



# Mapping Research on 1931 Chromaticity Diagram and Fengshui Five Elements Theory

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**Abstract.** The combination of Feng shui and lighting can create a yin and yang balanced light space, which will become the trend of lighting design in the new era. The suitable lighting environment is beneficial to the physical and mental health of the occupants. By collating and analyzing the theoretical system of Feng Shui, this paper maps the 1931 chromaticity diagram and the five elements, and then selects the appropriate light source to adjust the energy of the human body and the surrounding environment. The combination of traditional Chinese martial arts and modern lighting is a new kind of interdisciplinary research, which is of great significance for the harmonious between human and light.

**Keywords:** Fengshui · 1931 chromaticity diagram · Five elements theory · Lighting environment · Mapping model

## 1 Introduction

With the rapid development of science and technology in the 21st century, the needs to life are arisen, which manifested in various fields such as clothing, food, housing, and transportation [1]. The lighting affects the comfort of the living to a certain extent. To make the lighting and people better integrate is an eternal topic, and it is a complicated and long-term work [2]. Feng Shui is a theory that studies the microscopic substances (air, water and soil) and the macro environment (the universe) [1]. The core purpose is to live in harmony with nature [3]. This study explores the corresponding relationship between Feng Shui and colorimetry, deduces and analyzes the model, and extends it to indoor and outdoor light environments. This is a new application direction that realizes the integration of human and light.

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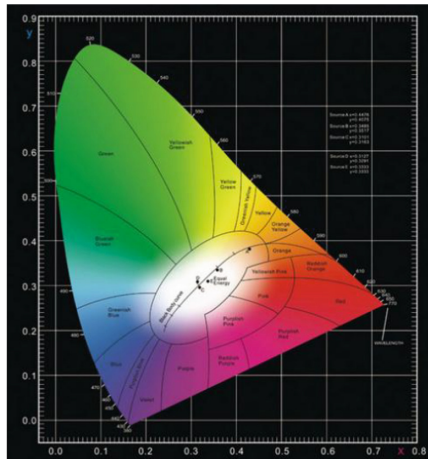
Supported by Science Foundation for Goldlamp Co., Ltd (2017-228195).

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J. Jin et al. (Eds.): GreeNets 2019, LNICST 282, pp. 267–275, 2019.  
[https://doi.org/10.1007/978-3-030-21730-3\\_27](https://doi.org/10.1007/978-3-030-21730-3_27)

## 2 Research Assumption

The functional expression  $v = f(u)$  of the Planckian locus represented in Chromatic coordinates as a chromaticity diagram [4]. In the chromaticity diagram, each color occupies a certain position, and the coordinates of the color are composed of the proportional coefficients R, G, and B, and the X-axis chromaticity coordinates in the chromaticity coordinates are equivalent to the ratio of the red primary color. The Y-axis chromaticity coordinate corresponds to the ratio of the green base color, and the Z coordinate axis can be calculated by  $X + Y + Z = 1$  [5].

The study used the 1931 chromaticity diagram of 2 degree field of view angle (as shown in Fig. 1). In the trajectory and surrounding of the Planckian locus, CIE artificially defined the A, B, C, D, E five characteristic points which representing five standard light sources. In these five points, the E point is a coordinate point of the white light spot, is a mixture of three primary colors of light and the same stimulating light energy, the corresponding color temperature is 5400 K, and point A is the chromaticity coordinate point of the standard illuminator A, the CCT (color temperature) is 2856 K; point B, which next to the Planckian locus, is the chromaticity coordinate point of the standard illuminator B, the CCT is 4874 K; which is similar to the noon sunshine; the point C that belows the Planckian locus is the chromaticity coordinate of standard illuminator C, the light color is similar to the daylight of the cloudy sky, CCT = 6774 K; and D is the chromaticity coordinate point of the standard illuminator D65, called recombination daylight, the CCT is 6504 K [6].



