is lower than the original sound.

[0021]

In addition, in the high band characteristic encoding method such as HE-AAC and the like described above, the frequency envelope of the high band side is used as characteristic information of the encoded high band signal components. However, it needs to reproduce the frequency envelope of the original high band side with high accuracy in a decoding side.

[0022]

Embodiments of t~~T~~he present invention ~~has been made in a consideration of such a circumstance and~~ provides a music signal having a better sound quality by expanding a frequency band.

SOLUTIONS TO PROBLEMS

[0023]

~~A signal processing apparatus according to a first aspect of the present invention includes: a demultiplexing unit that demultiplexes input encoded data to at least low band encoded data and coefficient information; a low band decoding unit that decodes the low band encoded data to produce low band signals; a selection unit that selects a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce the coefficient table or produces the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table; a high band sub-band power calculation unit that calculates high band sub-band~~

~~powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; and a high band signal production unit that produces the high band signals based on the high band sub-band powers and the low band sub-band signals.~~

According to a first aspect, there is provided a signal processing apparatus comprising: a demultiplexing unit that demultiplexes input encoded data to at least low band encoded data and coefficient information; a low band decoding unit that decodes the low band encoded data to produce low band signals; a selection unit that selects a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce the coefficient table or produces the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table; a high band sub-band power calculation unit that calculates high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; and a high band signal production unit that produces the high band signals based on the high band sub-band powers and the low band sub-band signals, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated coefficients to coefficients of a sub-band

having a higher frequency than the highest frequency to extend the coefficient table.

[0024]

The extension and reduction unit may duplicate the coefficients of a sub-band having a highest frequency which is included in the coefficient table and set the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0025]

The extension and reduction unit may delete the coefficients of a sub-band, which has a higher frequency than that of a sub-band having a highest frequency among sub-bands of the high band sub-band signals, from the coefficient table to reduce the coefficient table.

[0026]

~~A signal processing method or a program according to the first aspect of the invention includes the steps of demultiplexing input encoded data to at least low band encoded data and coefficient information; decoding the low band encoded data to produce low band signals; selecting a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; deleting the coefficients of some sub-bands to reduce the coefficient table or generating~~

~~the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table; calculating high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; and generating the high band signals based on the high band sub-band powers and the low band sub-band signals.~~

According to a second aspect, there is provided a signal processing method of a signal processing apparatus which includes a demultiplexing unit that demultiplexes input encoded data to at least low band encoded data and coefficient information, a low band decoding unit that decodes the low band encoded data to produce low band signals, a selection unit that selects a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side, an extension and reduction unit that deletes the coefficients of some sub-bands to reduce the coefficient table or produces the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table, a high band sub-band power calculation unit that calculates high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table, and a high band signal production unit that produces the high band signals based on the high band sub-band powers and the low band sub-band signals, the method comprising

the steps of causing: the demultiplexing unit to demultiplex the encoded data; the low band decoding unit to produce the low band signals; the selection unit to select the coefficient table; the extension and reduction unit to reduce or extend the coefficient table; the high band sub-band power calculation unit to calculate the high band sub-band powers; and the high band signal production unit to produce the high band signals, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

According to a third aspect, there is provided a program causing a computer to execute processes including the steps of: demultiplexing input encoded data to at least low band encoded data and coefficient information; decoding the low band encoded data to produce low band signals; selecting a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; deleting the coefficients of some sub-bands to reduce the coefficient table or generating the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table; calculating high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; and generating the high band signals based on the high band sub-band

powers and the low band sub-band signals, wherein the step of deleting the coefficients of some sub-bands comprises the steps of: duplicating the coefficients of a sub-band having a highest frequency which is included in the coefficient table; and setting the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0027]

According to the above~~first~~ aspect of the invention, input encoded data is demultiplexed to at least low band encoded data and coefficient information; the low band encoded data is decoded to produce low band signals; a coefficient table which is obtained based on the coefficient information is selected among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; the coefficients of some sub-bands are deleted to reduce the coefficient table or the coefficients of predetermined sub-bands are produced based on the coefficients of some sub-bands to extend the coefficient table; high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals are calculated based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; and the high band signals are produced based on the high band sub-band powers and the low band sub-band signals.

