Claims

1. Multi-channel signal generator for generating a multi-channel signal having a first channel and a second channel, comprising:

a first audio source for generating a first audio signal;

a second audio source for generating a second audio signal;

a mixing noise source for generating a mixing noise signal; and

a mixer for mixing the mixing noise signal and the first audio signal to obtain the first channel and for mixing the mixing noise signal and the second audio signal to obtain the second channel,

wherein the mixer comprises:

a first amplitude element for influencing an amplitude of the first audio signal;

a first adder for adding an output signal of the first amplitude element and at least a portion of the mixing noise signal;

a second amplitude element for influencing an amplitude of the second audio signal;

a second adder for adding an output of the second amplitude element and at least a portion of the mixing noise signal,

wherein an amount of influencing performed by the first amplitude element and an amount of influencing performed by the second amplitude element are equal to each other or the amount of influencing performed by the second amplitude element is different by less than 20 percent of the amount performed by the first amplitude element,

wherein the mixer comprises a third amplitude element for influencing an amplitude of the mixing noise signal,

wherein an amount of influencing performed by the third amplitude element depends on the amount of influencing performed by the first amplitude element or the second amplitude element, so that the amount of influencing performed by the third amplitude element becomes greater when the amount of influencing performed by the first amplitude element or the amount of influencing performed by the second amplitude element becomes smaller.

2. The channel signal generator claimed in claim 1, wherein the first audio source is a first noise source and the first audio signal is a first noise signal, and/or the second audio source is a second noise source and the second audio signal is a second noise signal,

wherein the first noise source and/or the second noise source is configured to generate the first noise signal and/or the second noise signal so that the first noise signal and/or the second noise signal is decorrelated from the mixing noise signal.

3. Multi-channel signal generator as claimed in claim 1 or 2, wherein the mixer is configured to generate the first channel and the second channel so that an amount of the mixing noise signal in the first channel is equal to an amount of the mixing noise signal in the second channel or is within a range of 80 percent to 120 percent of the amount of the mixing noise signal in the second channel.

4. Multi-channel signal generator as claimed in one of the preceding claims, wherein the mixer comprises a control input for receiving a control parameter, and wherein the mixer is configured to control an amount of the mixing noise signal in the first channel and the second channel in response to the control parameter.

5. Multi-channel signal generator as claimed in one of the preceding claims, wherein each of the first audio source, the second audio source and the mixing noise source is a Gaussian noise source.

6. Multi-channel signal generator as claimed in one of the preceding claims,

wherein the first audio source comprises a first noise generator to generate the first audio signal as a first noise signal, wherein the second audio source comprises a decorrelator for decorrelating the first noise signal to generate the second audio signal as a second noise signal, and wherein the mixing noise source comprises a second noise generator.

7. Multi-channel signal generator as claimed in one of claims 1 to 5,

wherein the first audio source comprises a first noise generator to generate the first audio signal as a first noise signal, wherein the second audio source comprises a second noise generator to generate the second audio signal as a second noise signal, and wherein the mixing noise source comprises a decorrelator for decorrelating the first noise signal or the second noise signal to generate the mixing noise signal.

8. Multi-channel signal generator as claimed in one of claims 1 to 5,

wherein one of the first audio source, the second audio source and the mixing noise source comprises a noise generator to generate a noise signal, and wherein another one of the first audio source, the second audio source and the mixing noise source comprises a first decorrelator for decorrelating the noise signal, and wherein a further one of the first audio source, the second audio source and the mixing noise source comprises a second decorrelator for decorrelating the noise signal, wherein the first decorrelator and the second decorrelator are different from each other so that output signals of the first decorrelator and the second decorrelator are decorrelated from each other.

9. Multi-channel signal generator as claimed in one of claims 1 to 5,

wherein the first audio source comprises a first noise generator, wherein the second audio source comprises a second noise generator, and wherein the mixing noise source comprises a third noise generator, wherein the first noise generator, the second noise generator and the third noise generator are configured to generate mutually decorrelated noise signals.

