EUROPEAN PATENT SPECIFICATION

(54) Audio signal processor selectively deriving harmony part from polyphonic parts

Vorrichtung zur Verarbeitung von Audiosignalen, wobei eine harmonische Stimme von polyphonischen Stimmen abgeleitet wird

Processeur de signal audio pour déduire sélectivement une voix harmonique à partir de voix polyphoniques

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(73) Proprietor: YAMAHA CORPORATION
Hamamatsu-shi, Shizuoka-ken 430 (JP)

(74) Representative:
Geyer, Ulrich F., Dr. Dipl.-Phys. et al
WAGNER & Geyer,
Patentanwälte,
Gewürzmühlstrasse 5
80538 München (DE)

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Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to an audio signal processor which introduces a harmony voice signal to a melody audio signal such as a singing voice signal, and more particularly relates to an audio signal processor which adds a harmony voice signal selectively to a singing voice signal having a particular melody among a plurality of concurrently input melody voice signals.

[0002] In the prior art, to cheer up karaoke singing, there is known a karaoke apparatus which creates harmony voices, for example, third degree higher than the singing voice of a karaoke singer, and which reproduces the harmony voices together with the original singing voice. Generally, such a harmonizing function of the karaoke apparatus is achieved by shifting a pitch of the singing voice signal to generate the harmony voice signal.

[0003] Karaoke songs available by the karaoke apparatus may contain duet songs which are composed of a multiple of melodic parts and which are sung by multiple (two) singers. In performance of the duet song, two singing voices are input to the karaoke apparatus at the same time, and the conventional karaoke apparatus having the harmonizing function adds harmonies to all of the input singing voice signals, so that the multiple parts of the reproduced song interfere with each other and tend to be inarticulate, resulting in disturbing the duet singing voice rather than cheering up the karaoke singing performance.


SUMMARY OF THE INVENTION

[0005] The purpose of the present invention is to provide a karaoke apparatus, which can extract a particular part from an input polyphonic audio signal and which selectively creates a harmony audio signal to the particular part, even if multiple singing voices are input.

[0006] According to the present invention, an audio signal processor comprises an input device that inputs a polyphonic audio signal containing a plurality of melodic parts which includes a music composition, a detecting device that detects a predetermined one of the plurality of the melodic parts contained in the input polyphonic audio signal, an extracting device that extracts the detected melodic part from the input polyphonic audio signal, a harmony generating device that shifts a pitch of the extracted melodic part to generate a harmony audio signal representative of an additional harmony part, and an output device that mixes the generated harmony audio signal to the input polyphonic audio signal so as to sound the music composition which contains the additional harmony part derived from the predetermined one of the melodic parts. In a specific form, the input device inputs a polyphonic audio signal containing a principal melodic part and a non-principal melodic part, and the detecting device specifically detects the principal melodic part, so that the additional harmony part derived from the principal melodic part is introduced into the sounded musical composition. Otherwise, the input device inputs a polyphonic audio signal containing a principal melodic part and at least one non-principal melodic part, and the detecting device detects the non-principal melodic part.

[0007] The audio signal processor according to the present invention operates as described below. First of all, the polyphonic audio signal is input through the audio signal input device. For instance, the audio signal processor can be applied to a karaoke apparatus, and the audio signal input device may be pickup devices such as microphones for karaoke singers, and an amplifier to amplify the microphone outputs. The particular part detecting device detects an audio signal component corresponding to a particular melodic part among the input multiple melodic parts. The particular part may be one of the main or principal melody part, harmony part, call-and-response part, for instance. The particular part can be detected according to memorized information indicative of a pattern the particular part. The particular part is detected when the same coincides with the memorized information. Alternatively, a particular part conforming a given rule can be detected. For example, the rule is such that the highest note may be presumably the main melody part to be detected as the particular melodic part. The detected audio signal component corresponding to the particular part is extracted from the input polyphonic audio signal. The particular part audio signal component can be extracted by selecting one of input channels through which the particular part audio signal is input, if the polyphonic audio signal is collectively input through the independent input channels such as a plurality of separate microphones. Otherwise, frequency components corresponding to fundamental frequencies of the particular part is separated from the polyphonic audio signal by filtering if the polyphonic audio signal is input through a common input channel such as a single pickup device or microphone. The pitch of the extracted particular melodic part is shifted in order to generate the harmony audio signal. The pitch can be shifted by simply changing a clock to read out the digitized and temporarily stored audio signal component of the particular melodic part. Otherwise, the harmony audio signal can be generated by shifting frequency components of the sound the particular part without altering a formant thereof. The generated harmony audio signal is mixed with the input polyphonic audio signal to thereby reproduce the composite audio signal accompanied with colorful harmonies.
DESCRIPTION OF EMBODIMENTS

