Research Article

Application of Improved Deep Belief Network Model in 3D Art Design

Zilin Ye

Department of Fine Arts, Bozhou University, Bozhou Anhui 236800, China

Correspondence should be addressed to Zilin Ye; 2011040003@bzuu.edu.cn

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In recent years, driven by the high-speed computing performance of computers and massive data on the Internet, deep nerve networks with highly abstract feature extraction and classification capabilities have been widely used in 3D art design and other fields, and a large number of breakthrough results have emerged. 3D art design is a research hotspot in the field of computer vision, which has broad application prospects and practical application value. Aiming at the problems of slow convergence and long training time of traditional deep belief network in the process of data feature expression, this paper proposes an unsupervised learning algorithm, namely adaptive deep belief network, and applies it to 3D art design. Its linear correction unit has good sparsity, which can improve the network performance well. The deep belief network DBN is formed by stacking the restricted Boltzmann machine RBM. The recognition research of 3D art design by optimizing the wavelet deep belief network can effectively improve the recognition rate and recognition speed of handwritten character recognition and achieve good results.

1. Introduction

With the accelerating pace of the development of message science and technique, the massive message exists in different forms, and people’s demand for the quality of various types of messages is getting higher and higher. The classification algorithm based on BP nerve network has limited representation ability in the case of image samples. Synthetic Aperture Radar (SAR) has the characteristics of all-weather, all-weather, multiband, and long-distance detection, so it has become the main detection method for battlefield perception. 3D art design has special multiplicative speckle noise and rich texture messages. 3D art design is a hot research topic at present, and more scholars are conducting research in this field. As an important branch of 3D art design, the handwritten character recognition technique is a hot spot in the current academic and even industrial research.

The existing image classification means mainly adopting two means, namely, the image classification method based on the generative model and the image classification method based on the discriminant model. Studies have shown that humans mainly rely on visual messages and voice messages to transmit and obtain a message. Among them, only about 20% of the message is transmitted through voice, while the visual message obtained from channels such as images or videos is as high as 75%. During the training process, the BP nerve network easily falls into the local minimum. The improper selection of the initial parameters of the nerve network will have a great impact on the classification performance of the nerve network, and its convergence speed is very slow. With the improvement of SAR imaging technique and the multiplication of 3D art design data, automatic target recognition technique to obtain and identify various military targets from a large amount of data and complex terrain scenes has become a research hotspot [1]. The former is based on the distribution of the joint probability of image features and image categories, such as the Bayesian classification model, Gaussian mixture model (GMM), and bag-of-words model (BOW); the latter is based on the conditions of image features and image categories. On the basis of the probability distribution, such as the K-nearest neighbor method (KNN), SVM decision tree, and artificial nerve network (ANN), images are an inseparable
part of our lives. 3D art design brings us a more intuitive, detailed, and easy-to-remember message, which is the basis for people to perceive the world, understand the world, and express the world. Deep belief nerve network is a deep network composed of RBM, which is a kind of deep learning [2]. Due to the special imaging mechanism of the 3D art design, the echoes of many scattered points randomly distributed in the same resolution unit in the scene are coherently superimposed to form serious, coherent speckle noise, which has a great impact on local features, which in turn affects the features. Extraction and Object Recognition [3]: The limitation of the shallow structure learning model is that the expression ability of complex functions is limited in the case of limited samples and computing units, and its generalization ability is restricted to a certain extent for complex classification problems [4]. Image resolution is an important measure of the richness of detail in an image. Image resolution refers to the amount of message contained in the image, that is, how many pixels are stored in the image per inch, and its unit is PPI (PixelsPerInch). In 2006, Hinton et al. proposed a greedy layer-by-layer unsupervised learning process based on DBN, which solved a series of problems in the traditional BP nerve network training process.

In recent years, the popular and mature SAR target recognition means include principal component analysis (PCA), independent component analysis (ICA), and Gabor wavelet decision fusion SAR target recognition means proposed in the literature. The deep learning model simulates the human visual system and the cognitive process of the human brain and realizes the abstract expression of data (image, voice, and text, etc.) with the help of the multilayer abstraction mechanism of the nerve network. Representation of data at different levels of abstraction improves the accuracy of tasks such as classification and prediction [5]. As the carrier of historical and cultural development and inheritance, language and writing are not only an important symbol for human beings to enter a civilized society but also an important way for human beings to communicate with each other [6]. Compared with the low-resolution image LR, the high-resolution 3D art design presents a richer detailed message and has a stronger message expression ability; it makes the image quality more delicate and more visually pleasing [7]. The innovation of this paper is as follows.

