Impact Factor: 9.9 ISSN-L: 2544-980X

Wave theory of sound and work on the hand positions of a gijjak player

Ganijon Khudoev [1]

Abstract: The article forms the Development of artistic thinking of a student can be considered as the main goal of the work of a teacher-musician, and the solution of highly specialized problems is a means of achieving this goal. Particular attention should be paid to the setting of the student's performing apparatus, to develop in the student a sense of natural posture, free position of the hands. Before proceeding to learning to play the gijjak, it is necessary to study a set of preparatory exercises. The purpose of these exercises is to teach the student to consciously control his movements and control the state of the muscles. When moving from a passive to an active state, it is necessary to record the work of the muscles that partictorate in the game.

Keywords: playing the gijjak, set of preparatory exercises, setting, hand positions, teacher-musician, muscle work

Introduction

During the 20th century, serious changes took place in the system of ideas about art, man and the world formed in the artistic culture of Uzbekistan. The directions of the synthesis of traditional and modern art of Uzbekistan are attracting great interest in many countries. Attention to the artistic culture of Uzbekistan has increased, especially under the influence of globalization trends, which have made the task of preserving national identity more urgent.

The musical performances, including the scenes with the emperors, were filled with subtexts that refer the viewer to historical facts, philosophical statements, and hidden meanings of the traditional Uzbek scale. These many subtexts could only be grasped, understood, and "read" by an educated audience (e.g., officials, literary, calligraphers, music teachers). Lovers of ancient Uzbek art seemed to have penetrated "deeply" into the work of painting or musical composition during the long process of understanding and comparison of "semantic codes" that are inaccessible to an ignorant viewer.

Figurative and associative connections between visual art and music appeared in ancient Uzbek traditional art and are reflected in the works of contemporary Uzbek authors. In the practice of modern Uzbek art, these connections are most actively manifested, as evidenced by the creative works of artists, composers and performing musicians, but they were not the object of special study in the history of theoretical art. The scientific innovation is related to the need to conduct a comprehensive comparative study that reveals the formation of figurative and associative connections in Uzbek music and visual art. Scientific novelty is also determined by the research subject itself - for the first time, figurative associative links between music and visual art were revealed in the case of traditional stringed instruments, in particular, the gijjak. The work reveals the content of mythological ideas and philosophical views showing the place and role of traditional string instruments in Uzbek artistic culture; specific aspects of the understanding of nature images in artistic works are revealed and their poetics is revealed.

In the works of traditional painting and musical art, the specific features of musical perception of nature images were revealed through figurative and associative connections characteristic of the closed traditional Uzbek artistic culture. In playing traditional stringed instruments, the strict rules of hand

---

[1] The head of the department of musical and theoretical sciences of the state institute of arts and culture of Uzbekistan, doctor of arts and philosophy, associate professor

placement and the main methods of sound production were through images of nature - the mating dance of birds, the chirping of cicadas, the sound of water, the ringing of bells. explained. The emotional understanding of the figurative and associative connections inherent in traditional art was enhanced by the poetic descrtortion of the positions taken by the musician's hand to produce sound ("crane in the wind", "riders flying in the gorge", "flow of water", " a fallen flower is carried away by flowing water"), depicted in a special picture for clarity, or shown in pamphlets.

In the traditional paintings created by the masters of the past, the sound of the instrument is depicted by accurately depicting the position of the musician's hands (the performer's face is depicted passively). The arrangement of the hands drawn in the picture reflected hidden figurative and semantic content and was associated with specific images of nature recreated by the musician, which could be understood and interpreted by an educated viewer. The sound of traditional musical instruments (especially the gijjak) is recreated in the painting with the help of hieroglyphic text, in which clear ideas about nature's reaction to the sound of music are poetically described ("the goose falls down from the sky after hearing the song" the flowers of the tree describes the story's flight from sadness."

