Claims

1. Audio encoder for producing an audio bitstream comprising one or more audio channels (AC) and/or one or more audio objects (AO), the audio encoder (1) comprising a metadata encoder (2) for producing a metadata bitstream (MBS), the audio encoder being configured:

to receive at least one dynamic range control gain sequence (DS) for an audio frame comprising one or more dynamic range control gains for a dynamic range control stage (5) of an audio decoder (3);

to receive at least one guided clipping prevention gain sequence (GS) for the audio frame comprising one or more guided clipping prevention gains for a guided clipping prevention stage (6) of the audio decoder (3); and

to include at least one of said dynamic range control gain sequences (DS) and at least one of said guided clipping prevention gain sequences (GS) into the metadata bitstream (MBS).

2. Audio encoder according to the preceding claim, wherein the metadata encoder (2) is configured to receive at least two dynamic range control gain sequences (DS) for the same audio frame comprising different dynamic range control gains, and to include the at least two dynamic range control gain sequences (DS) comprising different dynamic range control gains into the metadata bitstream (MBS).

3. Audio encoder according to one of the preceding claims, wherein the metadata encoder (2) is configured to receive a dynamic range control gain sequence (DS) comprising at least two dynamic range control gains related to different audio channels and/or to different audio ob-

jects, and to include the dynamic range control gain sequence (DS) comprising at least two dynamic range control gains related to different audio channels and/or to different audio objects and, optionally, the relationships of the dynamic range control gains to the audio channels and/or the audio objects into the metadata bitstream (MBS).

4. Audio encoder according to one of the preceding claims, wherein the metadata encoder (2) is configured to receive a dynamic range control gain sequence (DS) comprising at least two dynamic range control gains related to different frequency bands of the audio decoder, and to include the dynamic range control gain sequence (DS) comprising at least two dynamic range control gains related to different frequency bands of the decoder and, optionally, the relationships of the dynamic range control gains to the frequency bands of the decoder into the metadata bitstream (MBS).

5. Audio encoder according to one of the preceding claims, wherein the metadata encoder (2) is configured to receive at least two guided clipping prevention gain sequences (GS) comprising different guided clipping prevention gains, and to include the at least two guided clipping prevention gain sequences (GS) comprising the different guided clipping prevention gains into the metadata bitstream (MBS).

6. Audio encoder according to one of the preceding claims, wherein each dynamic range control sequence (DS) is related to one of the guided clipping prevention gain sequences (GS), wherein the metadata encoder (2) is configured to include relationships between the dynamic range control sequences (DS) and the guided clipping prevention gain sequences (GS) into the metadata bitstream (MBS).

7. Audio encoder according to one of the preceding claims, wherein the metadata encoder (2) is configured to receive a guided clipping preven-

tion gain sequence (GS) comprising at least two guided clipping prevention gains related to different audio channels and/or to different audio objects, and to include the guided clipping prevention gain sequence (GS) comprising at least two guided clipping prevention gains related to different audio channels and/or to different audio objects and, optionally, the relationships of the guided clipping prevention gains to the audio channels and/or the audio objects into the metadata bitstream (MBS).

8. Method for operating an audio encoder (1) for producing an audio bitstream comprising one or more audio channels and/or one or more audio objects, the audio encoder (1) comprising a metadata encoder (2) for producing a metadata bitstream (MBS), the method comprising the steps of:

receiving, on the part of the metadata encoder (2), at least one dynamic range control gain sequence (DS) comprising one or more dynamic range control gains for a dynamic range control stage (5) of an audio decoder (3);

receiving, on the part of the metadata encoder (2), at least one guided clipping prevention gain sequence (GS) comprising one or more guided clipping prevention gains for a guided clipping prevention stage (6) of the audio decoder (3); and

including, on the part of the metadata encoder (2), at least one of said dynamic range control gain sequences (DS) and at least one of said guided clipping prevention gain sequences (GS) into the metadata bitstream (MBS).

