Claims

1. Audio encoder for encoding a multichannel signal, comprising:

a downmixer for downmixing the multichannel signal to obtain a downmix signal,

a linear prediction domain core encoder for encoding the downmix signal, wherein the downmix signal has a low band and a high band, wherein the linear prediction domain core encoder is configured to apply a bandwidth extension processing for parametrically encoding the high band;

a filterbank for generating a spectral representation of the multichannel signal; and

a joint multichannel encoder configured to process the spectral representation comprising the low band and the high band of the multichannel signal to generate multichannel information,

wherein the linear prediction domain core encoder further comprises a linear prediction domain decoder for decoding the encoded downmix signal to obtain an encoded and decoded downmix signal; and

wherein the audio encoder further comprises a multichannel residual coder for calculating an encoded multichannel residual signal using the encoded and decoded downmix signal, the encoded multichannel residual signal representing an error between a decoded multichannel representation obtained by using the multichannel information and the multichannel signal before downmixing,

wherein the linear prediction domain decoder is configured to obtain, as the encoded and decoded downmix signal, only a low band signal representing the low band of the downmix signal, and wherein the encoded multichannel residual signal has only a band corresponding to the low band of the multichannel signal before downmixing,

or

wherein the linear prediction domain core encoder comprises an ACELP processor, wherein the ACELP processor is configured to operate on a downsampled downmix signal and wherein a time domain bandwidth extension processor is configured to parametrically encode the high band of the downmix signal removed from the downmix signal by the downsampling, and

wherein the linear prediction domain core encoder comprises a TCX processor, wherein the TCX processor is configured to operate on the downmix signal not downsampled or downsampled by a degree smaller than the downsampling for the ACELP processor, the TCX processor comprising a first time-frequency converter, a parameter generator for generating a parametric representation of a first set of bands and a quantizer encoder for generating a set of quantized encoded spectral lines for a second set of bands.

2. Audio encoder according to claim 1, wherein the time-frequency converter is different from the filterbank, wherein the filterbank comprises filter parameters optimized to generate a spectral representation of the multichannel signal, or wherein the time-frequency converter comprises filter parameters optimized to generate a parametric representation of a first set of bands.

3. Audio encoder according to claim 1 or 2, wherein the joint multichannel encoder comprises a first frame generator and wherein the linear prediction domain core encoder comprises a second frame generator, wherein the first frame generator and the second frame generator are configured to form a frame from the multichannel signal, wherein the first frame generator and the second frame generator are configured to form a frame of a similar length.

4. Audio encoder according to any of claims 1 to 3, further comprising:

a linear prediction domain encoder comprising the linear prediction domain core encoder and the multichannel encoder;

a frequency domain encoder; and

a controller for switching between the linear prediction domain encoder and the frequency domain encoder,

wherein the frequency domain encoder comprises a second joint multichannel encoder for encoding second multichannel information from the multichannel signal, wherein the second joint multichannel encoder is different from the first joint multichannel encoder, and

wherein the controller is configured such that a portion of the multichannel signal is represented either by an encoded frame of the linear prediction domain encoder or by an encoded frame of the frequency domain encoder.

5. Audio encoder according to any of claims 1 to 4,

wherein the linear prediction domain core encoder is configured to calculate the downmix signal as a parametric representation of a mid signal of an M/S multichannel audio signal;

wherein the multichannel residual coder is configured to calculate a side signal corresponding to the mid signal of the M/S multichannel audio signal, wherein the multichannel residual coder is configured to calculate a high band of the mid signal using simulating time domain bandwidth extension or wherein the multichannel residual coder is configured to predict the high band of the mid signal using finding a prediction information that minimizes a difference between a calculated side signal and a calculated full band mid signal from a previous frame.

6. Audio decoder for decoding an encoded audio signal comprising a core encoded signal, bandwidth extension parameters, and multichannel information, the audio decoder comprising:

a linear prediction domain core decoder for decoding the core encoded signal to generate a mono signal;

an analysis filterbank to convert the mono signal into a spectral representation;

a multichannel decoder for generating a first channel spectrum and a second channel spectrum from the spectral representation of the mono signal and the multichannel information; and

a synthesis filterbank processor for synthesis filtering the first channel spectrum to obtain a first channel signal and for synthesis filtering the second channel spectrum to obtain a second channel signal,

wherein the multichannel decoder is configured to obtain the first channel signal and the second channel signal from the mono signal, wherein the mono signal is a mid signal of a multichannel signal, to obtain a M/S (mid/side) multichannel decoded audio signal, to calculate the side signal from the multichannel information, and

to calculate a L/R (left/right) multichannel decoded audio signal from the M/S multichannel decoded audio signal, and to calculate the L/R multichannel decoded audio signal for a low band using the multichannel information and the side signal; or to calculate a predicted side signal from the mid signal and to calculate the L/R multichannel decoded audio signal for a high band using the predicted side signal and an ILD (inter channel level difference) value of the multichannel information,

or

wherein the linear prediction domain core decoder comprises:

a time domain bandwidth extension processor for generating a bandwidth-extended high band signal from the bandwidth extension parameters and the lowband mono signal or the core encoded signal, the bandwidth-extended high band signal being a decoded high band of the audio signal;

an ACELP decoder, a low band synthesizer, and an upsampler for outputting an upsampled low band signal being a decoded low band mono signal;

a combiner configured to calculate a full band ACELP decoded mono signal using the decoded low band mono signal and the decoded high band of the audio signal;

a TCX decoder and an intelligent gap filling processor to obtain a full band TCX decoded mono signal; and

a full band synthesis processor for combining the full band ACELP decoded mono signal and the full band TCX decoded mono signal, or

wherein a cross-path is provided for initializing the low band synthesizer using information derived by a low band spectrum-time conversion from the TCX decoder and the intelligent gap filling processor.

