Conversely, the estimated high frequency side frequency envelope has a predetermined negative slope, and even if this is adjusted at the origin point to a power nearer the original power spectrum, the difference from the original power spectrum increases as the frequency increases.

[0020]

Thus, with the PTL 1 band extending method, the estimated high frequency side frequency envelope cannot realize the original high frequency side frequency envelope with a high degree of precision. Consequently, if sound is generated and output from the music signal after extension of the frequency band, clarity of sound can be lost as compared to the original sound, from a listening perspective.

[0021]

Also, with a high frequency feature encoding method such as HE-AAC or the like as described above, high frequency side frequency envelope is used as feature information of the high frequency signal components to be encoded, but the decoding side is required to reproduce the original high frequency side frequency envelope in a highly precise manner.

[0022]

~~The~~Embodiments of the present invention ~~has been made taking such situations into consideration, and~~ enable~~s~~ music signals to be played with high sound quality due to the extension of

frequency bands.

Solution to Problem

[0023]

~~A frequency band extending device according to a first aspect of the present invention includes: signal dividing means configured to divide an input signal into multiple sub-band signals; feature amount calculating means configured to calculate feature amount which expresses a feature of the input signal using at least one of the multiple sub-band signals divided by the signal dividing means, and the input signal; high frequency sub-band power estimating means configured to calculate an estimated value of a high frequency sub-band power that is the power of a sub-band signal having a higher frequency band than the input signal based on the feature amount calculated by the feature amount calculating means; and high frequency signal component generating means configured to generate a high frequency signal component based on the multiple sub-band signals divided by the signal dividing means, and the estimated value of the high frequency sub-band power calculated by the high frequency sub-band power estimating means; with the frequency band of the input signal being extended using the high frequency signal component generated by the high frequency signal component generating means.~~According to a first aspect, there is provided a frequency band extending device comprising: signal dividing means configured to divide an input signal into a plurality of sub-band signals; feature amount calculating means configured to calculate a feature amount which expresses a feature of said input signal using at least one of said plurality of sub-band signals divided by said signal dividing means and said input signal; high frequency sub-band power estimating means configured to calculate an

estimated value of a high frequency sub-band power that is the power of a sub-band signal having a higher frequency band than said input signal based on said feature amount calculated by said feature amount calculating means; and high frequency signal component generating means configured to generate a high frequency signal component based on said plurality of sub-band signals divided by said signal dividing means and the estimated value of said high frequency sub-band power calculated by said high frequency sub-band power estimating means; wherein the frequency band of said input signal is extended using said high frequency signal component generated by said high frequency signal component generating means, and wherein said high frequency sub-band power estimating means calculates an estimated value of said high frequency sub-band power based on said feature amount and a coefficient for each high frequency sub-band obtained beforehand by learning.

[0024]

power based on the feature amount, and the coefficient and constant for each of the high frequency sub-bands; with the constant being calculated from a center-of-gravity vector for the new clusters obtained by further calculating the residual vector using the coefficient for each high frequency sub-band obtained by regression analysis with the teacher signals belonging to the cluster, and performing clustering of the residual vector thereof to multiple new clusters.

[0034]

The high frequency sub-band power estimating means may record the coefficient for each of the high frequency sub-bands, and a pointer that determines the coefficient for the each high frequency sub-band, in a correlated manner, and also record multiple sets of the pointer and the constant, and some of the multiple sets may include a pointer having the same value.

[0035]

The high frequency signal generating means may generate the high frequency signal component from a low frequency sub-band power that is a power of the multiple sub-band signals, and an estimated value of the high frequency sub-band power.

