WOOD RESEARCH
57 (4): 2012
523-530

PATTERN DESIGN AND FRACTAL ARTISTIC EXPRESSION BASED ON WOOD MACROSCOPIC AND MICROSCOPIC STRUCTURE

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(Received March 2012)

ABSTRACT

This paper introduces macroscopic and microscopic structure patterns of wood and characteristics of fractal art. It puts forward to used the texture, patterns as the basic element graphics formation of wood macroscopic and microscopic cell-pilled structure, through combined with computer graphics image and proceed with pattern design and fractal artistic expression of wood macroscopic and microscopic structure, can reflect people complex emotion feelings on nature, express more new art design forms that beyond traditional standard, promote human and wood communication stature, it fully exploit the visual esthetics of wood structure.

KEYWORDS: Wood macroscopic structure, wood microscopic structure, fractal pattern, artistic expression.

INTRODUCTION

The pattern which has fractal characteristics can be seen everywhere in the nature, like clouds, mountains, rivers, trees, buildings and other. Because of its beauty and the method of it, fractal art pattern has won more and more attention of people. And the fractal theory has gradually established the importance in the research of image features (Kumar and Mishra 1999). The theory of fractal geometry and fractal art design in combination with each other on based of different mathematical algorithms, and the use of computer graphics can always create unique graphics to give us wonderful feelings (Zorpette 1988, Keller et al. 1989, Chen et al. 1990). We can make full use of it when set the natural structure texture pattern of wood as the basic element pattern, use the method of fractal art to design and build new pattern, of course, it can help us

open new design ideas and methods at the same time.

Traditional arts in China usually give profound meaning to flowers, trees and animals in the nature to express the good wishes of the people by creating patterns. However, the trees in the nature have the most intimacy with human. Studies show that the reason why people were fond of wood texture was that the changes of wood texture were in rhythm with 1/f spectrum distribution which was same with the fluctuation of physiological rhythm of human body. So, when the wood texture stimulate the visual perception of human, it can give the rhythm feeling about movement and the life, the natural feeling about harmony and fluent to people and made people feel comfortable and beautiful (Zhao 1997).

The various texture and pattern which built with the cells in macroscopic and microscopic structure of wood become the art pattern which has kaleidoscopic and forms the unique beauty and charm. This kind of pattern gives unlimited charm and feeling of full of vitality. In real life people give a diverse range of use and processing technology on the wood of the macroscopic structure texture, however, the microscopic structure of wood which shows as inside part has always been neglected by people. Only when feel the beauty and use of wood from outside to inside can we learn the true perceptual cognition of wood then we can show better on consciousness and experience about wood. And, pay enough attention on the aesthetic, practical and functional of wood when in application.

When the structure pattern of wood in macroscopic and microscopic cell-piled performs the role as the materials for design, it has its own visual aesthetic and sensory characteristics of inherent characteristics, perceived characteristics. With the different demand for products of consumers, people have to consider the selection of material for this product, the structure, function, process embodiment of color matching etc. in design, and the more important was that the design should combine the nationality, culture, science and technology, economy and human factors etc.

Fractal art

As a new concept, fractal has infiltrated into various fields of science gradually (Zhang and Bao 1994, Qin and Liu 2003, Qin 2007). Fractal was the structures of the bridge between science and art, also the fusion of art and science, the unity mathematics and art aesthetic. The development of fractal art in recent years has aesthetic and scientific connotation and artistic reflection which based on the fractal geometry and sets it as its mathematical basis and combine the fractal theory with image and graphics at the same time, according to the nonlinear science theory and use the computer to create. It has indisputable aesthetic appeal.

Fractal art pattern can express the world of people' s inner emotional and the feelings of nature in most incisive way by used parameters formula, mapping, deformation, strengthen, trade-offs, exaggerating etc. It revealed the whole and local nature of contact but has the combination of unity and change, the harmony of symmetry and balance, the matching of rhythm and rhyme, the intersection of harmony and contrast, the changing of proportion and scale and so on. The modeling principle was a reflection of people to learn the nature world used fractal art, also a way for people to express themselves.