[0028]

~~A signal processing apparatus according to a second aspect of the present invention includes: a sub-band division~~

~~unit that produces low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce a coefficient table or produces coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having the coefficients for the respective sub-bands on the high band side; a pseudo high band sub-band power calculation unit that calculates pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; a selection unit that compares high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selects one of a plurality of the coefficient tables; and a production unit that produces data containing coefficient information for obtaining the selected coefficient table.~~

According to a fourth aspect, there is provided a signal processing apparatus comprising: a sub-band division unit that produces low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce a coefficient table or produces coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having the coefficients for the respective sub-bands on the high band side; a pseudo high band

sub-band power calculation unit that calculates pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; a selection unit that compares high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selects one of a plurality of the coefficient tables; and a production unit that produces data containing coefficient information for obtaining the selected coefficient table, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0029]

The extension and reduction unit may duplicate the coefficients of a sub-band having a highest frequency which is included in the coefficient table and set the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0030]

The extension and reduction unit may delete the coefficients of a sub-band, which has a higher frequency than that of a sub-band having a highest frequency among sub-bands

of the high band sub-band signals, from the coefficient table to reduce the coefficient table.

[0031]

~~A signal processing method or a program according to the second aspect of the invention includes the steps of generating low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal; deleting the coefficients of some sub-bands to reduce a coefficient table or generating coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having the coefficients for the respective sub-bands on the high band side; calculating pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; comparing high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selecting one of a plurality of the coefficient tables; and generating data containing coefficient information for obtaining the selected coefficient table.~~

According to a fifth aspect, there is provided a signal processing method of a signal processing apparatus which includes a sub-band division unit that produces low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal, an extension and reduction unit that deletes the coefficients of some sub-bands to reduce a coefficient table or produces

coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having coefficients for the respective sub-bands on the high band side, a pseudo high band sub-band power calculation unit that calculates pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals, a selection unit that compares high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selects one of a plurality of the coefficient tables, and a production unit that produces data containing coefficient information for obtaining the selected coefficient table, the method comprising the steps of causing: the sub-band division unit to produces the low band sub-band signals and the high band sub-band signals; the extension and reduction unit to reduce or extend the coefficient table; the pseudo high band sub-band power calculation unit to calculate the pseudo high band sub-band powers; the selection unit to select the coefficient table; and the production unit to produce the data containing coefficient information, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

According to a sixth aspect, there is provided a program causing a computer to execute processes including the steps of: generating low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band

sub-band signals of a plurality of sub-bands on a high band side of the input signal; deleting the coefficients of some sub-bands to reduce a coefficient table or generating coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having coefficients for the respective sub-bands on the high band side; calculating pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; comparing high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selecting one of a plurality of the coefficient tables; and generating data containing coefficient information for obtaining the selected coefficient table, wherein the step of deleting the coefficients of some sub-bands comprises the steps of: duplicating the coefficients of a sub-band having a highest frequency which is included in the coefficient table; and setting the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0032]

According to the above~~second~~ aspect of the invention, low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal are produced; the coefficients of some sub-bands are deleted to reduce a coefficient table or coefficients of predetermined sub-bands are produced based on coefficients

of some sub-bands to extend a coefficient table, the coefficient table having the coefficients for the respective sub-bands on the high band side; pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, are calculated for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers are compared to each other and one of a plurality of the coefficient tables is selected; and data containing coefficient information for obtaining the selected coefficient table is produced.

[0033]

~~A decoder according to a third aspect of the present invention includes: a demultiplexing unit that demultiplexes input encoded data to at least low band encoded data and coefficient information; a low band decoding unit that decodes the low band encoded data to produce low band signals; a selection unit that selects a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce the coefficient table or produces the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table; a high band sub-band power calculation unit that calculates high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended~~

~~or reduced coefficient table; a high band signal production unit that produces the high band signals based on the high band sub-band powers and the low band sub-band signals; and a synthesis unit that synthesizes the low band signal and the high band signal with each other to produce an output signal.~~

