Claims

1. A renderer for rendering a virtual audio scene depending on one or more audio channels of each sound source of one or more sound sources emitting sound into the virtual audio scene, wherein, to process the one or more audio channels of said sound source, the renderer comprises:

a late reverberation module configured for generating one or more late reverberation channels depending on the one or more audio channels of the sound source, wherein the one or more late reverberation channels represent a late-reverberation part of the sound emitted into the virtual audio scene by the sound source, and

a sound scene generator for generating, using the one or more late-reverberation channels, one or more audio output channels for reproducing the virtual audio scene,

wherein the late reverberation module is configured to generate the one or more late reverberation channels depending on the one or more audio channels of the sound source depending on a distance between the sound source and a listener in the virtual audio scene.

2. A renderer according to claim 1,

wherein the late reverberation module is configured to generate the one or more late reverberation channels depending on the one or more audio channels of the sound source such that a sound pressure level and/or an amplitude and/or a magnitude and/or an energy of the one or more late reverberation channels is adapted depending on the distance between the sound source and the listener in the virtual audio scene.

3. A renderer according to claim 2,

wherein the late reverberation module is configured to render the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels such that a greater distance between the sound source and the listener in the virtual audio scene results in a stronger attenuation of the level and/or the amplitude and/or the energy of the one or more late

reverberation channels compared to a smaller distance between the sound source and the listener in the virtual audio scene.

4. A renderer according to claim 2 or 3,

wherein the late reverberation module is configured to render the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels depending on a first distance between the sound source and the listener, such that the sound pressure level of the one or more late reverberation channels is reduced by a value between 1 dB and 2 dB compared to a an attenuation of the one or more audio channels, if the distance between the sound source and the listener is half of the first distance.

5. A renderer according to one of the preceding claims,

wherein the renderer further comprises a direct sound module configured for generating one or more direct sound channels depending on the one or more audio channels of the sound source, such that a greater distance between the sound source and the listener in the virtual audio scene results in a stronger attenuation of the level and/or the amplitude and/or the energy of the one or more direct sound channels compared to a smaller distance between the sound source and the listener in the virtual audio scene,

wherein the sound scene generator is configured to generate the one or more audio output channels for reproducing the virtual audio scene using the one or more direct sound channels.

6. A renderer according to claim 5,

wherein, if the distance between the sound source and the listener in the virtual audio scene is the greater distance instead of the smaller distance, the late reverberation module is configured to render the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels such that, the greater distance results in an attenuation of the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels which is relatively smaller compared to the attenuation of the level and/or the amplitude and/or the energy of

the one or more direct sound channels conducted by the direct sound module in response to the greater distance.

7. A renderer according to claim 6,

wherein, compared to when a distance between the sound source and the listener in the virtual audio scene is half of a current distance, if the distance between the sound source and the listener in the virtual audio scene is the current distance,

the late direct sound module is configured to render the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more direct sound channels, such that the sound pressure level of the one or more direct sound channels is reduced by a value between 5 dB and 7 dB, and

the late reverberation module is configured to render the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels, such that the sound pressure level of the one or more late reverberation channels is reduced by a value between 1 dB and 2 dB.

8. A renderer according to one of the preceding claims, further depending on claim 2,

wherein the renderer is configured to receive one or more information parameters comprising an indication on a strength of a distance attenuation for late reverberation, and

wherein the late reverberation module is configured to adapt the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels depending on the distance between the sound source and the listener in the virtual audio scene and depending on the indication on the strength of the distance attenuation for late reverberation.

9. A renderer according to claim 8,

wherein a bitstream comprises the one or more information parameters, and

wherein the renderer is configured to receive the bitstream and is configured to obtain the one or more information parameters from the bitstream; or the renderer is configured to receive the one or more information parameters from another unit that has received the bitstream and that has obtained the one or more information parameters from the bitstream.

10. A renderer according to claim 8 or 9,

wherein the one or more information parameters comprise a distance drop decibel factor and a reference distance, and

wherein the late reverberation module is configured to adapt the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels depending on the distance between the sound source and the listener in the virtual audio scene, depending on the distance drop decibel factor and depending on the reference distance.

11. A renderer according to claim 10,

wherein the late reverberation module is configured to adapt the sound pressure level and/or the amplitude and/or the magnitude and/or the energy of the one or more late reverberation channels depending on a gain dbGain that depends on:

distanceGainDbFactor * log10(refDistance / distance); and

distanceGainDbFactor = distanceGainDropDb / log10(2.0);

wherein distanceGainDropDb indicates the distance drop decibel factor,

wherein refDistance indicates the reference distance; and

wherein distance indicates the distance between the sound source and the listener in the virtual audio scene.

12. A renderer according to claim 10 or 11,

wherein the reference distance is a reference distance for an audio element according to MPEG-I 6DoF Audio Encoder Input Format (EIF), wherein the audio element is the sound source.

13. A renderer according to one of the preceding claims,

wherein the late reverberation module is configured to generate the one or more late reverberation channels using a feedback-delay-network reverberator.