1. In this paper, an image superresolution reconstruction algorithm based on a deep belief network is proposed.
2. This paper discusses how to transform RBM into a network structure for superresolution reconstruction problems, transform the output into real-valued output, and propose a resolution reconstruction method based on deep belief propagation.
3. Deep nerve network is the current frontier of machine learning. It has a very good ability to represent target messages, can achieve complex function approximation, and can effectively extract the texture and structural features of the target.
4. The experimental results on the MNIST handwriting dataset show that the ADBN algorithm can better mine the deep correlation between image features and has higher accuracy than traditional image classification algorithms.

The content of this article is as follows.

First, the background and the content of the inquiry are introduced. Then, the second part demonstrates the content with the relevant techniques. The third part discusses the related technologies of 3D art design. The generative model based on the probabilistic graphical model has been widely used in the fields of image and speech processing. Restricted Boltzmann machines have important research value in modeling data distribution. The fourth part discusses the main content of the subject. Deep belief networks and restricted Boltzmann machines can be used as feature extraction means or nerve networks with trained initial weights. The experimental results show that the deep belief network classification method is better than the traditional SVM algorithm with higher accuracy.

2. Related Work

Zhang Y and Huang G. proposed to apply the method of extrapolating the band-limited signal dually to solve the problem of optical image superresolution reconstruction [8]. Kumar S. proposed a method for resolution enhancement using complementary messages between multiple low-resolution degraded images [9]. Sheng D, J Deng, Zhang W, et al. proposed an example learning-based image super-resolution reconstruction algorithm, which has since ushered in a new era of learning-based superresolution reconstruction [10]. Qiu Y, Zhou E L, Xue H T, et al. proposed to detect edges first and then fit with templates to improve the visual effect of interpolated images [11]. Sun X, Wang G, Xu L, et al. suggested an edge-guided interpolation algorithm based on the least squares (LS) method, using the edge-guided characteristics of covariance adaptation to adjust the interpolation coefficients and adaptively obtain the interpolation function to improve the interpolation effect [12]. Yang J, Bao W, Liu Y, et al. propose an image superresolution reconstruction algorithm based on example learning [13]. Yang J, Bao W, Liu Y, et al. proposed to use Markov network to establish a probability transfer model between LR Patch and HR Patch, as well as HR Patch and its neighbors, and use a large amount of training data to learn and train it [14]. Dong Y, Dong Z, Zhao T, et al. proposed the idea of “phantom face,” which can obtain high-resolution images up to 8 times, but it is targeted and not universal [15]. Wang W, Tian W, Liao W, et al. proposed a writing adaptive technique with discriminating ability. The principle is to train corresponding classifiers according to the handwritten characters in the database and then combine these classifiers to form a larger classifier [16]. Wang H, Wang H, Jiang G, et al. proposed an adaptive handwriting recognition method, first building a writer-independent LDA classifier and then building a sample library using different writing style fonts of multiple handwriters. Finally, the LDA classifier is trained [17].
Aiming at the problems that the traditional deep belief network has a slow convergence speed and a long training time in the process of data feature expression, this paper proposes an unsupervised learning algorithm, namely an adaptive deep belief network, and applies it to the image classification task. Using the hierarchical and highly nonlinear structure of the deep belief network, it exerts its powerful data processing ability to recover a large amount of high-frequency messages of the image.

3. D Art Design

3.1. Restricted Boltzmann Machine. With the rapid development of the Internet and message technique, the Internet has provided users with more and more messages and services, but in the face of the exponential growth of message resources on the Internet, users have to spend a lot of time looking for a useful message for themselves [18]. In a probability graph, nodes represent variables, and edges represent the dependencies of variables [19]. According to the connection mode of nodes, probability graphs are divided into two categories: directed graphs and undirected graphs. Directed graphs can clearly represent the conditional probability between nodes and are suitable for knowledge reasoning. In recent years, learning the latent feature level of data from massive data has become a hot spot in the field of machine learning, and deep learning is an unsupervised learning method aimed at solving this problem [20].

