About the new section "Harmonizer" in the program

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As part of the software "IMEDIS-EXPERT", starting from version 5.0, the mode of harmonization of frequencies is provided. This section is intended to expand the diagnostic and therapeutic capabilities of the doctor using the program through the use of various harmonic relationships between frequencies.

As is known, most of the signal frequencies used during electropuncture therapy are in the range from 0.1 to 100 Hz. This is due to a number of reasons. In particular, it is in this range (up to 300 Hz with an intensity of up to 1 mT) that natural fluctuations
geomagnetic field, to which the body is "accustomed" to react with the entire history of the development of life on Earth [1]. The second factor determining the use of this frequency range is that the resonance frequencies (frequencies of ion cyclotron resonance) of many inorganic and organic ions that play an important role in the organization
intracellular metabolism. These are K +, Na +, Mg ions^{2+}, Ca^{2+}, Cl-, HCO^{3-},
amino acids, coenzymes, DNA packers, etc. [1] Finally, signals of low frequencies can be formed by modern electronic devices with high accuracy and stability of parameters, which allows us to speak about the therapeutic effect of frequencies measured with an accuracy of 2-3 decimal places.

Low-frequency exposure in the frequency range under consideration has the following characteristic features noted by many researchers:

- there is often a latent (latency) period before exposure is manifested - from several minutes to several days;
- the body's sensitivity to the effects depends on the state of the body and, as a rule, is increased if the body is weakened due to illness or other reasons;
- the sensitivity of biological objects to one or another type of impact is manifested in some frequency ranges and reaches a maximum at resonance frequencies within these ranges;
- there is an effect of amplitude bands similar to the above-mentioned frequency bands; this means that the maximum effect of electromagnetic influence is achieved in some ranges of signal amplitudes, and as a rule, a signal of medium or low intensity is required;

- the minimum, threshold amplitude of the impact was not revealed; a signal with a certain frequency has a given effect even with an extremely small amplitude;
- the frequency and amplitude ranges of action at the cellular and organ levels, as a rule, coincide.

If you analyze the information on the frequencies of EAF therapy, you can make sure that the entire range up to 100 Hz is sufficiently dense and evenly covered

therapeutic frequencies, and it may seem that, figuratively speaking, wherever you stick, you will get a therapeutic frequency everywhere. Perhaps the search for new therapy frequencies in this range no longer makes sense? Of course, this is not the case. For each individual problem, a small number (1–5, up to 10) frequencies are known, and the identification of new frequencies, both independent and complementary and optimizing the effect of the known ones, is quite an urgent task.

There are many strategies for finding frequencies - this is a random choice, and "pumping" the range, and the use of some mathematical and empirical considerations. In particular, it seems reasonable to study the frequencies that are in harmonic relations with those already known. The term "harmonic ratio" in this case should be understood as the fact that the investigated frequencies are members of a simple series, arithmetic or geometric progression. In particular, the term "harmonics" known from the field of physics and radio engineering means an arithmetic progression with a difference equal to the frequency under study, and the frequencies of musical notes differ in a certain amount of once, those. present by myself the elements geometric progression.

Arithmetic progression

Using this harmonization mode, you can build a series of harmonics of a given frequency. For this, as the first term and the step of the progression, it is necessary to indicate the frequency f itself, i.e. the resulting range of frequencies will include frequencies f, 2f, 3f, 4f, 5f ...

One of the arguments in favor of studying the harmonics of therapeutic frequencies is the law of dependence of effective frequencies for an ion with mass m and charge q, described by the author [1], which has the form

$f_n = 1 / n [q B_{DC} / (2 m)]$

It follows from this formula that in addition to the fundamental resonance frequency f_{one} there are additional frequencies that are negative harmonics f_{one}, those. fissionf_{one} by 2, by 3, etc.

To build a series that includes negative harmonics of frequency f, starting from the back data, you must specify as the step of the arithmetic oty, equal to progression of frequent f / n, where n is the number of the negative harmonic. To use it can either the Windows utility or the same Harmonizer window in the "Calculator", "Geometric progression", specifying n as the denominator of the progression and calculating for -1 step of the progression. The desired arithmetic progression should be built from -n-go to step 0.