[0036]

~~A frequency band extending method according to the~~

~~first aspect of the present invention includes: a signal dividing step arranged to divide an input signal into multiple sub-band signals; a feature amount calculating step arranged to calculate feature amount which expresses a feature of the input signal using at least one of the multiple sub-band signals divided by the processing in the signal dividing step, and the input signal; a high frequency sub-band power estimating step arranged to calculate an estimated value of a high frequency sub-band power that is the power of a sub-band signal having a higher frequency band than the input signal based on the feature amount calculated by the processing in the feature amount calculating step; and a high frequency signal component generating step arranged to generate a high frequency signal component based on the multiple sub-band signals divided by the processing in the signal dividing step, and the estimated value of the high frequency sub-band power calculated by the processing in the high frequency sub-band power estimating step; with the frequency band of the input signal being extended using the high frequency signal component generated by the processing in the high frequency signal component generating step.~~ According to a second aspect, there is provided a frequency band extending method comprising: a signal dividing step arranged to divide an input signal into a plurality of sub-band signals; a feature amount calculating step arranged to calculate a feature amount which expresses a feature of said input signal using at least one of said plurality of sub-band signals divided by the processing in said signal dividing step and said input signal; a high frequency sub-band power estimating step arranged to calculate an estimated value of a high frequency sub-band power that is the power of a sub-band signal having a higher frequency band than said input signal based on said feature amount calculated by the processing in

said feature amount calculating step; and a high frequency signal component generating step arranged to generate a high frequency signal component based on said plurality of sub-band signals divided by the processing in said signal dividing step and the estimated value of said high frequency sub-band power calculated by the processing in said high frequency sub-band power estimating step; wherein the frequency band of said input signal is extended using said high frequency signal component generated by the processing in said high frequency signal component generating step, and wherein said high frequency sub-band power estimating step calculates an estimated value of said high frequency sub-band power based on said feature amount and a coefficient for each high frequency sub-band obtained beforehand by learning.

[0037]

~~A program according to the first aspect of the present invention includes: a signal dividing step arranged to~~

~~divide an input signal into multiple sub-band signals; a feature amount calculating step arranged to calculate feature amount which expresses a feature of the input signal using at least one of the multiple sub-band signals divided by the processing in the signal dividing step, and the input signal; a high frequency sub-band power estimating step arranged to calculate an estimated value of a high frequency sub-band power that is the power of a sub-band signal having a higher frequency band than the input signal based on the feature amount calculated by the processing in the feature amount calculating step; and a high frequency signal component generating step arranged to generate a high frequency signal component based on the multiple sub-band signals divided by the processing in the signal dividing step, and the estimated value of the high frequency sub-band power calculated by the processing in the high frequency sub-band power estimating step; causing a computer to execute processing for extending the frequency band of the input signal using the high frequency signal component generated by the processing in the high frequency signal component generating step.~~ According to a third aspect, there is provided a program comprising: a signal dividing step arranged to divide an input signal into a plurality of sub-band signals; a feature amount calculating step arranged to calculate a feature amount which expresses a feature of said input signal using at least one of said

plurality of sub-band signals divided by the processing in said signal dividing step and said input signal; a high frequency sub-band power estimating step arranged to calculate an estimated value of a high frequency sub-band power that is the power of a sub-band signal having a higher frequency band than said input signal based on said feature amount calculated by the processing in said feature amount calculating step; and a high frequency signal component generating step arranged to generate a high frequency signal component based on said plurality of sub-band signals divided by the processing in said signal dividing step and the estimated value of said high frequency sub-band power calculated by the processing in said high frequency sub-band power estimating step; wherein a computer executes processing for extending the frequency band of said input signal using said high frequency signal component generated by the processing in said high frequency signal component generating step, and wherein said high frequency sub-band power estimating step calculates an estimated value of said high frequency sub-band power based on said feature amount and a coefficient for each high frequency sub-band obtained beforehand by learning.

[0038]

With the above~~first~~ aspects of the present invention, ~~divide~~ an input signal is divided into multiple sub-band signals, feature amount which expresses a feature of the input

is calculated with at least one of the multiple divided sub-band signals and the input signal, an estimated value of a high frequency sub-band power that is the power of a sub-band signal having a higher frequency band than the input signal is calculated based on the calculated feature amount, a high frequency signal component is generated based on the multiple divided sub-band signals, and the estimated value of the calculated high frequency sub-band power, and the frequency band of the input signal is generated with the generated high frequency signal component.

