a sub-band whose quantity of bits is greater than or equal to a second threshold. Specifically, the average quantity of allocated bits per spectral coefficient is compared with the second threshold, where the average quantity of allocated bits per spectral coefficient is the ratio of the quantity of bits allocated for each sub-band to the quantity of spectral coefficients in each sub-band, that is, an average quantity of allocated bits per spectral coefficient of one sub-band is a ratio of a quantity of bits allocated for the one sub-band to a quantity of spectral coefficients in the one sub-band; a harmonic parameter of a sub-band whose average quantity of allocated bits per spectral coefficient is greater than or equal to the second threshold is calculated, where the harmonic parameter represents harmonic strength or weakness of a frequency domain signal; and noise filling is performed, based on the harmonic parameter, on the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation. The second threshold may be preset, and the second threshold is less than or equal to the foregoing first threshold and may be another threshold such as 1.3 bits/spectral coefficient. The harmonic parameter harm is used to represent the harmonic strength or weakness of a frequency domain signal. In a case in which harmonicity of a frequency domain signal is strong, there are a relatively large quantity of spectral coefficients with a value of 0 in the spectral coefficients obtained by means of decoding, and noise filling does not need to be performed on these spectral coefficients with the value of 0. Therefore, if noise filling is differentially performed, based on the harmonic parameter, on the spectral coefficient (that is, a spectral coefficient with the value of 0) that has not been obtained by means of decoding, an error of noise filling performed on a part of the spectral coefficients, obtained by means of decoding, with the value of 0 may be avoided, thereby improving signal decoding quality.

[0054] The harmonic parameter harm of the sub-band whose average quantity of allocated bits per spectral coefficient is greater than or equal to the second threshold may be represented by one or more of: a peak-to-average ratio (that is, a ratio of a peak value to an average amplitude), a peak envelope ratio, sparsity of a spectral coefficient obtained by means of decoding, a bit allocation variance of an entire frame, an average envelope ratio, an average-to-peak ratio (that is, a ratio of an average amplitude to a peak value), an envelope peak ratio, and an envelope average ratio that are of the sub-band. A manner of calculating a harmonic parameter is briefly

(IFFT, Inverse Fast Fourier Transform). In practice, an engineering person skilled in the art understands a solution to how an output signal of a time domain is obtained according to a spectral coefficient, and details are not described herein again.

[0058] In the foregoing method for decoding a signal in this embodiment of the present invention, a sub-band with unsaturated bit allocation in sub-bands of a frequency domain signal is obtained by means of classification, and a spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation is restored, thereby improving signal decoding quality. In addition, in a case in which a spectral coefficient that has not been obtained by means of decoding is restored based on a harmonic parameter, an error of noise filling performed on spectral coefficients, obtained by means of decoding, with a value of 0 may be avoided, thereby further improving signal decoding quality.

[0059] FIG. 2 is a flowchart of noise filling processing 200 in a method for decoding a signal according to an embodiment of the present invention.

[0060] The noise filling processing 200 includes: calculating, according to an envelope of a sub-band with unsaturated bit allocation and a spectral coefficient obtained by means of decoding, a noise filling gain of the sub-band with unsaturated bit allocation (210); calculating a peak-to-average ratio of a sub-band whose average quantity of allocated bits per spectral coefficient is greater than or equal to a second threshold and obtaining a global noise factor based on a peak-to-average ratio of the sub-band with saturated bit allocation (220); correcting the noise filling gain based on a harmonic parameter and the global noise factor so as to obtain a target gain (230); and using the target gain and a weighted value of noise to restore a spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation (240).

[0061] In 210, for the sub-band sfm with unsaturated bit allocation, a noise filling gain gain of the sub-band sfm with unsaturated bit allocation may be calculated according to the following formula (5) or (6):

$$gain = \sqrt{norm[sfm] * norm[sfm] * size_sfm - \sum_i coef[i] * coef[i]} / size_sfm$$

formula (5)

$$gain = (norm[sfm] * size_sfm - \sum_i |coef[i]|) / size_sfm$$

formula (6), where

norm[sfm] is the envelope of the spectral coefficient that has been obtained by means of decoding and is in the sub-band (an index is sfm) with unsaturated bit allocation; $coef[i]$ is the i^{th} spectral coefficient that has been obtained by means of decoding and is in a sub-band with unsaturated bit allocation; and size_sfm is a quantity of spectral coefficients in the sub-band sfm with unsaturated bit allocation or a quantity of spectral coefficients that has been obtained by means of decoding and is in the sub-band sfm.

