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(54) MUSICAL-PIECE ANALYSIS DEVICE, MUSICAL-PIECE ANALYSIS METHOD, AND MUSICAL-PIECE ANALYSIS PROGRAM

MUSIKSTÜCKANALYSEVORRICHTUNG, MUSIKSTÜCKANALYSEVERFAHREN UND MUSIKSTÜCKANALYSEPROGRAMM

DISPOSITIF, PROCÉDÉ ET PROGRAMME D'ANALYSE DE MORCEAU DE MUSIQUE

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(73) Proprietor: **AlphaTheta Corporation**
Nishi-ku, Yokohama-shi
Kanagawa 220-0012 (JP)

(72) Inventor: **SUZUKI, Shiro**
Kanagawa 220-0012 (JP)

(74) Representative: **Gille Hrabal**
Partnerschaftsgesellschaft mbB
Patentanwälte
Brucknerstraße 20
40593 Düsseldorf (DE)

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JP-A- 2008 040 283 **JP-A- 2013 235 050**

- **Katy C Noland: "Computational tonality estimation: signal processing and hidden markov models", , 31 March 2009 (2009-03-31), pages 1-169, XP055568467, London, UK Retrieved from the Internet: URL:https://qmro.qmul.ac.uk/xmlui/bitstream/handle/123456789/8033/KCNolandThesis.pdf?sequence=1&isAllowed=y [retrieved on 2019-03-13]**

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Description

TECHNICAL FIELD

[0001] The present invention relates to a music piece analyzer, a music piece analysis method, and a music piece analysis program.

BACKGROUND ART

[0002] There has been typically known a technology of automatically analyzing a music piece in terms of a beat, a tempo, and a key and a scale of the music piece based on sound data of the music piece and the like (see, for instance, Patent Literature 1).

[0003] Sound data for a certain period of time is sampled and the inputted waveforms are analyzed using, for instance, FFT (Fast Fourier Transform).

[0004] Such a sound data analysis also has been used as a technology relating to a BPM (Beats Per Minute) music piece in a field of a DJ-related device.

[0005] When the sound data analysis is used in the DJ-related device, a music piece can be comfortably connected to another music piece using the analyzed tempo, key, and scale and the like. Accordingly, a high DJ-performance can be provided.

[0006] JP 2003 263170 A discloses a method for tone/tonality estimation in music data. For tone detection, peaks in the spectrum of the sound signal are localised. The analysis of the input sound signal is based on a sequence of windowed time signals with a hop size of 1/8 of a detected fundamental frequency period, and again on a second sequence of signal frames windowed with a second window and a hop size of 1/64 of the detected fundamental frequency period.

[0007] Katy C Noland: "Computational tonality estimation: signal processing and hidden markov models",, 31 March 2009 (2009-03-31), pages 1-169, XP055568467, London, UK discloses methods for tonality estimation. A pre-processing for extraction of the musical features from the input signal is disclosed and the framing prior to Fourier-transforming the input signal is discussed. The influence of the window and hop size on the estimation is discussed, and an optimal hop size is found to be linked to a change rate of keys in the sound signal as well as on tempo and rate of harmonic change.

[0008] JP 2007 052394 A is concerned with a beat/tempo estimation of music signals based on an FFT transferred input signal. A good compromise between frequency and tie resolution has to be found.

CITATION LIST

PATENT LITERATURE(S)

[0009] Patent Literature 1 : JP200-97084A

SUMMARY OF THE INVENTION

PROBLEM(S) TO BE SOLVED BY THE INVENTION

[0010] An FFT is typically executed at a fixed interval. Accordingly, in order to analyze long sound data, the FFT needs to be executed at an increased number of times, so that it takes time to analyze the sound data.

[0011] An object of the invention is to provide a music piece analyzer, a music piece analysis method, and a music piece analysis program, which are capable of shortening an analysis time irrespective of a length of sound data.

MEANS FOR SOLVING THE PROBLEM(S)

[0012] According to an aspect of the invention, a music piece analyzer includes:

a reproduction time detector configured to detect a reproduction time of an inputted sound data;
an execution interval setting unit configured to set an execution interval of Fast Fourier Transform (FFT) depending on the reproduction time detected by the reproduction time detector; and
a sound data analyzing unit configured to execute the FFT at the execution interval set by the execution interval setting unit to analyze the inputted sound data.

[0013] According to another aspect of the invention, a music piece analyzer includes:

a data length detector configured to detect a data length of an inputted sound data;
an execution interval setting unit configured to set an execution interval of Fast Fourier Transform (FFT) depending on the data length detected by the data length detector; and
a sound data analyzing unit configured to execute the FFT at the execution interval set by the execution interval setting unit to analyze the inputted sound data.

[0014] According to still another aspect of the invention, a music piece analysis method includes:

detecting a reproduction time of an inputted sound data;
setting an execution interval of Fast Fourier Transform (FFT) depending on the detected reproduction time; and
executing the FFT at the set execution interval to analyze the inputted sound data.

[0015] According to a further aspect of the invention, a music piece analysis program to be run on a computer includes:

detecting a reproduction time of an inputted sound data;
setting an execution interval of Fast Fourier Transform (FFT) depending on the detected reproduction time; and
executing the FFT at the set execution interval to analyze the inputted sound data.

BRIEF DESCRIPTION OF DRAWING(S)

[0016]

Fig. 1 is a block diagram showing a music piece analyzer according to an exemplary embodiment of the invention.
Fig. 2 is a schematic illustration for explaining copying of sound data in the exemplary embodiment.
Fig. 3 is a schematic illustration for explaining a window function in the exemplary embodiment.
Fig. 4 is a schematic illustration for explaining an execution interval of FFT in the exemplary embodiment.
Fig. 5 is a schematic illustration for explaining an execution interval of sound data requiring a long reproduction time in the exemplary embodiment.
Fig. 6 is a schematic illustration for explaining an execution interval of sound data requiring a short reproduction time in the exemplary embodiment.
Fig. 7 is a schematic illustration for explaining a key judgement after the FFT is executed in the exemplary embodiment.
Fig. 8 is another schematic illustration for explaining a key judgement after the FFT is executed in the exemplary embodiment.
Fig. 9 is a flowchart for explaining a music piece analysis method in the exemplary embodiment.

DESCRIPTION OF EMBODIMENT(S)

[0017] An exemplary embodiment of the invention will be described below.

[0018] Fig. 1 shows a music piece analyzer 1 according to the exemplary embodiment. The music piece analyzer 1 is configured to analyze sound data SD obtained by digitalizing inputted PCM data and the like, judge a key of the sound data SD, and display the key as a key display KD of the inputted sound data on a display screen of a display device and the like.

