Characteristic Analysis of Building Surface Material Combination

Yao Wang*
School of Fine Arts, Yunnan Normal University, Yunnan, China

*772967536@qq.com

Abstract. To study the composition of building materials, the composition and characteristics of building surface materials are analyzed. Based on the MPIRAN algorithm, 157 sets of samples are selected, of which 130 are used for study and the 27 is used for verification. Before modeling, all the sample inputs are normalized to the [0,1] range, and the mean error function is used to test the output error of the network. The commonly used RAN learning algorithm is compared with MPIRAN to verify its superiority. The simulation results show that MPIRAN learning algorithm is suitable for the classification of building materials. Compared with the other learning methods, it can also significantly reduce the number of hidden nodes in the network. Based on the above findings, it is concluded that the MPIRAN algorithm can reduce the network structure and improve the learning ability and calibration ability of the network, so that the correct classification of samples can be realized.

1. Introduction

The building is constructed by different materials in proper combination and in the form of joints, and it is also the embodiment of the construction techniques and the art of construction. From rammed earth, stone, wood to metal materials, and then to the use of composite materials, people continue to study and expand the types of materials and materials applications. Most of the spiritual expression of architecture is presented through architectural surface and architectural spaces. Moreover, the construction materials, especially the various properties of building materials and the detailed structure of buildings, have a great impact on them [1]. The texture and color of building materials give different expressions to the architecture and give the most direct impression for people. At the same time, it is the most direct medium for people to experience. Therefore, in the experience of architecture, the material performance of the building is more direct than that of the building space. Therefore, it is very important to study the material combination and the joint structure of the building surface [2]. This research can help architects to express the emotion and information of architecture accurately. More importantly, people can find common features in different architectural works of architects, and can better understand the architects' design concepts. Compared with the traditional architectural design, more emphasis is placed on the relationship between the plane and the epidermis, and the design of the different combinations of blocks and the change of space are slowly exhausted [3]. Today, architectural designers are not only limited to the traditional design ideas and traditional design system, but to pay attention to the use of building materials [4]. Through the combination of
different building materials and the detailed design of node structure, the form innovation has been achieved, which has greatly enriched the language of architectural design.

In this study, the material composition of the building surface and the influence of the detail joint structure on the building surface are analyzed. This comparison fully excavates the performance potential of different building materials in different construction projects. Through a large number of building materials combination of the epidermis and building node structure, the influence on the building surface is analyzed, which provides some guidance for the future design.

2. Material combinations of building surface

2.1. Material combinations of different shapes
When the building surface uses a variety of building materials, it has a combination of materials and shapes. In most buildings, the shapes used in the building are generally geometric, and the organic forms in nature are relatively few. Square material gives a sense of regularity, making the epidermis more precise and stable. The circular or curved material and the free form of curves give the impression of movement [5]. The acute angle gives directional directivity. For combinations of different shapes, the following combinations need to be grasped.

Map base relation: The relation between the graph and the bottom is the relation between the principal and the subordinate. As for the shape of the building's surface, it should be noted that the main building materials need to be clearly defined, while minor building materials can be properly used in other shapes. Only the clear expression of the principal and subordinate relationship can achieve the goal of highlighting the key points.

Fragmentary and overall structure: In the design of the building surface, the use of a building material will unify the entire building and is conducive to the integrity of the epidermis. To some extent, it is also a manifestation of beauty [6]. When the use of building materials is too fragmentary, through the integration of material and shape, a single geometric form is formed, which makes the building get the aesthetic feeling of the body.

2.2. Material combinations of different colors
Architects often use different colors for building materials. Through the collocation of colors, the architecture can reach the simplest way of architects' design conception, and the proper collocation of materials and colors also determines the quality of the building. In different geographical environment and cultural background, color also has a unique meaning. This is mainly caused by people's different backgrounds of life and aesthetic habits. For example, in the understanding of western countries, white stands for purity, while in our country, "white" has an ominous meaning [7]. In China, red represents happy event, but in western countries, the red represents blood. Therefore, the color selection of building materials should be based on the geographical, environmental and cultural background of the site, and local taboos should be avoided as much as possible.

