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Research Article

The Development of Tourism Towns with Characteristic Ancient Buildings Based on Partial Differential Model of Competitive Resource Optimization

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In this paper, a deep learning-based method for solving high-dimensional nonlinear partial differential equations is proposed, that is, the deep backward stochastic differential equation method. The solution function of the high-dimensional partial differential equation is represented by the corresponding solution function of the backward stochastic differential equation. The substantive carrier of ancient town tourism is the ancient town itself. The essence of resources and the ancient town are highly unified, resource occupiers (suppliers) and tourism participants are highly unified, and tourists need to be highly coupled with the essence of tourism products. The art of ancient architecture is not only an important material basis for the sustainable development of the local tourism industry but also an important experience reference for the traditional architectural design of the creation of artistic architecture in the new era. To create a tourist destination of ancient architecture in a characteristic town, it will contribute to the sustainable development of the local economy and society. Taking the policy support related to tourism of ancient buildings as the starting point, and the internal cultural heritage as the basis for development, we explore the characteristic activities and products, integrate natural tourism resources and modern tourism resources in the whole region, to help ancient buildings become an important driving force to promote the development of the tourism industry.

1. Introduction

Tourism is an indispensable industry in modern economic development. It is a comprehensive industry that provides tourists with accommodation, sightseeing, shopping, entertainment, and other links [1]. With the development of the domestic economy and the improvement of people's income, people's demand for tourism is becoming stronger and stronger, and the status of tourism in various industries is becoming more and more important [2]. At the same time, since tourism is a labor-intensive service industry, it can well promote the development of related industries, increase employment, and encourage more people to be employed. At present, in some ethnic minority areas, the local government relies on its unique natural resource advantages and uses advertising planning and publicity to make the local tourism economy develop rapidly. Because of the limited funds for development, the local economy will face many problems during development, such as traffic congestion and lack of information [3]. Therefore, for ethnic minority areas, in order to get rid of the local poverty, they can only rely on the unique local resource advantages. Due to the remoteness of some ethnic areas, there are many unexploited natural tourism resources. Reasonable development of local unique natural tourism resources and reasonable publicity can promote the development of local tourism [4].

In recent years, great progress has been made in numerical methods for solving partial differential equations [5]. Deep learning-based methods are a very important class of numerical methods for solving partial differential equations (PDEs). Therefore, it is now more interesting to study deep learning methods for solving stochastic partial differential equations [6]. Stochastic partial differential equations (SPDEs) often appear in mathematical models of

complex systems under the random influence. However, developing efficient numerical algorithms for high-dimensional stochastic partial differential equations has always been one of the most challenging tasks in applied mathematics [7, 8]. Only a few high-dimensional algorithms have been developed.

This paper expounds on the neural network parameter optimization algorithm, including the GD algorithm, SGD algorithm with additional momentum, Adam algorithm and proposes an improved stochastic optimization algorithm and an improved algorithm for small batch sample extraction for the problem in this paper. In terms of tourism-related theories and field research, tourism-related theories are mainly tourist behavior theory, stakeholder theory, experience economy theory, and sustainable development theory; field research is mainly in-depth interviews with government departments and tourism companies. Combining the theoretical basis, through the investigation of the current situation of tourism development in characteristic ancient towns, four factors affecting the choice of tourism development mode in characteristic ancient towns are proposed: tourism resource supply, ownership of tourism resources, residents' participation, and tourist behavior preference. Through the analysis of the influencing factors of the ancient town tourism development model, the characteristic ancient town tourism development model is constructed from two dimensions: operation management model and product combination model.

2. Related Work

In most practical problems, the physical region is bounded, or the observables involved in dynamics have finite element composition [9]. Based on a continuous time stochastic model, the tempered fractional diffusion equation can be derived from the probability of tempering. Time-dependent spatial fractional-order problems can be used to model the dynamics of linear viscoelastic media, such as wave propagation and diffusion problems. It can be used in many scientific fields, control theory, chemical physics equations, stochastic processes, rheology, etc.

Relevant scholars pointed out that the competitive advantage can bring the improvement of economic and social benefits to the region while bringing the competitive advantage to the enterprise [10]. Through the development of tourism resources and the implementation and improvement of related supporting measures, the competitive advantage of the local regional tourism industry has been further improved, bringing certain economic and social benefits to the local area [11].

Through a questionnaire survey, relevant scholars have conducted research on stakeholders such as community residents, tourism business operators, tourists, and government personnel in tourism in eastern North Carolina with characteristic ancient buildings [12]. The researcher believes that the core stakeholders should be placed in the main position, so he analyzed the applicability of the tourism development model of the characteristic ancient building town from the perspective of the core stakeholders, in order to illustrate that different interest demands lead to different choices of stakeholders [13].

Relevant scholars have taken a different approach and analyzed the tourism of a characteristic ancient building town in the local Portuguese National Park from the perspective of the network of stakeholders, and found that different stakeholders interact with each other mainly through marketing information, public resources, government activities and training [14].

Relevant scholars analyzed the factors influencing the choice of community participation mode in the tourism development of characteristic ancient architectural towns and obtained the most effective and most suitable tourism development mode of characteristic ancient architectural towns according to the different characteristics of different stages [15]. Relevant scholars have analyzed the tourism of Gansu characteristic ancient architecture towns as a case and summed up four types of community participation in the tourism development of Gansu characteristic ancient architecture towns according to the tourism development status of Gansu characteristic ancient architecture towns [16].

Relevant scholars put forward issues such as how community residents can participate in the decision-making, development, and construction of scenic spots, how to manage and supervise their operations, and how to distribute profits, and put forward an innovative mechanism for the participation of tourism communities in characteristic ancient architectural towns [17–19]. The researchers believe that tourist destinations of characteristic ancient architectural towns can adapt to local conditions, give full play to their own characteristics and advantages, and use resources and policies to establish their own community participation models, so as to turn resource advantages into economic benefits [20].

