Research on the Application of Modern Scientific and Technological Means Based on Functionalized Quantum Materials in Musical Instrument Manufacturing

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Abstract: in Contemporary Society, the Rapid Development of Science and Technology is Continuously Pushing Forward and Innovating Human Civilization. the Discipline of Musical Instrument Manufacturing Has Been a Combination of Natural Materials Such as Acoustics, Mechanics, Mathematics, Electronics and Humanities Such as Art. with the Development and Progress of Productive Forces, Musical Instruments That Express Human Thoughts and Feelings and Communicate with Each Other Are Also Continuously Developing and Progressing. in Order to Make a Good Musical Instrument, Many Problems Must Be Considered, Such as Material Physical Parameters, Acoustic Parameters, Geometric Shapes, Etc. We Want to Win a Place in the International and High-End Musical Instrument Market, Survive Better in This Big Family, and Show the World the First-Class Chinese Brand Western and National Musical Instruments. in Today's Society, Science and Technology Have Dominated All Fields and Permeated All Walks of Life. Based on the Analysis of Functional Quantum Materials, This Paper Expounds the Application of Modern Scientific and Technological Means in the Manufacturing Process of Modern Musical Instruments.

1. Introduction

In Contemporary Society, the Rapid Development of Science and Technology is Continuously Pushing Forward and Innovating Human Civilization. This Kind of Impetus is Manifested in All Fields of Contemporary Society, and Promotes the Material and Spiritual Cultural Needs of Human Beings to Further Improve [1]. Musical Instruments Are an Important Part of Performing Arts Equipment. with the Rapid Development of Modern Science and Technology, Electric Singing Musical Instruments, a Branch of Musical Instruments, Are Increasingly Closely Related to the Modern Stage, Recording and Performing Arts in China [2]. with the Rapid Development of Science and Technology, the Manufacture of Musical Instruments is Not Limited to Manual Operation, But Relies on Scientific and Technological Means for Greater Interpretation. the Discipline of Musical Instrument Manufacturing Has Been a Combination of Natural Materials Such as Acoustics, Mechanics, Mathematics, Electronics and Humanities Such as Art [3]. Music Art Belongs to the Category of Superstructure, and Musical Instrument Manufacturing Belongs to the Field of Economic Foundation. the Interaction between the Superstructure and the Economic Foundation Has Always Been the Driving Force for the Advancement of History [4]. When the Country's Doors Are Gradually Opened and When We Integrate Ourselves into the International Family, the World Knows Us and We Know the World. We Want to Gain a Place in the International and High-End Musical Instrument Market, to Survive Better in This Big Family, and to Show the World's First-Class Chinese Brands of Western and National Musical Instruments to the World [5].

China's Musical Instrument Manufacturing Industry Has Achieved Unprecedented Development Along with the Pace of Reform and Opening Up. At the Same Time, We Have Clearly Seen Our Own Backwardness and Gap [6]. with the Development and Progress of Productive Forces, Musical Instruments That Express Human Thoughts and Feelings and Communicate with Each Other Are Also Constantly Developing and Progressing. to Make a Good Musical Instrument, Many Issues

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Such as Physical Parameters, Acoustic Parameters, and Geometry of the Material Must Be Considered [7]. with the Improvement of People's Living Standards and Understanding of Music, the Demand for High-End Musical Instruments is Also Increasing, and Traditional Manual Techniques Are No Longer Suitable for Large-Scale Production of Musical Instruments. Our National Musical Instruments May Also Enter All Corners of the World. It is Our First Task to Seriously Recognize Our Problems is to Speed Up to Catch Up with the International Advanced Level [8]. Due to the Unique Nature of China's Economic System and the Manufacturing of Musical Instruments, the Connection between Musical Instrument Manufacturing and Science and Technology in Terms of Personnel Training or the Setting Up of Scientific Research Power is Relatively Weak, Which Makes People Have Certain Misunderstandings in the Concept of Understanding [9]. in Today's Society, Science and Technology Have Dominated Various Fields and Penetrated All Walks of Life. Compared with Western Developed Countries, China's Musical Instrument Manufacturing Industry Still Has a Long Way to Go. Based on the Perspective of Functionalized Quantum Materials, This Article Analyzes the Application of Modern Scientific and Technological Means in the Manufacturing Process of Modern Musical Instruments.

