Article

Research on the Application of Morphological Bionics in Clothing Design

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Abstract: ***Background:*** With the development and changes in the society, along with the emergence of environmental and ecological issues, people begin to think about the relationship between man and nature. Designers draw inspiration from the innate wisdom of nature, absorb the beauty and striking impact of natural biomorphisms, while excavating the distinctive characteristics of organisms in terms of form, color, texture and pattern. ***Purpose :*** This paper explores the integration of morphology bionics with garment design to create more vibrant designs that align with consumer's desire to incorporate elements of nature into their clothing for comfort. It examines the characteristics of biomorphic forms, design language, and expression, and outlines the methods for applying these principles to garment design. ***Methods:*** Using the literature research method, case study method, literature and picture analysis method, and inductive summary method, we summarize the expression of morpho-mimicry in apparel design by sorting out the theory of morpho-mimicry and apparel design and analyzing the brand show releases that are inspired by morpho-mimicry. ***Results:*** Natural life forms are an inexhaustible source of design innovation. Based on the diversity of life forms in nature for clothing design open up more ideas, to promote the harmonious development between man and nature, the development of the clothing industry has a certain role in promoting, and at the same time demand people to protect the earth's ecological environment. ***Conclusion:*** Because of its flexible design and mobility, the integration of morphology bionic and clothing, can vividly reflect the biological forms in nature, so giving the clothing the meaning of natural life and aesthetic characteristics, and at the same time help to promote the harmonious symbiotic relationship between man and nature. Combining biomimicry with clothes provides more options and a new design space and orientation for the innovation and development of clothing design.

Keywords: Morphological; Morphological bionics; Clothing design; Design application; Naturally

1. Introduction

1.1 Research Background

Since 2024, textile enterprises have resumed production in an organized manner. Demand gradually recovered in the domestic and foreign markets, and the national transfer mode was adjusted to change the structure, improve quality, increase efficiency, and provide other policy guidance. Industry supply and demand steadily recovered, confidence development consolidated, and the stability of economic operation, coordination, and internal dynamics strengthened. Starting well in the first quarter, the textile industry production, exports, efficiency, and other major operational indicators would help to achieve growth and economic operation. Looking ahead to the whole year, the textile industry is facing an ongoing complicated development of the situation. Still under many challenges, accelerating the consolidation of hundreds of stable and good foundations and the ongoing promotion of the development of high-quality products is

under progress (China Textile Federation Industrial Economics Research Institute, 2024). With the development of society and the occurrence of social events related to nature, people pay more and more attention to drawing reference inspiration from nature, converted into a design language used in clothing design, exploring the proposition of the relationship between man and nature, morphology biomimicry design has gradually become a trend in the fashion industry. Wearing garments with nature's bionic elements on the body enables people to connect with nature and have a sense of psychological comfort and belonging. Combining biomimicry with clothing not only satisfies people's pursuit of natural art but also stimulates the design process and offers rich ideas for clothing design. The use of morpho-bionic design art creation techniques in clothing explores the clothing embodiment of morpho-bionic vividness and dynamism to meet the consumer's aesthetics preferences, the pursuit of natural beauty and individuality, and also for the development of clothing to provide more innovation, enriching the design and creativity.

1.2 Research Purpose

This paper aims to explore the various forms of morpho-bionic expression in clothing to promote the development of the clothing industry. It starts by examining the concept of morpho-bionic and its application in clothing design. The paper then elaborates on the conceptual principles of morpho-bionic and biomimetic design and analyzes how they can be integrated into clothing. Furthermore, it analyzes the characteristics, significance, and value of morpho-bionic design in clothing. Based on the literature and case studies the paper summarizes the design methods and concludes that these methods can promote innovation in China's clothing industry and enhance clothing design. Morpho-mimicry is an innovative, interesting, and vivid approach, that combines the morphology of elements in nature. It involves extracting the morphology of nature from the perspective of aesthetics and based on artistic design methods, opening up design ideas for the application of morpho-mimicry design in apparel. Biological and material structures in nature have the potential to produce functional innovations and breakthroughs in clothing. These innovations aim to provide the wearer with a sense of relaxation and psychological healing, while also bridging the gap between man and nature at the same time, to promote a harmonious symbiotic relationship between man and nature. Beauty and artistic expression are important elements in aesthetics. The art symbols in this context represent a dynamic and natural beauty, incorporating a bionic morphology perspective to meet the demands for fashionable, commercial, and innovative clothing.

1.3 Research Content

This paper analyzes the classification, artistic characteristics, and aesthetic implications of morpho-mimicry from a research perspective. It also studies how the design language is expressed in clothes. Through the specific performance of morphological bionics in fashion shows, the presentation of morphological bionics in clothing is analyzed, and the design methods and application methods of morphological bionics in clothing are summarized. Morpho-bionic design is a modern emerging design method that provides rich materials and inspiration for clothing design and also expresses the close correlation between nature and clothing. Combining theoretical research with practical research provides a solid foundation and favorable guidance for the bionic design of clothing.Under the theoretical guidance of design method and application way, it combines with the background of the present era to satisfy the consumers' demand for innovative shape, appearance, and color of clothing as well as the aesthetic requirement of displaying their own personality (Li,2021).

