



## Revitalizing Ideological and Political Teaching through Nonlinear Optimization Models: A Perspective on Infrastructure Development

Chen Xing<sup>1</sup>, Xiaohong Wang<sup>2\*</sup> and Xiao Liu<sup>1</sup>

<sup>1</sup>School of Marxism, Cangzhou Normal University, Cangzhou 061600, China  
[chenxing7788@126.com](mailto:chenxing7788@126.com), [xiaoliu666@outlook.com](mailto:xiaoliu666@outlook.com)

<sup>2</sup>College of General Education Cangzhou Jiaotong College; Hebei Huanghua 061199, China  
[xiaohongwang2023@163.com](mailto:xiaohongwang2023@163.com)

Corresponding author: Xiaohong Wang, [xiaohongwang2023@163.com](mailto:xiaohongwang2023@163.com)

**Abstract:** In order to improve the effect of ideological and political teaching reform, this paper combines the nonlinear optimization model to improve modern education, and applies the model to ideological and political teaching. Moreover, this paper uses the feature extraction method of three-dimensional ideological and political teaching based on the level set method to extract the point cloud. According to the preprocessed 3D data volume, this paper initializes the level set outline and sets the initial parameters of the level set, and performs the level set evolution according to the original 3D data volume until the level set termination condition is satisfied. Finally, this paper extracts the fault point cloud data volume, and introduces GPGPU technology to perform parallel processing of the level set evolution process to improve the level set evolution efficiency. It can be seen from the experimental evaluation data that the effect of the ideological and political teaching reform based on the nonlinear optimization model is very obvious.

**Keywords:** nonlinear optimization; model; ideology and politics; teaching; Infrastructure Development

**DOI:** <https://doi.org/10.14733/cadaps.2023.S15.17-32>

### 1 INTRODUCTION

Teachers take the means of praise in teaching to encourage advanced students, and to spur backward students, to stimulate students' enthusiasm for learning. The purpose of criticizing students is to let students remember their unsatisfactory behaviors through the painful impression of criticism, and then make up their minds to correct their bad behaviors. However, with the continuous or repeated praise of the same kind, students' satisfaction with the praise will decrease, and even develop in the opposite direction, that is, "proud". At the same time, for students who have been criticized many times [4], with the increase of the number of criticisms, the students begin to forget the pain of the past, and finally the students feel almost no sense of criticism. In addition, the repeated ineffective criticism of teachers will hinder the formation of a good

psychological atmosphere in the classroom, and also hinder the maintenance of the prestige of the teacher's personality, so that it is difficult to strengthen the effect of classroom teaching [12]. It is crucial to consider these dynamics in the context of infrastructure development, as an effective and balanced approach to praise and criticism can contribute to creating a positive learning environment and supporting the overall development of students.

Students in a specific teaching situation will also have a certain sense of satisfaction with the situation, such as teaching environment, teaching facilities, teaching related regulations, teachers' teaching style, students' learning atmosphere, and so on. However, after a period of time, students will also have a phenomenon of diminishing marginal utility in low-key and inactive situations [3]. Therefore, it is necessary to solve the phenomenon of diminishing marginal utility in classroom teaching. In practice, interesting teaching, heuristic teaching, participatory teaching, and the organic combination of "teach a man to fish" and "teach a man to become fisherman" can greatly improve the marginal utility of classroom teaching [1].

Alleviating the phenomenon of diminishing marginal utility pays attention to the art of teaching, and a reasonable and effective arrangement of classroom teaching can play a "lubricant" and "catalyst" role that cannot be underestimated. It is particularly important to improve the art of teaching. First, on the basis of fully understanding the characteristics of students' cognition, teachers need to update their concepts to improve their theoretical and professional qualities [11]. At the same time, teachers need to fully prepare lessons, thoroughly understand the content of textbooks, consider not only what to teach, but also how to teach, and to strengthen the accumulation and update of knowledge. Second, it is necessary to enrich the forms of classroom teaching. For the content of teaching materials, it is necessary to replace different teaching methods in a timely manner, design different teaching plans, and alternately cooperate with various teaching plans and teaching methods, such as self-reading method, self-lecturing method, obstacle method, investigation method, debate method, etc. Moreover, it is necessary to make students "consume" different teaching methods and experience different teaching schemes, which can alleviate the phenomenon of diminishing marginal utility in classroom teaching. Finally, it is necessary to combine the use of modern teaching methods, such as teaching aids, wall charts, slides, projection, video, sound design, etc., to stimulate students in multiple directions, increase teaching capacity and density, improve teaching efficiency and the marginal utility value of classroom teaching [5].

When praising students. Pay attention to individual differences among students. For the same praise, students with different learning attitudes, different academic achievements, and different psychological expectations often have different effects. Some students may be greatly encouraged. Some students may be indifferent. The use of praise should be adapted to local conditions and vary from person to person. Pay attention to the timing of the praise and the appropriate angle of praise, so that the praise has a strong attractiveness and motivating force for each student, and the marginal utility value of the praise shows an increasing trend. Secondly, when criticizing students, since students react strongly to the first criticism, teachers should use the first criticism cautiously, so as not to seriously dampen the self-esteem and self-confidence of students, resulting in counterproductive effects [6]. When criticizing students, teachers should pay attention to four taboos: one is to avoid insulting the personality of others, and one cannot give a student a negative assertion based on a certain behavior; The negative emotions of the students are vented to the students; the third taboo is to take advantage of the crowd to oppress the students, even if the student's behavior affects many people; the fourth taboo is to inappropriately emphasize the chain reaction, and overemphasize the chain consequences, which will make a fuss. sense. At the same time, it is a negative effect that criticism makes students suffer, so teachers must pay attention to the language arts and methods of criticism[7].

