CLAIMS

1. Upmix or coding device for an audio signal, comprising:

an inverse coding device for determining a first channel and a second channel through linear inverse coding from an input signal;

characterized by

a first gain (50001) connected downstream to the inverse coding device in the first channel; or

a first gain (60001) connected downstream of the inverse coding device in the first channel and a second gain (60002) connected downstream of the inverse coding device in the second channel, that is different from the first gain (60001).

2. Upmix or coding device according to claim 1, designed for producing or further processing the first channel amplified with the first gain (50001, 60001) without combination with the second channel, and/or for producing or further processing the second channel amplified with the second gain (60002) without combination with the first channel.

3. Upmix or coding device according to one of the claims 1 to 2, wherein the first gain (50001, 60001) and/or the second gain (60002) is/are chosen depending on at least one parameter of a downmix that was used for generating the input channel.

4. Upmix or coding device according to one of the claims 1 to 2, having an optimization device designed for adjusting the value of the first gain (50001, 60001) and/or of the

second gain (60002) depending on the first channel and/or the second channel.

5. Upmix or coding device according to one of the claims 1 to 3, wherein the first gain (50001, 60001) and/or the second gain (60002) is/are permanently set.

6. Upmix or coding device according to claim 5, wherein the value of the first gain (50001, 60001) corresponds to 0.5 or $1/\sqrt{2}$.

7. Upmix or coding device according to one of the claims 1 to 6, having a level correcting device connected downstream of the inverse coding device and the first gain in the first channel and the second channel, designed for adjusting the levels of the first channel and of the second channel depending on at least one parameter of a downmix that was used for generating the input channel or depending on a received level.

8. Upmix or coding device according to claim 3, 5, 6 or 7, wherein the input signal is generated from two signals that are based on a multi-channel signal by means of weighted addition and the at least one parameter of the downmix corresponds to the weighting of the two signals or of the output signals.

9. Upmix or coding device according to one of the claims 1, 2, 3 or 7, having a receiver device for receiving the input signal and a first value and/or second value, wherein the first gain is adjusted according to the received first value and/or the second gain is adjusted according to the received second value.

10. Upmix or coding device according to one of the claims 1 to 9, wherein the inverse coding device is designed for determining the first channel and the second channel on the basis of parameters received with the input signal.

11. Upmix or coding device according to one of the claims 1 to 10, wherein the inverse coding device is designed for determining at least one gain of the inverse coding device and at least one delay of the inverse coding device on the basis of an angle between a sound source and a main axis of a microphone, a virtual left opening angle, a virtual right opening angle and a directional characteristic for the input signal, and for determining a first intermediate signal and a second intermediate signal on the basis of the at least one delay and of the at least one gain of the inverse coding device, and for determining the first channel and the second channel on the basis of the first intermediate signal and of the second intermediate signal.

12. Upmix or coding device according to claim 11, wherein the inverse coding device is designed for generating, on the basis of at least one weighting factor, the first channel and the second channel, each by means of the weighted addition and/or weighted subtraction of the first and second intermediate signal.

13. Upmix or coding device according to claim 11 or 12, wherein the inverse coding device is designed for determining two delays on the basis of the angle between the sound source and the main axis of the microphone, of the left opening angle, of the right opening angle and of the

directional characteristic, and for correcting these two delays through a common time factor (s).

14. Upmix or coding device according to one of the claims 11 to 13, wherein the angle between the sound source and the main axis of the microphone, the left opening angle, the right opening angle and/or the directional characteristic are constant.

15. Upmix or coding device according to one of the claims 1 to 14, having an optimization device for determining a suitable value for the first gain (50001, 60001) and/or for the second gain (60002) and/or for parameters of the linear inverse coding.

16. Upmix or coding device according to claim 15, wherein the optimization device is designed for determining the degree of correlation of the two channels reconstituted from the downmix or the two signals underlying the downmix, and for determining the value of the first gain (50001, 60001) and/or the second gain (60002) and/or the parameters of the linear inverse coding depending on the degree of correlation.

17. Upmix or coding device according to claim 16, wherein the optimization device is designed for determining the value of the first gain (50001, 60001) and/or the second gain (60002) and/or the parameters of the linear inverse coding depending on a target degree of correlation.