According to a seventh aspect, there is provided a decoder comprising: a demultiplexing unit that demultiplexes input encoded data to at least low band encoded data and coefficient information; a low band decoding unit that decodes the low band encoded data to produce low band signals; a selection unit that selects a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce the coefficient table or produces the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table; a high band sub-band power calculation unit that calculates high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; a high band signal production unit that produces the high band signals based on the high band sub-band powers and the low band sub-band signals; and a synthesis unit that synthesizes the low band signal and the high band signal with each other to produce an output signal, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated

coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0034]

~~A decoding method according to the third aspect of the invention includes the steps of demultiplexing input encoded data to at least low band encoded data and coefficient information; decoding the low band encoded data to produce low band signals; selecting a coefficient table which is obtained based on the coefficient information among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; deleting the coefficients of some sub-bands to reduce the coefficient table or generating the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table; calculating high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; generating the high band signals based on the high band sub-band powers and the low band sub-band signals; and synthesizing the low band signal and the high band signal with each other to produce an output signal.~~

According to an eighth aspect, there is provided a decoding method of a decoder which includes a demultiplexing unit that demultiplexes input encoded data to at least low band encoded data and coefficient information, a low band decoding unit that decodes the low band encoded data to produce low band signals, a selection unit that selects a coefficient table which is obtained based on the coefficient information

among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side, an extension and reduction unit that deletes the coefficients of some sub-bands to reduce the coefficient table or produces the coefficients of predetermined sub-bands based on the coefficients of some sub-bands to extend the coefficient table, a high band sub-band power calculation unit that calculates high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table, a high band signal production unit that produces the high band signals based on the high band sub-band powers and the low band sub-band signals, and a synthesis unit that synthesizes the low band signal and the high band signal with each other to produce an output signal, the method comprising the steps of causing: the demultiplexing unit to demultiplex the encoded data; the low band decoding unit to produce the low band signals; the selection unit to select the coefficient table; the extension and reduction unit to reduce or extend the coefficient table; the high band sub-band power calculation unit to calculate the high band sub-band powers; the high band signal production unit to produce the high band signals; and the synthesis unit to produce the output signal, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0035]

According to the above~~third~~ aspect of the invention, input encoded data is demultiplexed to at least low band encoded data and coefficient information; the low band encoded data is decoded to produce low band signals; a coefficient table

which is obtained based on the coefficient information is selected among a plurality of coefficient tables used for the production of high band signals and having coefficients for the respective sub-bands on a high band side; the coefficients of some sub-bands are deleted to reduce the coefficient table or the coefficients of predetermined sub-bands are produced based on the coefficients of some sub-bands to extend the coefficient table; high band sub-band powers of high band sub-band signals of the respective sub-bands constituting the high band signals are calculated based on low band sub-band signals of the respective sub-bands constituting the low band signals and the extended or reduced coefficient table; the high band signals are produced based on the high band sub-band powers and the low band sub-band signals; and the low band signal and the high band signal are synthesized with each other to produce an output signal.

[0036]

~~An encoder according to a fourth aspect of the present invention includes: a sub-band division unit that produces low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce a coefficient table or produces coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having coefficients for the respective sub-bands on the high band side; a pseudo high band sub-band power calculation unit that calculates pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on~~

~~the high band side based on the extended or reduced coefficient table and the low band sub-band signals; a selection unit that compares high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selects one of a plurality of the coefficient tables; a high band encoding unit that encodes coefficient information for obtaining the selected coefficient table to produce high band encoded data; a low band encoding unit that encodes low band signals of the input signal to produce low band encoded data; and a multiplexing unit that multiplexes the low band encoded data and the high band encoded data to produce an output code string.~~

According to a ninth aspect, there is provided an encoder comprising: a sub-band division unit that produces low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal; an extension and reduction unit that deletes the coefficients of some sub-bands to reduce a coefficient table or produces coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having coefficients for the respective sub-bands on the high band side; a pseudo high band sub-band power calculation unit that calculates pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; a selection unit that compares high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selects one of a plurality of the coefficient tables; a high band encoding unit that encodes coefficient information for obtaining the selected coefficient table to produce high

band encoded data; a low band encoding unit that encodes low band signals of the input signal to produce low band encoded data; and a multiplexing unit that multiplexes the low band encoded data and the high band encoded data to produce an output code string, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0037]

