SIGNAL PROCESSING METHOD AND APPARATUS

[0001] ~~This application claims priority to Chinese Patent Application No. 201410101859.1, filed with the Chinese Patent Office on March 19, 2014 and entitled "SIGNAL PROCESSING METHOD AND APPARATUS", which is incorporated herein by reference in its entirety~~.

TECHNICAL FIELD

[0002] The present invention relates to audio encoding and decoding technologies, and more specifically, to a signal processing method and apparatus.

BACKGROUND

[0003] In an existing frequency-domain encoding algorithm, during bit allocation, the following processing is included: allocating bits to each sub-band according to a sub-band envelope; sorting sub-bands in ascending order according to a quantity of allocated bits; starting encoding from a sub-band with a smallest quantity of allocated bits; and evenly allocating surplus bits left in an encoded sub-band to remaining unencoded sub-bands, where bits left in each sub-band are insufficient for encoding one information unit. Because allocation of surplus bits is merely even allocation to sub-bands with larger quantities of originally allocated bits determined by energy envelopes, a waste of bits is caused, resulting in a non-ideal encoding effect.

SUMMARY

[0004] Embodiments of the present invention provide a signal processing method and apparatus, which can avoid a waste of bits and improve encoding and decoding quality.

[0005] According to a first aspect, a signal processing method is provided, including: determining a total quantity of to-be-allocated bits corresponding to to-be-processed sub-bands of a current frame; implementing primary bit allocation on

the second-priority to-be-enhanced sub-band belongs to the sub-bands for secondary bit allocation.

[0040] With reference to the second aspect or any one of the foregoing possible implementation manners of the second aspect, in another possible implementation manner of the second aspect, the selection subunit is specifically configured to: determine a sub-band with a smaller average quantity of primary bits per unit bandwidth, a sub-band with a smaller quantity of primary bits per information unit, or a sub-band with a smaller quantity of primarily allocated bits, of two sub-bands adjacent to the top-priority to-be-enhanced sub-band as the second-priority to-be-enhanced sub-band.

[0041] With reference to the second aspect or any one of the foregoing possible implementation manners of the second aspect, in another possible implementation manner of the second aspect, the secondary bit allocation unit is specifically configured to: when a quantity of sub-bands included in the sub-bands for secondary bit allocation is greater than or equal to 2, implement secondary bit allocation on the sub-bands for secondary bit allocation according to a quantity of bits per information unit that is obtained from the primary information unit quantity determining operation, an average quantity of bits per unit bandwidth or a quantity of primarily allocated bits that is obtained from the primary information unit quantity determining operation, of each sub-band of the sub-bands for secondary bit allocation.

[0042] With reference to the second aspect or any one of the foregoing possible implementation manners of the second aspect, in another possible implementation manner of the second aspect, the primary bit allocation unit is specifically configured to: implement primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits and envelope values of sub-bands of the to-be-processed sub-bands.

[0043] With reference to the second aspect or any one of the foregoing possible implementation manners of the second aspect, in another possible implementation manner of the second aspect, the apparatus is a ~~decoder~~encoder, and the apparatus further includes: a quantization unit, configured to perform a quantization operation for each sub-band of the to-be-processed sub-bands according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain a quantized spectral coefficient corresponding to each sub-band, where the quantity of information units corresponding to each sub-band of the sub-bands for

to-be-processed sub-bands, or a coefficient quantization state of a corresponding previous-frame sub-band of at least one sub-band of the to-be-processed sub-bands; and the apparatus further includes: a second acquiring unit, configured to acquire the at least one parameter from a to-be-decoded bitstream.

[0047] According to a third aspect, a signal processing apparatus is provided, where the apparatus includes ~~the apparatus 800 includes~~ a memory and a processor, where the memory is configured to store program code; the processor is configured to call the program code stored in the memory to perform the following operations: determining a total quantity of to-be-allocated bits corresponding to to-be-processed sub-bands of a current frame; implementing primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band of the to-be-processed sub-bands; performing, according to the quantity of primarily allocated bits of each sub-band, a primary information unit quantity determining operation for each sub-band that has undergone the primary bit allocation, so as to obtain a total quantity of surplus bits of the current frame and a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands; selecting sub-bands for secondary bit allocation from the to-be-processed sub-bands according to a secondary bit allocation parameter, where the secondary bit allocation parameter includes at least one of a sub-band characteristic of each sub-band of the to-be-processed sub-bands or the total quantity of surplus bits; implementing secondary bit allocation on the sub-bands for secondary bit allocation, so as to allocate the surplus bits to the sub-bands for secondary bit allocation and obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; and performing, according to the quantities of primarily allocated bits and the quantities of secondarily allocated bits of the sub-bands for secondary bit allocation, a secondary information unit quantity determining operation for each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation.

[0048] With reference to the third aspect, in a first possible implementation manner of the third aspect, the sub-band characteristic of each sub-band of the to-be-processed sub-bands includes at least one of a characteristic of a signal carried in the sub-band, a bit allocation state corresponding to the sub-band, or a frequency range of the sub-band.

BRIEF DESCRIPTION OF DRAWINGS

[0069] To describe the technical solutions in the embodiments of the present invention more clearly, the following briefly describes the accompanying drawings required for describing the embodiments ~~or the prior art~~. Apparently, the accompanying drawings in the following description show merely some embodiments of the present invention, and a person of ordinary skill in the art may still derive other drawings from these accompanying drawings without creative efforts.

[0070] FIG. 1 is a schematic flowchart of a signal processing method according to an embodiment of the present invention;

[0071] FIG. 2 is a schematic flowchart of a signal processing method according to another embodiment of the present invention;

[0072] FIG. 3 is a schematic diagram of selecting sub-bands for secondary bit allocation according to another embodiment of the present invention;

[0073] FIG. 4 is a schematic diagram of selecting sub-bands for secondary bit allocation according to another embodiment of the present invention;

[0074] FIG. 5 is a schematic diagram of selecting sub-bands for secondary bit allocation according to another embodiment of the present invention;

[0075] FIG. 6 is a schematic diagram of selecting sub-bands for secondary bit allocation according to another embodiment of the present invention;

[0076] FIG. 7 is a schematic diagram of a secondary information unit quantity determining operation according to another embodiment of the present invention;

[0077] FIG. 8 is a schematic flowchart of a signal processing method according to another embodiment of the present invention;

[0078] FIG. 9 is a schematic flowchart of a signal processing method according to another embodiment of the present invention;

[0079] FIG. 10 is a schematic block diagram of a signal processing apparatus according to another embodiment of the present invention;

[0080] FIG. 11 is a schematic block diagram of a signal processing apparatus according to another embodiment of the present invention;

[0081] FIG. 12 is a schematic block diagram of a signal processing apparatus according to another embodiment of the present invention;

[0082] FIG. 13 is a schematic block diagram of a signal processing apparatus according to another embodiment of the present invention; and

[0083] FIG. 14 is a schematic block diagram of a signal processing apparatus according to another embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0084] The following clearly ~~and completely~~ describes the technical solutions in the embodiments of the present invention with reference to the accompanying drawings in the embodiments of the present invention. Apparently, the described embodiments are some but not all of the embodiments of the present invention. All other embodiments obtained by a person of ordinary skill in the art based on the embodiments of the present invention without creative efforts shall fall within the protection scope of the present invention.

[0085] FIG. 1 is a schematic flowchart of a signal processing~~bit allocation~~ method 100 according to an embodiment of the present invention. As shown in FIG. 1, the method 100 includes:

[0086] S110. Determine a total quantity of to-be-allocated bits corresponding to to-be-processed sub-bands of a current frame.

[0087] S120. Implement primary bit allocation on each sub-band of the to-be-processed sub-bands according to the total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band of the to-be-processed sub-bands.

[0088] S130. Perform, according to the quantity of primarily allocated bits of each sub-band, a primary information unit quantity determining operation for each sub-band of the to-be-processed sub-bands that has undergone the primary bit allocation, so as to obtain a total quantity of surplus bits of the current frame and a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands.

[0089] S140. Select sub-bands for secondary bit allocation from the to-be-processed sub-bands according to a secondary bit allocation parameter, where the secondary bit allocation parameter includes at least one of the total quantity of surplus bits or a sub-band characteristic of each sub-band of the to-be-processed sub-bands.

[0090] S150. Implement secondary bit allocation on the sub-bands for secondary bit allocation, so as to allocate the surplus bits to the sub-bands for secondary bit

units corresponding to each sub-band, and for a decoder side, an inverse quantization operation may be performed according to the quantity of information units corresponding to each sub-band.

[0093] It should be understood that, on the encoder side, the to-be-processed sub-bands in this embodiment of the present invention may be referred to as to-be-encoded sub-bands, and on the decoder side, the to-be-processed sub-bands in this embodiment of the present invention may be referred to as to-be-decoded sub-bands.

[0094] It should be understood that the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation.

[0095] It should be understood that, in this embodiment of the present invention, the quantity of information units corresponding to each sub-band and a quantity of surplus bits corresponding to each sub-band may be obtained by performing a primary information unit quantity determining operation for each sub-band of the to-be-processed sub-bands, where a sum of a quantity of bits occupied by the ~~quantity of~~ information units corresponding to each sub-band and the quantity of surplus bits corresponding to each sub-band is the quantity of primarily allocated bits of each sub-band, and the quantity of surplus bits corresponding to each sub-band is insufficient for encoding one information unit; then, the total quantity of surplus bits of the current frame may be obtained by summing up surplus bits corresponding to all sub-bands of the to-be-processed sub-bands of the current frame, and the total surplus bits of the current frame are allocated to the sub-bands for secondary bit allocation of the to-be-processed sub-bands of the current frame.

