Some Consideration in Life Science on Ethics and EMC around Audiovisual Information Technology Related to Blended Learning Style Pedagogy — In Connection with Latent Relationship between Electromagnetic and Acoustic Fields —

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Abstract

If taking the pedagogy for instance, sometimes, it is said that the pedagogy has the autonomy as learning just in bridge-building between the ontological science mainly accompanied with quantitative investigation and the value science (closely related to ethics) mainly accompanied with qualitative investigation. That is, since the usefulness of audiovisual information technology is now just well-known, in this paper, two sides related to the latent risk mainly on audiovisual electromagnetic (abbr. EM) environment, which are qualitative or quantitative and normative (from the top down way viewpoint) or descriptive (from the bottom up way viewpoint), are taken in the center of our consideration, originally because both are inseparably related as one of EMC problems in a deep point of view each other. From the standpoint of the former, we will discuss the risk of having inhumaness especially in an ethics due to weakening face-to-face human relationship which will be induced by audiovisual EM environment. From the standpoint of the latter, we dare to propose a view of us on the negative reflection (i.e., the latent risk including some biological effect mainly in EMC) for the wavy environmental problem (electromagnetic, sound, light waves and etc.) especially affected by audiovisual EM environment whose recognition in Japan is apt to be followed fairly late behind compared to one in EU. More concretely, let’s offer some new consideration on one side of life science problem closely connected with ethics and EMC around audiovisual information technology, as a form of “blended learning” better than “e-learning”.

KeyWords: Audiovisual environment, EMC, Relationism-First, Extended Correlation Analysis, Life Science, Blended Learning

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1 Introduction

As is well known, if citing an example of audiovisual education, in principle, the purpose of the education is called to raise the significance of our existence (in the lower side) toward value (in the upper side). Sometimes, it is said that the pedagogy has the autonomy as a blended style learning just in bridge-building between the ontological science mainly accompanied with quantitative investigation and the value science related ethics mainly accompanied with qualitative investigation. When the former is taken as the central aim, assuming that values has been already decided, as the descriptive one (for example, science for education), it is inclined to study the technic on effect like psychology, audiovisual teaching system and etc. as media on the way of its concretization (as seen in e-learning style). On the other hand, when the latter is taken as the central aim, as the normative one (for example, ethics and anthroposophy), it is apt to point towards the philosophical study directing the essence on criteria. It is necessary to require the support from the psychology as the methodology, and the ethics, the sociology and the philosophy as the purpose so that the pedagogy can build up the universal cultural science (as seen in blended learning style). Nowadays, with paying a special emphasis on the wisdom and the time resources more than on substances and the energy, it seems that uniting into one the above two sides has become most interesting. Generally, even ethics in itself is classified into two groups such as the learning for the moral phenomenon from the point of view of the former and the learning for the essence of morals (philosophy) from the point of view of the latter. Originally, both are inseparably related in a deep place each other, and moreover the former can be permitted only as the means of the latter (like as seen in an audiovisual EM system). Also, modern occurrence of the moral phenomenon is closely related in a deep place to the sociology of education from the aspect depending on the social custom supported by high-tech industries.

In this paper, as the subject of study, we deal with the audiovisual EM environment for the computer system playing the core role in the information and communication technologies. As is well known, in regard to the efficiency and the convenience of this system with additionally considered human factors, there have been already reported manifold discussions in the human engineering field too. So, by concentrating on not the utility of this system (like as seen in e-learning) but the latent risk of this system which is well timed and is connected with audiovisual education and its EM environment in the intellectual production, a view considered of us related to ethical problem is itemized below out of chronological order by fragmentarily learning and citing suggestion of many pioneers as far as we know, according to calling to mind (References are omitted because of only fragmentary and short citing as is specially emphasized in NOTE at the last part of this paper). That is, in this paper, two sides related to the latent risk, which are qualitative or quantitative and normative from the top down way
viewpoint or descriptive from the bottom up way viewpoint, are taken in the center of our consideration, with close relation to audiovisual aid and EMC [1-3].

From the standpoint of the former, we shall discuss especially the risk of having inhumaness due to weakening face-to-face communication (vivid and direct human contact can be seen) which will be induced by audiovisual EM environment (ethically vivid view of original human nature will be inseparably weakening according to the preference and authorization of scientific technique as if a hacker). From the standpoint of the latter, we dare to propose a view of us on the negative reflection or the latent risk (see the reference of ethics-related problems such as guidelines for ethics-related problems with “non-invasive research on human brain function” by the Japan Neuroscience Society, the invasion to the blood-brain barrier of EM wave and generation of micronucleus by EM waves, electrical hypersensitivity and so on) for the wavy environmental problem (electromagnetic, sound, light waves and etc.) in audiovisual EM environment. It is because we are originally afraid of the risk because of no action without reaction and no utility without risk just as seen remarkably in well-known EM problem[4-9] (with respect to the Relationism between material and human being surrounded with various types of wave as if the smog) in the shadow of the achievement of the rapid progress and the systematic development of the high-tech civilization (like an e-learning style), since the quality of our original human ability seems to be partly more and more lowered inseparably according to the use of high technology and we cannot help feeling that it is impossible to keep constantly our healthy natural life style supported by the synergism between mind and body, nature and man, or science and humanities (or literature).

2 Some Normative or Qualitative Suggestion Learned from Selected History on Philosophy of Ethics and Audiovisual EM Environment

As is now well known, on the problems of thoughts for an ethics, there are found many pioneers[11-15]. Though needless to say those are limited only within the range which we have known, according to bringing past pioneers’ thoughts to our memory, we will enumerate some suggestive views1 of us on ethics latently for the audiovisual EM environment with fragmentarily learning and citing their instructive aspects, especially by paying our attention to the relationship (mainly, risk and utility)

1 In the philosophy related to ethics, still now, there are many disputes concerning to spiritualism, materialism and pantheism and so on since Thales called the first philosopher by Aristoteles. We have suggested not general ethics (philosophy) but the ethics related to only the problem in the situation under using audiovisual EM system as a first step to achieve harmony between literature and science from the viewpoint of “Relationism-First”, little by little, in a form of "generalist".
between ethics (or normality) and technology (or science), as follows.