[0019] The music piece analyzer 1, which is in a form of a software application to be run in a general computer or a mobile information terminal installed with OS (Operation System), includes a reproduction time detector 2, a sound data judging unit 3, a sound data copier 4, a sound data analyzing unit 5, an execution interval setting unit 6, and a key judging unit 7.

[0020] The reproduction time detector 2 is configured to detect a reproduction time of the inputted sound data SD. Specifically, the reproduction time detector 2 detects a reproduction time of the inputted sound data SD by counting the number of sampling times from the start to the end of the sound data SD. After detecting the reproduction time, the reproduction time detector 2 outputs the detected reproduction time to the sound data judging unit 3 and the execution interval setting unit 6.

[0021] The sound data judging unit 3 is configured to judge whether the inputted sound data SD has the reproduction time equal to or more than a predetermined length based on the reproduction time detected by the reproduction time detector 2. Specifically, the sound data judging unit 3 judges whether the sound data SD has the reproduction time enough for the sound data analyzing unit 5 (later described) to analyze the sound data SD.

[0022] Whether the sound data SD can be analyzed or not is judged based on whether or not the sound data SD has the reproduction time equal to or more than the shortest time required for a window function applied to the sound data analyzing unit 5.

[0023] A time window length of the window function is determined based on a sampling frequency, a lowest frequency to be detected and a frequency resolution of the sound data SD.

[0024] For instance, in a typical BPM 200 music piece in four-quarter time, it takes 300 msec for one beat and it takes 75 msec for a semiquaver. When the FFT is executed and the sound data SD of a low sound at 27.5 Hz corresponding to a musical note A0 is analyzed, the sound data SD at least for 1.2 sec is required.

[0025] When judging the reproduction time of the sound data SD is less than the predetermined length, the sound data judging unit 3 outputs this judgement result to the sound data copier 4.

[0026] Based on the judgement result of the sound data judging unit 3, the sound data copier 4 is configured to copy the inputted sound data SD and put together the inputted sound data and the copied sound data so that the reproduction time of the obtained sound data becomes equal to or more than the predetermined length. Specifically, as shown in Fig. 2, the sound data copier 4 copies the sound data SD of the inputted reproduction time t1, pastes the copied data CD posteriorly to the sound data SD to put together, thereby generating a continuous sound data SD' of a reproduction time t2.

[0027] For instance, when the reproduction time t1 of the sound data SD is shorter than 1.2 sec in the above example, the sound data copier 4 repeats copying the sound data SD to generate the copied data CD, until the reproduction time t2 of the continuous sound data SD' becomes equal to or more than 1.2 sec.

[0028] It should be noted that the copying of the sound data SD only needs to be repeated so that the reproduction time t2 is long enough for the sound data analyzing unit 5 to analyze. The number N of the times of the copying may not always be an integer.

[0029] The sound data copier 4 outputs the sound data SD', the reproduction time of which is made equal to or more than a predetermined length by the copying, to the

sound data analyzing unit 5.

[0030] The sound data analyzing unit 5 is configured to analyze frequency spectra of the sound data SD or SD'. In the exemplary embodiment, the analysis is conducted using the FFT. However, the analysis method is not particularly limited to the method using the FFT. For instance, an analysis using DCT (Discrete Cosine transform), an analysis in terms of a time axis, an analysis in terms of a signal level, and an analysis in terms of a sound volume and an attack may be conducted.

[0031] As shown in Fig. 3, a hamming window HMW (window function) is usually applied to the FFT. The hamming window HMW is applied in order to soften an increase in a signal intensity at both ends of the time axis during the FFT execution to be less affected by a discontinuous joint of the sampled waveforms at the FFT execution.

[0032] Accordingly, since being too weak, the signal intensities at both the end of the time axis of the FFT-executed data cannot be used as the analysis data.

[0033] For this reason, in the exemplary embodiment, signal intensities in an analysis period T0, in which the signal intensity is not weakened, during the execution of FFT are used as analyzable data to analyze the frequency spectra. The analysis period T0 can be determined as needed. In the exemplary embodiment, the analysis period T0 is set based on a value obtained by the hamming window HMW being 0.7 (70%).

[0034] Although the hamming window HMW is used in the exemplary embodiment, the window function is not limited to the hamming window HMW but may be a hanning window, a flat-top window and the like.

[0035] Based on the reproduction time detected by the reproduction time detector 2, the execution interval setting unit 6 is configured to set an interval at which the sound data analyzing unit 5 executes the FFT.

[0036] Specifically, the execution interval setting unit 6 sets, as an execution interval TI, the start time of the second FFT2 after the first FFT1 is executed. In the exemplary embodiment, the third FFT3 is started after the elapse of the double execution interval TI (i.e., a time 2TI). Thus, another FFT is sequentially executed.

[0037] The setting of the execution interval TI depends on the reproduction time of the sound data SD or SD'.

[0038] For instance, with respect to a long sound data SD having the reproduction time of 30 sec or more, the execution interval setting unit 6 sets the execution interval TI to be large as shown in Fig. 5. With respect to a short sound data SD having the reproduction time less than 30 sec, the execution interval setting unit 6 sets the execution interval TI to be small as shown in Fig. 6. The minimum value of the execution interval TI is determined so that the analysis period T0 of each of FFT1, FFT2 and the like is continuous to a subsequent one of the analysis periods T0.

[0039] The execution interval setting unit 6 outputs the set execution interval TI to the above sound data analyzing unit 5.

[0040] The sound data analyzing unit 5 repeats executing the FFT based on the execution interval TI. Each time the sound data analyzing unit 5 executes the FFT, the sound data analyzing unit 5 outputs an analysis result to the key judging unit 7.

[0041] The key judging unit 7 is configured to judge a key of the sound data SD or SD' based on the analysis result outputted from the sound data analyzing unit 5.

[0042] Specifically, the key judging unit 7 stores reference frequencies of 24 musical notes including two kinds of keys (i.e., a minor key and a major key) of each of 12 musical notes in an octave.

[0043] The key judging unit 7 sums up the analysis results inputted each at the execution interval TI in the time axis direction to provide a total value, selects the reference frequency close to the frequency having a strong signal intensity based on the obtained total value, and obtains the signal intensity of each of the musical notes as shown in Fig. 7.

[0044] Next, as shown in Fig. 8, the key judging unit 7 rearranges the signal intensities in an order of a higher signal intensity, normalizes the signal intensities, selects some of the musical notes having high signal intensities, and judges a key of the sound data SD or SD'. The key judging unit 7 displays key judgement results of the sound data SD or SD' as a key display KD on a display of a computer or a screen of a mobile terminal.

