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The Aesthetic Imagery and Practical Considerations of Quilting Techniques in Down Jacket Pattern Design

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ABSTRACT

This study aims to explore the balance between the aesthetic imagery and practical functionality of quilting techniques in down jacket pattern design. Through experimental analysis of the shrinkage effects of different quilting techniques on down jacket patterns and in combination with aesthetic theories, methods for optimizing down jacket design are proposed. The results indicate that quilting techniques not only affect the functionality of down jackets but also shape unique aesthetic imagery through visual and tactile effects. By analyzing the impact of various quilting techniques on down jacket pattern design, integrating experimental data with aesthetic theories, and discussing how to enhance the aesthetic value of down jackets while meeting practical functions, this study provides a comprehensive design approach for down jackets that considers both aesthetics and practicality, assisting designers in ensuring beauty while also considering functionality and comfort.

KEY WORDS: Down jacket; Quilting technique; Shrinkage; Aesthetic imagery; Practical considerations

1. Introduction

Down jackets have become essential winter clothing due to their warmth, lightness, and softness. Their design must not only meet practical functions such as warmth but also possess certain aesthetic value. The quilting technique in down jackets not only serves practical functions but also carries aesthetic imagery, becoming an important bridge connecting functionality and fashion sense. From multiple perspectives, it can be seen that the quilting technique plays a dual role in design: meeting practical needs such as warmth and lightness while conveying brand concepts and consumer emotions through visual language. As a traditional technique, quilting also carries cultural and emotional expression in modern design. For example, Chen Pei's research points out that the Baroque-style quilting technique has unique expressiveness in clothing design, which can create designs with a retro-futuristic feel through the interaction of patterns and quilting and the combination of special techniques and quilting (Chen, 2022). This design not only meets modern consumers' needs for professionalization and denationalization but also reflects respect for and innovation of traditional culture.

The quilting technique, as an important part of down jacket design, not only affects the functionality of the garment but also

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shapes unique aesthetic imagery through visual and tactile effects. This paper analyzes the impact of different quilting techniques on down jacket pattern design, integrates experimental data with aesthetic theories, and explores how to enhance the aesthetic value of down jackets while meeting practical functions.

2. Research Questions

i. What is the impact of different quilting techniques on the shrinkage of down jacket patterns?

ii. How can quilting techniques enhance the aesthetic imagery of down jackets?

iii. How can the balance between aesthetics and practicality be achieved in down jackets while meeting practical functions?

3. Literature Review

3.1 Practical Functions of Down Jackets

The design of down jackets needs to consider practical functions such as warmth, lightness, and softness. Dai and Yu (2018) pointed out that the down content and the type of filling directly affect the warmth of down jackets. Wu (2007) emphasized the impact of the fit characteristics of down jackets on wearing comfort.

In practical applications, quilting techniques not only affect the appearance of clothing but also have an important impact on the structure, warmth, and comfort of the garment. For example, Ji's research indicates that the amount of down filling, quilting spacing, and quilting form are the main factors affecting the shrinkage of down jacket patterns, and the size of shrinkage directly affects the size and wearing comfort of the finished product (Ji, 2019). At the same time, Chen Fang's research also shows that the amount of down filling and quilting spacing are the main factors affecting the shrinkage of down jacket patterns, and the establishment of regression equations can effectively improve the accuracy of pattern making (Chen et al., 2014). These studies provide a scientific basis for the pattern design of down jackets, enabling designers to ensure beauty while also considering functionality and comfort.

In terms of functionality, quilting techniques are mainly reflected in the fixation of down and the warmth effect. Traditional down jacket quilting designs are relatively simple, while modern down jackets enhance anti-drilling performance through more refined quilting techniques such as "quilt first and then fill" and "seamless bonding." For example, Sidelong uses anti-run technology to prevent down feathers from drilling out of the needle holes through quilting first and then filling, thereby improving the warmth and durability of down jackets. This technology not only improves the user experience of the product but also extends its service life (Sidelong International Holdings Limited, 2020).

Quilting techniques also affect the structural stability of down jackets. Research shows that different types of quilting will create different structures and styles of down jackets, thereby affecting the shrinkage of the finished product size. For example, the shrinkage in the direction parallel to the quilting is smaller, while the shrinkage in the direction perpendicular to the quilting is larger. Therefore, the impact of quilting techniques on the size of the finished product must be considered in pattern design (Mao & Ning, 2019). This indicates that quilting techniques are not only part of aesthetic design but also a key factor in ensuring product structural stability.