[0039]

~~An encoding device according to a second aspect of the present invention includes: sub-band dividing means configured to divide an input signal into multiple sub-bands, and to generate a low frequency sub-band signal made up of multiple sub-bands at a low frequency side and a high frequency sub-band signal made up of multiple sub-bands at a high frequency side; feature amount calculating means configured to calculate feature amount that expresses a feature of the input signal, using at least one of the low frequency sub-band signal generated by the sub-band dividing means, and the input signal; pseudo high frequency sub-band power calculating means configured to calculate a pseudo high frequency sub-band power that is a pseudo power of the high frequency sub-band signal based on the feature amount~~

~~calculated by the feature amount calculating means; pseudo high frequency sub-band power difference calculating means configured to calculate a high frequency sub-band power that is the power of the high frequency sub-band signal from the high frequency sub-band signal generated by the sub-band dividing means, and to calculate pseudo high frequency sub-band power difference that is difference as to the pseudo high frequency sub-band power calculated by the pseudo high frequency sub-band power calculating means; high frequency encoding means configured to encode the pseudo high frequency sub-band power difference calculated by the pseudo high frequency sub-band power difference calculating means to generate high frequency encoded data; low frequency encoding means configured to encode a low frequency signal that is a low frequency signal of the input signal to generate low frequency encoded data; and multiplexing means configured to multiplex the low frequency encoded data generated by the low frequency encoding means, and the high frequency encoded data generated by the high frequency encoding means to obtain an output code string.~~According to a fourth aspect, there is provided an encoding device comprising: sub-band dividing means configured to divide an input signal into a plurality of sub-bands and to generate a low frequency sub-band signal made up of a plurality of sub-bands at a low frequency side and a high frequency sub-band signal made up of a plurality of sub-bands at a high frequency side; feature amount calculating means configured to calculate feature amount that expresses a feature of said input signal using at least one of said low frequency sub-band signal generated by said sub-band dividing means and said input signal; pseudo high frequency sub-band power calculating means configured to calculate a pseudo high frequency sub-band power that is a pseudo power of said high frequency sub-band signal based on

said feature amount calculated by said feature amount calculating means; pseudo high frequency sub-band power difference calculating means configured to calculate a high frequency sub-band power that is the power of said high frequency sub-band signal from said high frequency sub-band signal generated by said sub-band dividing means and to calculate pseudo high frequency sub-band power difference that is difference as to said pseudo high frequency sub-band power calculated by said pseudo high frequency sub-band power calculating means; high frequency encoding means configured to encode said pseudo high frequency sub-band power difference calculated by said pseudo high frequency sub-band power difference calculating means to generate high frequency encoded data; low frequency encoding means configured to encode a low frequency signal that is a low frequency signal of said input signal to generate low frequency encoded data; and multiplexing means configured to multiplex said low frequency encoded data generated by said low frequency encoding means and said high frequency encoded data generated by said high frequency encoding means to obtain an output code string, wherein said pseudo high frequency sub-band power difference calculating means calculates an evaluated value based on said pseudo high frequency sub-band power of each sub-band and said high frequency sub-band power for every plurality of coefficients for calculating said pseudo high frequency sub-band power; and wherein said high frequency encoding means generates an index indicating said coefficient of said evaluated value that is the highest evaluated value as said high frequency encoded data.

