Claims

1. Apparatus for synthesizing a spatially extended sound source, comprising:

a spatial information interface (100) for receiving a spatial range indication indicating a limited spatial range for the spatially extended sound source within a maximum spatial range (600);

a cue information provider (200) for providing one or more cue information items in response to the limited spatial range, wherein the one or more cue information items comprise an inter-channel correlation value provided in response to the limited spatial range; and

an audio processor (300) for processing an audio signal representing the spatially extended sound source using the one or more cue information items,

wherein the audio signal comprises a first audio channel for the spatially extended sound source and a second audio channel for the spatially extended sound source, or wherein the audio signal comprises a first audio channel for the spatially extended sound source and a second audio channel for the spatially extended sound source is derived from the first audio channel by a second channel processor (310), and

wherein the audio processor (300) is configured to perform a correlation processing to the first audio channel for the spatially extended sound source and the second audio channel for the spatially extended sound source to impose (320) a correlation between the first audio channel for the spatially extended sound source and the second audio channel for the spatially extended sound source using the inter-channel correlation value provided in response to the limited spatial range.

2. Apparatus of claim 1,

wherein the cue information provider (200) is configured to provide, as a further cue information item, at least one of an inter-channel phase difference item, an inter-channel time difference item, an inter-channel level difference and a gain item, and a first gain and a second gain information item, and

wherein the audio processor (300) is configured to impose an inter-channel phase difference, an inter-channel time difference or an inter-channel level difference or absolute levels of the first audio channel and the second audio channel using the at least one of the inter-channel phase difference item, the inter-channel time difference item, the inter-channel level difference and a gain item, and the first and the second gain item.

3. Apparatus of claim 1,

wherein the audio processor (300) is configured to impose, subsequent to the determination (320) of the correlation, the inter-channel phase difference (330), the inter-channel time difference or the inter-channel level difference (340) or the absolute levels of the first channel and the second channel, or

wherein the second channel processor (310) comprises a decorrelation filter or a neural network processor for deriving, from the first audio channel, the second audio channel so that the second audio channel is decorrelated from the first audio channel.

4. Apparatus of claim 1,

wherein the cue information provider (200) comprises a filter function provider (220) for providing audio filter functions as the one or more cue information item in response to the limited spatial range, and

wherein the audio processor (300) comprises a filter applicator (350) for applying the audio filter functions to the first audio channel and the second audio channel.

5. Apparatus of claim 4,

wherein the audio filter functions comprise, for each of the first and the second audio channel, a head related transfer function, a head related impulse response, a binaural room impulse response or a room impulse response, or

wherein the second channel processor (310) comprises a decorrelation filter or a neural network processor for deriving, from the first audio channel, the second audio

channel so that the second audio channel is decorrelated from the first audio channel.

6. Apparatus of claim 4 or claim 5,

wherein the filter applicator (350) is configured to apply the audio filter functions to a result of the correlation determination (320) performed by the audio processor (300) in response to the inter-channel correlation value.

7. Apparatus of one of the preceding claims,

wherein the cue information provider (200) comprises a memory (210) for storing information on different cue information items in relation to different limited spatial ranges, and

an output interface for retrieving, using the memory (210), the one or more cue information items associated with the limited spatial range.

8. Apparatus of claim 7, wherein the memory (210) comprises at least one of a look-up table, a vector codebook, a multi-dimensional function fit, a Gaussian Mixture Model (GMM), and a Support Vector Machine (SVM), and

wherein the output interface is configured to retrieve the one or more cue information items by looking up the look-up table or by using the vector codebook, or by applying the multi-dimensional function fit, or by using the GMM or the SVM.