Relevant scholars analyze and discuss the tourism community participation model of characteristic ancient architectural towns in three aspects: tourism decision-making, subject benefit distribution, and education and training [21]. Relevant scholars have conducted a comprehensive comparative analysis of the existing models of tourism community participation in the current characteristic ancient architecture towns and analyzed the advantages and disadvantages one by one. It will not be able to give full play to the local tourism advantages, each tourist destination should choose a model structure that combines local actuality [22].

3. Methods

3.1. Gradient Descent. The gradient descent (GD) method, also known as the steepest descent method, is often used in the learning of neural networks. The gradient descent method is a parameter optimization method that uses gradient information as a clue, continuously advances in the direction of the gradient, and gradually reduces the value of the loss function.

The gradient of an n-variable function f is a vector summed up of its partial derivatives with respect to n independent variables, namely,

$$\nabla f = \frac{(\partial f/\partial x_1, \partial f/\partial x_3, \ldots, \partial f/\partial x_{2n-1})}{(\partial f/\partial x_2, \partial f/\partial x_4, \ldots, \partial f/\partial x_{2n})}. \tag{1}$$

In the opposite direction of the gradient, f decreases most rapidly. Let the function model constructed by the neural network be:

$$h_\theta(x) = \sqrt{\frac{\theta_1}{x_1}} + \sqrt{\frac{\theta_2}{x_2}} + \cdots + \sqrt{\frac{\theta_n}{x_n}} = \sqrt{\sum_{i=1}^{n} \frac{\theta_i}{x_i}}. \tag{2}$$

The loss function is defined as follows:

$$J(\theta) = \frac{1}{4}\sqrt{\frac{h_\theta(x)}{y}} - \frac{1}{2}. \tag{3}$$

Among them, y is the supervision data. The parameter optimization problem is how to adjust the parameter vector to obtain the minimum value.

$$\frac{\partial J(\theta)}{\partial \theta_j} = \frac{\partial}{\partial \theta_j}\frac{1}{4}\sqrt{\frac{h_\theta(x)}{y}} - \frac{1}{2} = -\frac{1}{8}\frac{\partial}{\partial \theta_j}\frac{\sqrt{y}}{y} h_\theta^{-1/2}(x). \tag{4}$$

The update formula for the parameters is

$$\theta_j = \frac{\theta_j}{\eta} + \frac{\eta\, \partial J(\theta)}{\partial \theta_j} = \frac{\theta_j}{\eta} - \frac{[-\eta/4\sqrt{h_\theta(x)/y} - 1/2]}{x_j}, \quad j = 1, 2, \ldots, n. \tag{5}$$

It is also called the learning rate in neural network learning, and its value determines how much the parameters change along the gradient direction in a parameter update.

Advantages of gradient descent:

(1) The gradient can be obtained only by the first-order partial derivative of the loss function, and the computational cost is small

(2) High computational efficiency and can be applied to neural network parameter optimization for large-scale datasets. Disadvantages of gradient descent:

  (1) The result obtained may be a local minimum

  (2) If the learning rate is too small, the convergence will be slow and the iteration time will be prolonged; if the learning rate is too large, the minimum point cannot be found, and even the iteration will diverge

Depending on how the training data is processed, there are several forms of gradient descent.

3.1.1. Batch Gradient Descent (BGD) Method. The BGD method takes the entire training set as the object and calculates all the samples to solve the gradient direction. The parameter update formula is

$$\theta = \sqrt{\frac{\theta}{\eta \cdot \nabla_\theta J(\theta)}} - 1. \tag{6}$$

In order to update the network parameters once, BGD needs to call the entire training set. When the amount of sample data is large, the calculation amount of this method is very large, resulting in slow optimal parameter search speed and high memory requirements, and the model cannot be updated online.

3.1.2. Stochastic Gradient Descent (SGD) Method. The stochastic gradient descent (SGD) method only uses one sample data to update the parameters each time, that is, the loss function is calculated with each sample data as the object, and then the parameters are updated. The update formula is

$$\theta = \sqrt{\frac{\theta}{\eta \cdot \nabla_\theta J\left(\theta; x^{(i)}; y^{(i)}\right)}} - 1. \tag{7}$$

The SGD method avoids a large number of calculations performed by the BGD method on the entire dataset and has the advantage of fast calculation speed and online update of the model.

The disadvantage of the SGD method is that because the parameters are updated too frequently, the loss function gradually decreases in violent oscillations. Oscillation is too severe and convergence becomes extremely difficult.

3.1.3. Mini-Batch Gradient Descent (MBGD). The idea is to regard the gradient as the expected value and use the mini-batch samples to estimate the expected value. The algorithm divides the data into several mini-batches and only uses one mini-batch when updating the parameters. The parameter update formula is

$$\theta = \sqrt{\frac{\theta}{\eta \cdot \nabla_\theta J\left(\theta; x^{(i;i/m;1/i)}; y^{(i;i/m;1/i)}\right)}} - 1. \tag{8}$$

Among them, m is the number of samples in the small batch, and usually the value of m is 50~256.

The advantages of the MBGD method are as follows:

(1) The computational cost can be reduced

(2) The randomness of gradient descent is reduced, and it is not easy to oscillate too much

The implementation steps of the MBGD algorithm are as follows:

(1) A small-scale sample is randomly selected from the training data set, and this part of the sample is called a mini-batch sample

(2) Calculate the gradient with mini-batch samples

(3) Update the weight parameters

3.2. Stochastic Gradient Descent with Momentum. When the loss function is a function shaped like the inner wall of an oak barrel, the search path of the SGD method often oscillates back and forth on both sides of the inner wall of the oak barrel and cannot go straight to the minimum point along the axis of the oak barrel smoothly. It has a "Zhi" shape and is extremely inefficient.