(i) In the eighteenth century known as the enlightening times, many philosophers especially urged the importance of reflecting more humanistic ethics stand in the Christian religion to rationalize it further. But Julien Offray de La Mettrie insisted that every spiritual function cannot exist apart from every natural world (here we can see the beginnings for the synergism of humanities and science or ethics and technology) and Paul-Henri Thiry, Baron d’Holbach said that human ignorance (on the order of nature) is the mother of every religion by insisting that the justification of moral rules can be formed based on understanding the laws of nature and one’s unhappiness is due to one’s ignorance of the laws of nature (though it might be an ultraism on synergism of humanities and science, concerning to this, he additionally said that dominators and churchmen at that time may lead the truth to the wrong way and they may guide the general public into spiritual ignorance). After all, many philosophers at that time were perplexed on how to treat the general public different from an individual. Jean-Jacques Rousseau insisted on the latent risk that the remarkable change of the ethical character of human beings will be caused by leaving from close adherence to nature and he had already known the difficulty of finding the way to return to the past state of the simple life with warm social relationship since the key to open the road of intelligence for traffic chiefly exists in the environment of ethical education itself. More concretely, Jean-Jacques Rousseau insisted that the environment and the education filled with artificiality must be reversed widely with attacking the world trend with artificiality at that time such as the insincerity, the pretended politeness, the waterless love, the sense of civic responsibility and so on (then, as now) especially in ethics. As is well known, the wartime has gone when individually deepening the inside of one’s mind and one’s rationality was partly neglected. Especially, in Japan, the hand controlled the mouth occasionally to become reckless. Now, inversely, the mouth controls the hand and first of all one tends to rush about looking for a bad person by emphasizing only faults of others occasionally. Even at the present time, when one is irresponsible and talkative especially by use of only audiovisual EM system, or only e-learning style, it seems that the above philosophers’ suggestions are still useful. At the same time, it seems that these suggestions will serve as an important reference to find the risk latent in the environment of the audiovisual EM system which is the center of the object in this paper.

(ii) When we devote ourselves to human relations only through the audiovisual system by leaving the face-to-face human relations in which there are vivid experiences and direct contacts among
their living lives (like as seen in e-learning), we are afraid of the latent risk that we fall into the one-sided communication based on some subjective and prejudiced principle only by using the sense of sight and the sense of hearing. As Martin Heidegger pointed out severely, although the concept towards truth in principle must be original logos: reason which collects and unifies the information of all things in the universe, it has very often become oral logos: language which is superficial. It has been reduced to the surface epistemology whose purpose is to prove the justification of understanding oneself and it has become self-defensive. He said after all it seems that “truth” has been becoming to merely the self-assertion for “justification” of scholars and he said, “Listen to the voice of nature and obey it!” Heraclitus who was contemporary with Siddhattha Gotama insisted that original logos is the principle (for existence) that doesn’t depend on the subjectivity and we can find truth just beyond the subjectivity. By comparing all things in the universe to the living fire that burns and goes out by the natural laws (all things are in a state of flux), he violently fought throughout his life to defend the philosophy against the contamination by the principle of the subjectivity (that is, sometime, against the insincere talkativeness). In the present time when the high technology and the cyber communication by an audiovisual EM system is widely used, the more criticism toward others is severe, the more deepening oneself is sometimes lacked, it seems that this indication must be still now taken care of and we have to introduce more and more some blended learning style especially in the pedagogy beyond only an e-learning style.

(iii) The Italian philosopher Giordano Bruno in the age of Renaissance insisted that it is impossible to pursue truth sufficiently by the education in the specified artificial organization (i.e., the university attached to the church at that time) well known as scholasticism and spread the objection of scholasticism and the Copernican heliocentric theory at the risk of his life (just like the Japanese Buddhist monk Shinran) by throwing away his canonical robe and wandering around various places in Europe. He stuck his opinion in the Inquisition for seven years and was burned at the stake as a heretic by insisting that God is nature itself which include all things and it should be the ultimate goodness in ethics aiming at the union between the person and cosmic life and the Christian view for the afterlife especially at that time is partly even hypocritical. Still in the present time of high technology, if we pay a special emphasis on the educational standpoint (in a form of blended learning style) from the viewpoint with the cosmic, on the ethical wide sense of unity that mind and body cannot be separated and there is the mutual and close relationship between phenomena in nature and incidents in our human world, we must not make
use of the communication by the practical vivid experiences among many living human beings (in which activated lives can be seen) only as the supplement to the audiovisual education system like an e-learning style (which will be generally applied more and more). Especially in the present time when the lifeless material without actual living speaking is regarded as important and we are apt to be forced into the high-technological EM environment and the daily life style just like precarious day-to-day management without any purpose in our reflection, it seems to be fundamental that this point must keep to be our faith beyond the introspection.

(iv) Leo Tolstoy severely pointed out that with practical use of the scientific technology, ethical words related to human (such as true, goodness, beauty, love, life and so on) will be rejected more and more and new scientific (and operational) terms common in the world will be used as though there are no words except those along with the contamination perpetrated by the utility (or artificial) value and the lively core with the breath of life in the word are replaced to showy and superficial other word (related to mainly the material world) and that is redefined in a distorted form of the local meaning convenient to the artificial usage in each professional field and, finally, it may invite the risk that people will be driven into the thinking suspension to the understanding of the total image as if we cannot see anything in the dark. Nowadays, still in the audiovisual EM system based on the usage of IT, it seems to us that there are increasing the number of the inhabitants (with the economy of thinking and the renunciation of thinking) who are carried away by the current of the times (like thin ice) with averting their eyes from the negative part latent in the shadow and saying only the convenience (or artificial usefulness) with special emphasis (sometimes as seen in an e-learning). Since the separation of the front and the back (light and shadow, technology and ethics) on the mirror is originally impossible, it will become a suicidal act in the long run to entrust all our own lives with the local part of only the front side on the mirror as if laying it in pledge. For example, by believing that only phenomena and function are scientific with forgetting their essence and true meaning, sometimes, most of people in scientific world seem to welcome the tendency of increasing such a localization as the victory of the science. On the other hand, sometime, most of people in the religious world (Pharisees at that times) seem to believe deepening only the local part in the normative side to be their best. Moreover, a few people proudly assert that the day when the whole form and the true form can be clearly understood will come in future if each fragmental side interested by them will have been completely elucidated. However, Leo Tolstoy said that such a day will never come. In the present day of high technology like an audiovisual EM system, it seems that
it must be indispensable for the environment, especially for the fragmentation of ethical education, to introduce the concept in principle that mind and body cannot be separated and to cooperate each other based on the criterion of Relationism-First[16] in various different fields without losing ourselves in modern instrumental conveniences (Blended learning with no e-learning is vacancy but e-learning with no blended learning is blind action).