Another premise indicating the importance of the study of arithmetic progression as the law of changing the frequencies of exposure to biological objects are the laws of musical harmony. The influence of music on a person, at least on the emotional sphere, is undeniable. As you know [2–3], the principles of tuning musical instruments, known since ancient times, are based on the rule: the frequencies of sounds, the combination of which perceived by the human ear as euphonious, correlated as small whole numbers. For example, 2/1, 3/2, 5/4, etc. The principle of constructing a natural scale is known, when frequencies equal tof, 3f, 5f, 7f etc. (odd harmonics of the fundamental frequency), as well as their octaves, i.e. frequency,

differing from those listed up or down in 2, 4, 8, etc. times (power of two), as well as the odd harmonics of these derived frequencies. A number of authors engaged in music therapy argue that music composed precisely of such notes, and not of the steps of the equal temperament scale adopted in modern European music, has the greatest
therapeutic effect, in particular [2].

Geometric progression

The most important argument for research ranks frequencies, representing geometric progressions, is the fact that human sensory perception and sensitivity of the main nerve receptors is logarithmic. This is reflected in the well-known law of physiology: "The perceived intensity of stimulation is proportional to the logarithm of the intensity of the stimulating signal."

A special case of this law is the logarithmic sensitivity of the auditory analyzer to the frequency of the sound signal: the tone is perceived as increasing uniformly if the signal frequency increases by the same number of times during equal time intervals. The slew rate of a signal is often measured in octaves per unit of time, i.e. the time during which the signal frequency doubles is indicated.

The most significant relationship between frequencies is one octave difference, i.e. 2 times. The musician's ear perceives such sounds as, in a sense, "equivalent" - this is the same note, sounding an octave higher or lower. Strings that differ in length by 2 times begin to resonate when one of them sounds. The frequency of a note sounding an octave higher is the second harmonic of the frequency of the fundamental note, and it is by checking the frequencies corresponding to the fundamental as a power of two, up and down, that it makes sense to start looking for additional frequencies of biological influence.

To obtain the octaves of the fundamental frequency, you must set the step (denominator) of the geometric progression equal to 2 and indicate the base frequency.

Another important relationship between frequencies is the factor R (twelfth root of 2), which forms the modern musical equal temperament frequency scale, approximately R = 1.0595. By setting the known frequency of a problem as the fundamental frequency and as a step
(denominator) geometric progression number R, by calculating the progression up and down, you can get a number of frequencies that are in relation to musical harmony with a given one. Some of these frequencies are "well combined" with the base (consonant sound is observed for sound vibrations), some
“Antagonistic” (dissonance), however, the presence of some hidden sound communication for vibrations with such frequencies is clearly perceived by a person.

"Equal temperament" of modern musical scale is expressed in the fact that if we take the logarithm of the frequency of each of 12 notes scale, then the intervals between the logarithms of the frequencies of neighboring notes will be strictly the same. Some authors believe that such a “mechanical” intrusion into the simple “natural” harmony of the natural scale negates the spiritual and therapeutic potential hidden in music (the frequencies of the notes of the natural scale are about the same, but slightly different from the frequencies of the notes of the equal temperament scale). You can argue with this, and it can be

research. However, the biological properties of resonant frequencies are manifested in a certain frequency range, in which frequencies calculated according to both laws of harmony are most likely to fall, if they fall at all.

The ratio of the frequencies of sounds that form a musical scale

Music uses tonal sounds with frequencies from about 35 Hz to 4.5 kHz. Due to the fact that sounds differing in frequency by 2, 4, 8, etc. are similar to each other, the main musical sounds are formed by dividing the octave interval (the frequencies at its boundaries differ by 2 times) into a different number of smaller intervals.

Historically, the division of the octave was done in a natural way: for the main tone, there were sounds that create unison with its successive overtones, in other words, with a frequency that is a multiple of the frequency of the main tone, which were then reduced to one octave by a multiple decrease in the pitch (frequency) by 2 times. For example, unison with the first overtone produces the sound of an octave interval, with a second fifth, and so on. The resulting scale was called natural.

The natural way of dividing the octave gives an infinite number of sounds, on which, using all of them, it is impossible to build a musical system. Therefore, from the whole variety of received sounds, several basic ones are selected that most correspond to auditory perception. This limited set of sounds that make up music is called the fret. Each fret consists of a certain number of sounds within an octave, with a certain ratio between them.