3.2 Aesthetic Value of Down Jackets

As a multi-layer structural technique, quilting has a variety of forms and can create different visual effects and psychological feelings through elements such as line type, density, direction, and combination methods. The design of down jackets not only needs to meet practical functions but also needs to possess certain aesthetic value. Wang and Quan (2005) explored the impact of down jacket selection and sewing on fashion, pointing out that design not only needs to meet practical functions but also needs to possess certain aesthetic value. Liu (2016) analyzed the down jacket quilting design from an aesthetic perspective, emphasizing the importance of quilting techniques in shaping visual effects. Xu and Jiang's research shows that the type, direction, density, length, and combination methods of quilting lines will affect consumers' emotional evaluations, among which diagonal quilting is the most visually prominent, especially asymmetric diagonal quilting, which is favored for its unique dynamic beauty (Xu & Jiang, 2022). Wang and Cai combine traditional Chinese folk craftsmanship with modern design in the quilted cotton garment series 'Quilted in Clothes'. Through the interspersed use of different tactile fabrics and auxiliary materials, the layering and movement of the garments are enhanced, making the down garments visually light and graceful (Wang & Cai, 2023).). This design not only reflects the respect for traditional craftsmanship but also shows the integration of nature and humanity in modern design.

Quilting techniques in down jacket design create unique visual effects through the arrangement, density, direction, and combination of lines. For example, sidelong integrates "artistic quilting design" into traditional down jackets, shaping a sense of fashion beauty through the interweaving of lines, making down jackets both light and warm and diverse and fashionable (Sidelong International Holdings Limited, 2020). This design not only enhances the layering of the garment but also gives down jackets stronger modeling expressiveness. Research shows that the type, direction, density, length, and combination methods of quilting lines will affect consumers' emotional cognition, among which diagonal, asymmetric diagonal and special pattern types are the most concerned (Liu et al., 2023). These design elements not only enhance the visual appeal of the garment but also reflect consumers' demand for professionalization and fashion.

Quilting techniques are also closely related to brand positioning. Sidelong redefined the aesthetic standards of light and thin down jackets through "artistic quilting design" and the concept of "avant-garde designers," making down jackets an important vehicle for young consumers to express themselves and pursue fashion (Ji et al., 2022). This design language not only enhances the brand's professional image but also strengthens consumers' brand identification.

3.3 Research on Quilting Techniques

Liu (2016) studied the factors affecting down drilling in down jackets and the testing methods, pointing out that quilting techniques play an important role in preventing drilling. Wang (2017) explored the impact of down jacket sewing and filling techniques on styling from a technical perspective.

The innovative application of quilting techniques is not only reflected in appearance design but also the combination of techniques and materials. For example, Hu et al. developed high-density waterproof and anti-drilling down jackets by establishing

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per-separation areas on the lining and adding anti-drilling strips, effectively solving the problem of easy drilling of traditional down jackets during washing, improving the durability and appearance of the product (Hu et al., 2022). In addition, Shi et al. explored the application of computer quilting machines in down jacket production, improving production efficiency and product quality by optimizing the sewing process (Shi et al., 2021). These practices show that the innovation of quilting techniques is not only in design breakthroughs but also in continuous progress in process technology.

In modern down jacket design, the combination of quilting techniques and innovative design has become a trend. Sidelong integrates "artistic quilting design" with elements such as "splicing" and "knitting," unlocking new possibilities for down jacket crossover, making down jackets both light and warm and diverse and fashionable (Ding, 2022). This design not only meets consumers' dual needs for fashion and practicality but also promotes the transformation of down jackets from traditional warm clothing to fashionable accessories.

At the same time, the inheritance and innovation of traditional techniques are also an important direction for quilting design. Sidelong innovates the visual effect on the basis of inheriting the ancient quilting craft, shaping a sense of fashion beauty through the interweaving of lines, retaining the essence of traditional techniques while giving them new vitality (Ji et al., 2022). This "coexistence of tradition and innovation" design concept not only enhances the market competitiveness of the product but also strengthens the brand's cultural connotation.

4. Research Methods

i. Experimental Design

This study conducted experiments on various quilting techniques by making different quilting technique downpacks, measuring the size changes of the downpacks under different quilting techniques, and analyzing shrinkage differences.

ii. Data Analysis

Experimental data were analyzed in combination with aesthetic theories to analyze the impact of different quilting techniques on down jacket pattern design. Statistical software was used for data analysis to ensure the reliability of the results.

iii. Case Analysis

Typical down jacket styles were selected to analyze their quilting techniques and pattern designs, exploring the combination of aesthetics and practicality.

