Automatic pattern alteration for individual users based on optimized grading method

Xin Zhang[1,2], Ningrong Xie[1], Jin-tu Fan[1,2], and P.Y. Mok[1,2,*]
[1] School of Fashion and Textiles, The Hong Kong Polytechnic University, Hong Kong.
[2] Laboratory for Artificial Intelligence in Design, Hong Kong Special Administrative Region.
*Corresponding author: tracy.mok@polyu.edu.hk

KEYWORDS:
Pattern Alteration; Optimized Grading Method; Automatic Technique; Body Shapes

INTRODUCTION:

Pattern grading is an important process for mass production in apparel manufacturing (Schofield & LaBat, 2005) and has been widely adopted in the fashion industry to cover various body sizes. It balances the relationship between various sizes, typically taking the middle number of the size as the benchmark (base pattern) and calculating the distribution of the increase (or decrease) amounts at specific points to produce new patterns (Bye & DeLong, 1994; Schofield, 2007; Xiu et al., 2009) Schofield, 2007; Workman, 1991). Generally, grading methods that widely adopted in the mass production scales the base pattern to larger or smaller sizes proportionally in both circumference and length (Cooklin, 1990). A recognized limitation of this approach is its inability to meet the needs of those with non-average body shapes, resulting in an ill-fitting garment and decreased satisfaction (Bye et al., 2008). To generate the graded patterns, computer-aided technology (CAD) has become a widely adopted tool in recent years. CAD system utilizes the "nearest point" principle, where new or existing points on an adapted pattern derive their grading rule from corresponding points on the basic block pattern (Xiu & Wan, 2011). However, current CAD systems heavily rely on manual input of point increments, negatively affecting the efficiency of garment grading. To address the aforementioned research gap, this study proposes an optimized grading method that cater to: (1) diverse body shapes and (2) intelligent pipeline for automatic grading pattern generation.

METHOD:

This proposed method seeks to enhance traditional techniques to conform with the demands of the current market. The development of this method involves three main parts: Firstly, evaluating the effectiveness of traditional grading approaches in accommodating various body sizes and shapes. Secondly, identifying and consolidating fitting issues, while redefining the grading rules for non-average body shapes. Finally, testing the proposed method on different datasets that comprise varied body shapes, sizes, and garment styles while conducting quantitative and qualitative evaluations to gauge the validity and reliability of the methodology.

To test and enhance the proposed grading method, an experiment was conducted, which included the analysis of traditional grading techniques by Jeanne Price (1996) and Handford (2003), given their widespread usage in the field. The experiment also incorporated female body forms from

Alvanon, comprising of a diverse range of sizes and shapes across various regions. A basic female shirt style was selected as the prototype. Initially, grading was carried out virtually on 2D patterns using CLO software on different shapes and sizes of the Alvanon female forms. Subsequently, produced real shirts were employed to validate and evaluate the proposed methodology.

RESULTS:

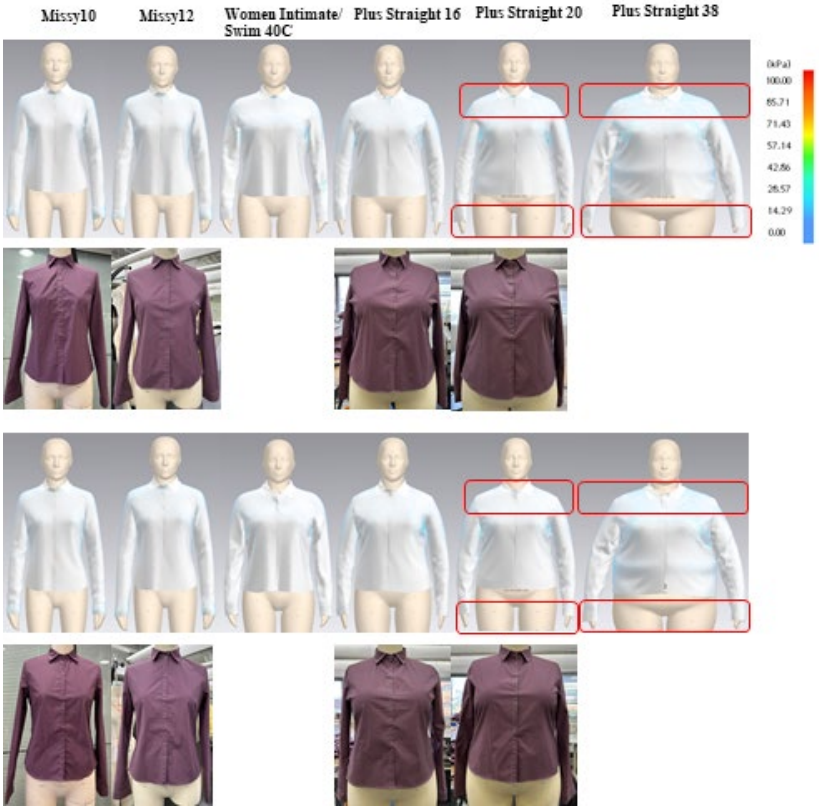

Figure 1 Results of two traditional grading techniques (upper: Jeanne Price (1996); lower: Handford (2003))

Figure 2 Results of using improved grading techniques

Figure 2 depicts the results of the improved grading rules for large-size forms with a low bust-to-waist ratio, using *Plus Straight 20* and *38* as typical examples. The figure highlights significant reductions in creases around the waist area, indicating improved fitting. Moreover, the shoulder area and sleeve length also witnessed noticeable enhancements.

The entire process was automated using the following steps: first, recognizing the garment style and its pattern pieces. Then, defining the grading origin and coordinates for each piece, followed by marking the grading points. Next, utilizing corresponding grading rules and distributions, new coordinates were automatically generated for each point to produce the graded pattern shape for a target body size and shape.

DISCUSSION AND CONCLUSION:

The results revealed that proportional grading, a widely utilized traditional approach, was unable to meet the fitting requirements of non-average body shapes, which corroborates similar findings by (Bye et al., 2008). Specifically, for the female shirt, the bust and waist area relationship presented a significant challenge during the grading process. Thus, thoroughly comprehending the target body shape and size is essential to provide customized grading rules to attain optimal fit. In a word, the challenge in intelligent grading lies in achieving a balance between adjusting the grading rules to accommodate varying body shapes while preserving the original garment shape. Although this study only examined the grading of basic female shirts, it provides valuable insights

into grading technique enhancements that address varying body shapes while automating the grading process. Further research will focus on refining the grading distribution and testing automatic grading algorithms for diverse garments.

ACKNOWLEDGEMENTS

This research is funded in part by the Innovation and Technology Fund (Project Code: ITP/028/21TP) and also by the Laboratory for Artificial Intelligence in Design (Project Code: RP3-6 and RP1-1) under the InnoHK Research Clusters, Hong Kong Special Administrative Region Government.

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