[0040]

The encoding device may further include low frequency decoding means configured to decode the low frequency encoded data generated by the low frequency encoding means to generate a low frequency signal; with the sub-band

[0047]

An encoding method according to the second aspect of the present invention includes: a sub-band dividing step arranged to divide an input signal into multiple sub-bands, and to generate a low frequency sub-band signal made up of multiple sub-bands at a low frequency side and a high frequency sub-band signal made up of multiple sub-bands at a high frequency side; a feature amount calculating step arranged to calculate feature amount that expresses a feature of the input signal, using at least one of the low frequency sub-band signal generated by the processing in the sub-band dividing step, and the input signal; a pseudo high frequency sub-band power calculating step arranged to calculate a pseudo high frequency sub-band power that is a pseudo power of the high frequency sub-band signal based on the feature amount calculated by the processing in the feature amount calculating step; a pseudo high frequency sub-band power difference calculating step arranged to calculate a high frequency sub-band power that is the power of the high frequency sub-band signal from the high frequency sub-band signal generated by the processing in the sub-band dividing step, and to calculate pseudo high frequency sub-band power difference that is difference as to the pseudo high frequency sub-band power calculated by the processing in the pseudo high frequency sub-band power

~~calculating step; a high frequency encoding step arranged to encode the pseudo high frequency sub-band power difference calculated by the processing in the pseudo high frequency sub-band power difference calculating step to generate high frequency encoded data; a low frequency encoding step arranged to encode a low frequency signal that is a low frequency signal of the input signal to generate low frequency encoded data; and a multiplexing step arranged to multiplex the low frequency encoded data generated by the processing in the low frequency encoding step, and the high frequency encoded data generated by the processing in the high frequency encoding step to obtain an output code string.~~

[0047]

According to a fifth aspect, there is provided an encoding method comprising: a sub-band dividing step arranged to divide an input signal into a plurality of sub-bands and to generate a low frequency sub-band signal made up of a plurality of sub-bands at a low frequency side and a high frequency sub-band signal made up of a plurality of sub-bands at a high frequency side; a feature amount calculating step arranged to calculate feature amount that expresses a feature of said input signal using at least one of said low frequency sub-band signal generated by the processing in said sub-band dividing step and said input signal; a pseudo high frequency sub-band power calculating step arranged to calculate a pseudo high frequency sub-band power that is a pseudo power of said high frequency sub-band signal based on said feature amount calculated by the processing in said feature amount calculating step; a pseudo high frequency sub-band power difference calculating step arranged to calculate a high frequency sub-band power that is the power of said high frequency sub-band signal from said high frequency sub-band signal generated by the processing in said sub-band dividing

step and to calculate pseudo high frequency sub-band power difference that is difference as to said pseudo high frequency sub-band power calculated by the processing in said pseudo high frequency sub-band power calculating step; a high frequency encoding step arranged to encode said pseudo high frequency sub-band power difference calculated by the processing in said pseudo high frequency sub-band power difference calculating step to generate high frequency encoded data; a low frequency encoding step arranged to encode a low frequency signal that is a low frequency signal of said input signal to generate low frequency encoded data; and a multiplexing step arranged to multiplex said low frequency encoded data generated by the processing in said low frequency encoding step and said high frequency encoded data generated by the processing in said high frequency encoding step to obtain an output code string, wherein said pseudo high frequency sub-band power difference calculating step is arranged to calculate an evaluated value based on said pseudo high frequency sub-band power of each sub-band and said high frequency sub-band power for every plurality of coefficients for calculating said pseudo high frequency sub-band power; and wherein said high frequency encoding step is arranged to generate an index indicating said coefficient of said evaluated value that is the highest evaluated value as said high frequency encoded data.

[0048]

~~A program according to the second aspect causing a computer to execute processing including: a sub-band dividing step arranged to divide an input signal into multiple sub-bands, and to generate a low frequency sub-band signal made up of multiple sub-bands at a low frequency side and a high frequency sub-band signal made up of multiple sub-bands at a high frequency side; a feature amount calculating~~