[0062] In 220, the global noise factor may be calculated based on the peak-to-average ratio sharp of the sub-band with saturated bit allocation (referring to the foregoing description with reference to formula (1). Specifically, an average value of the peak-to-average ratio sharp may be calculated, and a multiple of a reciprocal of the average value is used as the global noise factor fac.

[0063] In 230, the noise filling gain is corrected based on the harmonic parameter and the global noise factor to obtain the target gain $gain_T$. In an example, the target gain $gain_T$ may be obtained according to the following formula (7):

$$gain_T = fac \times harm \times gain \quad \text{formula (7), where}$$

fac is the global noise factor; harm is the harmonic parameter; and gain is the noise filling gain. In another example, it may also be that harmonic strength or weakness is determined first, and then the target gain $gain_T$ is obtained in a different manner according to the harmonic strength or weakness. For example, the harmonic parameter is compared with a fourth threshold.

[0064] When the harmonic parameter is greater than or equal to the fourth threshold, the target gain $gain_T$ is obtained by using the following formula (8):

$$gain_T=fac*gain*norm[sfm]/peak \quad \text{formula (8)}$$

[0065] When the harmonic parameter is less than the fourth threshold, the target gain $gain_T$ is obtained by using the following formula (9):

$$gain_T=fac'*gain,\ fac'=fac+step \quad \text{formula (9), where}$$

fac is the global noise factor; norm[sfm] is the envelope of the sub-band sfm with unsaturated bit allocation; peak is a maximum amplitude of the spectral coefficient, obtained by means of decoding, in the sub-band with unsaturated bit allocation; and step is a step by which the global noise factor changes. The global noise factor increases from a low frequency to a high frequency according to the step, and the step may be determined according to a highest sub-band for which

bits are allocated, or the global noise factor. The fourth threshold may be preset, or may be set changeably in practice according to a different signal feature.

[0066] In 240, the target gain and the weighted value of noise are used to restore the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation. In an example, the target gain and the weighted value of noise may be used to obtain filling noise, and the filling noise is used to perform noise filling on the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation to restore a frequency domain signal that has not been obtained by means of decoding. The noise may be noise, such as random noise, of any type. It should be noted that, the noise may further be used first herein to fill the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation, and then the target gain is exerted on the filling noise, so as to restore the spectral coefficient that has not been obtained by means of decoding. In addition, after noise filling is performed on the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation (that is, the spectral coefficient that has not been obtained by means of decoding is restored), interframe smoothing processing may further be performed on a restored spectral coefficient to achieve a better decoding effect.

[0067] In foregoing steps of FIG. 2, an execution sequence of some steps may be adjusted according to a requirement. For example, it may be that 220 is executed first and then 210 is executed, or it may be that 210 and 220 are simultaneously executed.

[0068] In addition, an abnormal sub-band with a large peak-to-average ratio may exist in the sub-band with unsaturated bit allocation, and for the abnormal sub-band, a target gain of the abnormal sub-band may further be corrected, so as to obtain a target gain that is more suitable for the abnormal sub-band. Specifically, a peak-to-average ratio of a spectral coefficient of the sub-band whose average quantity of allocated bits per spectral coefficient is greater than or equal to the second threshold may be calculated, and the peak-to-average ratio is compared with a third threshold; and for a sub-band whose peak-to-average ratio is greater than the third threshold, after a target gain is obtained in 230, a ratio (norm[sfm]/peak) of an envelope of the sub-band with unsaturated bit allocation to a maximum signal amplitude of the sub-band with unsaturated bit allocation may be used to correct the target gain of the sub-band

spectral coefficients in the sub-band. The first threshold may be preset, or may be easily obtained by an experiment.

