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A Computational Simulation Study of the Relationship Between Clarinet Technique and Symphonic Concerto in a Music Education Environment

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ABSTRACT
How to give full play to the clarinet in the symphony orchestra in the sound advantages and characteristics of the role, undoubtedly is an important topic of the current music research. Combined with years of working practice and learning experience in the symphony orchestra, the author explains the tonal advantages and characteristics of the clarinet in the symphony orchestra. For the study of the relationship between its tonal advantages and characteristics and the symphonic concerto, the author combines the finite element method in the music education environment, through the method of computational simulation, to explore the symphonic performance conditions, as well as the main discussion on the analysis of the boundary conditions with the vibration velocity and sound-absorbing materials, in order to achieve the purpose of improving the clarinet's musical and artistic level in the symphony orchestra. Through the study, we found that the numerical simulation of the relationship between the clarinet technology and the symphony orchestra concerto is analyzed by the local fundamental solution method with high computational accuracy, which lays the foundation for the successful application of this method to the numerical simulation of the sound field of the complex music education environment.

Keywords: finite element, computational simulation, local elementary solution method, clarinet technique, symphonic concerto

1. Introduction

The clarinet, also known as the clarinet or black pipe. It is a symphony orchestra woodwind system in the late generation of an instrument, once applied to make the symphony orchestra's musical language is richer, more beautiful, more distinctive, won the symphony orchestra in the “orator” and woodwinds

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in the "drama soprano" reputation [1]. With the continuous expansion of symphonic music works, genre, form and content, how to give full play to the clarinet in the symphony orchestra in the sound advantages and characteristics of the role of the clarinet, it is particularly important, particularly urgent.

In the music education environment, the demand for symphonic music adaptation is also increasing, and more and more exploring how to adapt the original orchestral repertoire in the symphony orchestra, so as to promote the reform and development of symphonic music education [2-4]. Clarinet has been favored by symphony orchestra by virtue of its convenient performance, distinctive sound range, low metallic feeling in the bass region, sweet and mild lyricism in the middle register, full and bright soprano register, loud and clear passion in the extreme soprano register, etc., and it has become an indispensable part of symphony orchestra's innovative development and performance [5-8]. It can be said that the clarinet plays an irreplaceable role in symphonic performance, which can greatly enrich the emotional expression of the performance, enhance the artistic infectious force of the musical works, and make the symphonic performance more unique and harmonious [9-11].

In addition, in the process of symphonic music performance and development, a variety of instruments need to coordinate and cooperate, and ultimately through the way of coordination and cooperation with each other, the charm and connotation of the whole work is expressed [12-13]. The clarinet in the symphony can effectively create musical dramatic conflict, interpretation of woodwind instrument features interpretation of colorful musical expression and portray a certain musical character, is other instruments can not be replaced [14-16]. In view of this, the study of clarinet technology and symphonic concerto relationship, to promote the effective integration of the clarinet into the entire orchestra performance, to improve the interpretation of the symphonic orchestra musical works of great significance.

In order to overcome the technical difficulties and bottlenecks of traditional numerical simulation methods for solving acoustic models in complex environments, this paper proposes a localized fundamental solution (LMFS) algorithm for simulating and analyzing acoustic problems in music education environments. Combined with the author's many years of work practice and learning experience in the symphony orchestra, the LMFS algorithm is applied to the computational simulation of the relationship between clarinet technology and symphonic concerto, in order to explore the timbral advantages and characteristics of clarinet technology in the symphony orchestra.

2. Clarinet and orchestral concerto in a music education environment

2.1. The concept and role of the music education environment

Education develops in a certain environment, and music education cannot develop without a music education environment. The music education environment is simply a method of utilizing the educational environment to promote the development of music education so as to achieve the educational purpose. The basic meaning of music education environment is the synthesis of all the factors that directly or indirectly play a restraining role on the development of music education. According to the ontological natural environment factors, music education environment can be divided into the explicit music education environment factors such as facilities, space, material materials and teachers' equipments in music education activities and the implicit music education environment factors such as emotions, moods, interpersonal relationships in music education activities as well as teachers' concepts, qualities, attitudes and other spiritual dimensions in education activities.

