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(71) Applicant: **SAMSUNG ELECTRONICS CO, . LTD.** [KR/KR]; 416, Maetan-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do 442-742 (KR).

(72) Inventors: **LEE, Nam-Suk**; 104-702 Hwanggol Maeul 1-danji Apt., Yeongtong-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-739 (KR). **LEE, Geon-Hyoung**; 206-1402 Unam Dreamvalley 2-cha Apt., 1039 Neung-dong, Hwaseong-si, Gyeonggi-do 445-990 (KR). **OH, Jae-One**; 502-903 Humansia Apt., Bora-dong, Giheung-gu, Yongin-si, Gyeonggi-do 446-752 (KR). **LEE, Chul-Woo**; (1-202) 825-32 Maetan 4-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-802 (KR). **JEONG, Jong-Hoon**; 101-2001 Woncheon Jugong 1-danji Apt., 1230 Maetan 4-dong, Yeongtong-gu, Suwon-si, Gyeonggi-do 443-755 (KR).

(74) Agent: **Y.P.LEE, MOCK & PARTNERS**; Koryo Building, 1575-1 Seocho-dong, Seocho-gu, Seoul 137-875 (KR).

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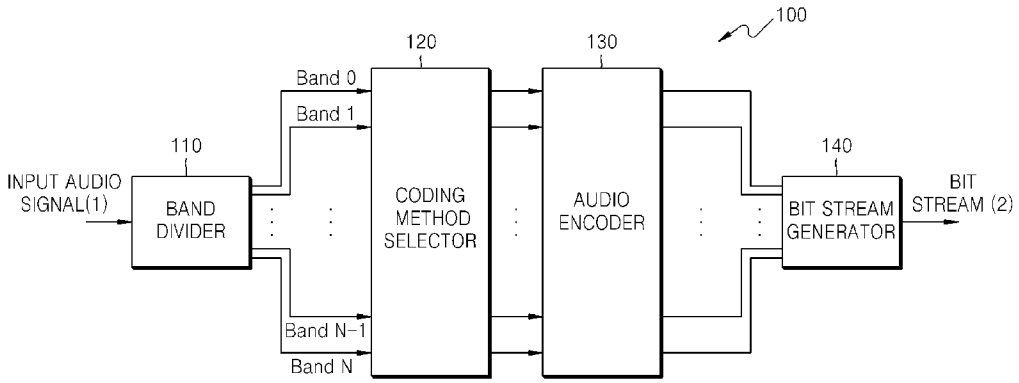
(54) Title: METHOD AND APPARATUS FOR ENCODING AUDIO SIGNAL, AND METHOD AND APPARATUS FOR DECODING AUDIO SIGNAL

FIG. 1



(57) Abstract: Methods and apparatuses for encoding and decoding of an audio signal using a mixture of a time-frequency method and a parametric method according to the audio band are provided. An encoding method of an audio signal includes: dividing input audio signals into a plurality of audio bands; selecting a coding method for each audio band; encoding each audio band according to the selected coding method for each band; and generating a bit stream including all the data encoded for each audio band, wherein selecting a coding method for each band comprises selecting smaller encoded data either from a parametric coding method or a time-frequency coding method.

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Description

METHOD AND APPARATUS FOR ENCODING AUDIO SIGNAL, AND METHOD AND APPARATUS FOR DECODING AUDIO SIGNAL

Technical Field

[1] This application claims priority from Korean Patent Application No. 10-2007-0027271, filed on March 20, 2007 in the Korean Intellectual Property Office, the disclosure of which is incorporated herein in its entirety by reference.

[2] Apparatuses and methods consistent with the present invention relate to encoding and decoding of an audio signal, and more particularly, to encoding and decoding an audio signal which apply an effective coding method for each band by dividing the audio signal into a plurality of bands.

Background Art

[3] An encoding method of an audio signal can be classified into a parametric coding method and a time-frequency coding method. In the case of the parametric coding method, an encoding efficiency is high when a bit rate of data is low. In other words, the encoding efficiency of the parametric coding method decreases as the bit rate increases. The time-frequency coding method is more effective than the parametric coding method when sound quality of the audio signal is high, that is, the bit rate is high. However, the time-frequency coding method is ineffective when the bit rate is low, since information on all frequency indices should be transmitted.

Disclosure of Invention

Technical Problem

[4] Thus, in order to improve the encoding efficiency, a related art method in which only either the parametric coding method or the time-frequency coding method is applied, has to be improved.

Technical Solution

[5] Exemplary embodiments of the present invention overcome the above disadvantages and other disadvantages not described above. Also, the present invention is not required to overcome the disadvantages described above, and an exemplary embodiment of the present invention may not overcome any of the problems described above.

[6] The present invention provides a method and apparatus for encoding an audio signal, in which the audio signal is divided into a plurality of bands and an efficient coding method is applied for each of the bands, and a computer readable recording medium having recorded thereon a program for executing the above described method.

[7] The present invention also provides a method and apparatus for decoding an audio signal, in which a bit stream generated by the encoding method is decoded for each band, and a computer readable recording medium having recorded thereon a program for executing the above described decoding method.