It is also difficult to name a field of technology that does not face acoustic problems: manufacturers of musical instruments are looking for ways to improve the acoustic properties of their products, builders are busy reducing household and industrial noise, reducing acoustic noise. research methods allow you to determine its quality without destroying a part, a complex stand provides complete information about the operation of the car engine and parts in the tank in a few minutes - and this important information is only the basis of the analysis of sound vibrations. Sound is a mechanical vibration that propagates in an elastic medium (gases, liquids, and solids). The Uzbek philosopher Ibn Sina thought about the connection between the pitch of sounds and the elements of nature: earth, water, air, fire and wind. History is silent about how the Uzbek philosopher managed to establish a connection. Acoustics, in one way or another, had to arise out of a natural interest in music and musical instruments. Just as the sweet tones of nature inspired man to create musical instruments, the sweet tones of musical instruments also inspired the desire to unlock the mystery of musical sounds. Thus, the appearance of acoustics is related to sounds that are pleasant to the ear. Developing human thinking tried to penetrate the sound phenomena of the surrounding nature.

If at the time of Pythagoras they knew that sound was somehow related to the movement of air, Aristotle went a step further in this area and already claimed that sound is created due to compression waves. Alexander the Great's teacher tried to base the physics of musical sound on observation and experience, but Aristotle's physics still lacked the depth of generalizations. A notable event is the invention of the monochord, which was first mentioned by the great Greek geometer Euclid, whose creative peak dates back to 300 BC. e. Perhaps the greatest physicist of antiquity was not the inventor of the monochord, and its prototype was already known to Pythagoras. But such is the fate of ancient inventions that many of them have no reliable authors. It is believed that the laws of propagation and reflection of sound were generally known during the time of Euclid. An attempt to create a wave theory of sound by analogy with the laws of propagation of waves on the surface of water was made in the 1st century BC. e. The famous Roman architect Marcus Vitruvius. The remarkable thing about his theory is that the air does not move along with the wave - just like the rising of a chtor on water and the wave passing through a stone thrown nearby: the waves are separated from the stone, but the chtor. do not follow them. It seemed like a simple observation, but such an analogy with the waves in the air did not occur to Vitruvius's contemporaries. By the way, they rejected the Vitruvian point of view on the basis that if the air remains in place and does not move with the sound wave, how can the propagation of sound in space be explained. ? Even sixteen or seventeen centuries later, physicists were confused about this issue. But let's continue. Marcus Fabius Quintilian (30-96 AD) used a straw to prove the existence of string resonance. The amazing range of interests of the ancients! Quintilian discovered one of the main phenomena of musical acoustics without being a physicist - he was, as you know, an orator! Severus Baetius (480-525 AD) wrote five books on music detailing the musical theory of his time. Along with Aristotle's problems, these books are one of the main sources of information about the musical acoustics of ancient times. Here are some excerpts from the books of Betius, the ideas expressed in them are remarkable for their closeness to modern views: "If everything was peaceful, not a single sound would touch our ears. This is what happens when listening to any movement where these things cannot collide. So a beat is needed to make a sound. However, action must be taken before the impact occurs. So, if there is to be sound, then there must be movement. Every movement has a moment of speed and a moment of slowness. If the movement during the beat is slow, then the low tone is excited, because just as slow movement is closer to rest, so is the low tone closer to silence. A loud sound is produced as a result of fast movement. In addition, the low tone, rising, reaches the middle, and the high tone, reaching it, falls. All sets of parts are combined in a certain ratio. Proportions are mostly known in numbers. Depending on multtorle or divisible ratios, consonant or dissonant tones are heard. Consonant tones are tones that are received at the same time and create a pleasant and harmonious sound. Dissonant tones are tones taken at the same time that do not produce a pleasant and coherent sound. At least four key concepts of musical acoustics are evident in this passage. First, there must be motion for sound to occur; secondly - the faster the movement when hitting, the higher the pitch and vice versa; third - each sound - tone - consists of separate parts, that is, in essence, we are talking about the complex nature of sound; fourth, tones are consonant or dissonant, producing a pleasant, combined sound or an unpleasant, isolated sound. The last statement is almost verbatim with the definition of consonance and dissonance accepted in modern books on musical acoustics, as quoted from Betius's books. Let's move forward immediately after a thousand years, because during this period the history of musical acoustics is not full of bright discoveries in any case, in the 16th century, wonderful and interesting events take place; Since the end of the 16th century, researchers have focused on the problem of establishing a relationshtor between height and the number of body vibrations. Now it is impossible to determine how many scientists worked on this problem and how they solved it.

