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Research on the Reform of Art Education and Teaching based on the Background of Big Data

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Abstract. In order to improve the quality of art education and teaching reform, this paper combines big data technology to carry out research on art education reform and improve the effect of art education reform. This paper introduces an improved multiband spectral subtraction method for amplitude spectral enhancement of speech by a log-MMSE estimator. The experimental results show that the algorithm can effectively reduce the "music noise" problem of traditional spectral subtraction, and reduce the distortion problem of the art teacher's dialogue speech. Moreover, the enhanced dialogue speech signal obtained by the improved multi-band spectral subtraction in this paper can extract more time-domain features of the speech signal than the traditional spectral subtraction method. Through experimental research, it can be seen that the art education model proposed in this paper can effectively improve the effect of modern art teaching and improve the teaching interaction between teachers and students.

Keywords: big data; art education; teaching; reform
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1 INTRODUCTION

With the development of information technology, the traditional "face-to-face" classroom teaching mode has been unable to fully meet the objective needs of college students' learning and growth. Blended teaching refers to the teaching mode that organically integrates offline teaching and online teaching. Moreover, blended teaching is a reform of teaching mode and a new exploration of teaching design by teachers [1]. Online teaching has great advantages in pre-class notification, in-class interaction, online learning, after-class Q&A, and homework correction. It is conducive to the convenient communication of pre-class teaching information and the rapid distribution of teaching resources, and also enables interactive methods such as classroom response, grading, group discussion, selection, and questionnaire surveys. In addition, it is also conducive to answering questions after class, implementing targeted guidance and checking the learning situation. Offline classroom teaching has the irreplaceable advantages of online teaching in terms of timely attention to students' learning status, on-site interaction between students and teachers and students [2].

The future higher education must be highly related to the market and industry, especially the teaching principles in some application-oriented higher technology schools: higher education should not only focus on pre service education, the training of future talents should not be separated from the society, higher education should be integrated before and after, and a systematic training system should be built [3]. At present, many countries in the world are actively engaged in the education and training of future talents, focusing on the reform and innovation of teaching concepts and models. In order to win the development in the next few decades, China has already started the layout of talent training and industrial upgrading [4]. The school can also set up courses such as "product design survey and research methods" and "product marketing" according to the situation to comprehensively improve students' horizontal professional development ability. The main problem of the current talent market in China lies in the structural imbalance between talent supply and demand. The main reasons for this kind of problem are: first, colleges and universities are seriously homogenized in professional curriculum and teaching, leading to the surplus of low-end talents in the industry; Second, in terms of education and training, the training of medium and high-end talents is insufficient, and there is a lack of innovative and technical professionals. The accumulation of middle and low-end talents leads to employment difficulties, and the lack of high-end talents makes the development of enterprises unable to get strong support, thus leading to a serious imbalance in the current talent market structure. Therefore, for the professional curriculum of product design, it is necessary to appropriately increase the proportion of product technology practice modules [5]. For example, in terms of "carving technology of handicrafts", the content of knowledge courses should be further differentiated, and the knowledge points should be from easy to difficult, step by step, and then focus on increasing practice class hours to strengthen the training of practical ability. The innovation of teaching content should actively introduce big data analysis to ensure clear teaching levels, improve teaching effects layer by layer, and constantly optimize teaching content to provide more personalized teaching services for students, so as to ensure that the higher education system is not separated from the society [6]. In terms of curriculum teaching design of product design specialty, the school needs to further clarify the industry's demand for basic knowledge and skills of talents. Invite professionals and practitioners in the industry to participate in the higher skills training and teaching work of the school, hold corresponding work tasks and higher skills analysis meetings, jointly discuss and cooperate in the development of corresponding course teaching content, and regularly evaluate and demonstrate the course content; In terms of teaching, it is also necessary to make a comprehensive analysis according to the requirements of enterprise posts for the post abilities that graduates should have, and combine the characteristics of product design specialty and the needs of the market environment to jointly cultivate their core abilities, that is, to strengthen the comprehensive training of abilities in product modeling, design performance, product software, technical practice, technical development, etc. [7]. Through the analysis of the needs of the society for core competence and the needs of enterprises' posts, we further refine our abilities, formulate corresponding courses according to the needs of ability training, define the teaching knowledge points of the courses, and then eliminate the contents of the previous textbooks that are repetitive, lagging, and have little to do with students' core competence, so as to further increase and optimize the knowledge points that meet the market demand [8]. Through the construction of modular professional courses, systematic analysis of the course structure, further optimize the basic knowledge in professional courses, such as traditional basic courses such as sketch and color sketch in basic courses, which can be integrated and optimized into a "modeling foundation" to meet the needs of the modern market, and the history of Chinese and foreign design can be changed into a "design overview"; The content that needs to be learned in the future can be designed and optimized step by step as the final core of professional content, such as "innovative design" and "design performance techniques", so that students can have a deep understanding of relevant professional content at school, and also can identify the future development direction [9]. The idea of optimizing the curriculum education reform is to conform to the market demand and establish the teaching concept and method of "broadening the foundation" and "emphasizing practice". Among them, the curriculum system setting of "broad foundation" is to further expand various general knowledge abilities, professional knowledge and other contents that are required or contacted in product design posts, such as "modeling foundation" and "design graphics" to cultivate students' basic design ability [10]; The curriculum system setting of "emphasizing practice" is to abandon the previous model of too much pure theory teaching, actively broaden the teaching scope, guide students to carry out practical activities and training, and pay attention to the openness, practicality and advancement in teaching [11]. The curriculum teaching of product design specialty should focus on optimization according to the needs of market enterprises and post capabilities, eliminating the past scene that students have studied hard for three years in school, but found that the knowledge they learned was completely useless when they came in and out of the society; The courses of product design specialty should promote the development of students' comprehensive literacy, and enable them to master the necessary theoretical methods, structural materials, functional forms, modeling and decoration related to product design; It is necessary to further train students' innovative thinking and humanistic art accomplishment. Teaching should be international and market oriented, with modern ideas and awareness, and use information technology to broaden teaching horizons and enrich teaching content [12]. In order to effectively solve the shortcomings of the traditional classroom teaching mode, it is necessary to take the development and utilization of curriculum resources as the main development direction of the future curriculum reform. In this regard, colleges and universities need to improve teachers' ability to develop curriculum resources, which should focus on the following aspects: first, strengthen the relationship between basic art curriculum teaching and market aesthetic needs, abandon the traditional theory-based curriculum resource development model, fully tap and grasp the current popular cultural elements in the market, and innovate the teaching content and form. For example, teachers can organize students to participate in social practice activities such as market survey and information survey, guide students to collect various aesthetic elements, product design styles, product design ideas, etc. in the market, and constantly enrich the teaching content of basic art courses [13]; Second, teachers also need to strengthen learning and reflection, actively participate in various training, scientific research, extramural learning activities, constantly explore the content of textbooks, make full use of the network channels to collect and sort out relevant product design concepts, constantly improve their professional teaching ability, and set an example to effectively stimulate students' interest and motivation in learning courses [14].

