vibration generating apparatus varied depending on different sound sources. They can be independently controlled in level.

(3) A modified preferred embodiment of the case (2), in which an audible sound and a hypersonic sound or its super-high-frequency components are synthesized on the spot and generated from one vibration generating apparatus.

Next, a fourth implemental example, in which the coexistence of the two effects of a vibration that can introduce the hypersonic effect, i.e., a hypersonic sound is utilized for safety measures, is described below. The following is an implemental example applied to an electric vehicle.

Recently, in place of the gasoline powered vehicles, development of electric vehicles (including hybrid cars, fuel cell powered cars, solar powered cars, etc.) has been rapidly promoted, and they have many advantages that the exhaust is clean and environment friendly, they have no engine noise, and so on. However, there is such an emerging serious problem that the electric vehicles, which use motors producing small noises in place of internal combustion engines that generate blast sounds, have quiet running noises, and therefore, the pedestrians, bicycle riders, car drivers and the like tend to fail in perceiving approaching electric vehicles, increasing the risks of traffic accidents, and urgent countermeasures need to be devised.

Accordingly, measures to generate a sort of sound from the electric vehicles are considered for easy perception of approaching electric vehicles. However, generating a sound at a level perceivable by the pedestrians and the like in the significant background noises on roads inevitably causes the problem of the "unpleasant" and "noisy" reactions.

This problem can be solved by utilizing the coexistence of the two effects of a hypersonic sound that introduce the hypersonic effect and enhances the fundamental brain activity. By generating a hypersonic sound from an electric vehicle **490** or complementing with the super-high-frequency components of the hypersonic sound, the pedestrians' sensibilities to sounds are sensitized, thereby inducing an effect that the sounds generated from electric vehicles can be easily caught even in an environment having significant traffic noises. On the other hand, the reward system of the brain is activated to improve the comfort of the sounds, and the level of the sound generated from the electric vehicle **490** can be raised up to a height sufficient for making a person **488** of the pedestrian or the like recognize the existence and approach of the vehicle and assure his or her safety without causing his or her "unpleasant" and "noisy" reactions. By the coexistence of the two effects, the comfort and safety can be remarkably improved (See FIG. **113**). In FIG. **113**, reference numeral **490** is an electric vehicle, in which a vibration generating apparatus **491** is installed.

A vibration generating apparatus and a sound source for achieving this can be provided by applying the vibration generating apparatuses described in the first to third preferred embodiments of the present application. Moreover, this vibration generating apparatus may be previously incorporated into the vehicle body, tires, window panes and the like or externally attached. Moreover, it is acceptable to generate a hypersonic sound having the predetermined autocorrelation order and contains an audible sound and a super-high-frequency vibration from a single vibration generating apparatus or to generate an audible sound and a super-high-frequency vibration from separate vibration generating apparatuses and make the levels and balances of them freely adjustable. Further, the sound source may be recorded in a recording medium or transmitted by broadcasting or a telecommunication system.

Further, the following advantages are also obtained in this implemental example. By radiating the hypersonic sound generated from the electric vehicle into a space of footways and motorways, the effects of inducing activation of the fundamental brain and the fundamental brain network of the pedestrians, bicycle riders, and the like existing in the space, leading the autonomic neural system, the endocrine system and the immune system responsible for the homeostatic maintenance and biophylaxis of the body to satisfactory states and enhancing comfort can be expected.

Further, by applying this vibration generating apparatus, an individual vehicle discrimination system can be made as follows. That is, in manufacturing an electric vehicle into which the vibration generating apparatus is incorporated, a signal structure having an individual frequency and time structure for each car is added into a vibration signal in the super-high-frequency range that exceeds the audible range upper limit and is not perceivable as a sound generated from it. This becomes a super-high-frequency unperceivable "vibration fingerprint", and it becomes possible to make it bear an individual vehicle identification function.

Then, a "vehicle super-high-frequency vibration fingerprint automatic reading apparatus" that automatically reads the "super-high-frequency vibration fingerprint" of each vehicle passing on a road is installed at each strategic spot on the road. It can be expected to utilize this system as a clue of criminal investigations such as pursuit of wanted vehicles and the like, making good use of it for crime prevention.

Other applications of this effect are shown. By complementing with a hypersonic sound or its super-high-frequency components in an office, the effects of enhancing the sensibility and the degree of awakening to sensory information inputs and improving the comfort, thereby improving the labor effectiveness of work.

By complementing with a hypersonic sound or its super-high-frequency components in houses and facilities where senior citizens reside, there are the effects of enhancing the senior citizens' sensibilities to sensory information inputs. As a result, the effect of preventing dementia is consequently expected, and the effect of heightening the comfort and maintaining and promoting psychosomatic health is provided.

By complementing with a hypersonic sound or its super-high-frequency components in classrooms in classrooms of schools, there are effects of improving the learning effect by enhancing the learners' sensibility to sensory information inputs, alleviating the irritative feelings of students and teachers, reducing school violence, and supporting the healthy growth of children and comfortable school lives.

By complementing with a hypersonic sound or its super-high-frequency components in the working environments of doctors and nurses who work in hospitals and clinics, there are the effects of enhancing the sensibilities to sensory information inputs and alleviating the tiredness and stress, thereby reducing medical errors.

By complementing with a hypersonic sound or its super-high-frequency components in the National Diet Building and other spaces that hold conferences, there are the effects of enhancing the conference attendees' sensibilities to sensory information inputs and alleviating angry feelings and irritative feelings due to conflicts of opinions, thereby reducing futile antagonisms and promoting smooth parliamentary proceedings.

Fifth Preferred Embodiment

A vibration discriminating apparatus and method according to the present invention is characterized by discriminating whether or not a given vibration signal is a vibration, that has components (audible range components) within the range of 20 Hz to 15 kHz or 20 kHz, or the audible frequency range perceivable as a sound by human beings and contains super-high-frequency components within the range exceeding the audible range up to, for example, 1 MHz, discriminating whether or not the given vibration signal has the autocorrelation order represented by the first property, discriminating whether or not the given vibration signal has the autocorrelation order represented by the second property, and discriminating whether or not the given vibration signal has the feature of the vibration signal by colligating the discrimination results by the above-mentioned three means.

An implemental example of the vibration discriminating apparatus and method is described below.

FIG. **87** is a flow chart showing derivation control processing of the fundamental brain activation effect according to the fifth preferred embodiment. That is, FIG. **87** shows the flow chart of a method for discriminating whether or not a given vibration signal is a variation that contains audible range components and super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect.

Referring to FIG. **87**, a vibration signal is first inputted in step S**1**, and the power spectrum of the given vibration signal is calculated in step S**2** by using the FFT method or a power spectrum estimation method using an autocorrelation model such as the maximum entropy method and the Yule-Walker method. Next, it is discriminated in step S**3** whether or not the given vibration signal contains components (hereinafter referred to as audible range components) within the human audible frequency range of not lower than 20 Hz and not higher than 20 kHz based on the obtained power spectrum, and it is judged that it is a vibration signal that cannot solely introduce the fundamental brain activation effect when no audible range components are contained (step S**19**). When the audible range components are contained, it is judged in step S**4** whether or not the vibration signal contains frequency components (hereinafter referred to as super-high-frequency components) that exceeds 20 kHz, or the human audible range upper limit and ranges up to a maximum frequency of, for example, 1 MHz. When no super-high-frequency component is contained, it is judged that it is a vibration that cannot solely introduce the fundamental brain activation effect. When super-high-frequency components are contained, the program flow proceeds to a first property discriminating process (steps S**5** to S**10**) and a second property discriminating process (steps S**11** to S**16**) on the autocorrelation order.

