CLAIMS

1. An interharmonic noise attenuation post filter (440; 550; 740; 1040; 1140) adapted to receive an input signal, which comprises a preliminary audio signal decoded according to one of a plurality of decoding modes, wherein post-filter activity is conventionally associated with particular decoding modes, and to supply an output audio signal,

characterized by a control section for selectively operating the post filter in one of the following modes:

i) a filtering mode, wherein it filters the preliminary audio signal to obtain a filtered signal and supplies this as output audio signal; and

ii) a pass-through mode, wherein it supplies the preliminary audio signal as output audio signal,

said control section being configured to enter the pass-through mode in response to the value of a post-filtering signal, whereby a conventionally filtered decoding mode is applied unfiltered.

2. The post filter of claim 1, wherein the post-filtering signal is included in the input signal.

3. The post filter of claim 1, further comprising a decision module (1120) adapted to estimate a pitch frequency of the preliminary audio signal and to assess at least one of the following criteria:

a) whether the power of spectral components below the pitch frequency exceeds a predetermined threshold;

b) whether spectral components below the pitch frequency are tonal;

c) whether the power of spectral components between harmonics of the pitch frequency exceed a predetermined threshold; and

d) whether spectral components between harmonics of the pitch frequency are tonal;

and, responsive to a positive determination, to take a decision to generate a negative post-filtering signal disabling the post filter.

4. A decoder system (400; 500; 700; 1000) for decoding a bit stream signal as an audio time signal, including:

a decoding section (410; 511, 512, 513; 711, 712, 713; 1011, 1013) for decoding a bit stream signal as a preliminary audio time signal; and

the interharmonic noise attenuation post filter of any of claims 1 to 3.

5. The decoder system of claim 4,

wherein the post filter has variable gain determining the interharmonic attenuation and the control section includes a gain controller operable to set the absolute value of the gain below a predetermined threshold, whereby the post filter is disabled.

6. The decoder system of claim 4 or 5,

wherein the post filter is adapted to attenuate only such spectral components which are located below a predetermined cut-off frequency.

7. The decoder system of claim 4,

the decoding section further comprising a code-excited linear prediction, CELP, decoding module (511; 711; 1011) and a transform-coded excitation, TCX, decoding module (512; 712) for decoding a bit stream signal as an audio time signal,

the control section being adapted operate the decoder system in at least the following modes:

a) the TCX module is enabled and the post filter is disabled;

b) the CELP module and the post filter are enabled; and

c) the CELP module is enabled and the post filter is disabled, wherein the preliminary audio time signal and the audio time signal coincide.

8. The decoder system of claim 6,

the decoding section further comprising an Advanced Audio Coding, AAC, decoding module (513; 713) for decoding a bit stream signal as an audio time signal,

the control section being adapted to operate the decoder also in the following mode:

d) the AAC module is enabled and the post filter is disabled.

9. The decoder system of claim 4,

wherein the bit stream signal is a Moving Pictures Experts Group, MPEG, bit stream and is segmented into time frames and the control section is adapted to disable an entire time frame or a sequence of entire time frames; and

the control section is further adapted to receive, for each time frame, a data field associated with this time frame and is operable, responsive to the value of the data field, to disable the post filter, whereby the preliminary audio time signal is output as the audio time signal.

10. The decoder system (400; 500; 700; 1000) of claim 4, wherein:

the decoding section is adapted to generate an intermediate decoded signal representing excitation and to provide this to the control section; and

the control section is adapted to compute an approximate difference signal, which approximates the signal component which is to be removed from the decoded signal by the post filter, as a difference between the intermediate decoded signal and the intermediate decoded signal when subjected to post filtering and to assess at least one of the following criteria:

a) whether the power of the approximate difference signal exceeds a predetermined threshold;

b) whether the character of the approximate difference signal is tonal;

c) whether a difference between magnitude frequency spectra of the approximate difference signal and of the audio time signal is unevenly distributed with respect to frequency;

d) whether a magnitude frequency spectrum of the approximate difference signal is localized to frequency intervals within a predetermined relevance envelope; and

e) whether a magnitude frequency spectrum of the approximate difference signal is localized to frequency intervals within a relevance envelope obtained by thresholding a magnitude frequency spectrum of the audio time signal by a magnitude of the largest signal component therein downscaled by a predetermined scale factor;

and, responsive to a positive determination, to disable the post filter, whereby the preliminary audio time signal is output as the audio time signal.