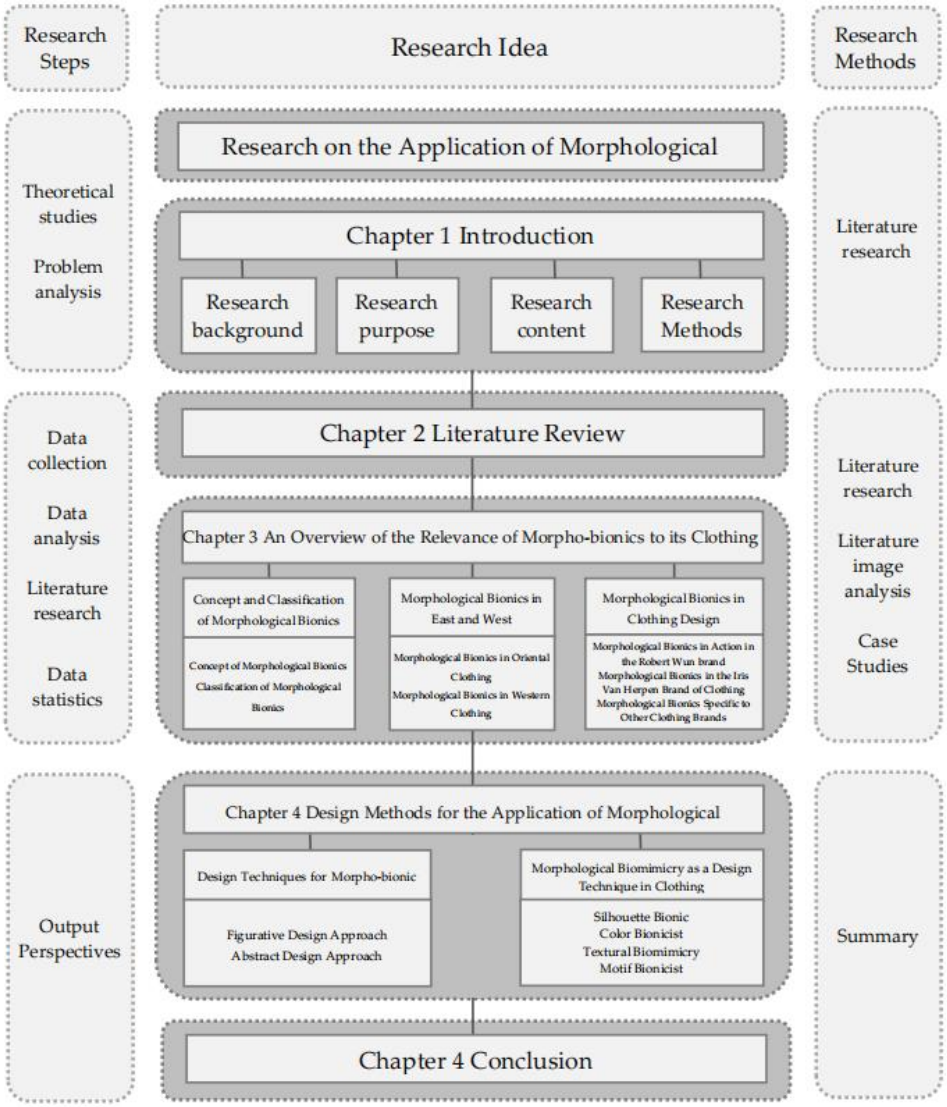

Figure 1: Frame diagram

1.4 Research Methods

The literature research method is used to analyze and summarize the concept of morphology, the design method of morpho-bionic, and its application in clothing. We adopt the technique of document picture analysis to examine the process of extracting bionic elements from natural forms in a logical manner, based on visual perspectives. The case study method is used to analyze the expression of biomimicry in clothing design with actual cases from domestic and international shows. The contents are analyzed and sorted out adopting the induction and summary method then the design application method of morpho-bionic in apparel is extracted.

Table 1: Research Methods

Research Methods	Specific Research Methods
Literature research method	A comprehensive review of both domestic and foreign literature has been conducted related to the subject for specific research on the theory, design method, and aesthetic implication of morpho-mimicry. Through the literature study, we can grasp the relevant concepts of morpho-mimicry, analyze and generalize its application in clothing. Furthermore, we summarize the various design methods and applications ultimately providing solid theoretical support for this research.

Picture analysis method	We looked at images of representative natural forms and analyzed how they could be extracted and presented in garments using biomimetic design techniques.
Case study method	Collection and collation of design applications of Morpho-mimicry, examples of the application of Morpho-mimicry in knitted garments, including analysis of cases in fashion shows, and analysis of application methods and design techniques of garment works, to summarize the design language of Morpho-mimicry in garments.
Induction and summary method	Summarize the application method and performance characteristics of morpho-bionic design in apparel, including specific examples from apparel brand shows. Additionally summarize the design cases that incorporate morpho-bionic elements, and on the basis of this, summarize and refine the design method.

2. Literature Review

The papers and journals in China Knowledge Network include research on bionic and clothing however, there is limited research on morphology bionic and clothing. This indicates that further in-depth research into this topic is significant. Bionic design is a popular discipline in the middle of the 20th century, which explores the artistic characteristics and aesthetic meaning of biomorphic forms on the basis of the beauty of the natural world. Morphological bionic design is a branch of bionic design, which is an emerging design technique in the development of modern clothing (Chen, 2021).