[0005] A karaoke apparatus, as an embodiment of the present invention, will be described referring to the drawings. The karaoke apparatus is structured in the form of a sound source karaoke apparatus. The sound source karaoke apparatus generates karaoke sound by driving a sound source device according to karaoke song data. The song data is a sequence data composed of parallel tracks which record performance data sequences, including pitch and timing of playing notes etc. The karaoke apparatus has a harmonizing function to create harmony voices having third or fifth degree of pitch difference relative to the original voice signal of the karaoke singer. The harmony voices are generated and reproduced by shifting the pitch of the voice signal of the karaoke singer. Further, even in the duet song performance where two singers separately sing two melody parts, the apparatus can detect a main or principal melody part, and create an additional harmony part only for the detected main melody part.

[0006] Figure 1 shows an audio signal processor included in a karaoke apparatus for generating a karaoke accompaniment sound and for processing the singing voice of the karaoke singer. On the other hand, a display controller for lyric words or background image, a song request controller and other components are not shown because they have conventional structures of the prior art. The song data used to perform a karaoke song is stored in a HDD 15. The HDD 15 stores several thousands of song data files. By choosing a desired title by a song selector, a sequencer 14 reads out the selected song data. The sequencer 14 is provided with a memory to temporarily store the read out song data, and a sequence program processor to sequentially read out the data from the memory. The read out data is subjected to predetermined processes a track by track basis.

[0017] Figures 2A and 2B show configuration of the song data. In Figure 2A, the song data includes a header containing the title and genre of the song, followed by an instrument sound track, a main melody track, a harmony track, a lyric track, a voice track, an effect track, and a voice data block. The main melody track is comprised of a sequence of event data and duration data \( \Delta t \) specifying an interval between adjacent events as shown in Figure 2B. The sequencer 14 counts the duration data \( \Delta t \) with a predetermined tempo clock. After counting up the duration data \( \Delta t \), the sequencer 14 reads out a next event data. The event data of the main melody track is distributed to a main melody detector 23 to select or detect a main melody part contained in the polyphonic audio signal input by a plurality of the karaoke players. Namely, the event data of the main melody data is utilized as particular part information to detect a particular part such as the main or principal melodic part.

[0018] As for the remaining tracks other than the main melody track, namely the instrumental sound track, harmony track, lyric track, voice track, and effect track are composed, similarly to the main melody track, of a sequence of event data and duration data. The instrumental sound track comprises multiple subtracks such as instrumental melody tracks of the karaoke accompaniment, rhythm tracks, and chord tracks.

[0019] In the karaoke performance, the sequencer 14 reads out the event data from the instrumental sound track and sends the event data to a sound source 16. The sound source 16 generates musical accompaniment sound according to the event data. The lyric track is a sequence track to display lyrics on a monitor. The sequencer 14 reads out the event data from the lyric track, and sends the data to a display controller. The display controller controls the lyric display according to the event data. The voice track is a sequence track to specify generation timings of a human voice such as a backing chorus and a call-and-response chorus, which are hard to synthesize by the sound source 16. The chorus voice signal is recorded as a multiple of voice data in the voice data block. In the karaoke performance, the sequencer 14 reads out the event data from the voice data track. The voice data specified by the event data is sent to an adder 28. The effect track is a sequence track to control an effector composed of a DSP included in the sound source 16. The effector imparts sound effects such as reverb to an input signal. The effect event data is fed to the sound source 16. The sound source 16 generates the instrumental sound signal having specified tones, pitches and volumes according to the event data of the instrumental sound track received from the sequencer 14. The generated instrumental sound signal is fed to the adder 28 in a DSP 13.

[0020] The karaoke apparatus is provided with an input device or pickup device in the form of a single or common microphone 10. When a pair of singers sing in duet song performance, the two singing voices are
picked up through the single microphone 10. The polyphonic audio signal of the singing voices picked up by the microphone 10 is amplified by an amplifier 11, and is then converted into a digital signal by an ADC 12. The digitally converted audio signal is fed to the DSP 13. The DSP 13 stores microprograms to carry out various functions schematically shown as blocks in Figure 1, and executes the microprograms to carry out all the functions shown as the blocks within each sampling cycle of the digital audio signal.