~~step arranged to calculate feature amount that expresses a feature of the input signal, using at least one of the low frequency sub band signal generated by the processing in the sub band dividing step, and the input signal; a pseudo high frequency sub band power calculatingstep arranged to calculate a pseudo high frequency sub band power that is a pseudo power of the high frequency sub band signal based on the feature amount calculated by the processing in the feature amount calculating step; a pseudo high frequency sub band power difference calculating step arranged to calculate a high frequency sub band power that is the power of the high frequency sub band signal from the high frequency sub band signal generated by the processing in the sub band dividing step, and to calculate pseudo high frequency sub band power difference that is difference as to the pseudo high frequency sub band power calculated by the processing in the pseudo high frequency sub band power calculating step; a high frequency encoding step arranged to encode the pseudo high frequency sub band power difference calculated by the processing in the pseudo high frequency sub band power difference calculating step to generate high frequency encoded data; a low frequency encoding step arranged to encode a low frequency signal that is a low frequency signal of the input signal to generate low frequency encoded data; and a multiplexing step arranged to multiplex the low frequency encoded data generated by the processing in the low frequency encoding step, and the high frequency encoded data generated by the processing in the high frequency encoding step to obtain an output code string.~~According to a sixth aspect, there is provided a program causing a computer to execute processing comprising: a sub-band dividing step arranged to divide an input signal into a plurality of sub-bands and to generate a low frequency sub-band signal made up of a plurality of sub-

bands at a low frequency side and a high frequency sub-band signal made up of a plurality of sub-bands at a high frequency side; a feature amount calculating step arranged to calculate feature amount that expresses a feature of said input signal using at least one of said low frequency sub-band signal generated by the processing in said sub-band dividing step and said input signal; a pseudo high frequency sub-band power calculating step arranged to calculate a pseudo high frequency sub-band power that is a pseudo power of said high frequency sub-band signal based on said feature amount calculated by the processing in said feature amount calculating step; a pseudo high frequency sub-band power difference calculating step arranged to calculate a high frequency sub-band power that is the power of said high frequency sub-band signal from said high frequency sub-band signal generated by the processing in said sub-band dividing step and to calculate pseudo high frequency sub-band power difference that is difference as to said pseudo high frequency sub-band power calculated by the processing in said pseudo high frequency sub-band power calculating step; a high frequency encoding step arranged to encode said pseudo high frequency sub-band power difference calculated by the processing in said pseudo high frequency sub-band power difference calculating step to generate high frequency encoded data; a low frequency encoding step arranged to encode a low frequency signal that is a low frequency signal of said input signal to generate low frequency encoded data; a multiplexing step arranged to multiplex said low frequency encoded data generated by the processing in said low frequency encoding step and said high frequency encoded data generated by the processing in said high frequency encoding step to obtain an output code string; wherein said pseudo high frequency sub-band power difference calculating step is

arranged to calculate an evaluated value based on said pseudo high frequency sub-band power of each sub-band and said high frequency sub-band power for every plurality of coefficients for calculating said pseudo high frequency sub-band power; and wherein said high frequency encoding step is arranged to generate an index indicating said coefficient of said evaluated value that is the highest evaluated value as said high frequency encoded data.

[0049]

With the above ~~second~~ aspects of the present invention, an input signal is divided into multiple sub-bands, a low frequency sub-band signal made up of multiple sub-bands at a low frequency side and a high frequency sub-band signal made up of multiple sub-bands at a high frequency side are generated, feature amount that expresses a feature of the input signal is calculated with at least one of the generated low frequency sub-band signal and the input signal, a pseudo high frequency sub-band power that is a pseudo power of the high frequency sub-band signal is calculated based on the calculated feature amount, a high frequency sub-band power that is the power of the high frequency sub-band signal is calculated from the generated high frequency sub-band signal, pseudo high frequency sub-band power difference that is difference as to the calculated pseudo high frequency sub-band power is calculated, the calculated pseudo high frequency sub-band power difference is encoded to generate high frequency encoded data, a low frequency signal that is a low frequency signal of the input signal is encoded to generate low frequency encoded data, and the generated low frequency encoded data and the generated high frequency encoded data are multiplexed to obtain an output code string.

