Application research of form bionics in industrial design Based on Grasshopper

Yanping Liu¹, Jing Xie²,*

¹Gongqing College of Nanchang University, Jiujiang City, Jiangxi Province, China, 332020
²Gongqing College of Nanchang University, Jiujiang City, Jiangxi Province, China, 332020

*Corresponding author e-mail: liuyanping@ncu.edu.cn

Abstract. With the development of The Times, the traditional industrial design has been unable to meet the needs of industrial development. In industrial design, the biomimetic technology of Grasshopper can improve the quality of industrial design. In this paper, the current situation and deficiencies of China's industrial design as well as corresponding strategies are firstly explained, and the morphological bionic design platform and design application analysis of Grasshopper are explored for readers' reference.

Keywords: Grasshopper Morphology, Industrial Design, Visual Programming, Parametric Design

1. Introduction
Nature will bring inspiration to people's design creation and improve the quality of design products. With the continuous development of computer technology, various parametric design concepts have been used in industrial design to break the deficiencies of traditional industrial design and provide industrial designers with more inspiration. Therefore, industrial design should make full use of Grasshopper parameter tools.

2. Current situation and deficiencies of China's industrial design

2.1. Current situation of Industrial design in China
The major of industrial design has a long history abroad. "The history of human design activities can be generally divided into three stages: the embryonic stage of design, the stage of handicraft design and the stage of industrial design. With the rise of the industrial revolution, human beings began to produce various products in large quantities with machines, and design activities entered a new stage of industrial design. After the Industrial Revolution came the development of machine production, division of labor and commerce, as well as major social and cultural changes that had a profound impact on subsequent industrial design. “In the three hundred years of world economic modernization, China has lost three good opportunities of economic modernization. China is a latecomer to economic..."
modernization. It started later than others, and the loss of major opportunities has made economic modernization more difficult. Although there are no fundamental differences in the basic structure and functions of graders at home and abroad, the technology level of China's grader industry lags behind that of foreign developed countries due to its late start and slow technological development. At present, the technology of China's grader products mainly comes from foreign countries, and most enterprises do not have their own core technology and proprietary technology, and the digestion and absorption of imported foreign technology is only to realize partial localization. In recent years, the development of general integration, analog design or transplant of foreign mature technology, through the secondary development of the design of products, most of the enterprise's scientific and technological innovation ability is insufficient.

2.2. Deficiencies in China's industrial design

The impact of the long-term planned economy and the financial storm in Southeast Asia has made China's economy never get out of the trough since the overheating state cooled down a few years ago. At the same time, as some fundamental and deep-seated problems in China's economic development have not yet been solved, such a state of wandering in the trough will not be able to be changed in a short time. Therefore, a series of problems affecting the further development of commodity economy, such as the growth of enterprise economy and the increase of national average income, and thus related to the growth of industrial design, will continue to exist. All of this will limit the need for enterprise product development and design. The influence of the public's consumption concept and the penetration rate of industrial design is also very important. The correct consumption concept of the public and the widespread popularization of industrial design are the "soil" for cultivating good industrial design. Due to the deviation of Chinese people's consumption concept and the low and surprising penetration rate of industrial design, the "soil" of China is very poor. Quite a few Entrepreneurs in China have insufficient understanding of the value of product design. They tend to value the role of technology, management and advertising, and are willing to invest in these aspects rather than offer reasonable prices for the entrusted design of products. The problem of cheap design has seriously restricted the development of Chinese product design industry. In the international market, Chinese design does not really participate in, and our domestic design is constantly copying, copying and copying, over the years of "introduction, digestion", in a sense, is a synonym for imitation. We only focus on the marketing of the domestic market and neglect the development of the international market. As a result, in some industries, they are unable to go out of the country and only focus on the immediate interests. This is also a great loss and impact on China's industrial design industry, and there is no better development without innovation.

