Computer-Aided-Design of Zero-Waste Garment Patterns

Master-level internship

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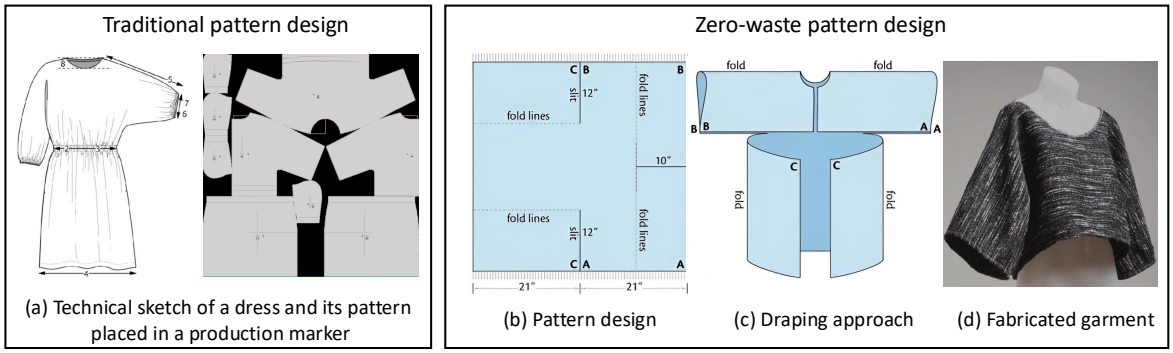

Figure 1: In traditional garment manufacturing, fabric cutting often leads to significant waste (indicated by the black area in the left image of (a)), mainly due to inefficiencies in the design and layout of garment panels. Zero-waste garment design aims to eliminate the waste. It consists in defining cuts, folds and seams over a piece of fabric (a) such that the entire piece can drape around the body (b) to form a garment (c). Designing zero-waste garments is very challenging because the cutting pattern needs to satisfy manufacturing constraints as well as aesthetic goals. In particular, both sides of each cut need to be used, and the resulting garment needs to fit well on the body. Image sources [1]

1 Context

Most garments are composed of pieces of fabric sawn together. Since these pieces are cut from rectangular panels of fabric, a lot of fabric is wasted when the pieces do not cover well the raw panel, as illustrated in Figure 1 (left). Zero-waste pattern design is an emerging practice that seeks to reduce fabric waste and achieve more sustainable production in the fashion industry. In its purest form, zero-waste pattern design consists in creating garments whose pieces cover a panel of fabric entirely, as shown in Figure 1 (right). However, creating zero-waste patterns is a very difficult design task, as each cut needs to be strategically placed such that both of its sides are used in the garment, and that the resulting garment fits well the human body.

Our goal in this project is to develop a Computer-Aided Design (CAD) tool to ease the creation of zero-waste garment patterns.

2 Approach

While numerous CAD tools have been developed to support garment design, including our own work [dMQP+23], very little research has been done on minimizing waste in garment patterns. A notable

[1] (a,d): [RM23] Page 26,27 and 92, (b,c): https://fr.pinterest.com/pin/69031806782460018/

exception is the recent system by Zhang et al. [ZMB+24] that assists users in managing constraints between cuts to form zero-waste patterns. However, their system is limited to straight cuts, and requires expertise to know where cuts should be placed. In another domain, Koo et al. [KHLM17] propose an optimization algorithm to reduce waste in patterns for furniture design.

We plan to take inspiration from both approaches to convert arbitrary garment patterns into zero-waste patterns. We envision several directions to achieve this goal, including dedicated user interactions to explore the space of possible patterns (e.g., specifying fixed and flexible design elements, placing seams at specific position) as well as differentiable simulation to jointly optimize coverage of the fabric panel and fit onto the target body [LLK19, LCL+24, Mac22].

3 Work environment and requirement

The internship will take place at Inria Université Côte d'Azur, in the GraphDeco team (https://team.inria.fr/graphdeco/). The team works on multiple topics related to computer graphics (3D modeling, rendering, physical simulation). We seek to create a dynamic, stimulating, and caring work environment. We will happily put you in touch with past students if you'd like to have first-hand accounts of life in the lab and our advising styles.

Candidates should have studied computer science. Knowledge in computer graphics, and in particular geometry processing, physical simulation or numerical optimization is a plus. All applications are welcome, regardless of age, gender, social or ethnic origin, sexual orientation or disability.

References

[dMQP+23] Charles de Malefette, Anran Qi, Amal Dev Parakkat, Marie-Paule Cani, and Takeo Igarashi. Perfectdart: Automatic dart design for garment fitting. In *SIGGRAPH Asia 2023 Technical Communications*, New York, NY, USA, 2023. Association for Computing Machinery.

[KHLM17] B. Koo, J. Hergel, S. Lefebvre, and N. J. Mitra. Towards zero-waste furniture design. *IEEE Transactions on Visualization and Computer Graphics*, 23(12):2627–2640, Dec 2017.

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