Advantageous Effects

[8] In the methods and apparatuses for encoding an audio signal, and the methods and apparatuses for decoding an audio signal according to exemplary embodiments of the present invention, by dividing the audio signal into a plurality of bands and selecting a coding method where the size of encoded data is small for each band, an effective encoding method is possible in comparison to a method of applying one coding method to the entire audio data. In other words, the exemplary embodiments of the present invention provide a method in which the time-frequency method and the parametric method are mixed and used according to each audio band.

Description of Drawings

[9] The above and other aspects of the present invention will become more apparent by describing in detail exemplary embodiments thereof with reference to the attached drawings in which:

[10] FIG. 1 is a block diagram of a structure of an audio signal encoding apparatus according to an exemplary embodiment of the present invention;

[11] FIG. 2 is a flowchart of an audio signal encoding method according to an exemplary embodiment of the present invention;

[12] FIG. 3 is a block diagram of a structure of an audio signal decoding apparatus according to an exemplary embodiment of the present invention;

[13] FIG. 4 is a flowchart of an audio signal decoding method according to an exemplary embodiment of the present invention; and

[14] FIG. 5 illustrates changes in the size of encoded data according to the number of sinusoidal signals and a coding method.

Best Mode

[15] According to an aspect of the present invention, there is provided a method of encoding an audio signal including, the method comprising: dividing an input audio signal into a plurality of audio bands; selecting a coding method for each of the audio bands; encoding audio data included in each of the audio bands according to the selected coding method for each of the bands; and generating a bit stream including all the encoded audio data for each of the audio bands, wherein the selecting of the coding method comprises selecting a coding method providing smaller encoded data from among a parametric coding method and a time-frequency coding method.

[16] The selecting the coding method for the each audio band may include: calculating a

number of sinusoidal signals included in a corresponding audio band; selecting the time-frequency coding method when the number of sinusoidal signals is equal to or greater than a predetermined value; and selecting the parametric coding method when the number of sinusoidal signals is smaller than the predetermined value.

[17] According to another aspect of the present invention, there is provided an apparatus for encoding an audio signal including: a band divider which divides an input audio signal into a plurality of audio bands; a coding method selector which selects a coding method for each of the audio bands; an audio encoder which encodes audio data included in each of the audio bands according to the selected coding method for each of the bands; and a bit stream generator generating a bit stream including all the encoded audio data for each of the audio bands, wherein the coding method selector selects a coding method providing smaller encoded data from among a parametric coding method and a time-frequency coding method.

[18] The coding method selector may select the time-frequency coding method when the number of sinusoidal signals included in an audio band is equal to or greater than a predetermined value, and selects the parametric coding method when the number of sinusoidal signals is smaller than the predetermined value.

[19] In the method and apparatus for encoding the audio signal, the parametric coding method may be a Sinusoidal Coding (SSC) method and the time-frequency coding method may be an Advanced Audio Coding (AAC) method.

[20] According to another aspect of the present invention, there is provided a method of encoding an audio signal including: dividing an input audio signal into a plurality of audio bands; encoding audio data included in each of the audio bands by applying a parametric coding method and a time-frequency coding method respectively; selecting a coding method providing smaller data for each of the audio bands from among the encoded audio data using the parametric coding method and the time-frequency coding method; and generating a bit stream including all the encoded audio data selected for the each of the audio bands.

[21] According to another aspect of the present invention, there is provided a method of decoding an audio signal including: dividing an input bit stream into audio data encoded for a plurality of audio bands; extracting information on a coding method used by an encoding apparatus for encoding the audio data, for each of the audio bands; decoding the encoded audio data for each of the audio bands, according to the coding method on the basis of the extracted information; and generating the audio signal by combining the decoded audio data for the respective audio bands, wherein the coding method is a coding method providing smaller encoded data that is selected from among a parametric coding method and a time-frequency coding method.

[22] According to another aspect of the present invention, there is provided an apparatus

of decoding an audio signal including: a bit stream divider which divides an input bit stream into audio data encoded for a plurality of audio bands; a coding method extractor which extracts information on a coding method used by an encoding apparatus for encoding the audio data, for each of the audio bands; an audio decoder which decodes the encoded audio data for each of the audio bands, according to the coding method on the basis of the extracted information; and an audio signal generator which generates the audio signal by combining the decoded audio data for each of the respective audio bands, wherein the coding method is a coding method providing smaller encoded data that is selected from among a parametric coding method and a time-frequency coding method.

[23] In the methods and apparatuses of the decoding audio signal, the time-frequency coding method is selected as the coding method when the number of sinusoidal signals included in the corresponding audio band is equal to or greater than a predetermined value, and selects the parametric coding method when the number of sinusoidal signals is smaller than the predetermined value.

[24] In the decoding method and apparatus, the parametric coding method may be an SSC method and the time-frequency method may be an AAC method.

Mode for Invention

[25] Hereinafter, exemplary embodiments of the present invention will be described in detail with reference to the appended drawings.

[26] FIG. 1 is a block diagram of a structure of an audio signal encoding apparatus 100 according to an exemplary embodiment of the present invention, and FIG. 2 is a flowchart of an audio signal encoding method according to an exemplary embodiment of the present invention.