According to different criteria, the educational environment can be categorized in different ways. According to the form of social organization, the educational environment can be divided into family music education environment, school music education environment and social music education environment. From the ontological nature of social factors, the educational environment can be divided into explicit and implicit educational environments (i.e., hard and soft environments). In addition, the educational environment can be divided into internal environment, external environment, big environment and small environment and so on.

The music education environment constrains the development of music education and influences students' thoughts and behaviors in a subtle way. Strengthening the attention to the optimization of the music education environment can comprehensively promote the development of music education. The function of music education environment is the role of music education environment on music education, and the role of music education environment on music education has both positive and negative aspects. A good music education environment will promote the development of music education and produce positive functions. Optimize the music education environment to produce a virtuous cycle between education and environment, give full play to the positive factors of the music education environment, and avoid the music education environment from transforming into negative aspects.

A good music education environment can provide a guiding function for the development of music education. The orienting function of the music education environment refers to the intervention and orientation of the music education environment on the value orientation of music education. The function of music education is ultimately expressed through its role in the politics, economy, culture, science and technology of the society. The purposeful and regular development needs of the society is not only one of the starting points of music education, but also the destination, and whether it can meet such needs is an objective measure of the value of music education. A good music education environment can also effectively motivate music teachers' enthusiasm for teaching and students' enthusiasm for learning, and mobilize and give full play to their self-consciousness and initiative. On the other hand, it is manifested that a good music education environment can provide a relaxed working and learning atmosphere for teachers and students. Conscious classroom and unconscious campus music environment to children to convey the correct humanistic concepts and good moral character. The adjusting function of a good music education environment refers to the controlling and regulating effect of the music education environment on the development of music education, which is accompanied by the orienting function of the environment. In different periods, the development of social politics, economy, culture, science and technology leads to different demands for the development of music education, and the state has to make macro adjustments from the education guideline, policy, education system, education structure, education content, etc., and the corresponding music education environment will also have certain adjustments.

2.2. Tonal advantages of the clarinet in the symphony orchestra

The clarinet, also known as the clarinet or black horn. It is the symphony orchestra woodwind system in the late generation of an instrument, once applied to make the symphony orchestra's music language is richer, more beautiful, more characteristic, won the symphony orchestra in the “orator” and woodwinds in the “drama soprano” of the beautiful name. With the continuous expansion of symphonic music works, genre, form and content, the clarinet in the symphony orchestra in the sound advantages and characteristics of the role of the clarinet, it is particularly important, particularly urgent. At the same time, with the atmosphere of the music education environment gradually strong, clarinet technology has also been emphasized in music education.

Symphony orchestra is composed of four systems: string section, woodwind section, brass section and percussion section. Clarinet, as one of the members of the woodwind group, has become an indispensable and important instrument in the modern symphony orchestra because of its tonal advantage and characteristic role.

Tone is the color of sound, which is the main feature of the instrument's personality and an important means of musical expression. Clarinet's colorful and varied timbre and the different characteristics of high, middle and low registers, as well as its vast range of almost four octaves, form its timbre advantage in the symphony orchestra, and achieve its important position in the symphony orchestra.

Each register of the clarinet expresses different characteristics and different souls. It has a loud and clear tone in the soprano region, a pure and elegant tone in the middle region, and a deep and wide bass region. This is the closest to the human voice of the timbre qualities, timbre advantages and the role played by people called the orchestra in the “orator”. In addition, the wide range of the clarinet, which allows it to switch freely in the high, middle and low registers, suitable for the expression of a variety of musical characteristics, even if the solo or in the symphony orchestra in the repertoire, all show the charm of the clarinet. In addition, the clarinet not only plays the role of a carrier in the ensemble of the symphony orchestra, but also has a remarkable and varied expressive power in melodic performance. It is the leading clarinet in the woodwind group with its unique timbre. Therefore, some people call the clarinet the “dramatic soprano” of woodwind instruments.

2.3. The clarinet's characteristic role in the symphony

The clarinet's characteristic role in symphonic music is shown in Figure 1, the clarinet's characteristic role in symphonic music performance is mainly manifested in the symphony orchestra, when the clarinet is matched with other instruments to produce a new musical effect. At the same time, the clarinet itself is also a strong musical expression of the instrument, perfect shape and rich playing techniques can make it adapt to the needs of all kinds of tone patterns. This kind of cooperation and independence makes the clarinet's characteristic role irreplaceable, and is also highly valued by composers.