Deep learning, as a method for discovering distributed feature representations of data, has attracted widespread attention in the field of machine learning. Among deep learning means, deep belief network is one of the most famous means and has been successfully applied to various machine learning means. However, the phenomenon of interpretation elimination greatly affects the interpretability of directed graphs, and some problems are naturally amenable to modeling with undirected graphs. At present, collaborative filtering algorithm is the most widely used and successful recommendation technique, but collaborative filtering algorithm also faces serious problems such as data sparsity, scalability, and cold start. The principle of collaborative filtering recommendation is shown in Figure 1.

Restricted Boltzmann Machine (RBM) is a generative model that can automatically extract data features in unsupervised learning scenarios. At present, RBM has attracted attention due to its powerful feature extraction capability and as the basic building block of deep belief networks. The machine learning community has paid close attention to it, and it has been widely used in many fields [21]. With the wide application of deep learning, its foundation, Boltzmann machine learning, has also attracted more and more attention. For the mixing process of Markov chains, try to speed up the convergence of Markov chains. Typical means are simulated annealing and simulated tempering. With the help of annealing and tempering algorithms, Markov chains can converge to a steady-state at a larger learning rate. Data sparsity is one of the key problems faced by collaborative filtering algorithms. High sparsity of scoring data often leads to the low prediction accuracy of collaborative filtering algorithms. Therefore, solving the data sparsity problem is of great significance to improve the prediction accuracy of collaborative filtering algorithms. Since the 1980s, the artificial nervous network has been an important research direction in the field of artificial intelligence. It is a computational model established by imitating the pattern of message transmission and processing between neurons in the brain. With the development of computer science and the Internet, With the development of techniques, the amount of data generated, stored, and analyzed by people has increased dramatically. It is a common demand for all walks of life to analyze these massive data and mine valuable message. The schematic diagram of the RBM structure is shown in Figure 2.

With the popularity of social networks, social relationships become more and more important, and opinions of friends in social networks often affect our decisions. Therefore, exploiting social relationships in social networks helps to solve the problem of data sparsity. It is a computational model established by imitating the pattern of message transmission and processing between neurons in the brain. In this context, as an innovative source of intelligent data analysis, machine learning and data mining technique has experienced rapid development in the past decade and has become one of the most active branches in the field of computer and artificial intelligence. Currently, deep learning has made significant breakthroughs in many fields, and the RBM, as one of the most important models in the field of deep learning, has received more and more attention [22]. Due to the structural characteristics of BM, the training of BM requires a lot of time, and the time complexity is very high. In addition, not only can we not accurately calculate the distribution defined by BM, but also it is very difficult to obtain random samples that obey the distribution defined by BM. Aiming at this problem, Smolensky proposed a RBM on the basis of BM. Among them, RBM restricts the intralayer connection of BM, which makes RBM have good properties.

3.2. Local Structural Similarity. With the development of human society towards a high degree of digitization, the rapid development and popularization of digital images, digital video, and digital TV will also become inevitable. The development and optimization of digital images and digital video systems in the acquisition, display, storage, and transmission of visual messages has become a very

![Figure 1: The principle of collaborative filtering recommendation.](image-url)
important and challenging field of work today. Enlargement of a single image is an ill-conditioned problem, and the lack of constraint message makes it difficult to make breakthroughs in solving the problem. Based on the similarity of image local structure and similarity preservation at different resolution scales, the idea of using local structure similarity to constrain the superresolution problem is born. Superresolution (SR) image reconstruction refers to the reconstruction of high-resolution (HR) images from a single or multiple low-resolution (LR) images in the same scene combined with prior knowledge, that is, using signal processing means to restore the imaging process. The high-frequency message lost in the HR method is shown in Figure 3.

Digital images often have different forms and levels of distortion after encoding, compression, transmission, and other processing processes. These distortions will affect the image quality to varying degrees. Correspondingly, there are also some means to improve image quality. In the actual imaging process, due to the physical limitations of imaging equipment, sufficient image resolution cannot be obtained, so people hope that an effective superresolution algorithm can make up for the lack of hardware. In recent years, single-image superresolution algorithms have been widely used and attracted great attention, such as low-resolution face recognition. A noise-contaminated image with a noise of 0.05-0.46 is shown in Figure 4.