[27] Referring to FIG. 1, the audio signal encoding apparatus 100 may include a band divider 110, a coding method selector 120, an audio encoder 130, and a bit stream generator 140.

[28] Referring to FIG. 1 and 2, the band divider 110 divides an input audio signal 1 into a plurality of audio bands Band 0 through to Band N (S100).

[29] The coding method selector 120 selects a coding method for each audio band (S110). The coding method selector 120 selects a more effective encoding method for a corresponding band from a parametric coding method and a time-frequency coding method. An effective encoding method denotes encoding by which encoded data is smaller than when encoded by using other methods.

[30] A coding method selecting method according to an exemplary embodiment of the present invention will now be described. First, the number of sinusoidal signals included in the corresponding audio band, that needs to select a coding method, is calculated. When the calculated number of sinusoidal signals is equal to or greater than

a predetermined value, a time-frequency coding method is selected. When the calculated number of sinusoidal signals is smaller than the predetermined value, a parametric coding method is selected. This coding method selecting method will be explained in more detail with reference to FIG. 5.

[31] The audio encoder 130 encodes each audio band according to the coding method selected for the each audio band (S120).

[32] When the parametric coding method is selected for a corresponding audio band, an audio signal included in the corresponding audio band is encoded by using the parametric coding method. An SSC method may be an example of the parametric coding method.

[33] When the time-frequency coding method is selected for the corresponding audio band, an audio signal included in the corresponding audio band is encoded by using the time-frequency coding method. The time-frequency coding method denotes a coding method which converts data in the time domain into the frequency domain value. An AAC method may be an example of the time-frequency coding method.

[34] The bit stream generator 140 generates a bit stream 2 which includes all of the encoded data for the each audio band (S130).

[35] FIG. 3 is a block diagram of a structure of an audio signal decoding apparatus 200 according to an exemplary embodiment of the present invention, and FIG. 4 is a flowchart of an audio signal decoding method according to an exemplary embodiment of the present invention.

[36] Referring to FIG. 3, the audio signal decoding apparatus 200 may include a bit stream divider 210, a coding method extractor 220, an audio decoder 230, and an audio signal generator 240.

[37] Referring to FIGS. 3 and 4, the bit stream divider 210 divides an input bit stream (11) into audio data encoded according to a plurality of audio bands (S200).

[38] The coding method extractor 220 extracts information on the coding method for each of the audio bands (S210). The coding method is a method used for encoding audio data of the corresponding audio band in an encoding apparatus. As described above, the encoding apparatus selects a method that provides smaller encoded data from among the parametric coding method and the time-frequency coding method, for each audio band. As explained above, according to an exemplary embodiment of the present invention, the encoding apparatus calculates the number of sinusoidal signals included in an audio band to select a coding method, and selects the time-frequency coding method when the calculated number of sinusoidal signals is equal to or greater than a predetermined value or selects the parametric coding method when the calculated number of sinusoidal signals is smaller than the predetermined value.

[39] The audio decoder 230 decodes audio data encoded according to the coding method

based on the extracted information for the each audio band (S220).

[40] When the information on a coding method for the corresponding audio band indicates the parametric coding method, encoded audio data for the corresponding audio band is decoded by using the parametric coding method. The SSC method is an example of the parametric coding method.

[41] When the information on a coding method for the corresponding audio band indicates the time-frequency coding method, encoded audio data for the corresponding audio band is decoded by using the time-frequency coding method. The AAC is an example of the time-frequency method.

[42] The audio signal generator 240 generates an output audio signal 12 by combining audio data decoded for each audio band (S230).

[43] A selection of the coding method according to the number of sinusoidal signals will now be explained in detail, with reference to FIG. 5. FIG. 5 illustrates changes in data size of encoded data according to the number of sinusoidal signals and a coding method.

[44] In the time-frequency coding method, a fundamental frequency is set and amplitude values and phase values of all frequencies which are multiples of the fundamental frequency are extracted and encoded. Accordingly, the size of the encoded data stays the same since information on the same number of frequencies is encoded regardless of the number of sinusoidal signals included in the audio signal, as indicated by a horizontal line 30 parallel to the X-axis.

[45] Meanwhile, in the parametric coding method, information on a frequency, an amplitude, and a phase value for each sinusoidal signal is encoded. Accordingly, as the number of sinusoidal signals increases, the size of encoded data increases, as indicated by a straight line 32 heading towards the top right hand side in FIG. 5.

[46] Accordingly, as shown in FIG. 5, the time-frequency coding method is effective when the number of sinusoidal signals is greater than the predetermined value N in SECTION B, and the parametric coding method is effective when the number of sinusoidal signals is smaller than the predetermined value N in SECTION A.

[47] There are various ways to determine the value N.

[48] The value N is the number of sinusoidal signals where the size of the data encoded by using the parametric coding method and the size of data encoded by using the time-frequency coding method are the same. Accordingly, the number of frequencies used in the time-frequency coding method, namely, the number of frequency indices, may be selected as the value N. The value N will be slightly less than the number of frequency indices, since information on a frequency is not encoded in the time-frequency coding method.