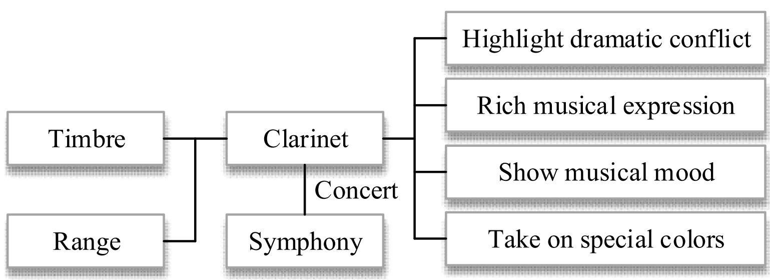


Fig. 1. Characteristic role of clarinet in symphony

1) Highlighting Dramatic Conflict. The tone of the clarinet is known for being warm and soft, rich in singing. It is suitable for expressing calm scenes and light moods. It is this sound effect that makes it the first choice for highlighting dramatic conflicts.

2) Enriching Musical Expressions. For symphonic music, it has both a grand and majestic side, and also has a refined side. Clarinet music is wide, spanning four octaves, at the same time can be competent from ppp to ff strength performance, and the clarinet itself also has the division of the tone area, can accurately show the subtle musical changes, so that the musical expression is enriched, and then get the rich expressive and infectious playing effect.

3) Expression of musical emotion. Clarinet includes soprano clarinet, alto clarinet, bass clarinet and other types, and it is precisely because of this richness in the range that it has a unique advantage in the expression of musical emotion.

4) Presenting special colors. In many symphonic works, out of special performance needs, composers often use special color, for example, in some Chinese symphonic works, there are often imitations of the sound of national instruments, which the clarinet is also fully capable of, and then make the style of the work to be strengthened.

2.4. Analysis of Clarinet Technique in Relation to Symphonic Concertos

Although the clarinet's shape and structure are not complicated, it is more difficult to play. Because it has a wide range of tones, the mastery of tone color is not an easy thing. Moreover, the clarinet's fingering technique is very rich, and each note has corresponding fingering requirements, different fingering techniques will make the acoustic effect change in different ways, so that the melodic weave becomes rich. Because of this, the clarinetist needs to use the same technique when conveying emotions. Clarinetists should strengthen the study and training of playing skills, analyze the musical works, understand the composer's original intention and feelings, circle the technical difficulties in the works, and practice the difficult pieces slowly in daily training, so that after overcoming all the technical difficulties, the emotions will flow naturally along with the melody. When learning a new piece of music, the first thing to do is to analyze the expression marks on the score, and understand the meaning of each expression mark in conjunction with the melodic changes. In the process of playing, the player should integrate his emotions into the work, and show the special emotional connotation of the clarinet through skillful techniques. Clarinet playing technique and artistic emotion are dialectical and unified relationship. The ultimate goal of improving playing skills is to realize the accurate expression of artistic emotions. Because the clarinet requires a high level of technique, when playing some difficult works, it is easy for the melody or notes to be flawed due to the lack of certain techniques. However, if the player's control of the emotion of the work is quite accurate, some small defects will make some classic performances on the stage. If the performer's control of the artistic emotion of the work is not precise enough, but his basic skills are solid and his playing skills are exquisite, he can also make up for some of the lack of emotional expression. Therefore, there is a dialectical relationship between playing skills and artistic expression.

3. Finite element-based computational simulation method for concertina relations

3.1. Finite element algorithm for the sound propagation problem

The space in which sound waves are transmitted is called a sound field, and sound fields are categorized as free, diffuse (reverberant), and semi-free sound fields. Based on the music education environment of the clarinet and symphony concert generally belongs to the indoor sound field environment, and is often more complex. In order to effectively analyze the relationship between the two concertos this paper is based on the finite element for computational simulation, next, first introduce the relevant theory and method.

Finite element method (FEM) is a simulation calculation method based on the principle of dissecting interpolation and variational to solve the original problem equivalent generalized variational or equivalent integral equation of the weak solution, the method is applicable to the numerical simulation calculation of arbitrary geological formations, to ensure that the simulation of wave propagation in the space of the complex morphology of the fidelity of the simulation [17]. The localized fundamental solution method (LMFS) is an improved method of finite element method based on Taylor expansion, which has greater advantages in acoustic simulation [18]. Currently, the mainstream finite element simulation software includes ANSYS, ABAQUS and COMSOL, etc. COMSOL is different from the earlier finite element simulation software based on single physical field simulation and analysis, and it can realize the simultaneous finite element simulation simulation in the case of multi-physical field.