Regarding the first property evaluation on the autocorrelation order, a three-dimensional power spectrum array of the vibration signal is first drawn in step S**5** by using the aforementioned method. Next, the local exponent of fractal dimension of the obtained three-dimensional power spectrum array is obtained in step S**6** by using the aforementioned method, and it is discriminated in step S**7** whether or not the minimum value of the local exponent of fractal dimension is not smaller than 2.2 within a range in which the spectro-temporal index ranges from 2^{-1} to 2^{-5}. When the minimum value of the local exponent of fractal dimension is smaller than 2.2, it is judged that the first property is not satisfied (step S**10**). When the minimum value of the local exponent of fractal dimension is not smaller than 2.2, the program flow proceeds to evaluation of the fluctuation range of the local exponent of fractal dimension. It is judged that the first property is satisfied (step S**9**) when the fluctuation range (absolute value) of the local exponent of fractal dimension is not greater than 0.4 when the spectro-temporal index is within the range of 2^{-1} to 2^{-5} in step S**8**, or it is judged that the first property is not satisfied (step S**10**) when the fluctuation range (absolute value) similarly exceeds 0.4 (step S**10**). Then, the program flow proceeds to step S**17**.

On the other hand, regarding evaluation of the second property on the autocorrelation order, an information entropy density is calculated in step S**11** by using the aforementioned method. Next, when the information entropy density obtained in step S**12** is zero or not greater than −5, it is judged that the second property is not satisfied (step S**16**). When the information entropy density is smaller than zero and not smaller than −5, the program flow proceeds to evaluation of the entropy variation index (EV-index) that is the time variance of the information entropy density. It is judged that the second property is satisfied when the entropy variation index (EV-index) calculated in step S**13** by the aforementioned method is greater than 0.001 (step S**15**), and it is judged that the second property is not satisfied when it is not greater than 0.001 (step S**16**). Then, the program flow proceeds to step S**17**.

In step S**17**, by colligating the above-mentioned results, it is judged that a vibration that satisfies either one of the first property and the second property on the autocorrelation order among vibrations that contain both the audible range components and the super-high-frequency components is the vibration that can introduce the fundamental brain activation effect (step S**18**). In contrast to this, it is judged that a vibration that satisfies neither the first property nor the second property, a vibration that contains no audible range components and a vibration that contains no super-high-frequency component among the vibrations that contain both the audible range components and the super-high-frequency components are each the vibration that cannot introduce the fundamental brain activation effect (step S19). Then, the present processing ends. It is acceptable to replace the order of execution of "step S3" with "step **4** to the step just before step S**17**". Moreover, it is acceptable to replace the order of execution of "step S7" with "step S**8**".

It is also acceptable to constitute the processing step of FIG. **87** of a computer program that can be executed by a computer, record it into a recording medium such as an optical disk that can be read by a computer and reproduce it by a drive apparatus. Moreover, it is acceptable to transmit the program of the processing by using a communication apparatus or a communication system.

FIG. **88** is a block diagram showing a structural example of a hardware circuit that carries out derivation control processing of the fundamental brain activation effect according to the fifth preferred embodiment. That is, FIG. **88** shows an example of an apparatus that discriminates whether a vibration signal satisfies the conditions as a vibration that contains audible range components and super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect. This apparatus is constituted mainly of the three constituents of a power spectrum judgment circuit **880**, a first property judgment circuit **884** of the autocorrelation order, and a second property judgment circuit **890** of the autocorrelation order described below, and these processes are constituted in correspondence with the processing of FIG. **87**.

The power spectrum judgment circuit **880** is constituted of an AD converter circuit **881** that digitizes an inputted vibration signal, a fast Fourier transform circuit **882** that carries out fast Fourier transform by using the output result thereof, and outputs a power spectrum, and a level judgment circuit **883** that judges whether or not the outputted power spectrum has a predetermined level in the audible range and the super-high-frequency range.

The first property judgment circuit **884** of the autocorrelation order is constituted of an AD converter circuit **885** that digitizes an inputted vibration signal, a high-pass filter **886** that has a cutoff frequency of, for example, 20 kHz, a three-dimensional power spectrum array calculating circuit **887** that carries out power spectrum estimation of the vibration signal by using an autocorrelation model and draws a three-dimensional power spectrum array based on it, a local exponent of fractal dimension calculating circuit **888** that calculates the fractal dimension of a three-dimensional power spectrum array curved surface, and a numerical value judgment circuit **889** that judges whether the obtained local exponent of fractal dimension and its fluctuation range have a predetermined property.

The second property judgment circuit **890** of the autocorrelation order is constituted of an AD converter circuit **891** that digitizes an inputted vibration signal, an information entropy calculating circuit **892** that calculates the information entropy density of the vibration signal and the entropy variation index (EV-index) that is its time variance by using the autocorrelation model, a numerical value judgment circuit **893** that judges whether the obtained information entropy density has a value within a predetermined range, an EV-index calculating circuit **894** that calculates the variance of the information entropy density and obtains the entropy variation index (EV-index), and a numerical value judgment circuit **895** that judges whether the value of the obtained entropy variation index (EV-index) is not smaller than a predetermined value.

Upon receiving inputs of the judgment results from these three circuits **880**, **884** and **890**, a logic judgment circuit **896** in the final stage judges whether the inputted vibration signal (1) has the audible range components and the super-high-frequency components, which are the essential conditions to be owned by the vibration signal that can introduce the fundamental brain activation effect, (2) has the first property on the autocorrelation order, or (3) satisfies the second property on the autocorrelation order, and judges whether or not the conditions of the vibration signal that can introduce the fundamental brain activation effect are satisfied based on the result.

The vibration discriminating apparatus of FIG. **88** may be configured of, for example, a DSP (digital signal processor), a digital calculator or computer.

Moreover, the vibration signal inputted to the vibration discriminating apparatus of FIG. **88** may be inputted by transducing the signal recorded in a storage medium such as a magnetic tape, a solid memory, an optical disk, a magnetooptical disk, and a hard disk into an electric signal or an electric vibration that is transduced and inputted from a receiver of an electromagnetic wave, light, an electric signal, or the like. Further, the inputted vibration signal may be an electric vibration transduced from an aerial vibration by a microphone or an electric signal transduced from a vibration of a solid or a liquid by a transducer.

Although FIG. **88** shows the example in which the vibration signal is inputted in parallel to the power spectrum judgment circuit **880**, the first property judgment circuit **884** and the second property judgment circuit **890**, these three circuits **880**, **884** and **890** may be connected in series or only two the three circuits **880**, **884** and **890** may be connected in parallel.