[0081] The restoring unit 330 may perform noise filling on the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation, so as to restore the spectral coefficient that has not been obtained by means of decoding. The sub-band with unsaturated bit allocation may include a sub-band for which no bit is allocated and a sub-band for which bits is allocated but bit allocation is unsaturated. Various noise filling methods may be used to restore the spectral coefficient that has not been obtained by means of decoding. In this embodiment of the present invention, the restoring unit 330 may perform noise filling based on a harmonic parameter harm of a sub-band whose quantity of bits is greater than or equal to a second threshold. Specifically, as shown in FIG. 4, the restoring unit 330 may include: a calculating component 410, configured to compare the average quantity of allocated bits per spectral coefficient with the second threshold, and calculate the harmonic parameter of the sub-band whose average quantity of allocated bits per spectral coefficient is greater than or equal to the second threshold, where the average quantity of allocated bits per spectral coefficient is the ratio of the quantity of bits allocated for each sub-band to the quantity of spectral coefficients in each sub-band, that is, an average quantity of allocated bits per spectral coefficient of one sub-band is a ratio of a quantity of bits allocated for the one sub-band to a quantity of spectral coefficients in the one sub-band, and the harmonic parameter represents harmonic strength or weakness of a frequency domain signal; and a filling component 420, configured to perform, based on the harmonic parameter, noise filling on the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation, so as to restore the spectral coefficient that has not been obtained by means of decoding. As previously described, the second threshold is less than or equal to the first threshold; therefore, the first threshold may be used as the second threshold. Another threshold less than the first threshold may also be set as the second threshold. A harmonic parameter harm of a frequency domain signal is used to represent harmonic strength or weakness of the frequency domain signal. In a case in which harmonicity is strong, there are a relatively large quantity of spectral coefficients with a value of 0 in the spectral coefficients obtained by means of decoding, and noise filling does not need to be performed on these

or (6) to calculate the noise filling gain of the sub-band with unsaturated bit allocation, use a multiple of a reciprocal of an average value of a peak-to-average ratio sharp (referring to descriptions with reference to formula (1) in the foregoing) of the sub-band with saturated bit allocation as a global noise factor fac; and correct the noise filling gain based on the harmonic parameter and the global noise factor so as to obtain a target gain $gain_T$. In an example of obtaining the target gain $gain_T$, the gain calculating module 421 may perform the following operations: comparing the harmonic parameter with a fourth threshold; when the harmonic parameter is greater than or equal to the fourth threshold, obtaining the target gain by using the foregoing formula (8); and when the harmonic parameter is less than the fourth threshold, obtaining the target gain by using the foregoing formula (9). In addition, the gain calculating module 421 may also directly use the foregoing formula (7) to obtain the target gain.

[0088] In another embodiment, the filling component 420 further includes a correction module 423, configured to calculate a peak-to-average ratio of the sub-band with unsaturated bit allocation and compare the peak-to-average ratio with a third threshold; and for a sub-band, whose peak-to-average ratio is greater than the third threshold, with unsaturated bit allocation, after a target gain is obtained, use a ratio of an envelope of the sub-band with unsaturated bit allocation to a maximum amplitude of a spectral coefficient, obtained by means of decoding, in the sub-band with unsaturated bit allocation to correct the target gain, so as to obtain a corrected target gain. The filling module uses the corrected target gain to restore the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation. A purpose is to correct an abnormal sub-band with a large peak-to-average ratio in the sub-band with unsaturated bit allocation, so as to obtain a more appropriate target gain.

[0089] In addition to performing noise filling in the foregoing manner, the filling module 422 may further first use noise to fill the spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation, and then exert the target gain on the filled noise, so as to restore the spectral coefficient that has not been obtained by means of decoding.

[0090] It should be noted that structural classification in FIG. 4 is merely exemplary, and may be flexibly implemented in another classification manner in

practice; for example, the calculating component 410 may be used to implement the operations of the gain calculating module 421.

[0091] FIG. 5 is a block diagram of an apparatus 500 according to another embodiment of the present invention. The apparatus 500 in FIG. 5 may be configured to implement steps and methods in the foregoing method embodiments. The apparatus 500 may be applied to a base station or a terminal in various communication systems. In the embodiment of FIG. 5, the apparatus 500 includes a receiving circuit 502, a decoding processor 503, a processing unit 504, a memory 505, and an antenna 501. The processing unit 504 controls an operation of the apparatus 500, and the processing unit 504 may also be referred to as a CPU (Central Processing Unit, central processing unit). The memory 505 may include a read-only memory and a random access memory, and provide an instruction and data to the processing unit 504. A part of the memory 505 may further include a nonvolatile random access memory (NVRAM). In a specific application, the apparatus 500 may be built in or may be a wireless communications device such as a mobile phone, and the apparatus 500 may further include a carrier that accommodates the receiving circuit 502, so as to allow the apparatus 500 to receive data from a remote location. The receiving circuit 501 may be coupled to the antenna 501. Components of the apparatus 500 are coupled together by using a bus system 506, where the bus system 506 further includes a power bus, a control bus, and a state signal bus in addition to a data bus. However, for clarity of description, various buses are marked as the bus system "506" in FIG. 5. The apparatus 500 may further include the processing unit 504 configured to process a signal, and in addition, further includes the decoding processor 503.