**Fig. 1.** CIE1931 chromaticity diagram

### 3 Set up the Mapping Model

In terms of the connection between Colorimetry and Feng Shui, the ancients established a five-color system as early as 2500 years ago, which is the earliest color system in the history of the world. The system is earlier than the Western in that age. In the Han Dynasty, the yin and yang five elements of the theory was prevailed. The theory showed that the color also has the attributes of yin and yang, black and blue belong to water, cyan and green belong to wood, red and purple belong to fire, yellow and brown belong to earth [7]. So, water represent black, metal represent white, fire represent red, wood represent green, earth represent yellow. In Feng Shui, metal, wood, water, fire, and earth are five components of the Five Elements. In the process of seeking the same point between lighting and Feng Shui, color and five elements are used as point of penetration for research.

In the process of searching the center point of the chromaticity map, the standard points A, B, C, D and E are respectively selected to establish the coordinate origin. Firstly, the CIE chromaticity map is established by MATLAB. By inputting the coordinates of 380–780 nm which form the edge of the tongue graph of the chromaticity map, then set up the coordinates on MATLAB. The MATLAB programming are used to select the suitable points in chromaticity diagram for the construction of coordinate system. For example, the point with wavelength 450 nm is set as M point, and the slope  $k_1, k_2, k_3, k_4, k_5$  of the point with standard point A, B, C, D and E are calculated respectively. Secondly,  $1/k$  can be used to calculate the corresponding vertical line. Then determine whether the line that M point located and the line perpendicular to it are located at the demarcation point of the color in chromaticity diagram. If so, keep it. If not, discard the result. The keep calculating until the most suitable point is found. The calculation results show that if the point with 492 nm wavelength is set as S point (0.0454, 0.2950) [8], and the slope of the line connecting S point with equal energy white light E point (0.333, 0.333) is  $k_1$ , then the slope of the line SE ( $k_1$ ) is  $-0.314$ ; and the point with wavelength of 565 nm is set as P point (0.4087, 0.5896), the slope of the connection between point P and point E, which is the equivalent mixing of white light, is  $k_2$ , and the slope of the line PE ( $k_2$ ) is 3.390; multiplying  $k_1$  and  $k_2$ ,  $k_1$  multiplying  $k_2$  is  $-1.06$ , which means that the two lines nearly vertically, and the most important is that these two lines also located on the color boundary, so that the line segment connecting 490 nm and point E and the line segment connecting 565 nm to point E were set as a new coordinate system, as shown in Fig. 2.

After consulting plenty of literature and analyzing the relevant data, 560 nm is the dividing line between yellow-green and yellow, and 492 nm is the dividing line between blue and blue-green, which is the boundary between water and wood. Therefore, as shown in Fig. 2, the and point S and point P are the boundary points of these two colors, and the point at the 610 nm where the SE extension line intersects the chromaticity diagram, is the boundary line of orange and red, which is the dividing line of earth and fire.

After finding the corresponding wavelength that divide the chromaticity and white with the five rows of wood, water, fire, earth and metal, and place the metal in the central part of the chromaticity diagram, and the chromaticity diagram is based on the

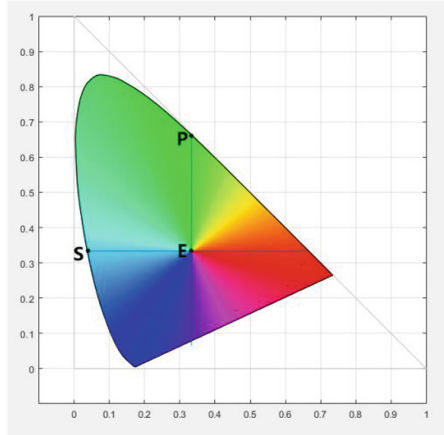


Fig. 2. New coordinate system established on the chromaticity diagram (Color figure online)