[49] Alternatively, instead of determining a value N in advance, a method of applying the

parametric coding method and the time-frequency coding method to a corresponding audio band and selecting smaller encoded data from the two pieces of encoded data obtained by using the parametric coding method and the time-frequency coding method may be considered.

[50] The invention can also be embodied as computer (including all devices having data processing functions) readable codes on a computer readable recording medium. The computer readable recording medium is any data storage device that can store data which can be thereafter read by a computer system. Examples of the computer readable recording medium include read-only memory (ROM), random-access memory (RAM), CD-ROMs, magnetic tapes, floppy disks, optical data storage devices.

[51] While the present invention has been particularly shown and described with reference to exemplary embodiments thereof, it will be understood by those of ordinary skill in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present invention as defined by the following claims.

Claims

[1] 1. A method of encoding an audio signal, the method comprising:
dividing an input audio signal into a plurality of audio bands;
selecting a coding method for each of the audio bands;
encoding audio data included in each of the audio bands according to the coding method selected for each of the bands; and
generating a bit stream including all of the encoded audio data included in each of the audio bands,
wherein the selecting the coding method comprises selecting a coding method providing smaller encoded data from among a parametric coding method and a time-frequency coding method.

[2] 2. The encoding method of claim 1, wherein the parametric coding method is a Sinusoidal Coding method.

[3] 3. The encoding method of claim 1, wherein the time-frequency coding method is an Advanced Audio Coding method.

[4] 4. The encoding method of claim 1, wherein the selecting the coding method for each of the audio bands comprises:
calculating a number of sinusoidal signals included in a corresponding audio band among the plurality of audio bands;
selecting the time-frequency coding method if the number of sinusoidal signals is equal to or greater than a predetermined value; and
selecting the parametric coding method if the number of sinusoidal signals is less than the predetermined value.

[5] 5. A method of encoding an audio signal, the method comprising:
dividing an input audio signal into a plurality of audio bands;
encoding audio data included in each of the audio bands according to each of a parametric coding method and a time-frequency coding method;
selecting smaller data for each of the audio bands from among the encoded audio data using the parametric coding method and the time-frequency coding method; and
generating a bit stream including all of the encoded audio data selected for each of the audio bands.

[6] 6. An apparatus for encoding an audio signal, the apparatus comprising:
a band divider which divides an input audio signal into a plurality of audio bands;
a coding method selector which selects a coding method for each of the audio bands;

an audio encoder which encodes audio data included in each of the audio bands according to the coding method selected for each of the bands; and

a bit stream generator which generates a bit stream including all of the encoded audio data for each of the audio bands,

wherein the coding method selector selects a coding method providing smaller encoded data from among a parametric coding method and a time-frequency coding method.

[7] 7. The encoding apparatus of claim 6, wherein the parametric coding method is a Sinusoidal Coding method.

[8] 8. The encoding apparatus of claim 6, wherein the time-frequency coding method is an Advanced Audio Coding method.

[9] 9. The encoding apparatus of claim 6, wherein the coding method selector selects the time-frequency coding method if the number of sinusoidal signals included in a corresponding audio band among the plurality of audio bands is equal to or greater than a predetermined value, and selects the parametric coding method if the number of sinusoidal signals is less than the predetermined value.

[10] 10. A method of decoding an audio signal, the method comprising:

dividing an input bit stream into audio data encoded for a plurality of audio bands;

extracting information on a coding method used by an encoding apparatus for encoding the audio data, for each of the audio bands;

decoding the encoded audio data for each of the audio bands, according to the coding method based on the extracted information; and

generating the audio signal by combining the decoded audio data for the respective audio bands,

wherein the coding method is a coding method providing smaller encoded data that is selected from among a parametric coding method and a time-frequency coding method.

[11] 11. The decoding method of claim 10, wherein the parametric coding method is a Sinusoidal Coding method.

[12] 12. The decoding method of claim 10, wherein the time-frequency coding method is an Advanced Audio Coding method.

[13] 13. The decoding method of claim 10, wherein the time-frequency coding method is selected as the coding method if the number of sinusoidal signals included in the corresponding audio band is equal to or greater than a predetermined value, and the parametric coding method is selected as the coding method if the number of sinusoidal signals is less than the predetermined value.

[14] 14. An apparatus for decoding an audio signal, the apparatus comprising:

a bit stream divider which divides an input bit stream into audio data encoded for a plurality of audio bands;

a coding method extractor which extracts information on a coding method used by an encoding apparatus for encoding the audio data, for each of the audio bands;

an audio decoder which decodes the encoded audio data for each of the audio bands, according to the coding method based on the extracted information; and

an audio signal generator which generates the audio signal by combining the decoded audio data for each of the respective audio bands,

wherein the coding method is a coding method providing smaller encoded data that is selected from a parametric coding method and a time-frequency coding method.

[15] 15. The decoding apparatus of claim 14, wherein the parametric coding method is a Sinusoidal Coding method.

[16] 16. The decoding apparatus of claim 14, wherein the time-frequency coding method is an Advanced Audio Coding method.

[17] 17. The decoding apparatus of claim 14, wherein the time-frequency coding method is selected as the coding method if the number of sinusoidal signals included in a corresponding audio band is equal to or greater than a predetermined value, and the parametric coding method is selected if the number of sinusoidal signals is smaller than the predetermined value.