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

10. Audio decoder for decoding an audio bitstream and a metadata bitstream (MBS) related to the audio bitstream, which are produced in particular by an audio encoder (1) according to one of claims 1 to 8, the audio decoder comprising:

an audio processing chain (4) configured to receive a decoded audio signal (DAS) derived from the audio bitstream and to adjust characteristics of an audio output signal (AOS) of the audio processing chain (4), the audio processing chain (4) comprising a plurality of adjustment stages (5, 6, 10, 11, 12, 13, 14) including a dynamic range control stage (5) for adjusting a dynamic range of the audio output signal (AOS) and a guided clipping prevention stage (6) for preventing of clipping of the audio output signal (AOS); and

a metadata decoder (7) configured to receive the metadata bitstream (MBS) and to extract dynamic range control gain sequences (DS) and guided clipping prevention gain sequences (GS) from the metadata bitstream (MBS), at least a part of the dynamic range control gain sequences (DS) being supplied to the dynamic range control stage (5), and at least a part of the guided clipping prevention gain sequences (GS) being supplied to the guided clipping prevention stage (6).

11. Audio decoder according to claim 10, wherein the metadata decoder (7) is configured to extract from the metadata bitstream (MBS) at least two dynamic range control gain sequences (DS) for the same audio frame comprising different dynamic range control gains.

12. Audio decoder according to claim 10 or 11, wherein the metadata decoder (7) is configured to extract from the metadata bitstream (MBS) a dynamic range control gain sequence (DS) comprising at least two dynamic range control gains related to different audio channels and/or to different audio objects.

13. Audio decoder according to one of the claims 10 to 12, wherein the metadata decoder (7) is configured to extract from the metadata bit-stream (MBS) a dynamic range control gain sequence (DS) comprising at least two dynamic range control gains related to different frequency bands of the audio decoder (3).

14. Audio decoder according to one of the claims 10 to 13, wherein the metadata decoder (7) is configured to extract from the metadata bit-stream (MBS) at least two guided clipping prevention gain sequences (GS) comprising different guided clipping prevention gains.

15. Audio decoder according to one of the claims 10 to 14, wherein the metadata decoder (7) is configured to extract from the metadata bit-stream (MBS) a guided clipping prevention gain sequence (GS) comprising at least two guided clipping prevention gains related to different audio channels and/or to different audio objects.

16. Audio decoder according to one of the claims 10 to 15, the audio decoder (3) further comprising a metadata and parameter control stage (8) configured to provide metadata and parameters (DS, GS, CLA, DI, DTL, PRL, IS, OMD, ICT) to at least one of the adjustment stages (5, 6, 10, 11, 12, 13, 14) on the basis of configuration information (CI) received from a configuration providing stage (9).

17. Audio decoder according to one of the claims 10 to 16, wherein the metadata and parameter control stage (8) is configured to select, in the event that a plurality of dynamic range control gain sequences (DS) is received, which of the plurality of dynamic range control gain sequences (DS) is supplied to the dynamic range control stage (5).

18. Audio decoder according to one of the claims 10 to 17, wherein the metadata and parameter control stage (8) is configured to select, in the event that a plurality of guided clipping prevention gain sequences (GS) is received, which of the plurality of guided clipping prevention gain sequences (GS) is supplied to the guided clipping prevention stage (6).

19. Audio decoder according to one of the claims 10 to 18, wherein the dynamic range control stage (5) in the direction of the signal flow is the first adjustment stage of the audio adjustment chain (8).

20. Audio decoder according to one of the claims 10 to 19, wherein the audio adjustment chain (4) comprises a format converter stage (10) configured to adjust a channel configuration of the audio output signal (AOS).

21. Audio decoder according to one of the claims 10 to 20, wherein the audio adjustment chain (4) comprises a loudness normalization stage (11) configured to normalize the loudness of the audio output signal (AOS).

22. Audio decoder according to one of the claims 10 to 21, wherein the audio adjustment chain (4) comprises a peak limiter stage (12) configured to limit peaks of the audio output (AOS) in the event that a threshold is exceeded.

23. Audio decoder according to one of the claims 10 to 22, wherein the audio adjustment chain (4) comprises an object renderer stage (13) configured to mix audio objects into channels of the audio output signal (AOS).