Therefore, the performance of fractal was infinite recursion iteration, as well as self similar fractal perspective brought us into the infinite mystery of the space and become the way of people to express their thoughts and feelings. Fractal creation was a manifestation of the basic elements of color, shape, space and design to create fractal art form which was expressive and abstract.

MATERIAL AND METHODS

Design materials

We can know that the comprehensive evaluate of wood were good or better through fuzzy comprehensive evaluation method. So we choose wood macroscopic and microscopic cells piled the structure pattern of the fractal pattern to design to show representative. We selected *Pinus sylvestris* for the wood macroscopic tangential section structure pattern, *Rhamnus dahuricus*, *Taxus cuspidata* for the wood microscopic transverse section structure pattern. *Larix gmelini, Robinia pseudoacacia* for the wood microscopic structure pattern of radial section and the *Pterocarya stenoptera*, *Robinia pseudoacacia*, *Maackia amurensis* for the wood microscopic tangential structure pattern.

Fractal art design

In this study, the fractal design and artistic expression of wood macroscopic and microscopic structural pattern, we use the software Ultra Fractal, Photoshop to the design fractal images. The most important feature of Ultra Fractal was that they do not need program and easy to define a new formula to satisfy the creation of designers. As shown Fig. below 1.

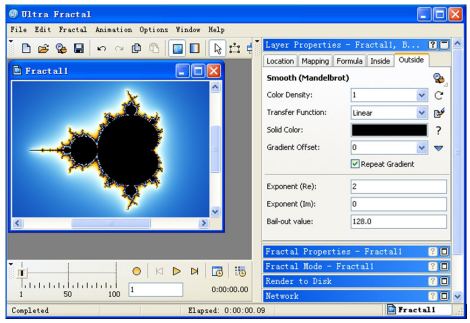


Fig. 1: Ultra Fractal 5.01 Software Interface.

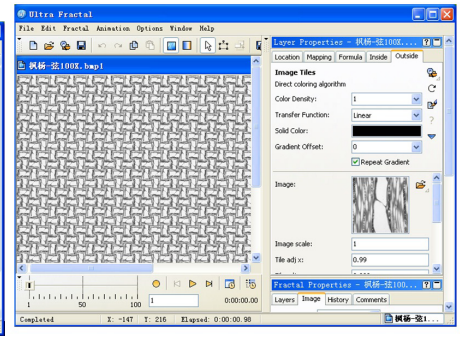


Fig. 2: Apply the ultra Fractal 5.01 for fractal design.

The following examples of fractal software Ultra Fractal 5.01 show that fractal art design with the structure pattern of the microscopic tangential section of wood (*Pterocarya stenoptera*) (Fig. 2). The first step to create a new wood structure fractal pattern was in the right toolbar outside option, choose "Image open" to selected import wood structure pattern of the original graphics as a basic graphics. The second step was choose the fractal formula you need from "Mapping" to decide the organizational structure of fractal patterns then you can design based on your need or aesthetic imagery, as well as the distribution of color. Finally, export the results of fractal patterns with the determined size, resolution, image format.