11. A method of decoding a bit stream signal as an audio time signal, including the steps of:

decoding a bit stream signal as a preliminary audio time signal in one of a plurality of decoding modes, wherein post-filter activity is conventionally associated with particular decoding modes; and

post-filtering the preliminary audio time signal by attenuating interharmonic noise, thereby obtaining an audio time signal,

characterized in that the post-filtering step is selectively omitted responsive to post-filtering information encoded in the bitstream signal, whereby a conventionally filtered decoding mode is applied unfiltered.

13. An encoder system (800) for encoding an audio time signal as a bit stream signal, including an encoding section (810) operable in several coding modes, for encoding an audio time signal as a bit stream signal,

characterized by a decision section (820) adapted to decide whether post filtering, which includes attenuation of interharmonic noise, is to be disabled at decoding of the bit stream signal separately from deciding on the coding mode and to encode this decision in the bit stream signal as post filtering information.

14. The encoder system of claim 13,

the decision section being adapted to:

detect a co-presence of a signal component with dominant fundamental frequency and a signal component located below the fundamental frequency and, optionally, between its harmonics; and

responsive to a positive determination, to take a decision to disable.

15. The encoder system of claims 13, further comprising a code-exited linear prediction, CELP, encoding module adapted to estimate a pitch frequency in the audio time signal,

wherein the decision section is adapted to detect spectral components located below the estimated pitch frequency and, responsive to a positive determination, to take a decision to disable.

16. The encoder system of claim 13,

further comprising a code-excited linear prediction, CELP, encoding module,

the decision section being adapted

to compute a difference between a predicted power of the audio time signal when CELP-coded and a predicted power of the audio time signal when CELP-coded and post-filtered, and,

responsive to this difference exceeding a predetermined threshold, to take a decision to disable.

17. The encoder system of claim 13,

further comprising a code-exited linear prediction, CELP, encoding module,

said encoding section further including a transform-coded excitation, TCX, encoding module,

wherein the decision section is adapted to select one of the following coding modes, preferably on the basis of a rate–distortion optimization:

a) TCX coding;

b) CELP coding with post filtering; and

c) CELP coding without post filtering,

the encoder system further comprising a coding selector (814) adapted to select one of the following super-modes:

i) Advanced Audio Coding, AAC coding, wherein the decision section is disabled; and

ii) TCX/CELP coding, wherein the decision section is enabled to select one of coding modes a), b) and c).

18. The encoder system of claim 13,

where the decision section is adapted to:

derive, from the audio time signal, an approximate difference signal approximating the signal component which is to be removed from a future decoded signal by the post filter;

assess at least one of the following criteria:

a) whether the power of the approximate difference signal exceeds a predetermined threshold;

b) whether the character of the approximate difference signal is tonal;

c) whether a difference between magnitude frequency spectra of the approximate difference signal and of the audio time signal is unevenly distributed with respect to frequency;

d) whether a magnitude frequency spectrum of the approximate difference signal is localized to frequency intervals within a predetermined relevance envelope; and

e) whether a magnitude frequency spectrum of the approximate difference signal is localized to frequency intervals within a relevance envelope obtained by thresholding a magnitude frequency spectrum of the audio time signal by a magnitude of the largest signal component therein downscaled by a predetermined scale factor;

and, responsive to a positive determination, to take a decision to disable the post filter.

19. A method of encoding an audio time signal as a bit stream signal, the method including the step of encoding an audio time signal as a bit stream signal in one of several coding modes,

characterized by the further step of deciding whether post filtering, which includes attenuation of interharmonic noise, is to be disabled at decoding of the bit stream signal separately from deciding on the coding mode and encoding this decision in the bit stream signal as post filtering information.

20. The method of claim 19, wherein the outcome of the step of deciding that post filtering is to be disabled is chosen from:

no attenuation,

full attenuation.

21. A computer-program product including a data carrier storing instructions for performing the method of any one of claims 11, 12, 19 and 20.

CLAIMS

1. An interharmonic noise attenuation post filter (440; 550; 740; 1040; 1140) adapted to receive an input signal, which comprises a preliminary audio signal decoded according to one of a plurality of decoding modes, wherein post-filter activity is conventionally associated with particular decoding modes, and to supply an output audio signal,

the interharmonic noise attenuation post filter further comprising a control section for selectively operating the post filter in one of the following modes:

i) a filtering mode, wherein it filters the preliminary audio signal to obtain a filtered signal and supplies this as output audio signal; and

ii) a pass-through mode, wherein it supplies the preliminary audio signal as output audio signal,

said control section being configured to enter the pass-through mode in response to the value of a post-filtering signal, whereby a conventionally filtered decoding mode is applied unfiltered.