In fact, the teaching of undergraduate courses should adopt an organic combination of classroom lectures, classroom discussions, case teaching, and experimental teaching, because this teaching form can mobilize students' initiative, enthusiasm, creativity, and improve their use of linear

programming methods to analyze and The ability to solve practical problems can achieve the purpose of linear programming teaching [2]. Case teaching is a student-centered interactive exploration process on real-world problems and a specific fact. Under certain realistic constraints, such as limited time, limited information, and a lot of uncertainty, enable students to use intelligence and emotion to exercise their ability to make critical decisions in the face of complex problems. In case analysis, students must observe the problem from the protagonist position of the case event, which requires analyzing the research problem before deciding how to solve the problem. In fact, there is no single correct problem for the students to solve. The answer to [10]. In the process of students seeking answers through discussion and making decisions face to face, they need to classify and organize actual data, use certain analytical tools and methods to analyze, and based on their actual experience, carry out research on the issues involved. Comprehensive research, so that conclusions can be drawn, and new problems may also be discovered. In the process of case teaching, in addition to acquiring solid knowledge, students can also exercise and improve their ability to analyze problems, work together and communicate [9]. From this definition, we can know that case teaching is a kind of teaching that simulates practice. All the problems involved in case teaching are real problems in practice. The process of case teaching includes case collection, compilation, case discussion organization, and case discussion. Summary and other aspects. The collection and compilation of cases is the premise of case teaching. At present, there are no teaching cases in the textbooks in our country. Therefore, to effectively carry out case teaching, since the teaching method adopts the combination of classroom lectures, classroom discussions, case teaching and experimental teaching, it is necessary to fully consider each case before collecting and compiling case teaching materials. The organic combination of teaching links, the case of what content should be inserted when the content is taught in the classroom, and then where to collect the cases. The teacher's manual mainly provides the organization and suggestions of the teaching process of each case, the detailed process and results of solving the problem, the explanation and evaluation of the methods and calculation results used, and the problems that need further research and discussion in the case [8].

This paper combines the nonlinear optimization model to improve modern education, and applies the model to ideological and political teaching to improve the scientific teaching of ideological teaching.

## **2 FEATURE EXTRACTION ALGORITHM FOR IDEOLOGICAL AND POLITICAL TEACHING CLASSROOM**

### **2.1 Level Set Extraction Method**

A threshold-based level set extraction method is proposed. Its teaching point cloud extraction process is shown in Figure 1(a). There are still some defects in the evolution of non-sexual volume data based on threshold level set method. Since this method takes the teaching point strictly according to the threshold, it is easy to ignore that the initial attribute value is not within the range of the teaching point. However, after several evolutions, the attribute value of this point can be used as a teaching point. At the same time, since the original data used in this paper are teaching ant body data, the implied teaching attributes are relatively narrow, and the teaching point cloud extracted by the threshold-based level set method is relatively fragmented and has poor continuity.

Therefore, this paper selects the improved method based on regional level set to extract the teaching point cloud. The flow chart of the extraction method is shown in Figure 1(b).

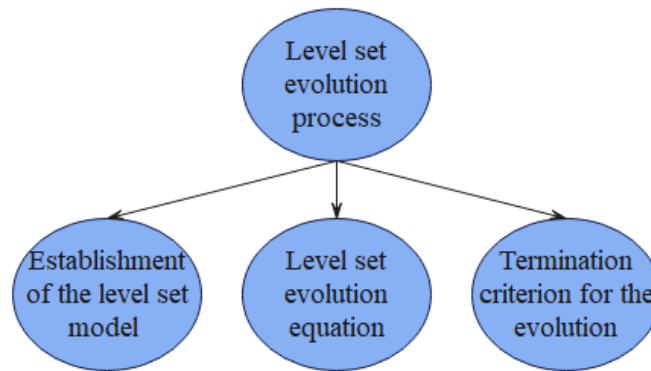
As shown in Figure 1(b) above, the main step of the process is to evolve the level set, and the main content of the evolution of the level set is shown in Figure 1(c). It includes three parts: the establishment of the level set model, the evolution equation and the termination criterion of the evolution. In the following, each part will be introduced one by one.



(a) Flow chart of the method for extracting teaching point cloud based on threshold



(b) Flow chart of the improved method for extracting point cloud based on regional teaching



(c) Level set evolution process diagram

**Figure 1:** Evolution process of level set model.

The C\_V-based model only utilizes the global grayscale information, and cannot correctly and effectively segment images with uneven grayscales. The improved C-V model introduces the key to segmenting this type of image, the local area information, into the C-V model, so as to achieve accurate segmentation of this type of image. The improved C-V model is hereinafter referred to as the Local Chan-Vese (LCV) model, that is, the local information C-V model.