[0050]

~~A decoding device according to a third aspect of the~~

~~present invention includes: demultiplexing means configured to demultiplex input encoded data into at least low frequency encoded data and an index; low frequency decoding means configured to decode the low frequency encoded data to generate a low frequency signal; sub-band dividing means configured to divide the band of the low frequency signal into multiple low frequency sub-bands to generate a low frequency sub-band signal for each of the low frequency sub-bands; and generating means configured to generate the high frequency signal based on the index and the low frequency sub-band signal.~~According to a seventh aspect, there is provided a decoding device comprising: demultiplexing means configured to demultiplex input encoded data into at least low frequency encoded data and an index; low frequency decoding means configured to decode said low frequency encoded data to generate a low frequency signal; sub-band dividing means configured to divide the band of said low frequency signal into a plurality of low frequency sub-bands to generate a low frequency sub-band signal for each of said low frequency sub-bands; and generating means configured to generate said high frequency signal based on said index and said low frequency sub-band signal, wherein said index is information indicating an estimating coefficient used for generation of said high frequency signal.

[0051]

The index may be obtained, at a device which encodes an input signal and outputs the encoded data, based on the input signal before encoding, and the high frequency signal estimated from the input signal.

[0052]

The index may have not been encoded.

[0053]

The index may be information indicating an estimating coefficient used for generation of the high frequency signal.

[0054]

The generating means may generate the high frequency signal based on, of the multiple estimating coefficients, the estimating coefficient indicated by the index.

index.

[0068]

The index may have been subjected to entropy encoding.

[0069]

~~A decoding method or program according to the third aspect includes: a demultiplexing step arranged to demultiplex input encoded data into at least low frequency encoded data and an index; a low frequency decoding step arranged to decode the low frequency encoded data to generate a low frequency signal; a sub-band dividing step arranged to divide the band of the low frequency signal into multiple low frequency sub-bands to generate a low frequency sub-band signal for each of the low frequency sub-bands; and a generating step arranged to generate the high frequency signal based on the index and the low frequency sub-band signal.~~According to an eighth aspect, there is provided a decoding method comprising: a demultiplexing step arranged to demultiplex input encoded data into at least low frequency encoded data and an index; a low frequency decoding step arranged to decode said low frequency encoded data to generate a low frequency signal; a sub-band dividing step arranged to divide the band of said low frequency signal into a plurality of low frequency sub-bands to generate a low frequency sub-band signal for each of said low frequency sub-bands; and a generating step arranged to generate said high frequency signal based on said index and said low frequency sub-band signal, wherein said index is information indicating an estimating coefficient used for generation of said high frequency signal.

[0069a]

According to a ninth aspect, there is provided a program causing a computer to execute processing comprising: a

demultiplexing step arranged to demultiplex input encoded data into at least low frequency encoded data and an index; a low frequency decoding step arranged to decode said low frequency encoded data to generate a low frequency signal; a sub-band dividing step arranged to divide the band of said low frequency signal into a plurality of low frequency sub-bands to generate a low frequency sub-band signal for each of said low frequency sub-bands; and a generating step arranged to generate said high frequency signal based on said index and said low frequency sub-band signal, wherein said index is information indicating an estimating coefficient used for generation of said high frequency signal.

[0070]

With the above aspects ~~third aspect~~ of the present invention, input encoded data is demultiplexed into at least low frequency encoded data and an index, the low frequency encoded data is decoded to generate a low frequency signal, the band of the low frequency signal is divided into multiple low frequency sub-bands to generate a low frequency sub-band signal for each of the low frequency sub-bands, and the high frequency signal is generated based on the index and the low frequency

sub-band signal.