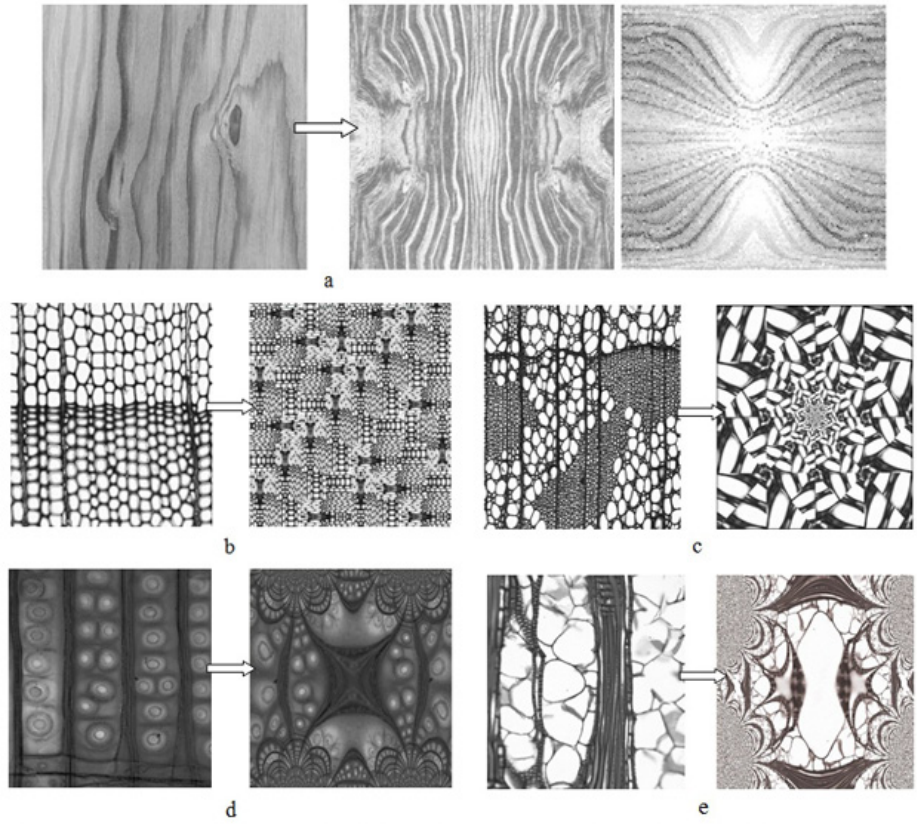
RESULTS AND DISCUSSION

Wood with its silent language to express its whole the external characteristics and the intrinsic property. People need to used sensory abilities to communicate with it, you will find the

beauty of its texture and color while you can understand it. And you can see the wonderful pattern of the inside about the permutations and combinations of microscopic structure of cells to bring more feelings on design for people.

The wood comes from nature, fractal to describe the nature of things, so they contact was natural, closer to human life (Song and Zhao 2010). The wood's natural structure texture, patterns, design itself has the fractal characteristics (Song and Zhao 2010). This natural and artificial fusion made that people explore the infinite mystery and dazzling beauty. The help of fractal theory, and use of transformation like mathematical formulas, line fractal, surface fractal and body fractal which for pattern design and the performance of fractal art with wood macroscopic and microscopic irregular structure of the complex graphics.

As shown by Fig. 3, the original natural form of the wood structure was used to simplify, hyperbole, generalizations and other practices designed to generate self-similar characteristics, beautiful fractal art patterns. Picture a was designed based on *Pinus sylvestris* macroscopic tangential surface texture and use of its natural texture transform form two nearly symmetric patterns of visual effects. Solid line and space combination in the whole pattern reflects the unity of order, the change in order, balanced movement, two patterned surface similar to the relief as well as the visual form of light sensitive dispersal gives an orderly, harmonious nature aesthetic feeling.



