original signal. When the logarithm value is smaller than the predetermined value, it is decided that the original signal is a no-sound, noises, or a voiceless sound portion corresponding to "p", "t", or the like in a voice. That is, in case of a voiced sound, since it is known that as a sound becomes an harmonic component, its power spectrum exponentially decreases, the sum ratio is equal to almost 0 dB. In case of noises, however, the power spectra are almost uniformly distributed in the whole frequency band and are not deviated in a special frequency band. According to experiments, therefore, when considering the power spectra of, for example, the harmonics of up to fifth degree, the sum ratio is lower than −10 dB.

When the plural pitch frequencies detecting apparatus of the present invention is applied to a purpose for an automatic score making or the like, therefore, so long as it is determined by using the discrimination index that the sum ratio of the power spectra of the original signal is smaller than a predetermined value, it is decided that the original signal is no-sound without estimating the fundamental frequency. By replacing it to data indicative of a rest note corresponding to the no-sound interval, the score can be accurately collected.

There is, however, a case where a discrimination between the noises and the voiceless sound cannot be performed by the discrimination index. For example, therefore, when the plural pitch frequencies detecting apparatus of the invention is applied to an object for an audio sound extraction which is executed to synthesize the audio sounds or the like, in order to prevent that information of the voiceless sound is lost, even if the sum ratio of the power spectra of the original signal is smaller than a predetermined value, the voiceless sound is estimated as one component sound constructing a multi-voice part and is again synthesized together with the harmonics components of the estimated one component sound. In this instance, by using a principle that a discriminating ability of an auditory sense of human being for a voiceless sound is high, the amplitude of the estimated one component sound and the amplitude of the harmonics component are again synthesized in a state in which the amplitude is attenuated into, for example, 1/2, thereby enabling the noises to be suppressed without losing the information of the voiceless sound.

Although the Fourier coefficients have been averaged in the embodiment, it is not always necessary to carry out the averaging process. Namely, by using the Fourier coefficients obtained in either one or steps **S15** and **S16** or either one of steps **S33** and **S34**, the pitch can be estimated to a certain degree. It is, however, preferable to execute the averaging process as shown in the embodiment in dependence on a system to which the invention is applied. In place of the averaging process, another proper process for generating a value correlating two values can be also used. Although the normalizing process is executed in step **S56** in the flows of FIGS. **9**, **10**, and **12**, it is performed to discriminate the maximum value with respect to the ratio for the total level of the energy levels of the components of all of the orthogonal function waves having waveforms each having the same start position and end position as those of the orthogonal function wave corresponding to the fundamental wave that is presumed. Thus it is also possible to replace the normalizing process to another equivalent process.

It will be understood that if an output of the analysis result in the analyzing unit **2** is supplied to the storing unit **4**, the apparatus of the invention can be used as a frequency analyzing apparatus having no function of the pitch frequency estimation. Although all of the components of the harmonics of the fundamental wave are eliminated in step **S62** in FIG. **10**, further, it is also possible to eliminate the components of a predetermined number of harmonics to a certain degree such that the component of the pitch frequency other than the pitch frequency which has already been estimated in step **S61** can be subsequently estimated.

According to the invention as described above, each fundamental frequency can be accurately estimated from the complex sound or the like with a relatively simple construction.

What is claimed is:

1. A frequency analyzing method of analyzing frequency components of an original signal, comprising:

a spectrum detecting step of detecting, from said original signal, energy levels of components of a predetermined number of orthogonal function waves which have waveforms each having a same start position and end position in a predetermined time window and in which the number of occurrences of periods in said predetermined time window or frequencies are different from each other; and

an orthogonal function wave changing step of changing at least one of said start position and said end position in said predetermined time window to change a width of an analysis frame after completion of said spectrum detecting step,

wherein said spectrum detecting step and said orthogonal function wave changing step are alternately repeated.

2. A method according to claim **1**, further having a level correcting step of obtaining a value correlating with two values which are given,

and wherein said spectrum detecting step has a first step of detecting, from said original signal, the energy levels of the components of a predetermined number of orthogonal function waves which have waveforms each having same fixed start position and variable end position in the predetermined time window and in which the number of occurrences of the periods in said predetermined time window or the frequencies are different from each other and a second step of detecting, from said original signal, the energy levels of the components of a predetermined number of orthogonal function waves which have waveforms each having same variable start position and fixed end position in said predetermined time window and in which the number of occurrences of the periods in said predetermined time window or the frequencies are different from each other,

said orthogonal function wave changing step has a step of changing said variable end position in said predetermined time window after completion of said first step and changing said variable start position in said predetermined time window after completion of said second step, and

said level correcting step has a step of calculating a value correlating with the energy level detected by said first step and the energy level detected by said second step with respect to the same orthogonal function wave.

3. A method according to claim **2**, wherein in said level correcting step, an average value of said two values which are given is obtained as a correlating value.

4. A frequency analyzing method of analyzing a frequency on the basis of energy levels of components of a plurality of orthogonal function waves detected from an original signal, comprising:

an operation discriminating step of assuming that one of said orthogonal function waves is set to a fundamental