The basic course of product design art covers a wide range of subjects with high professional requirements. It has certain requirements for students' abilities and has been widely applied and popularized in many industries. In order to effectively carry out product design, the reform of basic art curriculum needs to grasp the characteristics of professional curriculum and school running in colleges and universities, and comprehensively develop professional courses [15]. We should fully analyze the past curriculum reform experience, market development needs, and student development characteristics of colleges and universities, and focus on the following aspects: First, we should reform the art curriculum on the basis of grasping the market aesthetic trend and the actual needs of student development, strengthen the connection between the basic curriculum of product design aesthetics and real life, and improve the comprehensive quality and ability of students. When students are specifically engaged in product design related higher education, they need to master basic sketching skills. For this, teachers need to strengthen the training of students' basic skills in art courses, ensure that students can complete high-level sketching in a fixed time through practical training, and promote students to fully understand the value of sketching, so as to facilitate the smooth application in the later period. Second, teachers need to actively develop comprehensive courses, especially art experts should also strengthen the exploration of art courses, devote themselves to developing various comprehensive resources, broaden students' horizons, and provide students with a variety of development opportunities [16].

This paper combines big data technology to carry out research on art education reform, improve the effect of art education reform, and provide a reference for the intelligent development of art education in the information age.

2 RESEARCH ON SPEECH ENHANCEMENT ALGORITHM FOR ART TEACHERS

2.1 The Pronunciation Characteristics and Defects of Art Teachers

In online teaching, art teachers' control over pronunciation is far lower than in real teaching, which will cause serious "pronunciation disorders". Therefore, in the same noise environment, the signal-to-noise ratio (SNR) of the art teacher's speech will be lower, which is not conducive to the feature extraction of preprocessing in speech recognition Figure 1.

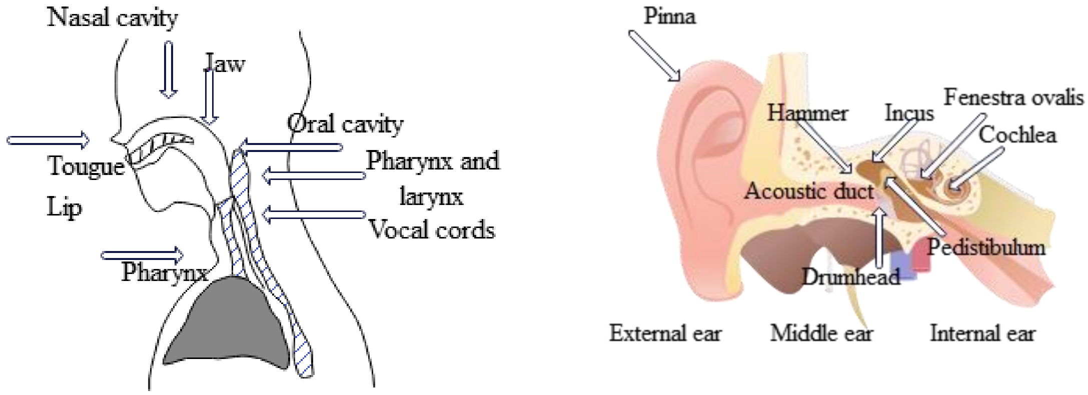

Figure 1: The human voice system: (a) Articulatory system, (b) Human ear structure.