In this paper, the acoustic characteristics are extracted and analyzed based on the simulation results of COMSOL finite element simulation and analysis software, so the finite element method in acoustics is briefly explained and derived. The basic idea of the finite element method is summarized as “reduce the whole to zero, simplify the complexity”. The finite element method is to wait for the solution of the complex physical domain, and its boundary conditions are divided into a limited number of simple and very small physical domain units, through the boundary conditions, the continuity and coupling conditions between the physical units, to establish a large matrix or group of numerical equations, the use of iterative or direct solving methods to solve the solution of the physical units, and ultimately get the entire complex physical domain of the approximate solution or the exact solution. The finite element method solution process is shown in Figure 2, the finite element method can be divided into pre-processing, processing and post-processing steps, for different physical problems, the solution steps are basically the same.

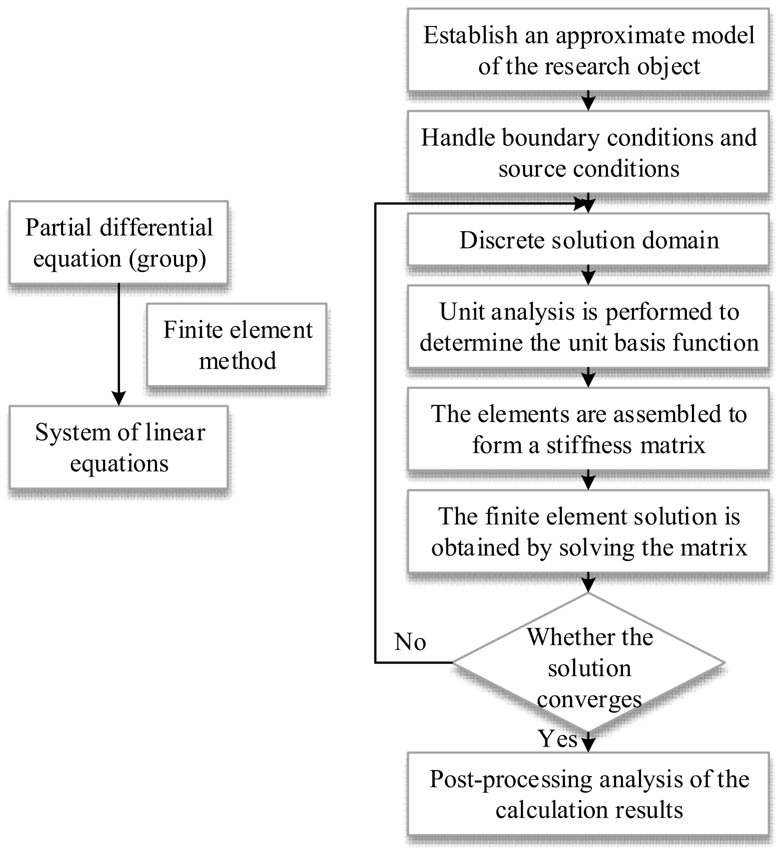


Fig. 2. Solution flow chart of finite element method

3.2. Finite Element Algorithms for Concordance-Oriented Chamber Sound Fields

Based on the music education environment of clarinet and symphony concerto is mainly carried out in relatively closed classrooms or performance halls, etc. For this reason, this paper carries out finite element computational simulations for closed classroom environments.

The steps of the finite element method to solve the problem are to decompose the defined domain of the solution into a finite set of non-overlapping cell grids, to approximate with a finite cell grid, to establish the relationship between the sound pressure of the nodes on the cell and other parameters, so as to obtain the overall equations, and then solve the equations numerically according to the corresponding boundary conditions.