[0021] In Figure 1, the digital signal input via the ADC 12 is fed to those of an autocorrelation analyzer 21 and delays 24 and 27. The autocorrelation analyzer 21 analyzes a cycle of a maximal value or peak of the input polyphonic audio signal, and detects a fundamental frequency of the singing voices of the multiple karaoke singers.

[0022] A basic principle of the detection of the fundamental frequency is schematically illustrated in Figures 7A-7C. Figure 7C shows a waveform of the input polyphonic audio signal, while Figures 7A and 7B show waveforms of two frequency components contained in the input polyphonic audio signal. The first component shown in Figure 7A has a longer period A, while the second component shown in Figure 7B has a shorter period B. For example, the period B is two-thirds of the period A. Every peak or maximal value of the input polyphonic audio signal is detected so that the shorter period B of the second frequency component is determined as a time interval between first and second peaks of the input polyphonic audio signal. A third peak of the input polyphonic audio signal falls inbetween the period B. Thus, the third peak is discriminated from the peaks of the second frequency component, and is determined to belong to the first frequency component. Consequently, the longer period A of the first frequency component is determined as a time interval between the first and third peaks. The fundamental frequency is given by reciprocal of the detected period.

[0023] Figure 3 shows a method of the autocorrelation analysis carried out by the autocorrelation analyzer 21. The theory of the autocorrelation analysis is known in the art, and therefore its computation details are omitted. Since the autocorrelation function of a periodic signal (i.e., the input polyphonic audio signal) is also a periodic signal having the same period as the original, the autocorrelation function of the signal having a sampling period P reaches a maximal value at 0, ± P, ± 2P ... samples regardless of the time origin of the signal. This period P corresponds the periods A and B shown in Figures 7A and 7B. Thus, the period of the signal can be estimated by searching the first maximal value of the autocorrelation function. In Figure 3, the maximal values appear at plural points, each of which is not at the whole or integer number ratio, hence it can be seen that these values correspond respectively to different periods of the singing voices of the two singers having the different frequency distributions. Thus, the fundamental frequencies of the singing voices can be detected separately for the pair of the karaoke players. The autocorrelation analyzer 21 sends the detected fundamental frequency information to those of a singing voice analyzer 22 and a main melody detector 23. As a voiced sound contained in the singing voice has a periodic waveform while a breathed sound has a noise-like waveform, the voiced and breathed sounds can be discriminated from each other by the autocorrelation analyzer 21. The result of the voiced/breathed sound detection is fed to the singing voice analyzer 22.

[0024] The main melody detector 23 detects which of the fundamental frequencies contained in the polyphonic audio signal input from the autocorrelation analyzer 21 corresponds to the singing voice of the main melody part according to the main melody information (the event data of the main melody track) input from the sequencer 14. The detection result is provided to a main melody extractor 25.

[0025] The singing voice analyzer 22 analyzes a state of the singing performance according to the analysis information including the fundamental frequency data input from the autocorrelation analyzer 21. The state of the singing performance represents whether the number of the active singer is 0 (no voice period such as interlude), 1 (solo verse or call-and-response period), or 2 or more (duet singing period). The singing voice analyzer 22 detects the state of the singing performance, and further detects whether the singing voice of a non-principal melodic part other than the principal melodic part harmonizes with the principal melodic part if multiple singers are concurrently singing. Such a detection is conducted based on the harmony information (the event data of the harmony track) input from the sequencer 14. The singing voice analyzer 22 detects also whether the singing voice of the principal or main melody part is currently in a voiced vowel period or breathed consonant period.

[0026] The singing voice analyzer 22 controls the operation of the main melody detector 23 and the main melody extractor 25 according to the result of analysis. If the detected state of the singing performance indicates a no voice period, the main melody detector 23 and the main melody extractor 25 are disabled in the no voice period, because the main melody part detection and the main melody part extraction are not required. If one of the two singers sings the main melody part while the other sings its harmony part, the main melody extractor 25 is disabled, because no harmony voice should be generated to avoid overlapping with the live harmony part. Disabling of the main melody extractor 25 makes a pitch shifter 26 to stop its harmony sound generation.

[0027] Alternatively, if one of the two singers sings the main melody part while the other sings its harmony part, it is possible to shift the pitch of the main melody part to a certain degree higher or lower from the harmony part performed by the other singer. For instance, if the other singer sings third degrees higher than the main melody
part, the pitch shifter 26 may shift the pitch of the main melody part fifth degrees up to thereby create another harmony part different from the live harmony part performed by the other singer.