[0096] It should be further understood that an information unit in this embodiment of the present invention is a unit for encoding, an information unit quantity determining operation is a specific process of an encoding or decoding operation, and the determining may be specifically performed according to a quantity of allocated bits. Certainly, for different encoding methods, an information unit may have different names. For example, in some encoding methods, an information unit is referred to as a pulse. Whatever name is used shall fall within the protection scope of the present

corresponding condition is not met, sub-bands for secondary bit allocation are selected from the low-frequency ones.

[0113] Optionally, in this embodiment of the present invention, the m first sub-band sets may be preconfigured, or may be selected by an encoding/decoding device from to-be-processed sub-band sets.

[0114] Optionally, in this embodiment of the present invention, no matter whether the m first sub-band sets are preconfigured, or selected by an encoding/decoding device, when the m first sub-band sets are selected, the m first sub-band sets may be determined according to bandwidth occupied by a to-be-encoded or to-be-decoded signal. For example, the occupied bandwidth is narrowband bandwidth (for example, the bandwidth is 4 ~~KHZ~~kHz), a set formed by sub-bands with a bandwidth greater than 2 ~~KHZ~~kHz may be determined as one first sub-band set, and a set formed by sub-bands with a bandwidth greater than 3 ~~KHZ~~kHz may be determined as another first sub-band set. For another example, the occupied bandwidth is wideband bandwidth (for example, the bandwidth is 8 ~~KHZ~~kHz), a set formed by sub-bands with a bandwidth greater than 5 ~~KHZ~~kHz may be determined as one first sub-band set, and a set formed by sub-bands with a bandwidth greater than 6 ~~KHZ~~kHz may be determined as another first sub-band set.

[0115] It should be understood that, in this embodiment of the present invention, the target sub-band set may be directly selected from the to-be-processed sub-bands according to a predetermined condition. In this case, the predetermined condition may be that a sub-band carries a signal of a harmonic type, and then all sub-bands carrying signals of a harmonic type may be determined to form the target sub-band set; or the predetermined condition may be that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of the to-be-processed sub-bands, and then all sub-bands of the current frame whose corresponding previous-frame sub-bands are coefficient-quantized may be determined to form the target sub-band set; or the predetermined condition may be that an envelope value of a sub-band of the current frame is greater than a threshold, and then all sub-bands of the current frame whose envelope values are greater than the threshold may be determined to form the target sub-band set, where the threshold may be determined according to an average envelope value of all sub-bands of the current frame, for example, the average envelope value may be directly determined as the threshold, or 4/5 of the average envelope value is determined as the threshold; or the predetermined condition includes at least two of the foregoing predetermined conditions, and then all

sub-bands meeting the at least two conditions are determined to form the target sub-band set.

[0116] In this embodiment of the present invention, after the target sub-band set is determined, the sub-bands for secondary bit allocation may be selected from the target sub-band set, where the sub-bands for secondary bit allocation may be selected from the target sub-band set according to at least one of an average quantity of primary bits per unit bandwidth of each sub-band, a quantity of primary bits per information unit of each sub-band, or a quantity of primarily allocated bits of each sub-band in the target sub-band set.

[0117] Specifically, a top-priority to-be-enhanced sub-band may be first determined, where a sub-band with a smallest average quantity of primary bits per unit bandwidth, a sub-band with a smallest quantity of bits per information unit, or a sub-band with a smallest quantity of primarily allocated bits in the target sub-band set may be determined as the top-priority to-be-enhanced sub-band, where the smallest quantity of bits per information unit and the smallest quantity of primarily allocated bits are obtained by the primary information unit quantity determining operation, and the top-priority to-be-enhanced sub-band belongs to the sub-bands for secondary bit allocation. Optionally, all the surplus bits may be directly allocated to the top-priority to-be-enhanced sub-band, that is, the sub-bands for secondary allocation may include only the top-priority to-be-enhanced sub-band, or another sub-band that belongs to the sub-bands for secondary bit allocation may be further selected. Specifically, determining whether to select another sub-band for secondary bit allocation and selecting another sub-band for secondary bit allocation may be implemented in the following two manners:

[0118] In a first implementation manner, when the total quantity of surplus bits is greater than a threshold a_N~~aN~~ and less than a_{N+1}~~aN+1~~, it is determined that N sub-bands for secondary bit allocation need to be selected, where a_N~~aN~~ and a_{N+1}~~aN+1~~ are respectively the Nth threshold and the $(N+1)^{th}$ threshold of multiple thresholds sorted in ascending order. When N is greater than or equal to 2, N–1 sub-bands for secondary bit allocation are selected from sub-bands in the target sub-band set other than the top-priority to-be-enhanced sub-band. Certainly, when N is equal to 1, there is no need to further select another sub-band for secondary bit allocation.

[0119] In this embodiment of the present invention, multiple refers to two or more than two. For example, multiple thresholds refer to two or more than two thresholds.

[0120] Optionally, in this embodiment of the present invention, the thresholds may be determined according to bandwidth occupied by a to-be-encoded or to-be-decoded signal and/or bandwidth of the top-priority to-be-enhanced sub-band. Optionally, the thresholds are in a positive correlation with bandwidth occupied by a to-be-encoded or to-be-decoded signal and/or bandwidth of the top-priority to-be-enhanced sub-band.

[0121] Optionally, the other N–1 sub-bands for secondary bit allocation may be selected based on the top-priority to-be-enhanced sub-band. To better maintain continuity of a spectrum, the N sub-bands for secondary bit allocation are successive in a frequency domain.

[0122] Specifically, when N is 2, a sub-band with a smaller average quantity of primary bits per unit bandwidth, a sub-band with a smaller quantity of bits per information unit, or a sub-band with a smaller quantity of primarily allocated bits, of two sub-bands adjacent to the top-priority to-be-enhanced sub-band may be determined as another sub-band for secondary bit allocation, where the smaller quantity of bits per information unit and the smaller quantity of primarily allocated bits are obtained by the primary information unit quantity determining operation. When N=3, two sub-bands k+1 and k–1 adjacent to the top-priority to-be-enhanced sub-band k may be determined as the sub-bands for secondary bit allocation. If N=4, sub-bands k+1 and k–1 may be determined as sub-bands for secondary bit allocation, and a sub-band with a smaller average quantity of primary bits per unit bandwidth, a sub-band with a smaller quantity of bits per information unit, or a sub-band with a smaller quantity of primarily allocated bits, of sub-bands k+2 and k–2 adjacent to sub-bands k+1 and k–1 may be determined as a sub-band for secondary bit allocation, where the smaller quantity of bits per information unit and the smaller quantity of primarily allocated bits are obtained from the primary information unit quantity determining operation. If $N \geq 5$, selection may also be further performed according to a manner similar to the foregoing manner. It should be understood that the tags k, k+1, k–1, and the like of the foregoing sub-bands are merely for ease of description and shall not be construed as a limitation on the present invention.

[0123] Certainly, in this embodiment of the present invention, there may be no need to ensure that the N sub-bands for secondary bit allocation are successive in a frequency domain. For example, N sub-bands with smaller average quantities of primary bits per unit bandwidth in the target sub-band set may be determined as the

sub-bands for secondary bit allocation according to average quantities of primary bits per unit bandwidth of all sub-bands; or N sub-bands with smaller quantities of bits per information unit ~~in bandwidth~~ in the target sub-band set may be determined as the sub-bands for secondary bit allocation according to quantities of primary bits per information unit of all sub-bands; or N sub-bands with quantities of primarily allocated bits in the target sub-band set may be determined as the sub-bands for secondary bit allocation according to quantities of primarily allocated bits of all sub-bands. Alternatively, one sub-band is selected from two sub-bands k+1 and k–1 adjacent to the top-priority to-be-enhanced sub-band k, and one sub-band is selected from sub-bands k+2 and k–2, and so on, until all N sub-bands are selected.

[0124] In a second implementation manner, when the total quantity of surplus bits is greater than a threshold a, it may be determined that a second-priority to-be-enhanced sub-band needs to be selected, and then, the second-priority to-be-enhanced sub-band is determined from the target sub-band set, where the sub-bands for secondary bit allocation include the top-priority to-be-enhanced sub-band and the second-priority to-be-enhanced sub-band. Alternatively, the second-priority to-be-enhanced sub-band may be first determined from the target sub-band set, and then it is determined whether the total quantity of surplus bits is greater than a threshold a; if the total quantity of surplus bits is greater than the threshold a, it may be determined that the second-priority to-be-enhanced sub-band belongs to the sub-bands for secondary bit allocation; or if the total quantity of surplus bits is not greater than the threshold a, the second-priority to-be-enhanced sub-band does not belong to the sub-bands for secondary bit allocation. Optionally, the top-priority to-be-enhanced sub-band and the second-priority to-be-enhanced sub-band are successive in a frequency domain, and specifically, a sub-band with a smaller average quantity of primary bits per unit bandwidth, a sub-band with a smaller quantity of primary bits per information unit, or a sub-band with a smaller quantity of primarily allocated bits, of two sub-bands adjacent to the top-priority to-be-enhanced sub-band may be determined as the second-priority to-be-enhanced sub-band.