[0045] Next, the key judgement of the sound data SD by the music piece analyzer 1 with the above arrangement will be described with reference to a flowchart shown in Fig. 9.

[0046] First, a user of the computer or the mobile terminal selects the music piece analyzer 1 on the screen to start a program and select the sound data SD that is an analysis target, the sound data SD is inputted to the music piece analyzer 1 (Step S1).

[0047] After the sound data SD is inputted, the reproduction time detector 2 detects the reproduction time of the sound data SD (Step S2).

[0048] The sound data judging unit 3 judges whether the reproduction time of the sound data SD is equal to or more than a predetermined length (Step S3).

[0049] When the reproduction time of the sound data SD is judged to be less than the predetermined length, the sound data copier 4 copies the sound data SD (Step S4) and pastes the copied data CD to the sound data SD to generate the continuous sound data SD'.

[0050] When the reproduction time of the initial sound data SD is equal to or more than the predetermined length, or when the reproduction time of the sound data SD' is equal to or more than the predetermined length, the execution interval setting unit 6 sets the execution interval TI at the sound data analyzing unit 5 based on the reproduction time of the sound data SD or SD' (Step S6).

[0051] The sound data analyzing unit 5 repeats the FFT based on the set execution interval TI to analyze the frequency spectra of the sound data SD or SD' (Step S7).

[0052] The sound data analyzing unit 5 judges whether the sound data SD or SD' ends (Step S8). After judging that the sound data SD or SD' ends, the sound data analyzing unit 5 outputs the analysis result to the key judging unit.

[0053] The key judging unit 7 judges a key of the sound data SD or SD' based on the analysis result (Step S9).

[0054] The key judging unit 7 displays the key of the sound data SD or SD' as the judgement result on a display of a computer or a screen of a mobile terminal (Step S10).

[0055] The exemplary embodiment provides the following advantages.

[0056] Since the music piece analyzer 1 includes the sound data copier 4, even a very short sound data SD can be transformed by copying into the sound data SD' having the reproduction time equal to or more than a predetermined length. Accordingly, irrespective of the reproduction time of the sound data SD, the sound data analyzing unit 5 can execute the FFT to analyze the frequency spectra, so that the key of the sound data SD or SD' can be judged.

[0057] With this arrangement, various sound data SD of DJ-related devices is usable irrespective of the length of the reproduction time of the sound data SD, so that a high DJ-performance can be provided.

[0058] Since the music piece analyzer 1 includes the reproduction time detector 2 and the execution interval setting unit 6, the execution interval TI of the FFT by the sound data analyzing unit 5 can be changed depending on the reproduction time of the sound data SD. Accordingly, when the reproduction time of the sound data SD is short, an analysis accuracy of the sound data SD can be improved by decreasing the execution interval TI and increasing the number of the FFT execution.

[0059] On the other hand, when the reproduction time of the sound data SD is long, an analysis time of the sound data SD can be shortened by prolonging the execution interval TI and decreasing the number of the FFT execution during the reproduction of the sound data SD. Although the long sound data SD tends to be roughly analyzed since the number of the FFT execution is relatively decreased, this number of the FFT execution is sufficient for use for the key judgement and the like, so that a favorable result can be obtained without any trouble.

[0060] The invention is by no means limited to the above exemplary embodiment, but includes the following modification(s).

[0061] Although the music piece analyzer 1 of the above exemplary embodiment judges the key of the sound data SD, the invention is not limited to the music piece analyzer 1 for the key judgement. The music piece analyzer 1 may be used for judging a key and a scale.

[0062] Although the execution interval setting unit 6 of the above exemplary embodiment sets the execution interval TI on the basis of the reproduction time of the sound data SD or SD', the execution interval TI in the invention is not necessarily set on the basis of the reproduction time. The execution interval may be set on the basis of a data length of the inputted sound data.

[0063] Any other arrangements compatible with the invention may be applied.

EXPLANATION OF CODE(S)

[0064] 1...music piece analyzer, 2...reproduction time detector, 3...sound data judging unit, 4... sound data copier, 5... sound data analyzing unit, 6... execution interval setting unit, 7...key judging unit, CD... copied data, HMW... hamming window, KD...key display, S1... Step, S2...Step, S3...Step, S4...Step, S6...Step, S7...Step, S8...Step, S9...Step, S10...Step, SD...sound data, T0...analysis period, tl...reproduction time, t2...reproduction time, TI... execution interval

Claims

1. A music piece analyzer (1) comprising:

a reproduction time detector (2) configured to detect a reproduction time of an inputted sound data;
an execution interval setting unit (6) configured to set an execution interval TI of Fast Fourier Transform (FFT) depending on the reproduction time detected by the reproduction time detector (2),
characterized by
a sound data analyzing unit (5) configured to execute the FFT at the execution interval TI set by the execution interval setting unit (6) to analyze the inputted sound data.

2. A music piece analyzer (1) comprising:

a data length detector configured to detect a data length of an inputted sound data;
an execution interval setting unit (6) configured to set an execution interval TI of Fast Fourier Transform (FFT) depending on the data length detected by the data length detector,
characterized by
a sound data analyzing unit (5) configured to execute the FFT at the execution interval TI set by the execution interval setting unit (6) to analyze the inputted sound data.

3. The music piece analyzer (1) according to claim 1 or 2, wherein
the execution interval setting unit (6) is configured:

to prolong the set execution interval of the FFT when the reproduction time or the data length of the inputted sound data is longer than a predetermined reproduction time or a predeter-

mined data length, and
to shorten the set execution interval of the FFT when the reproduction time or the data length of the inputted sound data is shorter than a predetermined reproduction time or a predetermined data length.

4. The music piece analyzer (1) according to claim 1 or 2, wherein

the music piece analyzer (1) further comprises a sound data copier (4) configured to copy the inputted sound data until the reproduction time or the data length of the inputted sound data is equal to or longer than a reproduction time or a data length analyzable by the FFT when the reproduction time or the data length of the inputted sound data is shorter than the reproduction time or the data length analyzable by the FFT, and
the sound data analyzing unit (5) analyzes the copied sound data.

5. A music piece analysis method comprising:

detecting a reproduction time of an inputted sound data;
setting an execution interval TI of Fast Fourier Transform (FFT) depending on the detected reproduction time; and
executing the FFT at the set execution internal TI to analyze the inputted sound data.

6. A music piece analysis program to be run on a computer, the program comprising:

detecting a reproduction time of an inputted sound data;
setting an execution interval TI of Fast Fourier Transform (FFT) depending on the detected reproduction time; and
executing the FFT at the set execution interval TI 1 to analyze the inputted sound data.