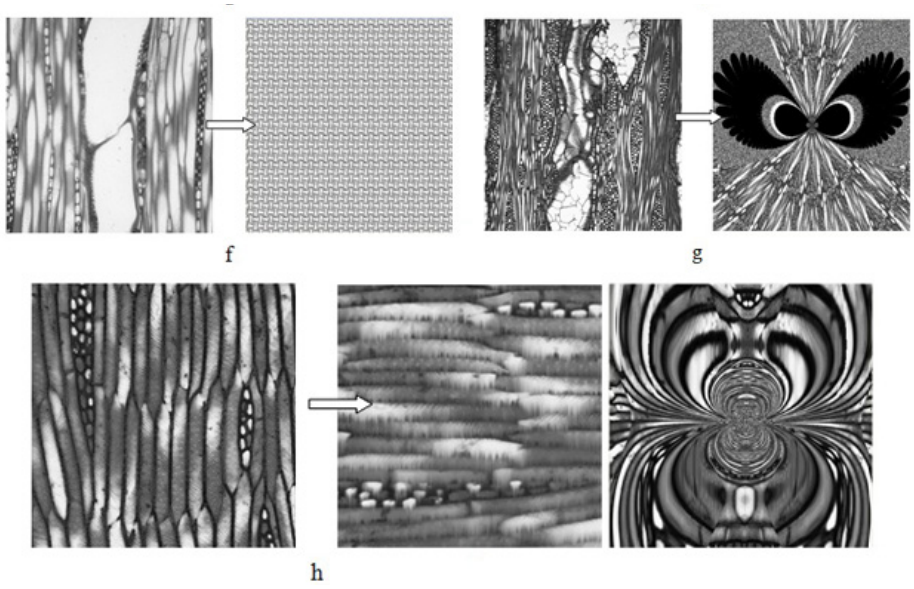


Fig. 3: Fractal pattern artistic expression of wood macro and micro structure, a) macroscopic tangential section of Pinus sylvestris, b) microscopic transverse section of Taxus cuspidata, c) microscopic transverse section of Rhamnus dahuricus, d) microscopic radial section of Larix gmelini, e) microscopic radial section of Robinia pseudoacacia. f) microscopic tangential section of Pterocarya stenoptera, g) microscopic tangential section of Robinia pseudoacacia, h) microscopic tangential section of Maackia amurensis.

As shown by Fig. 3b-h showed fractal pattern design of wood microscopic structure pattern. Combined with mathematical formulas of "Ultra Fractal" software and cells piled characteristics of wood microscopic structure, and design to create different kinds of visual patterns. In the process of design changes was mainly aimed at fractal pattern design like the pore, wood parenchyma, the tyloses in the vessels, wood fiber, wood rays of wood microscopic structure which these people cannot be perceived in reality the natural form, and obtained the patterns of artificial form that they both reflect simplicity, complexity of the pattern order, and also express different aesthetic experience of nature.

As shown by Fig. 3b and c showed fractal pattern design of wood microscopic transverse section structure pattern. Fig. 3b showed fractal pattern design of *Taxus cuspidata* microscopic transverse section pattern which performance juxtaposed arrangement of similar figures of numerous vessel cell, and reflected the irregularity of pattern shape and the local and whole self-similarity. Fig. 3c was fractal pattern design of *Rhamnus dahuricus* microscopic transverse section and use its natural cell graphic elements to transform the design into a fractal art patterns like kaleidoscope shape, and its stack off the type of design add details of gradual change and specific of pattern to fully show the complexity of regeneration and evolution of fractal patterns.

As shown by Fig. 3d and e showed fractal pattern design of wood microscopic radial section structure pattern. Fig. 3d showed fractal design of *Larix gmelini* microscopic radical section structure pattern. The whole pattern contains rules of formal beauty of diverse and unified like symmetry, balance, rhythm, cadence, contrast, harmony. It's simple fractal formula but can show many complex natural features. Fig. 3e showed fractal design of *Robinia pseudoacacia* microscopic

radial section structure pattern, shows symmetry and geometric patterns in self-similar, nestedness, adding to the endless details, giving an abstract and the beauty of the untamed nature.

As shown by Fig. 3f, g and h showed fractal pattern design of wood microscopic tangential structure patterns. Fig. 3f used wood cell tissue to produce patterns of unified and rich, showing the orderly beauty of the orderliness and repetitive, rhythm and cadence, and composition reflected the hierarchical relationship of morphology. Fig. 3g showed fractal design gives the expression of personal feelings, not only a decorative pattern but also an artistic works with a personal thought. Fig. 3h represent respectively to the blurring effect of the snowfield image, and contradictions, abstract visual effect of animal with the two patterns.

