equalization processing is performed on the five channel signals to obtain Le, Re, Ce, LSe, and RSe, and then stereo processing is performed on two equalized channel signals (for example, (Le, Re) or (LSe, RSe)) in the channel pair by using a stereo box based on the target channel pair set.

[00178] A stereo processing unit may use prediction-based or Karhunen-Loeve transform (Karhunen-Loeve Transform, KLT)-based processing, that is, two input channel signals are rotated (for example, by using a 2×2 rotation matrix) to maximize energy compression, to concentrate signal energy in one channel.

[00179] After processing the two input channel signals, the stereo processing unit outputs processed channel signals (P1 to P4) corresponding to the two channel signals and multi-channel side information, and the multi-channel side information includes a sum of correlation values and a target channel pair set.

[00180] FIG. 6 is an example diagram depicting a structure of a decoding apparatus to which a multi-channel audio decoding method is applied according to this application. The decoding apparatus may be the decoder 30 of the destination device 14 in the audio coding system 10, or may be the coding module 270 in the audio coding device 200. The decoding apparatus may include a bitstream demultiplexing interface, a channel decoding module, and a multi-channel processing module.

[00181] The bitstream demultiplexing interface receives an encoded multi-channel signal (for example, a serial bitstream (bitstream)) from an encoding apparatus, and obtains an encoded channel signal (E) and a multi-channel parameter (SIDE_PAIR) after demultiplexing, for example, E1, E2, E3, E4, ..., Ei–1, Ei, and SIDE_PAIR1, SIDE_PAIR2, ..., SIDE_PAIRm.

[00182] The channel decoding module decodes the encoded channel signals output by the bitstream demultiplexing interface by using a monophonic decoding unit (or a monophonic box or a monophonic tool) and outputs decoded channel signals (D). For example, E1, E2, E3, E4, ..., Ei-1, and Ei are respectively decoded by the monophonic decoding unit to obtain D1, D2, D3, D4, ..., Di–1, and Di ~~after E1 is decoded~~.

[00183] The multi-channel processing module includes a plurality of stereo processing units. The stereo processing unit may use prediction-based or KLT-based processing, that is, two input channel signals are reversely rotated (for example, by using a 2×2 rotation matrix), to transform the signals to original signal directions.

[00184] Which two of the decoded channel signals output by the channel decoding module are

CLAIMS

What is claimed is:

1. A multi-channel audio signal coding method, comprising:

obtaining a to-be-encoded first audio frame, wherein the first audio frame comprises at least five channel signals;

pairing the at least five channel signals according to a first pairing manner to obtain a first channel pair set, wherein the first channel pair set comprises at least one channel pair, and one channel pair comprises two channel signals of the at least five channel signals;

obtaining a first sum of correlation values of the first channel pair set, wherein one channel pair has one correlation value, and the correlation value indicates correlation between two channel signals of the channel pair;

pairing the at least five channel signals according to a second pairing manner to obtain a second channel pair set;

obtaining a second sum of correlation values of the second channel pair set;

determining a target pairing manner of the at least five channel signals based on the first sum of correlation values and the second sum of correlation values; and

encoding the at least five channel signals according to the target pairing manner, wherein the target pairing manner is the first pairing manner or the second pairing manner.

2. The method according to claim 1, wherein the determining a target pairing manner of the at least five channel signals based on the first sum of correlation values and the second sum of correlation values comprises:

when the first sum of correlation values is greater than the second sum of correlation values, determining that the target pairing manner is the first pairing manner; or

when the first sum of correlation values is equal to the second sum of correlation values, determining that the target pairing manner is the second pairing manner.

3. The method according to claim 1 or 2, wherein before the encoding the at least five channel signals according to the target pairing manner, the method further comprises:

obtaining a fluctuation interval value of the at least five channel signals;

when the target pairing manner is the first pairing manner, determining an energy equalization mode based on the fluctuation interval value of the at least five channel signals; or

when the target pairing manner is the second pairing manner, determining an energy equalization mode based on the fluctuation interval value of the at least five channel signals, and re-determining the target pairing manner of the at least five channel signals; and

separately performing energy equalization processing on the at least five channel signals according to the energy equalization mode to obtain at least five equalized channel signals, wherein

correspondingly, the encoding the at least five channel signals according to the target pairing manner comprises:

encoding the at least five equalized channel signals according to the target pairing manner.

