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Research on Leisure Chair Design Based on Morphological Bionics

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Abstract: This paper explores the design of leisure chairs based on morphological biomimicry, aiming to create aesthetically pleasing and functional seating by replicating the forms, structures, and functionalities of natural organisms. The study analyzes the concept of morphological biomimicry and its four application approaches (abstract biomimicry, concrete biomimicry, holistic biomimicry, and partial biomimicry), demonstrating their practical implementation through case studies. Finally, the paper outlines future development directions for morphological biomimicry in leisure chair design.

Keywords: Morphological Bionics; Leisure Chair Design; Morphological Bionics Design.

1. Introduction

With the continuous evolution of modern design concepts, there is growing emphasis on integrating functional utility with aesthetic value in product development. Morphological biomimicry, as an innovative design methodology, provides designers with abundant inspiration by replicating the forms, structures, and functionalities of natural organisms[1]. In the design of lounge chairs, the integration of morphological biomimicry not only significantly enhances the product's visual appeal but also systematically optimizes its functional performance and comfort experience, thereby precisely addressing contemporary consumers' deep-seated aspirations for a high-quality lifestyle. Specifically, by extracting optimal morphological, structural, and textural characteristics from biological organisms and translating them into design languages that conform to ergonomic and aesthetic expectations, this strategy enables lounge chairs to fulfill basic support functions while simultaneously embodying emotional, sustainable, and personalized values.

Accordingly, this paper first traces the theoretical lineage of morphological biomimicry, clarifying the core mechanism of the "morphology – function – meaning" triadic coupling. It then concentrates on the lounge chair as a paradigmatic seating typology, systematically mapping the practical pathways and comparative advantages of morphological biomimicry in form-generation, structural innovation, material iteration, and user-experience optimization. Finally, through a critical selection and analysis of representative domestic and international case studies, the paper reveals the verifiable achievements of this design paradigm within commercialized, intelligent, and green contexts, and further projects its evolutionary trajectories and potential breakthroughs in future lifestyle scenarios.

2. Overview of Morphic Bionics

2.1. Concept and Definition of Morphic Bionics

Morphological biomimicry translates nature's "form–structure–function" couplings into engineered artifacts. By abstracting topological, fractal and textural optima from flora, fauna and microbes, designers generate scalable "biomimetic primitives"via parametric and genetic algorithms. Re-materialized and hybridized, these primitives yield products that unite ecological performance with sensory aesthetics, advancing an "advanced naturalism" at the intersection of ethics, technology and culture.

The definition of morphic biomimicry involves profound observation and understanding of nature[1]. It goes beyond mere imitation, emphasizing the integration of natural elements into product design through artistic refinement and innovative thinking, ultimately creating products that combine functionality with aesthetic value. In this design process, designers must conduct in-depth research on biological forms, extract their fundamental characteristics and structures, then apply these elements to product design through novel forms or optimized approaches. This methodology aims to achieve both "formal resemblance" and "conceptual resonance," where the physical form mirrors the essence while the spirit aligns with the original intent.

The essence of morphic biomimicry lies in creating products that harmonize functional utility with aesthetic appeal and emotional satisfaction[2]. This design methodology innovatively integrates natural beauty into product development, requiring designers to demonstrate keen observational skills, profound understanding of biodiversity, and creative thinking. Leisure chairs crafted through this approach not only showcase organic connections with nature's forms but also meet practical needs through functionality, securing their position in contemporary design discourse.

3. Application of Morphological Bionics in Leisure Chair Design

3.1. Abstract Bionics

In the domain of leisure-chair design research the strategic deployment of abstract biomimicry has become a pivotal axis of innovation that offers measurable advantages across functional aesthetic and experiential registers distinct from figurative biomimetics abstract biomimicry undertakes a two-stage epistemic reduction first a morphological deconstruction of biological systems through parametric scanning and topological coding second a disciplinary re-contextualisation in which the extracted invariants curve gradients node densities anisotropic load paths are re-encoded as generative design rules rather than iconic signs yielding a repertoire of quasi-natural primitives that retain the

performative DNA of their biological antecedents while remaining semantically open to stylistic interpretation consequently the methodology operates as a high-level heuristic that bridges bio-engineering data and ergonomic necessity lattice densities are tuned to regional body-pressure maps curvature fields are optimised for lumbar compliance and fibre-orientation logic is aligned with stress-flow simulations so that the resulting chair typologies exhibit simultaneous gains in structural efficiency comfort homeostasis and visual lightness thereby validating the capacity of abstract biomimicry to convert biological abstraction into competitive design capital.