The fluctuation equation for sound pressure $p(r,t)$ in a closed classroom sound field is:

$$\nabla^2 p - \frac{1}{c^2}\frac{\partial^2 p}{\partial t^2} = -\rho_0 \frac{\partial q}{\partial t} \tag{1}$$

Taking the sound source as simple harmonic vibration, the sound source function $q(r,t) = q_0(r)e^{i\omega t}$, since the linear system is considered, the sound pressure at each point in the room has the same frequency of vibration, and the sound pressure can be expressed as:

$$p(r,t) = p(r,\omega)e^{j\omega t} \tag{2}$$

From Eqs. (1) and (2), the Helmholtz equation for the active is obtained by organizing the calculations:

$$\nabla^2 p_\omega(r) + k^2 p_\omega(r) = -j\omega\rho_0 q_0(r) \tag{3}$$

This translates into a frequency domain problem. Let $p = p_\omega(r), f = -j\omega\rho_0 q_0(r)$, then equation (3) is rewritten as:

$$\nabla^2 p + k^2 p = f \tag{4}$$

The sound pressure at any point in the cell is related to the sound pressure at the node:

$$p(x) = \sum_{j=1}^{n} p_j N_j(x) \tag{5}$$

where x is any point in the cell, p_j is the sound pressure at node j, N_j is the shape function at the node, and n is the number of cell nodes.

Let the volume of the closed space be V and the total area of the inner wall be S, where S_1 is the rigid wall surface and S_2 is the absorbing wall surface, then the boundary equations corresponding to the Helmholtz equations at the boundary are:

$$\begin{cases} \dfrac{\partial p}{\partial n} = 0, \text{On the boundary of } S_1 \\ \dfrac{\partial p}{\partial n} = -j\omega\rho_0 \dfrac{p}{z_s}, \text{On the boundary of } S_2 \end{cases} \tag{6}$$

From Eq. (4) and the boundary condition Eq. (6), the finite element equations are thus obtained based on the variational principle:

$$K^{(e)}P^{(e)} - k^2 M^{(e)}P^{(e)} + j\omega\rho_0 C^{(e)}P^{(e)} = F^{(e)} \tag{7}$$

where the matrices of the cells are:

$$K^{(e)} = \int_{V^{(e)}} (\nabla N)^T (\nabla N) dV, M^{(e)} = \int_{V^{(e)}} N^T N dV \tag{8}$$

$$C^{(e)} = \int_{S_2^{(e)}} \frac{N^T N}{Z_S} dS, F^{(e)} = \int_{V^{(e)}} f N dV \tag{9}$$

where N is the column vector formed by the interpolated form function of each node on the cell, and ∇N is the derivative matrix of the form function.

According to the unit combination rules in the finite element method, the overall matrix of the system ground can be obtained:

$$K = \sum_e K^{(e)}, M = \sum_e M^{(e)}, C = \sum_e C^{(e)}, F = \sum_e F^{(e)} \tag{10}$$

From this, the finite element equations of the system can be obtained:

$$(K - k^2 M + j\omega\rho_0 C)P = F \tag{11}$$

4. Computational simulation experiments in clarinet technique and orchestral concertos

4.1. Setting of parameters

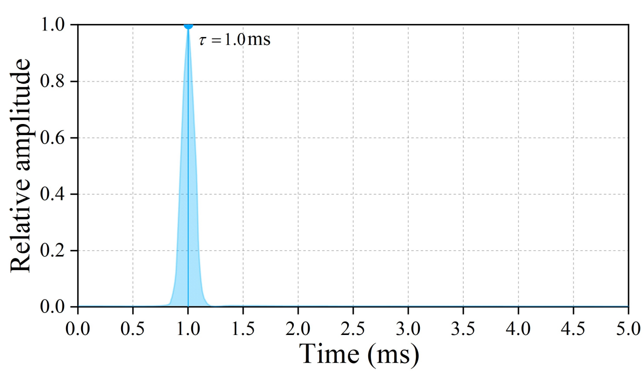
In this section, the simulation of the impulse response within the clarinet will be carried out in the time domain, using a non-uniform mesh form to divide the clarinet. In order to obtain the impulse response below 5 kHz, Gaussian pulses are used as point sources in this calculation. Considering the performance of the computer, the time step Δt is set to 0.130ms, and the corresponding sampling frequency $1/\Delta t$ is 10kHz.The impedance of the clarinet is set to $8712\ \mathrm{Pa \cdot m/s}$ in reference to the relevant literature, in which the point source and the four acoustic points are denoted as Point1~4.