[0028] Further, if it is detected that only one of the two singers is singing, the main melody detector 23 is disabled, because the sung part is definitely the main melody part. The main melody extractor 25 is commanded to skip or pass the input singing voice audio signal as it is. Thus, the solo singer's voice is sent to the pitch shifter 26 directly from the delay 24.

[0029] The algorithm of the main melody extractor 25 is changed depending on whether the main melody voice falls in a voiced or breathed sound period. If the voice signal of the main melody is of a voiced vowel sound, the voice signal has a relatively simple composition of harmonics of the fundamental tone (frequency), so that the extraction of the main melody part is carried out by filtering the harmonics of the composition. On the other hand, if the voice signal of the main melody is of a breathed consonant sound, the main melody part is extracted by a method different from that applied to the extraction of the breathed sound signal, because the voiced sound contains a lot of non-linear noise components.

[0030] The voice signal of the main melody extracted by the main melody extractor 25, or the solo singer's voice signal skipped through the main melody extractor 25 is fed to the pitch shifter 26. The pitch shifter 26 shifts the pitch of the input signal according to the harmony information provided from the sequencer 14, and the resulted signal is fed to the adder 28. The pitch shifter 26 reserves a formant (an envelope of the frequency spectrum) of the signal input from the preceding stage, and shifts only the frequency components covered by the formant. The level of each pitch-shifted component is adjusted so that it coincides with the envelope of the frequency spectrum as shown in Figure 4. Thus, only the pitch (frequency) is shifted without changing the tone of the voice.

[0031] In Figure 1, the adder 28 receives the thus generated harmony voice signal, as well as the karaoke accomplishment signal, the chorus signal directly input from the sequencer 14, and the singing voice signal directly input through the ADC 12 and the delay 27. The adder 28 mixes these singing voice signal, harmony voice signal, karaoke accomplishment signal, and chorus sound signal to synthesize a stereo audio signal. The mixed audio signal is distributed by the DSP 13 to a DAC 17. The DAC 17 converts the input digital stereo signal into an analog signal, and send it to an amplifier 18. The amplifier 18 amplifies the input analog signal and the amplified signal is reproduced through a loudspeaker 19. The two delays 24 and 27 are suitably inserted among the blocks in DSP 13 in order to compensate a signal delay created in the autocorrelation analyzer 21, the main melody detector 23 and so on. Thus, the karaoke apparatus analyzes the polyphonic audio signal of the singing voice input through the single microphone 10, detects which of the multi-part (two part) singing voices corresponds to the main melody part, and creates a harmony part selectively for the singing voice corresponding to the main melody part, so that only the main melody is added with the harmony even in a duet karaoke song performance.

[0032] Figure 5 is a schematic block diagram of the karaoke apparatus as another embodiment of the present invention. The difference between the karaoke apparatus shown in Figure 1 (the first embodiment) and the Figure 5 embodiment is that the apparatus shown in Figure 5 is provided with a multiple (two in Figure 5) of microphones for each of the karaoke singers. Each singing voice signal of the singer is separately or independently fed to a DSP 36. In Figure 5, the same reference numerals are attached to the blocks of the memory, its readout device for the karaoke song data, and the signal processing system of the audio signal after the singing voice signal and the karaoke accompaniment signal are mixed with each other. The explanation for them will be abridged hereunder, because they are the same as those in the first embodiment.