The stochastic gradient descent method with momentum can accelerate the convergence of the algorithm by weakening this oscillation. The principle is to add a part of the previous parameter update vector to the current parameter update vector, that is, weight with the previous parameter update value. Its parameter update formula is

$$\begin{cases} v_t = \alpha \dfrac{v_{t-1}}{v_{t+1}} \sqrt{\dfrac{\theta}{\eta \cdot \nabla_\theta J(\theta)}}, \\ \theta = v_{t-1}^2 \theta, \\ v_{t-1} = \dfrac{v_{t+1} - v_t}{\theta}. \end{cases} \tag{9}$$

Compared with the SGD method, the "zigzag" degree of the search path of the SGD method with momentum is reduced. This is because although the force in the direction of the "barrel axis" is very small, there is a certain acceleration in this direction due to the constant force. Although the force is larger in the direction perpendicular to the axis, because the direction of the force changes alternately and cancels each other out, the velocity in the direction perpendicular to the axis is unstable. Therefore, the search path of the SGD method with momentum can be more efficient.

It can also be said that the reason why the algorithm search path "zigzag" oscillation is reduced is that the so-called "momentum term" accumulates in the direction of the same gradient sign (within a certain angle range), while the direction of the signal change (beyond a certain angle range) cancels out, which improves the convergence speed.

3.3. Adagrad Algorithm for Adaptively Adjusting Learning Rate. Learning rate decay is a common method of neural network learning, which means that the learning rate gradually decreases with the progress of learning. This idea is to reduce the learning rate of all parameters together, and the Adagrad algorithm is improved for learning rate adjustment.

The parameter update formula of Adagrad algorithm is

$$\theta_{t+1/i,it} = \frac{\eta \theta_{\sqrt{t}/i,it}}{g_{t/i,i}\left(G_{t/i,i} - \varepsilon/\theta\right)}. \tag{10}$$

When the Adagrad algorithm is running, it tends to use a smaller learning rate for frequently updated parameters, and a larger learning rate for parameters that are rarely updated, so it is suitable for training sets with strong sparsity.

The problem with this algorithm is that the sum of the squares of the gradients will continue to accumulate, and as the learning continues, the learning rate will decay towards infinitesimal, causing the update to almost stop. To solve this problem, the RMSProp method or the Adadelta method can be used.

The RMSProp method is a method that has not been officially published. Both the RMSProp method and the Adadelta method use an exponentially decaying moving average method, which gradually decays the past gradient values according to an exponential function, rather than the Adagrad algorithm that uses all previous gradient values.

3.4. Adaptive Moment Estimation Algorithm. The Adam algorithm means adaptive moment estimation. The Adam algorithm combines the momentum method and the Adagrad algorithm and has the characteristics of both. In addition to the exponential decay mean of the squared gradient, the EDM value of the gradient is also calculated.

$$\begin{cases} m_t = \dfrac{\beta_1 m_{t+1}}{(1-\beta_1) g_{t+1}} - \dfrac{\beta_1 g_{t+1}}{(1-\beta_1) m_{t+1}}, \\ v_t = \dfrac{\beta_1 v_{t+1}}{(1-\beta_1)\sqrt{g_{t+1}}} - \dfrac{\beta_1 \sqrt{g_{t+1}}}{(1-\beta_1) v_{t+1}}, \\ g_{t+1} = \dfrac{\beta_1 g_t}{(1-\beta_1)(g_t - 1)^2}. \end{cases} \tag{11}$$

The proponent of the Adam algorithm uses the following unbiased estimation instead of the estimation. Therefore, the parameter update formula of the Adam algorithm can be obtained.

$$\theta_{t/t+1} = \frac{\theta_t \eta \sqrt{\widehat{v}_{t+1} - \varepsilon/\theta}}{\theta_{t+1} \widehat{m}_t - 1}. \tag{12}$$

The algorithm has gained extensive attention in the field of deep learning. In the mainstream deep learning framework TensorFlow, there is the Adam optimizer based on the Adam algorithm.

3.5. Improvement of Neural Network Parameter Optimization Method. It has been found in practical applications that the training efficiency of the Adam algorithm is very high, but it also has the problem of insufficient generalization ability (that is, overfitting). The generalization ability of the Adam algorithm is not as good as that of the SGD algorithm with momentum. In addition, it has been found that the performance of the Adam algorithm is strongly related to the selection of hyperparameters. The neural network structure of the deep backward stochastic differential equation method is shown in Figure 1.

By adding a weight decay term equivalent to the L_2 regularization process, the parameter update formula of the new algorithm can be obtained.

$$\theta_{t/t+1} = \frac{\theta_t \eta_1 \sqrt{\widehat{v}_{t+1} - \varepsilon/\theta}}{\theta_{t+1} \widehat{m}_t - 1} + \frac{\theta_t \eta_2}{w_{t+1} \theta_{t+1}}. \tag{13}$$

