Layer-Based Garment Modeling for Textile Form Weaving

Ph.D. Topic – Starting in fall 2026

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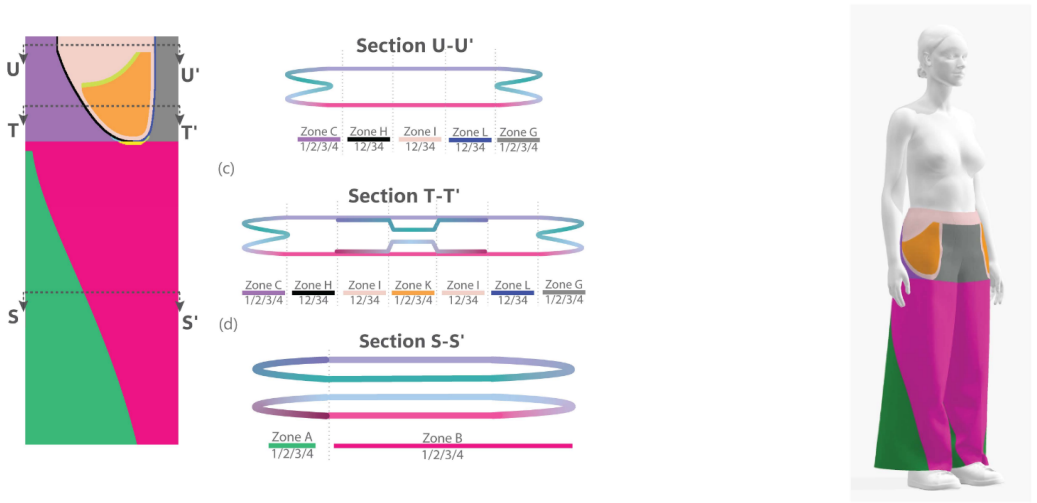

(a) Weaving pattern (left) and cross-sections (right) (b) Deployed garment

***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 Ph.D. is to develop the algorithmic foundations for garment design and simulation 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 data structures and algorithms for an interactive garment modeling tool that would allow users to specify the local layering structure of a garment and simulate the corresponding 3D shape obtained when deploying this structure. The simulation should reproduce deformations of the fabric that occur once it is released from the weaving loom, including deformation induced by specific types of yarn [3], which might require advanced yarn-level cloth simulation [4,5].

In the long term, we aim at developing an optimization framework that would allow users to directly edit the simulated 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 [6,7].

Work environment and requirement

The research will be conducted as a collaboration between the CRAFT team at Inria Université Grenoble Alpes, specialized in digital design and manufacturing, and the GraphDeco team at Inria Université Côte d'Azur, specialized in interactive shape modeling. The Ph.D. can take place in either team, with regular visits to the other team.

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

References

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