[0033] The outputs from the two microphones 30, 31 for duet singing are respectively amplified by amplifiers 32 and 33, and are then converted into digital signals by ADCs 34 and 35 before they are input to a DSP 36. In a DSP 36, a first singing voice signal input via the microphones 30 is fed to an autocorrelation analyzer 41 and to a delay 44 and an adder 47. A second singing voice signal input via the microphone 31 is fed to an autocorrelation analyzer 42 and to the delay 44 and the adder 47. The autocorrelation analyzers 41 and 42 respectively analyze the fundamental frequencies of the first and second singing voice signals. In this arrangement, the autocorrelation analyzers 41 and 42 need not separate the pair of the singing voices from each other to analyze the fundamental frequency. The result of the analysis is sent to a singing voice analyzer 43. The singing voice analyzer 43 checks or detects as to the number of singers, the main melody, and the harmony according to the input fundamental frequencies of the two singing voice signals, and the information relating to the main melody and the harmony melody input from the sequencer 14. Namely, the singing voice analyzer 43 detects if two singers are singing in duet, which singer is singing the main melody part in case of the duet singing, and if one voice signal harmonizes with the other. If the main melody part is detected, a corresponding select signal is fed to a selector 45. The selector 45 switches the signal path so that the singing voice signal detected as the main melody part is distributed to a pitch shifter 46. The pitch shifter 46 shifts the pitch of the input audio signal according to the harmony information input from the sequencer 14 for harmony voice generation. The harmony information is designed to determine a pitch shift amount of the main melody to create the corresponding harmony melody.
The harmony voice signal is fed to an adder 49. The adder 49 receives the harmony voice signal, as well as the karaoke accompaniment signal from the sound source 16, the chorus signal directly input from the sequencer 14, and the singing voice signal directly input through the ADCs 34 and 35, the adder 47 and a delay 48. The adder 49 mixes these singing voice signal, harmony voice signal, karaoke accompaniment signal, and chorus signal to create a stereo audio signal. The mixed audio signal is distributed by the DSP 36 to a DAC 17. In the embodiment described above, only the singing voice signal corresponding to the main melody part in a duet song is harmonized. However, it is possible to create a harmony selectively to a non-principal melody part other than the principal or main melody part, for example a call-and-response part. Further, it is possible to create harmonies to both of the principal melody part and the non-principal melody part. For instance, in the apparatus shown in Figure 5, a preferred or desired part may be selected and extracted for the harmony generation, with arranging the selector 45 switchable to the preferred part (the main melody part or the other part), and with distributing harmony information of the main melody part or the other part to the pitch shifter 46 in matching with the state of the selector 45.

Figure 6 shows an embodiment in which multiple singing voice signals are input to a single pickup device. In Figure 6, the same reference numerals are attached to the same elements as those in Figure 1, and the explanation thereof will be abridged hereunder. In this embodiment, the song data stored in the sequencer 14 contains a particular part track instead of the main melody track. A particular part detector 53 receives event data of the particular part track from the sequencer 14, and detects which of fundamental frequencies contained in the polyphonic audio signal from the autocorrelation analyzer 21 corresponds to the particular part. The result of the detection is entered to a particular part extractor 55. The particular part extractor 55 extracts the frequency component corresponding to the particular part from the polyphonic audio signal. The extracted component of the particular part is sent to the pitch shifter 26. The pitch shifter 26 shifts the pitch of the input signal to enrich the sound of the particular part. As described above, according to the present invention, even if multiple parts of audio signals are input, a particular part audio signal such as the main melody part can be detected and extracted from the input signals, in order to selectively create a harmony audio signal for the extracted audio signal, so that even in the polyphonic audio signal input, only the harmony voice derived from the particular part can be introduced and the karaoke performance can be cheered up much. Further, since the main melody is detected out of the polyphonic audio signal, the main melody can be extracted out of the singing voices even if a multiple of singers exchange their parts each other.

Claims

1. An audio signal processor (13) comprising:
   an input device (10, 11, 12) that inputs a polyphonic audio signal containing a plurality of melodic parts which constitute a music composition;
   a detecting device (21, 22, 23) that detects a predetermined one of the plurality of the melodic parts contained in the input polyphonic audio signal;
   an extracting device (25) that extracts the detected melodic part from the input polyphonic audio signal;
   a harmony generating device (26) that shifts a pitch of the extracted melodic part to generate a harmony audio signal representative of an additional harmony part; and
   an output device (28) that mixes the generated harmony audio signal to the input polyphonic audio signal so as to sound the music composition which contains the additional harmony part derived from the predetermined one of the melodic parts.

2. An audio signal processor (13) according to claim 1, wherein the input device (10, 11, 12) inputs a polyphonic audio signal containing a principal melodic part and a non-principal melodic part, and wherein the detecting device (21, 22, 23) specifically detects the principal melodic part, so that the additional harmony part derived from the principal melodic part is introduced into the sounded musical composition.

3. An audio signal processor (13) according to claim 2, further comprising a harmony check device that detects when the non-principal melodic part coincides with a pattern of the additional harmony part derived from the principal melodic part, and a disabling device that disables the harmony generating device in response to the harmony detecting device to thereby inhibit generation of the additional harmony part which would overlap with the non-principal melodic part.

4. An audio signal processor (13) according to claim 1, wherein the input device (10, 11, 12) inputs a polyphonic audio signal containing a principal melodic part and at least one non-principal melodic part, and wherein the detecting device (21, 22, 23) detects the non-principal melodic part.

5. An audio signal processor (13) according to claim 1, wherein the input device (10, 11, 12) comprises a single pickup device that concurrently picks up multiple sounds of the plurality of the melodic parts performed in parallel to each other to thereby input
the polyphonic audio signal containing the plurality of the melodic parts.