By using the discriminating apparatus of FIG. **88**, it becomes possible to judge whether or not the vibration signal outputted from the vibration generating apparatus or the individual mechanisms constituting it satisfies the conditions of the vibration signal that contains the audible range components and the super-high-frequency components having the predetermined autocorrelation order and can introduce the fundamental brain activation effect. Moreover, the characteristics of the vibration generating apparatus or the individual mechanisms constituting it can also be adjusted by feeding the judgment result back to the vibration generating apparatus or the individual mechanisms constituting it. Furthermore, by discriminating the vibration signal outputted from a given equipment, it becomes possible to evaluate whether or not the equipment has a function to appropriately process the vibration signal that can introduce the fundamental brain activation effect.

Next, an apparatus having a function to discriminate whether or not the conditions of the vibration that can introduce the fundamental brain activation effect by monitoring the actual vibration, and feeds it back to the vibration generating apparatus as a practical application of the aforementioned vibration discriminating apparatus is described below.

When it is judged that the vibration signal served as an object to be discriminated does not satisfy the conditions that it "contains the audible range components and the super-high-frequency components having the predetermined autocorrelation order" in a vibration discriminating apparatus, an actual vibration generated from the vibration signal has a high risk of deteriorating the fundamental brain activity in comparison with that in an ordinary background noise state in addition to the fact that it cannot introduce the fundamental brain activation effect. In such a case, it is effective to generate an alarm or the like as a reminder by feeding the discrimination result back to the vibration generating apparatus or to generate a vibration that can introduce the fundamental brain activation effect by adding a signal of a hypersonic sound or its super-high-frequency components.

FIG. **114** is a perspective view showing an implemental example of a vibration monitoring system **500** for adjusting the vibration generating setting by feedback to the vibration generating apparatus by using the judgment result on the autocorrelation order owned by the vibration according to the fifth preferred embodiment, and FIG. **115** is a block diagram showing a detailed configuration of the vibration monitoring system **500** of FIG. **114**.

The vibration monitoring system **500** shown in FIG. **114** is constituted of a vibration generating apparatus **501**, a vibration signal input apparatus **502** configured of a microphone **911** and a microphone amplifier **912**, a vibration discriminating apparatus **503**, a discrimination result-based control signal generating apparatus **504**, an alarm generator **506**, a vibration complementing apparatus **507**, and a discrimination result monitor apparatus **505**. Referring to FIG. **114**, an actual vibration generated from the vibration generating apparatus **501** is transduced into an electric signal by the vibration signal input apparatus **502** and thereafter inputted to the vibration discriminating apparatus **503**. The vibration discriminating apparatus **503**, which is configured similarly to the vibration discriminating apparatus of FIG. **88**, discriminates whether the inputted vibration signal has the conditions of the vibration that can introduce the fundamental brain activation effect, and outputs the discrimination result to the discrimination result-based control signal generating apparatus **504** and the discrimination result monitor apparatus **505**. When it is discriminated that "the inputted vibration signal does not have the conditions of the vibration that can introduce the fundamental brain activation effect, i.e., the inputted vibration signal cannot introduce the fundamental brain activation effect", the discrimination result-based control signal generating apparatus **504** outputs a control signal to the alarm generator **506** to generate an alarm, and/or outputs a control signal to the vibration complementing apparatus **507** to generate a hypersonic sound or its super-high-frequency component signal, and adds the generated signal to the signal of the vibration generating apparatus **501** to generate an addition signal. The discrimination result monitor apparatus **505** displays the discrimination result.

By the vibration monitoring system **500** as described above, the listener becomes able to confirm whether the vibration to which he or she is currently listening has the conditions of the vibration that can introduce the fundamental brain activation effect and becomes able to receive the hypersonic sound when the conditions are not satisfied, and this produces the positive effects of ameliorating and improving the psychosomatic state through the activation of the fundamental brain network system in addition to preventing the deterioration in his or her fundamental brain activity and assuring safety.

Supplementary Explanation of Formula

Hereinafter, the calculating formulas that derive the first property and the second property on the autocorrelation order are described. First of all, the local exponent of the fractal dimension of the temporospatial structure is described below. In this case, with regard to the three-dimensional power spectrum array of vibration signal data, the local exponent of the fractal dimension (box count dimension) of its shape was obtained according to the following procedure.

(1) It is assumed that unit analysis interval time series data obtained by dividing the time series data X of a vibration having a total duration of T seconds sampled by a sampling frequency $2f_N$ (f_N is the Nyquist frequency, or the maximum frequency of the object signal) into intervals having a duration of T_E seconds are $X_i(t)$ (i=1, 2, . . . , n; t=1, 2, . . . , $2f_N \times T_E$). In this case, it is assumed that $X_i(t)$ and $X_{i+1}(t)$ have an overlap interval of $T_E/2$ seconds corresponding to a half of the unit analysis interval duration. That is as follows:

$$X_{i+1}(t)=X_i(t+f_N \times T_E) \quad (1).$$

It is noted that i=1, 2, . . . , n−1; t=1, 2, . . . , $f_N \times T_E$. In this case, one-side power spectrum $Q_i(f)$ of the time series data $X_i(t)$ for each unit analysis interval is obtained by using the Yule-Walker (Yule-Walker) method of a 10-dimension autoregression model.

(2) From the one-side power spectrums $Q_i(f)$, components exceeding 20 kHz at the human audible range upper limit is extracted, and the same expressed in dB is assumed to be a power $P_i(f)$. That is as follows:

$$P_i(f)=10 \times \log_{10} Q_i(f) \quad (2).$$

It is noted that 20 kHz≦f≦f_N.

(3) Next, a plot in a three-dimensional space, of which the transverse axis represents the frequency f (20 kHz≦f≦f_N), the anteroposterior axis represents the interval "i" (i=1, 2, . . . , n), and the vertical axis represents the power $P_i(f)$, is called a three-dimensional power spectrum array. It is noted that the vertical axis is a logarithmic representation of the power spectrum $Q_i(f)$.

(4) In general, it is assumed that the number of cubes necessary when a curved surface S is covered with cubes each having one side length of r is N(r). When D such that N(r) is proportional to r^{-D} exists, D is called a fractal dimension (box count dimension) of the curved surface S. That is, when the curved surface S has the fractal structure,

$$N(r) \propto rD \quad (3)$$

that is the following equation holds:

$$N(r)=C \times r^{-D} \text{(where } C \text{ is a constant)} \quad (4).$$

If the logarithms of both members are taken in this case, the following equation is obtained:

$$\log N(r)=-D \times \log(r)+\log(C) \quad (5).$$

The Equation (5) indicates that the fractal dimension is formed by multiplying −1 by the inclination of a straight line when the number N(r) of cubes with respect to various lengths r is obtained in the curved surface S, and r and N(r) are plotted by double logarithm. However, it is infrequent that the actually given curved surface S takes a complete fractal structure. Accordingly, a sign-inverted inclination of a regression line obtained when the number N(r) with respect to various lengths r is plotted by double logarithm in the given curved surface S is regarded as a statistical fractal dimension.