In the field of speech enhancement, spectral subtraction has always been the preferred algorithm in engineering projects because of its ease of implementation and good operability. The principle is as follows:

$$y(n)=x(n)+d(n) \tag{1}$$

After Fourier transform, we can get:

$$Y(\omega)=X(\omega)+D(\omega) \tag{2}$$

We can express $Y(\omega)$ in polar coordinates:

$$Y(\omega)=|Y(\omega)|^{\mu(\omega)} \tag{3}$$

According to the basic principle of spectral subtraction, we can obtain an estimate of the pure signal spectrum through formula 2:

$$\hat{X}(\omega)=[|Y(\omega)|-\hat{D}(\omega)]e^{j\phi_j(\omega)} \tag{4}$$

Then, we convert this signal into a representation of the power spectrum:

$$|\hat{X}(\omega)|^2 = //Y(\omega)//|^2 - |\hat{D}(\omega)|^2 \quad (5)$$

The schematic diagram of spectral subtraction is shown in Figure 2:

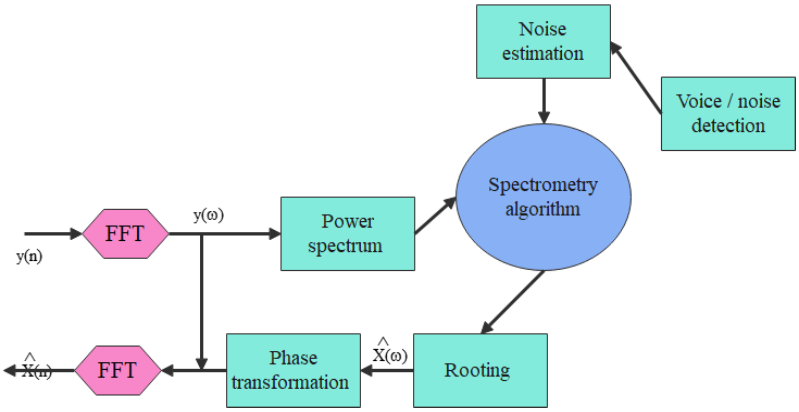

Figure 2: Flow chart of spectral subtraction.

The premise that spectral subtraction can perform perfect noise reduction is that the influence of environmental noise on the speech signal is uniform and continuous in the entire speech frequency band, but this is often not the case in practice. In reality, the noise interference received by art teachers during dialogue is usually judged as colored noise, which is a kind of noise with uneven spectrum amplitude. Therefore, its interference to the speech signal of the dialogue is also uneven and discontinuous. Under the external discontinuous and uneven noise interference, the noise spectrum after enhancement by spectral subtraction is prone to wrong estimation, resulting in the residual noise with musical sense, which is called "musical noise". It causes a bias to the feature extraction of subsequent speech recognition.

2.2 Multiband Spectral Subtraction

In the multi-band spectral subtraction algorithm, in order to reduce the influence of random noise in the environment on the art teacher's dialogue speech, we cut the speech into arbitrary overlapping subbands that do not interfere with each other. Furthermore, we use spectral subtraction to individually enhance the speech for each subband, and then recombine to obtain a cleaner speech signal. We generally use a bandpass filter to divide the subbands in the time domain, or divide the subbands by windowing in the frequency domain.

The estimation of the pure speech signal spectrum of the i-th subband is obtained by:

$$\left|\hat{X}_i(\omega_K)\right|^2 = \left|\bar{Y}_i(\omega_K)\right|^2 - \alpha_i \cdot \delta_i \cdot \left|\hat{D}_i(\omega_K)\right|^2 \; b_i \le \omega_i \le e_i \quad (6)$$

The negative value generated by the subtraction process of Equation 6 takes the lower limit according to the spectrum of the noisy signal:

$$\left|\hat{X}_i(\omega_K)\right|^2 = \begin{cases} \left|\hat{X}_i(\omega_K)\right|^2 & if \left|\hat{X}_i(\omega_K)\right|^2 > \beta\left|\bar{Y}_i(\omega_K)\right|^2 \\ \beta\left|\bar{Y}_i(\omega_K)\right|^2 & other \end{cases} \quad (7)$$

The spectral lower limit parameter β is set to 0.002. In order to solve the interference of "music noise", a small amount of noise needs to be written into the original voice signal again:

$$\left|\bar{\bar{X}}_i\left(\omega_K\right)\right|^2=\left|\hat{X}_i\left(\omega_K\right)\right|^2+0.05\cdot|\bar{Y}_i\left(\omega_k\right|^2 \tag{8}$$

The subband over-reduction factor α_i is a function of the signal-to-noise ratio of the ith frequency subband, and is calculated as follows:

$$\alpha_i\begin{cases}4.75 & SNR_i<-5 \\ 4-\frac{3}{20}\left(SNR_i\right) & -5\le SNR_i\le 20 \\ 1 & SNR_i>20\end{cases} \tag{9}$$

Among them, the sub-band signal-to-noise ratio is:

$$SNR_i(dB)=10\log\left[\frac{\sum_{\omega_k=b_i}^{e_i}|\bar{Y}_i\left(\omega_k\right)^2}{\sum_{\omega_k=b_i}^{e_i}|\hat{D}_i\left(\omega_k\right)^2}\right] \tag{10}$$

δ_i in formula 6 is determined empirically:

$$\delta_i=\begin{cases}1 & f_i\le 1kHz \\ 2.5 & 1kHz<f_i\le\frac{Fs}{2}-2kHz \\ 1.5 & f_i>\frac{Fs}{2}-2kHz\end{cases} \tag{11}$$

Because the low frequency band of the speech contains most of the speech energy of the whole speech, in order to minimize the speech distortion, we choose to use a smaller δ_i in the low frequency band.