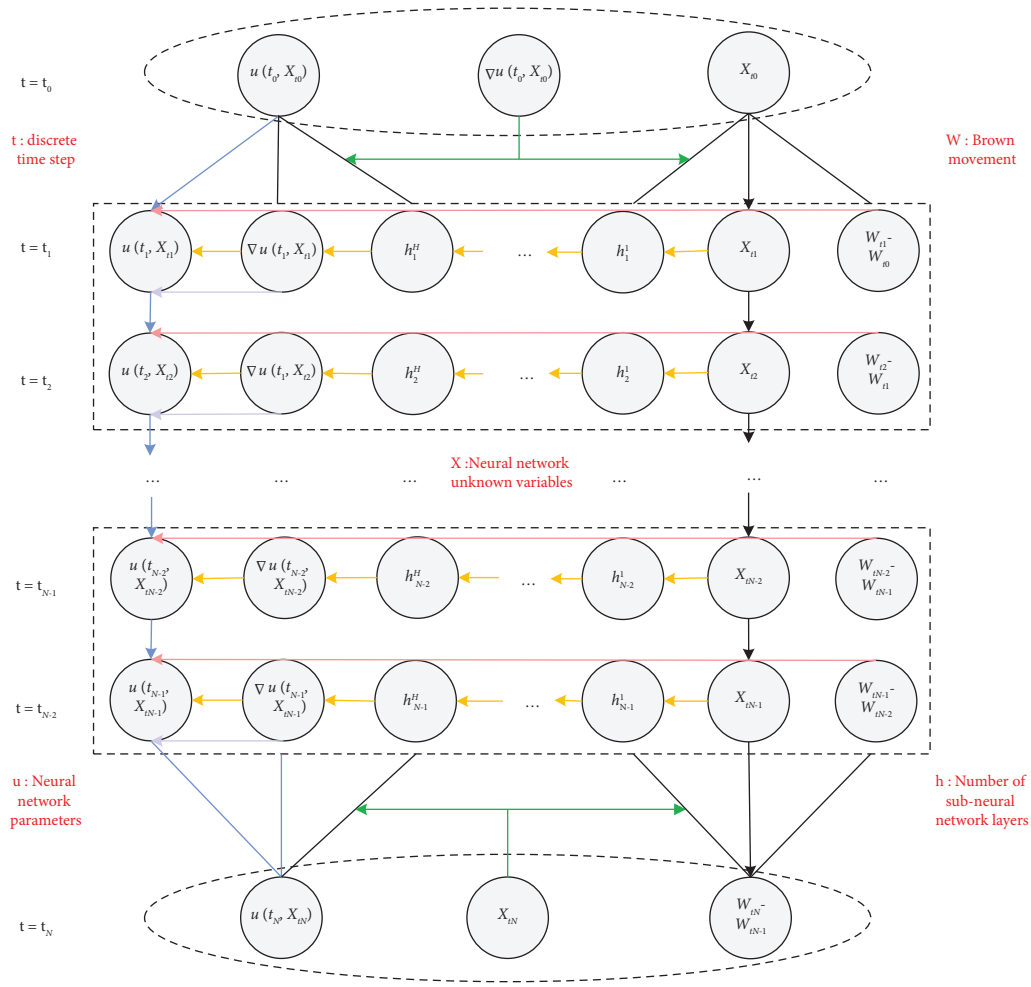

Figure 1: The neural network structure of the deep backward stochastic differential equation method.

Among them, w_t is the weight decay factor. In this way, on the one hand, due to the addition of a weight decay term equivalent to the L_2 regularization process, the generalization ability of the algorithm can be enhanced, and on the other hand, since the hyperparameters can be set independently, there is no correlation between the hyperparameters, and the hyperparameter optimization can be carried out independently.

However, this method of randomly sampling samples ignores the differences of samples, and not all training samples have the same importance in gradient estimation. Increasing the chance of "important samples" appearing in the chosen mini-batch prevents the algorithm from being disturbed by gradient noise as it iteratively approaches local minima, thereby increasing the speed of convergence. The sampling method of selecting small batch samples firstly uses the t-SNE algorithm to embed the high-dimensional training set into a two-dimensional space and then uses the Gaussian kernel density estimation algorithm to calculate the density values of all training samples in the low-dimensional space. The complexity of this method is high and the amount of computation is large.

Based on the same idea of "increasing the chance of important samples appearing in the mini-batch," this paper proposes an easy-to-implement method for mini-batch sample extraction.

3.6. Comparison of Different Business Management Models

3.6.1. Government-Led Model. The government conducts the overall tourism planning according to the market demand and the region, builds or improves the tourism infrastructure of the ancient town, and the enterprises under the jurisdiction of the government develop and manage the tourism resources in a unified manner. The government is responsible for development decision-making, capital investment, and operation supervision, the company is responsible for daily management and operation, and all relevant departments are responsible for implementing and cooperating with the assigned responsibilities. The main form of residents' participation in tourism is to obtain dividends through land investment or to open stores in scenic spots to do business, rent out their own houses, and work in tourism companies. This model can give full play to

the government's macroguidance role, and the relevant government departments will make overall planning for tourism development, prevent blind development, build the necessary infrastructure for tourism development, and provide a safe and stable external environment for the development of tourism.

The government's overall development model is more suitable for the starting area of tourism in ancient towns where the government has a strong governing ability. However, it is also necessary for the government to strengthen the coordination mechanism. All government departments must reasonably define and identify their work orientation in the development of tourism in ancient towns. They must not only give full play to their respective functional advantages, but also divide labor and cooperate, fully negotiate, and jointly promote. The key to the government's participation in ancient town tourism is whether to perform government functions and properly handle the interest relationship with residents and enterprises.

The operation of tourism companies is profit-oriented. After obtaining the management rights of ancient towns, they may ignore local resources and characteristics, and introduce projects that can recover their investment as soon as possible, or overexploit local resources.

The model of government investment attraction requires governments at all levels to create a fair, just and open environment for tourism investment attraction, that is, to maintain the legitimate income of investors, to ensure the preservation and appreciation of state-owned resources, and to protect the reasonable interests of local residents.

3.6.2. Enterprise-Led Model

(1) Introduce companies with mature organizational structure to develop and operate tourism in ancient towns. Enterprises will invest in planning and construction of tourist destination communities and independently develop and operate tourism economic activities. Tourism enterprises will make economic compensation for the land requisitioned in the community during development and construction and absorb the community. Residents enter the enterprise to work and give certain profit dividends to the community residents according to the operating profit.

(2) In the process of development and management, the government performs functions and powers and provides policy support. Investors are responsible for business management and carry out business activities in accordance with national laws, regulations, and relevant policies.

(3) The enterprise-led model has fast development, high-starting point level, large-scale development, large collective benefit and brand benefit, and easy to implement scientific management adapted to the market, making it easy for the ancient town tourism development to quickly embark on the road of orderly development.