[0092] The methods disclosed in the foregoing embodiments of the present invention may be applied to the decoding processor 503, or implemented by the decoding processor 503. The decoding processor 503 may be an integrated circuit chip, which has a signal processing capability. In an implementation process, the steps in the foregoing methods may be implemented by using an integrated logic circuit of hardware in the decoding processor 503 or instructions in a form of software. These instructions may be implemented and controlled by working with the processing unit 504. The foregoing decoding processor may be a general purpose processor, a digital signal processor (DSP), an application-specific integrated circuit (ASIC), a field programmable gate array (FPGA) or another programmable logic device, a discrete

gate or a transistor logic device, or a discrete hardware component. The foregoing decoding processor may implement or execute methods, steps, and logical block diagrams disclosed in the embodiments of the present invention. The general purpose processor may be a microprocessor, or the processor may also be any conventional processor, translator, or the like. Steps of the methods disclosed with reference to the embodiments of the present invention may be directly executed and accomplished by a decoding processor embodied as hardware, or may be executed and accomplished by using a combination of hardware and software modules in the decoding processor. The software module may be located in a mature storage medium in the art, such as a random access memory, a flash memory, a read-only memory, a programmable read-only memory, an electrically-erasable programmable memory, or a register. The storage medium is located in the memory 505. The decoding processor 503 reads information from the memory 505, and completes the steps of the foregoing methods in combination with the hardware.

[0093] For example, the device 300 for decoding a signal in FIG. 3 may be implemented by the decoding processor 503. In addition, the classifying unit 320, the restoring unit 330, and the output unit 340 in FIG. 3 may be implemented by the processing unit 504, or may be implemented by the decoding processor 503. However, the foregoing examples are merely exemplary, and are not intended to limit the embodiments of the present invention to this specific implementation manner.

[0094] Specifically, the memory 505 stores an instruction that enables the processor unit 504 or the decoding processor 503 to implement the following operations: obtaining spectral coefficients of sub-bands from a received bitstream by means of decoding; classifying sub-bands in which the spectral coefficients are located into a sub-band with saturated bit allocation and a sub-band with unsaturated bit allocation, where the sub-band with saturated bit allocation refers to a sub-band in which allocated bits can be used to encode all spectral coefficients in the sub-band, and the sub-band with unsaturated bit allocation refers to a sub-band in which allocated bits can be used to encode only a part of spectral coefficients in the sub-band, and a sub-band for which no bit is allocated; performing noise filling on a spectral coefficient that has not been obtained by means of decoding and is in the sub-band with unsaturated bit allocation, so as to restore the spectral coefficient that has not been obtained by means of decoding; and obtaining a frequency domain signal

CLAIMS:

1. A method for decoding an audio signal, comprising:

receiving a bitstream including a plurality of spectral coefficient parameters;

obtaining, based on the spectral coefficient parameters, spectral coefficients of a current frame of the audio signal by decoding the received bitstream;

classifying a sub-band of the current frame as a bit allocation un-saturated sub-band;

restoring a spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling; and

obtaining a frequency domain signal according to the obtained spectral coefficients and the restored spectral coefficient associated with the bit allocation un-saturated sub-band.

2. The method according to claim 1, wherein classifying the sub-band of the current frame as the bit allocation un-saturated sub-band comprises:

comparing an average quantity of allocated bits per spectral coefficient of the sub-band with a classification threshold, wherein the average quantity of allocated bits per spectral coefficient of the sub-band is a ratio of a quantity of bits allocated for the sub-band to a quantity of spectral coefficients in the sub-band;

classifying the sub-band as a bit allocation saturated sub-band when the average quantity of allocated bits per spectral coefficient of the sub-band is not less than the classification threshold; and

classifying the sub-band as the bit allocation un-saturated sub-band when the average quantity of allocated bits per spectral coefficient of the sub-band is less than the ~~first~~ classification threshold.

3. The method according to claim 1, wherein restoring the spectral coefficient associated with the bit allocation un-saturated sub-band comprises:

comparing an average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated sub-band with a harmonic parameter calculation threshold;

calculating a harmonic parameter of the bit allocation un-saturated sub-band when the average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated subband is not less than the harmonic parameter calculation threshold; and

restoring, based on the harmonic parameter, the spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling.