It is known that in 1585 the Italian Giovanni Benedetta published a treatise on musical intervals in Turin, in which he stated that in some and the same intervals, with the same ratio of pitch, the ratio of the frequencies of the vibrational motion of the bodies that produce these sounds is equal. Some of his calculations were published by Frenchman Isaac Beekman in 1618 to prove the relationshtor between pitch and vibration frequency. But the discovery of this connection is usually attributed to two other scientists: the French monk Marin Mersenne (1588-1648) and the great Galileo Galilei (1564-1642). Mersenne studied the vibrations of strings more thoroughly than Benedetta and Beckmann, and his experimental studies allowed him to conclude that, under equal conditions, the frequency of string vibrations is inversely proportional to the length of the string and directly proportional to the square root of the cross. cross-sectional area of the thread. Undoubtedly, at this time, an experiment was born to establish the relationshtor between the height and frequency of vibrations by means of a toothed wheel, which touched a piece of cardboard during its rotation; at the same time, if a large number of gears were selected (at the same rotation speed of the wheels), the frequency and pitch of the sound increased. This experiment is often carried out today. Although Galileo did not discover the relationshtor between height and frequency of oscillation, as some literary sources claim, he made a significant contribution to clarifying this problem. Galileo brilliantly expressed many of the main ideas of musical acoustics, which gives reason to consider him one of the founders of modern acoustics.

Impact Factor: 9.9 ISSN-L: 2544-980X

Galileo discusses the vibration of bodies in his famous work Discourses and Mathematical Arguments on Two New Branches of Science Concerning Mechanics and Local Motion, which was published in Leiden in 1638 and contains a systematic presentation of all his work in mechanics. . Starting with the consideration of the movement of the pendulum, the author moves on to consider various acoustic phenomena. The pendulum is not the source of sound vibrations for any musical instrument, but many laws of acoustics were discovered on its example. Galileo showed that pendulums of the same length have the same period of oscillation, even if one pendulum is lead and the other is a cork ball, that the frequency of oscillation of the pendulum depends on the length of the suspension, and that the period No matter how large the oscillation of the pendulum is, the oscillation does not depend on the amplitude. And the great make mistakes. Galileo's last statement is wrong: with large oscillation amplitudes of the pendulum and many other sources of oscillation, the period of oscillation changes slightly. Even a frequency standard such as the tuning fork, created many years after Galileo, has a slightly higher frequency at the beginning of the oscillations with large amplitudes than at the end of the oscillations with small amplitudes (although we do not notice this with the ear). Galileo then describes two interesting experiments that allow him to determine the physical meaning of the relationshtor between the height of a vibrating string and its frequency. It expresses the judgment that the meaning of this connection is determined by the number of oscillations per unit of time. In the first experiment, a glass container was placed at the bottom of a container filled with water. If the edge of the glass was rubbed with a finger, it began to make a sound, and waves ran along the surface of the water in a large container. Galileo noticed that glass could sometimes make a sound an octave higher, and more importantly, in this case the waves in the water were more frequent and had half the wavelength. In the second experiment, sound was produced by a copper plate, which Galileo cleaned of rust with an iron cutter.

Eruption was accompanied by a ringing sound, and several parallel thin lines could be seen on the plate from the incisor, which were at the same distance from each other. And just as in the experiment with the sound mirror, when the volume increased, this was achieved by increasing the speed of scraping with the cutter, the distance between the parallel marks on the plate decreased. Galileo again describes his experimental observation: the sound of the plate can make the strings of his spine sound. This effect is caused by a phenomenon we now call resonance. It seems that Galileo clearly understood the role of vibrations from one source (in this case, an even-toned spinal cord) that propagates through the air, causing vibrations from another source. The observer Galileo also noticed that if the wires resonating with the sound of the copper plates struck by an iron chisel were one-fifth of each other, the average distance between the marks on the plates would be 2 to 3. With such experiments, he could establish ratios of frequencies in musical intervals. Galileo tried to understand why musical intervals with simple ratios: 1:1, 1:2, 2:3, etc., sound pleasant to the ear (consonances, we now say) and musical intervals with large integer ratios. , 15: 16, - unpleasant (i.e. dissonances). Thus, in what Galileo calls his masterpiece, the Discourse, he addresses the issues that were the focus of attention in the field of musical acoustics in the 17th century. : generation of sound using vibrations, relationshtor between the height and frequency of vibrations, propagation of sound in air, resonance phenomenon, musical intervals, string vibrations (experimental study) and the dependence of string frequency on it. geometric and physical parameters. Since the 17th century, the theoretical and mathematical foundations of music acoustics have also developed. A mathematical apparatus was needed to describe the vibrations of all kinds of sources found in musical instruments. And for the latter, a fundamental law was needed that revealed the relationshtor between the deformation of a solid body and the force creating this deformation, a problem that was solved in 1660 and presented in the form of an anagram in 1675.