The model establishment of the C-V model is shown in the following formula (1):

$$\begin{aligned}
 F^{CV} = & \int_{\Omega} |I(x, y) - c_1|^2 H(\phi(x, y)) dx dy \\
 & + \int_{\Omega} |I(x, y) - c_2|^2 (1 - H(\phi(x, y))) dx dy \\
 & + \nu \int_{\Omega} |\nabla H(\phi(x, y))| dx dy
 \end{aligned} \tag{1}$$

Among them,  $\Omega$  represents the whole image area,  $H$  is the Heaviside function,  $v$  is the curvature,  $\phi$  represents the level set function, and its zero level set function  $C = \{(x, y) : \phi(x, y) < 0\}$  divides the whole area into two adjacent areas  $\Omega_1 = \{(x, y) : \phi(x, y) > 0\}$  and  $\Omega_2 = \{(x, y) : \phi(x, y) < 0\}$ . In formula (1), the first two terms represent data items, and the third term is used to smooth the resulting zero-level set curve. Therefore, image segmentation can be achieved by minimizing the  $F^{CV}$  energy function through the level set function  $\phi$ , the image gray mean values  $c_1$  and  $c_2$  of the two regions.

In order to extract the teaching point cloud in this paper, the gray-scale uneven image model used is shown in the following formula (2):

$$I = bJ + n \quad (2)$$

Among them,  $J$  represents the real image, that is, the actual teaching scatter distribution, which belongs to an invariant,  $b$  is the deviation field, indicating the degree of deviation from the actual teaching scatter distribution, and  $n$  is superimposed noise.

Based on this model, two guidelines are followed:

- (1) The deviation field  $b$  changes slowly, that is, for a three-dimensional grid data volume, the  $b$  value of a certain grid point can be approximated by the teaching attribute value of its local area.
- (2) The algorithm divides the actual three-dimensional grid data volume  $J$  into  $N$  mutually disjoint regions  $\Omega_1, \dots, \Omega_N$ , where  $c_1, \dots, c_N$  represents the mean value of the teaching attribute corresponding to each region. Among them,  $\Omega_1, \dots, \Omega_N$  satisfies the following conditions:

$$\Omega = \bigcup_{i=1}^N \Omega_i, \text{ 并且 } \Omega_i \cap \Omega_j = \emptyset \quad \forall i \neq j \quad (3)$$

The algorithm adopts the  $K$ -means clustering criterion, so in a single region  $\Omega_i$ , the energy model of this region is:

$$F_{x,y,z} = \sum_{i=1}^N \int_{\Omega_i} |I(x, y, z) - m_i|^2 u_i(x, y, z) dx dy dz \quad (4)$$

Among them,  $\Omega_i$  represents the local area range of the 3D mesh,  $I(x, y, z)$  represents the actual teaching attribute value of the point, and  $u_i(x, y, z)$  is a labeling function of the area  $\Omega_i$ , namely:

$$\begin{cases} u_i(x, y, z) = 1, & (x, y, z) \in \Omega_i \\ u_i(x, y, z) = 0, & (x, y, z) \notin \Omega_i \end{cases} \quad (5)$$

$m_i$  represents the cluster center, that is, the corrected regional teaching attribute value, that is,  $m_i = b(x, y, z)c_i$ . Among them,  $c_i$  represents the average teaching attribute value of the area where the point is located, and  $b(x, y, z)$  is the attribute deviation value at point  $(x, y, z)$ , that is, the deviation of the point from the average value of the attribute of the area to which the point belongs.

Since  $u_i(x, y, z)$  is the labeling function of region  $\Omega_i$ , formula (4) can be simplified as:

$$F_{x,y,z} = \sum_{i=1}^N \int_{\Omega_i \cap \theta_{x,y,z}} |I(x, y, z) - m_i|^2 dx dy dz$$

In addition, since  $m_i = b(x, y, z)c_i$  is jointly determined by the points in the local area of point  $(x, y, z)$ , the above formula (5) can be rewritten as:

$$\varepsilon_{x,y,z} = \sum_{i=1}^N \int_{\Omega_i \cap \theta_{x,y,z}} K(x, y, z) |I(x, y, z) - b(x, y, z)c_i|^2 dx dy dz \quad (6)$$

Among them,  $K(x, y, z)$  is a kernel function used to determine the extent of the local area of the 3D teaching attribute mesh. Therefore, based on the above content, a global energy function is defined, which is the energy function of this method.

$$\varepsilon = \int \left( \sum_{i=1}^N \int_{\Omega_i} K(x, y, z) |I(x, y, z) - b(x, y, z)c_i|^2 dx dy \right) dz \quad (7)$$

Among them,  $K(x, y, z)$  is a Gaussian kernel function.

This method adopts a model divided into two regions, namely:

$$\varepsilon = \int \left( \sum_{i=1}^N \int K(x, y, z) |I(x, y, z) - b(x, y, z)c_i|^2 dx dy \right) M_i(\phi(x, y, z)) dz \quad (8)$$

Among them,  $M_i(\phi(x, y, z))$  represents the identification function of each local area, which is used to mark the area and satisfies  $M_1(\phi) = H(\phi)$ ,  $M_2(\phi) = 1 - H(\phi)$  respectively. On this basis, the smoothing term and the distance regularization term are added, so the final regularization term consists of the energy function, the smoothing term and the distance regularizing term:

$$F^{LCV}(\phi, c, b) = \varepsilon(\phi, c, b) + \nu L(\phi) + \mu R_p(\phi) \quad (9)$$

Among them,  $c$  is the vector representation of  $c_1, \dots, c_N$  and  $\varepsilon(\phi, c, b)$  is the energy function.

$$\varepsilon(\phi, c, b) = \int \sum_{i=1}^N e_i(x, y, z) M_i(\phi(x, y, z)) dx dy dz \quad (10)$$

$$e(x, y, z) = I^2 K - 2c_i I(b * k) + c_i^2 (b^2 * k) \quad (11)$$

Among them, \* represents the convolution operation. In equation (9),  $L(\phi) = \int |\nabla H(\phi)| dx dy dz$  is used to calculate the area of the surface of the zero level set,  $R_p(\phi) = \int p(|\nabla \phi|) dx dy dz$  represents the distance regularization term is mainly used to solve the level set reinitialization problem, where  $p(s) = (1/2)(s-1)^2$  is a potential function.