24. Audio decoder according to one of the claims 10 to 23, wherein the audio adjustment chain (4) comprises a transducer adaption stage (14)

configured to adjust characteristics of the audio output signal (AOS) to a transducer system used for reproducing the audio output signal (AOS).

25. Audio decoder according to one of the claims 10 to 24, wherein the peak limiter stage (12) in the direction of the signal flow is the last adjustment stage of the audio adjustment chain (4).

26. Method for operating an audio decoder (3), in particular an audio decoder (3) according to one of claims 10 to 25, for decoding an audio bitstream and a metadata bitstream (MBS) related to the audio bitstream, which are produced in particular by an audio encoder (1) according to one of claims 1 to 8, the method comprising the steps of:

deriving a decoded audio signal (DAS) from the audio bitstream;

using an audio processing chain (4) having a plurality of adjusting stages for adjusting characteristics of an audio output signal (AOS) of the audio processing chain (4) including adjusting a dynamic range of the audio output signal (AOS) by a dynamic range control stage (5), which is an adjustment stage (5, 6, 10, 11, 12, 13, 14) of the adjustment chain (4), and preventing of clipping of the audio output signal (AOS) by a guided clipping prevention stage (6), which is an adjustment stage (5, 6, 10, 11, 12, 13, 14) of the adjustment chain (4);

receiving, on the part of a metadata decoder (7), the metadata bitstream (MBS) and extracting dynamic range control gain sequences (DS) and guided clipping prevention gain sequences (GS) from the metadata bitstream (MBS);

supplying at least a part of the dynamic range control gain sequences (DS) to the dynamic range control stage (5); and

supplying at least a part of the guided clipping prevention gain sequences (GS) to the guided clipping prevention stage (6).

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

28. Metadata encoder (2) for producing a metadata bitstream (MBS), the metadata encoder being configured:

to receive at least one dynamic range control gain sequence (DS) for an audio frame comprising one or more dynamic range control gains for a dynamic range control stage (5) of an audio decoder (3);

to receive at least one guided clipping prevention gain sequence (GS) for the audio frame comprising one or more guided clipping prevention gains for a guided clipping prevention stage (6) of the audio decoder (3); and

to include at least one of said dynamic range control gain sequences (DS) and at least one of said guided clipping prevention gain sequences (GS) into the metadata bitstream (MBS).

29. Unified speech and audio coding audio encoder for producing an audio bitstream comprising one or more audio channels (AC) and/or one or more audio objects (AO), the audio encoder (1) comprising a metadata encoder (2) for producing a metadata bitstream (MBS), the audio encoder being configured:

to receive at least one dynamic range control gain sequence (DS) for an audio frame comprising one or more dynamic range control gains for a dynamic range control stage (5) of an audio decoder (3);

to receive at least one guided clipping prevention gain sequence (GS) for the audio frame comprising one or more guided clipping prevention gains for a guided clipping prevention stage (6) of the audio decoder (3); and

to include at least one of said dynamic range control gain sequences (DS) and at least one of said guided clipping prevention gain sequences (GS) into the metadata bitstream (MBS).

30. Audio decoder for decoding an audio bitstream and a metadata bitstream (MBS) related to the audio bitstream, which are produced in particular by an audio encoder (1) according to one of claims 1 to 8, the audio decoder comprising:

an audio processing chain (4) configured to receive a decoded audio signal (DAS) derived from the audio bitstream and to adjust characteristics of an audio output signal (AOS) of the audio processing chain (4), the audio processing chain (4) comprising a plurality of adjustment stages (5, 6, 10, 11, 12, 13, 14) including a dynamic range control stage (5) for adjusting a dynamic range of the audio output signal (AOS), a loudness normalization stage (11) configured to normalize the loudness of the audio output signal (AOS) and a guided clipping prevention stage (6) for preventing of clipping of the audio output signal (AOS); and

a metadata decoder (7) configured to receive the metadata bitstream (MBS) and to extract dynamic range control gain sequences (DS) and guided clipping prevention gain sequences (GS) from the metadata bitstream (MBS), at least a part of the dynamic range control gain sequences (DS) being supplied to the dynamic range control stage (5), and at least a part of the guided clipping prevention gain sequences (GS) being supplied to the guided clipping prevention stage (6).