10. Multi-channel signal generator as claimed in one of the preceding claims,

wherein one of the first audio source, the second audio source and the mixing noise source comprises a pseudo random number sequence generator configured for generating a pseudo random number sequence in response to a seed, and wherein at least two of the first audio source, the second audio source and the mixing noise source are configured to initialize the pseudo random number sequence generator using different seeds.

11. Multi-channel signal generator as claimed in one of claims 1 to 6,

wherein at least one of the first audio source, the second audio source and the mixing noise source is configured to operate using a pre-stored noise table.

12. Multi-channel signal generator as claimed in one of claims 1 to 6,

wherein at least one of the first audio source, the second audio source and the mixing noise source is configured to generate a complex spectrum for a frame using a first noise value for a real part and a second noise value for an imaginary part.

13. Multi-channel signal generator as claimed in one of claims 11 and 12,wherein at least one noise generator is configured to generate a complex noise spectral value for a frequency bin k using for one of the real part and the imaginary part, a first random value at an index k and using, for the other one of the real part and the imaginary part, a second random value at an index (k+M), wherein the first noise value and the second noise value are included in a noise array, e.g. derived from a random number sequence generator or a noise table or a noise process, ranging from a start index to an end index, the start index being lower than M, and the end index being equal to or lower than 2M, wherein M and k are integer numbers.

14. Multi-channel signal generator as claimed in one of the preceding claims,

wherein the amount of influencing performed by the third amplitude element is the square root of a predetermined value and an amount of influencing performed by the first amplitude element and an amount of influencing performed by the second amplitude element is the square root of the difference between 1 and the predetermined value.

15. Multi-channel signal generator of one of the preceding claims, further comprising:

an input interface for receiving encoded audio data in a sequence of frames comprising an active frame and an inactive frame following the active frame; and

an audio decoder for decoding coded audio data for the active frame to generate a decoded multi-channel signal for the active frame,

wherein the first audio source, the second audio source, the mixing noise source and the mixer are active in the inactive frame to generate the multi-channel signal for the inactive frame.

16. Multi-channel signal generator as claimed in claim 15, wherein:

the encoded audio data for the active frame has a first plurality of coefficients describing a first number of frequency bins; and

the encoded audio data for the inactive frame has a second plurality of coefficients describing a second number of frequency bins,

wherein the first number of frequency bins is greater than the second number of frequency bins.

17. Multi-channel signal generator for generating a multi-channel signal having a first channel and a second channel, comprising:

a first audio source for generating a first audio signal;

a second audio source for generating a second audio signal;

a mixing noise source for generating a mixing noise signal;

a mixer for mixing the mixing noise signal and the first audio signal to obtain the first channel and for mixing the mixing noise signal and the second audio signal to obtain the second channel,

an input interface for receiving encoded audio data in a sequence of frames comprising an active frame and an inactive frame following the active frame; and

an audio decoder for decoding coded audio data for the active frame to generate a decoded multi-channel signal for the active frame,

wherein the first audio source, the second audio source, the mixing noise source and the mixer are active in the inactive frame to generate the multi-channel signal for the inactive frame,

wherein the encoded audio data for the inactive frame comprises silence insertion descriptor data comprising comfort noise data indicating a signal energy for each channel of the two channels, or for each of a first linear combination of the first and second channels and a second linear combination of the first and second channels, for the inactive frame and indicating a coherence between the first channel and the second channel in the inactive frame, and

wherein the mixer is configured to mix the mixing noise signal and the first audio signal or the second audio signal based on the comfort noise data indicating the coherence, and

wherein the multi-channel signal generator further comprises a signal modifier for modifying the first channel and the second channel or the first audio signal or the second audio signal or the mixing noise signal,

wherein the signal modifier is configured to be controlled by the comfort noise data indicating signal energies for the first audio channel and the second audio channel or indicating signal energies for a first linear combination of the first and second channels and a second linear combination of the first and second channels.