(v) Leo Tolstoy said that we must not confuse mere materials with the work itself (e.g., the progress of educational science technology doesn’t mean the improvement of educational contents) because we may be unable to indicate even how to give a share of a slice of bread in our hand even though you may merely know how many laws by which animal egos of individual or group and material are governed by discarding our deep rational consciousness which aims unification of whole thing and philanthropy. That is, the audiovisual information technology like an e-learning style is essentially different from the contents of the information sent from it. He said that we may be unable to pick out the true life and value of ourselves latent inside no matter how scientifically and objectively we at all times analyze and observe the personal relations in our real lives (we can see them) only in time and space. The pure Christian Tolstoy continued his writing activity by being fond of farming at the same time since he believed that true life style can be partly found in the lives of farmers of the northern provinces who continue to work day after day to the end of their lives as hard as they can, according to the truth that there is mutual and close relationship between phenomena in nature and incidents in our human world or heaven and earth cannot be separated. He said that no matter how talkatively scientists emphasizing only the lower structure (and/or the side of material) and also religionists emphasizing only the upper structure (and/or the side of worth) give the teachings by dividing the vivid whole with a sense of life into two parts, they may lead to teach precisely only the local knowledge in the died state by resolving the living whole image into fragments. After all they lost the unification. So, he insisted that we can become a believer of God at the end of deepening your own profound well-balanced reason and he was excommunicated from the Russian Orthodox Church at that time (cf. written works: “Criticism and dissection to dogmatic theology”), and he said The City of God is only in the ultimate conscience of yourself. He pointed out that they should practically service the education of primitive people like farmers by means of their knowledge, not as topdown doctrines but as ground up culture. If we believe strictly that mind and body have not be separated and, furthermore nature and man should be unified as the essence or the purpose of our life, it seems that at the present time when the
opportunities of face-to-face communication with direct contacts tend to decrease more and more (like as seen in only an e-learning style), if we want to dedicate ourselves to adopting audiovisual technology, we should show at least the pictures and/or movies with real vivid experiences including nature and/or macrocosm and being full of the human throbbing pulse (even in a form of blended learning style) more than only showy artificial performance as the contents of communication information in audiovisual EM system like an e-learning style.

(vi) It is nothing new to say that from the standpoint (i.e., materialism) of Karl Marx and Friedrich Engels, who advocated that human consciousness is essentially provided by actual life since the development of human spiritual life inevitably depends radically on the material development in society, reforms of (value) education and social system should be thought up as new driving force on the construction of new society based on the understanding of law of social development. However, it seems to be sure that Marx himself proposed his proposition not as the eternal and universal principle found in history but the mere fundamental idea, that is, leading strings for the concrete and deep research of social sciences. After all, it seems that it may suggest the necessity of newly building the affluent humanism based on his proposition further in the future. Also, it seems that there was a little confusion of the understanding concerning to the division of the lower and upper structures even while Engels was alive. As soon as Darwin’s theory of evolution was widely received, every side of harmonic cooperation in the organic natural world became to be misinterpreted only as the struggle for existence. Against it, Engels said definitely in dialectics of nature that it is like a childish act to generalize the historical evolution of the universe and various natural environment only from a viewpoint of this struggle for existence. From this standpoint, how concretely and organically we have to fuse into one the (value) educational philosophy at the present time and the environment of audiovisual (technical) education system (i.e., science for education in a wide sense), based on the first reasonable division of the upper and lower structures (taking with sublation)? First, it seems that based on the criterion of Relationism-First, we will have to change the scene of our mind since our infancy to prevent us from becoming permanent maneuvering person like a hacker who regard human relations as ones of machinery and have to find some serious blended learning style education capable of deeply learning the real vivid experience with a cosmic sense of unity (because there is a marked difference between artificial intelligence and our natural intelligence). Ideally, we will have to find systematically (e.g., even if in a small scale just like EMC) all-around education (toward the technical expert with the synergism of humanities and science having vividly high level sense
of ethical values and literary art) capable of assimilating to different culture in every possible opportunity, especially in making the best of an audiovisual EM system (as a form of blended learning style beyond e-learning style).

3 Some Descriptive and Quantitative Suggestion Linked with High-Tech of Science Related to EM and Sound in an Audiovisual System

It seems that the problems of High Technology Pollution, which are becoming to the central subject in EMC, were caused by ignoring multiple (linear and/or nonlinear) mutual relationship among many environmental factors in both sides of the natural world and the human society, by taking precedence of only utility (in an e-learning style) over the whole style of truth including any cultural ethics and reaction. For the purpose to solve such problems, first of all, we have proposed some methodology\[16, 17\] based on the criterion of Realationism-First (e.g., more concretely, hierarchical expansion form of Bayes’ principle) that the mutual relationship of related environmental factors as many as possible should be first investigated under the viewpoint that the truth should be superior to the other individually (selfishly?) specified utility sides. As a trial for intersubjective analytical method, here, we have tried to use some extended correlation analysis of Bayes’ principle (including from linear to nonlinear relationship) limited to the correlation between two factors such as light and shadow: risk and utility. As examples in principle, for electromagnetic filed (especially related to bioeffect - some risk side) and sound (related to our information communication - clear utility side) as two contrastive factors in the audiovisual EM environment, the subject on estimating how the magnetic field (especially risk side) will affect and/or interfere the sound (especially utility side) is investigated here. More concretely, in the case of attaching biological protective oscillator (TecnoAO: CE mark, ISO sanction) by taking the higher order correlation information into consideration, the probability distribution of the magnetic field eminently influenced by the above countermeasure can be estimated by only the measurement of the sound fluctuation. Through an example of the effectiveness of our method, we could partly confirm that the proposed method is useful for the inverse problem (inevitably needed in EMC, here, the problem estimating the sound (utility) from the magnetic field (risk)).

Nowadays, many bioeffects\[4-10\] (its incidence is sure but the degree of function is not sure still now) caused by electromagnetic, sound and light waves are known as follows. For example, the nervous system of mankind is so much affected by any field of EM, sound and light waves in the neighborhood of the specific frequency band from 15 Hz to 20 Hz (because calcium ions are occasionally lost out). This can be particularly induced even by the signal modulated into high frequency band with the slow change of its amplitude. Furthermore, the generated order, generated time interval and each of their
proper durations between sound and flash of lightning cannot be recognized as it is. There are the biological priority effect between the sense of sight and the sense of hearing that the sense of hearing is reflected by the sense of sight with more strong ability of evoking attention, the promotion effect between different senses, the synergistic effect between sense and stress, participation in VDT syndrome such as general malaise, relevance to circadian rhythm due to the reflection to the pineal body by the exposure of electromagnetic and light fields, the change of brain waves in the case when we have received sound and light at the same time, chromesthesia, the cooperation effect of music and picture and so on. Especially, from the above effects, in the environment of audiovisual system, there is the latent risk caused by the exposure of both EM and sound waves. In Japan, the recognition for this is apt to be followed fairly late behind compared to one in EU. However, it seems to us that this problem will be gradually recognized as tangible in the future. To evaluate the bioeffect of EM and sound waves, it is especially necessary to grasp not each of them but the whole image. So, to grasp the whole image, under a criterion of Relationism-First, we introduce first the extended correlation analysis already reported partly by us.