5. Experimental Process

5.1 Impact of Quilting Techniques on Shrinkage

The experimental design is as follows:

Materials: Different weight down, 290T and 320T lining materials were selected.

Techniques: Downpacks with different techniques such as horizontal quilting, diamond quilting, visible quilting, and hidden quilting were made.

Measurements: After filling with down, the longitudinal and transverse size changes of the down packs were measured, and the shrinkage was calculated.

Figure 1: Before Filling

Figure 2: After Filling

Source: Author's own work

Horizontal quilting is the most widely used quilting design in down jackets, giving a stable and coordinated visual effect. The width of the quilting grid in horizontal quilting can be arranged according to the needs of the styling, which can be regularly or irregularly distributed, and can be used locally or entirely. Narrow quilting is generally used for light and thin, fitted styles. Wide quilting is generally used for loose styles. Regardless of the distribution form, it is important to remember to quilt the down lines first and then fill the down (as shown in Figure 1), that is, two layers of lining material and one layer of fabric are superimposed, quilted together first, leaving an opening. Figure 2 shows the effect after filling the down. This can effectively avoid the risk of down running through the needle holes, while also improving the quilting speed and garment quality.

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Table 1: Shrinkage Table for 290T Lining with 100g and 80g Filling

290T Lining (100g per square filling)	Standard Size (cm)	Actual Size (cm)	Shrinkage (%)	Actual Use	Internal Shrinkage	External Shrinkage
5cm Quilting	50 (Longitudinal)	47.9	4.20%	4.20%	4.20%	4.20%
	50 (Transverse)	48.5	3.00%	3.00%	3.00%	3.00%
8.3cm Quilting	50 (Longitudinal)	48.1	3.80%	3.80%	3.80%	3.80%
	50 (Transverse)	48.6	2.80%	2.80%	2.80%	2.80%
12.5cm Quilting	50 (Longitudinal)	48.4	3.20%	3.20%	3.20%	3.20%
	50 (Transverse)	48.7	2.60%	2.60%	2.60%	2.60%
16.6cm Quilting	50 (Longitudinal)	48.6	2.80%	2.80%	2.80%	2.80%
	50 (Transverse)	48.1	2.40%	2.40%	2.40%	2.40%
290T Lining (80g per square filling)	**Standard Size (cm)**	**Actual Size (cm)**	**Shrinkage (%)**	**Actual Use**	**Internal Shrinkage**	**External Shrinkage**
5cm Quilting	50 (Longitudinal)	48	4.00%	4.00%	4.00%	4.00%
	50 (Transverse)	48.6	2.80%	2.80%	2.80%	2.80%
8.3cm Quilting	50 (Longitudinal)	48.2	3.60%	3.60%	3.60%	3.60%
	50 (Transverse)	48.7	2.60%	2.60%	2.60%	2.60%
12.5cm Quilting	50 (Longitudinal)	48.4	3.20%	3.20%	3.20%	3.20%
	50 (Transverse)	48.9	2.40%	2.40%	2.40%	2.40%
16.6cm Quilting	50 (Longitudinal)	48.6	2.80%	2.80%	2.80%	2.80%
	50 (Transverse)	48.9	2.20%	2.20%	2.20%	2.20%

Source: Researcher's own work

Table 2: Shrinkage Table for 320T Lining with 100g and 80g

320T Lining (100g per square filling)	Standard Size (cm)	Actual Size (cm)	Shrinkage (%)	Actual Use	Internal Shrinkage	External Shrinkage
5cm Quilting	50 (Longitudinal)	47.3	5.40%	5.40%	5.40%	5.40%
	50 (Transverse)	48.1	3.80%	3.80%	3.80%	3.80%
8.3cm Quilting	50 (Longitudinal)	47.6	4.80%	4.80%	4.80%	4.80%
	50 (Transverse)	48.4	3.20%	3.20%	3.20%	3.20%
12.5cm Quilting	50 (Longitudinal)	48.1	3.80%	3.80%	3.80%	3.80%
	50 (Transverse)	48.7	2.60%	2.60%	2.60%	2.60%
16.6cm Quilting	50 (Longitudinal)	48.5	3.00%	3.00%	3.00%	3.00%
	50 (Transverse)	49	2.00%	2.00%	2.00%	2.00%
320T Lining (80g per square filling)	**Standard Size (cm)**	**Actual Size (cm)**	**Shrinkage (%)**	**Actual Use**	**Internal Shrinkage**	**External Shrinkage**
5cm Quilting	50 (Longitudinal)	47.5	5.00%	5.00%	5.00%	5.00%
	50 (Transverse)	48.3	3.40%	3.40%	3.40%	3.40%
8.3cm Quilting	50 (Longitudinal)	47.7	4.60%	4.60%	4.60%	4.60%
	50 (Transverse)	48.5	3.00%	3.00%	3.00%	3.00%
12.5cm Quilting	50 (Longitudinal)	47.9	4.20%	4.20%	4.20%	4.20%
	50 (Transverse)	48.7	2.60%	2.60%	2.60%	2.60%
16.6cm Quilting	50 (Longitudinal)	48.1	3.80%	3.80%	3.80%	3.80%
	50 (Transverse)	48.9	2.20%	2.20%	2.20%	2.20%