9. Apparatus of one of the preceding claims,

wherein the cue information provider (200) is configured to store information on the one or more cue information items associated with a set of spaced candidate spatial ranges, the set of spaced limited spatial ranges covering the maximum spatial range (600), wherein the cue information provider (200) is configured to match (30) the limited spatial range to a candidate limited spatial range defining a candidate spatial range being closest to a specific limited spatial range defined by the limited spatial range and to provide the one or more cue information items associated with the matched candidate limited spatial range, or

wherein the limited spatial range comprises at least one of a pair of azimuth angles, a pair of elevation angles, an information on a horizontal distance, an information on a vertical distance, an information on an overall distance, and a pair of azimuth angles and a pair of elevation angles, or

wherein the spatial range indication comprises a code (S3, S5) identifying the limited spatial range as a specific sector of the maximum spatial range (600), wherein the maximum spatial range (600) comprises a plurality of different sectors.

10. Apparatus of claim 9, wherein a sector of the plurality of different sectors has a first extension in an azimuth or horizontal direction and a second extension in an elevation or vertical direction, wherein the second extension in an elevation or vertical direction of a sector is greater than the first extension, or wherein the second extension covers a maximum elevation or vertical direction range.

11. Apparatus of claim 9 or 10, wherein the plurality of different sectors are defined in such a way that a distance between centers of adjacent sectors in the azimuth or horizontal direction is greater than 5 degrees or even greater than or equal to 10 degrees.

12. Apparatus of one of the preceding claims,

wherein the audio processor (300) is configured to generate, from the audio signal, a processed first channel and a processed second channel for a binaural rendering or a loudspeaker rendering or an active crosstalk-reduction loudspeaker rendering.

13. Apparatus of one of the preceding claims,

wherein the cue information provider (200) is configured to provide one or more inter-channel cue values as the one or more cue information items,

wherein the audio processor (300) is configured to generate (320, 330, 340, 350), from the audio signal, a processed first channel and a processed second channel in such a way that the processed first channel and the processed second channel have

one or more inter-channel cues as controlled by the one or more inter-channel cue values.

14. Apparatus of one of the preceding claims, wherein the cue information provider (200) is configured for providing the one or more cue information items for a plurality of frequency bands in response to the limited spatial range being identical for the plurality of frequency bands, wherein the cue information items for different bands are different from each other.

15. Apparatus of one of the preceding claims,

wherein the cue information provider (200) is configured for providing one or more cue information items for a plurality of different frequency bands, and

wherein the audio processor (300) is configured to process the audio signal in a spectral domain, wherein a cue information item for a band is applied to a plurality of spectral values of the audio signal in the band.

16. Apparatus of one of the preceding claims,

wherein the first audio channel and the second audio channel are decorrelated with each other by a certain degree of decorrelation,

wherein the cue information provider (200) is configured for providing the inter-channel correlation value as the one or more cue information items, and

wherein the audio processor (300) is configured for decreasing (320) the certain degree of correlation between the first channel and the second channel to the value indicated by the inter-channel correlation value provided by the cue information provider (200).

17. Apparatus of one of the preceding claims, further comprising an audio signal interface (305) for receiving the audio signal representing the spatially extended sound source, wherein the audio signal only comprises the first audio channel, or wherein

the audio signal only comprises the first audio channel and the second audio channel, or wherein the audio signal does not comprise more audio channels than the first audio channel and the second audio channel.

18. Apparatus of one of the preceding claims, wherein the spatial information interface (100) is configured

for receiving (100) a listener position as the spatial range indication,

for calculating (120) a projection of a two-dimensional or three-dimensional hull associated with the spatially extended sound source onto a projection plane using, as the spatial range indication, the listener position and information on the spatially extended sound source such as a geometry or a position of the spatially extended sound source or for calculating (120) a two-dimensional or three-dimensional hull of a projection of a geometry of the spatially extended sound source onto a projection plane using, as the spatial range indication, the listener position and information on the spatially extended sound source such as a geometry or a position of the spatially extended sound source, and

for determining (140) the limited spatial range from hull projection data.

19. Apparatus of claim 20, wherein the spatial information interface (100) is configured to compute (121) the hull of the spatially extended sound source using as the information on the spatially extended sound source, the geometry of the spatially extended sound source and to project (122) the hull in a direction towards the listener using the listener position to obtain the projection of the two-dimensional or three-dimensional hull onto the projection plane, or to project (123) the geometry of the spatially extended sound source as defined by the information on the geometry of the spatially extended sound source in a direction towards the listener position and to calculate (124) the hull of a projected geometry to obtain the projection of the two-dimensional or three-dimensional hull onto the projection plane.