Patentansprüche

1. Ein Musikstück-Analysator (1), umfassend:

einen Wiedergabezeitdetektor (2), der dazu eingerichtet ist, eine Wiedergabezeit von eingegebenen Klangdaten zu detektieren;
eine Ausführungsintervall-Einstelleinheit (6), die dazu eingerichtet ist, ein Ausführungsintervall TI einer schnellen Fourier-Transformation (FFT) in Abhängigkeit von der von dem Wiedergabezeitdetektor (2) detektierten Wiedergabezeit einzustellen,
gekennzeichnet durch
eine Klangdaten-Analyseeinheit (5), die dazu eingerichtet ist, die FFT in dem von der Ausführungsintervall-Einstelleinheit (6) eingestellten Ausführungsintervall TI auszuführen, um die eingegebenen Klangdaten zu analysieren.

2. Ein Musikstück-Analysator (1), umfassend

einen Datenlängendetektor, der dazu eingerichtet ist, eine Datenlänge von eingegebenen Klangdaten zu detektieren;
eine Ausführungsintervall-Einstelleinheit (6), die dazu eingerichtet ist, ein Ausführungsintervall TI einer schnellen Fourier-Transformation (FFT) in Abhängigkeit von der durch den Datenlängendetektor detektierten Datenlänge einzustellen,
gekennzeichnet durch
eine Klangdaten-Analyseeinheit (5), die dazu eingerichtet ist, die FFT in dem von der Ausführungsintervall-Einstelleinheit (6) eingestellten Ausführungsintervall TI auszuführen, um die eingegebenen Klangdaten zu analysieren.

3. Der Musikstück-Analysator (1) gemäß Anspruch 1 oder 2, wobei
die Ausführungsintervall-Einstelleinheit (6) dazu eingerichtet ist:

das eingestellte Ausführungsintervall der FFT zu verlängern, wenn die Wiedergabezeit oder die Datenlänge der eingegebenen Klangdaten länger als eine vorbestimmte Wiedergabezeit oder eine vorbestimmte Datenlänge ist, und
das eingestellte Ausführungsintervall der FFT zu verkürzen, wenn die Wiedergabezeit oder die Datenlänge der eingegebenen Klangdaten kürzer als eine vorbestimmte Wiedergabezeit oder eine vorbestimmte Datenlänge ist.

4. Der Musikstück-Analysator (1) gemäß Anspruch 1 oder 2, wobei

der Musikstück-Analysator (1) ferner einen Klangdaten-Kopierer (4) umfasst, der dazu eingerichtet ist, die eingegebenen Klangdaten zu kopieren, bis die Wiedergabezeit oder die Datenlänge der eingegebenen Klangdaten gleich oder länger als eine durch die FFT analysierbare Wiedergabezeit oder Datenlänge ist, wenn die Wiedergabezeit oder die Datenlänge der eingegebenen Klangdaten kürzer als die durch die FFT analysierbare Wiedergabezeit oder Datenlänge ist, und
die Klangdaten-Analyseeinheit (5) die kopierten Klangdaten analysiert.

5. Ein Verfahren zur Analyse eines Musikstücks, um-

fassend:

Detektieren einer Wiedergabezeit von eingegebenen Klangdaten;
Einstellen eines Ausführungsintervalls TI einer schnellen Fourier-Transformation (FFT) in Abhängigkeit von der detektierten Wiedergabezeit; und
Ausführen der FFT in dem eingestellten Ausführungsintervall TI, um die eingegebenen Klangdaten zu analysieren.

6. Ein Musikstück-Analyseprogramm, das auf einem Computer ausführbar ist, wobei das Programm umfasst:

Detektieren einer Wiedergabezeit von eingegebenen Klangdaten;
Einstellen eines Ausführungsintervalls TI einer schnellen Fourier-Transformation (FFT) in Abhängigkeit von der detektierten Wiedergabezeit; und
Ausführen der FFT mit dem eingestellten Ausführungsintervall TI, um die eingegebenen Klangdaten zu analysieren.

Revendications

1. Analyseur de morceau de musique (1) comprenant :

un détecteur de temps de reproduction (2) configuré pour détecter un temps de reproduction des données audio entrées ;
une unité de réglage d'intervalle d'exécution (6) configurée pour fixer un intervalle d'exécution TI de Transformation de Fourier rapide (FFT) dépendant du temps de reproduction détecté par le détecteur de temps de reproduction (2),
caractérisé par
une unité d'analyse de données audio (5) configurée pour effectuer la FFT de l'intervalle d'exécution TI fixé par l'unité de réglage d'intervalle d'exécution (6) pour analyser les données audio entrées.

2. Analyseur de morceau de musique (1) comprenant :

un détecteur de longueur de données configuré pour détecter une longueur de données des données audio entrées ;
une unité de réglage d'intervalle d'exécution (6) configurée pour fixer un intervalle d'exécution TI de Transformation de Fourier rapide (FFT) dépendant de la longueur de données détectée par le détecteur de longueur de données,
caractérisé par
une unité d'analyse de données audio (5) configurée pour effectuer la FFT de l'intervalle d'exécution TI fixé par l'unité de réglage d'intervalle d'exécution (6) pour analyser les données audio entrées.

3. Analyseur de morceau de musique (1) selon la revendication 1 ou la revendication 2, dans lequel l'unité de réglage d'intervalle d'exécution (6) est configurée :

pour prolonger l'intervalle d'exécution fixé de la FFT, si le temps de reproduction ou la longueur de données des données audio entrées est plus long(ue) qu'un temps de reproduction prédéterminé ou une longueur de données prédéterminée, et
pour raccourcir l'intervalle d'exécution fixé de la FFT, si le temps de reproduction ou la longueur de données des données audio entrées est plus court(e) qu'un temps de reproduction prédéterminé ou une longueur de données prédéterminée.

4. Analyseur de morceau de musique (1) selon la revendication 1 ou la revendication 2, dans lequel

l'analyseur de morceau de musique (1) comprend en outre un copieur de données audio (4) configuré pour copier les données audio entrées jusqu'à ce que le temps de reproduction ou la longueur de données des données audio entrées soit égale à ou plus long(ue) qu'un temps de reproduction ou qu'une longueur de données analysable par la FFT, si le temps de reproduction ou la longueur de données des données audio entrées est plus court(e) que le temps de reproduction ou que la longueur de données analysable par la FFT, et
l'unité d'analyse de données audio (5) analyse les données audio copiées .

5. Procédé d'analyse de morceau de musique comprenant les étapes de :
détecter un temps de reproduction des données audio entrées :

fixer un intervalle d'exécution TI de Transformation de Fourier Rapide (FFT) dépendant du temps de reproduction détecté ; et
exécuter la FFT avec l'intervalle d'exécution fixé TI pour analyser les données audio entrées.