4. The method according to claim 3, wherein the determining an energy equalization mode based on the fluctuation interval value of the at least five channel signals comprises:

when the fluctuation interval value meets a preset condition, determining that the energy equalization mode is a first energy equalization mode; or

when the fluctuation interval value does not meet a preset condition, determining that the energy equalization mode is a second energy equalization mode.

5. The method according to claim 3 or 4, wherein the determining an energy equalization mode based on the fluctuation interval value of the at least five channel signals, and re-determining the target pairing manner of the at least five channel signals comprises:

when the fluctuation interval value meets the preset condition, determining that the target pairing manner is the first pairing manner, and the energy equalization mode is the first energy equalization mode; or

when the fluctuation interval value does not meet the preset condition, determining that the target pairing manner is the second pairing manner, and the energy equalization mode is the second energy equalization mode.

6. The method according to any one of claims 3 to 5, wherein before the determining an energy equalization mode based on the fluctuation interval value of the at least five channel signals, the method further comprises:

determining whether a coding bit rate corresponding to the first audio frame is greater than a bit rate threshold; and

when the coding bit rate is greater than the bit rate threshold, determining that the energy equalization mode is the second energy equalization mode; or

when the coding bit rate is less than or equal to the bit rate threshold, determining the energy

equalization mode based on the fluctuation interval value.

7. The method according to any one of claims 4 to 6, wherein the fluctuation interval value comprises energy flatness of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the energy flatness is less than a first threshold; or

the fluctuation interval value comprises amplitude flatness of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the amplitude flatness is less than a second threshold; or

the fluctuation interval value comprises energy deviation of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the energy deviation falls outside a first preset range; or

the fluctuation interval value comprises amplitude deviation of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the amplitude deviation falls outside a second preset range.

8. The method according to any one of claims 1 to 7, wherein the pairing the at least five channel signals according to a first pairing manner to obtain a first channel pair set comprises:

selecting a channel pair from channel pairs corresponding to the at least five channel signals, and adding the channel pair to the first channel pair set, to obtain a largest sum of correlation values.

9. The method according to any one of claims 1 to 8, wherein the pairing the at least five channel signals according to a second pairing manner to obtain a second channel pair set comprises:

first adding, to the second channel pair set, a channel pair with a largest correlation value in the channel pairs corresponding to the at least five channel signals; and

adding, to the second channel pair set, a channel pair with a largest correlation value in other channel pairs other than an associated channel pair in the channel pairs corresponding to the at least five channel signals, wherein the associated channel pair comprises any channel signal comprised in a channel pair added to the first channel pair set.

10. The method according to any one of claims 3 to 7, wherein when the energy equalization mode is the first energy equalization mode, the separately performing energy equalization processing on the at least five channel signals according to the energy equalization mode to obtain at least five equalized channel signals comprises:

calculating, for a current channel pair in a target channel pair set corresponding to the pairing

manner, an average value of energy or amplitude values of two channel signals comprised in the current channel pair, and separately performing energy equalization processing on the two channel signals based on the average value to obtain two corresponding equalized channel signals.

11. The method according to any one of claims 3 to 7, wherein when the energy equalization mode is the second energy equalization mode, the separately performing energy equalization processing on the at least five channel signals according to the energy equalization mode to obtain at least five equalized channel signals comprises:

calculating an average value of energy or amplitude values of the at least five channel signals, and separately performing energy equalization processing on the at least five channel signals based on the average value to obtain the at least five equalized channel signals.

12. A coding apparatus, comprising:

an obtaining module, configured to: obtain a to-be-encoded first audio frame, wherein the first audio frame comprises at least five channel signals; pair the at least five channel signals according to a first pairing manner to obtain a first channel pair set, wherein the first channel pair set comprises at least one channel pair, and one channel pair comprises two channel signals of the at least five channel signals; obtain a first sum of correlation values of the first channel pair set, wherein one channel pair has one correlation value, and the correlation value indicates correlation between two channel signals of the channel pair; pair the at least five channel signals according to a second pairing manner to obtain a second channel pair set; and obtain a second sum of correlation values of the second channel pair set;

a determining module, configured to determine a target pairing manner of the at least five channel signals based on the first sum of correlation values and the second sum of correlation values; and

a coding module, configured to encode the at least five channel signals according to the target pairing manner, wherein the target pairing manner is the first pairing manner or the second pairing manner.

13. The apparatus according to claim 12, wherein the determining module is specifically configured to: when the first sum of correlation values is greater than the second sum of correlation values, determine that the target pairing manner is the first pairing manner; or when the first sum of correlation values is equal to the second sum of correlation values, determine that the target pairing manner is the second pairing manner.