4. The method according to claim 3, wherein the harmonic parameter of the bit allocation un-saturated sub-band comprises a peak-to-average ratio of the bit allocation un-saturated sub-band.

5. The method according to claim 3, wherein restoring the spectral coefficient associated with the bit allocation un-saturated sub-band comprises:

calculating, according to an envelope of the bit allocation un-saturated sub-band and an obtained spectral coefficient of the bit allocation un-saturated sub-, a noise filling gain of the bit allocation un-saturated sub-band;

calculating a peak-to-average ratio of the bit allocation un-saturated sub-band;

obtaining a global noise factor based on the peak-to-average ratio;

correcting the noise filling gain based on the harmonic parameter and the global noise factor so as to obtain a target gain; and

restoring the spectral coefficient associated with the bit allocation un-saturated sub-band by using the target gain and a weighted value of noise.

6. The method according to claim 5, wherein restoring the spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling further comprises:

comparing the peak-to-average ratio with a correction threshold; and

correcting the target gain by using a ratio of an envelope of the bit allocation un-saturated sub-band to a maximum amplitude of obtained spectral coefficients of the bit allocation un-saturated sub-band.

7. The method according to claim 5, wherein correcting the noise filling gain based on the harmonic parameter and the global noise factor so as to obtain a target gain comprises:

comparing the harmonic parameter with a target gain obtaining threshold;

obtaining the target gain using $gain_T=fac*gain*norm/peak$ when the harmonic parameter is greater than or equal to the target gain obtaining threshold, wherein *gain* denotes the noise filling gain, wherein $gain_T$ denotes the target gain, wherein *fac* denotes the global noise factor, wherein *norm* denotes the envelope of the bit allocation un-saturated sub-band with unsaturated bit allocation, and wherein *peak* denotes a maximum amplitude of obtained spectral coefficients of the bit allocation un-saturated sub-band; and

obtaining the target gain using $gain_T=fac'*gain$ and $fac'=fac+step$ when the harmonic parameter is less than the target gain obtaining threshold, wherein *step* denotes a step by which the global noise factor changes according to a frequency.

8. The method according to claim 5, further comprising performing interframe smoothing processing on the restored spectral coefficient associated with the bit allocation un-saturated sub-band.

9. A device for decoding an audio signal, comprising:

a receiver configured to receive a bitstream including a plurality of spectral coefficient parameters;

a decoder coupled to the receiver and configured to obtain spectral coefficients of a current frame of the audio signal, based on the spectral coefficient parameters, by decoding the received bitstream; and

a processor coupled to the decoder and configured to:

classify a subband of the current frame as a bit allocation un-saturated sub-band;

restore a spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling; and

obtain a frequency domain signal according to the obtained spectral coefficients and the restored spectral coefficient associated with the bit allocation un-saturated sub-band.

10. The device according to claim 9, wherein the processor is further configured to:

compare an average quantity of allocated bits per spectral coefficient of the sub-band with a classification threshold, wherein the average quantity of allocated bits per spectral coefficient of the sub-band is a ratio of a quantity of bits allocated for the sub-band to a quantity of spectral coefficients in the sub-band;

classify the sub-band as a bit allocation saturated sub-band when the average quantity of allocated bits per spectral coefficient of the sub-band is not less than the classification threshold; and

classify the sub-band as the bit allocation un-saturated sub-band when the average quantity of allocated bits per spectral coefficient of the sub-band is less than the classification threshold.

11. The device according to claim 9, wherein the processor is further configured to:

compare an average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated sub-band with a harmonic parameter calculation-threshold;

calculate a harmonic parameter of the bit allocation un-saturated sub-band when the average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated sub-band is not less than the harmonic parameter calculation threshold; and

restore, based on the harmonic parameter, the spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling.

12. The device according to claim 11, wherein the harmonic parameter of the bit allocation un-saturated sub-band comprises a peak-to-average ratio of the bit allocation un-saturated sub-band.

13. The device according to claim 9, wherein processor is further configured to:

compare an average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated sub-band with 0; and

calculate a harmonic parameter of the bit allocation un-saturated sub-band when the average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated sub-band is not equal to 0, wherein the harmonic parameter represents harmonic strength or weakness of a frequency domain signal; and

restore, based on the harmonic parameter, the spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise.