The  $R_p(\phi)$  term can adopt an adaptive way to constrain the gradient level of the level set evolution function to be one of its minimum points, so as to ensure the stability of the level set model. In particular, it can be adaptively ensured that the signed distance function approximates the zero-level set function. Therefore, this improved model further guarantees the accuracy of numerical calculation, so it is not necessary to re-initialize the level set in the iterative process after adding this item.

Minimizing energy requires constant iterative processing. In each iteration process, the energy  $F^{LCV}(\phi, c, b)$  needs to be minimized according to the update of the three parameters  $\phi$ ,  $c$ , and  $b$ . When updating one of the parameters, the values after the previous iteration of the other two parameters are brought in for calculation.

(1) Update the value  $\phi$ : When  $c$  and  $b$  are determined, the minimization of  $F^{LCV}(\phi, c, b)$  can be calculated by the standard gradient descent method.

$$\frac{\partial \phi}{\partial t} = - \frac{\partial F}{\partial \phi} \quad (12)$$

Among them,  $\partial F / \partial \phi$  is the Gatto derivative of the energy function F, and the left side of formula (12) can be expressed as:

$$\frac{\partial \phi}{\partial t} = -\delta(\phi)(e_1 - e_2) + \nu \delta(\phi) \operatorname{div} \left( \frac{\nabla \phi}{|\nabla \phi|} \right) + \mu \operatorname{div} (d_p(|\nabla \phi|) \nabla \phi) \quad (13)$$

The above formula (13) can be calculated by the finite difference method. Among them,  $\nabla$  represents the gradient operation,  $\operatorname{div}(\bullet)$  represents the difference processing, and  $d_p(s)$  can be expressed as:

$$d_p(s) = \frac{p'(s)}{s} \quad (14)$$

(2) Update the  $c$  value: when  $\phi$  and  $b$  are determined, the  $c$  value when the energy  $\varepsilon(\phi, c, b)$  is minimized is the optimal  $c$  value  $\hat{c} = (\hat{c}_1, \dots, \hat{c}_N)$ .

$$\hat{c}_i = \frac{\int (b * k) I u_i dx dy dz}{\int (b^2 * k) u_i dx dy dz} \quad i = 1, \dots, N \quad (15)$$

Among them,  $u_1(x, y, z) = M_i(\phi(x, y, z))$ .

(3) Update the  $b$  value: when  $\phi$  and  $c$  are determined, the  $b$  value when the energy  $\varepsilon(\phi, c, b)$  is minimized is the optimal  $b$  value.

$$\hat{b} = \frac{(IJ^{(1)} * K)}{J^{(2)} * K} \quad (16)$$

Among them,  $J^{(1)} = \sum_{i=1}^N c_i u_i$ ,  $J^{(2)} = \sum_{i=1}^N c_i^2 u_i$ .

In the calculation process, the Heaviside function can be calculated with a smooth function approximating  $H$ , which is defined as follows:

$$H_\tau(\chi) = \frac{1}{2} \left[ 1 + \frac{2}{\pi} \operatorname{atan} \tan \left( \frac{\chi}{\tau} \right) \right] \quad (17)$$

Among them,  $\tau$  takes 1, and  $\delta(x)$  can be defined as:

$$\delta_\tau(x) = H'_\tau(x) = \frac{1}{\pi} \frac{\tau}{\tau^2 + x^2} \quad (18)$$

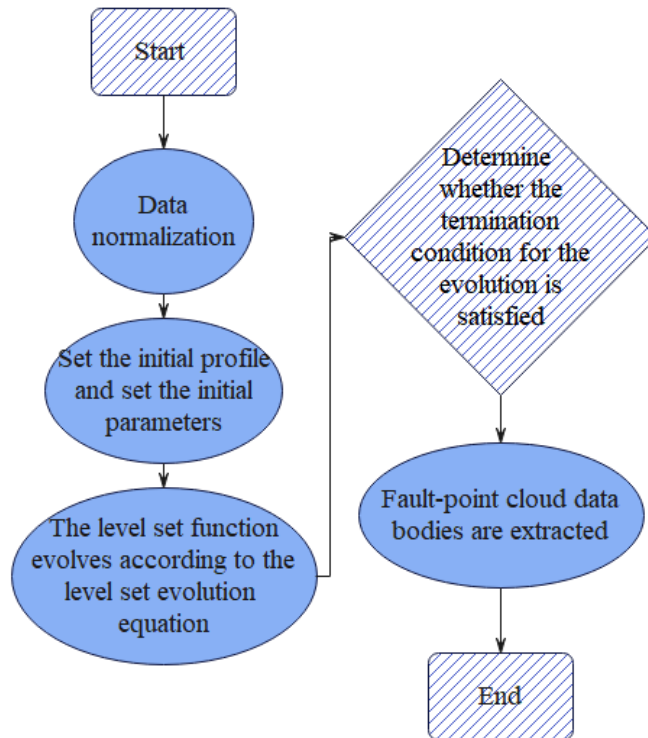
In practice, the zero level set of the 3D teaching data volume is a surface, so another form of this method can be used here. That is, by detecting the area  $L(\phi)$  of the evolution surface at each level set iteration to judge whether the evolution should be terminated. When the evolution reaches the real target body contour,  $L(\phi)$  should remain basically unchanged, which can give another termination criterion for level set evolution. When the absolute value  $|L(\phi(t)) - L(\phi(t-1))|$  of the surface area change is always smaller than a preset threshold within a given threshold  $T$  of level set iteration times, the level set evolution is terminated. The process of LCV model extracting 3D teaching point cloud is shown in Figure 2.