6. Programme d'analyse de morceau de musique comprenant les étapes de :
détecter un temps de reproduction des données audio entrées :

fixer un intervalle d'exécution TI de Transforma-

tion de Fourier Rapide (FFT) dépendant du temps de reproduction détecté ; et
exécuter la FFT avec l'intervalle d'exécution fixé TI pour analyser les données audio entrées.

FIG. 1

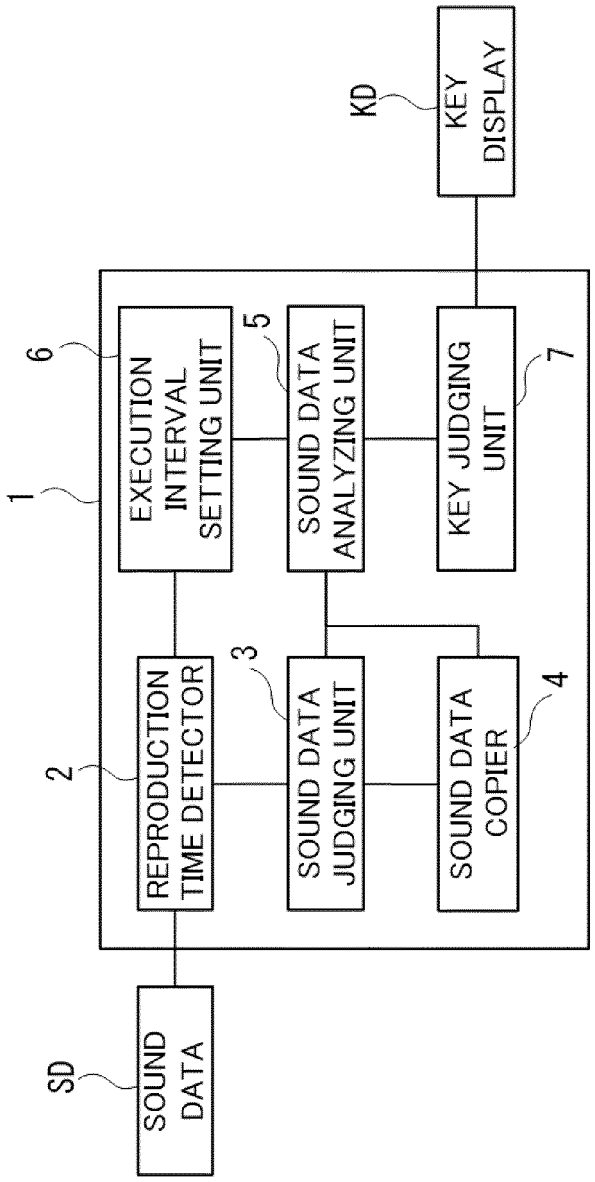

KD
KEY DISPLAY
1
6
5
7
EXECUTION INTERVAL SETTING UNIT
SOUND DATA ANALYZING UNIT
KEY JUDGING UNIT
2
3
4
REPRODUCTION TIME DETECTOR
SOUND DATA JUDGING UNIT
SOUND DATA COPIER
SD
SOUND DATA