18. Multi-channel signal generator as claimed in any of claims 15-17, wherein the audio data for the inactive frame comprises:

a first silence insertion descriptor frame for the first channel and a second silence insertion descriptor frame for the second channel,

wherein the first silence insertion descriptor frame comprises

comfort noise parameter data for the first channel, and/or for a first linear combination of the first and second channels, and

comfort noise generation side information for the first channel and the second channel, and

wherein the second silence insertion descriptor frame comprises

comfort noise parameter data for the second channel, and/or for a second linear combination of the first and second channels and

coherence information indicating a coherence between the first channel and the second channel in the inactive frame, and

wherein the multi-channel signal generator comprises a controller for controlling the generation of the multi-channel signal in the inactive frame using the comfort noise generation side information for the first silence insertion descriptor frame to determine a comfort noise generation mode for the first channel and the second channel, and/or for a first linear combination of the first and second channels and a second linear combination of the first and second channels, using the coherence information in the second silence insertion descriptor frame to set a coherence between the first channel and the second channel in the inactive frame, and using the comfort noise parameter data from the first silence insertion descriptor frame and using the comfort noise parameter data from the second silence insertion descriptor frame for setting an energy situation of the first channel and an energy situation of the second channel.

19. Multi-channel signal generator as claimed in any of claims 15-18, wherein the audio data for the inactive frame comprises:

at least one silence insertion descriptor frame for a first linear combination of the first and second channels and a second linear combination of the first and second channels,

wherein the at least one silence insertion descriptor frame comprises

comfort noise parameter data for the first linear combination of the first and second channels, and

comfort noise generation side information for the second linear combination of the first and second channels,

wherein the multi-channel signal generator comprises a controller for controlling the generation of the multi-channel signal in the inactive frame using the comfort noise generation side information for the first linear combination of the first and second channels and the second linear combination of the first and second channels,

using the coherence information in the second silence insertion descriptor frame to set a coherence between the first channel and the second channel in the inactive frame, and using the comfort noise parameter data from the at least one silence insertion descriptor frame and using the comfort noise parameter data from the at least one silence insertion descriptor frame for setting an energy situation of the first channel and an energy situation of the second channel.

20. Multi-channel signal generator as claimed in any of claims 17-19, further comprising a spectrum-time converter for converting a resulting first channel and a resulting second channel being spectrally adjusted and coherence-adjusted, into corresponding time domain representations to be combined with or concatenated to time domain representations of corresponding channels of the decoded multi-channel signal for the active frame.

21. Multi-channel signal generator as claimed in any of claims 15 to 20, wherein the audio data for the inactive frame comprises:

a silence insertion descriptor frame, wherein the silence insertion descriptor frame comprises comfort noise parameter data for the first and the second channel and comfort noise generation side information for the first channel and the second channel and/or for a first linear combination of the first and second channels and a second linear combination of the first and second channels, and coherence information indicating a coherence between the first channel and the second channel in the inactive frame, and

wherein the multi-channel signal generator comprises a controller for controlling the generation of the multi-channel signal in the inactive frame using the comfort noise generation side information for the silence insertion descriptor frame to determine a comfort noise generation mode for the first channel and the second channel, using the coherence information in the silence insertion descriptor frame to set a coherence between the first channel and the second channel in the inactive frame, and using the comfort noise parameter data from the silence insertion descriptor frame for setting an energy situation of the first channel and an energy situation of the second channel.

22. Multi-channel signal generator as claimed in any of claims 15-21,

wherein the encoded audio data for the inactive frame comprises silence insertion descriptor data comprising comfort noise data indicating a signal energy for

each channel in a mid/side representation and coherence data indicating the coherence between the first channel and the second channel in the left/right representation, wherein the multi-channel signal generator is configured to convert the mid/side representation of the signal energy onto a left/right representation of the signal energy in the first channel and the second channel,

wherein the mixer is configured to mix the mixing noise signal to the first audio signal and the second audio signal based on the coherence data to obtain the first channel and the second channel, and

wherein the multi-channel signal generator further comprises a signal modifier configured for modifying the first and second channel by shaping the first and second channel based on the signal energy in the left/right domain.

23. Multi-channel signal generator as claimed in claim 22, configured, in case the audio data contain signalling indicating that the energy in the side channel is smaller than a predetermined threshold, to zero the coefficients of the side channel.