14. The apparatus according to claim 12 or 13, wherein the determining module is further configured to: obtain a fluctuation interval value of the at least five channel signals; and when the target pairing manner is the first pairing manner, determine an energy equalization mode based on the fluctuation interval value of the at least five channel signals; or when the target pairing manner is the second pairing manner, determine an energy equalization mode based on the fluctuation interval value of the at least five channel signals, and re-determine the target pairing manner of the at least five channel signals; and

correspondingly, the coding module is further configured to: separately perform energy equalization processing on the at least five channel signals according to the energy equalization mode to obtain at least five equalized channel signals; and encode the at least five equalized channel signals according to the target pairing manner.

15. The apparatus according to claim 14, wherein the determining module is specifically configured to: when the fluctuation interval value meets a preset condition, determine that the energy equalization mode is a first energy equalization mode; or when the fluctuation interval value does not meet a preset condition, determine that the energy equalization mode is a second energy equalization mode.

16. The apparatus according to claim 14 or 15, wherein the determining module is specifically configured to: when the fluctuation interval value meets the preset condition, determine that the target pairing manner is the first pairing manner, and the energy equalization mode is the first energy equalization mode; or when the fluctuation interval value does not meet the preset condition, determine that the target pairing manner is the second pairing manner, and the energy equalization mode is the second energy equalization mode.

17. The apparatus according to any one of claims 14 to 16, wherein the determining module is further configured to: determine whether a coding bit rate corresponding to the first audio frame is greater than a bit rate threshold; and when the coding bit rate is greater than the bit rate threshold, determine that the energy equalization mode is the second energy equalization mode; or when the coding bit rate is less than or equal to the bit rate threshold, determine the energy equalization mode based on the fluctuation interval value.

18. The apparatus according to any one of claims 15 to 17, wherein the fluctuation interval value comprises energy flatness of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the energy flatness is less than a first threshold; or

the fluctuation interval value comprises amplitude flatness of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the amplitude flatness is less than a second threshold; or

the fluctuation interval value comprises energy deviation of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the energy deviation falls outside a first preset range; or

the fluctuation interval value comprises amplitude deviation of the first audio frame, and the fluctuation interval value meeting the preset condition indicates that the amplitude deviation falls outside a second preset range.

19. The apparatus according to any one of claims 12 to 18, wherein the obtaining module is specifically configured to: select a channel pair from channel pairs corresponding to the at least five channel signals, and add the channel pair to the first channel pair set, to obtain a largest sum of correlation values.

20. The apparatus according to any one of claims 12 to 19, wherein the obtaining module is specifically configured to: first add, to the second channel pair set, a channel pair with a largest correlation value in the channel pairs corresponding to the at least five channel signals; and add, to the second channel pair set, a channel pair with a largest correlation value in other channel pairs other than an associated channel pair in the channel pairs corresponding to the at least five channel signals, wherein the associated channel pair comprises any channel signal comprised in a channel pair added to the first channel pair set.

21. The apparatus according to any one of claims 14 to 18, wherein when the energy equalization mode is the first energy equalization mode, the coding module is specifically configured to: calculate, for a current channel pair in a target channel pair set corresponding to the pairing manner, an average value of energy or amplitude values of two channel signals comprised in the current channel pair; and separately perform energy equalization processing on the two channel signals based on the average value to obtain two corresponding equalized channel signals.

22. The apparatus according to any one of claims 14 to 18, wherein when the energy equalization mode is the second energy equalization mode, the coding module is specifically configured to: calculate an average value of energy or amplitude values of the at least five channel signals; and separately perform energy equalization processing on the at least five channel signals based on the average value to obtain the at least five equalized channel signals.

23. A device, comprising:

one or more processors; and

a memory, configured to store one or more programs, wherein

when the one or more programs are executed by the one or more processors, the one or more processors are enabled to implement the method according to any one of claims 1 to 11.

24. A computer-readable storage medium, comprising a computer program, wherein when the computer program is executed on a computer, the computer is enabled to perform the method according to any one of claims 1 to 11.

25. A computer-readable storage medium, comprising a coded bitstream obtained by using the multi-channel audio signal coding method according to any one of claims 1 to 11.

~~26. A computer program, wherein when the computer program is executed on a computer, the computer is enabled to perform the method according to any one of claims 1 to 11.~~