse filtering, and addition of missing tones.

9. Decoder of one of the preceding claims, further comprising:

a voice activity detector or a speech/non-speech discriminator,

wherein the signal estimator is configured to estimate the frequency enhanced signal using the parametric representation only when the voice activity detector or the speech/non-speech detector indicates a voice activity or a speech signal.

10. Decoder of claim 9,

wherein the signal estimator is configured to switch from one frequency enhancement procedure to a different frequency enhancement procedure or to use different parameters extracted from an encoded signal, when the voice activity detector or speech/non-speech detector indicates a non-speech signal or a signal not having a voice activity.

11. Decoder of one of the preceding claims, further comprising:

a signal classifier for classifying a frame of the core signal,

wherein the parameter generator is configured to use a first statistical model, when a signal frame is classified to belong to a first class of signals and to use a second different statistical model, when the frame is classified into a second different class of signals.

12. Decoder of one of the preceding claims,

wherein the statistical model is configured to provide, in response to a feature, a plurality of alternative of parametric representations,

wherein each alternative parametric representation has a probability being identical to a probability of a different alternative parametric representation or being different from the probability of the alternative parametric representation by less than 10 % of the highest probability.

13. Decoder of one of the preceding claims,

wherein the selection side information is only included in a frame of the encoded signal, when the parameter generator provides a plurality of parametric representation alternatives, and

wherein the selection side information is not included in a different frame of the encoded audio signal in which the parameter generator provides only a single parametric representation alternative in response to the feature.

14. Decoder of one of the preceding claims,

wherein the parameter generator is configured to receive parametric frequency enhancement information associated with the core signal, the parametric frequency enhancement information comprising a group of individual parameters,

wherein the parameter generator is configured to provide the selected parametric representation in addition to the parametric frequency enhancement information,

wherein the selected parametric representation comprises a parameter not included in the group of individual parameters or a parameter change value for changing a parameter in the group of individual parameters, and

wherein the signal estimator is configured for estimating the frequency enhanced audio signal using the selected parametric representation and the parametric frequency enhancement information.

15. Encoder for generating an encoded signal, comprising:

a core encoder for encoding an original signal to obtain an encoded audio signal having information on a smaller number of frequency bands compared to an original signal;

a selection side information generator for generating selection side information indicating a defined parametric representation alternative provided by a statistical model in response to a feature extracted from the original signal or from the encoded audio signal or from a decoded version of the encoded audio signal; and

an output interface for outputting the encoded signal, the encoded signal comprising the encoded audio signal and the selection side information.

16. Encoder of claim 15, further comprising:

a core decoder for decoding the encoded audio signal to obtain a decoded core signal,

wherein the selection side information generator comprises:

a feature extractor for extracting a feature from the decoded core signal;

a statistical model processor for generating a number of parametric representation alternatives for estimating a spectral range of a frequency enhanced signal not defined by the decoded core signal;

a signal estimator for estimating frequency enhanced audio signals for the parametric representation alternatives; and

a comparator for comparing the frequency enhanced audio signals to the original signal,

wherein the selection side information generator is configured to set the selection side information such that the selection side information uniquely defines the parametric representation alternative resulting in a frequency enhanced audio signal best matching with the original signal under an optimization criterion.

17. Encoder of claim 15,

wherein the original signal comprises associated meta information describing a sequence of acoustical information for a sequence of samples of the original audio signal,

wherein the selection side information generator comprises a metadata extractor for extracting the sequence of meta information; and

a metadata translator for translating the sequence of meta information into a sequence of the selection side information.

18. Encoder of claim 15 or 16,

wherein the selection side information generator is configured to generate a selection side information comprising a number N of bits per frame of the encoded audio signal,

wherein the statistical model is so that, at the most, an amount of parametric representation alternatives being equal to 2^N is provided.

19. Encoder of one of claims 15 to 17,

wherein the output interface is configured to only include the selection side information into the encoded signal, when a plurality of parametric representation alternatives are provided by the statistical model and to not include any selection side information into a frame for the encoded audio signal, in which the statistical model is operative to only provide a single parametric representation in response to the feature.

20. A method for generating a frequency enhanced audio signal, comprising:

extracting a feature from a core signal;

extracting a selection side information associated with the core signal;

generating a parametric representation for estimating a spectral range of the frequency enhanced audio signal not defined by the core signal, wherein a number of parametric representation alternatives is provided in response to the feature, and wherein one of the parametric representation alternatives is selected as the parametric representation in response to the selection side information; and

estimating the frequency enhanced audio signal using the parametric representation selected.

21. Method of generating an encoded signal, comprising:

encoding an original signal to obtain an encoded audio signal having information on a smaller number of frequency bands compared to an original signal;

generating selection side information indicating a defined parametric representation alternative provided by a statistical model in response to

a feature extracted from the original signal or from the encoded audio signal or from a decoded version of the encoded audio signal; and

outputting the encoded signal, the encoded signal comprising the encoded audio signal and the selection side information.

22. Computer program for performing, when running on a computer or a processor, the method of claim 20 or the method of claim 21.

23. Encoded signal comprising:

an encoded audio signal; and

selection side information indicating a defined parametric representation alternative provided by a statistical model in response to a feature extracted from an original signal or from the encoded audio signal or from a decoded version of the encoded audio signal.