2. The post filter of claim 1, wherein the post-filtering signal is included in the input signal.

3. The post filter of claim 1, further comprising a decision module (1120) adapted to estimate a pitch frequency of the preliminary audio signal and to assess at least one of the following criteria:

a) whether the power of spectral components below the pitch frequency exceeds a predetermined threshold;

b) whether spectral components below the pitch frequency are tonal;

c) whether the power of spectral components between harmonics of the pitch frequency exceed a predetermined threshold; and

d) whether spectral components between harmonics of the pitch frequency are tonal;

and, responsive to a positive determination, to take a decision to generate a negative post-filtering signal disabling the post filter.

4. A decoder system (400; 500; 700; 1000) for decoding a bit stream signal as an audio time signal, including:

a decoding section (410; 511, 512, 513; 711, 712, 713; 1011, 1013) for decoding a bit stream signal as a preliminary audio time signal; and

the interharmonic noise attenuation post filter of any of claims 1 to 3.

5. The decoder system of claim 4,

wherein the post filter has variable gain determining the interharmonic attenuation and the control section includes a gain controller operable to set the absolute value of the gain below a predetermined threshold, whereby the post filter is disabled.

6. The decoder system of claim 4 or 5,

wherein the post filter is adapted to attenuate only such spectral components which are located below a predetermined cut-off frequency.

7. The decoder system of claim 4,

the decoding section further comprising a code-excited linear prediction, CELP, decoding module (511; 711; 1011) and a transform-coded excitation, TCX, decoding module (512; 712) for decoding a bit stream signal as an audio time signal,

the control section being adapted operate the decoder system in at least the following modes:

a) the TCX module is enabled and the post filter is disabled;

b) the CELP module and the post filter are enabled; and

c) the CELP module is enabled and the post filter is disabled, wherein the preliminary audio time signal and the audio time signal coincide.

8. The decoder system of claim 6,

the decoding section further comprising an Advanced Audio Coding, AAC, decoding module (513; 713) for decoding a bit stream signal as an audio time signal,

the control section being adapted to operate the decoder also in the following mode:

d) the AAC module is enabled and the post filter is disabled.

9. The decoder system of claim 4,

wherein the bit stream signal is a Moving Pictures Experts Group, MPEG, bit stream and is segmented into time frames and the control section is adapted to disable an entire time frame or a sequence of entire time frames; and

the control section is further adapted to receive, for each time frame, a data field associated with this time frame and is operable, responsive to the value of the data field, to disable the post filter, whereby the preliminary audio time signal is output as the audio time signal.

10. A method of decoding a bit stream signal as an audio time signal, including the steps of:

decoding a bit stream signal as a preliminary audio time signal in one of a plurality of decoding modes, wherein post-filter activity is conventionally associated with particular decoding modes; and

post-filtering the preliminary audio time signal by attenuating interharmonic noise, thereby obtaining an audio time signal,

characterized in that the post-filtering step is selectively omitted responsive to post-filtering information encoded in the bitstream signal, whereby a conventionally filtered decoding mode is applied unfiltered.

11. An encoder system (800) for encoding an audio time signal as a bit stream signal, including an encoding section (810) operable in several coding modes, for encoding an audio time signal as a bit stream signal,

characterized by a decision section (820) adapted to decide whether post filtering, which includes attenuation of interharmonic noise, is to be disabled at decoding of the bit stream signal separately from deciding on the coding mode and to encode this decision in the bit stream signal as post filtering information.

12. The encoder system of claim 11,

the decision section being adapted to:

detect a co-presence of a signal component with dominant fundamental frequency and a signal component located below the fundamental frequency and, optionally, between its harmonics; and

responsive to a positive determination, to take a decision to disable.

13. The encoder system of claim 11,

further comprising a code-excited linear prediction, CELP, encoding module,

said encoding section further including a transform-coded excitation, TCX, encoding module,

wherein the decision section is adapted to select one of the following coding modes, preferably on the basis of a rate–distortion optimization:

a) TCX coding;

b) CELP coding with post filtering; and

c) CELP coding without post filtering,

the encoder system further comprising a coding selector (814) adapted to select one of the following super-modes:

i) Advanced Audio Coding, AAC coding, wherein the decision section is disabled; and

ii) TCX/CELP coding, wherein the decision section is enabled to select one of coding modes a), b) and c).

14. A method of encoding an audio time signal as a bit stream signal, the method including the step of encoding an audio time signal as a bit stream signal in one of several coding modes,

characterized by the further step of deciding whether post filtering, which includes attenuation of interharmonic noise, is to be disabled at decoding of the bit stream signal separately from deciding on the coding mode and encoding this decision in the bit stream signal as post filtering information.

15. A computer-program product including a data carrier storing instructions for performing the method of claim 10 or 14.