[0125] Optionally, the threshold a may be determined according to bandwidth of the top-priority to-be-enhanced sub-band and/or bandwidth occupied by a to-be-encoded or to-be-decoded signal. Optionally, the threshold a is in a positive correlation with bandwidth of the top-priority to-be-enhanced sub-band and/or bandwidth occupied by a to-be-encoded or to-be-decoded signal. For example, when

bandwidth of the to-be-encoded signal is 4 ~~kHZ~~kHz, the threshold may be set to 8, or when bandwidth of the to-be-encoded signal is 8 ~~kHZ~~kHz, the threshold a may be set to 12.

[0126] Certainly, the top-priority to-be-enhanced sub-band and the second-priority to-be-enhanced sub-band in this embodiment of the present invention may not necessarily be sub-bands that are successive in a frequency domain. For example, two sub-bands with smaller average quantities of bits per unit bandwidth in the target sub-band set are determined as the top-priority to-be-enhanced sub-band and the second-priority to-be-enhanced sub-band according to average quantities of bits per unit bandwidth of all sub-bands, where the average quantities of the bits per unit bandwidth of all the sub-bands are obtained from the primary information unit quantity determining operation; or two sub-bands with smaller quantities of bits per information unit ~~in bandwidth~~ in the target sub-band set are determined as the top-priority to-be-enhanced sub-band and the second-priority to-be-enhanced sub-band according to quantities of primary bits per information unit of all sub-bands; or two sub-bands with quantities of primarily allocated bits in the target sub-band set are determined as the top-priority to-be-enhanced sub-band and the second-priority to-be-enhanced sub-band according to quantities of primarily allocated bits of all sub-bands.

[0127] It should be understood that, in this embodiment of the present invention, the target sub-band set may alternatively not be determined, and the sub-bands for secondary bit allocation are selected directly from the to-be-processed sub-bands, where a quantity of the sub-bands for secondary bit allocation that need to be selected may be determined according to the total quantity of surplus bits. For example, h sub-bands with the smallest quantities of primarily allocated bits are determined as the sub-bands for secondary bit allocation (inclusive of h sub-bands). In the present invention, all sub-bands with a characteristic may also be determined as the sub-bands for secondary bit allocation. For example, sub-bands of the current frame whose corresponding previous-frame sub-bands are coefficient-quantized are determined as the sub-bands for secondary bit allocation, and so on.

[0128] The foregoing describes how the sub-bands for secondary bit allocation are determined. After the sub-bands for secondary bit allocation are determined, the surplus bits may be allocated to the sub-bands for secondary bit allocation. The following specifically describes how the surplus bits are allocated to the sub-bands for

secondary bit allocation.

[0129] In this embodiment of the present invention, when a quantity of sub-bands included in the sub-bands for secondary bit allocation is 1, all the surplus bits may be directly allocated to the one sub-band for secondary bit allocation.

[0130] In this embodiment of the present invention, when the sub-bands for secondary bit allocation include at least two sub-bands, the secondary bit allocation may be performed for each sub-band of the sub-bands for secondary bit allocation according to a quantity of primary bits per information unit, an average quantity of bits per unit bandwidth in the primary bit allocation, or the quantity of primarily allocated bits, of each sub-band of the sub-bands for secondary bit allocation. Specifically, the surplus bits may be allocated to the sub-bands for secondary bit allocation according to proportions. Specifically, there may be the following manners for determining an allocation proportion. In the following manners, it is assumed that there are a total of N sub-bands k_1, k_2, ..., and k_N, and an allocation proportion β_i for a sub-band k_i may be determined in the following manners:

(1) $$\beta_i = \frac{aver_bit[k_i]}{aver_bit[k_1] + aver_bit[k_2] + ... + aver_bit[k_N]}$$

where $aver_bit[k_i]$ indicates an average quantity of primary bits per unit bandwidth of the sub-band k_i, that is, $aver_bit[k_i] = \frac{Rk_1[k_i]}{bandwidth[k_i]}$, where $Rk_1[k_i]$ indicates a quantity of primarily allocated bits of the sub-band k_i, and $bandwidth[k_i]$ indicates bandwidth of the sub-band k_i.

(2) $$\beta_i = \frac{Rk_pulse[k_i]}{Rk_pulse[k_1] + Rk_pulse[k_2] + ... + Rk_pulse[k_N]}$$

where $Rk_pulse[k_i]$ indicates a quantity of primary bits per information unit of the sub-band k_i, that is, $Rk_pulse[k_i] = \frac{Rk_1[k_i]}{npluse[k_i]}$, where $Rk_1[k_i]$ indicates a quantity of primarily allocated bits of the sub-band k_i, and $npluse[k_i]$ indicates a quantity of primary information units of the sub-band k_i.

$$\beta_i = \frac{Rk_1[k_i]}{Rk_1[k_1] + Rk_1[k_2] + ... + Rk_1[k_N]} \quad (3)$$

where $Rk_1[k_i]$ indicates a quantity of primarily allocated bits of the sub-band k_i.

[0131] After the surplus bit allocation proportion for each sub-band of the sub-bands for secondary bit allocation is determined, the surplus bits may be allocated to each sub-band of the sub-bands for secondary bit allocation according to the proportion. Specifically, a quantity of secondarily allocated bits of the sub-band k_i is $Rk_2[k_i] = \beta_i * bit_surplus$, where $bit_surplus$ is the total quantity of surplus bits.

[0132] It should be understood that the above mentioned allocation proportion determining method is merely a specific embodiment of the present invention and shall not be construed as a limitation on the protection scope of the present invention. The above mentioned allocation proportion determining manner may have correspondingly transformations. For example, when the sub-bands for secondary bit allocation include two sub-bands, when an allocation proportion β for one sub-band among the sub-bands for secondary bit allocation is determined in any one of the foregoing three manners, a bit allocation proportion for the other sub-band may be determined ~~by means of~~as $1-\beta$. All these simple mathematical transformations should fall within the protection scope of the present invention.

[0133] It should be further understood that, although it is assumed that there are a total of N sub-bands k_1, k_2, ..., and k_N, the purpose is merely to make the description applicable to general cases, and N is not limited to being greater than or equal to 3 herein. In a case in which N is 2, the foregoing several secondary bit allocation proportions are also applicable.

[0134] Therefore, in this embodiment of the present invention, primary bit allocation is first performed for to-be-processed sub-bands of a current frame according to a total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band; a primary information unit quantity determining operation is performed for a sub-band that has undergone the primary bit allocation, so as to obtain a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands and a total quantity of surplus bits; then,

sub-bands for secondary bit allocation are determined according to at least one of a sub-band characteristic of each sub-band of the to-be-processed sub-bands or the total quantity of surplus bits, and the surplus bits are allocated to the sub-bands for secondary bit allocation to obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; a secondary information unit quantity determining operation is performed for each sub-band of the sub-bands for secondary bit allocation according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation. The surplus bits left in encoded sub-bands are not evenly allocated to remaining unencoded sub-bands, and therefore, available bits can be more properly and fully used and encoding and decoding quality is apparently improved.

[0135] For clearer understanding of the present invention, the following describes the present invention in detail with reference to FIG. 2 to FIG. 9.

[0136] FIG. 2 is a schematic flowchart of a ~~bit allocation method~~signal processing method 200 according to an embodiment of the present invention. As shown in FIG. 2, the method 200 includes:

[0137] S201. Determine to-be-processed sub-bands of a current frame and a total quantity of to-be-allocated bits corresponding to the to-be-processed sub-bands.

[0138] S202. Implement primary bit allocation on each sub-band according to the total quantity of to-be-allocated bits and an envelope value of each sub-band of the to-be-processed sub-bands, so as to allocate the to-be-allocated bits to the to-be-processed sub-bands and obtain a quantity of primarily allocated bits of each sub-band.

[0139] S203. Perform a primary information unit quantity determining operation for the to-be-processed sub-bands that has undergone the primary bit allocation, so as to obtain a quantity of information units corresponding to each sub-band and a total quantity of surplus bits of the current frame.

[0140] S204. Determine whether a sub-band in the m first sub-band sets meets a corresponding predetermined condition of m predetermined conditions, where a sub-band of any one of the first sub-band sets belongs to the to-be-processed sub-bands. The following provides detailed description with reference to multiple examples.

[0141] Example 1: m is 1, the predetermined condition is ~~whether~~ that a sub-band carrying a signal of a harmonic type exists in first M high-frequency sub-bands, and a first sub-band set is the first M high-frequency sub-bands. Then, whether a sub-band carrying a signal of a harmonic type exists in the first M high-frequency sub-bands is determined.

[0142] Example 2: m is 1, the predetermined condition is that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of first L high-frequency sub-bands, and a first sub-band set is the first L high-frequency sub-bands. Then, whether a coefficient-quantized sub-band exists in ~~current~~previous-frame sub-bands corresponding to the first L high-frequency sub-bands is determined.

[0143] Example 3: m is 1, and the predetermined condition is that an average envelope value of first J high-frequency sub-bands is greater than a threshold, where the average envelope value $aver_Ep$ of the first J high-frequency sub-bands and the corresponding threshold θ may be calculated as follows:

$$aver_Ep = \frac{\sum_{i=BANDS-J}^{BANDS-1} Ep[i]}{J}$$, where $Ep[i]$ indicates an envelope value of a sub-band i, and BANDS is a quantity of sub-bands; and

$$\theta = \frac{1}{3} \cdot \frac{\sum_{i=0}^{BANDS-J-1} Ep[i]}{BANDS-J}$$, where $Ep[i]$ indicates an envelope value of a sub-band i, and BANDS is a quantity of sub-bands.