Claims

1. Audio encoder for producing an audio bitstream comprising one or more audio channels and/or one or more audio objects, the audio encoder comprising a metadata encoder for producing a metadata bitstream, the audio encoder being configured:

to receive at least one dynamic range control gain sequence for an audio frame comprising one or more dynamic range control gains for a dynamic range control stage of an audio decoder;

to receive at least one guided clipping prevention gain sequence for the audio frame comprising one or more guided clipping prevention gains for a guided clipping prevention stage of the audio decoder; and

to include at least one of said dynamic range control gain sequences and at least one of said guided clipping prevention gain sequences into the metadata bitstream.

2. Audio encoder according to the preceding claim, wherein the metadata encoder is configured to receive at least two dynamic range control gain sequences for the same audio frame comprising different dynamic range control gains, and to include the at least two dynamic range control gain sequences comprising different dynamic range control gains into the metadata bitstream.

3. Audio encoder according to one of the preceding claims, wherein the metadata encoder is configured to receive a dynamic range control gain sequence comprising at least two dynamic range control gains related to different audio channels and/or to different audio objects, and to include the dynamic range control gain sequence comprising at least two dynamic range control gains related to different audio channels and/or

to different audio objects and, optionally, the relationships of the dynamic range control gains to the audio channels and/or the audio objects into the metadata bitstream.

4. Audio encoder according to one of the preceding claims, wherein the metadata encoder is configured to receive a dynamic range control gain sequence comprising at least two dynamic range control gains related to different frequency bands of the audio decoder, and to include the dynamic range control gain sequence comprising at least two dynamic range control gains related to different frequency bands of the decoder and, optionally, the relationships of the dynamic range control gains to the frequency bands of the decoder into the metadata bitstream.

5. Audio encoder according to one of the preceding claims, wherein the metadata encoder is configured to receive at least two guided clipping prevention gain sequences comprising different guided clipping prevention gains, and to include the at least two guided clipping prevention gain sequences comprising the different guided clipping prevention gains into the metadata bitstream.

6. Audio encoder according to one of the preceding claims, wherein each dynamic range control sequence is related to one of the guided clipping prevention gain sequences, wherein the metadata encoder is configured to include relationships between the dynamic range control sequences and the guided clipping prevention gain sequences into the metadata bitstream.

7. Audio encoder according to one of the preceding claims, wherein the metadata encoder is configured to receive a guided clipping prevention gain sequence comprising at least two guided clipping prevention gains related to different audio channels and/or to different audio objects, and to include the guided clipping prevention gain sequence comprising at

least two guided clipping prevention gains related to different audio channels and/or to different audio objects and, optionally, the relationships of the guided clipping prevention gains to the audio channels and/or the audio objects into the metadata bitstream.

8. Method for operating an audio encoder for producing an audio bitstream comprising one or more audio channels and/or one or more audio objects, the audio encoder comprising a metadata encoder for producing a metadata bitstream, the method comprising the steps of:

receiving, on the part of the metadata encoder, at least one dynamic range control gain sequence comprising one or more dynamic range control gains for a dynamic range control stage of an audio decoder;

receiving, on the part of the metadata encoder, at least one guided clipping prevention gain sequence comprising one or more guided clipping prevention gains for a guided clipping prevention stage of the audio decoder; and

including, on the part of the metadata encoder, at least one of said dynamic range control gain sequences and at least one of said guided clipping prevention gain sequences into the metadata bitstream.

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

10. Audio decoder for decoding an audio bitstream and a metadata bitstream related to the audio bitstream, which are produced in particular by an audio encoder according to one of claims 1 to 8, the audio decoder comprising:

an audio processing chain configured to receive a decoded audio signal

derived from the audio bitstream and to adjust characteristics of an audio output signal of the audio processing chain, the audio processing chain comprising a plurality of adjustment stages including a dynamic range control stage for adjusting a dynamic range of the audio output signal and a guided clipping prevention stage for preventing of clipping of the audio output signal; and

a metadata decoder configured to receive the metadata bitstream and to extract dynamic range control gain sequences and guided clipping prevention gain sequences from the metadata bitstream, at least a part of the dynamic range control gain sequences being supplied to the dynamic range control stage, and at least a part of the guided clipping prevention gain sequences being supplied to the guided clipping prevention stage.