7. Audio decoder of claim 6, further comprising:

a frequency domain decoder;

a second joint multichannel decoder for generating a second multichannel representation using an output of the frequency domain decoder and a second multichannel information; and

a first combiner for combining the first channel signal and the second channel signal with the second multichannel representation to obtain a decoded audio signal;

wherein the second joint multichannel decoder is different from the multichannel decoder.

8. Audio decoder of claim 6 or 7, wherein the analysis filterbank comprises a DFT to convert the mono signal into the spectral representation and wherein the synthesis filterbank processor comprises an IDFT to convert the first channel spectrum into the first channel signal and to convert the second channel spectrum into the second channel signal.

9. Audio decoder of claim 8, wherein the analysis filterbank is configured to apply a window on the DFT-converted spectral representation such that a right portion of the spectral representation of a previous frame and a left portion of the spectral representation of a current frame are overlapping, wherein the previous frame and the current frame are consecutive.

10. Audio decoder of claim 6, wherein the multichannel decoder is further configured

to perform a complex operation on the L/R decoded multichannel audio signal;

to calculate a magnitude of the complex operation using an energy of the encoded mid signal and an energy of the decoded L/R multichannel audio signal to obtain an energy compensation; and

to calculate a phase of the complex operation using an IPD (inter channel phase difference) value of the multichannel information.

11. Method for encoding a multichannel signal, the method comprising:

downmixing the multichannel signal to obtain a downmix signal,

linear prediction domain core encoding the downmix signal to obtain an encoded downmix signal, wherein the downmix signal has a low band and a high band, wherein the linear prediction domain core encoding the downmix signal comprises applying a bandwidth extension processing for parametrically encoding the high band;

generating a spectral representation of the multichannel signal; and

processing the spectral representation comprising the low band and the high band of the multichannel signal to generate multichannel information,

wherein the encoding the downmix signal further comprises decoding the encoded downmix signal to obtain an encoded and decoded downmix signal;

wherein the method further comprises calculating an encoded multichannel residual signal using the encoded and decoded downmix signal, the encoded multichannel residual signal representing an error between a decoded multichannel representation obtained by using the multichannel information and the multichannel signal before downmixing,

wherein the encoding the downmix signal comprises applying a bandwidth extension processing for parametrically encoding the high band, and

wherein the decoding the encoded downmix signal is configured to obtain, as the encoded and decoded downmix signal, only a low band signal representing the low band of the downmix signal, and wherein the encoded multichannel residual signal has only a band corresponding to the low band of the multichannel signal before downmixing,

or

wherein the encoding the downmix signal comprises performing an ACELP processing, wherein the ACELP processing is configured to operate on a downsampled downmix signal and wherein a time domain bandwidth extension processing is configured to parametrically the high band of the downmix signal removed from the downmix signal by the downsampling, and

wherein the encoding the downmix signal comprises TCX processing wherein the TCX processing is configured to operate on the downmix signal not downsampled or downsampled by a degree smaller than the downsampling for the ACELP processing, the TCX processing comprising a time-frequency converting, a parameter generating for generating a parametric representation of a first set of bands and a quantizing encoding for generating a set of quantized encoded spectral lines for a second set of bands.

12. Method of decoding an encoded audio signal, comprising a core encoded signal, bandwidth extension parameters, and multichannel information, the method comprising

linear prediction domain core decoding the core encoded signal to generate a mono signal;

converting the mono signal into a spectral representation;

generating a first channel spectrum and a second channel spectrum from the spectral representation of the mono signal and the multichannel information; and

synthesis filtering the first channel spectrum to obtain a first channel signal and synthesis filtering the second channel spectrum to obtain a second channel signal,

wherein the generating the first channel spectrum and the second channel spectrum comprises obtaining the first channel signal and the second channel signal from the mono signal, wherein the mono signal is a mid signal of a multichannel signal, to obtaining a M/S multichannel decoded audio signal, calculating the side signal from the multichannel information, and

calculating a L/R multichannel decoded audio signal from the M/S multichannel decoded audio signal, and calculating the L/R multichannel decoded audio signal for a low band using the multichannel information and the side signal; or calculating a predicted side signal from the mid signal and calculating the L/R multichannel decoded audio signal for a high band using the predicted side signal and an ILD (inter channel level difference) value of the multichannel information,

or

wherein the decoding the core encoded signal comprises:

time domain bandwidth extension processing for generating a bandwidth-extended high band signal from the bandwidth extension parameters and the lowband mono signal or the core encoded signal, the bandwidth-extended high band signal being a decoded high band of the audio signal;

ACELP decoding, low band synthesizing, and upsampling to generate an upsampled low band signal being a decoded low band mono signal;

calculating a full band ACELP decoded mono signal using combining the decoded low band mono signal and the decoded high band of the audio signal;

TCX decoding and intelligent gap filling processing to obtain a full band TCX decoded mono signal; and

full band synthesis processing comprising combining the full band ACELP decoded mono signal and the full band TCX decoded mono signal, or

wherein a cross-path is provided for initializing the low band synthesizer using information derived by a low band spectrum-time conversion from the TCX decoding and the intelligent gap filling processing.

13. Computer program for performing, when running on a computer or a processor, the method of claim 11 or claim 12.