[0144] In this case, whether the average envelope value $aver_Ep$ of the first J high-frequency sub-bands is greater than the threshold θ needs to be determined.

[0145] Example 4: m is 2, a first sub-band set is first L high-frequency sub-bands, and a corresponding predetermined condition is that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of the first L high-frequency sub-bands; another first sub-band set is the first ~~L~~ J high-frequency sub-bands, and a corresponding predetermined condition is that an average envelope value of the first J high-frequency sub-bands is greater than a threshold. Then, whether a coefficient-quantized sub-band exists in the corresponding previous-frame sub-bands of the first L high-frequency sub-bands needs to be determined, and whether the average envelope value of the first J high-frequency sub-bands is greater than the

threshold needs to be determined.

[0146] Example 5: m is 2, a first sub-band set is first L high-frequency sub-bands, and a corresponding predetermined condition is that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of the first L high-frequency sub-bands; another first sub-band set is first M high-frequency sub-bands, and a corresponding predetermined condition is that a sub-band carrying a signal of a harmonic type exists in the first M high-frequency sub-bands. Then, ~~that~~ whether a coefficient-quantized sub-band exists in the corresponding previous-frame sub-bands of the first L high-frequency sub-bands needs to be determined, and whether a sub-band carrying a signal of a harmonic type exists in the first M high-frequency sub-bands needs to be determined.

[0147] Example 6: m is 2, a first sub-band set is first J high-frequency sub-bands, and a corresponding predetermined condition is that an average envelope value of the first J high-frequency sub-bands is greater than a threshold; another first sub-band set is first M high-frequency sub-bands, and a corresponding predetermined condition is that a sub-band carrying a signal of a harmonic type exists in the first M high-frequency sub-bands. Then, whether the average envelope value of the first J high-frequency sub-bands is greater than the threshold needs to be determined, and whether a sub-band carrying a signal of a harmonic type exists in the first M high-frequency sub-bands needs to be determined.

[0148] Example 7: m is 3, a first sub-band set is first J high-frequency sub-bands, and a corresponding predetermined condition is that an average envelope value of the first J high-frequency sub-bands is greater than a threshold; another first sub-band set is first M high-frequency sub-bands, and a corresponding predetermined condition is that a sub-band carrying a signal of a harmonic type exists in the first M high-frequency sub-bands; and another first sub-band set is first L high-frequency sub-bands, and a corresponding predetermined condition is that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of the first L high-frequency sub-bands. Then, whether the average envelope value of the first J high-frequency sub-bands is greater than the threshold needs to be determined, whether a sub-band carrying a signal of a harmonic type exists in the first M high-frequency sub-bands needs to be determined, and whether a coefficient-quantized sub-band exists in the corresponding previous-frame sub-bands of the first L high-frequency sub-bands needs to be determined.

[0165] Step 2: Determine a threshold *alpha* according to bandwidth of the top-priority to-be-enhanced sub-band *k*, where the bandwidth of the top-priority to-be-enhanced sub-band may be in a positive correlation with the threshold *alpha*.

[0166] Step 3: Determine whether the total quantity of surplus bits *bit_surplus* is greater than the threshold *alpha*; if the total quantity of surplus bits *bit_surplus* is greater than the threshold *alpha*, determine the quantity N of the sub-bands for secondary bit allocation as 2; or if the total quantity of surplus bits *bit_surplus* is less than the threshold *alpha*, determine the quantity N of the sub-bands for secondary bit allocation as 1, for example, as shown in FIG. 3.

[0167] Step 4: If N is equal to 1, determine that the sub-bands for secondary bit allocation include only the foregoing top-priority to-be-enhanced sub-band *k*; or if N is equal to 2, the sub-bands for secondary bit allocation further include the second-priority to-be-enhanced sub-band k_1 determined in step 1 in addition to the top-priority to-be-enhanced sub-band *k*.

[0168] Manner 3:

[0169] Step 1: Assume that there are n−1 thresholds ($alpha_{n-1}$, $alpha_{n-2}$~~$alpha_{n-1}$~~, ..., and $alpha_1$) sorted in ascending order. Whether the total quantity (*bit_surplus*) of the surplus bits is greater than the threshold $alpha_{n-1}$ may be first determined. If the total quantity (*bit_surplus*) of the surplus bits is greater than the threshold $alpha_{n-1}$, determine that the quantity of sub-bands for secondary bit allocation is N=n; or if the total quantity (*bit_surplus*) of the surplus bits is not greater than the threshold $alpha_{n-1}$, determine whether *bit_surplus* is greater than the threshold $alpha_{n-2}$, and if *bit_surplus* is greater than the threshold $alpha_{n-2}$, determine that N=n-1, and so on, for example, as shown in FIG. 5, where a_n indicates $alpha_n$, a_{n-1} indicates $alpha_{n-1}$, and a_1 indicates $alpha_1$.

[0170] Step 2: When N=1, determine that the sub-bands for secondary bit allocation include only the foregoing top-priority to-be-enhanced sub-band *k*; or when N>1, the sub-bands for secondary bit allocation further include another sub-band in addition to the top-priority to-be-enhanced sub-band *k*. To maintain continuity of a spectrum, if N=2, a sub-band with a smaller quantity of primarily allocated bits, a sub-band with a smaller average quantity of primary bits per unit bandwidth, or a sub-band with a smaller quantity of bits per information unit in previous-frame sub-bands *k+2* and *k–2* adjacent to sub-bands *k+1* and *k–1* may be determined as one sub-band for secondary bit allocation, where the smaller quantity of bits per

information unit is obtained from the primary information unit quantity determining operation; if N=3, sub-bands $k+1$ and $k-1$ may be determined as the sub-bands for secondary bit allocation; if N=4, sub-bands $k+1$ and $k-1$ may be determined as the sub-bands for secondary bit allocation, and a sub-band is selected from sub-bands $k+2$ and $k-2$; or if N is greater than 4, another second-priority to-be-enhanced sub-band may be selected in a manner similar to the foregoing manner, for example, as shown in FIG. 6, second-priority to-be-enhanced sub-bands k_1, K_2, k_3, k_4, ..., and k_{n-1} are determined.

[0171] It should be understood that the foregoing manner 3 may also have another transformation, which should also fall within the protection scope of the present invention. For example, whether the total quantity of surplus bits *bit_surplus* is greater than the threshold $alpha_{n/2}$ may be first determined; if the total quantity of surplus bits *bit_surplus* is greater than the threshold $alpha_{n/2}$, determine whether the total quantity of surplus bits *bit_surplus* is less than $alpha_{(n/2)+1}$; and if the total quantity of surplus bits *bit_surplus* is less than $alpha_{(n/2)+1}$, determine whether the total quantity of surplus bits *bit_surplus* is greater than $alpha_{(n/2)-1}$ ~~and $alpha_{n/2+1}$~~, and so on.

[0172] S209. Allocate the surplus bits to the sub-bands for secondary bit allocation, so as to obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation. After the sub-bands for secondary bit allocation are determined, the surplus bits may be allocated to sub-bands included in the sub-bands for secondary bit allocation.

[0173] Specifically, when N=1, that is, the sub-bands for secondary bit allocation include only the top-priority to-be-enhanced sub-band, the surplus bits may all be allocated to the top-priority to-be-enhanced sub-band.

[0174] When N>1, the surplus bits may be allocated according to allocation proportions to sub-bands included in the sub-bands for secondary bit allocation, where a surplus bit allocation proportion for each sub-band may be determined according to a quantity of primary bits per information unit, an average quantity of primary bits per unit bandwidth, or a quantity of primarily allocated bits of the sub-band. For a specific determining method, reference may be made to the foregoing description.

[0175] S210. Perform, according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, a secondary information unit quantity determining operation for each

sub-band of the sub-bands for secondary bit allocation.

[0176] Specifically, as shown in FIG. 7, bits Rk_1 obtained in primary allocation and bits Rk_2 obtained in secondary allocation are integrated into Rk_{all}, and then the secondary information unit quantity determining operation is performed for the sub-bands for secondary bit allocation by using Rk_{all}.

[0177] Therefore, in this embodiment of the present invention, primary bit allocation is first performed for to-be-processed sub-bands according to a total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits; a primary information unit quantity determining operation is performed for a sub-band that has undergone the primary bit allocation, so as to obtain a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands and a total quantity of surplus bits; then, sub-bands for secondary bit allocation are determined according to at least one of a sub-band characteristic of each sub-band of the to-be-processed sub-bands or the total quantity of surplus bits, and the surplus bits are allocated to the sub-bands for secondary bit allocation to obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; a secondary information unit quantity determining operation is performed for each sub-band of the sub-bands for secondary bit allocation according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation. The surplus bits left in encoded sub-bands are not evenly allocated to remaining unencoded sub-bands, and therefore, available bits can be more properly and fully used and encoding and decoding quality is apparently improved.

[0178] The ~~bit allocation method~~signal processing methods in the embodiments of the present invention may be used on a decoder side and an encoder side.

[0179] When used on an encoder side, the method 100 may further include: performing a quantization operation for each sub-band according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain a quantized spectral coefficient corresponding to each sub-band, where the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units

include:

[0185] S301. After acquiring an input signal (for example, an audio signal), an encoder side may perform a time-frequency transform on the input signal to obtain a frequency-domain signal, where sub-bands occupied by the frequency-domain signal are referred to as to-be-encoded sub-bands below.