[18] 18. A computer readable recording medium having recorded thereon a computer program for executing an audio signal encoding method, the audio signal encoding method comprising:

dividing an input audio signal into a plurality of audio bands;

selecting a coding method for each of the audio bands;

encoding audio data included in each of the audio bands according to the coding method selected for each of the bands; and

generating a bit stream including all the encoded audio data in each audio band,

wherein the selecting the coding method comprises selecting a coding method providing smaller encoded data from among a parametric coding method and a time-frequency coding method.

[19] 19. A computer readable recording medium having recorded thereon a computer program for executing an audio signal encoding method, the audio signal encoding method comprising:

dividing an input audio signal into a plurality of audio bands;

encoding audio data included in each of the audio bands by applying each of a parametric coding method and a time-frequency coding method respectively;

selecting smaller data from among the encoded audio data using each of two different coding methods for each of the audio bands; and

generating a bit stream including all of the encoded audio data selected for each of the audio bands.

[20] 20. A computer readable recording medium having recorded thereon a computer program for executing an audio signal decoding method, the audio signal decoding method comprising:

dividing an input bit stream into audio data encoded for a plurality of audio bands;

extracting information on a coding method used by an encoding apparatus for encoding the audio data, for each of the audio bands;

decoding the encoded audio data for each of the audio bands, according to the coding method based on the extracted information; and

generating the audio signal by combining the decoded audio data for the respective audio bands,

wherein the coding method is a coding method providing smaller encoded data that is selected from among a parametric coding method and a time-frequency coding method.

FIG. 1

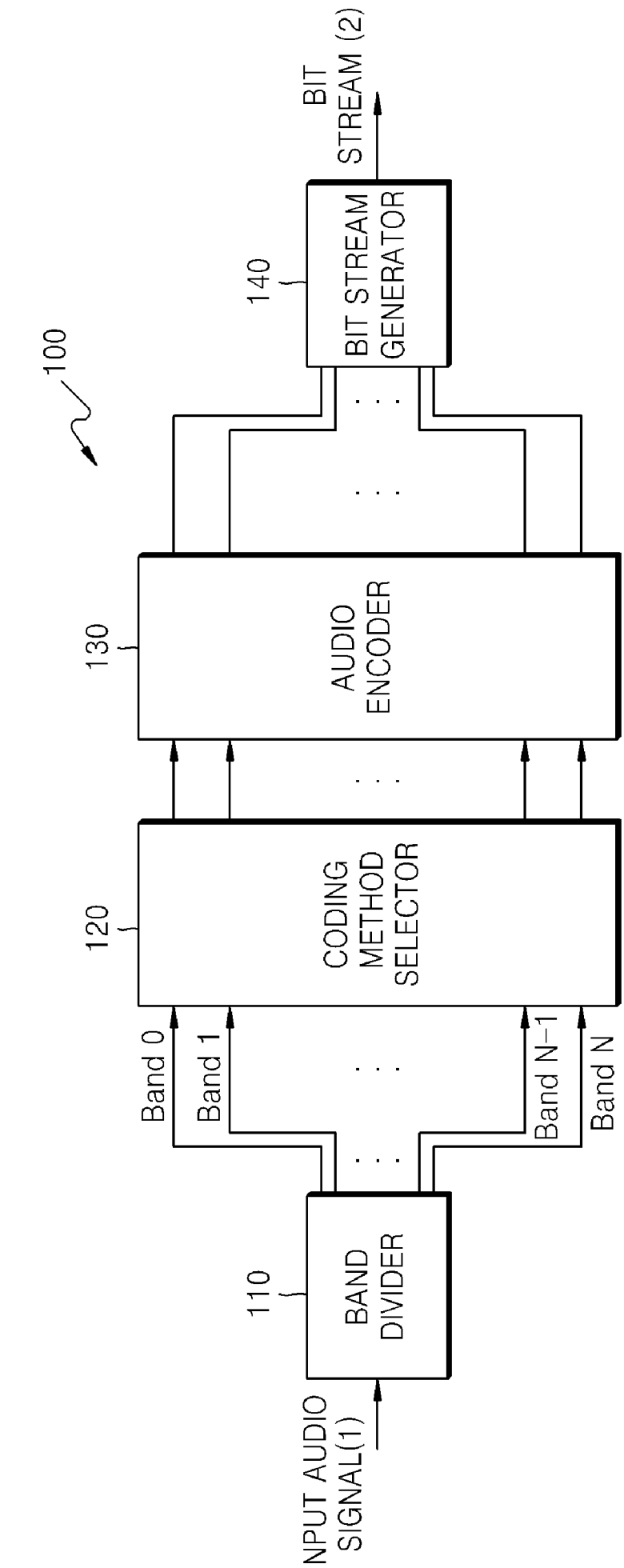

100
110
BAND DIVIDER
120
CODING METHOD SELECTOR
130
AUDIO ENCODER
140
BIT STREAM GENERATOR
INPUT AUDIO SIGNAL(1)
BIT STREAM (2)
Band 0
Band 1
Band N-1
Band N