~~An encoding method according the fourth aspect of the invention includes the steps of generating low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal; deleting the coefficients of some sub-bands to reduce a coefficient table or generating coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having coefficients for the respective sub-bands on the high band side; calculating pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; comparing high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selecting one of a plurality of the coefficient tables; encoding coefficient information for obtaining the selected~~

~~coefficient table to produce high band encoded data; encoding low band signals of the input signal to produce low band encoded data; and multiplexing the low band encoded data and the high band encoded data to produce an output code string.~~

According to a tenth aspect, there is provided an encoding method of an encoder which includes a sub-band division unit that produces low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal, an extension and reduction unit that deletes the coefficients of some sub-bands to reduce a coefficient table or produces coefficients of predetermined sub-bands based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having coefficients for the respective sub-bands on the high band side, a pseudo high band sub-band power calculation unit that calculates pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals, a selection unit that compares high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers to each other and selects one of a plurality of the coefficient tables, a high band encoding unit that encodes coefficient information for obtaining the selected coefficient table to produce high band encoded data, a low band encoding unit that encodes low band signals of the input signal to produce low band encoded data, and a multiplexing unit that multiplexes the low band encoded data and the high band encoded data to produce an output code string, the method comprising the steps of causing: the sub-band

division unit to produces the low band sub-band signals and the high band sub-band signals; the extension and reduction unit to reduce or extend the coefficient table; the pseudo high band sub-band power calculation unit to calculate the pseudo high band sub-band powers; the selection unit to select the coefficient table; the high band encoding unit to produce the high band encoded data; the low band encoding unit to produce the low band encoded data; and the multiplexing unit to produce the output code string, wherein the extension and reduction unit duplicates the coefficients of a sub-band having a highest frequency which is included in the coefficient table and sets the duplicated coefficients to coefficients of a sub-band having a higher frequency than the highest frequency to extend the coefficient table.

[0038]

According to the above~~fourth~~ aspect of the invention, low band sub-band signals of a plurality of sub-bands on a low band side of an input signal and high band sub-band signals of a plurality of sub-bands on a high band side of the input signal are produced; the coefficients of some sub-bands are deleted to reduce a coefficient table or coefficients of predetermined sub-bands are produced based on coefficients of some sub-bands to extend a coefficient table, the coefficient table having coefficients for the respective sub-bands on the high band side; pseudo high band sub-band powers, which are estimated values of powers of the high band sub-band signals, are calculated for the respective sub-bands on the high band side based on the extended or reduced coefficient table and the low band sub-band signals; high band sub-band powers of the high band sub-band signals and the pseudo high band sub-band powers are compared to each other and one

of a plurality of the coefficient tables is selected; coefficient information for obtaining the selected coefficient table is encoded to produce high band encoded data; low band signals of the input signal are encoded to produce low band encoded data; and the low band encoded data and the high band encoded data are multiplexed to produce an output code string.

EFFECTS OF THE INVENTION

[0039]

According to the above aspects of the invention~~first embodiment to the fourth embodiment~~, it is possible to reproduce music signal with high sound quality by expansion of a frequency band.

BRIEF DESCRIPTION OF DRAWINGS

[0040]

Fig. 1 is a view an example of illustrating in an example of a power spectrum of a low band after decoding an input signal and a frequency envelope of a high band estimated.

Fig. 2 is a view illustrating an example of an original power spectrum of music signal of an attack according to rapid change in time.

Fig. 3 is a block diagram illustrating a functional configuration example of a frequency band expansion apparatus in a first embodiment of the present invention.

Fig. 4 is a flowchart illustrating an example of a frequency band expansion process by a frequency band expansion apparatus in Fig. 3.

Fig. 5 is a view illustrating arrangement of a power spectrum of signal input to a frequency band expansion apparatus in Fig. 3 and arrangement on a frequency axis of a band pass filter.

Fig. 6 is a view illustrating an example illustrating frequency characteristics of a vocal region and a power spectrum of a high band estimated.

Fig. 7 is a view illustrating an example of a power spectrum of signal input to a frequency band expansion apparatus in Fig. 3.

Fig. 8 is a view illustrating an example of a power vector after liftering of an input signal in Fig. 7.

Fig. 9 is a block diagram illustrating a functional