[0186] S302. Determine a sub-band type of each sub-band of the to-be-encoded sub-bands, where the sub-band type of each sub-band may be a type of a signal carried in each sub-band, for example, the type of the signal may be harmonic or non-harmonic.

[0187] S303. Calculate and quantize a frequency-domain envelope according to the sub-band type of each sub-band that is determined in S302, so as to obtain an envelope value of each sub-band.

[0188] S304. Implement primary bit allocation on each sub-band according to the envelope value of each sub-band that is obtained in S303 and a total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band.

[0189] S305. Perform a primary information unit quantity determining operation for each sub-band that has undergone the primary bit allocation, so that a quantity of information units corresponding to each sub-band and a total quantity of surplus bits may be obtained.

[0190] S306. Determine sub-bands for secondary bit allocation from the to-be-encoded sub-bands of a current frame according to at least one of the sub-band type of each sub-band of the current frame that is determined in S302, the envelope value of each sub-band of the current frame that is determined in S303, the quantity of primarily allocated bits of each sub-band of the current frame that is determined in S304, or the total quantity of surplus bits that is determined in S305. Optionally, sub-bands for secondary bit allocation may also be determined according to a bit allocation state of a corresponding previous-frame sub-band of each sub-band.

[0191] S307. Allocate the surplus bits to the sub-bands for secondary bit allocation according to the sub-bands for secondary bit allocation determined in S306 and the total quantity of surplus bits that is determined in S305. For specific allocation, secondary bit allocation may be performed according to the ~~bits~~quantity of primarily allocated bits of each sub-band that has undergone the primary bit allocation in S304, and/or the quantity of primary bits per information unit (and/or an average quantity of bits per

value of each sub-band.

[0197] S402. Implement primary bit allocation on each sub-band according to the envelope value of each sub-band of the to-be-decoded sub-bands that is acquired in S401 and a total quantity of to-be-~~encoded~~ allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band.

[0198] S403. Perform a primary information unit quantity determining operation for each sub-band that has undergone the primary bit allocation, so that a quantity of information units corresponding to each sub-band and a total quantity of surplus bits may be obtained.

[0199] S404. Determine sub-bands for secondary bit allocation~~Sub-bands for secondary bit allocation may be determined~~ from the to-be-decoded sub-bands according to at least one of the sub-band type of each sub-band, the envelope value of each sub-band, or the bit allocation state of a corresponding previous-frame sub-band of each sub-band that is acquired in S401, or the total quantity of surplus bits that is determined in S403 (a specific parameter that is used for determining the sub-bands for secondary bit allocation may be kept consistent with that on an encoder side).

[0200] S405. Allocate the surplus bits to the sub-bands for secondary bit allocation according to the sub-bands for secondary bit allocation determined in S404 and the total quantity of surplus bits that is determined in S403, so as to obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation. For specific allocation, secondary bit allocation may be performed according to the ~~bits~~ quantity of the primarily allocated bits of each sub-band that has undergone the primary bit allocation in S402, and/or a quantity of bits per information unit (and/or an average quantity of bits per unit bandwidth) after the primary information unit quantity determining operation in S403.

[0201] S406. Perform, according to the quantity of primarily allocated bits that is obtained when the primary bit allocation (S402) is performed for the sub-bands for secondary bit allocation and the quantity of secondarily allocated bits that is obtained when the secondary bit allocation (S405) is performed, a secondary information unit quantity determining operation for each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation.

[0202] S407. Perform, according to the quantity of information units corresponding to each sub-band of the to-be-decoded sub-bands, an inverse

quantization operation for each sub-band obtained after the bitstream is decoded in S401, so as to obtain an inverse quantized spectral coefficient corresponding to each sub-band, where the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation.

[0203] S408. Perform a time-frequency transform on the inverse quantized spectral coefficient corresponding to each sub-band, so as to obtain an output signal (for example, an audio signal).

[0204] Therefore, in this embodiment of the present invention, primary bit allocation is first performed for to-be-processed sub-bands according to a total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits; a primary information unit quantity determining operation is performed for a sub-band that has undergone the primary bit allocation, so as to obtain a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands and a total quantity of surplus bits; then, sub-bands for secondary bit allocation are determined according to at least one of a sub-band characteristic of each sub-band of the to-be-processed sub-bands or the total quantity of surplus bits, and the surplus bits are allocated to the sub-bands for secondary bit allocation to obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; a secondary information unit quantity determining operation is performed for each sub-band of the sub-bands for secondary bit allocation according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation. The surplus bits left in encoded sub-bands are not evenly allocated to remaining unencoded sub-bands, and therefore, available bits can be more properly and fully used and encoding and decoding quality is apparently improved.

[0205] The foregoing has described the method in the embodiments of the present invention with reference to FIG. 1 to FIG. 9, and the following describes a signal processing apparatus in the embodiments of the present invention with reference to FIG. ~~9~~ 10 to FIG. 13.

[0223] Optionally, the primary bit allocation unit 520 is specifically configured to: implement primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits and envelope values of sub-bands of the to-be-processed sub-bands.

[0224] The signaling processing apparatus 500 in this embodiment of the present invention may be used to implement the signaling processing methods in the method embodiments. For brevity, details are not described herein.

[0225] Therefore, in this embodiment of the present invention, primary bit allocation is first performed for to-be-processed sub-bands according to a total quantity of to-be-allocated bits of a current frame, so as to obtain a quantity of primarily allocated bits; a primary information unit quantity determining operation is performed for a sub-band that has undergone the primary bit allocation, so as to obtain a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands and a total quantity of surplus bits; then, sub-bands for secondary bit allocation are determined according to at least one of a sub-band characteristic of each sub-band of the to-be-processed sub-bands or the total quantity of surplus bits, and the surplus bits are allocated to the sub-bands for secondary bit allocation to obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; a secondary information unit quantity determining operation is performed for each sub-band of the sub-bands for secondary bit allocation according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation. The surplus bits left in encoded sub-bands are not evenly allocated to remaining unencoded sub-bands, and therefore, available bits can be more properly and fully used and encoding and decoding quality is apparently improved.

[0226] Optionally, the signal processing apparatus in this embodiment of the present invention may be an encoder or may be a decoder. The following provides detailed description with reference to FIG. 12 and FIG. 13.

[0227] FIG. 12 is a schematic block diagram of ~~an encoder~~a signal processing apparatus 600 according to an embodiment of the present invention. A quantization unit 670 and a transport unit 680 may be further included in addition to a total bit quantity determining unit 610, a primary bit allocation unit 620, a primary information unit quantity determining unit 630, a sub-band selection unit 640, a secondary bit allocation unit 650, and a

secondary information unit quantity determining unit 660.

[0228] The quantization unit 670 is configured to perform a quantization operation for each sub-band of the to-be-processed sub-bands according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain a quantized spectral coefficient corresponding to each sub-band, where the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation.

[0229] The transport unit 680 is configured to write the quantized spectral coefficient into a bitstream and output the bitstream.

[0230] Optionally, the secondary bit allocation parameter includes at least one parameter of a type of a signal carried in at least one sub-band of the to-be-processed sub-bands, an envelope value of at least one sub-band of the to-be-processed sub-bands, or a coefficient quantization state of a corresponding previous-frame sub-band of at least one sub-band of the to-be-processed sub-bands.

[0231] The transport unit 680 is further configured to: write the at least one parameter into the bitstream.

[0232] It should be understood that the total bit quantity determining unit 610, the primary bit allocation unit 620, the primary information unit quantity determining unit 630, the sub-band selection unit 640, the secondary bit allocation unit 650, and the secondary information unit quantity determining unit 660 of the encoder 600 may be respectively equivalent to the total bit quantity determining unit 510, the primary bit allocation unit 520, the primary information unit quantity determining unit 530, the sub-band selection unit 540, the secondary bit allocation unit 550, and the secondary information unit quantity determining unit 560 of the signal processing apparatus 500. For brevity, details are not described herein. It should be further understood that the encoder 600 may further implement a corresponding procedure of the encoding method 300. For brevity, details are not described herein.

[0233] FIG. 13 is a schematic block diagram of a ~~decoder~~ signal processing apparatus 700 according to an embodiment of the present invention. An inverse quantization unit 770 and a first acquiring unit 780 may be further included in addition to a total bit quantity

determining unit 710, a primary bit allocation unit 720, a primary information unit quantity determining unit 730, a sub-band selection unit 740, a secondary bit allocation unit 750, and a secondary information unit quantity determining unit 760.

[0234] The inverse quantization unit 770 is configured to perform an inverse quantization operation for each sub-band of the to-be-processed sub-bands according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain an inverse quantized spectral coefficient corresponding to each sub-band, where the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation.

[0235] The first acquiring unit 780 is configured to acquire an output signal according to the inverse quantized spectral coefficient.

[0236] Optionally, the secondary bit allocation parameter includes at least one parameter of a type of a signal carried in at least one sub-band of the to-be-processed sub-bands, an envelope value of at least one sub-band of the to-be-processed sub-bands, or a coefficient quantization state of a corresponding previous-frame sub-band of at least one sub-band of the to-be-processed sub-bands. The decoder 700 further includes:

a second acquiring unit 790, configured to acquire the at least one parameter from a to-be-decoded bitstream.