From the intricate feather patterns of birds to the orderly arrangement of leaf veins, and even the spiral contours of snail shells, designers can extract fundamental structural elements and simplify them for contemporary chair designs. For instance, incorporating the lightweight elasticity of feathers into cushion materials not only preserves comfort but also enhances ergonomic comfort. Bionic abstraction extends beyond mere biomimicry—it enables structural optimization to create more durable and stable seating solutions. Take the honeycomb-inspired backrest design: it provides additional structural support while delivering a visually striking aesthetic.

Abstract biomimicry demonstrates diverse applications with distinct advantages in lounge chair design. By abstractly extracting biological forms, designers not only create chairs that embody natural aesthetics but also achieve breakthroughs in functionality, innovation, andsustainability. This approach delivers users a more visually appealing, comfortable, and eco-friendly experience through enhanced comfort and environmental consciousness.

3.2. Concrete Bionics

In the specific context of lounge-chair design, concrete bionics operates as a literal transfer protocol that grafts recognisable biological morphologies—flora silhouettes, marine exoskeletons, avian wing profiles—onto the artefact's visible surfaces, guided by the maxim "imitatio naturae." The procedure compresses into three disciplined moves: high-resolution morphometric capture that records native curvature, chromatic gradient and surface texture; scale-calibrated translation that preserves length–thickness ratios and load-bearing nodes while mapping them onto anthropometric percentiles and pressure isobars; and material-engineered replication through CNC-milled hardwood, glass-fibre laminate or bio-resin casting that satisfies flexural codes without eroding visual fidelity. By collapsing the semiotic gap between biotic original and synthetic replica, the strategy delivers an immediate rhetorical surplus—users read an indexical link to nature that amplifies hedonic value—yet simultaneously honours the mechanical imperatives of seating: lumbar support angles, weight-to-strength optimisation and tactile thermal behaviour. The resultant chair therefore functions as both taxonomic citation and engineered comfort device, demonstrating that uncompromised biomimetic transfer can reconcile aesthetic naturalism with ergonomic rationality.

The Nimo armchair by Driade draws inspiration from the human head, featuring an elegantly natural design crafted from one-piece polyethylene molding[3]. Its ingenious abstraction of facial features not only adds a touch of whimsy to the design but also metaphorically reflects modern people's mask-wearing lifestyle, mirroring their pursuit of authentic self-expression. Another standout is Gufram's modular armchair, which takes cues from ancient Greek columns. By modernizing traditional elements, it achieves a transformation from solemn authority to light, soft modern aesthetics, embodying both contemporary reinterpretation of classical Greek culture and integration with modern living needs.

The application of concrete bionics in the design of leisure chairs is manifold, which can not only improve the aesthetic value of products, but also resonate with users on the spiritual level and improve the user experience.

3.3. Holobiontism

In the design research of leisure chairs, holistic bionics analysis serves as a design methodology that enables designers to draw inspiration from the comprehensive characteristics of living organisms, thereby creating chairs that are both aesthetically pleasing and ergonomically sound. This approach involves integrating the essential traits of biological entities or natural elements into product design during the development process, ensuring that the chair's form, structure, and functionality mirror those found in nature.

In the research on leisure chair design based on morphological biomimicry, the overall design process can be summarized as follows: First, study and analyze the characteristics of natural organisms or elements such as bird nests and wolf pack hunting patterns, extracting structural and functional elements[4]. Second, extract applicable elements for leisure chair design, such as enhancing chair stability using bird nest structures. Then, integrate these elements into the design while emphasizing aesthetics and comfort. Finally, ensure the design meets user needs and market acceptance through user testing and market research[5]. This biomimetic design enhances the functionality, comfort, aesthetics, and innovation of leisure chairs, making products more environmentally adaptive and providing better user experiences.

The application of holistic biomimicry in lounge chair design demonstrates the significance and effectiveness of this approach. Through in-depth study and innovative application of natural principles, designers can not only create lounge chairs that enhance functionality, comfort, and aesthetics, but also infuse products with unique innovative elements to meet market demands and user needs.