This study was the used of fractal properties of the original unit pattern of the wood structure themselves to fractal art designs. Fractal patterns of wood structure showing different artistic effects which were intuitive, realistic, abstract, natural, dynamic. Not only embodied the idea of traditional aesthetics, such as balance, symmetry, harmony, etc., it also combined the idea of mathematics and aesthetics, expressed more beyond the traditional standards of art and design performance.

Therefore, used randomness and naturalness of fractal patterns of wood structure have been successively extended to book design, construction and interior decoration, wallpaper, floor tiles, wall tiles, decorative pattern design, and furniture design and performance of surface texture, decorative painting, vignette, packaging design, fashion design, industrial design etc. Fractal patterns of wood structure set of the art and emotion in one, and constantly gives to the imagination of beauty. So we can evoke positive emotions of the wood structure patterns, causing more interest, but also can affect purchase desire, purchase decision and purchasing behavior of wood products and other commodities.

CONCLUSIONS

Structure patterns of the wood macroscopic and microscopic cells piled can used the various method of design and create to show the very rich, spirit level and intangible wood culture and aesthetics meaning in human life, and used in different fields to enhanced exchanges realm for human and wood.

Fractal art was a scientific and artistic culture of the interaction. Fractal art of the wood macroscopic and microscopic structure was the comprehensive embodiment of nature, science and art. Fractal had an important impact for wood culture, but also a new form of art and fully explored the visual esthetics of the wood structure.

Aroused by explore the infinite mystery and aesthetics of the fractal, but also for design of wood macroscopic and microscopic structure patterns to increase value-added. Wood structure design in the future, to join the colors extracted from nature, and organic combination of the traditional art. Expression of visual esthetics of wood structure in the form of visual communication, and reflected truth, goodness and beauty in our lives which need study deeply.

ACKNOWLEDGMENT

The study was funded by the National Natural Science Foundation of China (Grant No. 30871967).

REFERENCES

1. Chen, S.S., Keller, J.M., Crownover, R.M., 1990: Shape from fractal geometry. Artificial Intelligence 43(2): 199-218.
2. Keller, J.M., Chen, S.S., Crownover, R.M., 1989: Texture description and segmentation through fractal geometry. Computer Vision Graphics Image Processing 45(2): 150-166.
3. Kumar, B.A., Mishra, J., 1999: Enhancing the beauty of fractals. In: Computational Intelligence and Multimedia Applications, 1999. ICCIMA '99. Proceedings. Third International Conference on. Pp 454-458.
4. Qin, Y.C., Liu, K., 2003: Advancement of applied studies of fractal theory in geography. Progress In: Geography 22(4): 426-436 (in Chinese).
5. Qin, X.J., 2007: Fractal art. Journal of Jinlin College of the Arts (Journal of China) (5): 3-12 (in Chinese).
6. Song, S.S., Zhao, G.J., 2010: Fractal research progress and application of furniture. Forestry Machinery & Woodworking Equipment (Journal of China) 38(6): 4-6 (in Chinese).
7. Song, S.S., Zhao, G.J., 2011: Fractal characteristics of macroscopic and microscopic cell-piled structure patterns of wood. Journal of Beijing Forestry University 33(4): 102-106 (in Chinese).
8. Zhang, J., Bao, H.S., 1994: Fractal geomorphology: Review and prospect. Geographical Research 13(3): 104-112 (in Chinese).
9. Zhao, G.J., 1997: Fluctuation spectrum of wood structure and creature physical rhythm. Wood Industry 11(6): 22-25 (in Chinese).
10. Zorpette, G., 1988: Fractals: Not just another pretty picture. Spectrum IEEE 25(10): 29-31.

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