### 3.1 Extended Correlation Analysis

As stated in the above, let's consider only two factors as one of quantitatively concrete examples (magnetic and sound waves) closely related to EMC problem in an e-learning style audiovisual system which seems to be impossible to pick up their mutual interaction without being based on a standpoint of Relationism-First. That is, first, the proposed method is limited to the relationship between only two factors $x$, $y$ as a trial at an early stage of our study. Generally, in any problem, main two faces: utility and risk can be always found and they must be considered at the same time and in the same ring (as possible). So, the proposed theory seems useful even though it is limited for only two factors.

Now, let us state the summary (its brief outlines of detailed calculation process is shown in Appendix A) of the extended correlation analysis\cite{16,17} according to the fluctuating amplitude ranges of the environmental factors $x$, $y$. In the real case, they usually fluctuate in a complicated probability distribution form deviated from any standard probability distribution form. To express the complicated probability density function (abbr. pdf) hierarchically, the following orthonormal series expansion form \cite{18} can be generally used:

$$P(x, y) = P_0(x)P_0(y)\sum_{m=0}^{\infty} \sum_{n=0}^{\infty} A_{mn}\phi_m^{(1)}(x)\phi_n^{(2)}(y)$$  \hspace{1cm} (1)

with

$$A_{mn} = \left\langle \phi_m^{(1)}(x)\phi_n^{(2)}(y) \right\rangle,$$  \hspace{1cm} (2)

where $P_0(x)$, $P_0(y)$ are the well-known standard pdf forms whose dominant fluctuations of $x$, $y$ are

approximately described, respectively, and \( \phi_m^{(1)}(x), \phi_n^{(2)}(y) \) are orthonormal functions with weighting function \( P_0(x), P_0(y) \), respectively and \(<\cdot\>) denotes an expectation operation with respect to \( x \) and \( y \). Especially, how to select the function form of \( P_0(x) \) or \( P_0(y) \) at the first stage of study is very important. All of linear and non-linear type correlation information are hierarchically and synthetically in every distribution parameters \( A_{mn} \), and every effect to \( y \) based on the fluctuation of \( x \) can be presented by the conditional pdf, \( P(y|x) \), of \( y \) conditioned by \( x \). Its general form can be obtained as follows:

\[
P(y|x) = \frac{P_0(y) \sum_{m=0}^{\infty} \sum_{n=0}^{\infty} A_{mn} \phi_m^{(1)}(x) \phi_n^{(2)}(y)}{\sum_{m=0}^{\infty} A_{mn} \phi_m^{(1)}(x)}.
\]

By using Eq. (3) and the following orthonormal expansion series form of \( y^k \) with an arbitray integer \( k \):

\[
y^k = \sum_{i=0}^{k} C_i \phi_i^{(2)}(y),
\]

the regression function of \( y^k \) with respect to \( x \) can be concretely expressed by the following hierarchical form:

\[
\langle y^k \mid x \rangle = \frac{\sum_{m=0}^{\infty} \sum_{n=0}^{\infty} C_k A_{mn} \phi_m^{(1)}(x)}{\sum_{m=0}^{\infty} A_{mn} \phi_m^{(1)}(x)}.
\]

Furthermore, by making use of all of the above used mutual correlations, the whole probability distribution of only one variable can be estimated and/or predicted from the observed data of another variable. That is, the pdf \( P_s(y) \) of only \( y \) from the observed data of \( x \) can be estimated and/or predicted by use of the following form:

\[
P_s(y) = P_0(y) \sum_{i=0}^{\infty} E_i \phi_i^{(2)}(y)
\]

with

\[
E_i = \langle \sum_{m=0}^{\infty} A_{mn} \phi_m^{(1)}(x) \rangle \langle \sum_{m=0}^{\infty} A_{mn} \phi_m^{(1)}(x) \rangle_x,
\]

where \(<\cdot>_x\) denotes an expectation operation with respect to \( x \). Inversely, the similar formula concerning to \( x \) from \( y \) can be obtained for \(<x^k \mid y>\) and \( P_s(x) \).

According to the fluctuating amplitude range of environmental factors due to physical meaning and/or the restriction of the measurement instrument, we have given \( P_0(x), P_0(y), \phi_m^{(1)}(x) \) and \( \phi_n^{(2)}(y) \) for the fluctuating amplitude range of \( x \) and \( y \) in the following.

(i) interval of \( x : (-\infty, \infty) \) and interval of \( y : (-\infty, \infty) \)

\[
P_0(x) = \frac{1}{\sqrt{2\pi}\sigma_x} e^{-\frac{(x-\mu_x)^2}{2\sigma_x^2}}, P_0(y) = \frac{1}{\sqrt{2\pi}\sigma_y} e^{-\frac{(y-\mu_y)^2}{2\sigma_y^2}}
\]
\[ \phi_m^{(1)} (x) = \frac{H_m \left( \frac{x - \mu_x}{\sigma_x} \right)}{\sqrt{\pi^m}}, \quad \phi_n^{(2)} (y) = \frac{H_n \left( \frac{y - \mu_y}{\sigma_y} \right)}{\sqrt{\pi^m}} \]

and

\[ C_{10} = \mu_y, \quad C_{11} = \sigma_y, \]

where \( H_m (\cdot) \) denotes the \( m \)-th order Hermite polynomial, \( \mu_x \) and \( \mu_y \) are means of \( x \) and \( y \), respectively, and \( \sigma_x \) and \( \sigma_y \) are standard deviations of \( x \) and \( y \), respectively. Let’s call Eq. (1) employing Eqs. (8), (9) the statistical Hermite series expansion type joint pdf.

(ii) interval of \( x : [0, \infty] \) and interval of \( y : [0, \infty] \)

\[
\begin{align*}
P_0 (x) &= \frac{1}{\Gamma (m_x) s_x} \left( \frac{x}{s_x} \right)^{m_x - 1} e^{-\frac{x^2}{2s_x^2}}, \\
\frac{\phi_0 (x)}{\phi_0 (y)} &= \frac{1}{\Gamma (m_y) s_y} \left( \frac{y}{s_y} \right)^{m_y - 1} e^{-\frac{y^2}{2s_y^2}},
\end{align*}
\]

with

\[
\begin{align*}
\phi_m^{(1)} (x) &= \sqrt{\frac{\Gamma (m_x) m!}{\Gamma (m_x + m)}} L_m^{(m_x - 1)} \left( x \frac{y}{s_x} \right), \\
\phi_n^{(2)} (y) &= \sqrt{\frac{\Gamma (m_y) m!}{\Gamma (m_y + n)}} L_n^{(m_y - 1)} \left( y \frac{y}{s_y} \right),
\end{align*}
\]

\[ m_x = \frac{\mu_x^2}{\sigma_x^2}, s_x = \frac{\sigma_x^2}{\mu_x}, m_y = \frac{\mu_y^2}{\sigma_y^2}, s_y = \frac{\sigma_y^2}{\mu_y} \]

and

\[ C_{10} = m_y s_y, C_{11} = -\sqrt{m_ys_y}, \]

where \( L_n^{(a)} (\cdot) \) denotes the \( n \)-th order associated Laguerre polynomial, \( \mu_x \) and \( \mu_y \) are means of \( x \) and \( y \), respectively, and \( \sigma_x \) and \( \sigma_y \) are standard deviations of \( x \) and \( y \), respectively. Let’s call Eq. (1) employing Eqs. (11), (12) and (13) the statistical Laguerre series expansion type joint pdf.