Robert Hooke's famous law, expressed in Latin as an anagram: "ut tensio sic vis" (as the stress is, so is the strain) serves as the basis for the theory of sound. The theory of elasticity, which is actually based on the theory of oscillating body movements, was enough for Hooke to go down in history. He can rightfully be considered the inventor of the idea of acoustic diagnosis of various mechanisms, including musical instruments, by the sounds they emit, and diagnosis of the condition of the human body by the noise of internal organs. Attempts to explain the propagation of sound waves in air by analogy with the propagation of waves or rtorples in water began in the 1st century BC. e. The first attempt to create a mathematical theory of wave motion was made by Isaac Newton (1642-1727) in his "Mathematical Foundations of Natural Philosophy" (1687), which showed how powerful mathematics is as a tool for studying physical processes. . The theory of wave motion is developed in the eighth chapter of the second book of the Elements. According to Newton, sound propagation is nothing more than air shocks caused by the impact of a vibrating body on the surrounding (air) spaces immediately adjacent to it. These shocks or impulses are transmitted to neighboring sections of the environment, and so on. Interestingly, Newton's hypotheses about the nature of the movement of individual particles of the medium (hypotheses that he could not confirm experimentally): when an impulse passes, particles contain particles. the environment begins to move in simple harmonic motion, in other words, according to the laws of pendulum oscillation; if such motion is true for one particle of the medium, it must be true for any other particle. Newton theoretically calculates the speed of a sound wave and concludes that the speed of sound is equal to the square root of the ratio of atmospheric pressure to air density. The first theoretical determination of the speed of sound was not entirely accurate, and later corrections were required. Newton also gave the first calculation of the wavelength of sound and calculated the wavelength of sound emitted by an open tube: the length of a sound wave is twice the length of the open tube. And although Newton considered air as a conductor of sound waves in his theoretical calculations, experimental evidence was obtained shortly before that the propagation of sound vibrations is impossible without air. The most thorough experiments in this direction were carried out by the brilliant scientist of his time, Robert Boyle (1627-1691), who once worked as Hooke's assistant. Using a pneumatic machine that released air from a glass container with a bell, Boyle established the law that the intensity of sound decreases when the air is reduced (1660). His experiments showed a very important connection between the sound source and the environment. Finally, in the 17th century, he dealt with another problem - the experimental determination of the speed of sound. The main method used by the researchers was the method proposed by Galileo, which consisted in measuring the time interval between the moment of light perception of the explosion and the time when the sound of the explosion reached the observer. Mersenne determined this time by the number of pulses and increased the speed of sound he determined - 450 m/sec. Pierre Gassendi (1592-1655), who worked in Paris, determined in 1635 the speed of sound in air for rifle and cannon balls, which differ in height: sharp, loud for guns and dull, low. vote for the ball. Thus, the important fact of the independence of the speed of sound from its height was established, and Aristotle's view that high tones spread faster than low sounds was rejected. In order not to return to this problem, we note that in 1738, the Paris Academy of Sciences made the most accurate measurements of the speed of sound - 332 m / sec at 0 ° C. They differ from the measurements taken at our time by less than 1% (331.45 ± 0.05 m / sec). History does not know many examples of how the measurement of physical quantities has stood the test of time for two centuries. In 1740, the Italian Bianzoni showed that the speed of sound increases with temperature (this fact is related to the fact that some musical instruments change