[0237] It should be understood that the total bit quantity determining unit 710, the primary bit allocation unit 720, the primary information unit quantity determining unit 730, the sub-band selection unit 740, the secondary bit allocation unit 750, and the secondary information unit quantity determining unit 760 of the ~~encoder~~ signal processing apparatus 700 may be respectively equivalent to the total bit quantity determining unit 510, the primary bit allocation unit 520, the primary information unit quantity determining unit 530, the sub-band selection unit 540, the secondary bit allocation unit 550, and the secondary information unit quantity determining unit 560 of the signal processing apparatus 500. For brevity, details are not described herein. It should be further understood that the decoder 700 may further implement a corresponding procedure of the decoding method 400. For brevity, details are not described herein.

CLAIMS

What is claimed is:

1. A signal processing method, comprising:

determining a total quantity of to-be-allocated bits corresponding to to-be-processed sub-bands of a current frame;

implementing primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band of the to-be-processed sub-bands;

performing, according to the quantity of primarily allocated bits of each sub-band, a primary information unit quantity determining operation for each sub-band that has undergone the primary bit allocation, so as to obtain a total quantity of surplus bits of the current frame and a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands;

selecting sub-bands for secondary bit allocation from the to-be-processed sub-bands according to a secondary bit allocation parameter, wherein the secondary bit allocation parameter comprises at least one of the total quantity of surplus bits or a sub-band characteristic of each sub-band of the to-be-processed sub-bands;

implementing secondary bit allocation on the sub-bands for secondary bit allocation, so as to allocate the surplus bits to the sub-bands for secondary bit allocation and obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; and

performing, according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, a secondary information unit quantity determining operation for each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation.

2. The method according to claim 1, wherein the sub-band characteristic of each sub-band of the to-be-processed sub-bands comprises at least one of a characteristic of a signal carried in the sub-band, a bit allocation state corresponding to the sub-band, or a frequency range of the sub-band.

3. The method according to claim 2, wherein:

the characteristic of the signal carried in the sub-band comprises at least one of a type of the signal carried in the sub-band or an envelope value of the sub-band; and

the bit allocation state corresponding to the sub-band comprises at least one of a coefficient quantization state of a corresponding previous-frame sub-band of the sub-band, a quantity of primary bits per information unit of the sub-band, an average quantity of primary bits per unit bandwidth of the sub-band, or a quantity of primarily allocated bits of the sub-band, wherein

the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the quantity of primary information units of the sub-band is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

4. The method according to claim 3, wherein the type of the signal carried in the sub-band comprises harmonic and/or non-harmonic.

5. The method according to any one of claims 1 to 4, wherein the selecting sub-bands for secondary bit allocation from the to-be-processed sub-bands comprises:

determining a target sub-band set according to at least one of the total quantity of surplus bits or the sub-band characteristic of each sub-band of the to-be-processed sub-bands, and selecting the sub-bands for secondary bit allocation from the target sub-band set, wherein a sub-band in the target sub-band set belongs to the to-be-processed sub-bands.

6. The method according to claim 5, wherein the determining a target sub-band set comprises:

determining the target sub-band set according to a sub-band characteristic of each sub-band in m first sub-band sets and m predetermined conditions in a one-to-one correspondence with the m first sub-band sets, wherein m is an integer greater than or equal to 1, and a sub-band in the m first sub-band sets belongs to the to-be-processed sub-bands, wherein

when all sub-band sets of the m first sub-band sets meet the corresponding predetermined conditions, a set formed by sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set, or when a sub-band set of the m first sub-band sets does not meet a corresponding predetermined condition, a set

formed by sub-bands of the to-be-processed sub-bands other than sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set; or

when at least one sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by all sub-bands in the at least one sub-band set is determined as the target sub-band set, or when no sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by sub-bands of the to-be-processed sub-bands that do not belong to any sub-band set of the m first sub-band sets is determined as the target sub-band set.

7. The method according to claim 6, wherein any predetermined condition of the m predetermined conditions comprises at least one of the following conditions:

that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of a corresponding first sub-band set, that an average envelope value of sub-bands in a corresponding first sub-band set is greater than a first threshold, or that a sub-band carrying a signal of a harmonic type exists in a corresponding first sub-band set.

8. The method according to claim 6 or 7, wherein a frequency of a sub-band in the m first sub-band sets is higher than a frequency of a sub-band of the to-be-processed sub-bands other than the sub-bands in the m first sub-band sets.

9. The method according to any one of claims 5 to 8, wherein the selecting the sub-bands for secondary bit allocation from the target sub-band set comprises:

selecting the sub-bands for secondary bit allocation from the target sub-band set according to at least one of a quantity of primarily allocated bits of each sub-band in the target sub-band set, an average quantity of primary bits per unit bandwidth of each sub-band in the target sub-band set, or a quantity of primary bits per information unit of each sub-band in the target sub-band set, wherein the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the quantity of primary information units of the sub-band is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

10. The method according to claim 9, wherein the selecting the sub-bands for secondary bit allocation from the target sub-band set comprises:

determining a sub-band with a smallest average quantity of primary bits per unit bandwidth, a sub-band with a smallest quantity of primary bits per information unit, or a sub-band with a smallest quantity of primarily allocated bits in the target sub-band set as a top-priority to-be-enhanced sub-band, wherein the top-priority to-be-enhanced sub-band belongs to the sub-bands for secondary bit allocation.

11. The method according to claim 10, wherein the selecting the sub-bands for secondary bit allocation from the target sub-band set further comprises:

when the total quantity of surplus bits is greater than a threshold a_N and less than a_{N+1}, determining that N sub-bands for secondary bit allocation need to be selected, wherein a_N and a_{N+1} are respectively the Nth threshold and the $(N+1)^{th}$ threshold of multiple thresholds sorted in ascending order; and

when N is greater than or equal to 2, selecting N–1 sub-bands for secondary bit allocation from sub-bands in the target sub-band set other than the top-priority to-be-enhanced sub-band.

12. The method according to claim 11, wherein the selecting N–1 sub-bands for secondary bit allocation from sub-bands in the target sub-band set other than the top-priority to-be-enhanced sub-band comprises:

determining the N–1 sub-bands for secondary bit allocation based on the top-priority to-be-enhanced sub-band for allocation, wherein the N sub-bands for secondary bit allocation are successive in a frequency domain.

13. The method according to claim 10, wherein the selecting the sub-bands for secondary bit allocation from the target sub-band set further comprises:

when the total quantity of surplus bits is greater than a threshold, determining a second-priority to-be-enhanced sub-band from the target sub-band set, wherein the sub-bands for secondary bit allocation comprise the second-priority to-be-enhanced sub-band and the top-priority to-be-enhanced sub-band.

14. The method according to claim 10, wherein the selecting the sub-bands for secondary bit allocation from the target sub-band set further comprises:

determining a second-priority to-be-enhanced sub-band from the target sub-band set; and

when the total quantity of surplus bits is greater than a threshold, determining that the second-priority to-be-enhanced sub-band belongs to the sub-bands for secondary bit allocation.

15. The method according to claim 13 or 14, wherein the determining a

second-priority to-be-enhanced sub-band from the target sub-band set comprises:

determining a sub-band with a smaller average quantity of primary bits per unit bandwidth, a sub-band with a smaller quantity of primary bits per information unit, or a sub-band with a smaller quantity of primarily allocated bits, of two sub-bands adjacent to the top-priority to-be-enhanced sub-band as the second-priority to-be-enhanced sub-band.

16. The method according to any one of claims 1 to 15, wherein the implementing secondary bit allocation on the sub-bands for secondary bit allocation comprises:

when a quantity of sub-bands comprised in the sub-bands for secondary bit allocation is greater than or equal to 2, implementing secondary bit allocation on the sub-bands for secondary bit allocation according to a quantity of primary bits per information unit, an average quantity of primary bits per unit bandwidth, or a quantity of primarily allocated bits, of each sub-band of the sub-bands for secondary bit allocation, wherein

the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the quantity of primary information units of the sub-band is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

17. The method according to any one of claims 1 to 16, wherein the implementing primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits comprises:

implementing primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits and envelope values of sub-bands of the to-be-processed sub-bands.

18. The method according to any one of claims 1 to 17, wherein when the method is executed by an encoder side, the method further comprises:

performing a quantization operation for each sub-band of the to-be-processed sub-bands according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain a quantized spectral coefficient corresponding to each sub-band, wherein the quantity of information units

corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation; and

writing the quantized spectral coefficient into a bitstream and outputting the bitstream.

19. The method according to claim 18, wherein the secondary bit allocation parameter comprises at least one parameter of a type of a signal carried in at least one sub-band of the to-be-processed sub-bands, an envelope value of at least one sub-band of the to-be-processed sub-bands, or a coefficient quantization state of a corresponding previous-frame sub-band of at least one sub-band of the to-be-processed sub-bands; and

the method further comprises: writing the at least one parameter into the bitstream.

20. The method according to any one of claims 1 to 17, wherein when the method is executed by a decoder side, the method further comprises:

performing an inverse quantization operation for each sub-band of the to-be-processed sub-bands according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain an inverse quantized spectral coefficient corresponding to each sub-band, wherein the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation; and

acquiring an output signal according to the inverse quantized spectral coefficient.

