Claims

1. Apparatus for sound rendering, configured to

receive information on a listener position and a sound source position;

render an audio signal of the sound source using a room impulse response whose early reflection portion is exclusively determined by an early reflection pattern

which is indicative of a constellation of early reflection positions, and

which is positioned at the listener position in a manner so that the early reflection positions are located around the listener position and at angular directions from the listener position which are invariant with respect to changes in a listener head orientation.

2. Apparatus of claim 1, configured to

receive at least one room acoustical parameter which is representative of an acoustical characteristic of an acoustic environment;

determine the early reflection pattern

in a manner so that a number of the early reflection positions depends on the at least one room acoustical parameter.

3. Apparatus of claim 2, wherein the at least one room acoustical parameter comprises one or more of

room dimensions,

room volume, and

predelay time to the late reverberation.

4. Apparatus of claim 2 or claim 3, wherein the at least one room acoustical parameter comprises merely one parameter selected out of

room dimensions,

room volume, and

predelay time to the late reverberation.

5. Apparatus of any previous claims 2 to 4, configured to, depending on the at least one room acoustical parameter, vary a mutual spacing of the early reflection positions and the number of early reflection positions.

6. Apparatus of any previous claims 2 to 5, configured to, depending on the at least one room acoustical parameter, parameterize one or more spiral functions centered at the listener position, and place the early reflection positions using the one or more spiral functions.

7. Apparatus of any previous claims 2 to 6, configured to read the at least one room acoustical parameter, from a bitstream comprising a representation of an audio signal to be rendered using the early reflection pattern.

8. Apparatus of any previous claims 2 to 7, configured to determine the number of early reflection positions so that

    the number is larger the larger the room dimensions are, or

    the number is larger the larger the room volume is, or

    the number is larger the larger the predelay time to the late reverberation is.

9. Apparatus of any previous claims 2 to 8, configured to determine the number of early reflection positions so that

    a farthest early reflection position from the listener position is larger the larger the room dimensions are or

    a farthest early reflection position from the listener position is larger the larger the room volume is, or

    a farthest early reflection position from the listener position is larger the larger the predelay time to the late reverberation is.

10. Apparatus of any previous claims 1 to 9, configured to determine the early reflection positions so that same are in a substantially uniform manner angularly distributed around the listener position.

11. Apparatus of any previous claims 1 to 10, wherein the early reflection positions lie in a horizontal plane along with the listener position.

12. Apparatus of any previous claims 1 to 11, configured to

receive at least one room acoustical parameter which is representative of an acoustical characteristic of an acoustic environment;

determine the early reflection pattern

by parameterizing one or more spiral functions centered at the listener position, and place the early reflection positions using the one or more spiral functions.

13. Apparatus of claim 12, wherein the one or more spiral functions comprise a first spiral function and a second spiral function wherein the apparatus is configured to place a first set of early reflection positions using the first spiral function and a second set of early reflection positions using the second spiral function so that each of the first set of early reflection positions is associated with a corresponding early reflection position of the second set of early reflection and is positioned on an opposite side of a line perpendicularly crossing a connecting line between the respective early reflection position and the corresponding early reflection position.

14. Apparatus of claim 13, wherein for each of first set of early reflection positions, the corresponding early reflection position of the second set of early reflection is angularly offset relative to the connecting line into an angular direction which is common for all early reflection positions of the first set of early reflection positions.

15. Apparatus of any previous claims 12 to 14, wherein the one or more spiral functions comprise a first spiral function and a second spiral function wherein the apparatus is configured to place a first set of early reflection positions using the first spiral function and a second set of early reflection positions using the second spiral function so that the first set of early reflection positions is determined in polar coordinates as (r1; $\beta 1$) and the second set of early reflection positions is determined in polar coordinates as (r2; $\beta 2$) with

$\beta 1 = n \cdot \frac{\pi}{3}$,

$\beta 2 = \frac{\pi}{8} + n \cdot \frac{\pi}{3}$,

n = [1:nER/2]

$base = 1.85$

$r1 = distfactor * base^{2*\beta 1/\pi}$

$r2 = -distfactor * base^{2*\beta 2/\pi}$

wherein nER is the number of early reflection positions and distfactor is a constant.

16. Apparatus of any previous claims 12 to 15, configured to read the at least one room acoustical parameter, from a bitstream comprising a representation of an audio signal to be rendered using the early reflection pattern.

17. Apparatus of any of claims 1 to 16, further configured to generate a diffuse late reverberation portion of the room impulse response.

18. Apparatus of any of claims 1 to 17, further configured to in rendering the audio signal, generate a set of loudspeaker signals by forming a summation over direct sound contribution loudspeaker signals relating to a direct sound source portion of the room impulse response and early reflection contribution loudspeaker signals relating to the early reflection portion of the room impulse response.

19. Apparatus of any of claims 1 to 18, further configured to generating early reflection contribution loudspeaker signals relating to the early reflection portion of the room impulse response by performing a rendition of the audio signal of the sound source from the early reflection positions.

20. Apparatus of claim 19, further configured to
in generating the early reflection contribution loudspeaker signals relating to the early reflection portion of the room impulse response by performing a rendition of the audio signal of the sound source from the early reflection positions,
render the audio signal of the sound source from each early reflection position in a manner level adjusted according to a distance of the respective early reflection position to the listener position.

21. Apparatus of claim 20, further configured to, in rendering the audio signal of the sound source from each early reflection position in a manner level adjusted according to a distance of the respective early reflection position to the listener position,

offset a level at which the audio signal of the sound source is rendered from the respective early reflection position, using a level offset, or amplify same with a level factor, which offset or factor is common for all early reflection positions, and

set the level offset or level factor according to an amplitude correction factor.

22. Apparatus of claims 20 or 21, further configured to, in rendering the audio signal of the sound source from each early reflection position in a manner level adjusted according

to the distance of the respective early reflection position to the listener position, modify the level adjustment according to the distance of the respective early reflection position to the listener position relative to a level adjustment used by the apparatus for rendering of the audio signal from the sound source position according to a distance attenuation exponent.

23. Apparatus of any of claims 19 to 22, further configured to, in generating the early reflection contribution loudspeaker signals relating to the early reflection portion of the room impulse response by performing a rendition of the audio signal of the sound source from the early reflection positions, render the audio signal of the sound source from each early reflection position in a manner spectrally shaped according to one or more frequency response parameters.

24. Apparatus of any of claims 1 to 23, further configured to, in performing the rendition of an audio signal of the sound source from the early reflection positions, use HRTFs specific for a listener head orientation.

25. Bitstream for being subject to sound rendition according to any of the previous claims 1 to 24.

26. Digital storage medium storing a bitstream for being subject to sound rendition according to claim 25.

27. Method for sound rendering, comprising

receiving information on a listener position and a sound source position;

rendering an audio signal of the sound source using a room impulse response whose early reflection portion is exclusively determined by an early reflection pattern

which is indicative of a constellation of early reflection positions, and

which is positioned at the listener position in a manner so that the early reflection positions are located around the listener position and at angular directions from the listener position which are invariant with respect to changes in a listener head orientation.

28. Computer program for causing a computer, when executing the computer program, to perform the method of claim 27.