The most ancient family of modes - diatonic - are formed using the fifth interval: the fifth (3rd harmonic of the fundamental frequency) is counted from the fundamental tone, another fifth is counted from the resulting tone, and so on six times; the resulting sounds are then reduced to one octave by lowering the pitch. This method of dividing the octave was proposed by Pythagoras. The seven received sounds of notes, or steps, form the basis of the European musical system, are called Do, Re, Mi, Fa, Sol, La, Si and form the so-called fifth circle. The resulting sounds correspond to the white keys of the grand piano.

If we continue the process of fifth division, then sounds are formed that are intermediate in relation to the main ones - they are called derivatives, altered (altered), or chromatisms. After the formation of five intermediate sounds, the circle is practically closed, therefore, the complete European musical system was formed from twelve sounds of seven main tones, "colored" by five altered semitones that are between each pair of main tones, except for Mi-Fa and Ci-Do. Altered sounds correspond to black piano keys. Together with the main sounds, they form a twelve-step scale, the distance between the elements of which is usually called a semitone. Altered sounds are designated by the name of the main ones: lowering the main sound flat (b), raising the sharp (#). Frets using these sounds are also called altered,

In addition to the 3rd harmonic, which gives the fifth interval, the practical

what matters is the 5th harmonic giving the third. However, in a number of cultures, other odd harmonics were also used in the construction of a musical scale. In a number of Asian systems, the octave is divided into 17 and 22 sounds (India), and the pentatonic scale (China) uses only five sounds out of the seven available in the diatonic modes (Do, Re, Mi, Sol, A) [2, 3]. Because of these fundamental differences, it is generally impossible to play the music of one system on the instruments of another.

The natural 12-step scale, although it is formed in a natural way, has a serious drawback - not quite uniform filling of the octave and unequal pitch ratios between adjacent steps, which creates problems when transposing - raising or lowering the entire piece of music or its part by the same number of steps up

or down. Therefore I.S. Bach, together with A. Werkmeister, was introduced musical practice into the so-called even-tempered in which the octave is musical scale, in divided into 12 parts with the same height ratio between them. The A note of the first octave has a frequency of 440 Hz, from which the frequencies of all notes of the scale are calculated. The frequencies of adjacent notes (one semitone apart) differ in the number of times, expressed by the irrational number "12th root of two".

Small deviations in the height of the steps in relation to the natural scale are not felt in solo performance, however, when playing with an instrument tuned in the natural scale, one of them must be adjusted, or the most dissonant consonances must be avoided.

The simplest musical harmonic combinations of frequencies

Low-frequency mechanical vibrations (sound) can have an undeniable effect on the emotional state of a person. First of all, through the emotional sphere, music is able to influence the state of human organs and systems. The second mechanism of direct influence of music, especially when singing, is direct mechanical resonance-frequency influence [2]. Let us try to formulate the inverse problem - expanding the spectrum of therapeutic effects of electric or magnetic resonance frequency therapy (direct exposure) through the use of the laws of musical harmony (determining the emotional impact of music).

Music creates a mood. The main factor that determines this mood is the use of a major or minor scale.

Music in the major scale creates a mood characterized by the following epithets: light, bright, joyful, open, affirming, happy, sublime. The major mode forms positive emotions, has an impact on Yang.

In the minor scale, the spectrum of the emotional impact of music can be characterized as: sad, sad, brooding, gloomy, lyrical, focused, threatening. Most of the listed qualities correspond to the concept of Yin-impact in the Chinese philosophical system.

Music in a major or minor scale can be used both for influence in order to reduce the severity and compensate
opposite emotional states, and to maintain relatives. Expanding this pattern, we can assume that

It makes sense to use harmonic relationships that form the major mode in pathological states of the Yin character (chronic destructive processes) and for the formation or maintenance of positive processes of the Yang character (toning). And vice versa, it makes sense to use harmonic relationships that form the minor mode in pathological conditions of the Yang character (acute inflammatory processes) and for the formation or maintenance of positive processes of the Yin character (sedation, sedation).

The basis that creates the mood of the major music is the major triad. These are three notes, the intervals between which are first 4, then 3 semitones. For example, these are the notes Do, Mi and Sol. When all three notes of a major triad are sounded in any sequence or simultaneously (forming a musical chord), the listener is in a “major” mood.