In image processing, especially in the field of image coding, the evaluation of image quality is a very important and indispensable task. The existing image quality evaluation means can be divided into two categories: subjective evaluation means and objective evaluation means. In order to reasonably evaluate some links of image communication, the research of image quality evaluation has become one of the basic technologies of image message engineering. With the development of digital communication technique and wireless communication technique, digital image technique has developed rapidly in the field of communication. Since the ultimate destination of image communication is people, and the images output by the image system is generally observed and evaluated by people, the research on image evaluation is one of the important technologies in image message engineering, and image quality evaluation has also become an important part of the image communication process. Superresolution algorithms are widely used in satellite images, medical images, visual surveillance, integrated circuit images, etc. Since the same LR image can be generated from different HR images, superresolution image reconstruction is inherently an ill-posed problem. For various objective evaluation means of image quality, the purpose of the research is to make the evaluation results consistent with human subjective perception. Currently, the internationally recognized most reliable method for evaluating the quality of an image or video is the subjective evaluation method because in most image applications, humans are the ultimate recipients. However, it also has drawbacks. This evaluation method has a large degree of freedom, and it is affected by the observer’s knowledge background, observation purpose, observation environment and conditions, and human visual psychological factors. The rating scale of the subjective evaluation method is shown in Table 1.

At present, most of the algorithms focus on the characterization of the constraint relationship between pixels in the image, and many image prior constraint functions are proposed, such as smoothness constraint, Markov random field constraint, line process constraint, and so on. The superresolution method based on multiple images, multi-source images, or image sequences can be regarded as an extension of the above-mentioned means in the case of increased messages. The key lies in the subpixel alignment between different images. The images are similar. For humans, visual perception and rapid understanding of images depend largely on parallel biological structures. From a behavioral science standpoint, these low-level behaviors are considered subconscious processes that are themselves not subject to any aggregate control nor any coordinator. For many years, people have hoped to find a quantitative measurement method of image fidelity and intelligibility as a basis for evaluating images and designing image systems, but people still do not fully understand the characteristics of human vision, especially the psychology of human vision. It is difficult to find a quantitative description method for the characteristics, so the image quality evaluation needs to be further studied.

4. Application of Improved Deep Belief Network Model in 3D Art Design

4.1. 3D Art Design Spot Reduction. SAR is the representative of microwave remote sensing. The speckle noise of synthetic aperture radar images seriously reduces the interpretability of the images and affects subsequent applications such as target detection, classification, and recognition. Synthetic Aperture Radar is an active microwave imaging remote sensing radar. Because of its ability to acquire real-time high-resolution image data in all-weather, all-day, large-area, and long-distance, it has become the main detection method and technique of space-to-Earth observation systems and has been widely used in military and civilian fields. In the processing of SAR, it is very important to eliminate the speckle and maintain the spatial distribution of the scattering characteristics of the target. 3D art design generally has coherent speckle noise, which seriously affects the extraction of ground object messages and the application effect of SAR images. Coherent speckle noise in 3D art design is a principal defect in the imaging process. We know that the
The standard SA method for image restoration is to classify each image element as belonging to one of a few predefined states or values; this is limited in many applications, especially for restoring RCS. In the actual annealing process, the current solution may be worse than the state in the middle. The comparison of wavelet schematic results is shown in Figure 5.

SAR has unique advantages in Earth observation in the field of Earth science remote sensing and has a very wide range of applications. From topographic measurement to large-scale land and marine message collection, global environmental monitoring, from urban land development, detection of green space vegetation desertification to rivers and lakes sea level, turbidity state determination, geological structure extraction, etc., especially in tropical rain forest climate in these areas, the synthetic aperture radar remote sensing technique with all-day and all-weather imaging capability often has unique advantages. Marked by the first ground images taken by the U.S. Space Shuttle at 250 km using SAR SIR-A in 1981, aerospace remote sensing technique has expanded from visible light and infrared to SAR remote sensing. 3D art design is obtained by coherent processing of the scattered signals of ground objects. For distributed targets, there may be a large amount of speckle noise, which has a certain impact on subsequent work such as edge detection, image segmentation, target detection, and recognition. In the past two decades, many scholars at home and abroad have proposed a large number of means to suppress speckle noise in images. Most of these means use a well-defined filter window to estimate the local noise variance of the coherent speckle image and then perform local filtering separately. In the past 20 years, many means for removing speckle noise in 3D art designs have been developed, and each method has its own advantages and

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Figure 3: Images with similar evaluation results by HR method.