14. A renderer according to one of the preceding claims,

wherein the renderer further comprises an early reflection module configured for generating one or more early reflection channels depending on the one or more audio channels of the sound source,

wherein the sound scene generator is configured to generate the one or more audio output channels for reproducing the virtual audio scene using the one or more early reflection channels.

15. A renderer according to one of the preceding claims,

wherein the renderer is configured to determine the distance between the sound source and a listener in the virtual audio scene depending on a position of the sound source and depending on a position of the listener,

wherein the position of the sound source and the position of the listener are defined for three dimensions, and/or

the position of the sound source and the position of the listener are defined for two dimensions, and/or

the position of the sound source is defined for three dimensions, and the listener position and orientation is defined for six-degrees-of-freedom, such that the position of the listener is defined for three dimensions, and the orientation of a head of the listener is defined using three rotation angles.

16. A renderer according to one of the preceding claims,

wherein the one or more audio channels of a sound source of the one or more sound sources are represented in an Ambisonics Domain, and wherein the sound scene generator is configured to reproduce the virtual audio scene depending on a property of one of a plurality of Spherical Harmonics, being associated with one of the one or more audio channels of said sound source, or

wherein the one or more audio channels of said sound source are represented in a different domain being different from the Ambisonics Domain, wherein said one or more audio channels of said sound source are derived from one or more other channels of said sound source being represented in the Ambisonics domain, wherein each audio channel of the one or more audio channels is derived from one of the one or more other channels depending on a property of one of a plurality of Spherical Harmonics, being associated with said other channel.

17. A renderer according to one of the preceding claims,

wherein the renderer comprises a binauralizer configured to generate two audio output channels for reproducing the virtual audio scene depending on the one or more late-reverberation channels.

18. A renderer according to one of the preceding claims,

wherein a bitstream comprises the one or more audio channels of each sound source of the one or more sound sources,

wherein the renderer is configured to receive the bitstream and is configured to obtain the one or more audio channels of each sound source of the one or more sound sources from the bitstream; or the renderer is configured to receive the one or more audio channels of each sound source of the one or more sound sources from another unit that has received the bitstream and that has obtained the one or more audio channels of each sound source of the one or more sound sources from the bitstream.

19. An apparatus comprising,

a decoder configured for decoding a bitstream to obtain the one or more audio channels of each sound source of one or more sound sources, and

a renderer according to one of the preceding claims for rendering a virtual audio scene depending on the one or more audio channels of each sound source of the one or more sound sources.

20. An apparatus according to claim 19,

wherein the renderer is a renderer according to claim 9,

wherein the bitstream comprises the one or more information parameters,

wherein the decoder is configured to obtain the one or more information parameters from the bitstream, and

wherein the renderer is configured to receive the one or more information parameters from the decoder.

21. A bitstream comprising,

an encoding of one or more audio channels of each sound source of one or more sound sources emitting sound into a virtual audio scene, and

one or more data fields comprising one or more information parameters which comprise an indication on a strength of a distance attenuation for late reverberation.

22. A bitstream according to claim 21,

wherein the one or more information parameters comprise a distance drop decibel factor and, optionally, a reference distance.

23. An encoder, configured for generating a bitstream,

wherein the encoder is configured to generate the bitstream such that the bitstream comprises an encoding of one or more audio channels of each sound source of one or more sound sources emitting sound into a virtual audio scene, and

wherein the encoder is configured to generate the bitstream such that the bitstream further comprises one or more data fields comprising one or more information

parameters which comprise an indication on a strength of a distance attenuation for late reverberation.

24. An encoder according to claim 23,

wherein the encoder is configured to generate the bitstream such that the one or more information parameters comprise a distance drop decibel factor and a reference distance.

25. An encoder according to claim 23 or 24,

wherein the encoder comprises an input interface configured for receiving the indication on the strength of the distance attenuation for late reverberation from a content creator.

26. An encoder according to claim 23 or 24,

wherein the encoder comprises a determination module configured for determining the indication on the strength of the distance attenuation for late reverberation from a content creator by an automatic processing which depends on one or more properties of a virtual environment.

27. A method for rendering a virtual audio scene depending on one or more audio channels of each sound source of one or more sound sources emitting sound into the virtual audio scene, wherein, for processing the one or more audio channels of said sound source, the method comprises:

generating one or more late reverberation channels depending on the one or more audio channels of the sound source, wherein the one or more late reverberation channels represent a late reverberation part of the sound emitted into the virtual audio scene by the sound source, and

generating, using the one or more late reverberation channels, one or more audio output channels for reproducing the virtual audio scene,

wherein generating the one or more late reverberation channels depending on the one or more audio channels of the sound source is conducted depending on a distance between the object source to a listener in the virtual audio scene.

28. A method for generating a bitstream, comprising

generating the bitstream such that the bitstream comprises an encoding of one or more audio channels of each sound source of one or more sound sources emitting sound into a virtual audio scene, and

generating the bitstream such that the bitstream further comprises one or more data fields comprising one or more information parameters which comprise an indication on a strength of a distance attenuation for late reverberation.

29. A computer program for implementing the method of claim 27 or 28 when being executed on a computer or signal processor.