FIG. 2

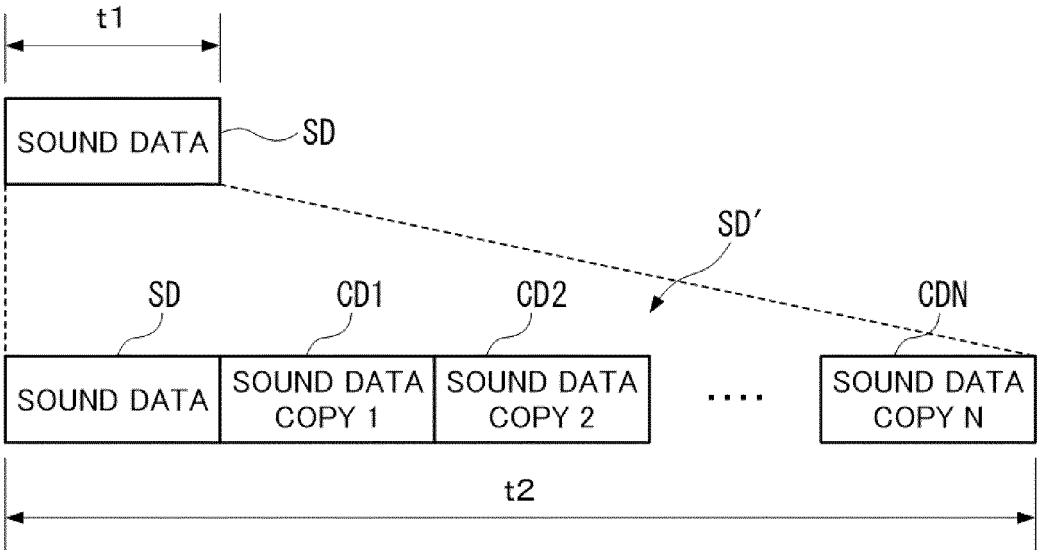

t1
SOUND DATA
SD
SD'
SD
CD1
CD2
CDN
SOUND DATA
SOUND DATA COPY 1
SOUND DATA COPY 2
....
SOUND DATA COPY N
t2

FIG. 3

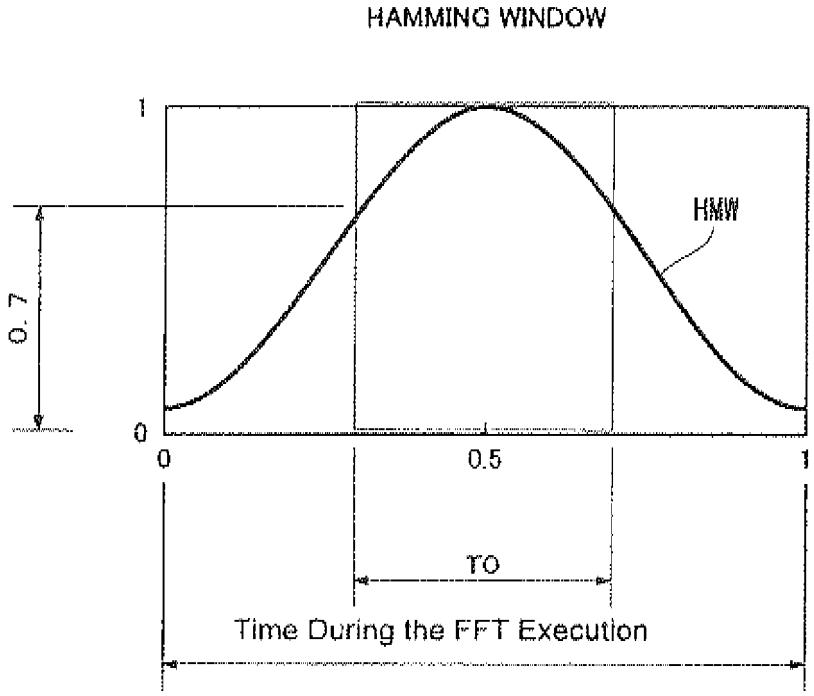

HAMMING WINDOW
1
0.7
0
HMW
0
0.5
1
TO
Time During the FFT Execution

FIG. 4

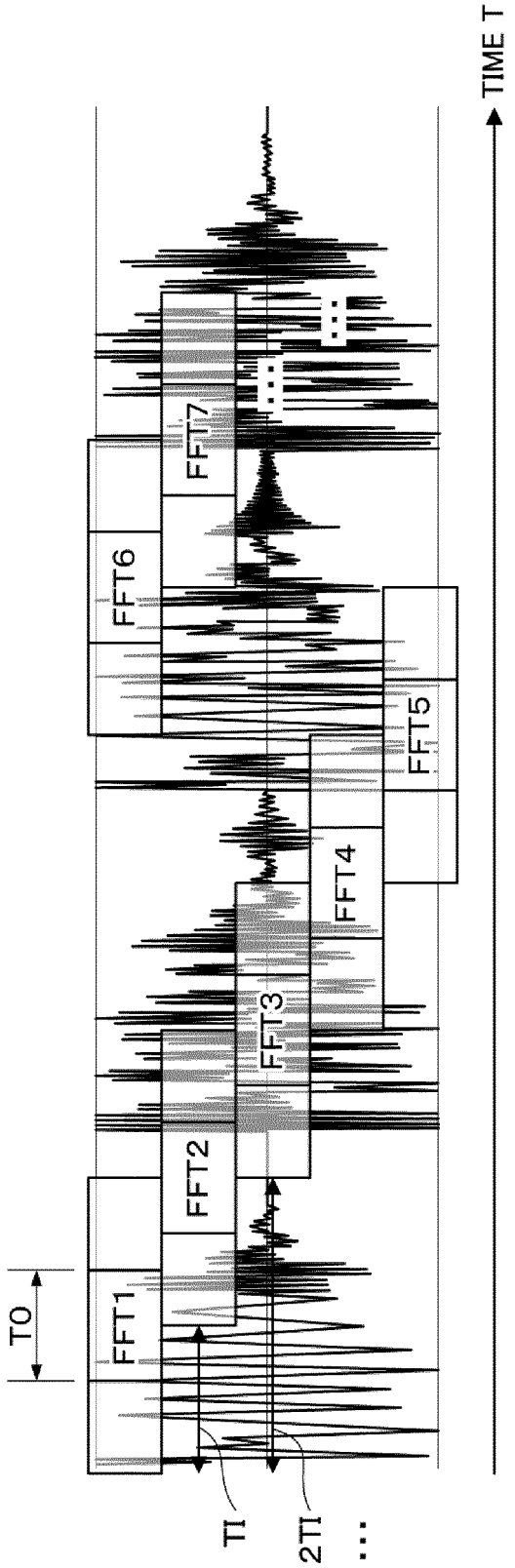


FIG.5

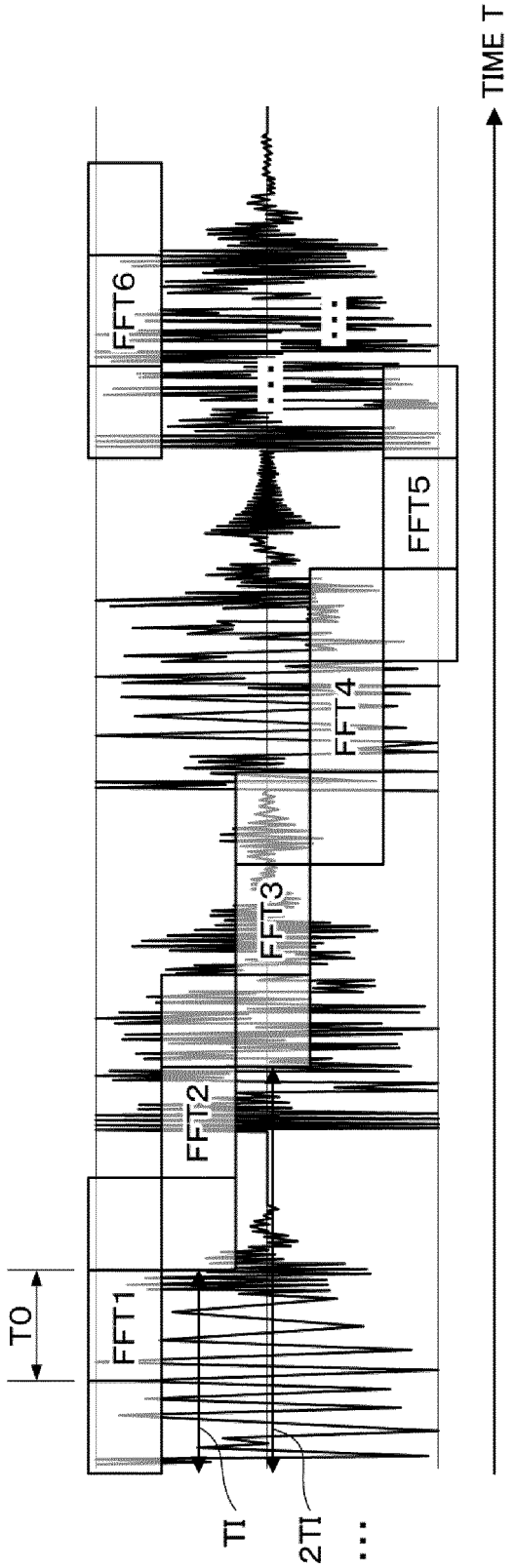