[0071]

~~A decoding device according to a fourth aspect of the~~ present invention includes: demultiplexing means configured to demultiplex input encoded data into low frequency encoded data and an index for obtaining an estimating coefficient used for generation of a high frequency signal; low frequency decoding means configured to decode the low frequency encoded data to generate a low frequency signal; sub-band dividing means configured to divide the band of the low frequency signal into multiple low frequency sub-bands to generate a low frequency sub-band signal for each of the low frequency sub-bands; feature amount calculating means configured to calculate feature amount that expresses a feature of the encoded data using at least one of the low frequency sub-band signal and the low frequency signal; high frequency sub-band power calculating means configured to calculate a high frequency sub-band power of the high frequency sub-band signal of the high frequency sub-band by multiplexing the feature amount by the estimating coefficient determined by the index of the multiple estimating coefficients prepared beforehand regarding each of multiple high frequency sub-bands making up the band of the high frequency signal, and obtaining the sum of the ~~feature amount by which the estimating coefficient has been~~

~~multiplied; and high frequency signal generating means configured to generate the high frequency signal using the high frequency sub-band power and the low frequency sub-band signal.~~According to a tenth aspect, there is provided a decoding device comprising: demultiplexing means configured to demultiplex input encoded data into low frequency encoded data and an index for obtaining an estimating coefficient used for generation of a high frequency signal; low frequency decoding means configured to decode said low frequency encoded data to generate a low frequency signal; sub-band dividing means configured to divide the band of said low frequency signal into a plurality of low frequency sub-bands to generate a low frequency sub-band signal for each of said low frequency sub-bands; feature amount calculating means configured to calculate feature amount that expresses a feature of said encoded data using at least one of said low frequency sub-band signal and said low frequency signal; high frequency sub-band power calculating means configured to calculate a high frequency sub-band power of the high frequency sub-band signal of said high frequency sub-band by multiplexing said feature amount by said estimating coefficient determined by said index of a plurality of said estimating coefficients prepared beforehand regarding each of a plurality of high frequency sub-bands making up the band of said high frequency signal, and obtaining the sum of said feature amount by which said estimating coefficient has been multiplied; and high frequency signal generating means configured to generate said high frequency signal using said high frequency sub-band power and said low frequency sub-band signal.

[0072]

The feature amount calculating means may calculate a low frequency sub-band power of the low frequency sub-band signal for each of the low frequency sub-bands as the feature amount.

[0073]

The index may be information for obtaining the estimating coefficient of the multiple estimating coefficients whereby the sum of squares of difference obtained for each of the high frequency sub-bands, which is difference between the high frequency sub-band power obtained from the true value of the high frequency signal, and the high frequency sub-band power generated with the estimating coefficient, becomes the minimum.

[0074]

The index may further include difference information indicating difference between the high frequency sub-band power obtained from the true value, and the high frequency sub-band power generated with the estimating coefficient; with the high frequency sub-band power calculating means further adding the difference indicated by the difference

The decoding device may further include, with the index being information indicating a difference vector made up of the difference for each of the high frequency sub-bands wherein difference between the high frequency sub-band power obtained from the true value of the high frequency signal, and the high frequency sub-band power generated with the estimating coefficient as an element, coefficient output means configured to obtain distance between a representative vector or representative value in feature space of the difference with the difference of the high frequency sub-bands as an element, obtained beforehand for each of the estimating coefficients, and the difference vector indicated by the index, and to supply the estimating coefficient of the representative vector or the representative value whereby the distance is the shortest, of the multiple estimating coefficients, to the high frequency sub-band power calculating means.

[0079]

~~A decoding method or program according to the fourth aspect of the present invention includes: a demultiplexing step arranged to demultiplex input encoded data into low frequency encoded data and an index for obtaining an estimating coefficient used for generation of a high frequency signal; a low frequency decoding step arranged to decode the low frequency encoded data to generate a low~~