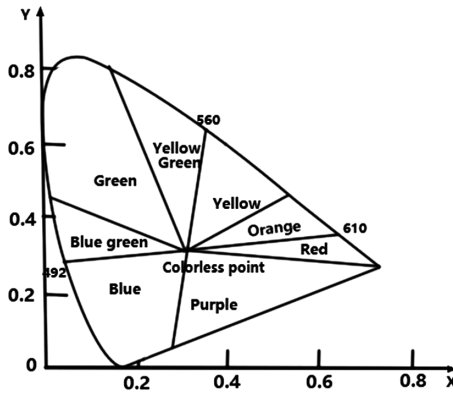


Fig. 3. Chromaticity diagram color block diagram

chromaticity coordinate of point E, and the color is broadly divided into five regions, as shown in Fig. 3, Dividing the chromaticity diagram into five color regions by coloring the same color in the human eye, which are green, blue, red, yellow, and white. It is found that the five elements and five colors can be matched on the chromaticity diagram. It is to say, each color area in the chromaticity diagram has its corresponding five element attribute, and not only the relationship between the five element but also the corresponding colors can also be used. There is a principle of mutual phase, and this theory is intuitively organized into a model map, that is a mapping model of Feng Shui five elements and chromaticity diagram, as shown in Fig. 4.

By analyzing this theory in a more intuitive way, The chromaticity diagram is expanded into a number of all the spectral colors with the same abscissa from 380 nm to 780 nm, and the properties of each wavelength range are marked on the number axis, as shown in Fig. 5.

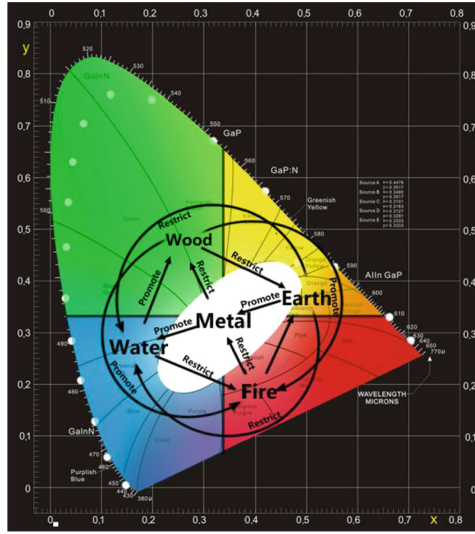


Fig. 4. Mapping model of five lines and chromaticity diagram (Color figure online)

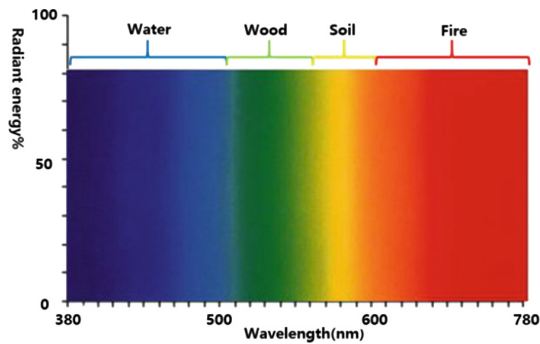
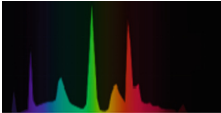
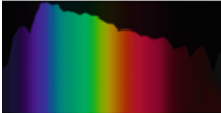
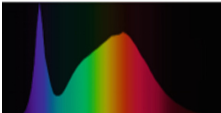
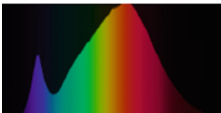
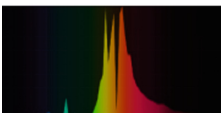


Fig. 5. Corresponding map between the visible bands and the five elements (Color figure online)

### 4 Set up the Mapping Model

The speculations on the principles of light Feng shui can be applied to indoor and outdoor houses to compensate for the housing owner’s fortune or compensate for the lack of a certain line. For example, if a house lacks wood, then we can use the principle of water promote wood [9], to make up for the vacancy of wood energy by increasing the energy of the water in the house. We can choose lamps with higher wavelengths in the spectrum from 450 nm to 500 nm, such as LED lights and so on. Through placing a lamp that can increase energy in a suitable position in the room to compensate for the defects and maintain the balance of the energy field in the room [10], as shown in Table 1.