(iii) interval of \( x : [a, b] \) and interval of \( y : [c, d] \)

\[
\begin{align*}
P_0 (x) &= \frac{(x - a)^{\gamma_1 - 1} (b - x)^{\alpha_1 - \gamma_1}}{(b - a)^{\alpha_1} B (\gamma_1, \alpha_1 - \gamma_1 + 1)}, \\
P_0 (y) &= \frac{(y - c)^{\gamma_2 - 1} (d - y)^{\alpha_2 - \gamma_2}}{(d - c)^{\alpha_2} B (\gamma_2, \alpha_2 - \gamma_2 + 1)},
\end{align*}
\]

\[
\begin{align*}
\phi_0^{(1)} (x) &= \sqrt{\frac{\Gamma (\alpha_1 + \gamma_1 - 1) \Gamma (\alpha_2 + 2m) \Gamma (\alpha_1 + m) \Gamma (\gamma_1 + m)}{\Gamma (\alpha_2 - \gamma_2 + 1) \Gamma (\alpha_1 - \gamma_1 + 1)} \Gamma (\gamma_1 + 1)}} G_m \left( \alpha_1, \gamma_1; \frac{x - a}{b - a} \right), \\
\phi_0^{(2)} (y) &= \sqrt{\frac{\Gamma (\alpha_2 - \gamma_2 + 1) \Gamma (\alpha_2 + 2m) \Gamma (\alpha_2 + n) \Gamma (\gamma_2 + n)}{\Gamma (\alpha_2 - \gamma_2 + 1) \Gamma (\gamma_2 + 1) \Gamma (\alpha_2 - \gamma_2 + 1)}} G_n \left( \alpha_2, \gamma_2; \frac{y - c}{d - c} \right),
\end{align*}
\]

\[
\begin{align*}
\alpha_1 &= \frac{(\mu_x - a) (b - \mu_x)}{\sigma_x^2} - 2, \quad \gamma_1 = \frac{(\mu_x - a) (\alpha_1 + 1)}{b - a}, \\
\alpha_2 &= \frac{(\mu_y - c) (d - \mu_y)}{\sigma_y^2} - 2, \quad \gamma_2 = \frac{(\mu_y - c) (\alpha_2 + 1)}{d - c}
\end{align*}
\]
Some Consideration in Life Science on Ethics and EMC around Audiovisual Information Technology Related to Blended Learning Style Pedagogy

and

\[ C_{10} = \frac{\gamma_2 (d - c)}{\alpha_2 + 1} + c, \quad C_{11} = -\frac{d - c}{\alpha_2 + 1} \sqrt{\frac{(\alpha_2 - \gamma_2 + 1) \gamma_2}{\alpha_2 + 2}}, \]  

(18)

where \( G_n (\alpha, \gamma; z) \) denotes the \( n \)-th order Jacobi’s polynomial, \( \mu_x \) and \( \mu_y \) are means of \( x \) and \( y \), respectively, and \( \sigma_x \) and \( \sigma_y \) are standard deviation of \( x \) and \( y \), respectively. Let’s call Eq. (1) employing Eqs. (15), (16) and (17) the statistical Jacobi series expansion type joint pdf.

3.2 Application to Some Trial Experiments for Audiovisual Environment Exposed by both EM and Acoustic Waves

3.2.1 Some Trial Experiment for Audiovisual Environment Exposed by both EM and Acoustic Waves from Display

We have tried to apply the proposed method to some trial experiments for audiovisual system exposed by both EM and acoustic waves. First, let’s show experiments in the following.

(i) Fig. 1(a) shows an experimental setup for the CRT display. When a shooting game (DOOM LEGACY) was played on a personal computer, the magnetic field strength and the sound level were measured each 5 seconds and 100 sets of sampled values are obtained. In this experiment, the sound level meter was set at the location of 30 cm distant from the personal computer and the EM strength meter was set at the location of \( d = 30 \text{cm} \) distant from the CRT display. The measurement was done before and after the attachment of the active bio-controller as some magnetic oscillator named as Tecno AO (partly, CE mark: ISO sanction) to the CRT display.

(ii) Fig. 1(b) shows experimental setup for LCD. In this experiment, under playing the same game stated above on personal computer, the magnetic field strength and the sound pressure level were measured before and after attaching Tecno AO to the side of LCD. The magnetic field strength and the sound pressure level was simultaneously sampled each 5 seconds and 99 sets of sampled values were obtained.

(iii) Fig. 1(c) shows experimental setup for a notebook computer. While DVD movie was played on the notebook computer, the magnetic field strength and the sound pressure level were measured each 5 seconds before and after attaching TecnoAO and 100 sets of sampled values are obtained.

(iv) Fig. 1(d) shows experimental setup for a cellular phone. When the cellular phone 1 (P906i,
Panasonic) was connecting with the cellular phone 2 and was simultaneously receiving the sound of the regenerated DVD movie from cellular phone 2, the magnetic field strength and the sound pressure level around cellular phone 1 were observed. The sound pressure level and the magnetic field strength were measured each 10 seconds and 100 sets of sampled values were obtained.

In each experiment, the measurement was done before and after the attachment of the active bio-controller as some magnetic oscillator (TecnoAO) to the display. Then, it could be clearly seen that the magnetic field strength (connected with some risk side) is reduced by the attachment of TecnoAO although the sound pressure level (connected with clear utility side) doesn’t change so much, similarly in any of the above cases.

