Layer-Based Garment Modeling for Textile Form Weaving

Master 2 internship

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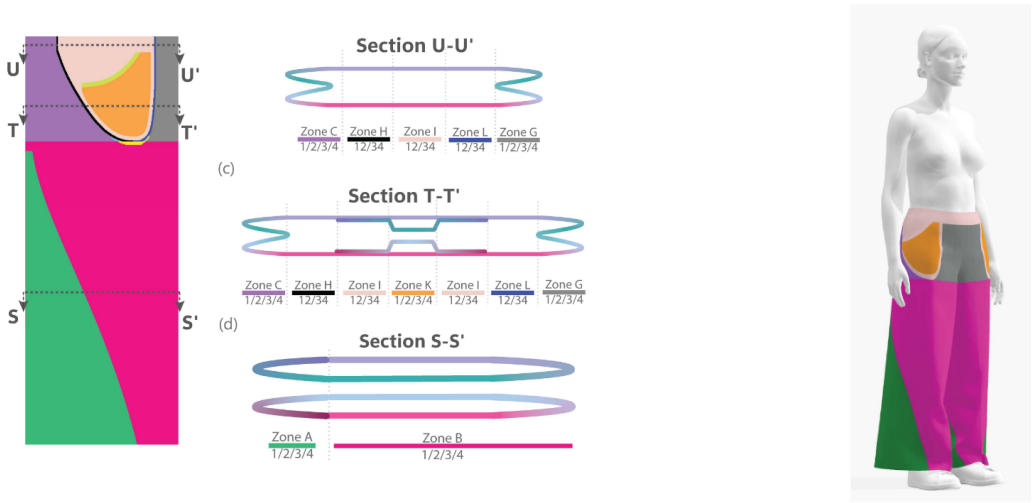

(a) Weaving pattern (left) and cross-sections (right) (b) Deployed garment

***Figure 1:**. Textile Form Weaving allows to manufacture entire garments by weaving them as stacks of connected textile layers (a, colors on the left denote different layer structures, visualized as cross-sections on the right). Once manufactured, the garment can be deployed to adopt its 3D form (b). Illustrations from [1].*

Context

Mass production of garments is responsible for significant waste in the fashion industry. During the manufacturing process, most garments are produced by cutting and sewing fabric panels of diverse shapes, which results in fabric cutting waste. Once fabricated in standardized sizes, many garments do not correspond well to consumers' fit or taste, and are left unsold or are thrown away after little use. Moreover, the manual labor of cutting and sewing is often done in low-wage remote countries, which further increases the environmental impact of garment production.

Textile Form Weaving is an innovative manufacturing technique that holds the potential of offering a viable solution for zero-waste, local, on-demand fabrication of custom garments [1]. This technology relies on standard looms to produce garments as a connected stack of textile layers (Fig.1), alleviating the need for manual cutting and sewing.

However, existing software for garment design is centered on the traditional process of sewing fabric panels [2], offering little support to the design of layered textile forms. The goal of this internship is to develop a garment design tool centered around textile layers for Textile Form Weaving.

Approach

This research will be conducted in collaboration with experts in garment weaving from TU Delft Industrial Design Engineering [1,3]. Together, we will first formalize the principles of layered-based Textile Form Weaving and deduce typical layer arrangements that can be achieved with this technology. Next, we will develop an interactive garment modeling tool that allows users to specify the local layering structure of a garment and visualize the corresponding 3D shape obtained when deploying this structure. This modeling tool could also account for deformation of the fabric that can occur once it is released from the weaving loom, including deformation induced by specific types of yarn [3].

In the long term, we aim at developing an optimization framework that would allow users to directly edit the desired 3D garment, and would automatically deduce the corresponding layered weaving pattern, similar in spirit to bi-directional editing tools that have been proposed for cut-and-sew garment modeling [4,5].

Work environment and requirement

The internship will take place at Inria Université Grenoble Alpes in the CRAFT group specialized in digital design and manufacturing. The work will be conducted in collaboration with the GraphDeco group at Inria Université Côte d'Azur, which is specialized in interactive shape modeling.

Candidates should have studied computer science. Knowledge in computer graphics, and in particular geometry processing, physical simulation and numerical optimization is a plus.

References

[1] Milou Voorwinden, Alice Buso, Elvin Karana, and Holly McQuillan. A Design Space for Animated Textile-forms through Shuttle Weaving: A Case of 3D Woven Trousers. ACM Designing Interactive Systems Conference. 2025. https://dl.acm.org/doi/10.1145/3715336.3735741

[2] CLO3D Fashion Design Software, https://www.clo3d.com/

[3] Alice Buso, Holly McQuillan, Kaspar Jansen, Elvin Karana. The unfolding of textileness in animated textiles: An exploration of woven textile-forms. DRS 2022. https://dl.designresearchsociety.org/drs-conference-papers/drs2022/researchpapers/208/

[4] Nobuyuki Umetani, Danny M. Kaufman, Takeo Igarashi, Eitan Grinspun. Sensitive Couture for Interactive Garment Editing and Modeling. SIGGRAPH 2011. https://www.cs.columbia.edu/cg/SC/

[5] Aric Bartle, Alla Sheffer, Vladimir G. Kim, Danny M. Kaufman, Nicholas Vining, Floraine Berthouzoz. Physics-driven pattern adjustment for direct 3D garment editing. SIGGRAPH 2016. https://www.floraine.org/research/physics-driven-pattern-adjustment-for-direct-3d-garment-editing/