Usually, when calculating the clarinet impulse response, it is necessary to add an excitation source to the calculation. In practical measurements, the maximum length sequence (MLS) or swept signal is usually used as the excitation sound source to attenuate the effect of noise on the measurement results. However, in numerical simulation, since there is no ambient noise, a pulsed sound source can be used as the excitation signal, which makes the computational simulation more efficient. Gaussian pulse is a common signal in time domain simulation, and another common signal is differential Gaussian pulse. In this paper, the Gaussian pulse is taken as the excitation source for simulation, and its time-domain expression is as follows:

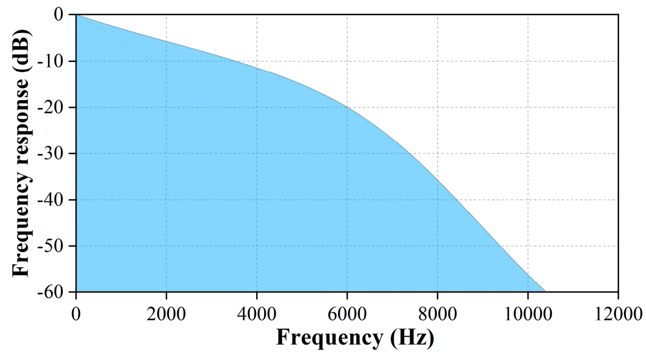
$$g(t)=\begin{cases} Ae^{-\pi^2 f_0^2 (t-\tau)^2} & 0<t<2\tau \\ 0 & \text{other} \end{cases} \tag{12}$$

In the above equation, $1/f_0$ is the half-width of the Gaussian pulse source, and τ is the moment when the peak of the pulse appears. It can be known that the higher f_0 is, the narrower the width of the Gaussian pulse is, and the larger the frequency width of the Gaussian pulse is.

In order to get the low and medium frequency impulse response below 5 kHz, f_0 is set to 5 kHz in the simulation, and the simulated pulse waveform of the clarinet source and its amplitude-frequency response are shown in Fig. 3. Among them, Fig. 3(a) shows the time-domain plot of the Gaussian pulse at $f_0 = 5\,\mathrm{kHz}$, $\tau = 1.0\,\mathrm{ms}$, and Fig. 3(b) shows its corresponding amplitude-frequency response. It can be seen that the energy of the signal is almost entirely concentrated within 10 kHz, and most of it is concentrated within 4 kHz, so the size of f_0 determines the effective frequency range of the Gaussian pulse.



(a) Gaussian pulse time domain diagram



(b) amplitude-frequency characteristics of Gaussian pulses

Fig. 3. Gaussian pulse waveform and its frequency response

4.2. *Computational simulation results*

In this simulation, the time step is set to be 0.120 ms, and the corresponding sampling frequency is 10 kHz, and the impulse response data of the four sound-receiving points (P1-P4) are exported to the MATLAB software to be processed by the frequency correction, etc., and the simulation results of the impulse response of the four sound-receiving points of the clarinet are shown in Fig. 4. It can be seen that the relative amplitudes of the four affected points of the clarinet are -0.0136, -0.3553, 0.029 and -0.029, respectively, and the relative amplitudes are in the range of ±0.4, which is in line with the timbre characteristics of the clarinet. At the same time, due to the small relative amplitude of the clarinet, the clarinet performance requires higher playing skills, and it is easy to appear the phenomenon of flaws in the melody or notes when playing some works with larger difficulty coefficients.

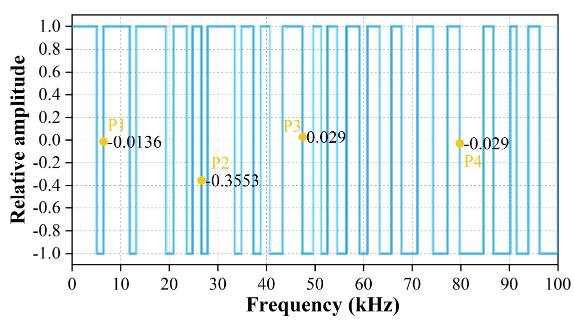


Fig. 4. Simulation results of impulse response of 4 sound receiving points of clarinet

4.3. *Comparative analysis of different methods*

In the analysis of sound field problems of clarinet technique and orchestral concerto in a practical music education setting, the parameters of the computational model such as density, Young's modulus, Poisson's ratio, and external excitation are difficult to determine. Uncertainty in the numerical analysis of computational simulation is mainly reflected in four aspects:

1) Uncertainty of acoustic constants. In the process of sound propagation, the acoustic constants that affect the sound pressure distribution in the sound field include the air density and the speed of sound. The propagation speed of sound in the air is related to the ambient temperature and pressure, and once the ambient temperature is unstable or has a large change, the speed of sound and air density will also change. Therefore, in the actual music education environment, the speed of sound and air density is often uncertain.