**Table 1.** Correspondence table of five elements

Five Elements attribute	Color	Wavelength range	Spectral type	light source
Metal	White	380-780nm		Sun light, D65 light source
Wood	Green	492-554nm		Fluorescent lamp
Water	Blue	380-491nm		LED lamps with a color temperature of 4000k
Fire	Red	611-770nm		Low color temperature LED light
Earth	Yellow	555-610nm		Sodium lamp

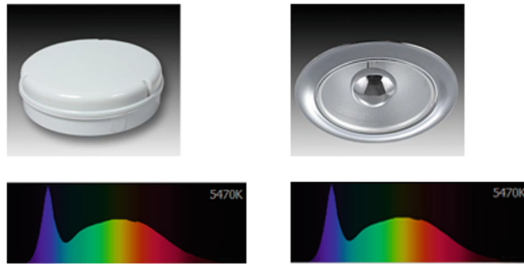
## 5 Example Description

Because the orientation, location, furniture placement and other factors of the house that may have certain impact on the energy field, which due to the lack of energy in a certain space, the energy should be investigated conscientiously. Taking a living room that lack water energy in a house as an example, we create an indoor model and use the light to supplement the energy field. The model of Fig. 6 is based on the lighting design software Dialux Evo.

It is very important to consider the energy of living room, because it is one of the most significant place in our daily life. It is also an important place to meet guests and friends. The feng shui of the living room is related to the fortune of the family. Due to the lack of water energy of this case and according to the correspondence of five elements in Table 1, by using the lamps with higher water energy, the energy field can



**Fig. 6.** Day view of the living room



**Fig. 7.** Selection of room lamps

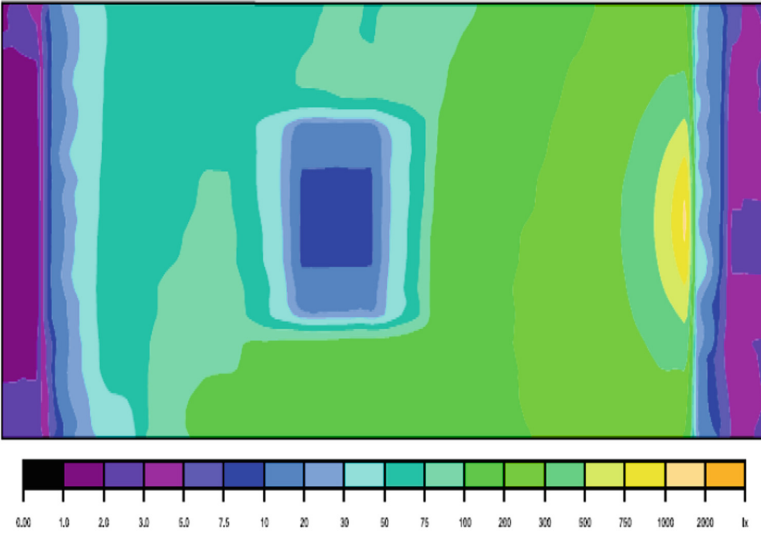
be adjusted. Therefore, in terms of lamps, select the LED light that spectral peak between 400 and 450 nm can supplement the energy field, as shown in Fig. 7.

The lighting simulation is based on the Dialux evo. Figure 8 shows the simulated night view of the living room. In Dialux evo, the pseudo-color map can also be exported, as shown in Fig. 9.

In the case above, by simulate a space which lack of some energy, in order to reflect the practical application of the mapping model of the five elements and the chromaticity diagram. The corresponding light source is used to supplement the missing energy field of the environment. However, is also need to be adjust according to actual condition.



Fig. 8. Night view of the living room



比例: 1:25

Fig. 9. Pseudo-color map of meeting room (Color figure online)



## 6 Conclusion

This study combines the five elements of Fengshui with modern chromaticity diagram theory. By searching for the relationship between these two subject, the five attributes of metal, wood, water, fire and earth and five colors of white, green, blue, red and yellow are mapped. In combination, a mapping model of five elements and chromaticity diagrams can be obtained. This model can be extended to the luminaire products, and the energy of the source spectrum itself can be used to adjust the energy field of indoor and outdoor houses, which is beneficial to the harmony of people and lighting. It is a potential and new application direction. This research is aimed at the exploration between two different subject areas. Therefore, there are still some limitations in mapping analysis and model building, and will continue to expand and improve in the future work.

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