Source: Researcher's own work

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The same amount of filling with different quilting widths results in different levels of fluffiness, and the pattern allowance for shrinkage will also be different. A 50*50 double-layer lining was taken, and experiments were conducted with quilting widths of 5CM, 8.3CM, 12.5CM, and 16.6CM respectively. The quilting lines were made first, leaving an opening, and then filled with 90% down content at a filling weight of 100 grams per square meter. After quilting, the length in the longitudinal and transverse directions was measured respectively. The shrinkage in the longitudinal and transverse directions can be calculated respectively. The shrinkage allowance for the lining can be determined according to the finished size.

Experimental data (see Tables 1 and 2) show that different quilting techniques have a significant impact on the shrinkage of down jacket patterns. The specific results are as follows:

Horizontal quilting: Under the same weight, the shrinkage of 290T lining is significantly less than that of 320T lining. For example, when the filling amount is 100 grams per square, the longitudinal shrinkage of 290T lining is 5.4%, and the transverse shrinkage is 3.8%; while the longitudinal shrinkage of 320T lining is 6.2%, and the transverse shrinkage is 4.5%.

Impact of quilting width: The narrower the quilting, the greater the shrinkage; the wider the quilting, the smaller the shrinkage. For example, the shrinkage of 5CM wide quilting is significantly greater than that of 12.5CM wide quilting.

5.2 Shaping of Aesthetic Imagery

Through the analysis of the visual and tactile effects of different quilting techniques, it was found that quilting techniques not only affect the functionality of down jackets but also shape unique aesthetic imagery through visual and tactile effects:

Horizontal quilting: It gives a stable and coordinated visual effect and is suitable for light and thin, fitted styles. For example, the visible quilting down jacket shown in Figure 1 has a quilting spacing of 3.5-5.5cm, and the overall effect is simple and generous.

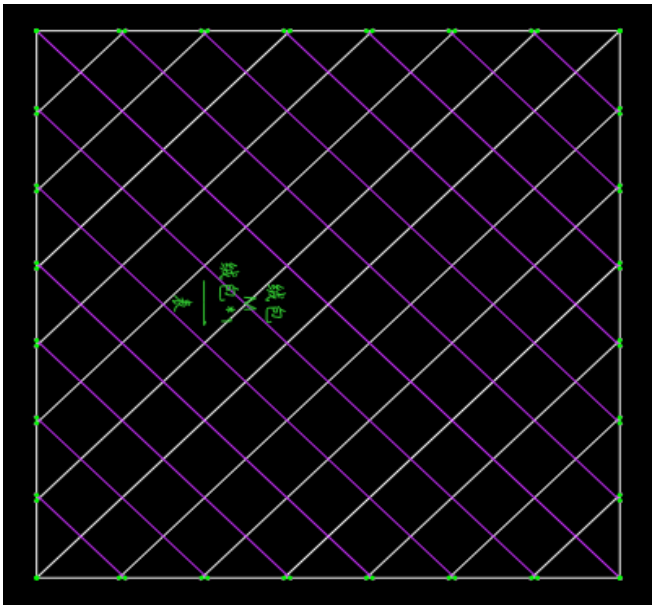

Figure 3: CAD Pattern Diamond Quilting

Source: Author's own work

Diamond quilting: It is more fashionable and artistic and is suitable for the combination of light and thin fabrics and regular thickness fabrics. For example, the 7CM×7CM diamond quilting shown in Figure 1-7 has a more complex and rich visual effect.

Hidden quilting technique: By hiding the quilting lines, increases the layering and overall feeling of the down jacket. For example, the ordinary hidden quilting style shown in Figure 2-1, with no visible quilting lines on the surface, has a smoother and neater overall effect.