![Fig. 1 Experimental setups.](image-url)
3.2.2 Application to Trial Experiments

(1) Method by use of statistical Hermite series expansion

Let’s show the results by applying the method by use of the statistical Hermite series expansion type joint pdf to the above experiments. The results for the experiment (i) is shown in Figs. 2 and 3. To get the theoretical regression function in Fig. 2, for the equation set $k = 1$ in Eq. (5), as the denominator, the sum of the initial term and expansion terms from the 1st to the 8-th order was used. And as the numerator, the sum of the initial term and expansion term of only the 1st order, the sum of the initial term and expansion terms from the 1st to the 2nd order, the sum of the initial term and expansion terms from the 1st to the 3rd order and the sum of the initial term and expansion terms from the 1st to the 4-th order were used. We call them (1, 8) approximation, (2, 8) approximation, (3, 8) approximation and (4, 8) approximation, respectively. To get the theoretical cumulative probability distribution in Fig. 3, in the numerator of Eq. (7), expansion terms from the initial to the 6-th order were used and in the denominator of Eq. (7), expansion terms from the initial to 8-th order were used. In Eq. (6), the initial term, the sum of the initial term and expansion terms from the 1st to the 3rd order, and the sum of the initial term and expansion terms from the 1st to the 6-th order were used. We call them the 1st approximation, the 4-th approximation and the 7-th approximation, respectively.

In Fig. 2, it can be seen that the theoretical regression function agrees better with experimental conditional expectations as the degree of approximation increases. Especially, in Fig. 3, it can be clearly
Fig. 3 A comparison between the theoretically estimated cumulative probability distributions and experimentally sampled values for the experiment (i).

Fig. 4 A comparison between the theoretically estimated cumulative probability distributions and experimentally sampled values for the experiment (ii).

Fig. 5 A comparison between experimental conditional expectations and theoretical regression functions of the sound pressure level to the magnetic field strength without attachment of Tecno AO for the experiment (iii).
(a) Magnetic field strength

(b) Sound pressure level

Fig. 6 A comparison between the theoretically estimated cumulative probability distributions and experimentally sampled values for the experiment (iii).

Fig. 7 A comparison between experimental conditional expectations and theoretical regression functions of the sound pressure level to the magnetic field strength without attachment of Tecno AO for the experiment (iv).

(a) Magnetic field strength

(b) Sound pressure level

Fig. 8 A comparison between the theoretically estimated cumulative probability distributions and experimentally sampled values for the experiment (iv).
seen that the difference between theoretical cumulative probability distribution and experimental values becomes smaller as the degree of approximation increases.

The results for the experiment (ii) is shown in Fig. 4. In the same way for Fig. 3, the theoretical cumulative probability distributions in Fig. 4 were calculated. In Fig. 4, it can be clearly seen that the difference between theoretical cumulative probability distribution and experimental values becomes smaller as the degree of approximation increases. This shows the effectiveness of using the higher order mutual correlation.

The results for the experiment (iii) is shown in Figs. 5 and 6. In the same way for the above figures, the theoretical cumulative probability distributions in Fig. 5 were calculated. In Fig. 5, it can be seen that the theoretical regression function agrees better with experimental conditional expectations as the degree of approximation increases. Especially, in Fig. 6, it can be clearly seen that the difference between theoretical cumulative probability distribution and experimental values becomes smaller as the degree of approximation increases.

The results for the experiment (iv) is shown in Figs. 7 and 8. In the same way for the above figures, the theoretical cumulative probability distributions in Fig. 8 were calculated. In Fig. 7, it can be seen that the theoretical regression function agrees in some degree better with experimental conditional expectations as the degree of approximation increases. Especially, in Figs. 8, it can be clearly seen that the difference between theoretical cumulative probability distribution and experimental values becomes smaller as the degree of approximation increases.

Although the results by applying our method by use of the statistical Laguerre series type joint pdf to the experiments were obtained in almost the same style in this method, those are omitted owing to page limitation. However, their experimental results and related explanation will be announced publicly in the next paper.

(2) Method by use of the statistical Jacobi series expansion
Let’s show the results by applying our method by use of the statistical Jacobi series type joint pdf to the experiments. The statistical Hermite series expansion is a special case when $a, c$ tend to negative infinity and $b, d$ tend to infinity in the statistical Jacobi series expansion, and the statistical Laguere series expansion is a special case when $a, c$ were set to zero and $b, d$ tend to infinity in the statistical Jacobi series expansion. The results for the experiment (i) is shown in Figs. 9 and 10. In the case without attachment of TecnoAO, the finite interval $[a, b]=[30 \text{ mA/m}, 42 \text{ mA/m}]$ of magnetic field fluctuation was chosen, and the finite interval $[c, d]=[45 \text{ dB}, 78 \text{ dB}]$ of sound pressure level fluctuation was chosen.
In the case with attachment of TecnoAO, the finite interval \([a, b]=[39 \text{ mA/m}, 42 \text{ mA/m}]\) of magnetic field fluctuation was chosen, the finite interval \([c, d]=[45 \text{ dB}, 78 \text{ dB}]\) of sound pressure level fluctuation was chosen.

To get the theoretical regression function in Fig. 9, for the equation set \(k = 1\) in Eq. (5), as the denominator, the sum of initial term and expansion terms from the 1st to 8-th order were used, and as the numerator, the sum of initial term and expansion term of only the first order, the sum of initial term and expansion terms from the 1st to the 2nd order, the sum of initial term and expansion terms from the 1st to the 3rd order, and the sum of initial term and expansion terms from the 1st to the 4-th order were used. We call them \((1, 4)\) approximation, \((2, 4)\) approximation, \((3, 4)\) approximation and \((4, 4)\) approximation, respectively.

To get the theoretical cumulative probability distribution in Fig. 10, in the numerator of Eq. (7), expansion terms from initial to the 4-th order were used and in the denominator of Eq. (7), expansion terms from initial to the 6-th order were used. In Eq. (6), initial term, the sum of initial term and expansion terms from the 1st to the 3rd order, and the sum of initial term and expansion terms from the 1st to the 6-th order were used. We call them the 1st approximation, the 4-th approximation and the 7-th approximation, respectively.

The results for the experiment (ii) is shown in Fig. 11. In the case without attachment of TecnoAO, the finite interval \([a, b]=[0.72 \text{ mA/m}, 0.82 \text{ mA/m}]\) of magnetic field fluctuation was chosen, and the finite interval \([c, d]=[41 \text{ dB}, 68.5 \text{ dB}]\) of sound pressure level fluctuation was chosen. In the case with

![Theoretical regression curves](image)

**Fig. 9** A comparison between experimental conditional expectations and theoretical regression functions of the sound pressure level to the magnetic field strength without attachment of Tecno AO for the experiment (i).
attachment of TecnoAO, the finite interval \([a, b]=[0.7 \text{ mA/m}, 0.8 \text{ mA/m}]\) of magnetic field fluctuation was chosen, and the finite interval \([c, d]=[41 \text{ dB}, 74 \text{ dB}]\) of sound pressure level fluctuation was chosen.