11. Audio decoder according to claim 10, wherein the metadata decoder is configured to extract from the metadata bitstream at least two dynamic range control gain sequences for the same audio frame comprising different dynamic range control gains.

12. Audio decoder according to claim 10 or 11, wherein the metadata decoder is configured to extract from the metadata bitstream a dynamic range control gain sequence comprising at least two dynamic range control gains related to different audio channels and/or to different audio objects.

13. Audio decoder according to one of the claims 10 to 12, wherein the metadata decoder is configured to extract from the metadata bitstream a dynamic range control gain sequence comprising at least two dynamic range control gains related to different frequency bands of the audio decoder.

14. Audio decoder according to one of the claims 10 to 13, wherein the metadata decoder is configured to extract from the metadata bitstream at least two guided clipping prevention gain sequences comprising different guided clipping prevention gains.

15. Audio decoder according to one of the claims 10 to 14, wherein the metadata decoder is configured to extract from the metadata bitstream a guided clipping prevention gain sequence comprising at least two guided clipping prevention gains related to different audio channels and/or to different audio objects.

16. Audio decoder according to one of the claims 10 to 15, the audio decoder further comprising a metadata and parameter control stage configured to provide metadata and parameters to at least one of the adjustment stages on the basis of configuration information received from a configuration providing stage.

17. Audio decoder according to one of the claims 10 to 16, wherein the metadata and parameter control stage is configured to select, in the event that a plurality of dynamic range control gain sequences is received, which of the plurality of dynamic range control gain sequences is supplied to the dynamic range control stage.

18. Audio decoder according to one of the claims 10 to 17, wherein the metadata and parameter control stage is configured to select, in the event that a plurality of guided clipping prevention gain sequences is received, which of the plurality of guided clipping prevention gain sequences is supplied to the guided clipping prevention stage.

19. Audio decoder according to one of the claims 10 to 18, wherein the dynamic range control stage in the direction of the signal flow is the first adjustment stage of the audio adjustment chain.

20. Audio decoder according to one of the claims 10 to 19, wherein the audio adjustment chain comprises a format converter stage configured to adjust a channel configuration of the audio output signal.

21. Audio decoder according to one of the claims 10 to 20, wherein the audio adjustment chain comprises a loudness normalization stage configured to normalize the loudness of the audio output signal.

22. Audio decoder according to one of the claims 10 to 21, wherein the audio adjustment chain comprises a peak limiter stage configured to limit peaks of the audio output in the event that a threshold is exceeded.

23. Audio decoder according to one of the claims 10 to 22, wherein the audio adjustment chain comprises an object renderer stage configured to mix audio objects into channels of the audio output signal.

24. Audio decoder according to one of the claims 10 to 23, wherein the audio adjustment chain comprises a transducer adaption stage configured to adjust characteristics of the audio output signal to a transducer system used for reproducing the audio output signal.

25. Audio decoder according to one of the claims 10 to 24, wherein the peak limiter stage in the direction of the signal flow is the last adjustment stage of the audio adjustment chain.

26. Method for operating an audio decoder, in particular an audio decoder according to one of claims 10 to 25, for decoding an audio bitstream and a metadata bitstream related to the audio bitstream, which are produced in particular by an audio encoder according to one of claims 1 to 8, the method comprising the steps of:

deriving a decoded audio signal from the audio bitstream;

using an audio processing chain having a plurality of adjusting stages for adjusting characteristics of an audio output signal of the audio processing chain including adjusting a dynamic range of the audio output signal by a dynamic range control stage, which is an adjustment stage of the adjustment chain, and preventing of clipping of the audio output signal by a guided clipping prevention stage, which is an adjustment stage of the adjustment chain;

receiving, on the part of a metadata decoder, the metadata bitstream and extracting dynamic range control gain sequences and guided clipping prevention gain sequences from the metadata bitstream;

supplying at least a part of the dynamic range control gain sequences to the dynamic range control stage; and

supplying at least a part of the guided clipping prevention gain sequences to the guided clipping prevention stage.

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