2) Uncertainty of external excitation. The sources of excitation in the internal sound field of the actual music education environment include the sound of ensemble instruments, human voices, and electronic music sound, etc., so the excitation generated is constantly changing and difficult to determine.

3) Uncertainty of measurement and assembly. Due to the limitations of musical instrument processing accuracy, measurement and assembly errors and the existence of external disturbances and other factors, the geometric dimensions of the acoustic system of musical instruments, such as the thickness of the material is often uncertain.

4) Uncertainty of boundary conditions. In the actual music teaching problem, the performance conditions of the symphony are complicated, and its boundary conditions are also uncertain. Therefore, in the numerical simulation analysis later, the main discussion is to analyze the boundary conditions with vibration velocity and sound-absorbing materials.

In the numerical analysis of this paper, the above uncertainties will be set as idealized fixed parameters in the calculation, with the air density inside the cavity as ρ=1.125 kg/m^3 and the sound velocity as 345 m/s. The calculated frequency, for the external excitation under the conditions of the clarinet vibration and so on. In addition, the Local Fundamental Solution Method (LMFS) for analyzing the numerical simulation of the relationship between clarinet technology and orchestral concertina needs to be analyzed in comparison with the traditional numerical methods Finite Element Method (FEM) or Generalized Finite Difference Method (GFDM) based on Taylor expansion. The FEM results obtained by COMSOL Multiphysics 5.4 are used as a reference solution for verifying the performance of LMFS in acoustic analysis under complex boundary conditions.

In order to verify the feasibility of the methods used in solving acoustic problems, Table 1 compares the relative errors obtained from different numerical methods computed on the test nodes. In MATLAB, LMFS and GFDM are configured with the same number of total nodes $N = 1246(\Delta h = 0.02m)$. To obtain good computational accuracy in LMFS simulation analysis can be set m to 15. To ensure the accuracy of FEM, the number of cells is divided into 3050 in the finite element software COMSOL. From the data in the table, it can be seen that for the same total number of nodes, the method used, LMFS, can obtain a relatively accurate computational accuracy than GFDM. In addition, the numerical method can also achieve better numerical accuracy when the number of computational nodes used is lower than the number of meshes of the traditional finite element method, and also shows the potential of LMFS in reducing the operational memory and improving the efficiency of numerical computation.

Table 1. Relative errors of different methods at *f*=500Hz

Test point	LMFS	GFDM	FEM
(0.2, 0)	1.042×10^{-4}	1.007×10^{-2}	9.872×10^{-3}
(0.4, 0)	5.043×10^{-4}	1.418×10^{-2}	9.026×10^{-2}
(0.6, 0)	1.385×10^{-4}	1.081×10^{-2}	1.535×10^{-2}
(0.8, 0)	8.916×10^{-4}	2.424×10^{-2}	9.180×10^{-2}
(1.0, 0)	1.955×10^{-4}	9.081×10^{-3}	1.661×10^{-2}

In the discussion in Chapter 3, it was found that the parameters of the false boundary radius have some influence on the computational accuracy, and in order to rationally select the radius parameters of the used method under complex boundary conditions, different false distance parameters R_S are discussed and analyzed below. The numerical results obtained from the $(R_s = 1.5, 2.0, 2.5, 3.0)$ LMFS calculations with different parameters are given in Fig. 5. It can be seen from the figure that the computational accuracy of the method used is relatively accurate and stable under different parameters. The relative errors under different false boundary parameters are shown in Fig. 6, from which it can also be observed that the accuracy of LMFS calculations with impedance-containing boundary conditions is not very sensitive to the variation of the false boundary radius parameter R_S, with the relative errors all within ± 0.3. Therefore, for simplicity, parameter $R_S = 2.0$ is chosen for all computational simulations solving the relationship between the clarinet technique and the symphonic concerto.