The results for the experiment (iii) is shown in Fig. 12. In the case without attachment of TecnoAO, the finite interval \([a, b]=[26 \text{ mA/m}, 31 \text{ mA/m}]\) of magnetic field fluctuation was chosen, and the finite interval \([c, d]=[41 \text{ dB}, 90 \text{ dB}]\) of sound pressure level fluctuation was chosen. In the case with attachment of TecnoAO, the finite interval \([a, b]=[25 \text{ mA/m}, 31 \text{ mA/m}]\) of magnetic field fluctuation was chosen, and the finite interval \([c, d]=[20 \text{ dB}, 170 \text{ dB}]\) of sound pressure level fluctuation was chosen.

The results for the experiment (iv) is shown in Fig. 13. In the case without attachment of TecnoAO, the finite interval \([a, b]=[0.25 \text{ mG}, 0.36 \text{ mG}]\) of magnetic field fluctuation was chosen, and the finite interval \([c, d]=[42 \text{ dB}, 60 \text{ dB}]\) of sound pressure level fluctuation was chosen. In the case with
attachment of TecnoAO, the finite interval \([a, b]=[0.2 \text{ mG}, 0.28 \text{ mG}]\) of magnetic field fluctuation was chosen, and the finite interval \([c, d]=[42 \text{ dB}, 56 \text{ dB}]\) of sound pressure level fluctuation was chosen.

In Figs. 10, 11, 12 and 13, it can be seen that the difference between theoretical cumulative probability distribution and experimental values becomes smaller as the degree of approximation increases. After all, results in (1) and (2) mean that it is necessary to make use of not only the lower order correlation but also the higher order correlation for the correlation analysis between environmental factors (magnetic field strength and sound pressure level) although it is too difficult to find its latent relationship between them by making use of the first and the second order correlation between them in terms of usual linear regression analysis. Furthermore, these results show that we can make use of the proposed method based on the primary criterion of Relationism-First for investigating the magnetic field (with some risk) only by measuring the acoustic field (with clear utility) and investigating the acoustic field only by measuring the magnetic field.

Fig. 12  A comparison between the theoretically estimated cumulative probability distributions and experimentally sampled values for the experiment (iii).

Fig. 13  A comparison between the theoretically estimated cumulative probability distributions and experimentally sampled values for the experiment (iv).
4 CONCLUSIONS

As some issues latent in an audiovisual EM system especially related to the basic important position of blended learning beyond the operational e-learning, first, the qualitative risk given in the normative form has been pointed out with very fragmentally learning the old history from the ethical viewpoint of “Relationism-First”, especially for fear that it might not be good to refer to unnecessary detailed part in each segmental professional information, for our original purpose of emphasizing only the relationship itself between ethics and audiovisual technology. Next, the quantitative risk given in the descriptive form, that is, the wavy environmental problem (electromagnetic, sound waves) has been experimentally and theoretically pointed out especially having a keen awareness of the problem on the basic significance of blended learning exceeding somewhat splendid usefulness of e-learning in the field of pedagogy. As the methodology to get some whole image of the wavy environment, especially under a criterion of Relationism-First, it has been proposed that our proposed theory on extended correlation analysis is fairly reasonable and its usefulness has been fairly experimentally confirmed even if it might cover only some local scope, at least, in the style of principle experiment, except for the style of practical effectiveness in each segmental actual field. Especially, comparatively speaking, it had better to be noticed that the difference between the theoretical cumulative probability distribution curve (reflecting a whole image) and experimental sampled values becomes sufficiently smaller as the degree of approximation increases with adoption of many theoretical expansion terms (i.e., toward the higher order). In a case of comparing between the theoretical regression function curve of the first order (reflecting only a local image) and experimentally sampled points of conditional expectation seems to be not sufficient because of a fairly small number of experimental data owing to segmental limitation of our artificially preset conditional level (for a study on only local aspect).

NOTE

The purpose of our study is to find the way to harmonize between the literature and the science in the present time when there are many difficult problems such as environmental problems and the problems caused by ICT and genetic engineering and nanotechnology. In this paper, we would like to emphasize the need of some synergistic aspect between science and literature as a form of blended learning, especially in the study of EM environmental problem, more concretely, between ethics and EMC in the audiovisual environmental field (closely connected with well-known life science). That is, we would like to emphasize variously correlated information directly connected with an idea of relational concept (i.e., Relationism-First), more than a large amount of detailed information on individually separated professional field discovered after first artificially neglecting their mutual relationship.
Though we could find a fairly many classical reference books and papers in the respective literature and science field of individually separated professional study related to our present subject, here, we tried to focalize on how to accumulate these references in some significant style connected with only relational concept itself (i.e., Relationism-First) as much as we can, especially in the literature side.

In this sense, we positively didn’t touch on the individual detail of each professional references and tried to quote only mutually relational part of respective information in a style of very shortness, because we were afraid that our detailed quotation of too unrelated fragmentary knowledge maybe injure some original vivid expression of a whole image based on a relational concept (i.e., Relationism-First). Consequently, too many quotation of individually professional reference papers (especially in the literature side) were darlingly omitted in this paper and only small number of reference papers and dictionaries were quoted as their representative examples (also, owing to the page limit). On this point, we would like to get the reader’s better understanding.

In the first half of this paper, we dared to insist our sense of values to deepen our consideration, although there are theoretical heated disputes of the philosophy in history. In the latter half of this paper, we have not described the detail in the experiments intentionally to seize generally the relationship between our sense of values and physical effects in audiovisual system.

In this study, it should be noted that we have considered universally the audiovisual system both in the first half and in the latter half of this paper based on the concept of Relationism-First from the standpoint as a generalist of blended learning style.

P.S.1
For purpose of emphasizing some harmony between science and literature, most of philosophical sentence in the first chapter (relate to literature) is quoted from previously reported another paper [19] in the same style.

P.S.2
We have get the following reply to the conformity of our paper from Igor Grushetsky (Editor of Technical Acoustics), because of speciality on research paper and excess of page limit:

After long consideration our experts have concluded that your paper contains original and very interesting ideas. But philosophical content is too large for technical journal. Therefore the reviewers did not recommend to publish the paper in Technical Acoustics. Requirements for papers became more exacting lately.

However, it cannot be helped for us to think that most important viewpoint in our human life style should be focused on the following essentially basic point: We are absolutely impossible to pick up various interactive information of every types (from the lower linear to higher order nonlinear
correlations or from only two kinds to more than 3 kinds of different factors) among various kinds of cosmic and human factors (e.g., like between life and death, culture and science fields, heaven and person, mind and body, religion and science, action and reaction, spiritual and material, and etc.) without being based on the generalist’s standpoint of “Relationism-First” beyond the viewpoint of specialist’s standpoint of “Professionalism-First”.