6. An audio signal processor (13) according to claim 5, wherein the extracting device (25) filters the polyphonic audio signal input by the single pickup device to separate therefrom a frequency component corresponding to the detected melodic part.

7. An audio signal processor (13) according to claim 1, wherein the detecting device (21, 22, 23) comprises an analyzing device that analyzes the input polyphonic audio signal to detect therefrom a plurality of fundamental frequencies corresponding to the plurality of the melodic parts, and a selecting device that compares the plurality of the fundamental frequencies with provisionally memorized particular part information so as to select the particular one of the melodic parts which coincides with the particular part information.

8. An audio signal processor (13) according to claim 1, wherein the harmony generating device (26) shifts a pitch of the extracted melodic part to generate a harmony audio signal representative of an additional harmony part.

9. An audio signal processor (13) according to claim 8, further comprising a harmony detecting device that detects when one of the melodic parts other than the particular melodic part coincides with the harmony information, and a disabling device that disables the harmony generating device in response to the harmony detecting device to thereby inhibit creation of the additional harmony part which would overlap with said one of the melodic parts.

10. A harmony creating method comprising the steps of:

   - inputting a polyphonic audio signal (10, 11, 12) containing a plurality of melodic parts which constitute a music composition;
   - detecting a predetermined one of the plurality of the melodic parts (21, 22, 23) contained in the input polyphonic audio signal;
   - extracting the detected melodic part from the input polyphonic audio signal (25);
   - shifting a pitch of the extracted melodic part (26) to generate a harmony audio signal representative of an additional harmony part; and
   - mixing the generated harmony audio signal to the input polyphonic audio signal (28) so as to sound the music composition which contains the additional harmony part derived from the predetermined one of the melodic parts.

Patentansprüche

1. Audiosignalprozessor (13) mit einer Eingabeeinrichtung (10, 11, 12), die eine polyphones Audiosignal eingibt, welches eine Vielzahl Melodie-Parts bzw. Melodie-Teile enthält, die eine Musikkomposition bilden; eine Detektiereinrichtung (21, 22, 23), die einen vorbestimmten Teil aus der Vielzahl von Melodie-Teilen detektiert, die in dem eingegebenen polyphonen Audiosignal enthalten sind; eine Herauszieheinrichtung (25), die den detektierten Melodie-Teil aus dem eingegebenen polyphonen Audiosignal herauszieht; eine Harmonie-Erzeugungseinrichtung (26), die die Tonhöhe des herausgezogenen Melodie-Teils verändert, um ein Harmonie-Audiosignal zu erzeugen, das repräsentativ ist für einen zusätzlichen Harmonie-Part bzw. -Teil; und eine AusgabeEinrichtung (28), die das erzeugte Harmonie-Audiosignal zu dem eingegebenen polyphonen Audiosignal mischt, um die Musikkomposition erklingen zu lassen, die den zusätzlichen Harmonie-Teil enthält, welcher von dem vorbestimmten Melodie-Teil abgeleitet wurde.


5. Audiosignalprozessor (13) gemäß Anspruch 1, wo-
bei die Eingabeeinrichtung (10, 11, 12) eine einige 
Aufnahmeeinrichtung aufweist, die gleichzeitig 
mehrere, parallel zueinander gespielte bzw. vorge-
brachte Töne bzw. Klänge der Vielzahl von Melodie-
teilen aufnimmt, um dadurch das polyphone Audio-
signal einzugeben, welches die Vielzahl von Melo-
die-Teilen enthält.

6. Audiosignalprozessor (13) gemäß Anspruch 5, wo-
bei die Herauszieheinrichtung (25) das von der ein-
zigen Aufnahmevorrichtung aufgenommene poly-
phone Audiosignal filtert, um eine Frequenzkompo-
mente entsprechend dem detektierten Melodie-Teil 
davon zu trennen.

7. Audiosignalprozessor (13) gemäß Anspruch 1, wo-
bei die Detektiereinrichtung (21, 22, 23) eine Ana-
lyseeinrichtung, die das eingegebene polyphone 
Audiosignal analysiert, um daraus eine Vielzahl von 
Grundfrequenzen entsprechend der Vielzahl von 
Melodie-Teilen zu detektieren, und eine Auswahl-
einrichtung aufweist, welche die Vielzahl von 
Grundfrequenzen mit vorläufig gespeicherter Infor-
mation eines bestimmten Teils vergleicht, um den 
den besten Melodie-Teil auszuwählen, der mit der 
Information des bestimmten Teils übereinstimmt.