2. The Basic Situation of Musical Instrument Production in China

Electroacoustic Musical Instruments Are One of the New Musical Instruments Born with the Development of Science and Technology. Electroacoustic Musical Instruments Have Greatly Exceeded the Application Range of Traditional Musical Instruments in Terms of Their Expressive Force and Application Range. the Development of Electroacoustic Musical Instruments in Just a Few Decades Has Surpassed the Functions of Traditional Musical Instruments Developed by Human Beings for Thousands of Years. Due to the Different Characteristics of Molecular Structure and Tissue Composition of Various Materials, How to Scientifically Handle and Use Them to Achieve the Best Effect of Various Technical Indexes of Musical Instrument Products, Especially Acoustic Quality, Needs to Be Answered on the Basis of Scientific Research. the Timbre and Volume of the Musical Instrument Are Not Only Related to the Material of the Musical Instrument Itself, But Also Vary According to the Heat Treatment of the Material, the Organizational Structure, the Pronunciation Method, the Pronunciation Process, the Vibration Mode, the Form of the Resonance Body, Etc. the Basic Elements of Musical Instruments Are Various Materials: Wood, Film, Steel, Etc. Different Materials and Different Uses Have Different Effects on the Sound Production of Musical Instruments. Before Processing, the Materials Have to Go through Relevant Treatments Such as Dehydration and Drying, Chemical Treatment to Increase Elasticity or Hardness, Etc. People Use Metals Such as Steel for Musical Instrument Manufacturing. the Earliest is to Use the Steel to Make the Musical Instrument, and Then the Cast Iron is Used to Make the Piano Stand and the High-Carbon Steel Filament is Used to Make the Strings. Only by the Scientific Use and Processing of Materials Can the Acoustic Quality of Musical Instruments Be Greatly Improved, and the Limited Resources of Our Country Can Be Maximized.

In Recent Years, the Development Speed of Electronic Musical Instruments Has Greatly Exceeded the Production of Traditional Musical Instruments. the Production Scale of Various Electronic Music Product Multinational Companies in the World is Constantly Expanding, and the Product Varieties Are Constantly Being Renovated, and One after Another. Modern Technology Firstly Affected the Performance of the Characteristics of Music, Mainly Because Modern Technology Had a Great Impact on Music Production. Modern Technology Has Not Only Improved Traditional National Musical Instruments, Widened the Performance Area of Traditional National Musical Instruments, But Also Created New Electronic Musical Instruments. Modern Technology Has Also Promoted the Generation of Computer Music, Which Not Only Diversified the Characteristics of Music Creation, But Also Made Music Creation Faster [10]. People Have Recognized the Importance of the Protection of the Environment and Resources to Human Development. with the Prohibition of Logging and Arrest of Natural Materials, the Research of Alternative Materials for Musical Instruments Will Become More and More Important. Using the Resonance Principle of Physics, the Successful Reform of Science and Technology Has Enhanced

the Sound Effect of Musical Instruments. We Know That the Degree of Coupling between the Solitary String and the Surrounding Air is Very Low, But the Coupling between the Outer Plate and the Air is Higher Than That of the Solitary String and the Air. Absorption is Transformed into Sound, Thereby Enhancing the Sound Effect of the Sound.

3. Application of Modern Scientific and Technological Means

As far as natural resources are concerned, our materials are not bad, but the price is low due to low technical content, poor manufacturing process and low acoustic quality. Only through scientific description can we find out the reasons that affect the sound quality scientifically and find out the factors that affect the acoustic quality of musical instruments fundamentally from the physical structure. Only in this way can we thoroughly solve the problem of poor acoustic quality of musical instruments in our country. Popular music was introduced into our country and quickly accepted by the general public. It has become a popular modern music. Assuming that the string pressure is applied to the local part of the sound board through the string code, the local part of the sound board will deform, the local tension will increase, while the local tension increases, other local tensions will irregularly rise or fall [11]. Electronic keyboard musical instruments have gradually formed large-scale brand production, with a significant increase in output, continuous improvement in product quality, and increasing grades of varieties. The popularization of modern pop music has stimulated the production of electronic musical instruments such as electronic pianos and electric guitars. In the manufacture of musical instruments, the analysis of the vibration mode of the instrument itself is crucial.

The analysis of vibration modes of musical instruments in modern times mainly includes laser holographic analysis technology and finite element analysis technology. One of the most important technical indicators of musical instrument products is acoustic quality, and the improvement of acoustic quality can only rely on the strength of scientific research. Consonance intervals and dissonance intervals from music acoustics and law are shown in Table 1. It can be seen that the first and second discordant intervals appear at 1/6 and 1/7 of the string, respectively. Choosing the 1/8 position can effectively suppress the dissonant overtones at 1/6 and 1/7.

Table 1 Degrees of Harmony Consonance

Partial name	String vibration length	Degree of harmony
First quarter	1/10	Complete concord
Second quarter	1/20	Absolute concord
Third quarter	1/30	Incomplete concord
Fourth quarter	1/40	Disharmony
Fifth quarter	1/50	Absolute concord
Sixth note	1/60	Incomplete concord

The spectral centroid of the audio indicates that the front and sound bands are power spectral coefficients. For the convenience of calculation, the coefficients less than 65Hz have been combined. The center of gravity of the logarithmic high frequency power spectrum is as follows:

$$K_{s,d} = \frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}\frac{\left|\left|W_{s,d}(m,n)\right| - \mu_{s,d}\right|^4}{{\sigma_{s,d}}^4} \tag{1}$$

Spread spectrum is the root of the mean square value of the power spectrum of the center of gravity of each frame, as shown in the following formula:

$$D(\mathbf{V}_t, \mathbf{V}_t') = \sqrt{\sum_{i=1}^{c}\left(\frac{V_{ti} - V_{ti}'}{\left|V_{ti}\right| + \left|V_{ti}'\right|}\right)^2} \tag{2}$$