(5) On the above basis, the three-dimensional power spectrum array obtained by the Equation (4) is considered to be a three-dimensional curved surface SA, and the transverse axis and the anteroposterior axis are first severally scaled so that the maximum width along each axes of the curved surface SA each becomes one. In the vertical axis direction, the amplitude is scaled by the geometric mean of the scales of contraction/enlargement on the transverse axis and the anteroposterior axis.

(6) Next, a cube B_k obtained by equally dividing each side of a cube, which has a side length of one and a bottom surface defined by the orthogonal projection of the curved surface SA on a flat plane constituted of the transverse axis and the anteroposterior axis, by q^k is considered. In this case, q is a real number satisfying q>1, and k is an integer satisfying k≧0. The length of one side of the cube B_k is q^{-k}. Moreover, assuming that the number of cubes B_k necessary for covering the curved surface SA with the cubes B_k is M(k), then N(r)=M(k), and $r=q^{-k}$ in the Equation (5). When these are substituted into the Equation (5) paying attention to the fact that D is an inclination obtained from the regression line, the following equation is obtained:

$$\log M(k) \approx D \times \log(q^k)+\log(C) \quad (6).$$

Likewise, the following equation is obtained.

$$\log M(k+1) \approx D \times \log(q^{k+1})+\log(C) \quad (7).$$

(7) In this case, assuming that the value of local D between k and k+1 is L(k), then the following equation is obtained.

$$\begin{aligned} L(k) &= (\log M(k+1) - \log M(k)) / (\log(q^{k+1}) - \log(q^k)) \\ &= (\log M(k+1) - \log M(k)) / \log(q). \end{aligned} \quad (8)$$

It is herein defined that q^{-k} is the spectro-temporal index of the curved surface SA, and L(k) is the local exponent of fractal dimension of the curved surface SA at the spectro-temporal index q^{-k}.

(8) The local exponent L(k) of the fractal dimension corresponds to the derivative value of the graph in the Equation (5) obtained by a difference and can be calculated in a curved surface of which the fractal dimension cannot be strictly defined. When the curved surface SA takes a fractal structure within a definite range of the spectro-temporal index, L(k) has a value close to a constant value that is not an integer (two in the case of a flat surface) corresponding to the topological dimension. Accordingly, the fractal structure of the curved surface SA was analyzed by examining the behavior of this local exponent.

In the preferred embodiments and the implemental examples of the present invention, calculations are performed by using the above-mentioned method on the conditions: f_N=96 kHz, T=51.2 seconds, T_E=0.2 seconds, q=2, and k=1, 2, 3, 4, 5.

Next, the calculation method of the information entropy density of the vibration signal is described below. In this case, the information entropy density of the time series data of a vibration signal was obtained according to the following procedures.

(1) It is assumed that the time series data X of a vibration having a total duration of T seconds sampled by a sampling frequency $2f_N$ (f_N is the Nyquist frequency, or the maximum frequency of the object signal) into intervals having a duration of T_E seconds are $X_i(t)$ ($i=1, 2, \ldots, n$; $t=1, 2, \ldots, 2f_N \times T_E$).

(2) Assuming that the two-side and one-side power spectrums of $X_i(t)$ are $S_i(f)$ and $Q_i(f)$, when the probability density function of $X_i(t)$ has a Gaussian distribution, the information entropy density h_i is expressed by the following equation (See, for example, the Non-Patent Document 7):

$$\begin{aligned} h_i &= \frac{1}{4f_N}\int_{-f_N}^{f_N} \log S_i(f)\,df + \frac{1}{2}\log 2f_N \\ &= \frac{1}{2f_N}\int_0^{f_N} \log\{f_N \times Q_i(f)\}\,df \end{aligned}$$

(3) If the one-side power spectrum $Q_i(f)$ is obtained from the time series data $X_i(t)$ for each unit analysis interval by using the Yule-Walker method of a 10-dimension autocorrelation model and substituted into the Equation (2), then the information entropy density h_i for an interval "i" is obtained.

(4) With regard to the information entropy density h_i, it is assumed that a variance $var(h_i)$ from an interval 1 to an interval n is the entropy variation index (EV-index). In the present preferred embodiment, calculations are performed under the conditions: f_N=96 kHz, T=51.2 seconds, and T_E=0.2 seconds.

INDUSTRIAL APPLICABILITY

As described in detail above, according to the present invention, the detailed properties of the hypersonic sound are clarified, and the apparatuses and methods that can introduce the hypersonic sound and the apparatuses and methods for discriminating the vibration can be provided. With the above-mentioned arrangement, it becomes possible to induce the activation of the fundamental brain and the fundamental brain network (fundamental brain network system) including the reward system neural circuit of the brain unitarily comprehensively responsible for the generation of reactions of pleasure, beauty and emotion in a human being, consequently boost the aesthetic sensibility to various general sensory inputs inclusive of sounds, and enhance the pleasure, beauty and emotion. Moreover, it becomes possible to not only induce the effects of invigorating the physical activation such as homeostatic maintenance and biophylaxis of the whole body managed by the fundamental brain but also comprehensively remedying lifestyle-related diseases of metabolic syndromes such as hypertension, hyperlipemia and diabetes, cancer, cerebrovascular disorder and cardiopathy, immune abnormalities including pollinosis and atopic dermatitis, various mental disorders such as depression, schizophrenia, dementia, chronic fatigue syndrome and attention-deficit hyperactivity disorder, behavioral abnormalities such as suicide and self-injurious behaviors, abnormal exaltation of aggressiveness and so on, which are caused by the abnormality of the fundamental brain activity and pose serious problems in the modern society, also making it possible to induce the effect of maintaining healthy and comfortable life. These effects owned by the present invention are expected to be used in the following various industries.

First of all, the present invention directly provides technological innovations for various industries relevant to the information and communication technology.

In the audio equipment industry, many of the existent audio apparatuses and audio and video (AV) apparatuses used in home theaters and the like, which have been rapidly popularized in recent years, can neither record nor reproduce super-high-frequency components essential for introducing the fundamental brain activation effect due to the signal formats and limitations in the performance of the reproducing apparatuses and therefore unable to introduce the fundamental brain activation effect. The present invention makes it possible to generate a vibration that introduce the fundamental brain activation effect even when these existent apparatuses are used and provide the listeners with beauty, emotion, health and comfort. By the present technological innovation, it is expected to open a new market in the audio equipment industry.

In the contents industry, the majority of huge amount of contents, which have been audio recorded or audio and video recorded in the field after the 1980's, have recordable and reproducible band upper limits limited to 22 kHz to 24 kHz in conformity to digital contents standard used in the contemporary studios coping with the changeover in the mainstream of the package media to the digital media of CDs and the like, and unable to introduce the fundamental brain activation effect. The present invention makes it possible to generate a vibration that can introduce the fundamental brain activation effect from such contents. This makes it possible to heighten the artistic values of the huge amount of existent contents properties and safety. In addition, by making it possible to generate the fundamental brain activation effect even in the video and audio contents such that an image and a sound are simultaneously presented, the present invention overcomes such a conventional technological problem that image quality and sound quality are in a trade-off relation due to restrictions in the recordable and transmissible information capacity and the information transmission rate, thereby enhancing the listeners' aesthetic sensibilities to images and sounds in parallel to introduce an effect substantially equivalent to an increase in the information capacity and making it possible to produce contents of which the sensuous artistic values are comprehensively heightened.