8. Audiosignalprozessor (13) gemäß Anspruch 1, wo-
bei die Harmonie-Erzeugungsvorrichtung (26) die 
Tonhöhe des herausgezogenen Melodie-Teils ver-
ändert, um den zusätzlichen Harmonie-Teil zu er-
zehen, und zwar gemäß der vorläufig gespeicher-
ten Harmonie-Information, die eine Tonhöhendiffe-
renz zwischen dem bestimmten Melodie-Teil und 
dem zusätzlichen Harmonie-Teil bezeichnet bzw.
bestimmt.

9. Audiosignalprozessor (13) gemäß Anspruch 8, wo-
bei ferner folgendes vorgesehen ist: eine Harmo-
nie-Detektiervorrichtung, die detektiert, wenn ein 
anderer als der bestimmte Melodie-Teil mit der Har-
monie-Information zusammenfällt, und eine Sperr-
einrichtung, die die Harmonie-Erzeugungseinrich-
tung anspricht, um dadurch Erzeugung des zusätz-
lchen Harmonie-Teils zu verhindern, der sich mit 
dem erwähnten Melodie-Teil überschneiden würde.

10. Harmonie-Erzeugungsverfahren, das die folgen-
den Schritte aufweist:

   Eingebung eines polyphonen Audiosignals 
   (10, 11, 12), welches eine Vielzahl Melodie-
Parts bzw. Melodie-Teile enthält, die eine Mu-
sikkomposition bilden;
   Detektieren eines vorbestimmten Teils aus der 
   Vielzahl von Melodie-Teilen (21, 22, 23), die in
dem eingegebenen polyphonen Audiosignal 
enthalten sind;
   Herausziehen des detektierten Melodie-Teils 
aus dem eingegebenen polyphonen Audiosi-
gnal (25);
   Verändern der Tonhöhe des herausgezogenen 
Melodie-Teils (26), um ein Harmonie-Audiosi-
gnal zu erzeugen, das repräsentativ ist für ei-
nen zusätzlichen Harmonie-Part bzw. -Teil; und 
Mischen des erzeugten Harmonie-Audiosi-
gnals zu dem eingegebenen polyphonen Au-
diosignal (28), um die Musikkomposition erklrin-
gen zu lassen, die den zusätzlichen Harmonie-
Teil enthält, welcher von dem vorbestimmten 
Melodie-Teil abgeleitet wurde.

Revendications

1. Processeur de signaux audio (13) comprenant :
   un dispositif d'entrée (10, 11, 12) qui introduit 
   un signal audio polyphonique contenant une 
   pluralité de parties mélodiques qui constituent 
   une composition musicale ;
   un dispositif de détection (21, 22, 23) qui dé-
tecte l'une prédéterminée de la pluralité de par-
ties mélodiques contenues dans le signal audio 
   polyphonique d'entrée ;
   un dispositif d'extraction (25) qui extrait la partie 
   mélodique détectée du signal audio polyphonique 
   d'entrée ;
   un dispositif de production (26) d'harmonie qui 
   décale un accord de la partie mélodique extrai-
te pour produire un signal audio d'harmonie re-
présentatif d'une partie d'harmonie supplemen-
taire ; et 
   un dispositif de sortie (28) qui mélique le signal 
   audio d'harmonie produit au signal audio poly-
phonique d'entrée de façon à restituer la com-
position musicale qui contient la partie d'har-
monie supplémentaire obtenue à partir de l'une 
   prédéterminée des parties mélodiques.

2. Processeur de signaux audio (13) selon la revendi-
cation 1, dans lequel le dispositif d'entrée (10, 11, 
12) introduit un signal audio polyphonique conte-
nant une partie mélodique principale et une partie 
mélodique non principale, et dans lequel le dispo-
sitif de détection (21, 22, 23) détecte spécifique-
ment la partie mélodique principale, de sorte que 
de partie d'harmonie supplémentaire obtenue à partir 
de la partie mélodique principale est introduite dans 
de la composition musicale restituée.

3. Processeur de signaux audio (13) selon la revendi-
cation 2, comprenant en outre un dispositif de vérifi-
cation d'harmonie qui détecte quand la partie mé-
lodique non principale coïncide avec un motif de la partie d'harmonie supplémentaire obtenue à partir de la partie mélodique principale, et un dispositif d'invalidation qui invalide le dispositif de production d'harmonie en réponse au dispositif de détection d'harmonie pour inhiber ainsi la production de la partie d'harmonie supplémentaire qui recouvrirait la partie mélodique non principale.