Impact Factor: 9.9 ISSN-L: 2544-980X

their tuning with changes in ambient temperature). Perhaps the most important place in the history of musical acoustics is occupied by strings. In fact, strings are used as a source of vibration in a large group of musical instruments. Many laws of acoustics were discovered using the example of string vibrations, because string vibrations are relatively easy to observe and study. A relatively simple descrtortion of the physical process in a vibrating string makes it easier to consider the obscure questions related to the nature of musical tones. The main laws of M. wire vibrations, obtained by experiment, were mentioned above by Ersen in 1636. These laws are perfectly illustrated by stringed instruments. Different tones are obtained by shortening the vibrating part of the string, for example, in a guitar or violin, and in tuning the strings of these instruments, their exact pitch is obtained by changing the tension for strings of the same length. At the same time that Newton published the second edition of his Princtoria, between 1700 and 1707, the Paris Academy of Sciences published the works of Joseph Saveur (1653-1716) on the various sources of the sound of musical instruments. Thus, Saver paid great attention to the consideration of the laws of vibration of strings. The main results of Saver's research are as follows:

1. A string stretched between two supports can vibrate in parts. In this case, the individual points of the thread are very strongly deviated from the equilibrium position, and Saver calls these points antinodes; others do not move at all - Saver calls them knots. These names still exist in science.
2. Vibrations of individual parts of the string correspond to higher frequencies compared to the frequency of the whole string, fixed points - without knots.
3. The high frequencies of the string are multtorles of the normal vibration frequency. The priority in terminology here also belongs to Saver - he called the frequencies corresponding to the vibrations of individual parts of the string the highest harmonic tones, and the lowest sound corresponding to the normal vibration of the whole string was called the fundamental. tone All these terms, which were introduced in 1700, have not changed to this day. 4. A vibrating string can produce sounds corresponding to several harmonic tones at the same time. The last important fact comes close to revealing the characteristics of musical sound. Saver did not limit himself only to experimental studies and theoretically, based on some questionable assumptions, tried to calculate the frequency of vibration of wires. However, the English mathematician Brooke Taylor (1685-1731), who was the first to obtain an exact dynamical solution to the oscillating line problem, is known as the author of the theorem of infinite series. Taylor calculated the frequency of a string tone (the fundamental note) as a function of its length, weight, tension, and gravitational acceleration. With these calculations, Taylor laid the foundation for mathematical physics, which is the theoretical basis of music acoustics. According to Taylor's calculations, the fundamental vibrational frequency of the string is in good agreement with the empirical formulas obtained for the string by Mersenne and Galileo. Taylor considered only one particular case of string vibration, that is, the vibration of the fundamental tone - the mathematical apparatus of that time was still very weak. But he opened the first path, and the problem he solved immediately attracted the attention of the most prominent mathematicians of the 18th century. Through the works of the Frenchman Jean D. Alembert (1717-1783), the Swiss Daniel Bernoulli (1700-1782) and Leonhard Euler (1707-1783), who spent most of his life in Russia, and the Italian Lagrange (1736-). 1813), solved the problem of a vibrating string and obtained the differential equation of its motion in the form used in our mathematics. days. If we follow the strict chronology of events, then Euler was the first mathematician who theoretically solved the physical side of the problem of the movement of wires. Euler's work on the theory of string vibration dates back to 1739, in his "An Attempt at a New Theory of Music" he stated that the speed of propagation of a wave along a string depends on the wavelength of the excited sound determined that it is not. Euler generally made the greatest

contribution to the theory of standing vibrations of strings. D. Alembert is generally credited with being the first (1747) to derive the differential equation of a vibrating string in the form it is now commonly written. D. Alembert found the general solution of this famous wave equation in the form of waves moving in different directions along the string. D. Bernoulli published a theoretical explanation of string harmonics in "Scientific Notes" of the Berlin Academy of Sciences. He showed that many independent parts of a string can vibrate simultaneously and produce many simple harmonic vibrations. The displacement of individual points of the string is an algebraic sum of the displacements corresponding to simple harmonic components. Here, Bernoulli puts forward and substantiates the principle of the simultaneous coexistence of small vibrations that do not affect each other, the principle called "superposition". Needless to say, this effective principle was not immediately recognized even among famous mathematicians. In 1759, Lagrange proposed a solution to the string vibration problem in an important paper addressed to the Academy of Turin. Lagrange imagined a string consisting of a finite number of particles of the same mass, equidistant from each other and connected by a common string. Lagrange first finds the oscillations of these few sections of the string and then obtains a solution for an arbitrarily large number of sections. Many conflicting theories of string oscillations were proposed by 18th-century mathematicians, many opinions clashed in discussing these issues, and, unfortunately, famous mathematicians such as Bernoulli, D'Alembert, Euler, and Lagrange debated the nature of the solutions. differential equations on the pages of scientific journals, sometimes with sharp attacks on each other, with gross slander. Each of them defended their point of view and did not always consider the enemy's theory impartially. In any case, as a result of intense discussions, the foundations of those methods of mathematical physics were laid, with the help of which musical instruments are now very intensively studied and calculated all over the world. The study of string vibrations occupied an important place in the theoretical work of 18th century scientists, but the problems of vibrations of other sources of musical sounds were not ignored. As mentioned above, Newton calculated the wavelengths emitted by tubes. It is based on the calculations, which were involved in Saver's experimental work. Saver in his Memoirs (1700-1707) investigates the phenomenon of beats that occur when two organ pipes sound simultaneously, only slightly different in frequency. The beating phenomenon itself has long been well known to organ designers, but Saver's merit is that he emphasized the importance of the observed phenomenon and developed a method for determining the number of vibrations based on it and its interpretation.