## 2.2 Three-Dimensional Teaching Point Cloud Skeleton Extraction Method With Contour

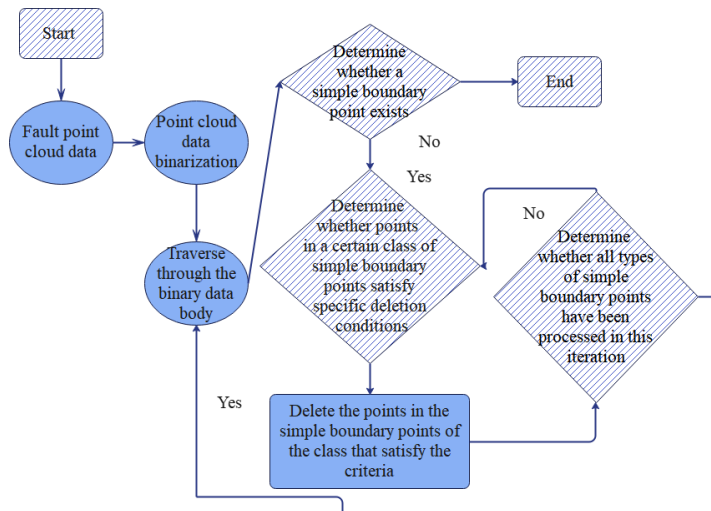
### (1) Binarization of point cloud data

The purpose of data binarization is to separate the target points and background points in the point cloud grid data volume, so as to facilitate the subsequent extraction of the teaching point cloud skeleton through the refinement method, as shown in Figure 3. The 3D teaching point cloud mesh data volume is extracted based on the GPU level set method. Due to the particularity of the level set method, the extracted teaching point cloud data volume takes the zero level set surface as the interface. The value of the grid point is positive, that is, a grid point value distribution with positive outside and inside negative is presented, as shown in Figure 4(a).

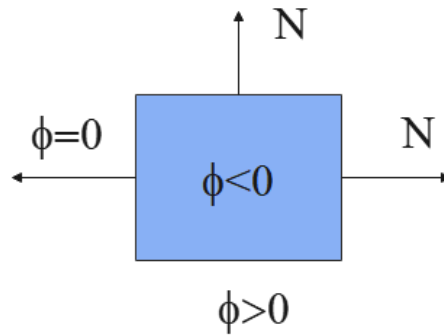




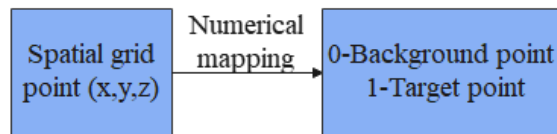
**Figure 2:** Schematic diagram of the process of extracting 3D teaching point cloud.



**Figure 3:** Flow chart of skeleton extraction of 3D teaching point cloud.



(a) Schematic diagram of level set function value distribution



(b) Schematic diagram of level set function value mapping

**Figure 4:** Level set function diagram.

The teaching skeleton point of interest in this paper is located inside the zero level set surface, so the extraction of the teaching skeleton point can be realized by extracting the central axis of the image surrounded by the zero level set surface.

The process of point cloud data binarization is to establish a mapping process from three-dimensional space grid points to 1 value or 0 value, where the 1 value point represents the target point we are interested in, and the 0 value represents the background point, as shown in Figure 4 (b). Among them, the mapping threshold selected in this paper is to take the threshold as 0 according to the evolution result of the level set method, that is, the grid points less than 0 are mapped to 1, and the grid points greater than 0 are mapped to 0.

After binarizing the point cloud data volume, the 1-value grid points in the obtained binary data volume represent the target points we are interested in, and the 0-value grid points represent the background points. Among them, the set  $S$  represents the set of all 1-valued grid points, and the set  $\bar{S}$  represents the set of all 0-valued grid points.

(2) Selection of templates

The parallel refinement method used in this paper uses a 3x3x3 template.

In the following, several definitions about this template grid are introduced.