~~frequency signal; a sub-band dividing step arranged to divide the band of the low frequency signal into multiple low frequency sub-bands to generate a low frequency sub-band signal for each of the low frequency sub-bands; a feature amount calculating step arranged to calculate feature amount that expresses a feature of the encoded data using at least one of the low frequency sub-band signal and the low frequency signal; a high frequency sub-band power calculating step arranged to calculate a high frequency sub-band power of the high frequency sub-band signal of the high frequency sub-band by multiplexing the feature amount by the estimating coefficient determined by the index of the multiple estimating coefficients prepared beforehand regarding each of multiple high frequency sub-bands making up the band of the high frequency signal, and obtaining the sum of the feature amount by which the estimating coefficient has been multiplied; and a high frequency signal generating step arranged to generate the high frequency signal using the high frequency sub-band power and the low frequency sub-band signal.~~According to an eleventh aspect, there is provided a decoding method comprising: a demultiplexing step arranged to demultiplex input encoded data into low frequency encoded data and an index for obtaining an estimating coefficient used for generation of a high frequency signal; a low frequency decoding step arranged to decode said low frequency encoded data to generate a low frequency signal; a sub-band dividing step arranged to divide the band of said low frequency signal into a plurality of low frequency sub-bands to generate a low frequency sub-band signal for each of said low frequency sub-bands; a feature amount calculating step arranged to calculate a feature amount that expresses a feature of said encoded data using at least one of said low frequency sub-band signal and said low frequency signal; a high frequency

sub-band power calculating step arranged to calculate a high frequency sub-band power of the high frequency sub-band signal of said high frequency sub-band by multiplexing said feature amount by said estimating coefficient determined by said index of a plurality of said estimating coefficients prepared beforehand regarding each of a plurality of high frequency sub-bands making up the band of said high frequency signal and obtaining the sum of said feature amount by which said estimating coefficient has been multiplied; and a high frequency signal generating step arranged to generate said high frequency signal using said high frequency sub-band power and said low frequency sub-band signal.

[0079a]

According to a twelfth aspect, there is provided a program causing a computer to execute processing comprising: a demultiplexing step arranged to demultiplex input encoded data into low frequency encoded data and an index for obtaining an estimating coefficient used for generation of a high frequency signal; a low frequency decoding step arranged to decode said low frequency encoded data to generate a low frequency signal; a sub-band dividing step arranged to divide the band of said low frequency signal into a plurality of low frequency sub-bands to generate a low frequency sub-band signal for each of said low frequency sub-bands; a feature amount calculating step arranged to calculate a feature amount that expresses a feature of said encoded data using at least one of said low frequency sub-band signal and said low frequency signal; a high frequency sub-band power calculating step arranged to calculate a high

frequency sub-band power of the high frequency sub-band signal of said high frequency sub-band by multiplexing said feature amount by said estimating coefficient determined by said index of a plurality of said estimating coefficients prepared beforehand regarding each of a plurality of high frequency sub-bands making up the band of said high frequency signal and obtaining the sum of said feature amount by which said estimating coefficient has been multiplied; and a high frequency signal generating step arranged to generate said high frequency signal using said high frequency sub-band power and said low frequency sub-band signal.

[0080]

With the above ~~fourth~~ aspects of the present invention, input encoded data is demultiplexed into low frequency encoded data and an index for obtaining an estimating coefficient used for generation of a high frequency signal, the low

frequency encoded data is decoded to generate a low frequency signal, the band of the low frequency signal is divided into multiple low frequency sub-bands to generate a low frequency sub-band signal for each of the low frequency sub-bands, feature amount that expresses a feature of the encoded data is calculated with at least one of the low frequency sub-band signal and the low frequency signal, a high frequency sub-band power of the high frequency sub-band signal of the high frequency sub-band is calculated by multiplexing the feature amount by the estimating coefficient determined by the index of the multiple estimating coefficients prepared beforehand regarding each of multiple high frequency sub-bands making up the band of the high frequency signal, and obtaining the sum of the feature amount by which the estimating coefficient has been multiplied, and the high frequency signal is generated with the high frequency sub-band power and the low frequency sub-band signal.

Advantageous Effects of Invention

[0081]

According to the above ~~first aspect through fourth~~ aspects of the present invention, music signals can be played with higher sound quality due to the extension of frequency bands.

Brief Description of Drawings

[0082]