20. Apparatus of claim 18 or claim 19, wherein the spatial information interface (100) is configured to determine the limited spatial range so that a border of a sector defined by the limited spatial range is located on the right of the projection plane with respect

to the listener and/or on the left of the projection plane with respect to the listener and/or on top of the projection plane with respect to the listener and/or at the bottom of the projection plane with respect to the listener or coincides e.g. within a tolerance of +/- 10 % with one of a right border, a left border, an upper border and a lower border of the projection plane with respect to the listener.

21. Method of synthesizing a spatially extended sound source, the method comprising:

receiving a spatial range indication indicating a limited spatial range for the spatially extended sound source within a maximum spatial range (600);

providing one or more cue information items in response to the limited spatial range, wherein the one or more cue information items comprise an inter-channel correlation value provided in response to the limited spatial range; and

processing an audio signal representing the spatially extended sound source using the one or more cue information items,

wherein the audio signal comprises a first audio channel for the spatially extended sound source and a second audio channel for the spatially extended sound source, or wherein the audio signal comprises a first audio channel for the spatially extended sound source and a second audio channel for the spatially extended sound source is derived from the first audio channel by a second channel processor (310), and

wherein the processing comprises performing a correlation processing to the first audio channel for the spatially extended sound source and the second audio channel for the spatially extended sound source to impose (320) a correlation between the first audio channel for the spatially extended sound source and the second audio channel for the spatially extended sound source using the inter-channel correlation value provided in response to the limited spatial range.

22. Computer program for performing, when running on a computer or a processor, the method of claim 21.

Claims

1. Apparatus for synthesizing a spatially extended sound source, comprising:

a spatial information interface (100) for receiving a spatial range indication indicating a limited spatial range for the spatially extended sound source within a maximum spatial range (600);

a cue information provider (200) for providing one or more cue information items in response to the limited spatial range; and

an audio processor (300) for processing an audio signal representing the spatially extended sound source using the one or more cue information items.

2. Apparatus of claim 1,

wherein the cue information provider (200) is configured to provide, as a cue information item, an inter-channel correlation value,

wherein the audio signal comprises a first audio channel and a second audio channel for the spatially extended sound source, or wherein the audio signal comprises a first audio channel and a second audio channel is derived from the first audio channel by a second channel processor (310), and

wherein the audio processor (300) is configured to impose (320) a correlation between the first audio channel and the second audio channel using the inter-channel correlation value.

3. Apparatus of claim 1 or 2,

wherein the cue information provider (200) is configured to provide, as a further cue information item, at least one of an inter-channel phase difference item, an inter-channel time difference item, an inter-channel level difference and a gain item, and a first gain and a second gain information item,

wherein the audio signal comprises a first audio channel and a second audio channel for the spatially extended sound source, or wherein the audio signal comprises a first

audio channel and a second audio channel is derived from the first audio channel by a second channel processor (310), and

wherein the audio processor (300) is configured to impose an inter-channel phase difference, an inter-channel time difference or an inter-channel level difference or absolute levels of the first audio channel and the second audio channel using the at least one of the inter-channel phase difference item, the inter-channel time difference item, the inter-channel level difference and a gain item, and the first and the second gain item.

4. Apparatus of claim 1 or 2,

wherein the audio processor (300) is configured to impose (320) a correlation between the first channel and the second channel and, subsequent to the determination (320) of the correlation, to impose the inter-channel phase difference (330), the inter-channel time difference or the inter-channel level difference (340) or the absolute levels of the first channel and the second channel, or

wherein the second channel processor (310) comprises a decorrelation filter or a neural network processor for deriving, from the first audio channel, the second audio channel so that the second audio channel is decorrelated from the first audio channel.