For the choice of material color, usually, color has a certain role to show the unique shape of the building. In general, a color is chosen as the main hue, and then other colors are selected as the auxiliary tones, which form the master-slave relationship with the shape combination of the building materials. For building materials, the choice of color should try to respect the following principle:

Principle of integrity: For building materials, the principle of overall use of color is mainly two aspects. One is the integrity of the color matching of the building itself, and the other is the overall collocation of the color of the building and the surrounding environment. Comparatively speaking, the latter is more important [8]. The new design of a single building should try to mix with the surrounding natural environment and the building environment, and should not appear too unexpected. Since most of the buildings in a region are designed by different architectural designers, it is difficult to coordinate the building shapes and harmonize them through architectural colors so as to achieve the harmony of the whole building.
Combination of architectural function: Different functions should have different color combinations. For example, the collocation of kindergarten buildings is mainly based on children's series. In combination with children's naivety and active nature, the collocation of colors should be more diversified. The main use of the hospital crowd is the patient, white can give patients a quiet and tidy feeling. In combination with the function of the building, the use of color can add a lot of value to the building.

2.3. Relation between the shape and color in a material composition
In the combination of building materials, we not only need to pay attention to the shape and color of the material, but also pay attention to the mutual influence between the two. For buildings with relatively simple shapes, most of them change the design of materials to make them interesting. For building materials that are quite rich in construction, this choice is often relatively simple [9].

If the building shape has been quite rich, but still use more complex construction materials, it will cause the building surface of uncoordinated. In the combination of building materials color and building materials, we should try to make them match reasonably. The color should change with the change of the shape of the building.

3. Application of MRIRAN algorithm on building materials

3.1. Classification of building materials
Building material is a general term for all the materials used to construct buildings. Building materials bear all sorts of functions in architecture. For example, the material used for load-bearing components is mainly subjected to external forces, and water-resistant materials are often eroded by water. In order to make the building safe, applicable, durable and economical, it is necessary to fully understand and grasp the nature and characteristics of various materials.

The composition of building materials usually refers to their chemical composition and mineral composition. Chemical composition refers to the kind and content of chemical elements and compounds in the material [10]. The composition and relative content of materials not only affect their chemical properties, but also affect the physical properties of materials. For example, the general construction of steel prone to corrosion, adding chromium and nickel elements in smelting can improve the rust resistance of steel, this material is called stainless steel. Moreover, concrete can be changed obviously after adding admixtures in concrete mixing, which is due to the change of the phase structure of the material. Physical chemistry refers to the homogeneous part of the system in which the physical and chemical properties are the same. The term "phase" refers to the phase composition and their relations at different scales of matter. Therefore, the study of the phase structure and formation mechanism of materials is of great significance for mastering the properties of materials, selecting materials reasonably, and improving the properties of materials.

3.2. Simulation result
157 sets of samples were selected, of which 130 were used for study and the 27 was used for verification. Before modelling, all the sample inputs are normalized to the [0,1] range, and the mean square error function is used to test the output error of the network. The commonly used RAN learning algorithm is compared with it to verify its superiority. The simulation curve is shown in figure 1.
The curves of learning error  

The curves of calibration error  

**Figure 1.** Simulation of MPIRAN learning algorithm on components classification of building material

Figure 1 (a) - (b) represents the learning error curve and the calibration error curve, respectively. The abscissa is the number of studies, and the ordinate corresponds to the corresponding curve. Two different color lines correspond to the MPIRAN learning algorithm and the RAN learning algorithm, respectively. The figures show that the indicators also tend to be smooth and convergent with the increase of the number of learning. The specific simulation results are shown in table 1.

**Table 1.** Result of MPIRAN learning algorithm on components classification of building material

|                | Number of hidden nodes | Learning error (10^-2) | Calibration error (10^-2) | Learning accuracy (%) | Calibration accuracy (%) |
|----------------|------------------------|------------------------|---------------------------|-----------------------|-------------------------|
| MPIRAN         | 18                     | 3.0459                 | 3.1615                    | 97.7                  | 96.3                    |
| RAN            | 28                     | 3.7356                 | 3.9818                    | 95.4                  | 92.6                    |

The data in table 1 show that MPIRAN learning algorithm is applied to the classification of building materials. Compared with the other two learning methods, it can also significantly reduce the number of hidden nodes in the network, and improve the ability of network learning and verification.

From the above simulation curves and results, it can be seen that the MPIRAN learning algorithm is applicable to the classification of building material components, and can also obtain the conclusion similar to the two-dimensional XOR problem. While greatly simplifying the network structure, the learning ability and verification ability of the network have been significantly improved. Moreover, the algorithm is more stable than the other two learning algorithms, and is less affected by the sample.

