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Construction and Application of Clothing Pattern Design Model Based on Directed Graph Method

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Abstract

At present, the intelligent design of clothing patterns still needs to rely on the experience of the pattern maker, and it cannot liberate the pattern maker from the complicated design work. The efficiency and flexibility of the design of clothing patterns are not high. In order to realize the intelligent pattern design of design knowledge automation, a directed graph method is proposed to construct a clothing pattern design model, and the model is used to analyze the clothing pattern. In view of the characteristics of clothing pattern design, the directed graph method is used to record the pattern design process, and the model of clothing pattern design is constructed. The model is accurately analyzed by decomposing the original model of clothing pattern design into sub-models of each structural line. Application examples verify the feasibility of constructing a pattern design model and application by the directed graph method. The research results show that the pattern design model can clearly express the pattern design process and the valuable experience involved, and can accurately and quickly analyze the pattern. This research can provide a way to extract, collect, process, share and reuse pattern design knowledge for intelligent clothing design, and improve the efficiency of clothing pattern design.

Keywords: Directed Graph; Knowledge Automation; Clothing Pattern Design Model

1 Introduction

"Made in China 2025" pointed out that intelligent manufacturing is the main direction of China's manufacturing 2025 [1], and knowledge automation is the foundation and the key to the intelligent industry [2]. Knowledge automation mainly refers to the automation of knowledge-based work. Knowledge-based work is the use and creation of knowledge. It is the work that can be completed only by a knowledgeable person or system. It is a creative mental work that produces useful information and knowledge [3].

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At present, there are three main ways to realize the intelligent design of clothing patterns: 1) the use of artificial intelligence technologies; 2) unfolding 3D clothing to form a 2D pattern; 3) basing on the parametric design ideas [4]. In terms of artificial intelligence: Liu Weimin et al. [5] used the BP neural network algorithm to establish the changes on waist and hip size circumference. Through directly using the matching of data, the parametric design of men's waistband, abdomen, and hip modification rules was realized. Preliminarily, it also realized the intelligent pattern design of male tailored trousers. Liu Fang et al. [6] used human dimension data as the input vector and the sample size of the fitted female suits as the output vector. By establishing a BP neural network model, the nonlinear mapping relation between the body size data and the sample size data of the suit was studied to realize the automatic generation from the body size to the pattern size of the tailored suit.

In terms of unfolding 3D clothing to form a 2D pattern, Zhou Hengji [7] constructed a personalized 3D digital human mannequin for legs accords, with the characteristics of the human body, and flatten it to get a 2D vector. The research has been conducted on the generation of rules from the 2D vector to the female trousers prototype. Yuko Mesuda et al. [8] proposed a method of virtual draping by representing the actual draping process, i.e., a pattern is made from cloth model through mapping.

In terms of parametric design, in Ye Qinwen's research [9], the double arc was used to fit the garment pattern contour curve and in combination with the parameterization function of Auto CAD, the parameterized curve constraint model was constructed. Based on this, a parameterized garment pattern was established. In addition, the paper pattern generation efficiency of personalized clothing was improved using this method. Zhang Linli et al. [10] developed parametric patternmaking software for the back body of a shirt based on the Mat Lab platform of software development. The software promoted the response capability of apparel customization.

In other aspects, Hyun-Sook Han et al. [11] developed an automated custom-pattern-making system using the width-height independent grading method for semi-customized clothing. Once the basic-size pattern and grading value are prepared, the width-height independent grading system can quickly generate numerous patterns of different proportions by combining waist girth and height measurements. Adrian R.G. Harwood et al. [12] introduced JBlockCreator, an application and extensible API for the automatic drafting of custom pattern blocks from body measurement data. JBlockCreator provides plotting tools for displaying complex measurement data in a manner which facilitates the study of pattern drafting theory and helps towards the development of new relationships between measurements, consequently improving the situation in practice.

The current artificial intelligence and parametric design methods are well suitable for the pattern intelligent design of fixed clothing styles, such as men's shirts. For the changeable clothing style design, the pattern still needs to be adjusted by pattern designers. The method of unfolding 3D clothing to form a 2D pattern has high requirements on the operator's technical and artistic accomplishments, so only by relying on the experience of the designer can we design a good clothing pattern. Therefore, although the existing methods have realized the intelligent design of the clothing pattern to a certain extent, it cannot liberate the pattern designer from the complicated design work and in addition, still relies highly on the experience of the patternmaker. To realize the intellectualization of pattern design knowledge, a directed graph method is used to record the pattern design process and analyze the pattern, hoping to reveal the design experience of the designers and provide a way for the automation of pattern design knowledge.