5. Apparatus of claim 1 or 2,

wherein the cue information provider (200) comprises a filter function provider (220) for providing audio filter functions as the one or more cue information item in response to the limited spatial range, and

wherein the audio signal comprises a first audio channel and a second audio channel for the spatially extended sound source, or wherein the audio signal comprises a first audio channel and a second audio channel is derived from the first audio channel by a second channel processor (310), and

wherein the audio processor (300) comprises a filter applicator (350) for applying the audio filter functions to the first audio channel and the second audio channel.

6. Apparatus of claim 5,

wherein the audio filter functions comprise, for each of the first and the second audio channel, a head related transfer function, a head related impulse response, a binaural room impulse response or a room impulse response, or

wherein the second channel processor (310) comprises a decorrelation filter or a neural network processor for deriving, from the first audio channel, the second audio channel so that the second audio channel is decorrelated from the first audio channel.

7. Apparatus of claim 5 or claim 6,

wherein the cue information provider (200) is configured to provide, as a cue information item, an inter-channel correlation value,

wherein the audio signal comprises a first audio channel and a second audio channel for the spatially extended sound source, or wherein the audio signal comprises a first audio channel and a second audio channel is derived from the first audio channel by a second channel processor (310), and

wherein the audio processor (300) is configured to impose (320) a correlation between the first audio channel and the second audio channel using the inter-channel correlation value, and

wherein the filter applicator (350) is configured to apply the audio filter functions to a result of the correlation determination (320) performed by the audio processor (300) in response to the inter-channel correlation value.

8. Apparatus of one of the preceding claims,

wherein the cue information provider (200) comprises at least one of a memory (210) for storing information on different cue information items in relation to different limited spatial ranges, and

an output interface for retrieving, using the memory (210), the one or more cue information items associated with the limited spatial range.

9. Apparatus of claim 8, wherein the memory (210) comprises at least one of a look-up table, a vector codebook, a multi-dimensional function fit, a Gaussian Mixture Model (GMM), and a Support Vector Machine (SVM), and

wherein the output interface is configured to retrieve the one or more cue information items by looking up the look-up table or by using the vector codebook, or by applying the multi-dimensional function fit, or by using the GMM or the SVM.

10. Apparatus of one of the preceding claims,

wherein the cue information provider (200) is configured to store information on the one or more cue information items associated with a set of spaced candidate spatial ranges, the set of spaced limited spatial ranges covering the maximum spatial range (600), wherein the cue information provider (200) is configured to match (30) the limited spatial range to a candidate limited spatial range defining a candidate spatial range being closest to a specific limited spatial range defined by the limited spatial range and to provide the one or more cue information items associated with the matched candidate limited spatial range, or

wherein the limited spatial range comprises at least one of a pair of azimuth angles, a pair of elevation angles, an information on a horizontal distance, an information on a vertical distance, an information on an overall distance, and a pair of azimuth angles and a pair of elevation angles, or

wherein the spatial range indication comprises a code (S3, S5) identifying the limited spatial range as a specific sector of the maximum spatial range (600), wherein the maximum spatial range (600) comprises a plurality of different sectors.

11. Apparatus of claim 10, wherein a sector of the plurality of different sectors has a first extension in an azimuth or horizontal direction and a second extension in an elevation or vertical direction, wherein the second extension in an elevation or vertical direction of a sector is greater than the first extension, or wherein the second extension covers a maximum elevation or vertical direction range.

12. Apparatus of claim 10 or 11, wherein the plurality of different sectors are defined in such a way that a distance between centers of adjacent sectors in the azimuth or

horizontal direction is greater than 5 degrees or even greater than or equal to 10 degrees.

13. Apparatus of one of the preceding claims,

wherein the audio processor (300) is configured to generate, from the audio signal, a processed first channel and a processed second channel for a binaural rendering or a loudspeaker rendering or an active crosstalk-reduction loudspeaker rendering.

14. Apparatus of one of the preceding claims,

wherein the cue information provider (200) is configured to provide one or more inter-channel cue values as the one or more cue information items,

wherein the audio processor (300) is configured to generate (320, 330, 340, 350), from the audio signal, a processed first channel and a processed second channel in such a way that the processed first channel and the processed second channel have one or more inter-channel cues as controlled by the one or more inter-channel cue values.