The basic realization principle of multi-band spectral subtraction is as follows:

(1) The algorithm first preprocesses the noisy speech signal.

(2) The preprocessing of the initial signal is used in each sound frame before and after, and its amplitude spectrum form is as follows:

$$\left|\bar{Y}_i\left(\omega_k\right)\right|=\sum_{n=-M}^{M}W_n\left|Y_{i-n}\left(\omega_k\right)\right| \tag{12}$$

(3) The algorithm uses multi-band spectral subtraction to process the speech in segments. It is necessary to ensure that each segment of speech does not have the same part and calculate the over-subtraction factor, so that it can be approximated that the noise in each segment of speech signal is uniform.

(4) The algorithm performs spectral subtraction in each subband individually. The algorithm uses spectral subtraction to obtain spectral estimates of the enhanced speech signal for each subband.

The schematic diagram of multi-band spectral subtraction is as follows (figure 3):

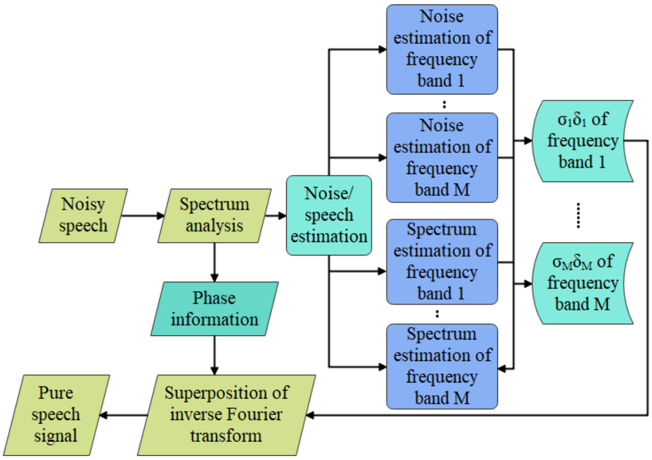

Figure 3: Flowchart of multiband spectral subtraction.

2.3 MMSE Estimator

Multi-band spectral subtraction is a very practical speech enhancement algorithm. However, due to the aging of the vocal cords of art teachers, the SNR of the output noisy speech is low, and the multi-band spectral subtraction will cause slight speech distortion in the environment with relatively low SNR. Therefore, in view of this deficiency, this paper introduces MMSE estimation to enhance the original speech, and optimizes the entire speech enhancement algorithm.

MMSE is a speech enhancement algorithm based on a statistical model. The optimal estimation formula is as follows:

$$e = E\left\{\left(\hat{X}_k - X_k\right)^2\right\} \tag{13}$$

The expected value of the Bayesian mean square error is obtained according to the joint probability density $p\left(Y \mid X_k\right)$, and the Bayesian formula is as follows:

$$Bmse\left(\hat{X}_k\right) = \iint \left(X_k - \hat{X}_k\right)^2 p\left(Y, X_k\right) dY dX_k \tag{14}$$

The optimized MMSE estimator is obtained by finding the minimum value of $\hat{X}_k$ with respect to formula 14:

$$\begin{aligned} \hat{X}_k &= \int X_k p\left(X_k \mid Y\right) dX_k \\ &= E\left[X_k \mid Y\right] \\ &= E\left[X_K \mid Y\left(\omega_0\right) Y\left(\omega_1\right) \ldots Y\left(\omega_{N-1}\right)\right] \end{aligned} \tag{15}$$

$p\left(X_k \mid Y\left(\omega_k\right)\right)$ can be obtained from the Bayesian criterion:

$$
\begin{aligned}
p\left(X_k \mid Y\left(\omega_k\right)\right) &= \frac{p\left(Y\left(\omega_k\right) \mid X_k\right) p\left(X_k\right)}{p\left(Y\left(\omega_k\right)\right)} \\
&= \frac{p\left(Y\left(\omega_k\right) \mid X_k\right) p\left(X_k\right)}{\int p\left(Y\left(\omega_k\right) \mid x_k\right) p\left(x_k\right) dx_k}
\end{aligned} \tag{16}
$$

The Fourier transform coefficients are statistically independent from each other:

$$
E\left[X_k \mid Y\left(\omega_0\right) Y\left(\omega_1\right) Y\left(\omega_2\right) \ldots Y\left(\omega_{N-1}\right)\right] = E\left[X_k \mid Y\left(\omega_k\right)\right] \tag{17}
$$

Taking $p\left(X_k \mid Y\left(\omega_k\right)\right)$ into formula 15, it can be simplified to:

$$
\begin{aligned}
\hat{X}_k &= E\left[X_k \mid Y\left(\omega_k\right)\right] \\
&= \frac{\int_0^{\infty} x_k p\left(Y\left(\omega_k\right) \mid x_k\right) p\left(x_k\right) dx_k}{\int_0^{\infty} p\left(Y\left(\omega_k\right) \mid x_k\right) p\left(x_k\right) dx_k}
\end{aligned} \tag{18}
$$