The 6-adjacent grid (denoted by  $N_6(v)$ ) of a spatial grid point  $(k, j, i)$  is defined as the following formula(19):

$$N_6(v) = \{(t, s, r) \mid |t - k| + |s - j| + |r - i| = 1\} \quad (19)$$

At the same time, the 26 adjacent grids of a spatial grid point  $(k, j, i)$  (denoted by  $N_{26}(v)$ ) are defined as formula (20):

$$N_{26}(v) = \{(t, s, r) \mid \max(|t - k|, |s - j|, |r - i|) = 1\} \quad (20)$$

Among them,  $(t, s, r) \in Z^3$ , and  $Z^3$  are defined as shown in formula(21):

$$Z^3 = \{v = (k, j, i) \mid (k, j, i) < (k_{\max}, j_{\max}, i_{\max})\} \quad (21)$$

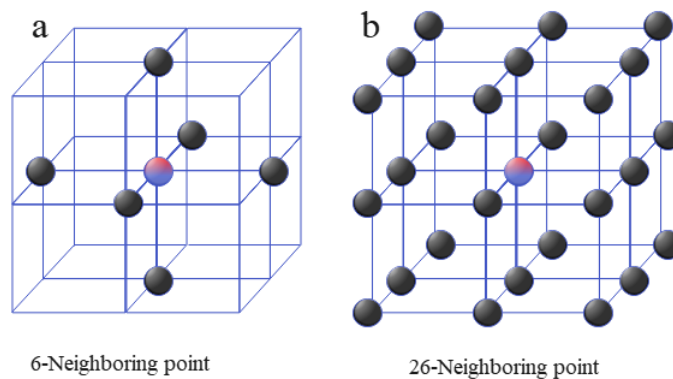
Among them,  $k_{\max}, j_{\max}, i_{\max}$  represents the maximum value of the length of the three-dimensional mesh data volume in three directions, respectively.

Figure 5 is a schematic diagram of two commonly used adjacent points: 6-adjacent point and 26-adjacent point, wherein the red point represents the seed point, and the black point represents its adjacent point.

It can be seen from Figure 5 that any 6-adjacent point of a spatial grid point  $x$  and point  $x$  have at least one common surface, and any 26-adjacent point of a spatial grid point  $x$  has at least one common point with  $x$ . The following adjacent dots in this document represent the symbol  $N(v)$

unless otherwise specified, which all represent  $N_{26}(v)$ .

For a binary grid data volume in a three-dimensional space (the grid point values are all 0 or 1), it is defined that two equal grid points  $x_1$  and  $x_2$  are 6-connected (or 26-connected). If there are several grid points  $y_0 (= x_1), y_1, \dots, y_n (= x_2)$  such that each point  $y_i$  belongs to the 6-neighbors (or 26-neighbors) of point  $y_{i-1} (1 \leq i \leq n)$ , all  $y_i$  are the same value as  $x_1$  and  $x_2$ .



**Figure 5:** Schematic diagram of adjacent points.

This paper is based on the template to judge the local connectivity and define the simple boundary points and surface points of the grid.

### (3) Simple boundary points and surface points

In the refinement algorithm in this paper, two types of grid points are mainly used: simple boundary points and surface points. These two types of grid points are the necessary conditions for judging

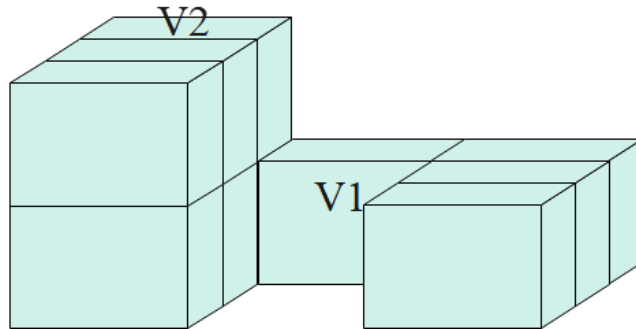
whether the grid points in the refinement algorithm should be deleted. These two types of grid points will be introduced in turn.

### 1) Definition of Simple Boundary Points

Simple boundary points are grid points that satisfy certain "simple" conditions on the basis of boundary points. That is to say, for a boundary point, if the connectivity between the points in the set  $S$  and the set  $\bar{S}$  remains unchanged after the boundary point is deleted, the boundary point is called a simple boundary point. Its judgment expression is shown in the following formula (22):

$$\begin{aligned} \delta G(S \cap N(v)) &= 0; \text{ and} \\ \delta O(S \cap N(v)) &= 0 \end{aligned} \quad (22)$$

Among them,  $G(S) = v - e + f$ ,  $v$  represent the number of vertices in the set  $S$ ,  $e$  represents the number of edges,  $f$  represents the number of faces,  $O(S)$  represents the connectivity of the points in the set  $S$ , and  $\delta$  represents the rate of change operation. Then,  $\delta G(S \cap N(v))$  represents the difference of  $G(S \cap N(v))$  when the point  $v$  is not included and the point  $v$  is included, and  $\delta O(S \cap N(v))$  is the change in the connectivity of the set  $S \cap N(v)$  when the point  $v$  is not included and the point  $v$  is included.



**Figure 6:** Schematic diagram of simple boundary point.

At the same time, because of  $\delta O(S \cap N(v)) = \delta O(\bar{S} \cap N(v))$ ,  $\delta G(S \cap N(v)) = 0$  means that point  $v$  is a boundary point, and  $\delta O(S \cap N(v)) = 0$  means that after deleting point  $v$ , the connectivity between set  $S$  and set  $\bar{S}$  remains unchanged.

As shown in Figure 6, point  $v^1$  is a simple boundary point, while point  $v^2$  is not.

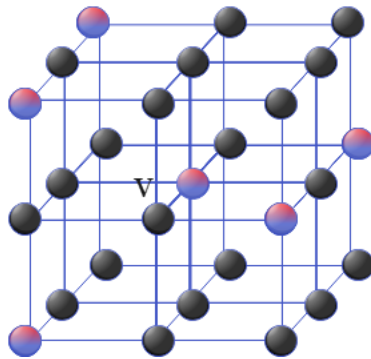
### 2) Surface point

First, we define the Gua limit, as shown in Figure 6b, with the point  $v$  marked in red as the coordinate origin, the  $3 \times 3 \times 3$  grid can be divided into eight  $2 \times 2 \times 2$  small grids. Moreover, each small grid of  $2 \times 2 \times 2$  is a hexagram limit of point  $v$ .