18. Upmix or coding device according to claim 19, wherein the optimization device is designed to determine the target degree of correlation on the basis of the nature of

the two channels, the nature of the first downmix channel, the nature of the two signals underlying the first downmix channel and/or on the basis of the nature of the channels of the multichannel signal underlying the first downmix channel.

19. Upmix or coding device according to claim 18, wherein the target correlation

for voice or vocal recordings is greater than or equal to plus zero-point-five-one ($k \geq +0.51$), in particular greater than or equal to plus zero-point-six-six ($\geq +0,66$), and/or

for transients, is greater than or equal to plus zero-point-two-five ($\geq 0,25$), in particular greater than or equal to plus zero-point-four ($\geq 0,40$), and/or

in the case of other signals, is greater than or equal to minus zero-point-one-five ($\geq -0,15$), in particular greater than or equal to zero (≥ 0).

20. Upmix or coding device according to one of the claims 15 to 19, wherein the optimization device contains a comparison device for the comparison of the two channels with the two signals underlying the first downmix channel in order to determine a suitable value for the first gain (50001, 60001) and/or for the second gain (60002) and/or for parameters of the linear inverse coding.

21. Upmix or coding device according to one of the claims 1 to 20, wherein means for the determination of the position of phantom sources are used.

22. Upmix or coding device according to one of the claims 1 to 21, wherein means for a signal analysis or means for determining algebraic invariants are used.

23. Upmix or coding device according to one of the claims 1 to 22, wherein means for a Karhunen-Loève transformation (KLT) or Principal Component Analysis (PCA) are used.

24. Upmix or coding device according to one of the claims 1 to 23, wherein means for optimizing the determination of algebraic invariants on the basis of a Karhunen-Loève transformation (KLT) or Principal Component Analysis (PCA) are used.

25. Upmix or coding device according to one of the claims 1 to 24, wherein means for optimizing one or several parameters of a non-linear or associated linear inverse coding on the basis of the main reflections or the reverb diffusion are used.

26. Upmix or coding device according to one of the claims 1 to 25, wherein means for the level correction and time correction of signals on the basis of the respective loudspeaker positions are used.

27. Upmix or coding device according to one of the claims 1 to 26, wherein means for wave field synthesis or means for Head Related Transfer Functions (HRTF) or means for Binaural Room Impulse Responses (BRIR) are used.

28. Coding device for an audio signal, comprising:

a down-mixer for generating a downmix channel by

means of the weighted addition of two signals based on a multichannel signal,

characterized by

an optimization device designed for determining a suitable value for an upmix or coding device according to one of the claims 1 to 27 for the first gain (50001, 60001) and/or the second gain (60002).

29. Coding device according to claim 28, wherein the optimization device contains an upmix or coding device according to one of the claims 1 to 27 for the reconstruction of the two signals from the downmix signal to determine the suitable value.

30. Coding device according to claim 28 or 29, wherein the optimization device is designed to optimize the weighting of the two signals for the first downmix channel.

31. Storage means having a downmix signal, based on a multi-channel signal, characterized by a value for a first gain for an upmix or coding device according to one of the claims 1 to 27.

32. Storage means according to claim 31, further comprising levels of channels of the multi-channel signal or levels of channels of the downmix signal.

33. System comprising:

coding device for generating a downmix channel on the bases of two signals, based on a multi-channel signal,

characterized by

upmix or coding device according to one of the claims

1 to 27 designed for the reconstruction of the two signals from the first downmix channel.

34. System according to claim 33, wherein the coding device is a coding device according to one of the claims 28 to 30.

35. Method for upmixing or coding an audio signal, having the steps of:

determining a first channel and a second channel through linear inverse coding from an input signal;

characterized by

multiplication of the first channel with a first gain (50001); or

multiplication of the first channel with a first gain (60001) and of the second channel with a second gain (60002), which is different from the first gain (60001).

36. Method for coding an audio signal, having the steps of:

generating a first downmix channel by means of weighted addition of two signals, which are based on a multi-channel,

characterized by,

determining a suitable value for a the first gain (50001, 60001) and/or the second gain (60002) for an upmixing or coding according to claim 26.

37. Computer program designed, when run on a processor, for executing the steps of a method according to claim 35 or 36.

38. Upmix or coding device for upmixing a downmix signal with a first number of channels on a multi-channel signal with a greater second number of channels, comprising:

comparative correlation device for the formation of at least one inter-channel from at least two channels, that are based on channels of the downmix signal, by extracting the correlated parts of the two channels,

output device for the formation of the multi-channel signal on the basis of the channels of the downmix signal and the inter-channels;

characterized by

an upmix or coding device according to one of the claims 1 to 27 for the generation of at least a further channel by means of non-linear inverse coding based on the inter-channels or one of the channels.