Here, we use the established model formula:

$$
p\left(Y\left(\omega_k\right) \mid X_k\right) p\left(X_k\right) = \int_0^{2\pi} p\left(Y\left(\omega_k\right) \mid X_k, \theta_k\right) p\left(X_k, \theta_k\right) d\theta_k \tag{19}
$$

θ_k is the actual value of the phase of the random variable $X\left(\omega_k\right)$, and we can get:

$$
X_k = \frac{\int_0^{\infty} \int_0^{2\pi} x_k p\left(Y\left(\omega_k\right) \mid x_k, \theta_k\right) p\left(x_k, \theta_x\right) d\theta_x dx_k}{\int_0^{\infty} \int_0^{2\pi} p\left(Y\left(\omega_k\right) \mid x_k, \theta_k\right) p\left(x_k, \theta_k\right) d\theta_k dx_k} \tag{20}
$$

$p\left(Y\left(\omega_k\right) \mid x_k, \theta_k\right)$ is also Gaussian:

$$
p\left(Y\left(\omega_k\right) \mid x_k, \theta_k\right) = p_D\left(Y\left(\omega_k\right) - X\left(\omega_k\right)\right) \tag{21}
$$

Formula 20 translates to:

$$
p\left(Y\left(\omega_k\right) \mid x_k, \theta_k\right) = \frac{1}{\pi \lambda_d(k)} exp\left\{-\frac{1}{\pi \lambda_d(k)} \left|Y\left(\omega_k\right) - X\left(\omega_k\right)\right|^2\right\} \tag{22}
$$

Since the probability density function of $\theta_k(k)$ is uniformly distributed in $(-\pi, \pi)$, we can obtain the joint probability density function $p\left(x_k, \theta_k\right)$ as:

$$
p\left(x_k, \theta_k\right) = \frac{x_k}{\pi \lambda_x(k)} exp\left\{-\frac{x_k^2}{\lambda_x(k)}\right\} \tag{23}
$$

By substituting formula 22 and formula 23 into formula 18, the MMSE-optimized magnitude spectrum estimator can be obtained:

$$X_k = \sqrt{\lambda_k}\,\Gamma(1.5)\Phi\left(-0.5,1;-v_k\right) \tag{24}$$

ξ_k、γ_k is shown in s 25 and 26:

$$\xi_k = \frac{\lambda_k(k)}{\lambda_d(k)} \tag{25}$$

$$\gamma_k = \frac{Y_k^2}{\lambda_d(k)} \tag{26}$$

The intermediate variable v_k is obtained from formula 25 and formula 26 as shown in Equation 27, and finally a simplified MMSE magnitude spectrum estimator is obtained:

$$v_k = \frac{\xi_k}{1+\xi_k}\gamma_k \tag{27}$$

$$\hat{X}_k = \frac{\sqrt{\pi}}{2}\frac{\sqrt{v_k}}{\gamma_k}exp\left(-\frac{v_k}{\gamma_k}\right)\left[\left(1+v_k\right)I_0\left(\frac{v_k}{2}\right)+v_k I_1\left(\frac{v_k}{2}\right)\right]Y_k \tag{28}$$

Before using this algorithm, ξ_k should be estimated first. At present, the mainstream a priori SNR methods include maximum likelihood estimation (ML) and leading decision method (DD). This paper adopts the lead-decision method (DD).

The basic principle of the prior decision method to obtain the prior SNR is: the algorithm divides the speech signal into frames, and we obtain the SNR of the last analysis frame through the speech amplitude estimation and noise estimation of the last analysis frame. Combined with the posterior SNR estimation of the previous analysis frame, the algorithm obtains the prior SNR ξ_k of the current frame by recursive formula 29:

$$\xi_k(m) = a\frac{\hat{X}_k^2(m-1)}{\lambda_d(k,m-1)}+(1-a)max\left[\gamma_k(m)-1,0\right] \tag{29}$$

When using the pilot decision method, we need to impose initial conditions on the first frame, usually we set m=0, and $\hat{\xi}_k(0)$ can be obtained as:

$$\hat{\xi}_k(0) = a+(1-a)max\left[\gamma_k(0)-1,0\right] \tag{30}$$

In formula 30, a is usually taken as 0.98.

2.4 Improved Multiband Spectral Subtraction

Since this paper mainly faces the noise problem of art teachers, it is usually an environment with low signal-to-noise ratio. In a low-signal-to-noise ratio environment, the effective MCRA algorithm performs noise estimation.