21. The method according to claim 20, wherein the secondary bit allocation parameter comprises at least one parameter of a type of a signal carried in at least one sub-band of the to-be-processed sub-bands, an envelope value of at least one sub-band of the to-be-processed sub-bands, or a coefficient quantization state of a corresponding previous-frame sub-band of at least one sub-band of the to-be-processed sub-bands; and

the method further comprises: acquiring the at least one parameter from a

to-be-decoded bitstream.

22. A signal processing apparatus, comprising:

a total bit quantity determining unit, configured to determine a total quantity of to-be-allocated bits corresponding to to-be-processed sub-bands of a current frame;

a primary bit allocation unit, configured to implement primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band of the to-be-processed sub-bands;

a primary information unit quantity determining unit, configured to perform, according to the quantity of primarily allocated bits of each sub-band, a primary information unit quantity determining operation for each sub-band that has undergone the primary bit allocation, so as to obtain a total quantity of surplus bits of the current frame and a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands;

a sub-band selection unit, configured to select sub-bands for secondary bit allocation from the to-be-processed sub-bands according to a secondary bit allocation parameter, wherein the secondary bit allocation parameter comprises at least one of the total quantity of surplus bits or a sub-band characteristic of each sub-band of the to-be-processed sub-bands;

a secondary bit allocation unit, configured to implement secondary bit allocation on the sub-bands for secondary bit allocation, so as to allocate the surplus bits to the sub-bands for secondary bit allocation and obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; and

a secondary information unit quantity determining unit, configured to perform, according to the quantities of primarily allocated bits and the quantities of secondarily allocated bits of the sub-bands for secondary bit allocation, a secondary information unit quantity determining operation for each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation.

23. The apparatus according to claim 22, wherein the sub-band characteristic of each sub-band of the to-be-processed sub-bands comprises at least one of a characteristic of a signal carried in the sub-band, a bit allocation state corresponding to the sub-band, or a frequency range of the sub-band.

24. The apparatus according to claim 23, wherein:

the characteristic of the signal carried in the sub-band comprises at least one of a type of the signal carried in the sub-band or an envelope value of the sub-band; and/or

the bit allocation state corresponding to the sub-band comprises at least one of a coefficient quantization state of a corresponding previous-frame sub-band of the sub-band, a quantity of primary bits per information unit of the sub-band, an average quantity of primary bits per unit bandwidth of the sub-band, or a quantity of primarily allocated bits of the sub-band, wherein

the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the quantity of primary information units of the sub-band is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

25. The apparatus according to claim 24, wherein the type of the signal carried in the sub-band comprises harmonic and/or non-harmonic.

26. The apparatus according to any one of claims 22 to 25, wherein the sub-band selection unit comprises:

a determining subunit, configured to determine a target sub-band set according to at least one of the total quantity of surplus bits or the sub-band characteristic of each sub-band of the to-be-processed sub-bands; and

a selection subunit, configured to select the sub-bands for secondary bit allocation from the target sub-band set, wherein a sub-band in the target sub-band set belongs to the to-be-processed sub-bands.

27. The apparatus according to claim 26, wherein the determining subunit is specifically configured to:

determine the target sub-band set according to a sub-band characteristic of each sub-band in m first sub-band sets and m predetermined conditions in a one-to-one correspondence with the m first sub-band sets, wherein m is an integer greater than or equal to 1, and a sub-band in the m first sub-band sets belongs to the to-be-processed sub-bands, wherein

when all sub-band sets of the m first sub-band sets meet the corresponding predetermined conditions, a set formed by sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set, or when a sub-band set of the

m first sub-band sets does not meet a corresponding predetermined condition, a set formed by sub-bands of the to-be-processed sub-bands other than sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set; or

when at least one sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by all sub-bands in the at least one sub-band set is determined as the target sub-band set, or when no sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by sub-bands of the to-be-processed sub-bands that do not belong to any sub-band set of the m first sub-band sets is determined as the target sub-band set.

28. The apparatus according to claim 27, wherein any predetermined condition of the m predetermined conditions comprises at least one of the following conditions:

that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of a corresponding first sub-band set, that an average envelope value of sub-bands in a corresponding first sub-band set is greater than a first threshold, or that a sub-band carrying a signal of a harmonic type exists in a corresponding first sub-band set.

29. The apparatus according to claim 27 or 28, wherein a frequency of a sub-band in the m first sub-band sets is higher than a frequency of a sub-band of the to-be-processed sub-bands other than the sub-bands in the m first sub-band sets.

30. The apparatus according to any one of claims 26 to 29, wherein the selection subunit is specifically configured to:

select the sub-bands for secondary bit allocation from the target sub-band set according to at least one of an average quantity of primary bits per unit bandwidth of each sub-band, a quantity of primary bits per information unit of each sub-band, or a quantity of primarily allocated bits of each sub-band in the target sub-band set, wherein the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the quantity of primary information units of the sub-band is the quantity of information units that is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

31. The apparatus according to claim 30, wherein the selection subunit is

specifically configured to:

determine a sub-band with a smallest average quantity of primary bits per unit bandwidth, a sub-band with a smallest quantity of primary bits per information unit, or a sub-band with a smallest quantity of primarily allocated bits in the target sub-band set as a top-priority to-be-enhanced sub-band, wherein the top-priority to-be-enhanced sub-band belongs to the sub-bands for secondary bit allocation.

32. The apparatus according to claim 31, wherein the selection subunit is specifically configured to:

when the total quantity of surplus bits is greater than a threshold a_N and less than a_{N+1}, determine that N sub-bands for secondary bit allocation need to be selected, wherein a_N and a_{N+1} are respectively the Nth threshold and the $(N+1)^{th}$ threshold of multiple thresholds sorted in ascending order; and

when N is greater than or equal to 2, select N–1 sub-bands for secondary bit allocation from sub-bands in the target sub-band set other than the top-priority to-be-enhanced sub-band.

33. The apparatus according to claim 32, wherein the selection subunit is specifically configured to:

determine the N–1 sub-bands for secondary bit allocation based on the top-priority to-be-enhanced sub-band for allocation, wherein the N sub-bands for secondary bit allocation are successive in a frequency domain.

34. The apparatus according to claim 31, wherein the selection subunit is specifically configured to:

when the total quantity of surplus bits is greater than a threshold, determine a second-priority to-be-enhanced sub-band from the target sub-band set, wherein the sub-bands for secondary bit allocation comprise the second-priority to-be-enhanced sub-band and the top-priority to-be-enhanced sub-band.

35. The apparatus according to claim 31, wherein the selection subunit is specifically configured to:

determine a second-priority to-be-enhanced sub-band from the target sub-band set; and

when the total quantity of surplus bits is greater than a threshold, determine that the second-priority to-be-enhanced sub-band belongs to the sub-bands for secondary bit allocation.

36. The apparatus according to claim 34 or 35, wherein the selection subunit is

specifically configured to:

determine a sub-band with a smaller average quantity of primary bits per unit bandwidth, a sub-band with a smaller quantity of primary bits per information unit, or a sub-band with a smaller quantity of primarily allocated bits, of two sub-bands adjacent to the top-priority to-be-enhanced sub-band as the second-priority to-be-enhanced sub-band.

37. The apparatus according to any one of claims 22 to 36, wherein the secondary bit allocation unit is specifically configured to:

when a quantity of sub-bands comprised in the sub-bands for secondary bit allocation is equal to 2, implement secondary bit allocation on the sub-bands for secondary bit allocation according to a quantity of primary bits per information unit, an average quantity of primary bits per unit bandwidth, or a quantity of primarily allocated bits, of each sub-band of the sub-bands for secondary bit allocation, wherein

the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the quantity of primary information units of the sub-band is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

38. The apparatus according to any one of claims 22 to 37, wherein the primary bit allocation unit is specifically configured to:

implement primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits and envelope values of sub-bands of the to-be-processed sub-bands.

39. The apparatus according to any one of claims 22 to 38, wherein the apparatus is a decoder, and the apparatus further comprises:

a quantization unit, configured to perform a quantization operation for each sub-band of the to-be-processed sub-bands according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain a quantized spectral coefficient corresponding to each sub-band, wherein the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of

information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation; and

a transport unit, configured to write the quantized spectral coefficient into a bitstream and output the bitstream.

40. The apparatus according to claim 39, wherein the secondary bit allocation parameter comprises at least one parameter of a type of a signal carried in at least one sub-band of the to-be-processed sub-bands, an envelope value of at least one sub-band of the to-be-processed sub-bands, or a coefficient quantization state of a corresponding previous-frame sub-band of at least one sub-band of the to-be-processed sub-bands; and

the transport unit is further configured to: write the at least one parameter into the bitstream.

41. The apparatus according to any one of claims 22 to 38, wherein the apparatus is a decoder, and the apparatus further comprises:

an inverse quantization unit, configured to perform an inverse quantization operation for each sub-band of the to-be-processed sub-bands according to the quantity of information units corresponding to each sub-band of the to-be-processed sub-bands, so as to obtain an inverse quantized spectral coefficient corresponding to each sub-band, wherein the quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation is the quantity of information units that is obtained from the secondary information unit quantity determining operation, and a quantity of information units corresponding to another sub-band is a quantity of information units that is obtained from the primary information unit quantity determining operation; and

a first acquiring unit, configured to acquire an output signal according to the inverse quantized spectral coefficient.

42. The apparatus according to claim 41, wherein the secondary bit allocation parameter comprises at least one parameter of a type of a signal carried in at least one sub-band of the to-be-processed sub-bands, an envelope value of at least one sub-band of the to-be-processed sub-bands, or a coefficient quantization state of a corresponding previous-frame sub-band of at least one sub-band of the to-be-processed sub-bands; and

the apparatus further comprises:

a second acquiring unit, configured to acquire the at least one parameter from a

to-be-decoded bitstream.