In the broadcasting and distribution industries, most of the audio signals that are transmitted and distributed via the current television broadcastings and Internet communications cannot activate the fundamental brain since they use formats that can neither record nor reproduce super-high-frequency components essential for introducing the fundamental brain activation effect. The present invention makes it possible to generate a vibration that can introduce the fundamental brain activation effect from these vibration signals that are broadcasted and distributed. Moreover, if a format capable of transmitting super-high-frequency components will be adopted in the future, the present invention makes it possible to produce and transmit contents containing vibration signals that can introduce the fundamental brain activation effect. Further, similar to the effects expected in the contents industry, means for transmitting a plurality of different kinds of sensory information such as videos and images in a manner similar to that of the television broadcasting and moving picture distribution overcomes such a conventional technological problem that image quality and sound quality are in a trade-off relation due to restrictions in the information transmission rate of the communication lines, thereby enhancing the viewers' aesthetic sensibilities to videos and sounds in parallel to introduce an effect substantially equivalent to an increase in the information capacity transmittable per hour and making it possible to distribute contents of which the sensuous artistic values are comprehensively heightened.

In addition to the uses in various industries relevant to the information and communication technologies described above, the present invention makes it possible to improve vibration information of the environment that surrounds human beings to make it able to introduce the fundamental brain activation effect. This new information environment creating technique is expected to be used in various industries.

First of all, in the medical industry field, by improving the vibration information in the spaces where modern people live to make it able to introduce the fundamental brain activation effect, it becomes possible to conduct the prevention and remedy of various disorders, which are generally called the modern diseases such as various lifestyle-related diseases and mental and behavioral disorders considered to be largely influenced by the deterioration in the fundamental brain activity on the onset and transition of the diseases and cause serious problems in the modern society. Further, it becomes possible to heighten the immunity, reduce stresses, and establish and maintain a healthy comfortable lives by improving the fundamental brain activity.

Next, in the city planning and building industry field, by improving vibration information in urban districts and public spaces and the like in the current cities to make it able to introduce the fundamental brain activation effect, it becomes possible to conduct improvements and prevention of various lifestyle-related diseases and mental and behavioral disorder symptoms due to the deterioration in the fundamental brain activity, which causes serious problems under the modern urban environments, and maintain healthy lives of people who reside or commute to work or study in cities. Further, by actualizing towns that people want to visit again, moles that make shopping happier, prosperous paths, and plazas that somehow attract people, it becomes possible to improve the comfort and ability to pull in more customers and conduct the activation of districts.

In the child care and educational industrial field, improving vibration information in domestic spaces and school spaces to make it able to introduce the fundamental brain activation effect conducts prevention of autism that is caused by the malfunction of the fundamental brain activity and is rapidly increasing in recent years, conducts improvement and prevention of various mental and behavioral disorder symptoms such as bullying, truancy, suicidal and self-injurious behaviors, eating disorders and classroom disruption and has large industrial applicability in achieving child's psychosomatic healthy growth.

In the public transportation and automobile industry field, by improving vibration information at driver's seats and cockpit seats of railways, airplanes, automobiles and the like to make it able to introduce the fundamental brain activation effect, it is expected to heighten the attention arousal level, which is one of the important functions that the fundamental brain bears and prevent the occurrence of accidents caused by human errors, doze and the like of pilots and drivers. In addition, by improving vibration information in stations and airports or vehicles and airplanes to make it able to introduce the fundamental brain activation effect, it becomes possible to remarkably improve comfort in customer gathering and prevent the violent behaviors of passengers and suicidal cases, which have increased particularly in the railroad industry in recent years causing serious problems. Further, it is expected to prevent or remedy the onset of passengers' modern diseases by utilizing the public transportation system and achieve a public transportation that can maintain healthier lives.

By being linked to not only the aforementioned industries but also any and all environment creation industries of individual spaces and public spaces, such as living spaces, duty spaces, public institution spaces, and urban district spaces, the present invention is expected to be linked to the rise of a new industry, which should be called an "information environment creation industry" that creates a vibration information environment to heighten the comfort and safety of people who use those spaces.

The present invention leads to full-fledged restructuring of the contents and vibration generating apparatuses of vibration information that has conventionally been accumulated and used in all the aforementioned industries and the environmental creation techniques that utilize them.

The industrial economical effects, which are produced by the practical applications of the present invention that can be developed to expansive domains as described above, are immeasurable.

REFERENCE NUMERALS

1: gamelan
2: microphone
3: preamplifier
4: AD converter
5: DA converter
6: reproducing amplifier
7*a*: high-pass filter (HPF)
7*b*: low-pass filter (LPF)
8*a*, **8*b***: power amplifier
9*aa*, **9*ba***: right loudspeaker
9*ab*, **9*bb***: left loudspeaker
10: magnetic recording and reproducing device
11: magnetic recording part
12: magnetic recording head
13: magnetic tape
14: magnetic reproducing head
15: magnetic reproducing part
16: magnetic tape running direction
20: room
30: human being (listener)
31: brain wave data receiving and recording apparatus
32: brain wave detecting and transmitting device
33, **34**: antenna
41: tomographic apparatus
42: tomographic detecting device
70: vibration signal amplifier
71, **71A**: loudspeaker
72: vibration signal recording and reproducing apparatus
74: microphone
75: audible range sound characteristic measuring instrument
76: reproduction vibration characteristic adjuster
77: BGM reproducing apparatus
81, **82**, **83**: Listener
81*p*: portable music player
90: human being (listener)
91: chair
92: vibration generating device
101: brainstem
102: thalamus