References

1. Ибрагимов О. Фергано-Ташкентские макоми. – Т.: Media Land. 2006. – 175 с.
2. Ibrohimov O. Maqom asoslari. – T.: Turon Iqbol nashriyoti. 2018. – 160 b.
3. Ibrohimov O., Xudoyev G‘. Musiqa tarixi. – T.: “Barkamol fayz media” nashriyoti. 2018. – 310 b.
4. Ibrohimov O. Ushshoqlar xususida//Madaniyat chorrahalari. elektron jurnali. 2019-yil, 1-soni. 10-16-b.
5. Rajabov I. Maqomlar. (YUNESKO va Markaziy Osiyo mumtoz musiqasi – Shashmaqomni asrash bo‘yicha Yaponiya Trast Jamg‘armasining hamkorlikdagi loyihasi. Nashrga tayyorlovchi va maxsus muharrir: O.Ibrohimov). – T.: San’at. 2006. – 404 b.
6. Fitrat A. O‘zbek klassik musiqasi va uning tarixi. – T.: Fan. 1993. – 56 b.
7. Ergasheva Ch. O‘zbek kasbiy musiqasida nazira an’analari (Ushshoq namunalari misolida). San’atshunoslik fanlari bo‘yicha falsafa doktorlik (PhD) dissertatsiyasi. – T.: O‘zR FA San’atshunoslik instituti kutubxonasi. 2018. Inv.№968.
8. Худоев Г.М. “Нозанин” намойиш этади. «Театр» журнали, 6(6), 37-38.

9. Худоев Г.М. Вглядываясь в культуру Древней Бухары. Журнал литературы и искусствознания, 5(8), 630-633.
10. Худоев Г.М. (2019). Кўҳна Бухоро сарой мусиқаси–мақом ижрочилик анъаналари. Перекрёсток культуры, 1(3).
11. Khudoev G. (2015). Peering into Culture of Ancient Bukhara. Journal of Literature and Art Studies, 5(8), 630-633.
12. Худоев Г.М. Бухоро махаллий ахоли мусика маданияти санъатшунослар нигохида. O'zDSMI. “Ўрта асрлар шарқ алломалари ва мутафаккирлари тарихий меросида”, 230-236.
13. Худоев Г.М. Миллий мусиқа–миллий мафкурамиз ўзаги. Boshlang'ich ta'limda innovatsion texnologiyalarni qo'llash istiqbollari, 162-163.
14. Худоев Г.М. Об исполнительских традициях Бухарского Шашмакома. Интернаука, 4(244), 32-35.
15. Худоев Г.М. Бухоро мумтоз мусиқа анъаналари. Классические музыкальные традиции Бухары. – Т.: O‘zR FA San’atshunoslik instituti kutubxonasi. 2018.
16. Худоев Г.М. Мухаммасхон Матлаб ая. “Театр” журналы, 12-13.
17. Худоев Г.М. Ўлмас анъаналар йўлида. “Гулистон” журнали, 9.
18. Худоев Г.М. Заррага жо бўлган олам. Тафаккур журнали, 122-123.
19. Худоев Г.М. Бухоро мумтоз мусиқасида созанда санъати. Ўзбекистон давлат санъат ва маданият институти хабарлари журнали, 28-32.
20. Худоев Г.М. Бухоро мумтоз мусиқа санъати. Мозийдан садо журнали, 46-48