FIG. 2

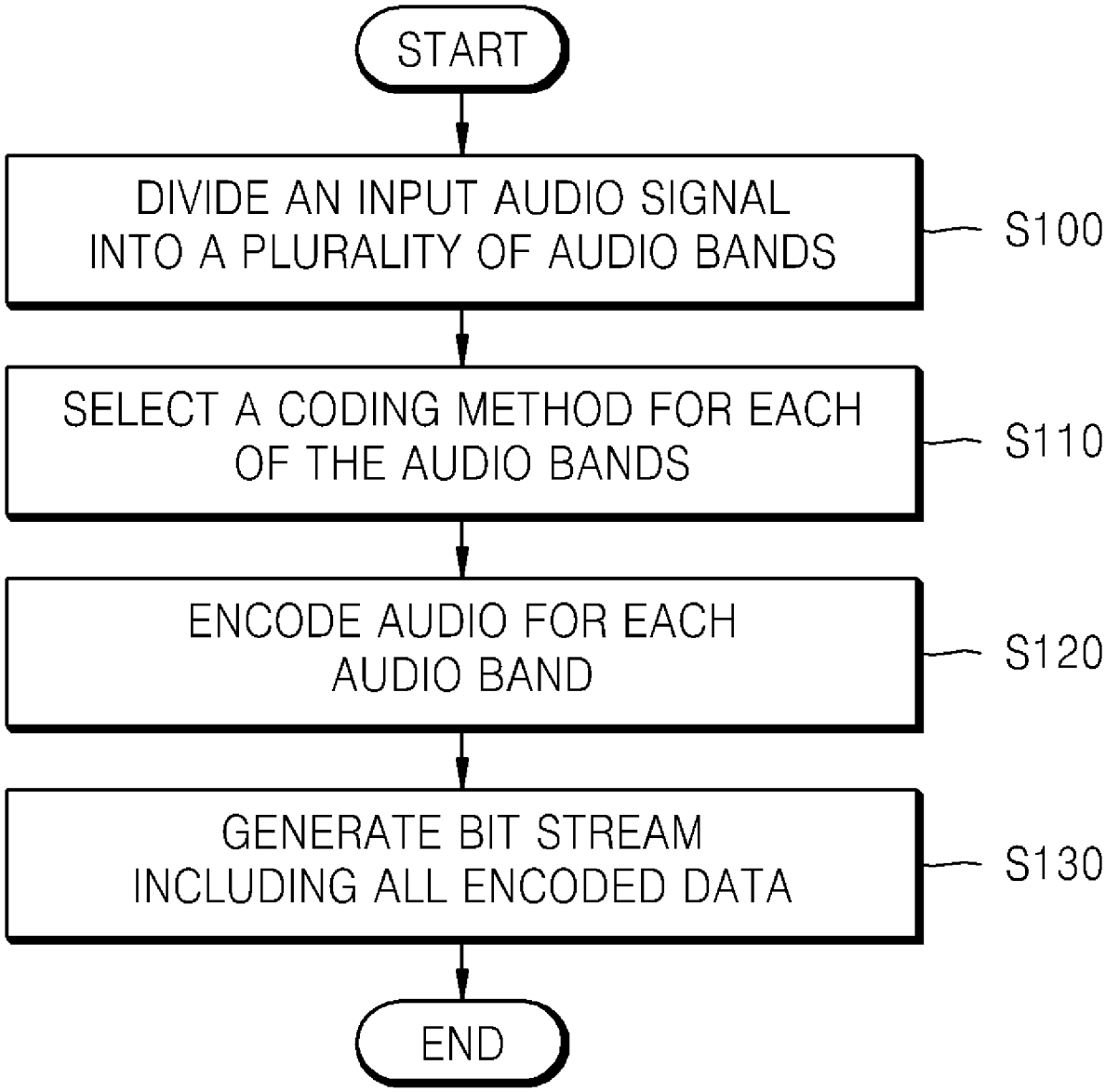

START
DIVIDE AN INPUT AUDIO SIGNAL INTO A PLURALITY OF AUDIO BANDS
S100
SELECT A CODING METHOD FOR EACH OF THE AUDIO BANDS
S110
ENCODE AUDIO FOR EACH AUDIO BAND
S120
GENERATE BIT STREAM INCLUDING ALL ENCODED DATA
S130
END