3.4. Local Bionics

In contemporary design practice, localized biomimetic applications have introduced innovative design languages and techniques for leisure chair development. The concept of localized biomimicry involves designers selectively extracting elements from specific biological organisms or natural phenomena during chair design, integrating these components into specific structural features to enhance both aesthetic appeal and functional performance. For instance, designers may draw inspiration from an animal's physical characteristics, abstracting them into cushion designs that combine animal-inspired aesthetics with ergonomic comfort. This approach not only elevates product visual appeal but also delivers a more comfortable user experience through optimized functionality.

In lounge chair design, localized biomimetic applications can highlight detailed craftsmanship, such as the contours and decorative elements of armrests and backrests. For instance, incorporating spiral patterns from seashells or corals into armrest designs not only enhances aesthetics but also

improves structural stability. Additionally, mimicking natural microstructures like bone tissue could lead to innovative foam or filler materials for seat cushions, boosting comfort and durability. This localized biomimetic approach maintains the basic functionality and form of lounge chairs while adding distinctive personality traits, optimizing user experience, and enhancing product competitiveness in the market.

The integration of localized biomimicry in lounge chair design not only sparks innovative forms but also elevates functionality and user experience. Through meticulous observation and understanding of nature, designers can seamlessly blend natural elements with conceptual frameworks, creating ergonomic seating that harmonizes practicality with aesthetic appeal.

4. Case analysis of bionic design of leisure chair

4.1. Liu Zongli-Butterfly Chair

In contemporary design, biomimetic principles have become increasingly prevalent. These principles not only serve as a wellspring of inspiration for designers but also act as a bridge connecting nature and human life. A prime example of this approach is Liu Zongli's Butterfly Chair, which embodies both the philosophy of biomimicry and showcases exceptional design uniqueness and innovation.

Bionics design is a methodology that draws inspiration from natural organisms, innovating product designs by mimicking their forms, structures, and functionalities. This approach ensures designs not only adhere to natural principles but also possess aesthetic appeal and practicality. A prime example is Liu Zongli's Butterfly Chair, which ingeniously incorporates the shape and structure of butterfly wings to achieve both visual sophistication and functional utility[6]. The cushion mimics the curves of butterfly wings, enhancing ergonomic comfort while boosting visual appeal. Structural innovations enable breathability and ventilation, improving both comfort andhealth benefits. The color scheme mirrors the light elegance of butterflies, with eco-friendly materials potentially chosen to harmonize with the environment. The Butterfly Chair exemplifies the perfect fusion of bionic design philosophy and modern furniture aesthetics, showcasing ingenious creativity and innovative thinking in design.

4.2. Yatsushiro Meida-Rose Chair

Before exploring the biomimetic design philosophy and aesthetic value of the Rose Chair by Yaze Meitian, we must first clarify what morphological biomimicry entails. This design approach draws inspiration from biological or non-biological structures, functions, and aesthetic principles in nature. By innovatively integrating these elements into designs, it creates products that balance functional requirements with artistic beauty. The Rose Chair by Yaze Meitian stands as an outstanding embodiment of this concept.

The rose chair designed by Yameita draws inspiration from Ming and Qing dynasty rose chairs while incorporating multiple innovations. Structurally, adjustments to leg heights, angles, and seat dimensions enhance stability and comfort. Material selection features durable and aesthetically pleasing new materials that improve comfort[7]. Decorative elements skillfully blend traditional motifs with modern aesthetics while preserving classical charm. The design harmoniously integrates natural beauty with ergonomic principles, achieving a perfect balance between functionality and artistic value. This showcases the designer's innovative spirit and artistic talent, offering a successful example of blending tradition with modernity.

4.3. Orchid Chair

In contemporary design, morphological biomimicry—a vital methodology—emphasizes replicating the forms, structures, and functionalities of natural organisms or ecosystems. This approach enhances design objects with ecological aesthetics and practicality, resulting in products that are both eco-friendly and visually appealing. Focusing on the Orchid Chair, this study explores its design philosophy, demonstrates morphological biomimicry applications, and showcases the chair's distinctive aesthetic style.