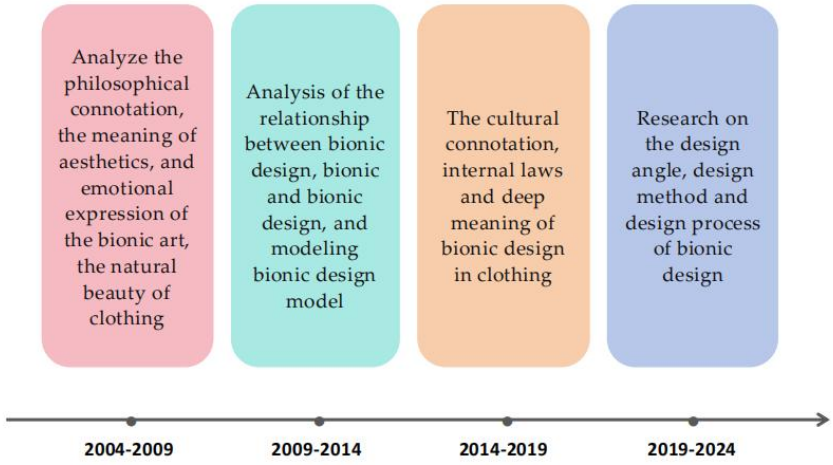

Figure 2: Literature review collation

Analyzing the concept of form, there is a standard interpretation of the word form in dictionaries, The word "form" in Chinese has the following explanations in the dictionary: ①Shape and demeanor. It also refers to the way things appear under certain conditions. ②The change of form of a word (Xia, 2010). For the formation of the art and design disciplines, the word "form" is also included, and is more often than not given to the concepts of shape and modeling (Wu, 2008). Lee analyzes the term "morphology" and explains that "morphology" has two levels of meaning: "shape" and "form"(Li, 2019). Zuo introduced the philosophical concept of form, and the value and significance of form are particularly prominent in the field of art and design (Zuo, 2021). Research and analysis from the perspective of bionic design, tracing the origin and development of bionic design, and analyzing the classification of bionic design and its characteristics (Xu, 2016). Cai examines the relationship between bionics and bionic design within the historical context. The study also reviews the elements and characteristics of the bionic design (Cai, 2013). Bionic design is a design method that incorporates the principles of bionics in the design process (Sun, 2010). Systematically introduces and expounds the evolution of the connotation of bionics, the basic theories of bionics, the basic principles, and the main methods and techniques from a macro perspective, and puts forward the viewpoints that living things are the teachers of human beings, human beings are the spirits of all living things, and human beings must learn from living things (Ren, 2016). Analyzing the philosophical significance of bionic design in clothing, Cui points out the

philosophical and aesthetic connotations of the bionic art of clothing, as well as the formal expression of bionic design in clothing (Cui, 2005). Guan puts forward the aesthetic naturalism of clothing design art, explaining the natural beauty, of the natural beauty form of clothing in traditional culture, as well as the philosophical connotation and new values of the natural beauty of clothing (Guan, 2008). Xu believes in the use of the bionic design of clothing to meet the expression of human emotional needs, giving life and cultural connotations of clothing, and enhancing the harmony between mankind and the natural world (Xu, 2018). For the research of the morpho-bionic design method, Liu proposed the classification of "prototype, variant, and heterotype" and summarized the extraction method of biological features. It is proposed to use the mind map method to promote the logical correlation between organisms and products so as to form the biomimetic design (Liu, 2020). Morphological biomimicry in product modeling uses the relevant theories of design as the basis of design, cognitive psychology, formal aesthetics, product semantics, and biomimicry design attributes of the four aspects of knowledge integrated into the practice of morphology biomimicry design (Xu, 2016) (Xu, 2019). Luo proposed the design methods of overall bionic design and local bionic design, figurative bionic design, and abstract bionic design, and summarized the value of bionic design on multiple levels (Luo, 2020). Yu proposed that biomimetic design especially emphasizes the cognition related to form, and made a detailed elaboration on the knowledge and cases related to biomorphism. (Yu, 2005). Guo pointed out the pleasantness of morpho-bionic, which can create a sense of intimacy between people and products, and proposed an ideal morpho-bionic design model, a comprehensive model of product morpho-bionic design and a process based on the general methodology of bionic research (Guo, 2012). For the research and analysis of the application of bionic design in clothing, Jiang analyses the principle of language expression of clothing anthropomorphism and bionic design and analyses the inherent rules and deeper meanings of its design dimensions, reorganization of elements, design forms and their social functions (Jiang, 2019). Chen analyzed the characteristics of direct bionics and indirect bionics respectively, and systematically analyzed the specific methods of bionics in modern clothing design to derive the design process of clothing bionics and the systematic and comprehensive application in clothing (Chen, 2022). Chen through imitation, borrowing, artistic reprocessing, and other design means reasonably applied to personalized custom women's clothing design (Chen, 2022). Di focuses on the form and folding of insect wings, and extracts the morphological elements through hand-drawing analysis and tailoring experiments, transforming them into the language of garment design and applying them to the shape and structure of the garments. In the design, the experiment is combined with the various ways of wearing clothes to explore the combination of fashion and function (Di, 2020).

Table 2: Summary of Literature Features

Research Direction	Reference	Trait
The Significance of Nature and Morphological Bionics	"Nature Design" "Reinterpreting Form Bionic Design and its Application in Design Innovation with Multiple Methods"	The impact of nature on fashion, architecture, pattern design, interior design and interiors products. Morpho-Bionic Designer provides a rich bionic database and ample creative resources.
Bionic design approach	"Methodology for product design based on the study of bionics" "Design for Sustainability"	Explore the methodology of bionic design in several stages and detail the techniques and procedures required at each stage, as well as the algorithms that can be applied.
Bionic Applications in Clothing	"Application Research of Bionic Modeling on High Fashion" "Discuss Bionic Design of Modern Fashion"	Explore the application of bionic modeling and its artistry to clothing styling, color and fabrics.