Figure 4: Noise-contaminated image with a noise of 0.05406.
disadvantages. Since 3D art design is a reflection of the scattering characteristics of ground objects, different images have different processing results. The message of each pixel is carried by radar cross section, so in many applications, consider the inverse problem of deriving under the condition of given observed image intensity. The number of iterations is different for the two noise reduction means effect, as shown in Figure 6 which shows the recovered atomic ratio, and Figure 7 shows the average error rate.

Compared with visible light and infrared remote sensing, SAR remote sensing has many advantages. First of all, SAR can penetrate clouds and rain areas, work day and night, and is an all-weather, all-day sensor; secondly, SAR can also penetrate vegetation to a certain extent and can provide visible light and infrared remote sensing. Speckle noise is granular in 3D art design. Since the SAR emits pure coherent waves, when the coherent signal illuminates the target, the coherent effect occurs between the scattered signal of the random scattering surface on the target and the coherent signal emitted by the radar, thereby forming speckle noise. Suppressing speckle noise and reconstructing the radar cross-sectional area RCS of the image is the basic work for the interpretation and application of 3D art design. The ideal noise reduction method is to suppress speckle noise while preserving edge and detail messages well. Speckle affects the characteristics of the image, and image speckle reduction can be represented by the Bayes method:

\[
P_{\text{AP}} (\sigma | I) = \frac{P_{\text{speckle}}(I | \sigma) P_{\sigma}(\sigma)}{P_{\text{I}}(I)},
\]

where \( I \) is the image intensity, \( \sigma \) is the RCS, and \( P_{\text{AP}} (\sigma | I) \) is the posterior probability of getting \( \sigma \) from the image intensity \( I \), which is what we want. \( P_{\text{speckle}}(I | \sigma) \) is the likelihood function, describing the effect of blobs. For L-view SAR, the following \( \Gamma \) distribution is generally used:

\[
P_{\text{speckle}}(I | \sigma) = \left( \frac{I}{\sigma} \right)^{L-1} \Gamma(L) \exp \left[ -\frac{IL}{\sigma} \right].
\]

\[
P_{\text{I}}(I) = \int P(I | \sigma) P_{\sigma}(\sigma) d\sigma \text{ is only used to normalize the expression, so in most cases this can be ignored.}
\]

Let \( z_{ij} \) be the degenerate pixel value at position \((i,j)\) in the original 3D art design of size \( N \times N \) (that is, the actual pixel value of the 3D art design with noise), usually, the image with multiplicative noise. Most of the medium noise is concentrated in the brighter areas. Expressed mathematically, the degraded pixel value \( z_{ij} \) is expressed as formula (3):

\[
z_{ij} = x_{ij} + \mu_{ij}.
\]

Let \( E[u_{ij}] = \pi_{ij} \), where \( E \) is the ideal (expected) expression, and \( u_{ij} \) be the mean of the noise sequence. Then: In formula \( E[(u_{ij} - \pi_{ij}) (u_{kj} - \pi_{kj})] = \sigma^2 \delta_{ik} \delta_{kj}, \sigma \) is the noise standard deviation; \( \delta_{ik}, \delta_{kj} \) is the Kronecker delta function.