**3.3. Simulation result analysis**

Compared with RAN learning algorithm, MPIRAN learning algorithm has its own advantages, but also has certain pertinence. The commonly used RAN learning algorithm is based on the new conditions, that is, distance measurement and error measurement to adjust the hidden layer. At the same time, it uses the input and output information of samples, it can effectively improve the learning efficiency, but it also has some shortcomings. For example, the common RAN network does not have any initial nodes, which leads to inefficient network learning. Also, the common RAN network is determined by the new condition, whether the new hidden layer nodes are added, and the hidden layer parameters are adjusted, and the new condition is greatly affected by the input samples and their input order. In view of some shortcomings of RAN learning algorithm, the MPIRAN learning algorithm is improved. It can be divided into several aspects: The largest error sample is used instead of the sequential sample to input the network, and the hidden layer center is adjusted by similarity parameter. In order to verify its influence on the usual RAN learning algorithm, the classification of building materials...
materials is taken as an example, and its simulation is carried out. Compared it with the usual RAN learning algorithm, the simulation curve is shown in figure 2.

![Simulation curves](image)

(a) The curves of learning accuracy  
(b) The curves of calibration accuracy

**Figure 2. Simulation of the influence on differences compared to RAN**

Figure 2 (a) - (b) represents the learning accuracy curve and the calibration accuracy curve, respectively. The abscissa is the number of studies, and the ordinate corresponds to the corresponding curve. The three curves correspond to the different simulation curves, including the RAN learning algorithm simulation curve, the improved simulation curves for RAN networks using only similarity parameters and the simulation curve which uses only the largest error samples to improve the new condition of RAN. The figures show that the indicators also tend to be smooth and convergent with the increase of the number of learning. The specific simulation results are shown in table 2.

Table 2 clearly shows the impact of each part on the RAN network. The use of similarity parameters can adjust the center change according to the distance between the input samples and the hidden centers, which is more conducive to the change of the hidden center. Although the network structure has increased to a certain extent, the learning ability and verification ability of the network have been improved to a certain extent. The maximum error sample is used to improve the new condition of RAN network, so the network hidden layer structure is greatly simplified. This is due to the novelty of the sample's error. It is beneficial to the network learning, but the verification effect is not ideal.

**Table 2. Result of the influence on differences compared to RAN**

|                  | Number of hidden nodes | Learning error \((10^{-2})\) | Calibration error \((10^{-2})\) | Learning accuracy (%) | Calibration accuracy (%) |
|------------------|------------------------|------------------------------|------------------------------|-----------------------|--------------------------|
| RAN              | 28                     | 3.7356                       | 3.9818                       | 95.4                  | 92.6                     |
| Maximum error sample | 17                    | 3.2856                       | 5.2079                       | 96.2                  | 85.2                     |
| Similarity degree | 31                     | 3.5468                       | 3.5688                       | 96.2                  | 92.6                     |

To sum up, the figure 2 and table 2 show that the use of samples that produce the largest error instead of the sequential sample input network has a greater impact on the network structure. This is because the new conditions are sensitive to the characteristics and order of the input samples. The use of similarity parameters is beneficial to the change of hidden layer center, and can improve the learning ability and verification ability of the network.

A MPIRAN learning algorithm is presented in this chapter. Through the comparison of classification problems, the classification of building material components is simulated and compared with the commonly used RAN learning algorithms. The simulation results show that the algorithm can
reduce the network structure and improve the learning ability and calibration ability of the network, so that the correct classification of samples can be realized.

4. Conclusion
The material combination of the building epidermis and the detail node structure are studied in this paper. Starting from the surface composition of building materials, the composition characteristics of different material surfaces are discussed, and the use strategy of materials is summarized. In the choice of building materials, architects first need to clearly understand the attributes of various materials, and explore the connotation of material expression. They must dig out the characteristics of the material in terms of form and color, and combine, match and connect creatively. Secondly, the MPIRAN learning algorithm for building material classification is proposed in this paper. In view of the deficiency of RAN learning algorithm, the learning algorithm has been improved. First, the network is initialized. Then, in the course of learning, samples with maximum error are selected instead of sequential samples into the network. Making full use of its novelty can greatly simplify the network structure. The algorithm can achieve the correct classification of samples in a certain pattern classification problem, and get better network performance in the case of simple network structure.

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