3. An Overview of the Relevance of Morpho-bionics to its Clothing

3.1 Concept and Classification of Morphological Bionics

3.1.1 Concept of Morphological Bionics

Morphological biomimicry is a design approach that imitates the physical form of substances in nature such as their external outline, internal structure, and symbolic meaning (Gao,2023). It is a more intuitive form of design expression, and can be broadly divided into two types: figurative biomimicry, which directly replicates the form of living organisms; and abstract biomimicry, which abstracts the most distinctive features of biological forms to create a representation (Sun,2022). This design method aims to create a tangible resemblance to the object being mimicked. Biomimetic form design is the main content of biomimetic design, it involves designers studying the external forms of natural organisms such as animals, plants, microorganisms, human beings, and using this knowledge to inform the artistic process of designing objects. The goal is to create designs that evoke associations with nature and fulfill people ' s emotional need to reconnect with the natural world.

3.1.2 Classification of Morphological Bionics

There are many different kinds of life forms in nature, and each form has a different way of motion expression. Morpho-mimicry can be analyzed from different perspectives and can be classified in different ways, including the classification of animal and plant species, the classification of organisms according to their movement, the classification of the whole or part of the biomimetic elements in the selection of biomorphic forms, as well as the classification of the biomimetic prototypes as figurative or abstract biomimicry.

Table 3: Classification of morphological bionic

Classification Method	Concrete Content
By type of organism	Animal bionics; plant bionics; insect bionics; human bionics and microbial bionics
Dynamics by mimicry organisms	Dynamic bionics and static bionics
Integrity by imitation	Integral bionics and local bionics
According to the degree of realism of the imitation	Figurative bionics and abstract bionics

3.2 Morphological Bionics in Eastern and Western Clothing

3.2.1 Morphological Bionics in Oriental Clothing

Since ancient times, the life forms in nature have been the most dynamic and artistic source of clothing creation. Nature covers a diverse and astonishing array of life forms, and the biomimetic design method has been formed by studying the characteristics of living creatures and imitating, metaphorizing, and associating them with ecological phenomena (Zhang,2008). The application of biomimetic design in clothing has also originated from this approach.

The bionic of ancient Chinese clothing expresses certain design semantics and has a strong sense of artistic beauty. The twelve chapters of the ancient Chinese pattern are the symbol pattern of the emperor and nobles' ceremonial clothing, taking the elements in the natural world and applying them to the clothing in a figurative way. The phoenix-tailed skirt of the Qing Dynasty was made of colorful strips of cloth attached to the waist, with the end of the strips cut into sharp corners, resembling the tail of a phoenix and so named, and draped in satin, with gold threads and bird and flower motifs as a backdrop. Ming Dynasty women's popular clothing Shui Tian clothes, is a colorful piece of brocade material patchwork sewing made of clothing because the whole piece of clothing fabric colors are intertwined with each other, the shape of the South as a paddy field. In a poem by Wang Wei of the Tang Dynasty, there is a

description of "Begging for food from Xiangji and tailoring clothes from Shuitian", which explains the origin of the bionic shape of Shuitian clothes. The pleated skirt of the Ming and Qing dynasties refers to the skirt composed of many fine, vertical folds, and when a woman walks, the skirt changes its form as if it were a cascade of fish scales. The robes of the Qing Dynasty included more slits, these slit robes are said to be "arrow clothes", because the cuffs are equipped with cloth arrows, in order to shoot arrows while on horseback. Furthermore, the sleeves were designed in the shape of a horse's hoof, hence are called "horseshoe sleeves" (Yang,1997). Overall, Chinese clothing history has incorporated elements of bionics, which have enriched its artistic culture and equipped ancient Chinese clothing with expressive qualities.

3.2.2 Morphological Bionics in Western Clothing

Clothing design emerged in a large number of design movements and styles spanning from the end of the 19th century to the beginning of the 20th century. The Art Nouveau movement took flora and fauna as the original form of design and drew on their forms and aesthetics. People regarded the modeling of natural creatures as design materials and expressed the modeling of creatures and their changing forms on clothing using techniques such as printing, dyeing, embroidery, patterns, lace patterns, and so on.

For the early Western morpho-bionic garments, there is a greater tendency to vary the outer contours. The leg of mutton sleeve is a sleeve that looks like a leg of mutton and is characterised by a fat shoulder and cuff, and a narrow cuff. It has a pleat at the top of the sleeve cage, and is tapered at the cuff (Jia,2007), with a very European classicist aesthetic. Bow ties have their origins in both ancient Chinese and European history. Bow ties as a design element also have a long history in fashion and jewelry design, for example, Garrard made a set of three bow brooches for Queen Victoria in 1858, showing the popularity of the bow tie among the European aristocracy. In the Spanish period after the middle of the 16th century, the popularity of the Ruff collar, which is a unique decorative collar, the form of its wheel-shaped shape, the side elevation of a figure of eight continuous folds, the outer edge of the mouth part of the use of lace and carving embroidery decorations. The shape is very similar to a peculiar round flower, and the bionic form is especially vivid and obvious. In the West is a very typical form of bionic modeling clothing and in the Western tuxedo, the basic structure of the form of the front body is short, suit collar modeling, the back body long, and the back piece of clothing a swallow-tailed shape with two slits, its form derived from the tail of the swallow, the form applied to the back of the suit in the hemline part of the suit, so it is called the swallow-tailed suit. To sum up, western clothing pays more attention to the overall shape of the form of biomimicry, is more inclined to change the external contour line of the clothing, and pursuit of three-dimensional visual aesthetic effect.

3.3 Morphological Bionics Specific to Clothing Design Branding

China maintains its position as the world’s largest exporter of clothing due to its industrial advantage, strong supply chain resilience, and the ability to overcome challenges such as weak demand and rising costs. The country’s complete industrial chain, adequate supply of raw materials, and well-developed industrial clusters contribute to its leading position in the global clothing export industry. The European Union is the second largest market for clothing exports. The Union consists of 15 developed countries in the textile industry, which ensures a stable supply of export clothing. This shows the significant role of the garment industry in China's economic development.