Use the best linear approximation algorithm instead of the multiplicative model:

\[
z_{ij}' = Ax_{ij} + Bu_{ij} + C,
\]

where \( A, B, \) and \( C \) are nonrandom variables. The criterion for their values is to minimize the mean square error of \( z_{ij} \) and \( z_{ij}' \), and to make \( z_{ij}' \) a non-Bayesian estimate of \( z_{ij} \). In order to achieve the above conditions, the following conditions must be met:

\[
Ax_{ij} + Bu_{ij} + C = x_{ij} + \pi_{ij}.
\]

Substitute formulas (5) into (4) to form the mean square error and make it the smallest:
\[ J = E\left[ A(x_{i,j} - \bar{x}_{i,j}) + B(u_{i,j} - \bar{u}_{i,j}) - (\bar{x}_{i,j}u_{i,j} - \bar{x}_{i,j}\bar{u}_{i,j}) \right]^2. \]  

(6)

Let formula (6) be the minimum, and we can get:

\[ z_{i,j} = \bar{u}_{i,j}x_{i,j} + \bar{x}_{i,j}(u_{i,j} - \bar{u}_{i,j}). \]  

(7)

It can be seen that formula (7) is actually the first-order Leibniz series expansion of \( z_{i,j} \) to \( (\bar{x}_{i,j}, \bar{u}_{i,j}) \). The mean value \( x_{i,j} \) and variable \( Q_{i,j} \) of \( x_{i,j} \) can be obtained by the following formulas:

\[ \bar{x}_{i,j} = \frac{x_{i,j}}{u_{i,j}}, \]  

(8)

\[ Q_{i,j} = \frac{\text{var}(z_{i,j}) + z_{i,j}^2}{\sigma^2 + u_{i,j}^2} - x_{i,j}^2. \]  

(9)

In the formula, \( \text{var}(z_{i,j}) \) is the variable of \( z_{i,j} \); the values of \( \text{var}(z_{i,j}) \) and \( \text{var}(z_{i,j}) \) are the approximate values of the local mean and local variables of the original SAR image.

Applying the Kalman filtering algorithm to formula (7), and substituting formula (8) and formula (9), formula (10) can be obtained, where \( \bar{x}_{i,j} \) is the approximate value of \( x_{i,j} \):

\[ \bar{x}_{i,j} = x_{i,j} + k_{i,j}(z_{i,j} - u_{i,j}x_{i,j}), \]  

(10)

where

\[ k_{i,j} = \frac{u_{i,j}Q_{i,j}}{\sigma^2 + u_{i,j}Q_{i,j}}. \]  

(11)

By formula (11), the pixel value \( x_{i,j} \) of the filtered \( x_{i,j} \) can be obtained.

4.2. Deep Belief Network. Nowadays, research on deep learning in the fields of computer vision, pattern recognition, artificial intelligence, image processing, and data mining is thought-provoking. Deep learning models are increasingly worth exploring and mining [23]. Feature extraction is a key link in SAR image target recognition. The coherent speckle and nonsmooth properties in SAR images make it difficult to apply traditional feature extraction methods for optical images. Although a deep belief network (DBN) can be used for feature learning automatically, this method belongs to the unsupervised learning method, which makes the learned features irrelevant to the specific task [24]. The belief network can automatically learn and extract features from data and has outstanding advantages in feature learning. A deep belief network is a deep architecture consisting of multiple restricted Boltzmann machines. Aiming at the problem of loss of message caused by the input of restricted Boltzmann machine being generally a binary vector in deep belief network classification, which reduces the classification effect, it is proposed to increase the noise in the sigmoid unit to scale the input to \([0,1]\) interval, a numerical attribute deep belief network classification method using a top-level restricted Boltzmann machine with a Gaussian hidden node to implement the classification function. The comparison results of image recognition performance of different algorithms are shown in Table 2.