110: head portion
110*a*: external auditory meatus
111: headphone
111*a*, **111***b*: headphone housing
112: headband
115: signal band dividing circuit
116, **117**: signal amplifier
118: signal input plug
120: super-high-frequency vibration generating device
121: audible range loudspeaker
124: ear pad
125: small battery
160: broach type signal generating apparatus
161: battery socket cover
162: memory socket cover
163: clasp fastening portion
164: clasp
170: flat plate
171, **171***a*: liquid current generating apparatus
172, **172***a*-**172***i*: protrusion
173, **174**, **175**: transducer
176: actuator
177: depth variable circular dimple
178: height variable circular protrusion
179: protrusion
180: vibration signal generating apparatus
181: vibration signal preamplifier
182: high-pass filter
183: super-high-frequency component vibration signal amplifier
184: super-high-frequency component vibration generating device
185: low-pass filter
186: audible range component vibration signal amplifier
187: audible range component vibration generating device
200: signal reproducing apparatus
201: memory
202: micro amplifier
203: battery
210: shirt
230: horizontal waterway
231: floor surface
240: apparatus housing
241: water droplet generator
242: liquid
243, **244**: transducer
245: microphone
246: mixer
250: apparatus housing
251-255: partition plate
256: compressed air generator
257, **258**, **259**: partition plate position variable direction
260: metal piece
260*a*: metal piece vibration direction
261: cylindrical member
262: protrusion
300: signal source disc
301: player
302: preamplifier
310: left channel circuit
311: high-pass filter (HPF)
312: low-pass filter (LPF)
313, **313***a*, **313***b*: earphone amplifier
314, **314***a*, **314***b*: power amplifier
320: right channel circuit
330: loudspeaker system
331: tweeter
332: full-range loudspeaker
333: woofer
334, **334***a*, **334***b*: earphone
335: power distribution network
340: listener
341: listener's head
350: full face helmet
360: sound insulation full body coat
370: vibration generating apparatus
371: connection type super-high-frequency vibration generating device
372, **373**: super-high-frequency vibration generating device
374: super-high-frequency vibration generating device integrated cable
375: signal source memory
376: amplifier unit
377: power supply unit
380: signal transmitter
381: transducer
382: signal reconstruction circuit
383: signal transmission circuit
390: distribution network
391: signal reconstruction circuit
400: portable signal receiver
401: signal receiving circuit
402: signal reconstruction circuit
403: vibration generating apparatus
410: Portable telephone
411: loudspeaker
412: housing
413: sheet
414: super-high-frequency vibration generating device
415: headset
416: cable
417: super-high-frequency vibration generating device
418: piezoplastic sheath
420: portable music player
421: earphone
422: cable
423: vibration generating apparatus
424: super-high-frequency vibration generating device
425: memory
426: micro amplifier
427: battery
430: concert hall
431: stage
432: wireless vibration signal transmitter
433: wireless vibration signal receiver and vibration generating apparatus
434: pendant type vibration generating apparatus
435: ceiling hanged type vibration generating apparatus
436: chair mounted type vibration generating apparatus
437: chair embedded type vibration generating apparatus
440: electronic musical instrument apparatus
441: electronic musical instrument
442: complementing vibration source
443: adder
444: digital synthesizer
450: space
451: vibration generating apparatus
460: vibrating wall
461: listener
470: vibration signal reproducing apparatus
470*d*: recording medium
471: vibration signal amplifier
472: public-address system
473: microphone

474: vibration signal addition adjuster
475: microphone
476: vibration measuring instrument
480: Station yard
481: pillar mounted type vibration generating apparatus
482: signal receiver
483: super-high-frequency vibration signal receiver
484: loudspeaker (public-address system)
485: vibration generating apparatus
485*m*: memory
486: hypersonic sound generating apparatus
487: loudspeaker (public-address system)
488: person
489: super-high-frequency vibration generating apparatus
490: electric vehicle
491: vibration generating apparatus
500: vibration monitoring system
501: vibration generating apparatus
502: vibration signal input apparatus
503: vibration discriminating apparatus
504: discrimination result-based control signal generating apparatus
505: discrimination result monitor apparatus
506: alarm generator
507: vibration complementing apparatus
511: vibration signal analyzing apparatus
512: risk judgment apparatus
513: vibration complementing apparatus
540: vibration generating space
541: vibration signal storage device
542: vibration generating apparatus
560: vibration generating space
561: sound source
562: chair
563: listener
570: vibration generating space
571, **572**: vibration generating apparatus
581, **582**, **584**: amplifier
583: adder
610: CD player
611: signal complementing apparatus
612: amplifier
613: loudspeaker
620: portable player
621: signal complementing apparatus
622: earphone
623: super-high-frequency vibrating object
624: listener
630: television receiver
631: signal complementing apparatus
632: loudspeaker
641, **643**: reproducing circuit
642: band expanding circuit
644: adder
645: high-pass filter
651, **661**, **661-1-661-4**: original vibration signal storage device
652, **662**, **662-1-662-4**: reproducing circuit
653: band expanding circuit
654: adder
663: high-pass filter
664*a*, **664***b*, **667***a*, **667***b*: switch
665: voltage-controlled amplifier (VCA)
666: attenuator
670: comparator
671: absolute value signal detector circuit
672: control signal generator circuit
673, **674**: AD converter
673*a*: frequency converter
675, **675**A: active processing circuit
675*a*: convolution calculator
675*b*: autocorrelation coefficient controller
675*c*: multipliers
675*d*: transfer function controller
675*e*: time series converter
676: autocorrelation coefficient calculator
676*a*: transfer function calculator
677: reproducing circuit
678: high-pass filter
679: adder
680: controller
680*m*: memory
681-688: switch
691, **692**: adder
693,**694**: filter
695: Super Audio CD (SACD)
696: SACD player
697: low-pass filter
698, **699**: high-pass filter
700: vibration transmission medium filled container
701: actuator
702: elastic vibrating object
703: moving magnet type fluctuation detector device
704: moving magnet
705: coil
706: vibration transmission medium
710: capacitor type fluctuation detector device
711: movable electrode
712, **713**: fixed electrode
714: bias voltage source
720: elastic vibrating object
730: fluctuation detecting coil with elastic vibrating object
731, **732**: permanent magnet
750: elastic vibrating object
751: vibration detector device
800, **800***a*, **800***b*, **800***c*: super-high-frequency vibration generating apparatus
812: listener
812*a*: head portion
812*b*: body surface
830*p*: pendant type vibration generating apparatus
832: transducer
832A: super-high-frequency vibration reproducing apparatus
832*a*: super-high-frequency transducer
833: micro amplifier
834: memory
835: battery
850: portable music player
851: headphone
852: display
853: Blu-ray Disc
854: Blu-ray disc player
855: AV amplifier
856: 5.1 ch surround loudspeaker system
860: super-high-frequency vibration presenting apparatus
860S: signal generating apparatus
860C: bathtub
860L: liquid
870: loudspeaker
870A: full-range loudspeaker
881: AD converter circuit
882: Fast Fourier transform circuit
883: level judgment circuit
884: first property judgment circuit

885: AD converter circuit
886: high-pass filter
887: three-dimensional power spectrum array calculating circuit
888: local exponent of fractal dimension calculating circuit
889: numerical value judgment circuit
890: second property judgment circuit
891: AD converter circuit
892: information entropy density calculating circuit
893: numerical value judgment circuit
894: EV-index calculating circuit
895: numerical value judgment circuit
896: logic judgment circuit
900: audible range vibration generating apparatus
900*a*: headphone
910: vibration signal input apparatus
911: microphone
912: microphone amplifier
915: analysis result monitor
916: alarm generator
950: vibration generating apparatus
952: sauna type super-high-frequency vibration presenting apparatus
952*a*: super-high-frequency transducer
954: cockpit of airplane etc.
954*a* to **954***d*: super-high-frequency vibration presenting apparatus
955: super-high-frequency vibration shower room
955*a*: shower type super-high-frequency vibration presenting apparatus
961: vibration complementing apparatus
962: detection generating apparatus
962*a*: vibration generating apparatus
962*b*: premises sound detector apparatus
SW1, SW2, SW3, SW4: switch

The invention claimed is:

1. A vibration generating apparatus comprising:

a device for generating one of a vibration and a vibration signal, the one of the vibration and the vibration signal containing (i) audible range components that are vibration components in an audible frequency range and (ii) super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency,

wherein the one of the vibration and the vibration signal has an autocorrelation order represented by at least one of a first property and a second property,

wherein the vibration generating apparatus introduces a fundamental brain activation effect into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, the fundamental brain activation effect being introduced by applying one of the vibration and an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

2. A vibration generating space apparatus for generating a vibration having an autocorrelation order by radiating the vibration generated by one of (i) at least one vibration generating apparatus installed in the vibration generating space apparatus for forming a vibration generating space, into the vibration generating space apparatus, (ii) applying one of addition and mutual interference to vibrations in the vibration generating space apparatus, and (iii) making elements constituting the vibration generating space apparatus resonate with the vibrations, the vibration generating space apparatus comprising:

a device for generating one of a vibration and a vibration signal, the one of the vibration and the vibration signal containing (i) audible range components that are vibration components in an audible frequency range and (ii) super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency,

wherein the one of the vibration and the vibration signal has the autocorrelation order represented by at least one of a first property and a second property,

wherein the vibration generating space apparatus introduces a fundamental brain activation effect into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, the fundamental brain activation effect being introduced by applying one of the vibration and an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension has a value of not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

3. A vibration generating method comprising:

a step of generating one of a vibration and a vibration signal, the one of the vibration and the vibration signal containing (i) audible range components that are vibration components in an audible frequency range and (ii) super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency,

wherein the one of the vibration and the vibration signal has an autocorrelation order represented by at least one of a first property and a second property,

wherein the vibration generating method introduces a fundamental brain activation effect into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, the fundamental brain activation effect being introduced by applying one of the vibration and an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

4. The vibration generating apparatus as claimed in claim **1**, further comprising an adder for adding a complementing vibration signal that has the autocorrelation order and is generated by the vibration generating apparatus to an original vibration signal not having the autocorrelation order, and for outputting a vibration signal of a result of the adding.

5. The vibration generating apparatus as claimed in claim **1**, further comprising:

a band expanding device for performing band expanding so that a band of an original signal exceeds the audible frequency range with respect to an original vibration signal not having the autocorrelation order, and for outputting a band-expanded vibration signal that contains the band exceeding the audible frequency range and the band of the original vibration signal; and

an adder for adding a complementing vibration signal that has the autocorrelation order and is generated by the vibration generating apparatus to the band-expanded vibration signal, and for outputting a vibration signal of a result of the adding.

6. The vibration generating apparatus as claimed in claim **4**, further comprising a high-pass filter device, which is located between the vibration generating apparatus and the adder, for performing high-pass filtering of the complementing vibration signal having the autocorrelation order.

7. The vibration generating apparatus as claimed in claim **5**, further comprising an attenuator for comparing a signal level of one of the original vibration signal and the band-expanded vibration signal with a predetermined threshold value, and attenuating, by a predetermined attenuation amount, one of the complementing vibration signal that has the autocorrelation order and is inputted to the adder, and a high-pass filtered signal thereof when a signal level is smaller than the predetermined threshold value.

8. The vibration generating apparatus as claimed in claim **5**, further comprising a level changing device for detecting an absolute value of a signal level of one of the original vibration signal and the band-expanded vibration signal and performing one of amplification and attenuation of a signal level of one of the complementing vibration signal that has the autocorrelation order and is inputted to the adder, and a high-pass filtered signal thereof in accordance with a magnitude of the absolute value of the signal level.

9. The vibration generating apparatus as claimed in claim 5,

wherein the complementing vibration signal that has the autocorrelation order and is inputted to the adder contains a plurality of kinds of vibration signals each having the autocorrelation order, and

wherein the vibration generating apparatus further comprises a controller for selecting at least one kind of complementing vibration signal from among the plurality of kinds of complementing vibration signals in correspondence with at least one of the original vibration signal and the band-expanded vibration signal, and outputting the selected signal to the adder.

10. The vibration generating apparatus as claimed in claim 1, further comprising a first processor for calculating an autocorrelation coefficient of a reference vibration signal having the autocorrelation order, and performing a convolution calculation of an original vibration signal not having the autocorrelation order with the calculated autocorrelation coefficient, so as to generate the vibration signal having the autocorrelation order.

11. The vibration generating apparatus as claimed in claim 1, further comprising a second processor for calculating a transfer function of a reference vibration signal having the autocorrelation order, and multiplying an original vibration signal not having the autocorrelation order by the calculated transfer function, so as to generate the vibration signal having the autocorrelation order.

12. The vibration generating apparatus as claimed in claim 1, comprising:

an elastic vibrating object which elastically vibrates by utilizing physical characteristics including elasticity, natural vibration, and stress strain;

a first transducer for transducing one of the vibration signal having the autocorrelation order, and a vibration signal not having the autocorrelation order into a vibration, and applying the transduced vibration to the elastic vibrating object; and

a second transducer for transducing the vibration of the elastic vibrating object into an electric signal,

wherein one of enhancement and imparting is performed on at least one of the first property and the second property on the autocorrelation order in the vibration signal by application of the vibration signal to the elastic vibrating object by the first transducer, and

wherein one of attenuation and removal is performed on vibration components not introducing the fundamental brain activation effect and existing as an electric signal but not existing in the elastic vibrating object, so as to perform one of emphasizing and imparting an effect of a vibration that can introduce the fundamental brain activation effect.

13. The vibration generating apparatus as claimed in claim 12, wherein the elastic vibrating object is installed in a container filled with a predetermined vibration transmission medium.

14. The vibration generating apparatus as claimed in claim 1, wherein the vibration generating apparatus introduces the fundamental brain activation effect into (i) a fundamental brain of the human including a reward system neural circuit, which is a brain function region being unitarily comprehensively responsible for a generation of all reactions of pleasure, beauty and emotion and (ii) the fundamental brain network, the fundamental brain activation effect being introduced by applying a vibration generated by the vibration generating apparatus to the human while applying predetermined information to the human through at least one of visual sensation, gustatory sensation, somatic sensation and olfactory sensation other than auditory sensation, so as to enhance aesthetic sensibility to at least one piece of information, which is applied to the human at a same time as the vibration and is selected from visual sensation, gustatory sensation, somatic sensation and olfactory sensation other than auditory sensation, and enhancing reactions of pleasure, beauty and emotion.

15. The vibration generating method as claimed in claim 3, wherein the vibration generating method includes:

introducing the fundamental brain activation effect into (i) a fundamental brain of the human including a reward system neural circuit, which is a brain function region being unitarily comprehensively responsible for a generation of all reactions of pleasure, beauty and emotion and (ii) the fundamental brain network, the fundamental brain activation effect being introduced by applying a vibration generated by the vibration generating apparatus to the human while applying predetermined information to the human through at least one of visual sensation, gustatory sensation, somatic sensation and olfactory sensation other than auditory sensation, so as to enhance aesthetic sensibility to at least one piece of information, which is applied to the human at a same time as the vibration and is selected from visual sensation, gustatory sensation, somatic sensation and olfactory sensation other than auditory sensation, and enhancing reactions of pleasure, beauty and emotion.