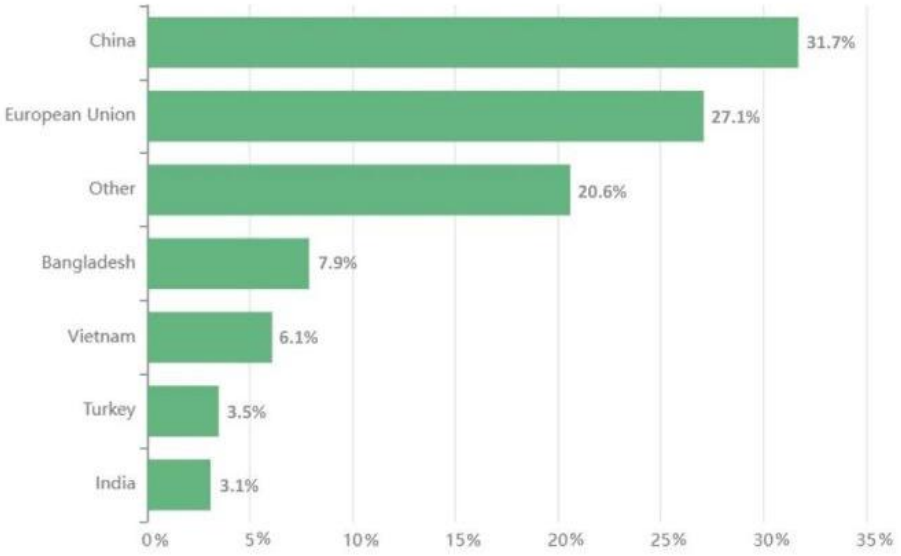

Figure 3: Global Apparel Export Value and Major Countries' Share in 2022
Source: World Trade Organization, Meet Intelligence

As China's supply-side structural reform progresses, the apparel industry has gradually recovered from a challenging period of transformation, and the industry's future development prospects are expected to improve progressively. It can be seen that China's apparel retail merchandise sales are developing in an upward trend, indicating a promising future for the apparel industry.

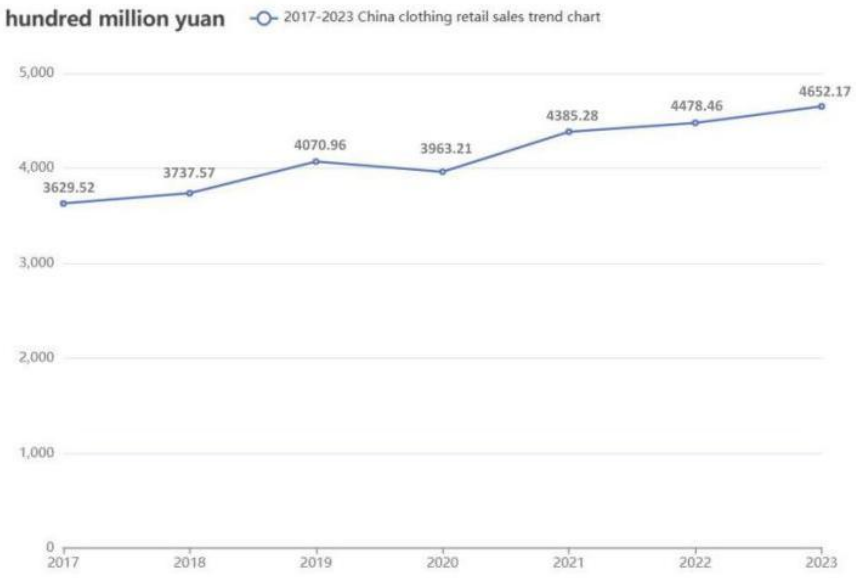

Figure 4: China Apparel Retail Merchandise Sales Trend, 2017-2023
Source: www.askci.com

As the clothing industry shows good trends, an increasing number of clothing designers are creating their own brands and exploring more innovative styles of clothing. Simultaneously there is a growing number of brand shops that are being established. In the last four years, there has been a significant surge in the establishment of physical shops by Chinese designer companies, and even the epidemic has not been able to stop this trend. In 2023, there was a 10% increase in the number of new shops compared to the previous year, while the number of designer brands opening new shops fell by 26%

year-on-year. This shows that Chinese designer brands, after being in the market for more than a decade are now entering a new stage of development. The influence of these brands is becoming more prominent, with some brands gradually gaining wider market recognition. The brands are taking advantage of the opportunity and the business landscape is starting to take shape. The development of the brand extends beyond retail channel amd includes cooperation with the international fashion week stage. This has helped to increase brand awareness and reputation, and even had an impact overseas.