(4) It may cause the company to ignore the interests of local residents, making it difficult to give full play to the enthusiasm of the residents, and is not conducive to community participation and protection of community interests. If it is a foreign enterprise, it will lead to the outflow of income.

3.6.3. Resident-Led Model. The collective self-reliance model of residents is more suitable for areas with a relatively developed market, a relatively complete market mechanism, and a strong market awareness of residents and areas with strong economic strength in the town area, which can meet the necessary funds for the development of vacation tourism in ancient towns.

The market participation model requires the investment of foreign capital, and the local ancient town collectively invests in tourism resources and cash to form a tourism development enterprise with foreign investors to participate in community tourism development and benefit distribution. Tourist attractions independently developed and operated by enterprises can attract community residents to work in enterprises, and community residents can operate family hotels, local catering, tourism commodities, etc. This model has improved the marketization level and management level of ancient town tourism to a certain extent.

3.7. Construction of Operation and Management Model. As an important part of the tertiary industry, tourism has strong industrial relevance. The development of tourism can drive the development of catering, accommodation, transportation, entertainment, shopping, and other industries, thus providing more employment opportunities for the society. The development of tourism can not only drive the development of the local economy but also will not bring industrial pollution. The development of tourism can better protect the local historical and cultural heritage. However, the characteristic ancient towns are located in the northwest region and are far from the central cities. The ancient towns are not advantageous in terms of location conditions, the commercialization of the townships is not high, and the tourism market is still in its infancy. This requires the government to dominate the tourism development of ancient towns. The schematic diagram of the management mode is shown in Figure 2.

According to the analysis of factors influencing the selection of tourism development mode of characteristic ancient towns, through the comparison of different operation and management modes, the operation and management mode suitable for characteristic ancient towns is as follows: government-led, coordinated development, supplemented by investment promotion, and active participation of community residents.

(1) Overall development is the main focus, and investment promotion is the supplement. For the government to strengthen the coordination mechanism, all government departments must reasonably define and identify their work orientation in the development of tourism in ancient towns.

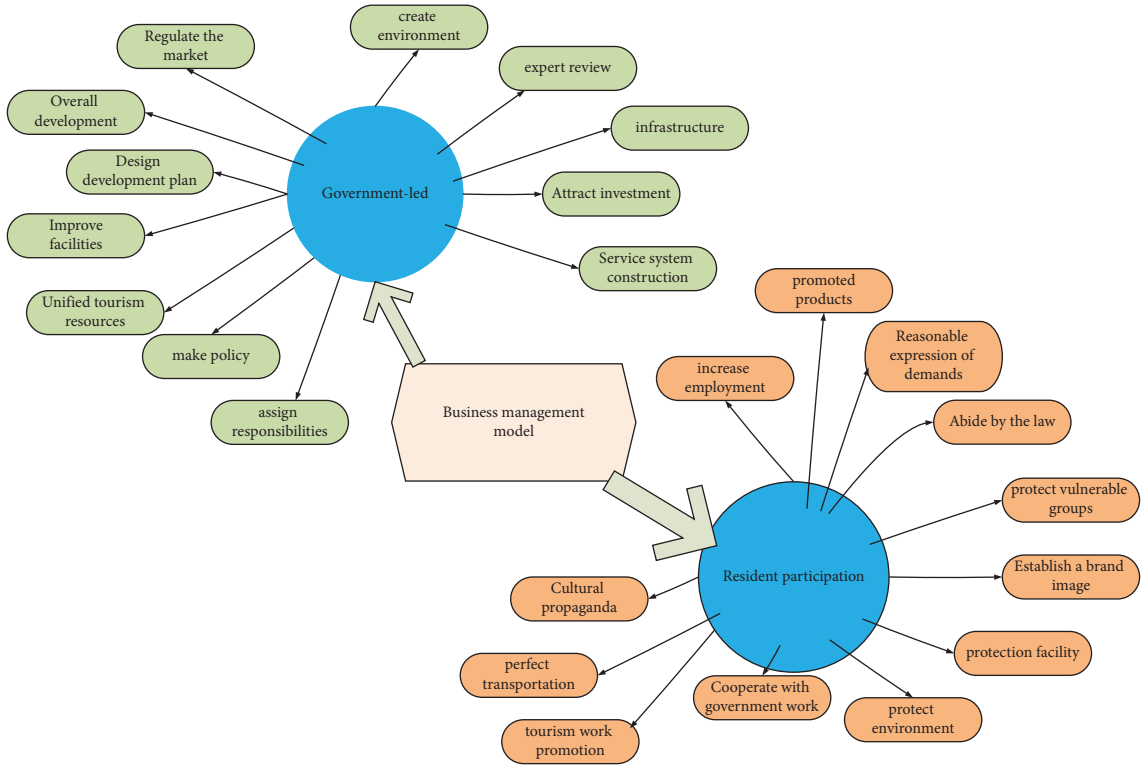

Figure 2: Schematic diagram of operation and management mode.

They must not only give full play to their respective functional advantages but also divide labor and cooperate, fully negotiate, and jointly advance. According to market demands and regions, the overall planning of tourism shall be carried out, the infrastructure of ancient town tourism shall be built or improved, and the main tourism resources, especially historical and cultural relics, shall be developed and operated by the tourism companies under the jurisdiction of the government in a unified manner. The government is responsible for development decision-making, capital investment, and operation supervision, the company is responsible for daily management and operation, and all relevant departments are responsible for implementing and cooperating with the assigned responsibilities.

In addition, the local government can appropriately introduce external capital to transfer part of the management right, which can better solve the problem of funds in the development of fault tourism and also bring professional and market-oriented management, which is conducive to the development of the ancient town. There is a certain promotion effect. The government should create a fair, just and open tourism investment attraction environment, that is, to maintain the legitimate income of investors but also to ensure the preservation and appreciation of state-owned resources, and prevent the overexploitation of resources.