FIG. 3

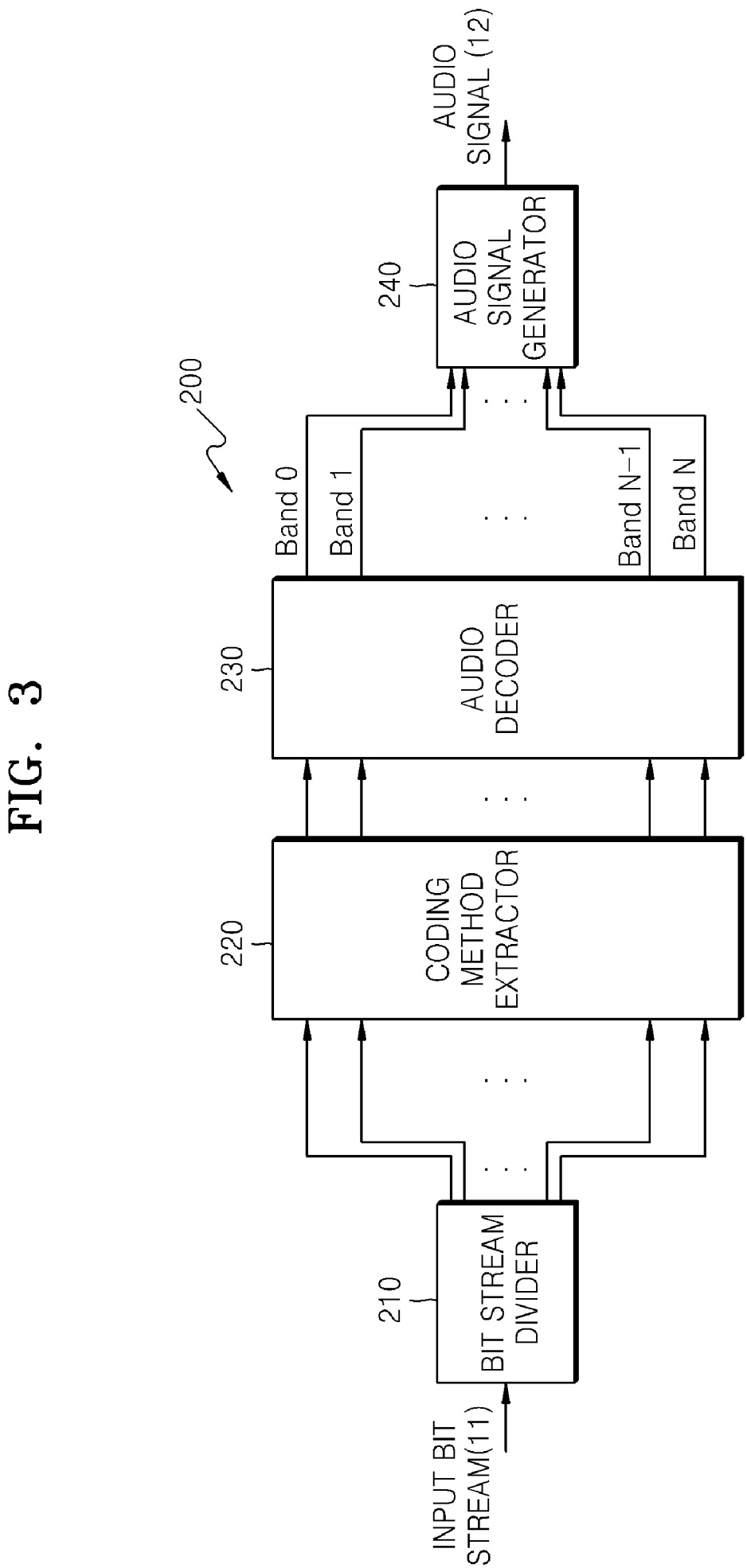

INPUT BIT STREAM(11)
210
BIT STREAM DIVIDER
220
CODING METHOD EXTRACTOR
230
AUDIO DECODER
Band 0
Band 1
Band N-1
Band N
240
AUDIO SIGNAL GENERATOR
AUDIO SIGNAL (12)
200