CLAIMS

1. A signal processing method (100), comprising:

determining (S110) a total quantity of to-be-allocated bits corresponding to to-be-processed sub-bands of a current frame;

implementing (S120) primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band of the to-be-processed sub-bands;

performing (S130), according to the quantity of primarily allocated bits of each sub-band, a primary information unit quantity determining operation for each sub-band that has undergone the primary bit allocation, so as to obtain a total quantity of surplus bits of the current frame and a quantity of information units corresponding to each sub-band of the to-be-processed sub-bands;

selecting (S140) sub-bands for secondary bit allocation from the to-be-processed sub-bands according to a secondary bit allocation parameter, wherein the secondary bit allocation parameter comprises at least one of the total quantity of surplus bits or a sub-band characteristic of each sub-band of the to-be-processed sub-bands;

implementing (S150) secondary bit allocation on the sub-bands for secondary bit allocation, so as to allocate the surplus bits to the sub-bands for secondary bit allocation and obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; and

performing (S160), according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, a secondary information unit quantity determining operation for each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation.

2. The method according to claim 1, wherein the sub-band characteristic of each sub-band of the to-be-processed sub-bands comprises at least one of a characteristic of a signal carried in the sub-band, a bit allocation state corresponding to the sub-band, or a frequency range of the sub-band.

3. The method according to claim 2, wherein:

the characteristic of the signal carried in the sub-band comprises at least one of a

type of the signal carried in the sub-band or an envelope value of the sub-band; and

the bit allocation state corresponding to the sub-band comprises at least one of a coefficient quantization state of a corresponding previous-frame sub-band of the sub-band, a quantity of primary bits per information unit of the sub-band, an average quantity of primary bits per unit bandwidth of the sub-band, or a quantity of primarily allocated bits of the sub-band, wherein

the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the quantity of primary information units of the sub-band is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

4. The method according to claim 3, wherein the type of the signal carried in the sub-band comprises harmonic or non-harmonic.

5. The method according to any one of claims 1 to 4, wherein a quantity of the selected sub-bands for secondary bit allocation is two.

6. The method according to any one of claims 1 to 5, wherein the selected sub-bands for secondary bit allocation are successive in a frequency domain.

7. The method according to any one of claims 1 to 6, wherein the selecting sub-bands for secondary bit allocation from the to-be-processed sub-bands comprises:

determining a target sub-band set according to at least one of the total quantity of surplus bits or the sub-band characteristic of each sub-band of the to-be-processed sub-bands, and selecting the sub-bands for secondary bit allocation from the target sub-band set, wherein a sub-band in the target sub-band set belongs to the to-be-processed sub-bands.

8. The method according to claim 7, wherein the determining a target sub-band set comprises:

determining the target sub-band set according to a sub-band characteristic of each sub-band in m first sub-band sets and m predetermined conditions in a one-to-one correspondence with the m first sub-band sets, wherein m is an integer greater than or equal to 1, and a sub-band in the m first sub-band sets belongs to the to-be-processed sub-bands, wherein

when all sub-band sets of the m first sub-band sets meet the corresponding

predetermined conditions, a set formed by sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set, or when a sub-band set of the m first sub-band sets does not meet a corresponding predetermined condition, a set formed by sub-bands of the to-be-processed sub-bands other than sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set; or

when at least one sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by all sub-bands in the at least one sub-band set is determined as the target sub-band set, or when no sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by sub-bands of the to-be-processed sub-bands that do not belong to any sub-band set of the m first sub-band sets is determined as the target sub-band set.

9. The method according to claim 8, wherein any predetermined condition of the m predetermined conditions comprises at least one of the following conditions:

that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of a corresponding first sub-band set, that an average envelope value of sub-bands in a corresponding first sub-band set is greater than a first threshold, or that a sub-band carrying a signal of a harmonic type exists in a corresponding first sub-band set.

10. The method according to claim 8 or 9, wherein a frequency of a sub-band in the m first sub-band sets is higher than a frequency of a sub-band of the to-be-processed sub-bands other than the sub-bands in the m first sub-band sets.

11. A signal processing apparatus (500), comprising:

a total bit quantity determining unit (510), configured to determine a total quantity of to-be-allocated bits corresponding to to-be-processed sub-bands of a current frame;

a primary bit allocation unit (520), configured to implement primary bit allocation on the to-be-processed sub-bands according to the total quantity of to-be-allocated bits, so as to obtain a quantity of primarily allocated bits of each sub-band of the to-be-processed sub-bands;

a primary information unit quantity determining unit (530), configured to perform, according to the quantity of primarily allocated bits of each sub-band, a primary information unit quantity determining operation for each sub-band that has undergone the primary bit allocation, so as to obtain a total quantity of surplus bits of the current frame and a quantity of information units corresponding to each sub-band

of the to-be-processed sub-bands;

a sub-band selection unit (540), configured to select sub-bands for secondary bit allocation from the to-be-processed sub-bands according to a secondary bit allocation parameter, wherein the secondary bit allocation parameter comprises at least one of the total quantity of surplus bits or a sub-band characteristic of each sub-band of the to-be-processed sub-bands;

a secondary bit allocation unit (550), configured to implement secondary bit allocation on the sub-bands for secondary bit allocation, so as to allocate the surplus bits to the sub-bands for secondary bit allocation and obtain a quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation; and

a secondary information unit quantity determining unit (560), configured to perform, according to the quantity of primarily allocated bits and the quantity of secondarily allocated bits of each sub-band of the sub-bands for secondary bit allocation, a secondary information unit quantity determining operation for each sub-band of the sub-bands for secondary bit allocation, so as to re-obtain a quantity of information units corresponding to each sub-band of the sub-bands for secondary bit allocation.

12. The apparatus according to claim 11, wherein the sub-band characteristic of each sub-band of the to-be-processed sub-bands comprises at least one of a characteristic of a signal carried in the sub-band, a bit allocation state corresponding to the sub-band, or a frequency range of the sub-band.

13. The apparatus according to claim 12, wherein:

the characteristic of the signal carried in the sub-band comprises at least one of a type of the signal carried in the sub-band or an envelope value of the sub-band; and/or

the bit allocation state corresponding to the sub-band comprises at least one of a coefficient quantization state of a corresponding previous-frame sub-band of the sub-band, a quantity of primary bits per information unit of the sub-band, an average quantity of primary bits per unit bandwidth of the sub-band, or a quantity of primarily allocated bits of the sub-band, wherein

the average quantity of primary bits per unit bandwidth of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and bandwidth of the sub-band, and the quantity of primary bits per information unit of the sub-band is determined according to the quantity of primarily allocated bits of the sub-band and a quantity of primary information units of the sub-band, wherein the

quantity of primary information units of the sub-band is obtained from the primary information unit quantity determining operation that the sub-band has undergone.

14. The apparatus according to claim 13, wherein the type of the signal carried in the sub-band comprises harmonic or non-harmonic.

15. The apparatus according to any one of claims 11 to 14, wherein a quantity of the selected sub-bands for secondary bit allocation is two.

16. The apparatus according to any one of claims 11 to 15, wherein the selected sub-bands for secondary bit allocation are successive in a frequency domain.

17. The apparatus according to any one of claims 11 to 16, wherein the sub-band selection unit (540) comprises:

a determining subunit (542), configured to determine a target sub-band set according to at least one of the total quantity of surplus bits or the sub-band characteristic of each sub-band of the to-be-processed sub-bands; and

a selection subunit (546), configured to select the sub-bands for secondary bit allocation from the target sub-band set, wherein a sub-band in the target sub-band set belongs to the to-be-processed sub-bands.

18. The apparatus according to claim 17, wherein the determining subunit (542) is specifically configured to:

determine the target sub-band set according to a sub-band characteristic of each sub-band in m first sub-band sets and m predetermined conditions in a one-to-one correspondence with the m first sub-band sets, wherein m is an integer greater than or equal to 1, and a sub-band in the m first sub-band sets belongs to the to-be-processed sub-bands, wherein

when all sub-band sets of the m first sub-band sets meet the corresponding predetermined conditions, a set formed by sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set, or when a sub-band set of the m first sub-band sets does not meet a corresponding predetermined condition, a set formed by sub-bands of the to-be-processed sub-bands other than sub-bands that belong to all the m first sub-band sets is determined as the target sub-band set; or

when at least one sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by all sub-bands in the at least one sub-band set is determined as the target sub-band set, or when no sub-band set of the m first sub-band sets meets a corresponding predetermined condition, a set formed by sub-bands of the to-be-processed sub-bands that do not belong to any sub-band set of

the m first sub-band sets is determined as the target sub-band set.

19. The apparatus according to claim 18, wherein any predetermined condition of the m predetermined conditions comprises at least one of the following conditions:

that a coefficient-quantized sub-band exists in corresponding previous-frame sub-bands of a corresponding first sub-band set, that an average envelope value of sub-bands in a corresponding first sub-band set is greater than a first threshold, or that a sub-band carrying a signal of a harmonic type exists in a corresponding first sub-band set.

20. The apparatus according to claim 18 or 19, wherein a frequency of a sub-band in the m first sub-band sets is higher than a frequency of a sub-band of the to-be-processed sub-bands other than the sub-bands in the m first sub-band sets.