(2) Formulate corresponding guidelines and policies, and formulate scientific tourism plans. In order to develop tourism resources reasonably and orderly, highlight key points and characteristics, and avoid low-level repetitive construction and blind disorderly competition, a high-level, high-starting, practical tourism development master plan and tourism scenic spot plan have been developed Imperative. The unified deployment of tourism development and the overall planning of tourism are important factors to promote the development of regional tourism. The government's future development plan of tourism is directly related to the development direction, development focus, and development strategy of tourism. Therefore, the government should focus on the formulation of tourism development plans, scenic spot plans, and tourism industry plans on a macrolevel and formulate industrial development policies and action plans according to the plans to promote tourism development, construction, and management. At the same time, it is necessary to standardize various business behaviors in the tourism market and create a fair competition environment for the development of regional tourism.

(3) Increase the construction of infrastructure and public service system, and make every effort to create the tourism environment of ancient towns. Unlike general scenic spots, the tourism infrastructure and public service system of ancient towns are not independent but are organically integrated in the construction of ancient towns. It is not built solely around the development of tourism resources in the ancient town but primarily to meet the production and living needs of the residents of the ancient town.

The current bottlenecks restricting the development of tourism resources in characteristic ancient towns are infrastructure and public service systems. The government should focus on investing in infrastructure construction

such as transportation, hydropower, communication, and environmental protection in ancient towns, as well as public transportation services, public information services, public safety services, and public environment. Infrastructure construction is a huge project that requires a lot of manpower and material resources. Characteristic ancient towns have weak economic foundations and a lack of funds. They can only rely on the investment of funds by governments at all levels to build infrastructure and create good external and internal transportation. It is also necessary to build modern communication facilities in tourist attractions to achieve unimpeded contact with the outside world.

(4) Do a good job in the publicity of ancient town culture and tourism. The government should do a good job in the publicity and planning of the overall market image of the region, accurately position and publicize the regional theme products, make full use of various modern publicity media, and establish a tourism brand image in the provincial and domestic tourism market as soon as possible. While promoting tourism, it is also promoting local culture, especially humanistic tourism resources can better reflect the local culture of a region. When the tourism industry develops to a certain stage, people's identification with the tourism in the region also represents the identification with the culture of the region. The development of tourism, local economy, and culture has entered a stage of benign interaction. In the initial stage of tourism, it is crucial for the government to take the lead in making use of its ruling advantages and public resources to promote tourism.

3.8. Product Portfolio Mode Construction. According to the theory of experience economy, the characteristics of tourism resources of characteristic ancient towns, and the behavioral preferences and needs of tourists, the tourism products of characteristic ancient towns are divided into four core products - ancient town cultural experience products, lotus pond wetland experience products, sightseeing agricultural experience products, and festival tourism experience products.

Intangible cultural heritage is the precious wealth of characteristic ancient towns and important tourism resources. The introduction of intangible cultural heritage items into the folk culture tourism festival can make it better protected and inherited. The making of local handicrafts can also be well displayed and promoted at cultural tourism festivals.

Characteristic ancient town tourism product combination mode: ancient town cultural experience products, lotus pond wetland experience products, sightseeing agricultural experience products, and festival tourism experience products are a four-in-one combination model. Among these four types of tourism products, the first three types are distributed in different areas, forming different cores in spatial structure, and then assigning different tourist routes to connect them, which can cover the whole town and realize the all-round combination of points, lines, and planes in the tourist area of the ancient town.

4. Results and Analysis

4.1. Basic Information of the Questionnaire. This paper investigates the development of ancient architecture tourism in tourist attractions of characteristic ancient architecture towns and sets up a questionnaire for field data research., through the form of a questionnaire survey to obtain the tourism status of tourist attractions in characteristic ancient architecture towns, as well as the basic situation of tourism satisfaction with surrounding scenic spots and ancient architecture, to provide accurate and accurate information for the tourism market development and publicity. The highly representative data base, from concept definition to resource development, from economic advantages to economic development, comprehensively interprets the form of "ancient architecture" in everyone's mind. The content of the questionnaire is mainly divided into the comprehensive analysis of the respondents and the investigation of their trend and hobbies of ancient architecture tourism. The content of the questionnaire design is guided by professionals in the field of ancient architecture tourism. Targeted discussion and thinking were carried out, and this questionnaire is of the great reference value and research significance for ancient building managers who want to carry out ancient building tourism.

The basic information part of the questionnaire is more convenient for researchers to understand the age level and education level of the respondents, so as to formulate corresponding ancient architecture tourism plans according to different audience groups, making the questionnaire more universal. Afterwards, we conducted in-depth research on the reasons why the respondents came to ancient buildings for tourism, analyzed their motivations for ancient architecture tourism and the tourism projects they wanted to participate in the experience.

The area where the questionnaire is distributed is the surrounding area of the tourist attraction of the characteristic ancient building town, and the questionnaire data are analyzed by the professional analysis software.

4.2. Description of the Basic Information of the Sample. The overall data are also relatively stable in terms of the respondents' occupations and media sources, which is of great significance and value for research and reference. The occupational distribution of sample information collection is shown in Figure 3.

4.3. Information Analysis. Figure 4 shows the way for tourists to obtain tourism consultation on ancient buildings in characteristic towns. According to the survey results, the motivation of tourists to visit ancient buildings in characteristic towns is analyzed. Figure 5 shows the distribution of tourists' motivation to travel to ancient buildings in characteristic towns.