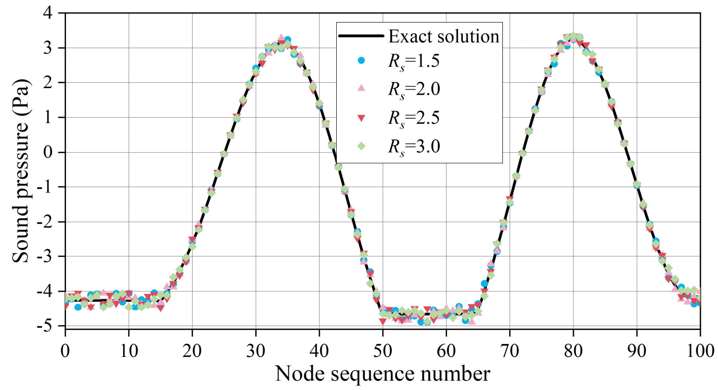


Fig. 5. Numerical results under different false boundary parameters

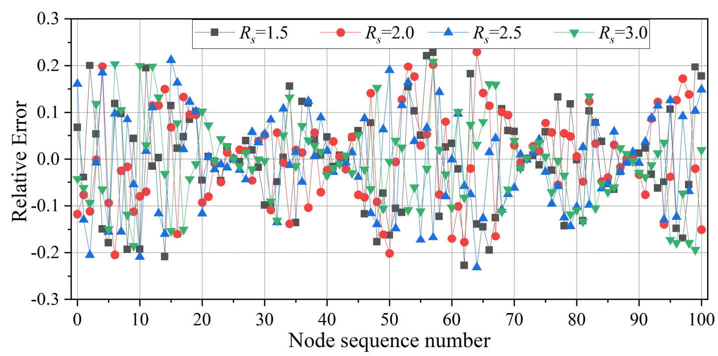


Fig. 6. Relative errors under different false boundary parameters

Figure 7 demonstrates the sound pressure data at the bottom boundary at different frequencies, and the curve in the figure shows that the numerical results at the test nodes are in perfect agreement with the exact solution. It is also more intuitively verified, that the accuracy of the proposed numerical simulation method for the prediction and analysis of the low and middle frequency sound field in the clarinet technique and symphonic concerto process.

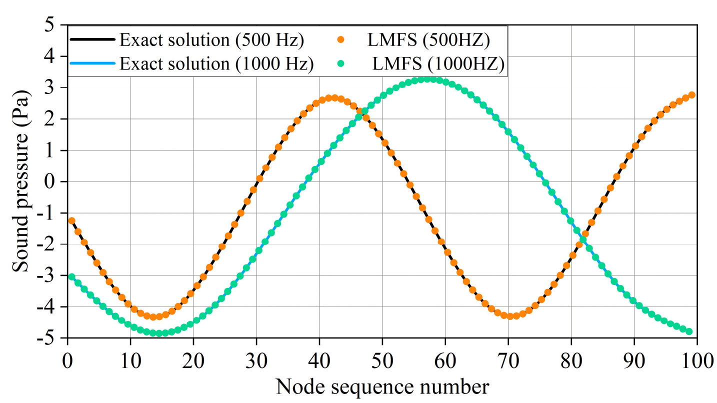


Fig. 7. Numerical results obtained by LMFS calculation

5. Conclusion

The clarinet's tonal advantages and characteristic role in the symphony orchestra are irreplaceable by any other instruments. To give full play to its tonal advantages and characteristic role, it is necessary to explore the relationship between clarinet technique and symphonic concerto in a scientific way. Only in this way can the artistic and educational value of the clarinet in the symphony orchestra be truly realized. The numerical simulation calculation method based on the local fundamental solution method can ensure the realism of the sound wave propagation simulation in the complex music education environment. It is on the basis of this feature that we have solved the relationship between clarinet technology and symphonic concerto using the local fundamental solution method. By comparing with the traditional mesh-based finite element method, we found that the relative errors of the LMFS computational accuracy are controlled within ± 0.3 and are not very sensitive to the parameters in such a complex environment as music education, which also verifies the accuracy and high efficiency of the local elementary solution method in simulating complex acoustic models. However, as a new numerical algorithm, LMFS is still in the stage of continuous development and improvement, and many key issues need to be further studied.

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