First of all, this paper assumes that there are two hypothetical models, one is the existence of speech, and the other is that speech does not exist:

$$H_0^k : Y(\lambda,k) = D(\lambda,k)$$
$$H_1^k : Y(\lambda,k) = X(\lambda,k) + D(\lambda,k) \tag{31}$$

With these two hypothetical models, we can update the noise spectrum based on these models as follows:

$$H_0^k : \hat{\sigma}_D^2(\lambda,k) = \alpha\hat{\sigma}_D^2(\lambda-1,k) + (1-\alpha)|Y(\lambda,k)|^2$$
$$H_0^1 : \hat{\sigma}_D^2(\lambda,k) = \hat{\sigma}_D^2(\lambda-1,k) \tag{32}$$

(1) First, we update the noise estimation principle according to the presence or absence of speech segments, and obtain the mean square estimation of the noise power density as follows:

$$\hat{\sigma}_d^2(\lambda,k) = E\left[\sigma_d^2(\lambda,k)|H_0\right]p\left(H_0|Y(\lambda,k)\right) + E\left[\sigma_d^2(\lambda,k)|H_1\right]p\left(H_1|Y(\lambda,k)\right) \tag{33}$$

(2) The smooth estimation of the power spectral density of noisy speech is as follows:

$$S(\lambda,k) = \alpha_s S(\lambda-1,k) + \left(1-\alpha_s\right)S_f(\lambda,k) \tag{34}$$

Among them, α_s is the smoothing factor and S is the spectrum of noisy speech, where:

$$S_f(\lambda,k) = \sum_{i=-L_w}^{L_w} w(i)|Y(\lambda,k-i)|^2 \tag{35}$$

(3) To find S_{min}, we need to track the minimum value of S:

$$\begin{aligned} & if P_{min}(\lambda-1,k) < P(\lambda,k) \\ & P_{min}(\lambda,k) = \gamma P_{min}(\lambda-1,k) + \frac{1-\gamma}{1-\beta}(P(\lambda,k) - \beta P(\lambda-1,k)) \\ & else \\ & P_{min}(\lambda,k) = P(\lambda,k) \\ & end \end{aligned} \tag{36}$$

(4) The algorithm next finds $p(\lambda,k)$ and smooths it in time domain:

$$\begin{aligned} & if S_r(\lambda,k) > \delta \\ & p(\lambda,k) = 1 \quad \text{Voice presence} \\ & else \\ & p(\lambda,k) = 1 \quad \text{Voice does not exist} \\ & end \end{aligned} \tag{37}$$

The algorithm performs time-domain smoothing on $p(\lambda,k)$:

$$\hat{p}(\lambda,k) = \alpha_p \hat{p}(\lambda-1,k) + \left(1-\alpha_p\right)p(\lambda,k) \tag{38}$$

(5) The algorithm calculates the relevant smoothing factor:

$$\alpha_d(\lambda,k) = \alpha + (1-\alpha)p(\lambda,k) \tag{39}$$

Among them, $\alpha_d(\lambda,k)=P\left(H_1^k \mid Y(\lambda,k)\right)$.

(6) The algorithm updates the noise spectrum:

$$\hat{\delta}_d(\lambda,k)=\alpha_d(\lambda,k)\hat{\delta}_d^2(\lambda-1,k)+\left[1-\alpha_d(\lambda,k)\right]Y(\lambda,k)\Big|^2 \tag{40}$$

The parameters of this paper are set to $\alpha=0.95,\alpha_s=0.8,\delta=5$ and $\alpha_p=0.2$.

The MMSE estimator is more suitable for processing speech. Because of its better hearing to the human ear, this estimator is used in this paper. The basic principles are as follows:

$$log\,\hat{X}_k=E\left\{log\,X_k \mid Y\left(\omega_k\right)\right\} \tag{41}$$

By solving formula 41, we find $\hat{X}_k$:

$$\hat{X}_k=exp\left(E\left\{log\,X_k \mid Y\left(\omega_k\right)\right\}\right) \tag{42}$$

If $Z_k=log\,X_k$, then the moment generating function of Z_k based on condition $Y\left(\omega_k\right)$ is:

$$\Phi_{Z_k|Y(\omega_k)}(\mu)=E\left\{X_k^{\mu} \mid Y\left(\omega_k\right)\right\} \tag{43}$$

The conditional mean of $log\,X_k$ can be obtained by taking the derivative of the matrix generating function $\Phi_{Z_t|Y(\omega_*)}(\mu)$ at $\mu=0$, namely:

$$E\left\{log\,X_k \mid Y\left(\omega_k\right)\right\}=\frac{d}{d\mu}\Phi_{Z_k|Y(\omega_k)}(\mu)\Big|_{\mu=0} \tag{44}$$

We also need to find the value of the moment generating function $\Phi_{Z_k|Y(\omega_k)}(\mu)$. From formula 43, we need to find the value of $E\left\{X_k^{\mu} \mid Y\left(\omega_k\right)\right\}$, namely:

$$z_k \mid Y\left(\omega_k\right)(\mu)=\frac{\int_0^{\infty}\int_0^{2\pi} x_k^{\mu}\, p\left(Y\left(\omega_k\right) \mid x_k,\theta_k\right) p\left(x_k,\theta_k\right) d\theta_k dx_k}{\int_0^{\infty}\int_0^{2\pi} p\left(Y\left(\omega_k\right) \mid x_k,\theta_k\right) p\left(x_k,\theta_k\right) d\theta_k dx_k} \tag{45}$$

We derive the same statistical model as the previous MMSE estimator. Substituting formulas 22 and 23 into formula 45, we get:

$$\Phi_{Z_k|Y(\omega_k)}(\mu)=\lambda_k^{\mu/2}\Gamma(\mu/2+1)\Phi\left(-\mu/2,1;-v_k\right) \tag{46}$$