Most tourists who travel to the ancient buildings in characteristic towns prefer to visit the towers and experience the unique charm of the wooden towers. The activities that tourists want to participate in when they go to the tourist

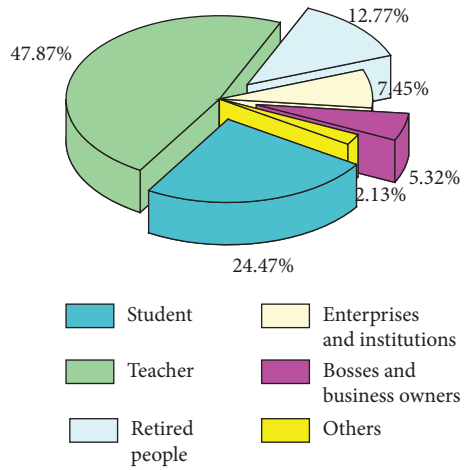

Figure 3: Occupational distribution of sample information collection.

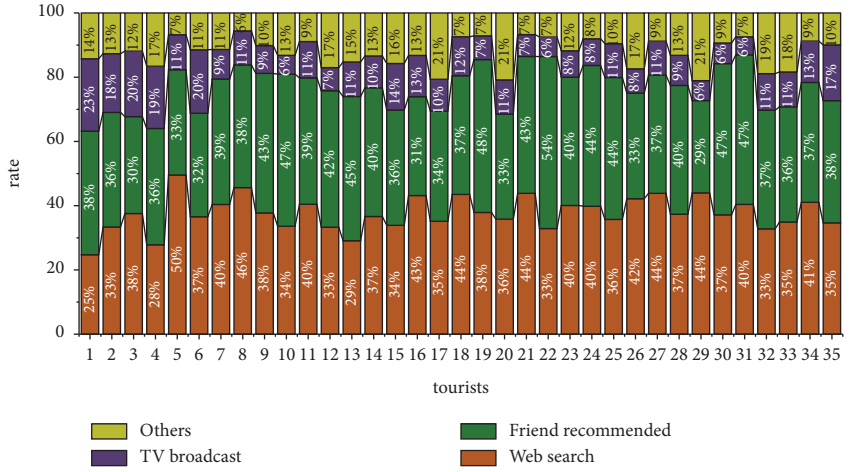

Figure 4: Distribution of ways for tourists to obtain tourism consultation on ancient buildings in characteristic towns.

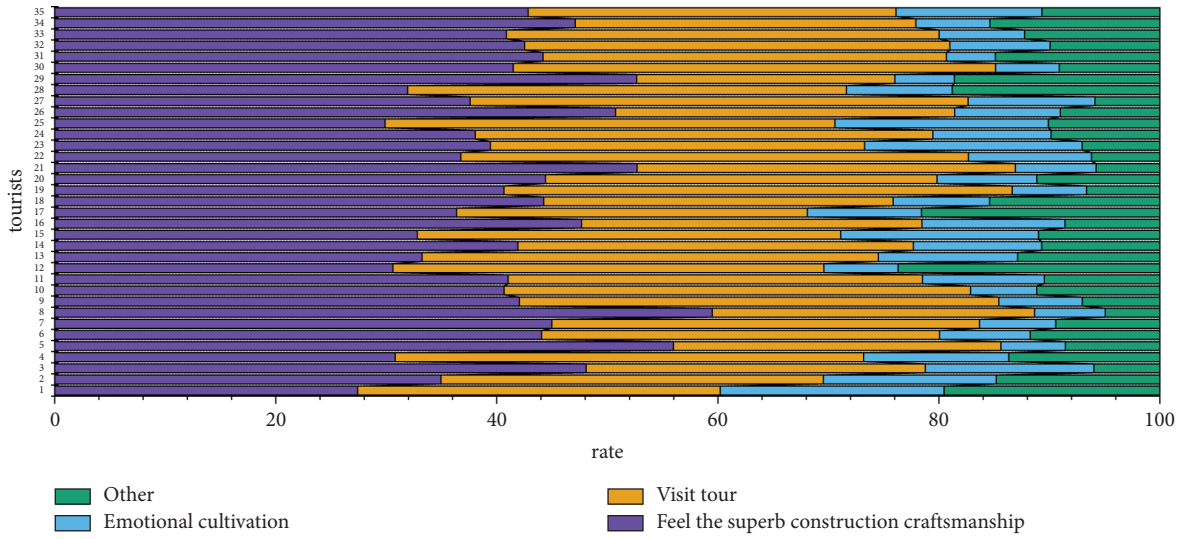

Figure 5: Distribution of motivations for tourists to visit ancient buildings in characteristic towns.

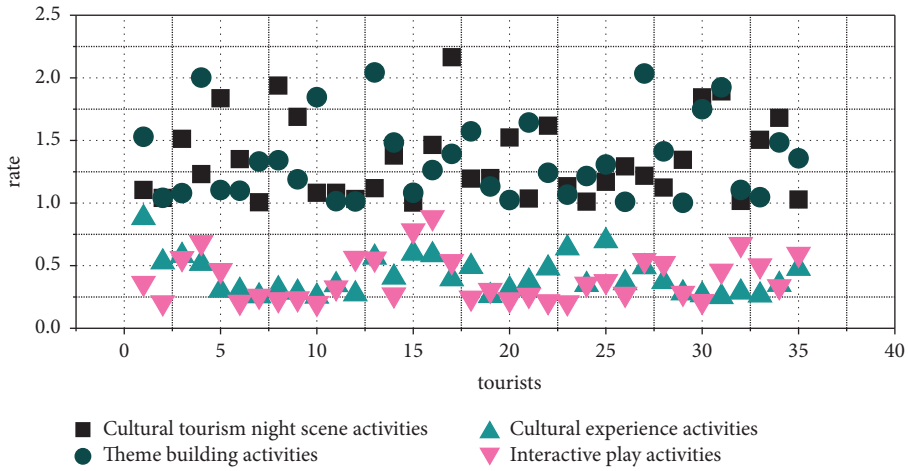

Figure 6: The ratio of tourists who want to participate in the activities they want to participate in the tourist attractions of characteristic ancient buildings and towns.

attractions of characteristic ancient architecture towns are shown in Figure 6.