At the beginning of the development of DBN, in order to solve the research problem of fast and automatic learning features, Hinton et al. proposed a fast learning algorithm applied to DBN, which provided a new way to understand and analyze DBN models and opened up the expansion of deep learning models gate and applied it to various fields of real life [25]. SAR image target recognition has potential applications in military and national defense security. For example, this technique can be used for tasks such as identification of friend or foe, battlefield detection, and disaster assessment. In the classification of the polarized 3D art design, there are problems of the low utilization rate of massive features and strong subjectivity of feature selection. To solve this problem, a polarized 3D art design classification method based on a deep belief network is proposed. Deep belief networks and restricted Boltzmann machines can be used as feature extraction means or nervous networks with trained initial weights. Due to the initialization of the connection weights rather than just the random weights of the nervous network, the deep belief network classification should have better performance than the original traditional nervous network classification. The scope of DBN improvement includes the following: one is to improve the quality of input samples through preprocessing (feature fusion, denoising); the other is to use various optimization strategies (early termination, dropout) to deeply improve the parameters of the DBN model or select different classifiers. Although researchers have done a lot of work in the past few years, target recognition in SAR images is still very difficult and challenging research. As its key link, the quality of feature extraction seriously affects the final recognition accuracy and results. Polarimetric Synthetic Aperture Radar is a high-resolution imaging system capable of penetrating clouds and rain all day, all-weather, and rich object message. It is one of the main directions of remote sensing development. Most of the current classification learning means are multishallow structure algorithms, such as support vector machine (SVM), Boosting [1], and Logistic Regression. The limitation is that the ability to represent complex functions is limited in the case of limited samples and computing units. The generalization ability of the classification problem is restricted to a certain extent. The number of iterations accuracy is shown in Figure 8.

The different areas of DBN improvement are: in the field of text detection, DBN combines computing device architecture and text stroke width; in the field of face and emotion, DBN combines key features (local texture features) required for human body recognition; in the field of remote sensing image feature classification, DBN combines spectral message and spatial message contained in hyperspectral images. Those DBN improvements have been successfully applied to many pattern recognition tasks. For example: speech modeling and facial feature tracking. A deep belief network is a deep network model composed of a multilayer RBM. Polarization describes the spatial trajectory formed by the electric field vector endpoints of electromagnetic waves as a function of time and can reflect the vector characteristics.
of electromagnetic waves. Therefore, polarimetric SAR can describe the scattering mechanism of the target through the complex scattering matrix, provide a more abundant message, and has many advantages in image classification and recognition. BP algorithm is a typical algorithm for traditional training of multilayer networks, but in fact, this training method is not ideal for networks with only a few layers. A probabilistic generative model of higher-order correlations between Although we can use supervised learning to fine-tune the weights in deep belief networks, it is essentially an unsupervised learning method. The sigmoid function curve comparison is shown in Figure 9. Studies have shown that using polarimetric SAR data for land cover classification can achieve higher accuracy. Deep learning forms more abstract high-level representations (attribute categories or features) by combining low-level features to discover distributed feature representations of data. DBN is a deep network structure composed of multiple layers of RBM. DBN is based on the research of the biological nerve network and the development of the shallow nerve network. It is a probability generation model and infers the distribution of data samples through the joint probability distribution. At present, the main method of polarization 3D art design classification is to extract features according to the scattering characteristics of target objects and select an appropriate classifier for image classification. RBM includes visible layer and hidden layer, and the bottom layer is visible and used. One reason for binary feature vectors is that most of the messages available on DBNs are assumed to be binary features (0 or 1), and trying to use the numerical properties of continuous features is still experimental. The DBN generation model enables the entire nerve network to generate training data according to the maximum probability by training the weights between neurons in the network structure, forming high-level abstract features, and improving the classification performance of the model.

5. Conclusions

Image superresolution reconstruction has received extensive attention in recent years because of its application prospects and practical application value, and a large number of excellent algorithms have emerged. These algorithms can be roughly divided into three categories: interpolation-based image superresolution reconstruction algorithms, reconstruction-based image superresolution algorithms, and learning-based image superresolution reconstruction algorithms. In this paper, the concept of adaptive step size is introduced into the CD algorithm of RBM learning and training, and an ADBN algorithm is proposed. The deep network structure learning model is applied to the image classification task, and the specific algorithm implementation and image classification of ADBN are given. Classification framework, the experimental results on the MNIST handwriting dataset demonstrate the effectiveness of the algorithm. Aiming at the defects of serious noise, difficulty in feature extraction, and insufficient labels in 3D art design, a nonlocal mean image speckle reduction algorithm based on dual-tree complex wavelet transform was designed, and a deep nerve network was used to extract and recognize SAR targets. Character recognition, as an example, is a branch of optical character recognition and an important research field in pattern recognition. Compared with the traditional DBN, the algorithm proposed in this paper shows great advantages, and the recognition rate and recognition speed are improved.

Data Availability

The data used to support the findings of this study are included in the article

Conflicts of Interest

The authors declare that they have no conflicts of interest.
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