15. Apparatus of claim 14,

wherein the cue information provider (200) is configured to provide one or more inter-channel correlation cue values as the one or more cue information items,

wherein the audio processor (300) is configured to generate (320), from the audio signal, a processed first channel and a processed second channel in such a way that the processed first channel and the processed second channel have an inter-channel correlation value as controlled by the one or more inter-channel correlation cue values.

16. Apparatus of one of the preceding claims, wherein the cue information provider (200) is configured for providing the one or more cue information items for a plurality of frequency bands in response to the limited spatial range being identical for the plurality of frequency bands, wherein the cue information items for different bands are different from each other.

17. Apparatus of one of the preceding claims,

wherein the cue information provider (200) is configured for providing one or more cue information items for a plurality of different frequency bands, and

wherein the audio processor (300) is configured to process the audio signal in a spectral domain, wherein a cue information item for a band is applied to a plurality of spectral values of the audio signal in the band.

18. Apparatus of one of the preceding claims,

wherein the audio processor (300) is configured to either receive a first audio channel and a second audio channel as the audio signal representing the spatially extended sound source, or wherein the audio processor (300) is configured to receive a first audio channel as the audio signal representing the spatially extending sound source and to derive the second audio channel by a second channel processor (310),

wherein the first audio channel and the second audio channel are decorrelated with each other by a certain degree of decorrelation,

wherein the cue information provider (200) is configured for providing an inter-channel correlation value as the one or more cue information items, and

wherein the audio processor (300) is configured for decreasing (320) a correlation degree between the first channel and the second channel to the value indicated by the one or more inter-channel correlation cues provided by the cue information provider (200).

19. Apparatus of one of the preceding claims, further comprising an audio signal interface (305) for receiving the audio signal representing the spatially extended sound source, wherein the audio signal only comprises a first audio channel or only comprises a first audio channel and a second audio channel, or the audio signal does not comprise more than two audio channels.

20. Apparatus of one of the preceding claims, wherein the spatial information interface (100) is configured

for receiving (100) a listener position as the spatial range indication,

for calculating (120) a projection of a two-dimensional or three-dimensional hull associated with the spatially extended sound source onto a projection plane using, as the spatial range indication, the listener position and information on the spatially extended sound source such as a geometry or a position of the spatially extended sound source or for calculating (120) a two-dimensional or three-dimensional hull of a projection of a geometry of the spatially extended sound source onto a projection plane using, as the spatial range indication, the listener position and information on the spatially extended sound source such as a geometry or a position of the spatially extended sound source, and

for determining (140) the limited spatial range from hull projection data.

21. Apparatus of claim 20, wherein the spatial information interface (100) is configured to compute (121) the hull of the spatially extended sound source using as the information on the spatially extended sound source, the geometry of the spatially extended sound source and to project (122) the hull in a direction towards the listener using the listener position to obtain the projection of the two-dimensional or three-dimensional hull onto the projection plane, or to project (123) the geometry of the spatially extended sound source as defined by the information on the geometry of the spatially extended sound source in a direction towards the listener position and to calculate (124) the hull of a projected geometry to obtain the projection of the two-dimensional or three-dimensional hull onto the projection plane.

22. Apparatus of claim 20 or claim 21, wherein the spatial information interface (100) is configured to determine the limited spatial range so that a border of a sector defined by the limited spatial range is located on the right of the projection plane with respect to the listener and/or on the left of the projection plane with respect to the listener and/or on top of the projection plane with respect to the listener and/or at the bottom of the projection plane with respect to the listener or coincides e.g. within a tolerance of +/- 10 % with one of a right border, a left border, an upper border and a lower border of the projection plane with respect to the listener.

23. Method of synthesizing a spatially extended sound source, the method comprising:

receiving a spatial range indication indicating a limited spatial range for the spatially extended sound source within a maximum spatial range (600);

providing one or more cue information items in response to the limited spatial range; and

processing an audio signal representing the spatially extended sound source using the one or more cue information items.

24. Computer program for performing, when running on a computer or a processor, the method of claim 23.