16. A non-transitory computer-readable recording medium for recording a vibration signal generated by a vibration generating apparatus, the vibration signal being recorded onto the non-transitory computer-readable recording medium by a computer,

wherein the vibration generating apparatus comprises a device for generating one of a vibration and a vibration signal, the one of the vibration and the vibration signal containing (i) audible range components that are vibration components in an audible frequency range and (ii) super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency,

wherein the one of the vibration and the vibration signal has an autocorrelation order represented by at least one of a first property and a second property,

wherein the vibration generating introduces a fundamental brain activation effect into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, the fundamental brain activation effect being introduced by applying one of the vibration and an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

17. A communication apparatus comprising:

a communication device for transmitting a vibration signal generated by a vibration generating apparatus via a communication medium,

wherein the vibration generating apparatus comprises a device for generating one of a vibration and a vibration signal, the one of the vibration and the vibration signal containing (i) audible range components that are vibration components in an audible frequency range and (ii) super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency,

wherein the one of the vibration and the vibration signal has an autocorrelation order represented by at least one of a first property and a second property,

wherein the vibration generating apparatus introduces a fundamental brain activation effect into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, the fundamental brain activation effect being introduced by applying one of the vibration and an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, and, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

18. A vibration discriminating apparatus comprising:

a discriminator for discriminating whether or not an inputted vibration signal (i) contains audible range components that are vibration components in an audible frequency range (ii) contains super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency and (iii) has an autocorrelation order represented by at least one of a first property and a second property,

wherein the discriminator further discriminates whether or not a fundamental brain activation effect can be introduced into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, by applying an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

19. The vibration discriminating apparatus as claimed in claim **8**, wherein the discriminator comprises:

a first partial discriminator for discriminating whether or not the inputted vibration signal contains (i) components in the audible frequency range and (ii) the super-high-frequency components within the range exceeding the audible frequency range up to the predetermined maximum frequency;

a second partial discriminator for discriminating whether or not the inputted vibration signal has the autocorrelation order represented by the first property;

a third partial discriminator for discriminating whether or not the inputted vibration signal has the autocorrelation order represented by the second property; and

a final discriminator for discriminating whether or not the inputted vibration signal has the autocorrelation order based on discrimination results of the first partial discriminator, the second partial discriminator and the third partial discriminator.

20. A vibration monitoring system comprising a vibration discriminating apparatus,

wherein the vibration discriminating apparatus comprises a discriminator for discriminating whether or not an inputted vibration signal (i) contains audible range components that are vibration components in an audible frequency range (ii) contains super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency and (iii) has an autocorrelation order represented by at least one of a first property and a second property,

wherein the discriminator further discriminates whether or not a fundamental brain activation effect can be introduced into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, applying an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds, and

wherein the vibration monitoring system comprises at least one of the following:

an alarm generator for outputting an alarm when a discrimination result of the discriminator indicates that the inputted vibration signal cannot introduce the fundamental brain activation effect; and

an adder for adding a complementing vibration signal that has the autocorrelation order and is generated by the vibration generating apparatus claimed in claim **1** to the inputted vibration signal when the discrimination result of the discriminator indicates that the inputted vibration signal cannot introduce the fundamental brain activation effect.

21. A vibration discriminating method comprising:

a discrimination step of discriminating whether or not an inputted vibration signal (i) contains audible range components that are vibration components in an audible frequency range, ii) contains super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency and (iii) has an autocorrelation order represented by at least one of a first property and a second property,

wherein the discrimination step further includes discriminating whether or not a fundamental brain activation effect can be introduced into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, by applying an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

22. The vibration discriminating method as claimed in claim **21**, wherein the discrimination step further comprises:

a first partial discrimination step of discriminating whether or not the inputted vibration signal contains (i) components in the audible frequency range and (ii) the super-high-frequency components within the range exceeding the audible frequency range up to the predetermined maximum frequency;

a second partial discrimination step of discriminating whether or not the inputted vibration signal has the autocorrelation order represented by the first property;

a third partial discrimination step of discriminating whether or not the inputted vibration signal has the autocorrelation order represented by the second property; and

a final discrimination step of discriminating whether or not the inputted vibration signal has the autocorrelation order based on discrimination results of the first partial discrimination step, the second partial discrimination step and the third partial discrimination step.

23. A computer-executable program product, the program product causing a computer to execute a vibration discriminating method comprising:

a discrimination step of discriminating whether or not an inputted vibration signal (i) contains audible range components that are vibration components in an audible frequency range, (ii) contains super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency and (iii) has an autocorrelation order represented by at least one of a first property and a second property,

wherein the discrimination step further includes discriminating whether or not a fundamental brain activation effect can be introduced into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, by applying an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

24. A non-transitory computer-readable recording medium having a program product recorded thereon, the program product being executed by a computer and causing the computer to execute a vibration discriminating method comprising:

a discrimination step of discriminating whether or not an inputted vibration signal (i) contains audible range components that are vibration components in an audible frequency range, (ii) contains super-high-frequency components within a range exceeding the audible frequency range up to a predetermined maximum frequency and (iii) has an autocorrelation order represented by at least one of a first property and a second property,

wherein the discrimination step further includes discriminating whether or not a fundamental brain activation effect can be introduced into (i) a fundamental brain of a human including a brain stem, a thalamus and a hypothalamus, the brain stem, the thalamus and the hypothalamus being regions performing fundamental functions of the fundamental brain of the human and (ii) a fundamental brain network of neuronal projection from the fundamental brain to various brain regions, by applying an actual vibration generated from the vibration signal to the human,

wherein the first property has a fractal nature, such that (i) a shape of a three-dimensional power spectrum array of time, frequency and power of components of the one of the vibration and the vibration signal exceeding the audible frequency range is a complexity having a self-similarity, (ii) a local exponent of fractal dimension represents the self-similarity of the shape, (iii) the local exponent of fractal dimension is obtained by calculating a fractal dimension of a curved surface of the three-dimensional power spectrum array using a box-counting method and by inverting a sign of an inclination of a straight line that interconnects two mutually adjacent points when logarithms of a necessary minimum number of reference boxes for covering the curved surface are plotted with respect to a logarithm of a size of each one side of the reference boxes, (iv) the local exponent of fractal dimension is not smaller than 2.2 and not greater than 2.8 in a range in which a spectro-temporal index defined by normalizing one side of a reference box of the reference boxes is 2^{-1} to 2^{-5} and (v) a fluctuation range of the local exponent of fractal dimension is within 0.4 when the spectro-temporal index changes in the range of 2^{-1} to 2^{-5}, and

wherein the second property is defined, such that (i) a degree of one of predictability and irregularity of a time series of the vibration signal changes with time, except for the time series of the vibration signal that is completely predictable and regular and except for the time series of the vibration signal that is completely unpredictable and random, (ii) an information entropy density representing an irregularity of time series data has a value in a range of not smaller than −5 and smaller than zero and (iii) an entropy variation index (EV-index), which is a variance of the information entropy density and represents a degree of time variance, has a value of not smaller than 0.001 for 51.2 seconds.

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