After taking the derivative of $\Phi_{Z_k|Y(\omega_k)}(\mu)$ with respect to μ and finding its value at $\mu=0$, we get the conditional mean of $log\,X_k$:

$$E\left\{log\,X_k \mid Y\left(\omega_k\right)\right\}=\frac{1}{2}log\,\lambda_k+\frac{1}{2}log\,v_k+\frac{1}{2}\int_{v_k}^{\infty}\frac{e^{-t}}{t}dt \tag{47}$$

Finally, we bring the above formula into 42 to get the estimator expression:

$$\hat{X}_k = \frac{\xi_k}{\xi_k + 1} exp\left\{ \frac{1}{2}\int_{v_k}^{\infty} \frac{e^{-t}}{t} dt \right\} Y_k \overset{\Delta}{=} G_{LSA}(\xi_k, v_k) Y_k \tag{48}$$

The block diagram of the improved algorithm is shown in Figure 4:

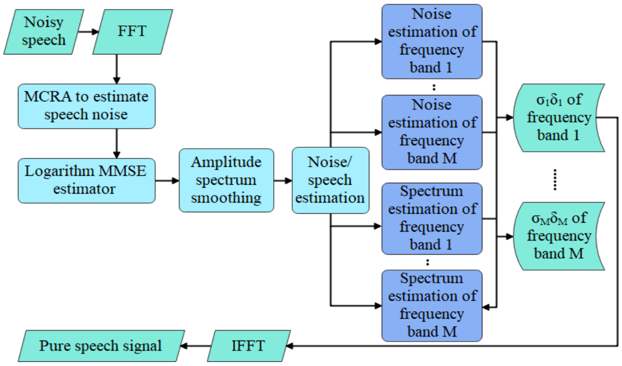

Figure 4: Flowchart of the improved algorithm.

2.5 Speech Quality Evaluation Method

The best way to evaluate the speech enhancement algorithm is to evaluate the enhanced speech quality. This paper introduces two evaluation methods, subjective and objective, to comprehensively evaluate the enhanced speech.

This paper mainly chooses the segmentation signal-to-noise ratio (segSNR) evaluation method for speech quality and the perceptual speech quality (PESQ) evaluation for speech intelligibility.

The expression for the segmentation signal-to-noise ratio is as follows:

$$seg\ SNR = \frac{10}{M}\sum_{m=0}^{M-1} log_{10} \frac{\sum_{n=Nm}^{Nm+N-1} x^2(n)}{\sum_{n=Nm}^{Nm+N-1} (x(n) - \hat{x}(n))^2} \tag{49}$$

PESQ is an objective assessment based on assessing the perceptual intelligibility of speech. The calculation structure of the PESQ measure is shown in Figure 5:

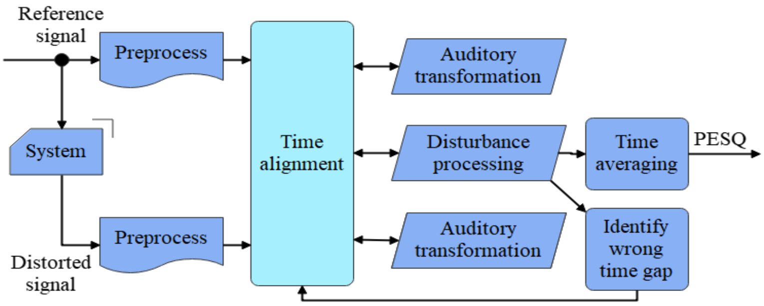

Figure 5: PESQ evaluation schematic diagram.

The PESQ score ranges from 1 to 4.5, which is basically the same as the mean opinion score (MOS) score, and can be used as the evaluation standard for speech intelligibility in this paper.

The experimental data of this paper is obtained through the software CoolEditPro2.0 software to obtain 50 speeches of art teachers in the same quiet environment. The relatively pure dialogue voice is selected as the original voice used in this experiment, and the voice content is "Today's weather is really good". The noise is selected from the white noise, pink noise, and restaurant noise in the Noise-92.7 database. The sampling frequency is set to 8kHz, and the sampling accuracy is 16bits. A pure dialogue speech is selected with three kinds of noised speech to form a noisy speech with a signal-to-noise ratio of 0. Matlab is used for spectral subtraction and improved multi-band spectral subtraction for comparative experiments.

Figures 6-8 are the time-domain spectrogram and spectrogram of the speech enhanced by the algorithm in this paper:

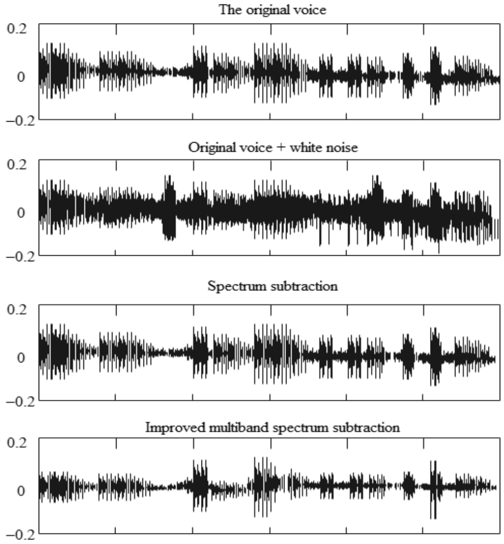

Figure 6: Original speech + white noise.