FIG. 4

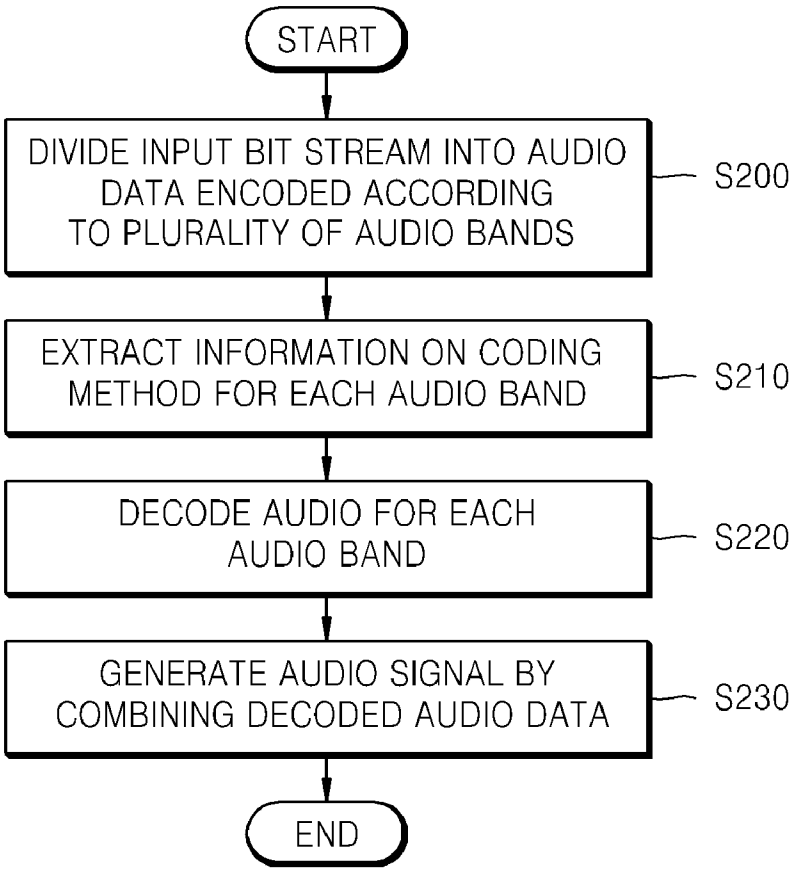
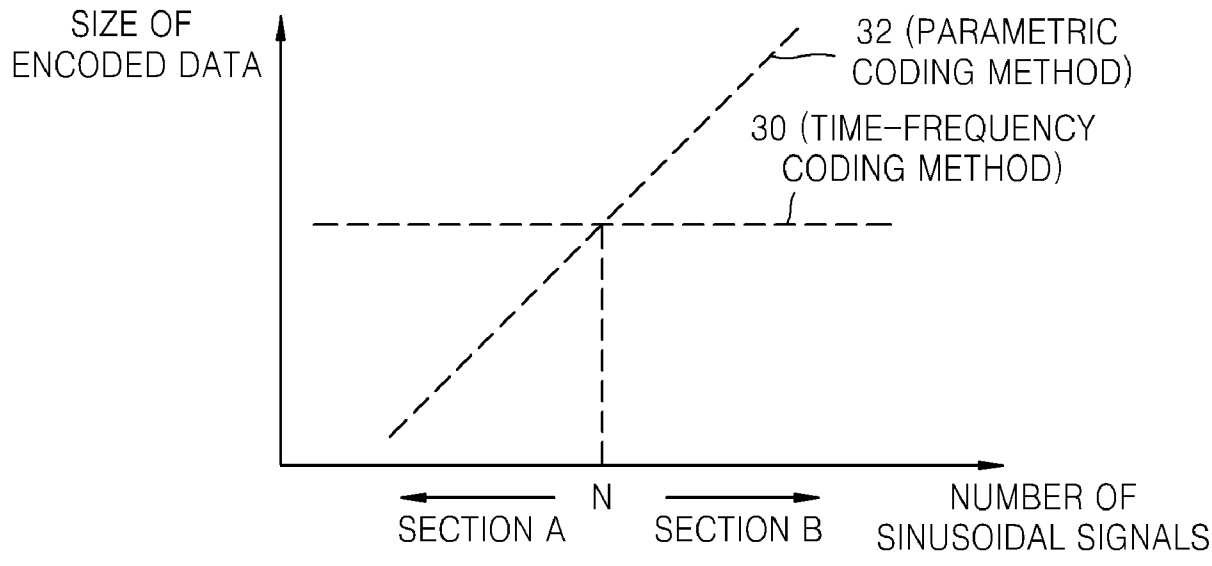

START
DIVIDE INPUT BIT STREAM INTO AUDIO DATA ENCODED ACCORDING TO PLURALITY OF AUDIO BANDS
S200
EXTRACT INFORMATION ON CODING METHOD FOR EACH AUDIO BAND
S210
DECODE AUDIO FOR EACH AUDIO BAND
S220
GENERATE AUDIO SIGNAL BY COMBINING DECODED AUDIO DATA
S230
END

FIG. 5


SIZE OF ENCODED DATA
32 (PARAMETRIC CODING METHOD)
30 (TIME-FREQUENCY CODING METHOD)
N
SECTION A
SECTION B
NUMBER OF SINUSOIDAL SIGNALS

INTERNATIONAL SEARCH REPORT

International application No.
PCT/KR2008/000207

A. CLASSIFICATION OF SUBJECT MATTER

G10L 19/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 8 H04B 1/66 G01H 1/12 H03M 7/30 G01L 9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

KOREAN UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975
JAPANESE UTILITY MODELS AND APPLICATIONS FOR UTILITY MODELS SINCE 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal) "AUDIO""ENCOD*""DECOD*""BAND""SUBBAND""TIME*""FREQUENCY"

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 918 401 B1 (SAMSUNG ELECTRONICS CO) 15 MARCH 2006 See Fig 2 and Abstract	1, 5, 10, 14, 18-20
A	US 5,886,276 A (LEVINE et al.) 23 MARCH 1999 See Fig 1, Column 4 Line 29 ~ Column 6 Line 67	1, 5, 10, 14, 18-20
A	US 6,487,535 B1 (SMYTH et al.) 26 NOVEMBER 2002 See Fig 5, Fig 6, Column 9 Line 23 ~ Column 12 Line 31	1
A	JP 10285402 A (SAMSUNG ELECTRONICS CO) 23 OCTOBER 1998 See Fig 1, Abstract	1
A	JP 12068852 A (MATSUSHITA ELECTRIC IND CO) 03 MARCH 2000 See Fig 8, Abstract	1
A	US 6,349,284 B1 (PARK et al.) 19 FEBRUARY 2002 See Abstract	1
A	US 5,809,474 A (PARK) 15 SEPTEMBER 1998 See Abstract	1

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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Name and mailing address of the ISA/KR
Korean Intellectual Property Office
Government Complex-Daejeon, 139 Seonsa-ro, Seo-gu, Daejeon 302-701, Republic of Korea
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