Since we extract the skeleton of the 3D teaching point cloud is to extract the central axis of the point cloud data volume, and the point  $v$  on the surface is defined as follows. First, point  $v$  belongs to the target point, and for any octant of  $N(v)$ , if there are:

$$|N_i^2(v)| < 3 \quad (23)$$

As shown in Figure 7, the point  $v$  is a surface point, in which the black point represents the point with a value of 1, that is, the target point, and the hollow point represents the point with a value of 0, that is, the background point.



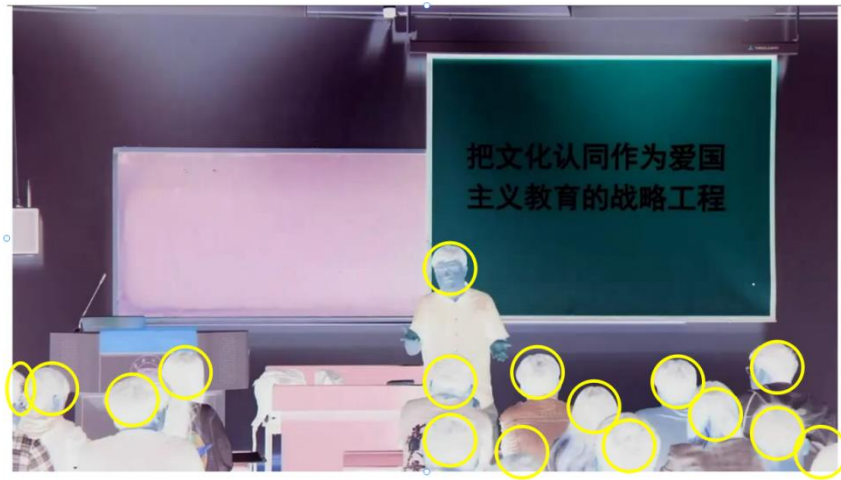
**Figure 7:** Schematic diagram of surface points.

### 3 THE REFORM OF IDEOLOGICAL AND POLITICAL TEACHING BASED ON NONLINEAR OPTIMIZATION MODEL

Figure 8 shows the feature identification model of ideological and political teaching through the nonlinear optimization model in this paper. Through this model, the characteristics of teachers and students can be accurately identified, which can effectively improve the judgment effect of teaching classroom and improve the effect of ideological and political teaching.



(a) Image processing of ideological and political teaching



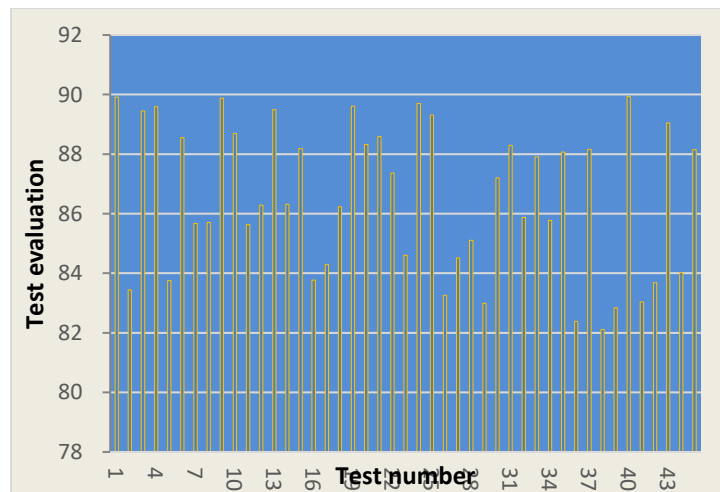
(b) Feature recognition of ideological and political teaching

**Figure 8:** Image feature recognition of ideological and political teaching.

On the basis of the above, the effect of the ideological and political teaching reform based on the nonlinear optimization model is judged, and the simulation evaluation is carried out through multiple sets of data, and the experimental evaluation data shown in Table 1 and Figure 9 are finally obtained.

| Num | Test evaluation | Num | Test evaluation | Num | Test evaluation |
|-----|-----------------|-----|-----------------|-----|-----------------|
| 1   | 89.919          | 16  | 83.773          | 31  | 88.293          |
| 2   | 83.442          | 17  | 84.294          | 32  | 85.876          |
| 3   | 89.453          | 18  | 86.237          | 33  | 87.909          |
| 4   | 89.595          | 19  | 89.611          | 34  | 85.775          |
| 5   | 83.757          | 20  | 88.321          | 35  | 88.067          |
| 6   | 88.553          | 21  | 88.591          | 36  | 82.381          |
| 7   | 85.674          | 22  | 87.359          | 37  | 88.159          |
| 8   | 85.710          | 23  | 84.601          | 38  | 82.116          |
| 9   | 89.876          | 24  | 89.704          | 39  | 82.839          |
| 10  | 88.696          | 25  | 89.316          | 40  | 89.932          |
| 11  | 85.632          | 26  | 83.263          | 41  | 83.039          |
| 12  | 86.292          | 27  | 84.519          | 42  | 83.685          |
| 13  | 89.490          | 28  | 85.108          | 43  | 89.044          |
| 14  | 86.315          | 29  | 82.991          | 44  | 84.020          |
| 15  | 88.183          | 30  | 87.198          | 45  | 88.149          |

**Table 1:** Test evaluation data.



**Figure 9:** Evaluation results of ideological and political teaching.

It can be seen from the experimental evaluation data that the effect of the ideological and political teaching reform based on the nonlinear optimization model is very obvious.