4. Processeur de signaux audio (13) selon la revendication 1, dans lequel le dispositif d'entrée (10, 11, 12) introduit un signal audio polyphonique contenant une partie mélodique principale et au moins une partie mélodique non principale et dans lequel le dispositif de détection (21, 22, 23) détecte la partie mélodique non principale.

5. Processeur de signaux audio (13) selon la revendication 1, dans lequel le dispositif d'entrée (10, 11, 12) comprend un dispositif unique de prise de son qui capte simultanément les nombreux sons de la pluralité de parties mélodiques exécutées en parallèle les unes avec les autres pour acquérir ainsi le signal audio polyphonique contenant la pluralité de parties mélodiques.

6. Processeur de signaux audio (13) selon la revendication 5, dans lequel le dispositif d'extraction (25) filtre le signal audio polyphonique d'entrée par le dispositif de prise de son unique pour en séparer une composante fréquentielle correspondant à la partie mélodique détectée.

7. Processeur de signaux audio (13) selon la revendication 1, dans lequel le dispositif d'analyse qui analyse le signal audio polyphonique d'entrée pour détecter à partir de celui-ci une pluralité de fréquences fondamentales correspondant à la pluralité de parties mélodiques et un dispositif de sélection qui compare la pluralité de fréquences fondamentales à des informations de partie particulière mémorisées au préalable de façon à sélectionner celle particulière des parties mélodiques qui coïncide avec l'information de partie particulière.

8. Processeur de signaux audio (13) selon la revendication 1, dans lequel le dispositif de production d'harmonie (26) décale un accord de la partie mélodique extraite pour créer la partie d'harmonie supplémentaire selon l'information d'harmonie supplémentaire au préalable qui désigne une différence d'accord entre la partie mélodique particulière et la partie d'harmonie supplémentaire.

9. Processeur de signaux audio (13) selon la revendication 8, comprenant en outre un dispositif de détection d'harmonie qui détecte quand l'une des parties mélodiques autre que la partie mélodique particulière coïncide avec l'information d'harmonie et un dispositif d'invalidation qui invalide le dispositif de production d'harmonie en réponse au dispositif de détection d'harmonie pour inhiber ainsi la création de la partie d'harmonie supplémentaire qui recouvrirait ladite une des parties mélodiques.

10. Procédé de création d'harmonie comprenant les étapes suivantes :

- introduire un signal audio polyphonique (10, 11, 12) contenant une pluralité de parties mélodiques qui constituent une composition musicale ;
- détecter l'une prédéterminée de la pluralité de parties mélodiques (21, 22, 23) contenue dans le signal audio polyphonique d'entrée ;
- extraire la partie mélodique détectée du signal audio polyphonique d'entrée (25) ;
- décaler un accord de la partie mélodique extraite (26) pour produire un signal audio d'harmonie représentatif d'une partie d'harmonie supplémentaire ; et
- mélanger le signal audio d'harmonie produit au signal audio polyphonique d'entrée (28) de façon à restituer la composition musicale qui contient la partie d'harmonie supplémentaire obtenue à partir de l'une prédéterminée des parties mélodiques.
FIGURE 2A

<table>
<thead>
<tr>
<th>HEADER</th>
<th>INSTRUMENT SOUND TRACK</th>
<th>VOICE DATA 1</th>
</tr>
</thead>
<tbody>
<tr>
<td>TITLE GENRE</td>
<td>MAIN MELODY TRACK</td>
<td>VOICE DATA 2</td>
</tr>
<tr>
<td>DATE OF RELEASE</td>
<td>HARMONY TRACK</td>
<td></td>
</tr>
<tr>
<td>LENGTH</td>
<td>LYRIC TRACK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>VOICE TRACK</td>
<td></td>
</tr>
<tr>
<td></td>
<td>EFFECT TRACK</td>
<td></td>
</tr>
</tbody>
</table>

FIGURE 2B

Δt EVENT DATA Δt EVENT DATA Δt EVENT DATA Δt EVENT DATA Δt EVENT DATA
FIGURE 3

PEAK CORRESPONDING TO THE PITCH OF THE LOWER MELODY SINGER

AUTOCORRELATION FUNCTION

PERIODIC POSITION CORRESPONDING TO THE MAIN MELODY
(THE PEAK NEAR THIS POINT IS ESTIMATED AS THE MAIN MELODY.)

FIGURE 4

LEVEL

FREQUENCY

LEVEL

FREQUENCY
FIGURE 7A

FIGURE 7B

FIGURE 7C