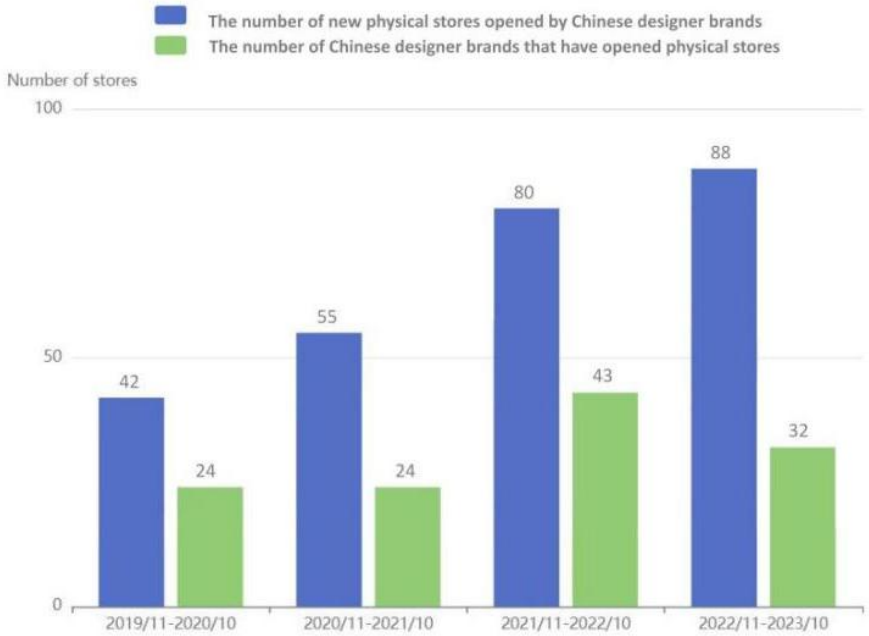

Figure 5: Number of New Physical Stores Opened by Designer Brands in China, 2019-2023
Source: Chinese Designer Brands Database

3.3.1 Morphological Bionics in Action in the Robert Wun brand

Robert Wun, a Hong Kong, China designer in 2021, specializes in the use of bold inspirational transformation techniques. He constantly pushes the boundaries of innovation by sculpting unique clothing silhouettes and intricate details. Additionally, he specializes in the use of a variety of forms to create biomimetic designs for clothing. In the Spring/Summer 2020 "Mulan" series, the designers drew inspiration from plant elements to create the name of Mulan. They use the iconic orchid as a model and incorporate wave elements into the architectural design to create a futuristic and elegant silhouette. The use of three-dimensional tailoring techniques ensured a perfect fit on the human body, enhancing the artistic appeal of the clothing. The Autumn/Winter 2021 collection draws inspiration from the unique U-shaped tail feathers of Chinese swallows. It is specially dedicated to creating a modern and contemporary women's style, giving women's clothing a strong sense of "girl power" through the combination of sculptural silhouettes and futuristic materials. The theme for the Spring/Summer 2023 is “Ready-to-wear collection”. "The Hummingbird's Gesture", featuring wavy pleats and ruffles, inspired by the curves and feathers of birds. The detailed arrangement of feathers given by nature is transformed by the designer into regular pleats, which enhance the sense of futuristic fashion by sculpting three-dimensional layers of waves and stacks of ruffles.

Robert Wun's design philosophy focuses on exploring the contradiction between nature and artificiality, inspired by the curiosity of man and nature. He blends innovative materials with new techniques and the beauty of nature with modern aesthetics. This results in creating sparks of creativity between conflicts and contrasts.

The artist's approach is forward-thinking and innovative, while also respecting traditional values. The artist skilfully combines refined ideas and exquisite craftsmanship, advocating a new, minimalist and bold aesthetic. Through the inspiration gained from the natural world, elements are discovered in figurative things, and elements such as flowers, birds, and armor are applied to the clothing. The power originating from nature gives people a primitive and authentic sensation, hence allowing everyone to derive different interpretations.

Figure 6: Robert Wun 2020AW-2021AW-2023SS

Source: https://www.robertwun.com/aw20 & /aw21 & /ss23

3.3.2 Morphological Bionics in the Iris Van Herpen Brand of Clothing

Iris van Herpen is a Dutch designer who created the eponymous fashion brand named after him in 2007. Iris van Herpen's autumn/winter 2018 collection shows the exploration of the world of the deep sea, with Syntopia as the theme. The collection presents a bizarre underwater world, where the designer skillfully combines biological characteristics with technology, breaking the boundaries of space. Relying on the refractive effect of special materials, it shows the marvelous and changing world of the deep sea. Using 3D printing technology, silk, tulle, polyester film, and other materials are processed in a special form to create a visually striking display of dancing waves and folding cut surfaces. This technique gives the clothes a sense of the flowing motion of seawater. The "Roots of Rebirth" (R) collection for the spring and summer of 2021 is a groundbreaking fashion show that is the first of its kind in the marine world. The Spring/Summer 2021 collection, featured 21 shapes inspired by the roots and spores of plants, showing the intricate entanglement of mycelium and respiratory life, weaving a dialogue between the above and below-ground worlds. As the models walked, the garments formed an animated lace, with the entanglement between each piece resembling the growth of regenerating roots. The collection uses signature 3D printing and kinetic art installations to integrate technology into the structure of the garments. Each look brings a new era of haute couture with a sense of adoration and reverence for nature. The Autumn/Winter 2023 collection is titled "Architectonics" and draws inspiration from the future of floating cities and bionic design concepts. The collection was created by Jacques Rougerie, an architect and oceanographer, who wanted to document the relationship between human life, the realm of the living and nature, and the ocean. The Floating City utilizes bionics to establish self-sustaining ecosystems that thrive both above and below coastal waters.

"Mobility" is the word that best describes Iris van Herpen. A large part of his designs are inspired by nature, with elements such as the cascading lines of fungi, waves of water, and the texture of leaves. These aspects are skilfully integrated into his garments, resulting in visually captivating clothes that possess both dynamism as well

as a lightweight feel. The lightness and texture of the garments create a marvelous interaction between the garments and the human body.

Figure 7: Iris van Herpen 2018AW-2021SS-2021AW

Source: https://www.vogue.com/fashion-shows/fall-2018-couture/iris-van-herpen & /spring-2021-couture/iris-van-herpen & /fall-2023-couture/iris-van-herpen

3.3.3 Morphological Bionics Specific to Other Clothing Brands

Dion Lee's Spring/Summer 2023 collection is themed “Biomimicry”, which is dedicated to a deeper analysis of the relationship between plants and animals. The collection incorporates botanical textures, insect textures, and patterns to form the brand's symbols. By employing bionic design principles humans have established a bridge between the primitive natural world and the modern city. This connection allows for a philosophy of survival that extends beyond individual existence. Different materials interact with one another, creating a dynamic equilibrium in complex and turbulent environments. This collective behavior promotes a harmonious relationship between the human and the natural world, enabling a balanced way of living.