14. The device according to claim 13, wherein the processor calculates the harmonic parameter by:

calculating at least one parameter of a peak-to-average ratio, a peak envelope ratio, sparsity of an obtained spectral coefficient, a bit allocation variance of the frame, an average envelope ratio, an average-to-peak ratio, an envelope peak ratio, or an envelope average ratio that are of the bit allocation un-saturated sub-band; and

using at least one of the calculated as the harmonic parameter.

15. The device according to claim 14, wherein processor further comprises:

calculating, according to an envelope of the bit allocation un-saturated sub-band and an obtained spectral coefficient of the bit allocation un-saturated sub-band, a noise filling gain of the bit allocation un-saturated sub-band;

obtaining a global noise factor based on the peak-to-average ratio;

correcting the noise filling gain based on the harmonic parameter and the global noise factor so as to obtain a target gain; and

using the target gain and a weighted value of noise to restore the spectral coefficient associated with the bit allocation un-saturated sub-band.

16. The device according to claim 15, wherein the processor is further configured to:

compare the peak-to-average ratio with a correction threshold;

correct the target gain by using a ratio of an envelope of the bit allocation un-saturated sub-band to a maximum amplitude of spectral coefficients of the bit allocation un-saturated sub-band when the peak-to-average ratio is greater than the correction threshold; and

use the corrected target gain and the weighted value of noise to restore the spectral coefficient associated with the bit allocation un-saturated sub-band.

17. The device according to claim 15, wherein the processor is further configured to:

compare the harmonic parameter with a target gain obtaining threshold;

obtain the target gain using $gain_T=fac*gain*norm/peak$ when the harmonic parameter is greater than or equal to the target gain obtaining threshold, wherein *gain* denotes the noise filling gain, wherein $gain_T$ denotes the target gain, wherein *fac* denotes the global noise factor, wherein *norm* denotes the envelope of the sub-band with unsaturated bit allocation, and wherein *peak* denotes a maximum amplitude of obtained spectral coefficients of the bit allocation un-saturated sub-band; and

obtain the target gain using $gain_T=fac'*gain$ and $fac'=fac+step$ when the harmonic parameter is less than the target gain obtaining threshold, wherein *step* denotes a step by which the global noise factor changes according to a frequency.

18. The device according to claim 15, wherein the processor is further configured to perform interframe smoothing processing on the restored spectral coefficient of the bit allocation un-saturated sub-band.

19. A non-transitory computer readable storage medium, tangibly embodying computer program code, which, when executed by a processor, causes the processor to:

receive a bitstream including a plurality of spectral coefficient parameters;

obtain spectral coefficients of a current frame of the audio signal, based on the spectral coefficient parameters, by decoding the received bitstream;

classify a sub-band of the current frame as a bit allocation un-saturated sub-band;

restore a spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling; and

obtain a frequency domain signal according to the obtained spectral coefficients and the restored spectral coefficient associated with the bit allocation un-saturated sub-band.

20. The non-transitory computer readable storage medium according to claim 19, wherein classifying the sub-band of the current frame as the bit allocation un-saturated sub-band comprises:

comparing an average quantity of allocated bits per spectral coefficient of the subband with a classification threshold, wherein the average quantity of allocated bits per spectral coefficient one of the sub-bands is a ratio of a quantity of bits allocated for the sub-band to a quantity of spectral coefficients in the sub-band; and

classifying the sub-band as a bit allocation saturated sub-band when the average quantity of allocated bits per spectral coefficient of the sub-band is not less than the classification threshold, and classifying the sub-band as the bit allocation un-saturated sub-band when the average quantity of allocated bits per spectral coefficient is less than the classification threshold.

21. The non-transitory computer readable storage medium according to claim 19, wherein restoring a spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling comprises:

comparing an average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated sub-band with a harmonic parameter calculation threshold;

calculating a harmonic parameter of the bit allocation un-saturated sub-band when the average quantity of allocated bits per spectral coefficient of the bit allocation un-saturated sub-band is not less than the harmonic parameter calculation threshold; and

restoring, based on the harmonic parameter, the spectral coefficient associated with the bit allocation un-saturated sub-band by performing noise filling.

22. The non-transitory computer readable storage medium according to claim 21, wherein the harmonic parameter of the bit allocation un-saturated sub-band comprises a peak-to-average ratio of the bit allocation un-saturated sub-band.