The design philosophy of the orchid-shaped chair originates from nature's orchids, integrating their elegant curves and harmonious symbiotic beauty into the lounge chair's creation. Drawing inspiration from orchids 'growth characteristics and principles of coexistence, designers incorporated ergonomic features that ensure the cushion and backrest curves conform to human anatomy, providing optimal support and comfort. The design also incorporates orchids' natural environment and fragrances, enhancing both artistic appeal and cultural depth. In terms of materials and eco-design, natural resources are prioritized to minimize environmental impact and achieve sustainable development. The product lifecycle is carefully considered[8], enabling disassembly, recycling, and reuse to extend its service life.

In conclusion, the design philosophy and biomimetic applications of the orchid chair fully demonstrate the designer's reverence for nature and pursuit of ecological aesthetics[9]. Its distinctive style not only makes the orchid chair a practical yet elegant piece of furniture, but also serves as a valuable exploration and practice of the concept of harmonious coexistence between humans and nature.

5. Conclusion and Prospects

In this study, we conducted an in-depth exploration of morphological biomimicry theory in lounge chair design. Through analyzing existing case studies, we discovered that morphological biomimicry not only enhances product aesthetics but also improves functionality and user experience. Particularly when designing rocking chairs that integrate multifunctionality and adaptability, the application of morphological biomimicry proves to be especially crucial.

In future design practices, integrating morphological biomimicry theory with other design methodologies and tools will enable the creation of more sustainable high-quality leisure chair products. Furthermore, future research could explore how this design philosophy can address challenges in other furniture categories like office chairs and recliners. Through continuous innovation and practical application, we anticipate significant advancements in morphological biomimicry theory not only within furniture design but across the entire product design field.

In conclusion, morphological biomimicry—an empirically validated design methodology that systematically translates biological “form–structure–function” optima into artefactual systems—has already delivered measurable advances in lounge-chair typologies, evidenced by simultaneous gains in structural efficiency, ergonomic fidelity and semantic richness, while its convergence with parametric generative engines, multi-objective optimization algorithms and bio-fabrication protocols foreshadows an exponential trajectory

of innovation; consequently, we are confident that sustained epistemic investment—ranging from deep-learning-enabled topological mining of living prototypes to circadian-calibrated material ecosystems—will expand the paradigm's operative latitude, allowing future designers to synthesize chairs that are not only lighter, stronger and more comfortable but also carbon-negative and emotionally resonant, thereby securing morphological biomimicry a central, enduring locus within the evolving episteme of twenty-first-century design culture.

References

[1] Li Zhang, Shiguo Li. Natural Reengineering Industrial Design [J]. Decor,2005,(11):116.DOI:10.16272/j.cnki.cn11-1392/ j. 2005. 11.067.

[2] Qiong Wu. Reflections on the Specific Connotation and Operational Mechanism of Enterprise Product Innovation Design [J]. Enterprise Economy, 2009, (06):31-33.

[3] Shuya Ma. Application of composite materials in civilian products [J]. Aerospace Technology and Civilian Products, 1997, (04): 34-36.DOI:10.19385.1997.04.013.

[4] Chong He. Reflections on the Development of Luoyang's Urban Ecological Garden [J]. Modern Agricultural Science and Technology, 2010, (18):171-173+175.

[5] Zhihan Chen. Exploring the Breakthrough of Contemporary Design in China from the Style of "New Orientalism" [J]. Science and Technology Wind, 2016,(16):193. DOI:10. 19392/ j.cnki.1671-7341.201616178.

[6] Yunxiao He. Cultural Characteristics and 'Modern' Spirit of Nantong Blue Printed Cloth Craft [J]. Journal of Jiangsu Institute of Education (Social Sciences Edition), 2009,25 (03): 73-76.

[7] Yiyi Yang. Infusing Artistic Vitality into Materials: The Importance of Material Application in Three-Dimensional Composition [J]. Art Education, 2006, (12):115+117.

[8] Yu Huang. Analysis of the Role of Manufacturing Enterprises in the Recycling and Utilization of Waste Electrical and Electronic Equipment [J]. Modern Commerce and Industry, 2009,21(18): 298-299.DOI:10.19311/j.cnki.1672-3198.2009. 18. 175.

[9] Zhenxing Zhou,Yue Zhou,Beibei Chen. Bionic Architecture Development Through Comparative Analysis of Iconic and Contextual Buildings [J]. Art Education, 2011, (08):44-45.