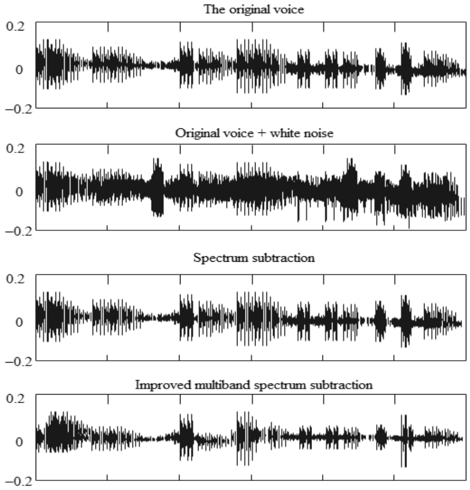

Figure 7: Original speech + pink noise.

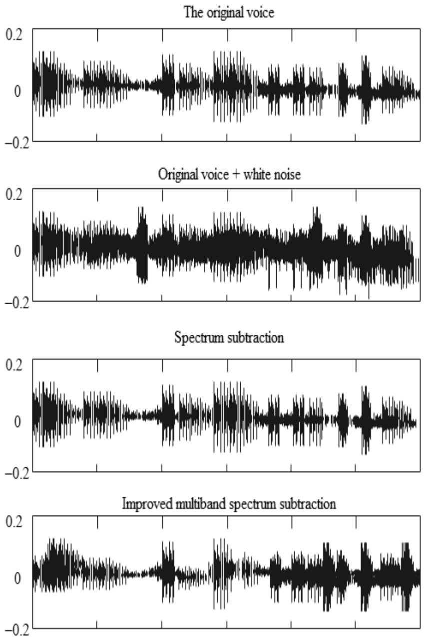

Figure 8: Original speech + white noise.

3 RESEARCH ON THE REFORM OF ART EDUCATION AND TECHNOLOGY BASED ON THE BACKGROUND OF BIGDATA

This paper combines the art classroom speech recognition algorithm in the second part to carry out the reform of art teaching under the background of big data, and improve the teaching quality of online art teaching. On the basis of system analysis, combined with the user's organizational functions and work habits, this system uses the method of dividing subsystems by function to divide the system. The functional structure of the system is shown in Figure 9.

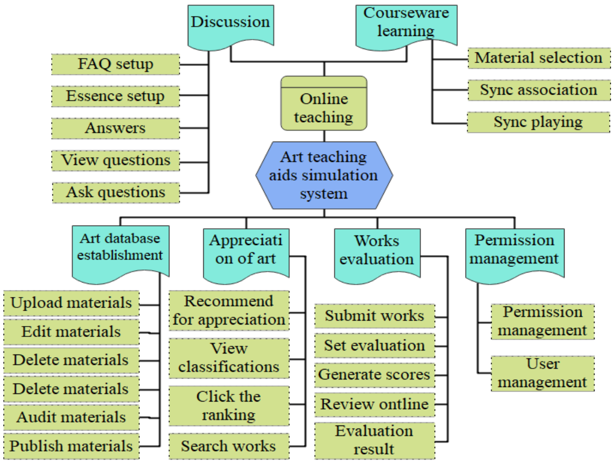

Figure 9: System functional structure diagram.

The teaching effect of the art education model proposed in this paper is tested, and the teaching effect of the system is counted. The system is verified by the experimental teaching model, and the test results shown in Table 1 are obtained.

Num	Teaching effect	Num	Teaching effect	Num	Teaching effect
1	87.361	12	85.419	23	86.988
2	88.724	13	84.849	24	88.997
3	81.753	14	88.095	25	87.951
4	85.458	15	82.968	26	85.065
5	85.639	16	84.588	27	84.436
6	81.149	17	85.838	28	85.485
7	86.855	18	84.413	29	81.611
8	86.286	19	87.863	30	85.614
9	87.237	20	85.035	31	88.359
10	83.394	21	87.323	32	83.394
11	84.427	22	88.631	33	88.522

Table 1: Verification of the effect of art education teaching system.

Through the research, it can be seen that the art education model proposed in this paper can effectively improve the effect of modern art teaching and improve the teaching interaction between teachers and students.

4 CONCLUSIONS

Under the background of the "Internet +" era, people have more ways to acquire knowledge, which also brings development opportunities and challenges to traditional teaching activities. For learners, this is a learning revolution, as we are already in an era that promotes self-directed and lifelong learning. For educators, it has ushered in new challenges and opportunities for teaching experiments and reform and innovation. Teachers should make full use of new technical means and constantly break through traditional teaching methods to better meet the needs of learners who can learn everywhere, all the time, and everyone. This paper combines the big data technology to carry out research on the reform of art education to improve the effect of the reform of art education. Through experimental research, it can be seen that the art education model proposed in this paper can effectively improve the effect of modern art teaching and improve the teaching interaction between teachers and students.

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