39. Upmix or coding device according to claim 38, wherein the comparative correlation device is designed to adapt the at least one intermediate signal to a received level.

40. Upmix or coding device according to claim 38 or 39, wherein the comparative correlation device is designed to correct a channel of the downmix signal by means of the inter-channel.

41. Upmix or coding device according to one of the claims 38 to 40, wherein the downmix signal comprises four channels of a first plane, with a front-right, back-right, back-left and a front-left channel, and the comparative correlation device is designed to form from the four channels of the downmix signal a front-central, a back-central a left-central and a right-central channel.

42. Upmix or coding device according to claim 41, wherein the upmix or coding device is designed according to one of the claims 1 to 20, to form a channel between the front-middle and the front-left channel from the front-left channel and/or form a channel between the front-middle and the front-right channel from the front-right channel.

CLAIMS

1. Upmix or coding device for an audio signal, comprising:

an inverse coding device for determining a first channel and a second channel of the audio signal through linear inverse coding from an input signal;

a first gain (50001) connected downstream to the inverse coding device in the first channel for multiplying the first channel with a first factor; or

a first gain (60001) connected downstream of the inverse coding device in the first channel for multiplying the first channel with a first factor and a second gain (60002) connected downstream of the inverse coding device in the second channel for multiplying the second channel with a second factor, that is different from the first factor,

characterized in that

the upmix or coding device is designed for producing or further processing the first channel multiplied with the first factor without combination with the second channel, and/or for producing or further processing the second channel multiplied with the second factor without combination with the first channel.

2. Upmix or coding device according to claim 1, wherein the first factor in the first gain (50001, 60001) and/or the second factor in the second gain (60002) is/are chosen depending on at least one parameter of a downmix that was used for generating the input channel.

3. Upmix or coding device according to claim 1, having an optimization device designed for adjusting the value of the first factor in the first gain (50001, 60001) and/or of the second factor in the second gain (60002) depending on the first channel and/or the second channel.

4. Upmix or coding device according to one of the claims 1 to 2, wherein the first factor in the first gain (50001, 60001) and/or the second factor in the second gain (60002) is/are permanently set.

5. Upmix or coding device according to claim 4, wherein the value of the first gain (50001, 60001) corresponds to 0.5 or $1/\sqrt{2}$.

6. Upmix or coding device according to one of the claims 1 to 5, having a level correcting device connected downstream of the inverse coding device and the first gain in the first channel and the second channel, designed for adjusting the levels of the first channel and of the second channel depending on at least one parameter of a downmix that was used for generating the input signal or depending on a received level.

7. Upmix or coding device according to claim 2 or 6, wherein the input signal is generated from two signals that are based on a multi-channel signal by means of weighted addition and the at least one parameter of the downmix corresponds to the weighting of the two signals.

8. Upmix or coding device according to one of the claims 1, 2 or 6, having a receiver device for receiving the input signal and a first value and/or second value, wherein the first factor in the first gain is adjusted according to the received first value and/or the second factor in the second gain is adjusted according to the received second value.

9. Upmix or coding device according to one of the claims 1 to 8, wherein the inverse coding device is designed for determining the first channel and the second channel on the basis of parameters received with the input signal.

10. Upmix or coding device according to one of the claims 1 to 9, wherein the inverse coding device is designed for determining at least one factor of at least one gain of the inverse coding device and at least one delay of the inverse coding device on the basis of an angle between a sound source and a main axis of a microphone, a virtual left opening angle, a virtual right opening angle and a directional characteristic for the input signal, and for determining a first intermediate signal and a second intermediate signal on the basis of the at least one delay and of the at least one factor of the at least one gain of the inverse coding device, and for determining the first channel and the second channel on the basis of the first intermediate signal and of the second intermediate signal.

11. Upmix or coding device according to claim 10, wherein the inverse coding device is designed for generating, on the basis of at least one weighting factor, the first channel and the second channel, each by means of

the weighted addition and/or weighted subtraction of the first and second intermediate signal.