Guo Pei's Autumn/Winter 2020 Haute Couture collection is inspired by the African savannah, using wildlife as the design theme. The collection aims to strip away the urban environment and return to the primitive and vastness of the African savannah. Through haute couture, the collection seeks to intimately interact with the wildlife and explore a return to one’s true self. It aims to preserve the most primitive aspects of life, where everything follows the laws of nature to survive, migrate, and reproduce. The garment is adorned with meticulously crafted animal elements such as zebras, giraffes, and elephants using a combination of embroidery and wool felting. These are skilfully applied to the sleeves, shoulders, and bodies of the garments, so that the garments are bursting with vigor and power, and the rhythms of nature. This artistic composition elegantly pays honor to life, creating a spiritual and extraordinary tribute.

Rahul Mishra's Spring/Summer 2024 Haute Couture collection incorporated animal bionic elements such as dragonflies, butterflies, bees, geckos, and more. The models wore a black circle resembling a large petri dish on which a giant embroidered creature was displayed. The delicate hand embroidery reproduces the intricate forms of the insects, creating a "bionic" aesthetic. The collection is called "Superhero" because the designer believes that these humble creatures are "the good architects of the earth, and we must learn how to live with them and curb the instinct to kill them." The designer wanted to draw attention to how biodiversity is in danger and how reptile and insect species are disappearing through the expression of the collection.

Figure 8: Dion Lee 2023SS & Guo Pei 2020AW & Rahul Mishra 2024SS

Source: https://fashion.ifeng.com/c/8JKC14K3BlM & https://www.sohu.com/a/406823846_559321 & https://www.sohu.com/a/777929057_121124631

4. Design Methods for the Application of Morphological Biomimicry in Clothing

4.1 Design Techniques for Morpho-bionic Elements

4.1.1 Figurative Design Approach

The figurative design method is to express the intuitive morphological characteristics and laws of the bionic object with explicit design language and artistic treatment (Gao,2023). It involves direct imitation or reference to the natural form found in the ecosystem. The purpose of bionic design is to create a pictorial design that reproduces the modeling, coloring, pattern, or clothing of the natural life. The resulting designs are vivid, have an affinity with nature, and strive to maximize authenticity. The designer's emotional attachment to the beautiful things in life is evident in their ability to capture and portray a distinctive image of life. Their design approach is clear and vivid, producing a purely natural sense of beauty that connects with people on an intuitive level. Identify the essential attributes by preserving the characteristics of the biological prototype, simplifying its processing, and extracting the most representative morphological features. The extracted features are artistically processed by applying design principles such as symmetry, balance, rhythm, etc., to enhance their suitability for apparel design.

4.1.2 Abstract Design Approach

The Abstract design method is to take the shape of nature as the source of form design. It emphasizes the extraction of the intrinsic form of the creature's essential properties, from the concrete, image of the form gradually evolved into an artistic, abstract form. This is a kind of bionic design method using association and innovative thinking to complete the design process. It generalizes the characteristics of biological prototypes and reflects the unique nature of things as a whole. Using conceptual design, the aim is to accurately reflect the original unique nature of the bionic prototype. This will result in a "psychological" response from the viewer or wearer leading to personal subjective associations with prototype form. The abstract form of bionic has a high degree of simplicity and generality. Its abstract nature stimulates rich association and inventive interpretations, resulting in interesting and highly artistic characteristics (Jiang,2015). Different degrees of abstraction design techniques are used to express the designer’s intentions for the bionic prototype, including emotions, a sense of beauty, ideological concepts, and other influencing factors. The designs strongly express the

designer's ideological message and have unique symbolic significance, and their modeling can be varied and profound.

4.2 Morphological Biomimicry as a Design Technique in Clothing

4.2.1 Silhouette Bionic

Clothing silhouette refers to the general outline of the external shape of a complete set of clothing, which is one of the crucial elements in clothing design. It not only determines the overall impression of a garment but also has a far-reaching impact on the change of fashion. Clothing silhouettes include A-shape, H-shape, X-shape, T-shape, O-shape, S-shape, V-shape, and Y-shape. The silhouette of clothing is the first element of clothing style modeling. Silhouette biomimicry means that designers observe the external forms of plants and animals in nature, extract their lines, structures, proportions, and other features, and then apply these features to the silhouette design of garments, so as to create garments with both natural beauty and ergonomics. The diverse biological forms in nature provide ample creative space for clothing silhouette, whether it is the shape of trees, fungi, flowers, and plants in plant form, or the shape of jellyfish, giraffes, birds, and other dynamic creatures in animal form, as well as mountains, oceans, lightning and other material forms in nature, all of which can be reasonably applied in silhouette to follow the principle of the Law of Formal Beauty and be designed in the style and modeling of garments. The design of clothing is based on the principle of formal beauty. The progress of science and technology has led to the development of clothing materials and rich clothing processes. As a result, clothing designs have become more diverse and colorful, with designers incorporating the human body curves into three-dimensional spatial transformations. This is achieved through techniques such as three-dimensional printing, three-dimensional sewing, three-dimensional knitting, and auxiliary materials to achieve the silhouette of the three-dimensional expression. The application of silhouette bionics in clothing shows designers' deep understanding and innovative use of the morphological characteristics of the natural world. This design method not only enriches the shape and structure of garments but also brings unique visual identification and aesthetic value to garments.