3. Countermeasures against the lack of innovation ability in the development of industrial design in China

To construct the national strategy of industrial design innovation from the macro level, China must incorporate the industrial design innovation into the national innovation strategy if the industrial design is to get vigorous development in the future. In recent years, countries have begun to support the industrial design industry, only these are not enough, however, because China as a manufacturing power in the future and the future of the world economic and political power, our country also must build founding strategic industrial design as soon as possible, at the same time for the government to give help, industrial design can provide preferential policies to help attract and talents, in the city, such as: Wuxi has built the only state-level industrial design theme park a Wuxi industrial design park, gathered a large number of high-quality industrial design innovation resources. The government encourages the demand of various industries and the innovation results of applied industrial design with various preferential policies. The government can also establish an innovation platform to encourage innovation by design groups, so as to improve the competitiveness of the manufacturing industry.
3.1. Carry out Chinese traditional culture innovation in design
Specific methods of cultural application in design can be divided into three categories:
(1) Traditional cultural modeling can be used in the shape of industrial design products, such as Chinese oracle bone inscriptions;
(2) In the material of the product, we can use Chinese native materials, such as bamboo.
(3) In the color matching, the iconic Chinese red can be used on some industrial products (FIG. 1 integrates the design of Chinese red elements).

![Figure 1](journal.png)

**Figure 1.** Design incorporating Chinese red elements.

The application of national culture in product design should not only be reflected in the appearance, but also reflect the unique thoughts of China, which can be broadly divided into Confucianism and Taoism. Thought is the soul of design and guide’s design. The well-known Japanese brand Muja has created an Oriental flavor and embodies the Japanese national culture.

3.2. Strengthen the training of innovative talents
The development of an industry depends on education. In the 1980s, only 20 colleges and universities offered the subject of industrial design. In 2014, nearly 200 colleges and universities offered the subject of industrial design, which shows that the subject of industrial design has been popularized in colleges and universities. In the information age, industrial design education should not only train students from the perspective of their major, but also guide students in a number of cross subjects. To develop students’ knowledge in science, art and humanities on the basis of solid professional foundation, and to enable students to have a comprehensive and inclusive understanding of multiple disciplines is the foundation for cultivating excellent industrial design talents to realize innovation. In addition, colleges and universities can try to develop and establish a project innovation base, and make use of part of the course time, teachers will lead students to the base for product design and operation practice. Through such learning, students can combine theory and practice to understand product design and directly apply the innovative theories to practice. On the one hand, they can learn the innovative knowledge system of industrial design theories mentioned by the teacher in class; on the other hand, they can carry out operational exercises in the base. Such a teaching system will be more conducive to the cultivation of students’ innovative thinking, so the innovation enthusiasm of college students should be improved.

4. Analysis on the bionic design platform of grasshopper and its design and application in the industrial field

4.1. Brief introduction of the biomimetic design platform of Grasshopper
Parametric design refers to the use of parametric design to describe the relatively complex geometric relations by controlling the design given by the designer. In essence, it is a kind of geometric function constraint relationship. In the process of computer modeling, all design elements are taken as variables of a function, related variables are linked by designing different function algorithms, and the model
can be automatically generated or changed by defining parameters. Parametric design is widely used in industrial design. Parametric software platform mainly includes three kinds of software data visualization software. Manufacturing data, shape and structure analysis software modeling software and its corresponding programming language.

Grasshopper is the Rhino visual programming platform run plug-in, by means of program development will different algorithms modularization, by modeling the logical combination of different battery components, to generate a different model, battery classified according to different functions, each battery module corresponding to different input (input) and output (output), the related data input unit when modeling calculation, The input values, namely the parameters of the model, are tunable and more efficient than conventional modeling when processing multiple model data at the same time.

4.2. Design application of visual programming parameters in the industrial field

4.2.1. Application in the field of construction design
Parameterized design of mathematical geometric constraints represented by Creo, Slidworks, UG and other software is widely used in industrial manufacturing. However, the application and recognition of Grasshopper parametric design represented by visual programming in the field of manufacturing design is not as wide as the application of geometric constraint parametric design in the field of construction design. The existing applications of parametric design in the field of manufacturing design at home and abroad mainly include automobile intake grille design, apparel, shoes and caps design, public seats and lamps design, etc. (FIG. 2 lighting design based on visual programming parameters).

![Figure 2. Lighting design based on visual programming parameters.](image)

5. Conclusion
To sum up, in order to improve the quality of industrial design, it is necessary to strengthen the training of design talents. In addition, by constructing Grasshopper's biomimetic design platform in industrial design, related variables can be correlated with different functional algorithms to generate a new model design method, which promotes the development of industrial design.

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