FIG.6

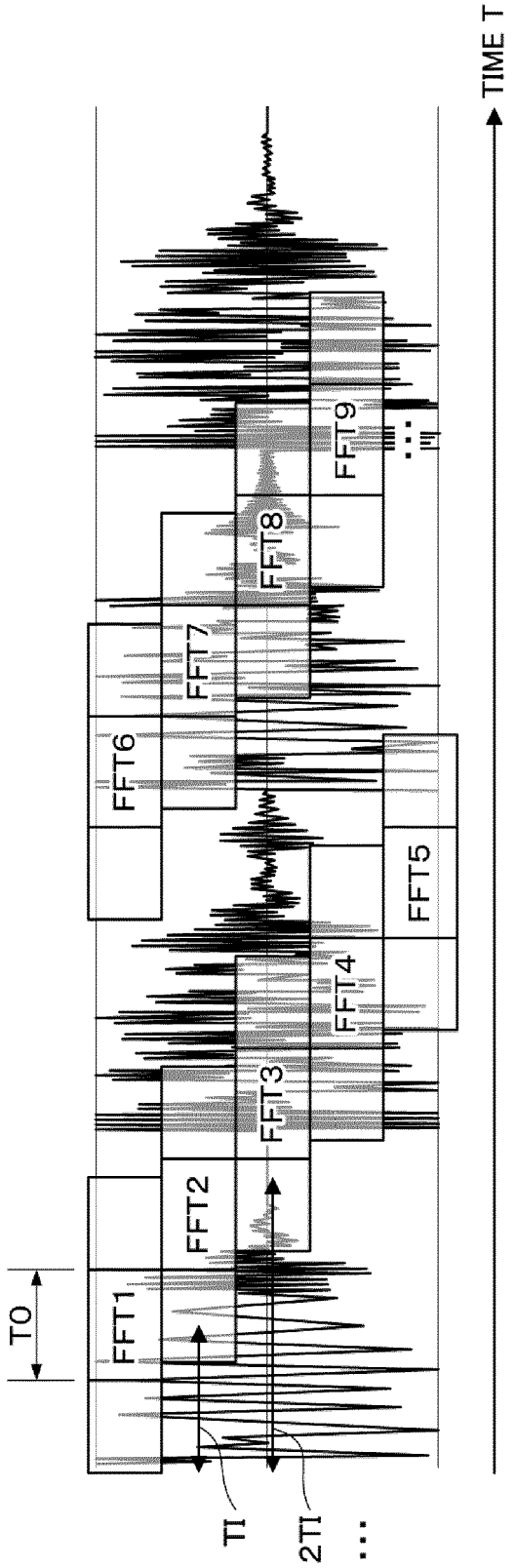


FIG. 7

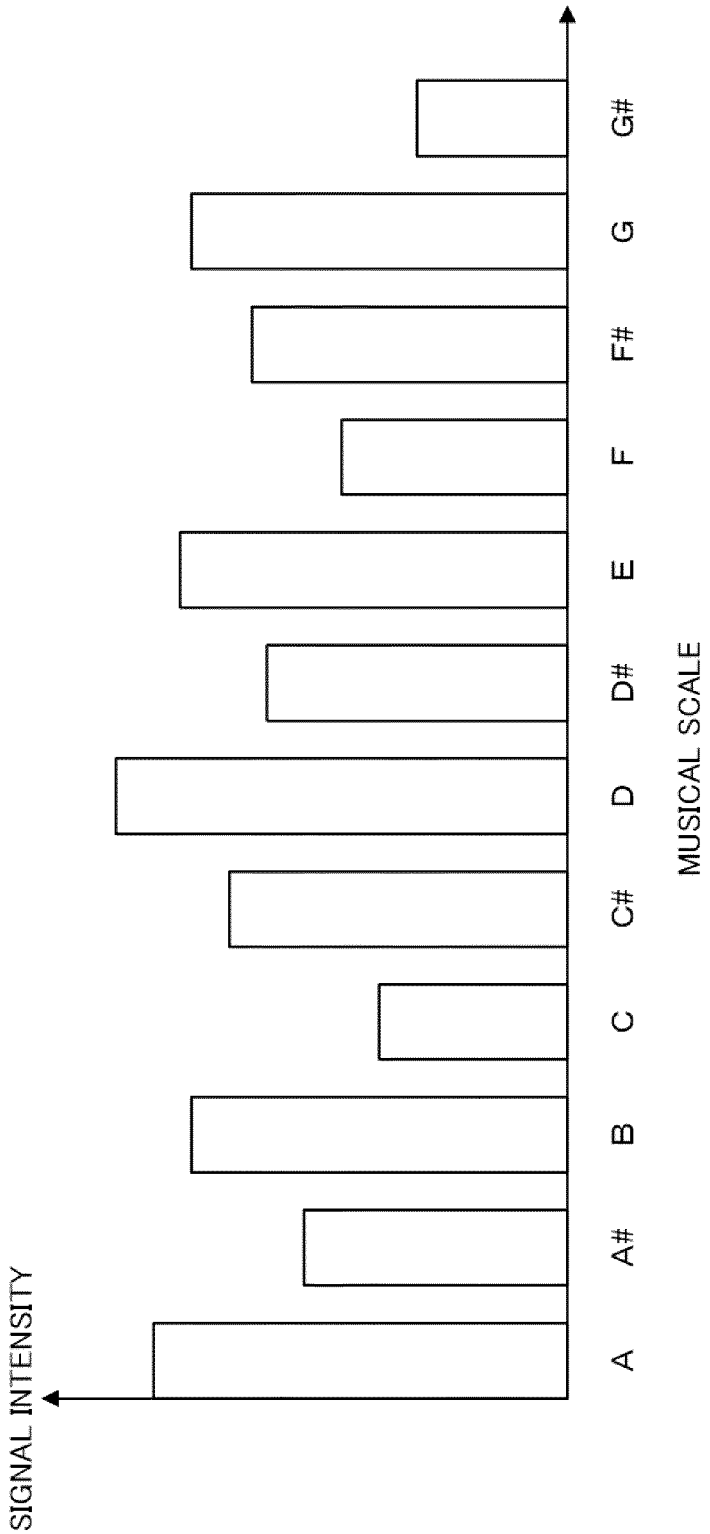


FIG. 8

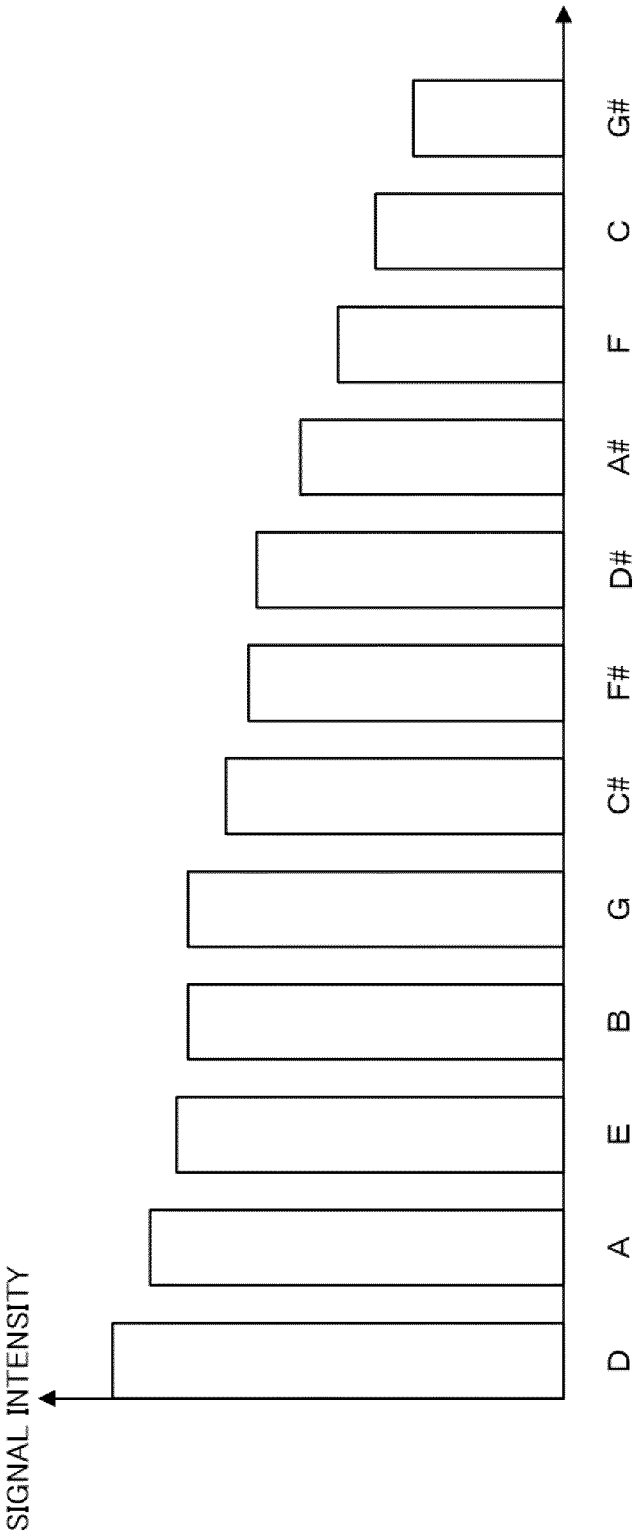
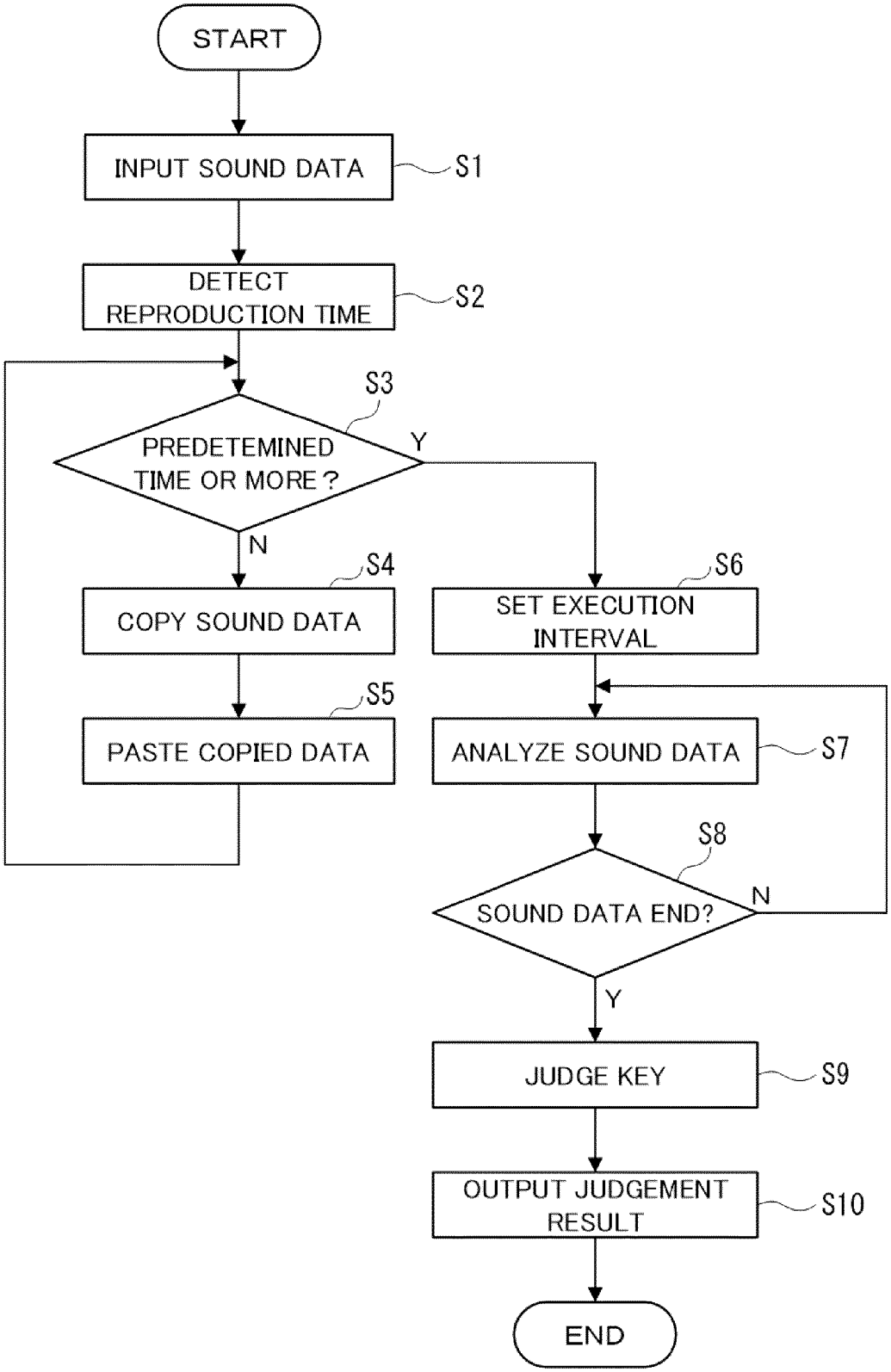


FIG. 9


START
INPUT SOUND DATA
S1
DETECT REPRODUCTION TIME
S2
S3
PREDETEMINED TIME OR MORE ?
Y
N
S4
COPY SOUND DATA
S5
PASTE COPIED DATA
S6
SET EXECUTION INTERVAL
ANALYZE SOUND DATA
S7
S8
SOUND DATA END?
N
Y
JUDGE KEY
S9
OUTPUT JUDGEMENT RESULT
S10
END

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003263170 A **[0006]**
- JP 2007052394 A **[0008]**
- JP 20097084 A **[0009]**

Non-patent literature cited in the description

- **KATY C NOLAND.** *Computational tonality estimation: signal processing and hidden markov models,* 31 March 2009, 1-169 **[0007]**