

Claims

1. Apparatus for generating a sound field description from an input signal comprising at least two channels, the apparatus comprising:
 - 5 an input signal analyzer (600) for obtaining direction data and diffuseness data from the input signal;
 - 10 an estimator (620) for estimating a first energy- or amplitude-related measure for an omnidirectional component derived from the input signal and for estimating a second energy- or amplitude-related measure for a directional component derived from the input signal, and
 - 15 a sound component generator (750) for generating sound field components of the sound field description, wherein the sound component generator (750) is configured to perform an energy compensation of the directional component using the first energy- or amplitude-related measure, the second energy- or amplitude-related measure, the direction data and the diffuseness data.
- 20 2. Apparatus of claim 1, wherein the input signal comprises the at least two channels, wherein the estimator (620) is configured to calculate the omnidirectional component using an addition of the at least two channels, and to calculate the directional component using a subtraction of the at least two channels (815).
- 25 3. Apparatus of claim 1, wherein the input signal comprises the omnidirectional component and one or more directional components, and wherein the estimator (620) is configured to calculate the first amplitude related measure for the omnidirectional component using the input signal and to calculate the second energy- or amplitude-related measure for each of the one or more directional components from the input signal.
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4. Apparatus of claim 1, wherein the input signal comprises an A-format or B-format representation with at least two channels, and wherein the estimator (620) is configured to derive (816) the omnidirectional component and the directional components using a weighted linear combination of the at least two channels.
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5. Apparatus of one of the preceding claims, wherein the input signal analyzer (600) is configured to extract the diffuseness data from metadata associated with the input signal or to extract the diffuseness data from the input signal by a signal analysis of the input signal having the at least two channels or components.

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6. Apparatus of one of the preceding claims, wherein the estimator (620) is configured to calculate the first energy- or amplitude-related measure or the second energy- or amplitude-related measure from an absolute value of a complex amplitude or a magnitude raised to a power greater than 1 and lower than 5 or being equal to 2 or 3.

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7. Apparatus of one of the preceding claims,

wherein the sound component generator (750) comprises an energy compensator for performing the energy compensation, the energy compensator comprising a compensation gain calculator (910) for calculating a compensation gain using the first energy- or amplitude-related measure, the second energy- or amplitude-related measure, the direction data and the diffuseness data.

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8. Apparatus of one of the preceding claims, wherein the sound component generator (750) is configured to calculate (410), from the direction data, a directional gain and to combine the directional gain and the diffuseness data for performing the energy compensation.

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9. Apparatus of one of the preceding claims, wherein the estimator (620) is configured to estimate the second energy- or amplitude-related measure for a first directional component and a third energy- or amplitude-related measure for a second directional component, to calculate a first compensation gain for the first directional component using the first and the second energy- or amplitude-related measures, and to calculate a second compensation gain for the second directional component using the first and the third energy- or amplitude-related measures.

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10. Apparatus of claim 7,

wherein the compensation gain calculator (910) is configured to calculate a first gain factor depending on the diffuseness data and at least one of the number of sound

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field components in a second group, a maximum order of sound field components of a first group and a maximum number of sound field components of the second group, to calculate a second gain factor depending on the first energy- or amplitude-related measure for the omnidirectional component, the second energy- or amplitude-related measure for the directional component, the direction data and the diffuseness data, and to calculate the compensation gain using the first gain factor and the second gain factor,

wherein the sound component generator (750) is configured to use the same direction data and diffuseness data for calculating the first compensation gain and the second compensation gain.

11. Apparatus of one of claims 7 to 10,

wherein the compensation gain calculator (910) is configured to calculate a gain factor based on the following equation

$$g_s = \sqrt{\frac{E\{|B_0^0|^2\}}{E\{|B_l^m|^2\}}(Q_l\Psi + (1 - \Psi)(G_l^m(\varphi, \theta))^2)},$$

or

$$g_s = \sqrt{\Psi + \frac{E\{|B_0^0|^2\}}{E\{|B_l^m|^2\}}(1 - \Psi)(G_l^m(\varphi, \theta))^2},$$

wherein Ψ represents the diffuseness data, $E\{|B_0^0|^2\}$ represents the first energy- or amplitude-related measure, $E\{|B_l^m|^2\}$ represents the second energy- or amplitude-related measure, B_0^0 is the omnidirectional component, B_l^m is the directional component, $(G_l^m(\varphi, \theta))$ is a direction gain derived from direction data φ, θ , φ is an azimuth angle, θ is an elevation angle, Q_l is a directivity factor of order l , and g_s is the gain factor.