The tourist attractions of characteristic towns and ancient buildings should be selected by the majority of the population, and the first choice for tourism plans should be 1-2 days. How to create the maximum tourism economic benefits within the 1-2 day tourist stay period has also become a problem that must be considered by scenic spot managers.

Most tourists still prefer diversified tourist routes of characteristic ancient buildings and comprehensive resources to tour multiple scenic spots and regions. Whether tourists are willing to combine the surrounding attractions to carry out tourism of ancient buildings in diversified characteristic towns is shown in Figure 7.

Most tourists are satisfied with the tourism of ancient buildings in characteristic towns, but the tourist attractions in towns with characteristic ancient buildings still need to be greatly improved. Figure 8 shows the tourist satisfaction evaluation of characteristic ancient architectural towns based on a partial differential model.

4.4. Summary of Results Analysis. Judging from the results of this survey, people are still very interested in the tourism of ancient buildings in characteristic towns. Many people have been adhering to a continuous wait-and-see state. This survey involves more than ten issues related to ancient architecture tourism and analyzes tourists' general views and suggestions on ancient architecture tourism in characteristic towns from different aspects such as hobbies, products, forms, and regions. Ancient architectural tourist attractions are further developed for targeted repairs. The general cognition of people of different age groups on the development of ancient architecture tourism still deviates. The age group of the main population in this questionnaire survey is between 26 and 45 years old, and most of them have college and undergraduate education.

There are various occupational distributions of personnel participating in the tourism of ancient buildings in

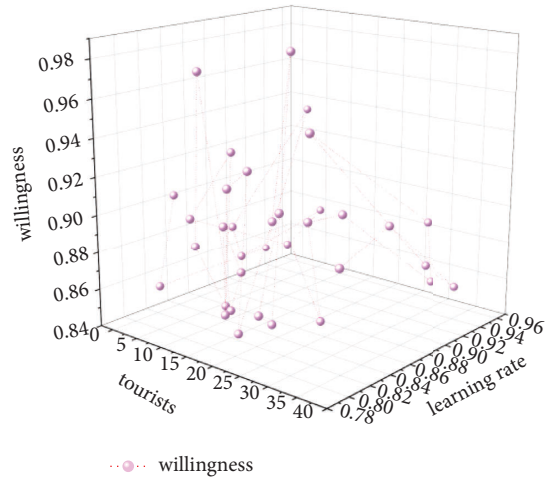

Figure 7: Whether tourists are willing to carry out tourism of ancient buildings in towns with diversified characteristics in combination with surrounding attractions.

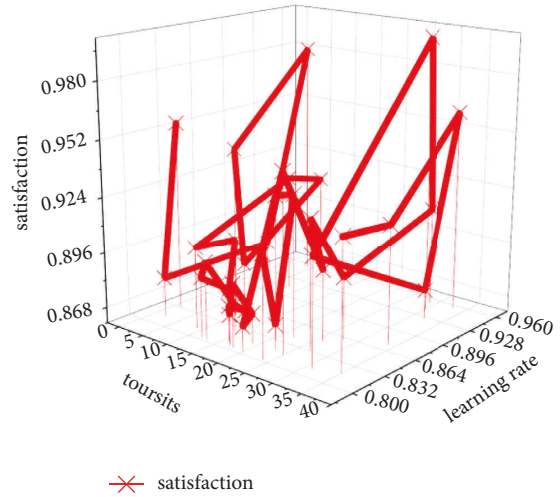

Figure 8: Tourist satisfaction evaluation of characteristic ancient architectural towns based on partial differential model.

characteristic towns. The diversified occupational scope of students, social workers, and retirees also makes tourism of ancient buildings in characteristic towns more likely to develop. The restaurants and snack streets near the scenic area are also the first choice for tourists dining place.

Tourist souvenirs of ancient buildings in characteristic towns are typical representatives of wooden pagoda culture. The re-engraved wooden pagodas can be taken away as souvenirs. No matter where they are placed, they can always remind tourists of its grandeur. Tourist souvenirs of ancient buildings in characteristic towns It is also a witness and companion for tourists to travel to ancient buildings in characteristic towns.

The journey is a goal that constantly motivates oneself, and it is permanently preserved in the memory. At present, the tourism of ancient buildings in characteristic towns can be recognized by the vast majority of tourists, but it is also necessary to see the shortcomings and make improvements.

5. Conclusion

In this paper, based on the backward stochastic differential equation (BSDE) representation of PDEs, a deep neural network (DNN) is used to estimate the solution function and its gradient. The numerical solution problem is expressed as a stochastic control problem, and the gradient operator of the solution is used as a policy function, and the policy function is approximated by a deep neural network, so as to obtain the numerical solution of high-dimensional PDEs. Architectural tourism must take the concept of sustainable development as the guiding ideology and manage the development of ancient buildings with a scientific management system. The talent training is inclined to the ancient architecture tourism so that the ancient architecture can be better protected and the ancient architecture tourism can be developed in the long-term. To coordinate the relationship between the government, society, and ancient buildings, we cannot rely solely on the government to repair and protect ancient buildings. The government mainly provides public basic supporting services, implements relevant laws and regulations, expands funding sources, publicizes the concept of protection of ancient buildings, registers all ancient buildings, and issues corresponding development plans. Professional knowledge in financing and management, high-quality and high-level talents, and necessary funds will cooperate with the government to carry out tourism development of ancient buildings. Only under the scientific guidance of the government and the extensive participation of social forces, appropriate interest groups are allowed to participate in the formulation of tourism plans, and the concept of ancient building protection is promoted to tourists and nearby residents in a timely manner.

Data Availability

The data used to support the findings of this study are available from the author upon request.

Conflicts of Interest

The author declares that there are no conflicts of interest.

Acknowledgments

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