Appendix A  Extended Correlation Analysis

First, let’s derive the expansion expression of the marginal density function of $x$, $P(x)$. By using the joint density function of $x$ and $y$, $P(x, y)$, the marginal density function of $x$, $P(x)$, can be expressed as

$$P(x) = \int_{-\infty}^{\infty} P(x, y)dy. \quad (A1)$$

By substituting Eq. (1) into Eq. (A1), $P(x)$ can be rewritten as

$$P(x) = P_0(x) \sum_{m=0}^{\infty} \sum_{n=0}^{\infty} A_{mn} \phi_m^{(1)}(x) \int_{-\infty}^{\infty} P_0(y) \phi_n^{(2)}(y) dy. \quad (A2)$$

By using the orthonormal property of $\phi_n^{(2)}(y)$:

$$\int_{-\infty}^{\infty} \phi_m^{(2)}(y) \phi_n^{(2)}(y) P_0(y) dy = \delta_{mn} \quad (A3)$$

($\delta_{mn}$ denotes the kronecker’s delta)

and

$$\phi_0^{(2)}(y) = 1, \quad (A4)$$

we can obtain the series expansion expression:

$$P(x) = P_0(x) \sum_{m=0}^{\infty} A_{m0} \phi_m^{(1)}(x). \quad (A5)$$

Next, let’s derive Eq. (3) based on Bayes’ theorem:

$$P(y|x) = \frac{P(x, y)}{P(x)}. \quad (A6)$$

Substituting Eqs. (1) and (A5) into Eq. (A6) easily leads to Eq. (3). Furthermore, let’s derive Eq. (5). The regression function of $y^k$ with respect to $x$ is defined as

$$\langle y^k | x \rangle = \int_{-\infty}^{\infty} y^k P(y | x) dy. \quad (A7)$$

By substituting Eqs. (3) and (4) into Eq. (A7) and changing the order of integral and summation, Eq. (A7) can be rewritten as
first, let’s derive eq. (10). from eq. (9), coefficients \( c_{10}, c_{11} \) are defined as follows:
\[
y = c_{10} \phi_0^{(2)}(y) + c_{11} \phi_1^{(2)}(y) .
\]
(B1)

First, let’s derive eq. (10). from eq. (9), \( \phi_0^{(2)}(y) \) and \( \phi_1^{(2)}(y) \) are given as
\[
\begin{align*}
\phi_0^{(2)}(y) &= 1, \\
\phi_1^{(2)}(y) &= \frac{y - \mu_y}{\sigma_y} .
\end{align*}
\]
(B2)

By substituting eq. (B2) into the right-hand side of eq. (B1) and arranging it as a sum of powers of \( y \), eq. (B1) is rewritten as
\[
y = \left( c_{10} - \frac{\mu_y}{\sigma_y} c_{11} \right) + \frac{c_{11}}{\sigma_y} y .
\]
(B3)

Comparing corresponding coefficients of the terms with the same powers of \( y \) in both sides of eq. (B3) leads to the following simultaneous equations:

\[
\begin{align*}
c_{10} - \frac{\mu_y}{\sigma_y} c_{11} &= 1, \\
\frac{c_{11}}{\sigma_y} &= \frac{\mu_y}{\sigma_y} .
\end{align*}
\]
By solving Eq. (B4), Eq. (10) can be obtained. Next, let’s derive Eq. (14). From Eq. (12), \( \phi_0^{(2)}(y) \) and \( \phi_1^{(2)}(y) \) are given as

\[
\begin{align*}
\phi_0^{(2)}(y) &= 1, \\
\phi_1^{(2)}(y) &= \frac{1}{\sqrt{m_y}} \left( m_y - \frac{y}{s_y} \right).
\end{align*}
\]

By substituting Eq. (B5) into the right-hand side of Eq. (B1) and arranging it as a sum of powers of \( y \), Eq. (B1) is rewritten as

\[
y = (C_{10} + \sqrt{m_y}C_{11}) - \frac{C_{11}}{\sqrt{m_y} s_y} y.
\]

Comparing corresponding coefficients of the terms with the same power of \( y \) in both sides of Eq. (B6) leads to the following simultaneous equations:

\[
\begin{align*}
C_{10} + \sqrt{m_y}C_{11} &= 0, \\
-\frac{C_{11}}{\sqrt{m_y} s_y} &= 1.
\end{align*}
\]

By solving Eq. (B7), Eq. (14) can be obtained. Finally, let’s derive Eq. (18). From Eq. (16),

\[
\begin{align*}
\phi_0^{(2)}(y) &= 1, \\
\phi_1^{(2)}(y) &= \sqrt{\frac{(\alpha_2 + 2) \Gamma(\alpha_2 - \gamma_2 + 1) \Gamma(\gamma_2 + 1)}{\Gamma(\alpha_2 - \gamma_2 + 2) \Gamma(\gamma_2)}} \left( 1 - \frac{\alpha_2 + 1}{\gamma_2} \frac{y - c}{d - c} \right).
\end{align*}
\]

By substituting Eq. (B8) into the right-hand side of Eq. (B1), Eq. (B1) is rewritten as

\[
y = C_{10} + C_{11} \sqrt{\frac{(\alpha_2 + 2) \Gamma(\alpha_2 - \gamma_2 + 1) \Gamma(\gamma_2 + 1)}{\Gamma(\alpha_2 - \gamma_2 + 2) \Gamma(\gamma_2)}} \left( 1 - \frac{\alpha_2 + 1}{\gamma_2} \frac{y - c}{d - c} \right).
\]

Upon arranging Eq. (B9) as a sum of powers of \( y \) and comparing the coefficients of \( y \) in the left-hand side with the ones of right hand side, the following simultaneous equations are obtained:

\[
\begin{align*}
C_{10} + C_{11} \sqrt{\frac{(\alpha_2 + 2) \Gamma(\alpha_2 - \gamma_2 + 1) \Gamma(\gamma_2 + 1)}{\Gamma(\alpha_2 - \gamma_2 + 2) \Gamma(\gamma_2)}} \left( 1 + \frac{\alpha_2 + 1}{\gamma_2} \frac{c}{d - c} \right) &= 0, \\
-C_{11} \sqrt{\frac{(\alpha_2 + 2) \Gamma(\alpha_2 - \gamma_2 + 1) \Gamma(\gamma_2 + 1)}{\Gamma(\alpha_2 - \gamma_2 + 2) \Gamma(\gamma_2)}} \left( \frac{\alpha_2 + 1}{\gamma_2} \frac{1}{d - c} \right) &= 1.
\end{align*}
\]

By solving Eq. (B10), Eq. (18) can be obtained.
References