5.3 Balance of Practicality and Aesthetics

It was found that while meeting practical functions, the aesthetic value of down jackets can be effectively enhanced by reasonably selecting quilting techniques and fabrics. For example:

Choosing the right combination of fabric and lining: While ensuring warmth, reduce the bulky feeling and enhance the overall beauty of the garment. For example, choosing 290T lining can reduce shrinkage and make the garment more fitted to the body curve.

Optimizing quilting techniques: Through reasonable quilting design, not only can drilling be prevented, but the visual effect can also be enhanced. For example, the "quilt first and then fill" technique can effectively avoid down running through the needle holes and enhance the quality feeling of the garment.

6. Discussion

The quilting technique of down jackets plays a dual role in pattern design: on the one hand, it conveys aesthetic imagery through visual language, meeting consumers' pursuit of fashion and professionalization; on the other hand, it ensures the warmth, lightness, and durability of down jackets through structural design and process treatment. Brands such as Sidelong have successfully achieved the unity of functionality and fashion by combining "artistic quilting design" and "innovative sewing techniques," setting a new benchmark for down jacket design. In the future, as consumers' attention to professionalization and sustainable fashion increases, quilting techniques will play an even more important role in design, becoming an important bridge connecting tradition and modernity, practicality and aesthetics.

The quilting technique of down jackets not only carries practical functions but also contains rich aesthetic imagery and design considerations. From multiple research and practical cases, it can be seen that quilting, as one of the traditional Chinese techniques, its application in modern clothing design not only reflects the inheritance of traditional aesthetics but also shows the response to and innovation of modern consumer aesthetics.

6.1 Balance of Aesthetics and Practicality

How to enhance the aesthetic value of down jackets while meeting practical functions is a key issue that needs to be considered in design. By reasonably selecting quilting techniques and fabrics, the overall beauty of the garment can be enhanced while ensuring warmth, reducing the bulky feeling. For example, choosing the right combination of fabric and lining can reduce shrinkage and make the garment more fitted to the body curve.

6.2 Integration of Culture and Fashion

The design of down jackets not only needs to meet practical functions but also needs to possess certain aesthetic value. By introducing traditional aesthetic concepts and modern fashion elements, the cultural connotation and fashion sense of down jackets can be enhanced. For example, traditional horizontal quilting techniques can be improved through modern design methods to make them more fashionable. At the same time, aesthetic imagery from different cultural backgrounds can also be integrated through

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quilting techniques, providing more creativity and inspiration for down jacket design.

6.3 Further Discussion Points

Aesthetic imagery in different cultural contexts: Future research can further explore the combination of aesthetic imagery and practical functions in different cultural contexts, providing more theoretical support and practical guidance for down jacket design.

Sustainable design considerations: While meeting practical and aesthetic needs, how to consider the sustainable development of down jackets, such as using environmentally friendly and recyclable materials, is also an important direction for future research.

7. Conclusion

This study deeply investigates the impact of quilting techniques on down jacket pattern design through experimental analysis and theoretical discussion, especially the balance between aesthetic imagery and practical functions. The results show that quilting techniques not only affect the functionality of down jackets but also shape unique aesthetic imagery through visual and tactile effects. By reasonably selecting quilting techniques and fabrics, the aesthetic value of down jackets can be effectively enhanced while meeting practical functions. This study provides a comprehensive design method for down jackets that considers both aesthetics and practicality. Through experimental data and theoretical analysis, it provides a scientific basis for designers in selecting quilting techniques and fabrics, helping to enhance the overall quality and market competitiveness of down jackets.

The research summary shows that different quilting techniques have a significant impact on the shrinkage of down jacket patterns, and quilting techniques shape unique aesthetic imagery through visual and tactile effects. The balance between practicality and aesthetics can be achieved by reasonably selecting quilting techniques and fabrics to ensure warmth while reducing the bulky feeling and enhancing the overall beauty of the garment. The contribution of this study lies in providing a new perspective on down jacket design, that is, considering both aesthetic and practical factors in the design process to meet consumers' dual needs for fashion and functionality.

Future research directions can further explore the combination of aesthetic imagery and practical functions in different cultural contexts, as well as how to consider the sustainable development of down jackets while meeting practical and aesthetic needs, such as using environmentally friendly and recyclable materials. With the further integration of design and technology, quilting techniques will play an important role in more fields, bringing more possibilities and innovations to clothing design.

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