The basis that creates the mood of minor music is the minor triad. These are three notes, the intervals between which are first 3, then 4 semitones. For example, these are the notes A, Do and Mi. When all three notes of a minor triad are sounded in any sequence or at the same time, the listener develops a "minor" mood.

Also noteworthy are two seventh chords, which are built on the basis of triads by adding a fourth note. This is a dominant seventh chord, the four notes of which are played at intervals of 4, 3, and 3 semitones. The chord is built on the basis of a major triad, but its bright mood is compensated by a fourth, slightly dissonant sound. This is a neutral chord, combining such qualities as thoughtfulness, lyricism, openness with the general position in musical harmony, which is more characteristic of the major chord. You can compare his mood with a light painting painted with watercolors, the properties of the major chord are "diluted", this is a soft effect of the Yang direction.

Finally, a diminished seventh chord. Mathematically, it is perfect because of its complete symmetry. The four notes of this chord are arranged at intervals of 3, 3, and 3 semitones. Due to the symmetry of these chords with different "contents" there are only 3, not 12, like any others, and it simultaneously belongs to four of the 12 keys. Therefore, the diminished seventh chord is often used as a "hyperspace tunnel" for constructing modulations (euphonious transitions) between unrelated musical keys. The emotional coloring of the diminished seventh chord is also "blurred" in comparison with the minor chord, to which it is closest, and the main epithets corresponding to the diminished seventh chord are: mystery, anxiety; he is able to emphasize the depth of the experience expressed in music, but he himself does not carry a pronounced mood of sadness or sorrow. This chord symbolizes the gentle influence of the Yin direction.

To obtain frequencies that are in harmonic relationship with the given one, in accordance with the rules of the described triads and chords, it is necessary in the "Harmonizer" window to select the "Musical" dependence type and the type of law for harmonization: major chord (maj), minor chord (m), dominant seventh chord (7) or diminished seventh chord (dim). Length
sequences for harmonization should be specified in octaves, not in steps (as for arithmetic or geometric progression). Notes of the mentioned

chords during sequential reproduction "work" in any combination and order of enumeration.

It should be noted that a more or less complex piece of music usually contains fragments sounding in minor and major, and its overall emotional impact on the listener is formed according to laws that are much more complex than the combined impact of major and minor. The outlined patterns are just elementary bricks that make up music. Ways of writing "good" music that is guaranteed to have the desired emotional impact on the listener is a matter of the composer's talent, science cannot yet offer effective methods for this.

Diatonic frets

Seven of the twelve steps of the chromatic scale form a diatonic scale (an example is the seven notes Do, Re, Mi, Fa Sol, La, Si). In modern European music, any melody or chord accompaniment uses primarily seven notes of the diatonic scale (major or minor), although any of the 12 notes may appear in the piece.

Depending on "what place" to begin to sort out the seven notes listed above, you can get a major scale (from C), a natural minor scale (from A) and other modes (Dorian, Locrian, etc.). Thus, the frequencies that form the musical mode, by themselves, do not give an emotional coloring (major or minor) - the order of their enumeration is important, changing which you can get both. At the same time, the search of frequencies in the order of the minor scale allows you to hear the minor melody, in the order of the major - the major. Thus, it is recommended to use the frequencies of the diatonic mode taking into account the sequence of their search.

To obtain frequencies that are in a harmonic ratio with the given one, in accordance with the rules for major and minor scales, it is necessary to select the "Musical" dependence type in the "Harmonizer" window and the type of law for harmonization: major or minor scale. The length of the sequence for harmonization is specified in octaves, not in steps (as for arithmetic or geometric progression).

In his work [2] S.V. Shusharjan highlights the rhythmic and melodic therapeutic effects of music. In this case, a relatively high-frequency musical sound that forms a melody is, as it were, modulated by a musical rhythm with a frequency of several hertz (several vibrations or beats per second). Low-frequency electromagnetic oscillations for EAF therapy correspond to rhythmic musical oscillations. Therefore, the application of the laws of musical harmony to them, acting for the oscillations of the sound frequency, is an interesting hypothesis that requires verification and confirmation.

Literature

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