12. Upmix or coding device according to claim 10 or 11, wherein the inverse coding device is designed for determining two delays on the basis of the angle between the sound source and the main axis of the microphone, of the left opening angle, of the right opening angle and of the directional characteristic, and for correcting these two delays through a common time factor (s).

13. Upmix or coding device according to one of the claims 10 to 12, wherein the angle between the sound source and the main axis of the microphone, the left opening angle, the right opening angle and/or the directional characteristic are constant.

14. Upmix or coding device according to one of the claims 1 to 13, having an optimization device for determining a suitable value for the first factor in the first gain (50001, 60001) and/or for the second factor in the second gain (60002) and/or for parameters of the linear inverse coding.

15. Upmix or coding device according to claim 14, wherein the optimization device is designed for determining the degree of correlation of the first channel and the second channel or of two signals underlying a downmix which was used for the creation of the input signal, and for determining the value of the first factor in the first gain (50001, 60001) and/or the second factor in the second gain

(60002) and/or the parameters of the linear inverse coding depending on the degree of correlation.

16. Upmix or coding device according to claim 15, wherein the optimization device is designed for determining the value of the first factor in the first gain (50001, 60001) and/or the second factor in the second gain (60002) and/or the parameters of the linear inverse coding depending on a target degree of correlation.

17. Upmix or coding device according to claim 16, wherein the optimization device is designed to determine the target degree of correlation on the basis of the nature of the first channel and the second channel or of the two signals underlying the downmix.

18. Upmix or coding device according to claim 16 or 17, wherein the target correlation

for voice or vocal recordings is greater than or equal to plus zero-point-five-one ($k \geq +0.51$), in particular greater than or equal to plus zero-point-six-six ($\geq +0,66$), and/or

for transients, is greater than or equal to plus zero-point-two-five ($\geq 0,25$), in particular greater than or equal to plus zero-point-four ($\geq 0,40$), and/or

in the case of other signals, is greater than or equal to minus zero-point-one-five ($\geq -0,15$), in particular greater than or equal to zero (≥ 0).

19. Upmix or coding device according to one of the claims 14 to 18, wherein the optimization device contains a

comparison device for the comparison of the first channel and the second channel with the two signals underlying the downmix in order to determine a suitable value for the first factor in the first gain (50001, 60001) and/or for the second factor in the second gain (60002) and/or for parameters of the linear inverse coding.

20. Coding device for an audio signal, comprising:

a down-mixer for generating a downmix signal by means of the weighted addition of two signals based on a multichannel signal,

characterized by

an optimization device designed for determining a suitable value for an upmix or coding device according to one of the claims 1 to 19 for the first factor in the first gain (50001, 60001) and/or the second factor in the second gain (60002).

21. Coding device according to claim 20, wherein the optimization device contains an upmix or coding device according to one of the claims 1 to 19 for the reconstruction of the two signals from the downmix signal to determine the suitable value.

22. Coding device according to claim 20 or 21, wherein the optimization device is designed to optimize the weighting of the two signals for the downmix signal.

23. Storage means having a downmix signal with at least one downmix channel, based on a multi-channel signal and a value for the first factor in the first gain for an upmix or coding device according to one of the claims 1 to 19.

24. Storage means according to claim 23, further comprising levels of channels of the multi-channel signal or levels of channels of the downmix signal.

25. System comprising:

coding device for generating a downmix channel on the bases of two signals, based on a multi-channel signal,

storage means or transmission means for transmitting the downmix channel, and

upmix or coding device according to one of the claims 1 to 19 designed for the reconstruction of the two signals from the transmitted downmix channel.

26. System according to claim 25, wherein the coding device according is a coding device according to one of the claims 20 to 22.

27. Method for upmixing or coding an audio signal, having the steps of:

determining a first channel and a second channel of the audio signal through linear inverse coding from an input signal;

multiplication of the first channel with a first factor; or

multiplication of the first channel with a first factor and of the second channel with a second factor, which is different from the first factor

wherein the first channel multiplied with the first factor is not combined with the second channel after this multiplication, and/or the second channel multiplied with

the second factor is not combined with the first channel after this multiplication.

28. Method for coding an audio signal, having the steps of:

generating a downmix channel by means of weighted addition of two signals, which are based on a multi-channel,

determining a suitable value for a the first factor and/or the second factor for an upmixing or coding according to claim 27.

29. Computer program designed, when run on a processor, for executing the steps of a method according to claim 27 or 28.