24. Multi-channel signal generator as claimed in claim 22 or 23, wherein the audio data for the inactive frame comprises:

at least one silence insertion descriptor frame, wherein the at least one silence insertion descriptor frame comprises comfort noise parameter data for the mid and the side channel and comfort noise generation side information for the mid and the side channel, and coherence information indicating a coherence between the first channel and the second channel in the inactive frame, and

wherein the multi-channel signal generator comprises a controller for controlling the generation of the multi-channel signal in the inactive frame using the comfort noise generation side information for the silence insertion descriptor frame to determine a comfort noise generation mode for the first channel and the second channel, using the coherence information in the silence insertion descriptor frame to set a coherence between the first channel and the second channel in the inactive frame, and using the comfort noise parameter data, or a processed version thereof, from the silence insertion descriptor frame for setting an energy situation of the first channel and an energy situation of the second channel.

25. Multi-channel signal generator as claimed in any of claims 15-24, further configured to scale signal energy coefficients for the first and second channel by gain information, encoded with the comfort noise parameter data for the first and second channel.

26. Multi-channel signal generator as claimed in any of the preceding claims, configured to convert the generated multi-channel signal from a frequency domain version to a time domain version.

27. The channel signal generator claimed in any of the preceding claims, wherein the first audio source is a first noise source and the first audio signal is a first noise signal, or the second audio source is a second noise source and the second audio signal is a second noise signal,

wherein the first noise source or the second noise source is configured to generate the first noise signal or the second noise signal so that the first noise signal or the second noise signal are at least partially correlated, and

wherein the mixing noise source is configured for generating the mixing noise signal with a first mixing noise portion and a second mixing noise portion, the second mixing noise portion being at least partially decorrelated from the first mixing noise portion; and

wherein the mixer is configured for mixing the first mixing noise portion of the mixing noise signal and the first audio signal to obtain the first channel and for mixing the second mixing noise portion of the mixing noise signal and the second audio signal to obtain the second channel.

28. Multi-channel signal generator for generating a multi-channel signal having a first channel and a second channel, comprising:

a first audio source for generating a first audio signal;

a second audio source for generating a second audio signal;

a mixing noise source for generating a mixing noise signal; and

a mixer for mixing the mixing noise signal and the first audio signal to obtain the first channel and for mixing the mixing noise signal and the second audio signal to obtain the second channel,

wherein the first audio source is a first noise source and the first audio signal is a first noise signal, or the second audio source is a second noise source and the second audio signal is a second noise signal,

wherein the first noise source or the second noise source is configured to generate the first noise signal or the second noise signal so that the first noise signal or the second noise signal are at least partially correlated, and

wherein the mixing noise source is configured for generating the mixing noise signal with a first mixing noise portion and a second mixing noise portion, the second mixing noise portion being at least partially decorrelated from the first mixing noise portion; and

wherein the mixer is configured for mixing the first mixing noise portion of the mixing noise signal and the first audio signal to obtain the first channel and for mixing the second mixing noise portion of the mixing noise signal and the second audio signal to obtain the second channel.

29. Method of generating a multi-channel signal having a first channel and a second channel, comprising:

generating a first audio signal using a first audio source;

generating a second audio signal using a second audio source;

generating a mixing noise signal using a mixing noise source; and

mixing the mixing noise signal and the first audio signal to obtain the first channel and mixing the mixing noise signal and the second audio signal to obtain the second channel, the method comprising:

using a first amplitude element influencing an amplitude of the first audio signal;

using a first adder adding an output signal of the first amplitude element and at least a portion of the mixing noise signal;

using a second amplitude element influencing an amplitude of the second audio signal;

using a second adder adding an output of the second amplitude element and at least a portion of the mixing noise signal,

wherein an amount of influencing performed by the first amplitude element and an amount of influencing performed by the second amplitude element are equal to each other or the amount of influencing performed by the second amplitude element is different by less than 20 percent of the amount performed by the first amplitude element,

wherein mixing uses a third amplitude element influencing an amplitude of the mixing noise signal,

wherein an amount of influencing performed by the third amplitude element depends on the amount of influencing performed by the first amplitude element or the second amplitude element, so that the amount of influencing performed by the third amplitude element becomes greater when the amount of influencing performed by the first amplitude element or the amount of influencing performed by the second amplitude element becomes smaller.