The standard deviation of the mean of all frames is used to describe the spreading of the music object. Spectral flatness Spectral flatness describes the property of flatness of the power spectrum

and is the range of the boundary function:

$$\log\Gamma(x) = -\gamma x - \log(x) + \sum_{k=1}^{\infty}[\frac{x}{k} - \log(1+\frac{x}{k})] \tag{3}$$

The exquisite craftsmanship has led to the improvement of the accuracy of the musical instrument's range. For example, the erhu is a stringed instrument. The production principle of the stringed instrument is to use two fixed points to tighten the middle string. In this way, when people rub the string with the horsetail bow, the string will resonate when excited. The waveform is similar to some specific functions. Similar functions that can be selected in the experiment are, Gaussian function and Cauchy function weighted by sine and cosine. Figure 1 is a1 audio domain waveform.

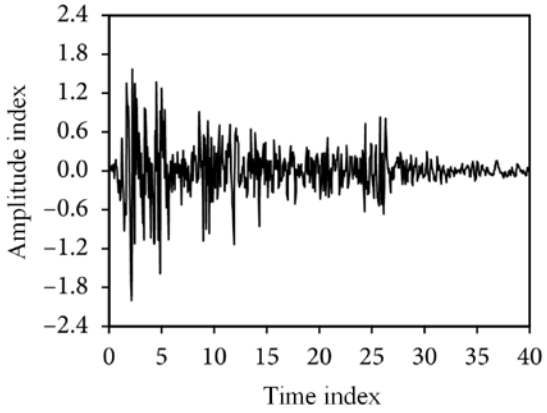

Fig.1 A1 Audio Domain Waveform

The spectral centroid of the audio indicates that the front and sound bands are power spectral coefficients. For the convenience of calculation, the coefficients less than 65Hz have been combined. The center of gravity of the logarithmic high frequency power spectrum is as follows:

$$K_{s,d} = \frac{1}{MN}\sum_{m=1}^{M}\sum_{n=1}^{N}\frac{\left|\left|W_{s,d}(m,n)\right| - \mu_{s,d}\right|^4}{{\sigma_{s,d}}^4} \tag{4}$$

Spread spectrum is the root of the mean square value of the power spectrum of the center of gravity of each frame, as shown in the following formula:

$$D(\mathbf{V}_t, \mathbf{V}_t') = \sqrt{\sum_{i=1}^{c}\left(\frac{V_{ti} - V_{ti}'}{|V_{ti}| + |V_{ti}'|}\right)^2} \tag{5}$$

The standard deviation of the mean of all frames is used to describe the spreading of the music object. Spectral flatness Spectral flatness describes the property of flatness of the power spectrum and is the range of the boundary function:

$$\log\Gamma(x) = -\gamma x - \log(x) + \sum_{k=1}^{\infty}[\frac{x}{k} - \log(1+\frac{x}{k})] \tag{6}$$

After entering the new century, the production of electronic musical instruments in our country has seen new development. On the basis of the original production of electronic musical instruments, it has developed into digital piano. This resonance is transmitted to the surroundings through air vibrations, forming the sound of playing erhu that people hear [12]. Even if the strings with different materials adopt the same excitation method, excitation position and excitation intensity, they will have different silveriness. Digital piano is a new kind of musical instrument that combines electronic musical instruments and traditional musical instruments closely. It integrates human feelings and strength into the performance of electronic musical instruments and makes the expressive force of electroacoustic musical instruments more humanized. In physics, it is believed that the timbre of vibrating string and the response of string, the exciting position and mode of

string, the exciting force of string and resonant cavity are all related. Moreover, different vibration frequencies will lead to different overtones. After several years of development, China's electronic musical instrument industry has formed a pattern of coexistence of various economic components, with a large domestic and foreign sales market, a complete range of products, close integration with the world's high and new technologies, and gradual realization of digital production.

4. Conclusion

The application of modern scientific and technological means in the musical instrument manufacturing industry has greatly improved the production efficiency and processing precision. Science and technology is also the first productive force in the musical instrument manufacturing industry. The sustainable development of the musical instrument manufacturing industry depends on the strength of science and technology, and the popularization, improvement and research of science and technology in the whole industry are carried out immediately. The use of modern scientific and technological means of production plays a positive role in the mass production of musical instruments. At the same time, integrating the manufacturer's personalized ideas into the manufacture of musical instruments will produce more perfect musical instruments. In physics, it is believed that the timbre of vibrating string and the response of string, the exciting position and mode of string, the exciting force of string and resonant cavity are all related. Using the resonance principle of physics, the successful reform of science and technology has enhanced the sound effect of musical instruments. Only scientific description can scientifically find out the reasons that affect the sound quality, and fundamentally find out the elements that affect the acoustic quality of musical instruments from the physical structure. Only in this way can we completely solve the problem of poor acoustic quality of musical instruments in China. In the manufacture of musical instruments, the application of modern scientific and technological means and functional quantum materials can reduce the wood formation of musical instruments, which is conducive to the popularization and promotion of musical instruments, and can produce greater economic and social benefits.

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