12. Apparatus of one of claims 7 to 11, wherein the compensation gain calculator (910) is configured

to increase the compensation gain with an increasing first energy- or amplitude-related measure, or

to decrease the compensation gain with an increasing second energy- or amplitude-related measure, or

to increase the compensation gain using an increasing direction gain, or

to increase the compensation gain with a decreasing number of directional components.

13. Apparatus of one of claims 7 to 12,

wherein the sound component generator (750) is configured for generating, from the input signal, one or more sound field components of a first group of sound field components having for each sound field component a direct component and a diffuse component, and for generating, from the input signal, a second group of sound field components having only a direct component,

wherein the compensation gain calculator (910) is configured to calculate the compensation gain using the diffuseness data and at least one of the number of sound field components in the second group, the number of diffuse components in the first group, a maximum order of sound field components of the first group, and a maximum order of sound field components of the second group.

14. Apparatus of one of claims 7 to 13, wherein the compensation gain calculator (910,) is configured to perform a gain factor manipulation using a limitation with a fixed maximum threshold or a fixed minimum threshold or using a compression function for compressing low or high gain factors towards medium gain factors to obtain the compensation gain.

15. Apparatus of one of the preceding claims,

wherein the sound component generator (750) is configured to generate other sound field components of other orders, wherein a combiner (430) is configured to combine the sound field components of the sound field description and the other sound field components of other orders to obtain the sound field description having an order being higher than an order of the input signal.

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16. Apparatus of one of claims 7 to 15, wherein the energy compensator (910) comprises a compensation gain applicator for applying the compensation gain to at least one sound field component.

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17. Apparatus of one of the preceding claims, wherein the sound component generator (750) comprises a low-order component generator (810) for generating a low-order sound field description from the input signal up to a predetermined order and the predetermined mode, wherein the low-order component generator (810) is configured to derive the low-order sound field description by copying or taking the input signal or forming a weighted combination of the channels of the input signal,

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wherein the low order sound field description comprises the omnidirectional component and the directional component generated by the copying or the taking or the linear combination.

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18. Apparatus of claim 17, wherein the sound component generator (750) further comprises:

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a mid-order component generator (820) for generating a mid-order sound field description above the predetermined order or at the predetermined order and above the predetermined mode and below or at a first truncation order using a synthesis of at least one direct portion and of at least one diffuse portion using the direction data and the diffuseness data so that the mid-order sound field description comprises a direct contribution and a diffuse contribution; and

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a high-order components generator (830) for generating a high-order sound field description having a component above the first truncation order using a synthesis of at least one direct portion, wherein the high order sound field description comprises a direct contribution only.

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19. Apparatus of one of the preceding claims,

wherein a first group of sound field components up to an order I of coefficients and a second group of sound field components above the order I of coefficients are orthogonal to each other, or wherein the sound field components are at least one of coefficients of orthogonal basis functions, coefficients of spatial basis functions, coefficients of spherical or circular harmonics, and Ambisonics coefficients.

20. Apparatus of one of the preceding claims,

an analysis filter bank (400) for generating the one or more sound field components for a plurality of different time-frequency tiles, wherein the input signal analyzer (600) is configured to obtain a diffuseness data item for each time-frequency tile, and wherein the sound component generator (750) is configured to perform the energy compensation separately for each time-frequency tile.

21. Method for generating a sound field description from an input signal comprising at least two channels, comprising:

obtaining direction data and diffuseness data from the input signal;

estimating a first energy- or amplitude-related measure for an omnidirectional component derived from the input signal and estimating a second energy- or amplitude-related measure for a directional component derived from the input signal, and

generating sound field components of the sound field description, wherein the generating comprises performing an energy compensation of the directional component using the first energy- or amplitude-related measure, the second energy- or amplitude-related measure, the direction data and the diffuseness data.

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