CLAIMS

1. An audio 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 of an audio signal;

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;

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, or,

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.

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 the 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 the 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. An audio 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 of audio signal;

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;

the apparatus further comprises a quantization unit or an inverse quantization unit, wherein

the quantization unit 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,

the inverse quantization unit 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,

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.

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 the 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 the 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.