#### 4 CONCLUSION

In the process of ideological and political teaching, teachers impart knowledge to students with high efficiency, high density and large amount of information in a short period of time. At the same time, the students received the content taught by the teacher quickly and impressed, and the students were more active, motivated and interested in listening to the class. At this time, the student attendance rate is also the highest. However, after more than a certain number of lectures, with the extension of the class time and the increase of the amount of information, the students will feel that the amount of knowledge they receive in the same time decreases. Moreover, the phenomenon of increasing and decreasing marginal utility of students in learning knowledge and consumer consumption behavior is similar. This paper improves modern education by combining the nonlinear optimization model, and applies the model to ideological and political teaching to improve the scientific teaching of ideological teaching. It can be seen from the experimental evaluation data that the effect of the ideological and political teaching reform based on the nonlinear optimization model is very obvious.

Xiaohong Wang, <https://orcid.org/0009-0007-9009-7211>

ChenXing, <https://orcid.org/0009-0004-8622-428X>

XiaoLiu, <https://orcid.org/0009-0000-9769-2725>

#### ACKNOWLEDGEMENT

This work was supported by Hubei Education Science Planning Project in 2018, Name: Research on the Application of the "Four-in-One" Course Mode of Ideological and Political Education in Applied Colleges under the Background of Internet plus (Item Number: 2018GB082)

## REFERENCES

- [1] Alfalah, S. F.; Falah, J. F.; Alfalah, T.; Elfalah, M.; Muhaidat, N.; Falah, O.: A comparative study between a virtual reality heart anatomy system and traditional medical teaching modalities, *Virtual Reality*, 23(3), 2019, 229-234. <https://doi.org/10.1007/s10055-018-0359-y>
- [2] Alonso, J. M. :Teaching Explainable Artificial Intelligence to High School Students, *International Journal of Computational Intelligence Systems*, 13(1), 2020, 974-987. <https://doi.org/10.2991/ijcis.d.200715.003>
- [3] Bennie, S. J.; Ranaghan, K. E.; Deeks, H.; Goldsmith, H. E.; O'Connor, M. B.; Mulholland, A. J.; Glowacki, D. R.: Teaching enzyme catalysis using interactive molecular dynamics in virtual reality, *Journal of Chemical Education*, 96(11), 2019, 2488-2496. <https://doi.org/10.1021/acs.jchemed.9b00181>
- [4] Cooper, G.; Park, H.; Nasr, Z.; Thong, L. P.; Johnson, R.: Using virtual reality in the classroom: preservice teachers' perceptions of its use as a teaching and learning tool, *Educational Media International*, 56(1), 2019, 1-13. <https://doi.org/10.1080/09523987.2019.1583461>
- [5] Dayarathna, V. L.; Karam, S.; Jaradat, R.; Hamilton, M. A.; Nagahi, M.; Joshi, S.; Driouche, B.: Assessment of the efficacy and effectiveness of virtual reality teaching module: A gender-based comparison. *International Journal of Engineering Education*, 36(6), 2020, 1938-1955.
- [6] Hernandez-Pozas, O.; Carreon-Flores, H.: Teaching international business using virtual reality, *Journal of Teaching in International Business*, 30(2), 2019, 196-212. <https://doi.org/10.1080/08975930.2019.1663779>
- [7] Lee, Y.: An analysis of the influence of block-type programming language-based artificial intelligence education on the learner's attitude in artificial intelligence, *Journal of The Korean Association of Information Education*, 23(2), 2019, 189-196. <https://doi.org/10.14352/jkaie.2019.23.2.189>
- [8] Rampton, V.; Mittelman, M.; Goldhahn, J.: Implications of artificial intelligence for medical education, *The Lancet Digital Health*, 2(3), 2020 , e111-e112. [https://doi.org/10.1016/S2589-7500\(20\)30023-6](https://doi.org/10.1016/S2589-7500(20)30023-6)
- [9] Ribeiro, P.; Simões, H.; Ferreira, M.: Teaching artificial intelligence and logic programming in a competitive environment, *Informatics in Education*, 8(1), 2009, 85-100. <https://doi.org/10.15388/infedu.2009.06>
- [10] Yang, R.: Artificial Intelligence-Based Strategies for Improving the Teaching Effect of Art Major Courses in Colleges, *International Journal of Emerging Technologies in Learning (IJET)*, 15(22), 2020, 146-160. <https://doi.org/10.3991/ijet.v15i22.18199>
- [11] Zhao, H.; Lyu, J.; Liu, X.; Liu, Z.: Customization-oriented product flexible manufacturing experience system design based on VR, In *IOP Conference Series: Materials Science and Engineering*, 561(1), 2019, 012098. IOP Publishing. <https://doi.org/10.1088/1757-899X/561/1/012098>
- [12] Zhao, J.; Xu, X.; Jiang, H.; Ding, Y.: The effectiveness of virtual reality-based technology on anatomy teaching: a meta-analysis of randomized controlled studies, *BMC medical education*, 20(1), 2020, 1-10. <https://doi.org/10.1186/s12909-020-1994-z>