4.2.2 Color Bionicist

Color gives humans a very important and intuitive perception. Clothing color bionics is a method of applying the colors of nature to clothing design, by studying and imitating the colors and forms of creatures in nature and drawing on their colors to create unique clothing. It not only enriches the visual charm of clothing but also bring people the beauty of nature and harmony. Nature is a world full of vitality and colors, and various creatures and natural landscapes provide endless inspiration for designers, for example, the wings of butterflies, the scales of tropical fish, the petals of flowers, etc. All of these natural elements have unique colors and textures, which can be applied to the design of clothing. Color mimicry can be divided into single-color mimicry, multi-color mimicry, and functional color mimicry. Monochromatic biomimicry is the direct application of natural colors, and designers can extract a single color from a natural object for application. Multi-color biomimicry refers to the harmonious coexistence of multiple colors that can often be seen in nature, such as flowers, butterfly wings, etc. Designers can imitate these natural color combinations and apply them in clothing design to create a colorful visual effect. Functional color mimicry refers to the fact that in the natural world, there are many creatures with protective color functional features, which are usually closely related to their survival strategies. Some animals adapt to the environment by changing their colors as well as avoiding the harm of their natural enemies, so as to better camouflage themselves; while some other plants attract pollinating insects with their bright colors. Therefore, in apparel design, designers observe and record the color and morphological features of living creatures in nature,

analyze the biological functions and adaptability of these features, extract the key color and morphological elements, and reasonably use color-changing fabrics and yarns, as well as special techniques to achieve color bionics. Color bionics brings novel visual effects to garment design, and enhances the aesthetics and attractiveness of garments. By imitating the colors of nature, designers can break the traditional design framework and explore a new design language.

4.2.3 Textural Biomimicry

Texture is a specific physical quality on the surface of an object due to different materials, which can be natural or artificially created. Different textures can stimulate people's tactile and visual perceptions, thus generating different psychological feelings and reactions. Texture biomimicry in garment design refers to a design approach that draws on and simulates the special properties of textures and organizational structures found biological surfaces in nature. It also involve the creation of new fabrics and apparel design through the sense of touch. By simulating the texture of nature, designers are able to develop new designs with innovative functional and aesthetic values. The biodiversity of nature provides rich inspiration for myomimicry. For example, the microstructure of fish scales, the lustre of snake skin, and the delicate texture of butterfly wings are all natural elements with unique textures and tactile sensations that can be applied to the design of apparel fabrics. Texture biomimicry requires designers to first conduct in-depth observation and research on creatures in nature to understand their texture, organizational structure and tactile characteristics. Designers extract the key elements of biological texture and process them artistically in order to incorporate them into fabric design. Then, by experimenting with different fiber materials, weaving methods, and post-processing techniques, they combine the elements of natural texture with fabric design to create fabrics with unique tactile and visual effects. Designers can enhance the wearer’s connection with nature by imitating its texture and tactile qualities in their garments, resulting in visually appealing and artistic clothing.

4.2.4 Motif Bionicist

Pattern bionics refers to observing the forms, textures, or colors of plants, animals, or other living organisms in nature. These natural elements are then used to create patterns and structures that are applied to clothing design using artistic methods. The goal is to create clothing that combines natural beauty with innovative design. The design method of pattern bionic is not only limited to the direct imitation of natural forms but also involves the in-depth analysis and innovative application of the structure, function, and other characteristics of natural patterns. Through observation, the characteristics of natural life forms are extracted, and these characteristics are applied to the design, so as to create patterns that are both beautiful and of artistic value. In clothing design, the application of pattern bionics can increase the visual appeal and artistic value of clothing, for example, by imitating the pattern of animal fur or plant texture to create a unique fabric design. The expression of pattern is a very direct and especially important design element in clothing. It involves extracting elements from patterns found in nature such as animal and plant forms, as well as natural material form, and incorporating them into clothing design. Pattern bionics is widely and diversely applied in the design of both domestic and foreign clothing brands. London designer Giles Deacon is famous for his love of nature, and his design often appears in patterns inspired by plants and animals and other natural elements. The famous British designer Alexander McQueen in his 2010 spring/summer collection "Plato's Atlantis", drew inspiration from the nature of all kinds of insects and reptiles in the skin texture to create a series of strong visual effects of the printed clothing. These designs demonstrate the application of pattern bionics in clothing design. Pattern bionics is a way of incorporating the aesthetics and functionality of nature into clothing, emphasizing the

harmony between design and nature, and creating more sustainable and aesthetically pleasing garments that mimic nature in a captivating and attractive manner.

5. Conclusion

This paper takes "Research on Design Methods of Morpho-mimicry in Clothing" as the selected topic. We study the concept of morphology, the philosophical connotation and method of morpho-mimicry, analyze the feasibility and practical significance of the application of morpho-mimicry in clothing design by combining domestic and international examples of morpho-mimicry in clothing design, and explore the relationship between morphology in nature and clothing. Through the study of theory, the extraction of bionic prototypes and the design method of morpho-bionic in apparel are summarized to provide design thinking and guidance for the application of morpho-bionic in apparel. Clothing is a way of presenting people's psychological needs, reflecting their aesthetic value and the pursuit of personalized clothing. As the saying goes: art comes from life and is higher than life. Nature provides a constant source of inspiration for the design, the use of nature in the form of life elements combined with clothing, follow the laws of formal beauty, enriching the form of expression of clothing, exploring the harmonious symbiosis between man and nature, the relationship between the community of destiny, with a unique aesthetic connotation and value. Let the design present a diversified trend and adapt to the modern market demand.

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