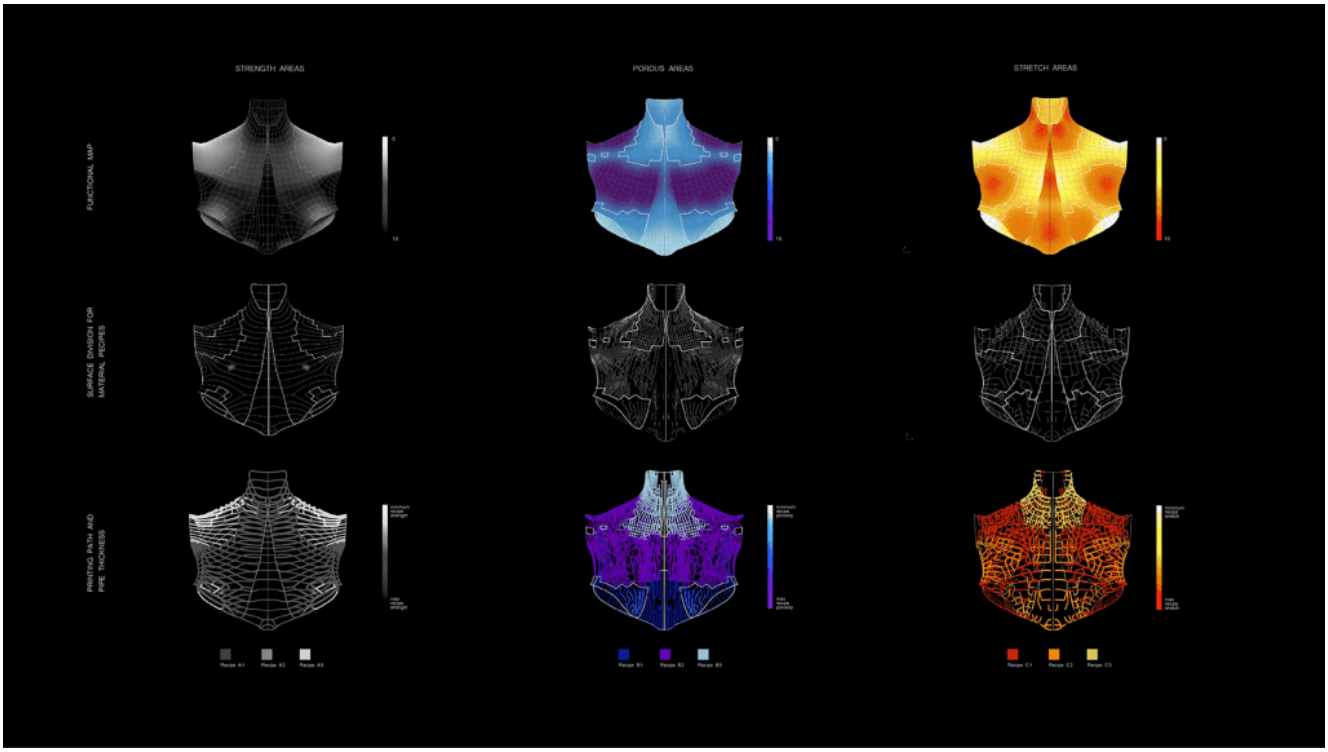
Adaptive Fashion: Designing with Body Data

What if garments could be designed not only to cover the body, but to respond directly to its needs? Adaptive Fashion is a research project that seeks to answer this question by developing a data-driven methodology for creating “intelligent” clothing patterns. By translating information from the human body into computational rules, the project reimagines fashion design as a system governed by measurable parameters.



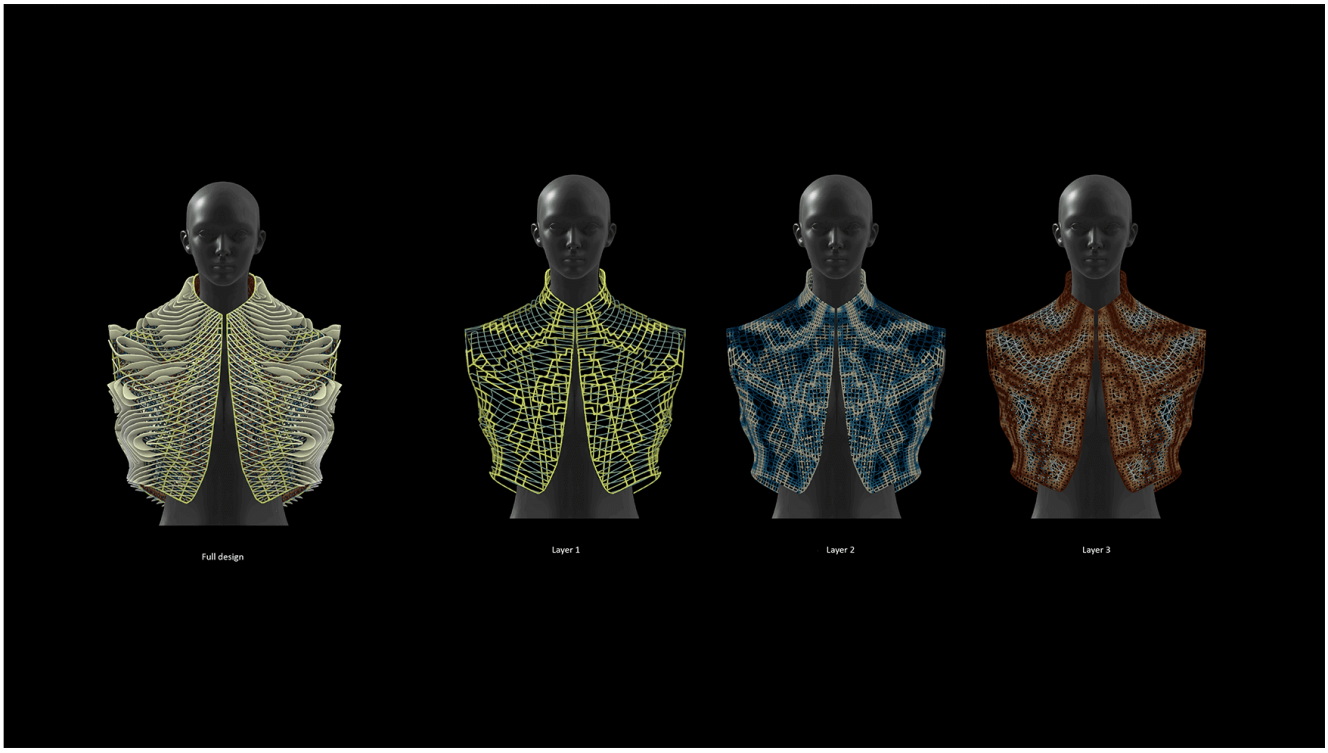
Color maps and geometry construction

FROM QUESTIONS TO PARAMETERS

The project originated from a series of fundamental questions: *How is a garment truly created? Who decides its shape, its materials, and its lifespan?* Traditional fashion design methods offered no precise way to transform these inquiries into operational design logic. The turning point came with the use of body data. Proportions, posture, and areas of skin stress became quantifiable inputs, enabling the generation of garments that adapt to the body’s multiple conditions throughout their

lifecycle.

This shift positioned the garment not as a static covering, but as an adaptive system. Applications extend across sportswear, medical supports, and other scenarios where garments must actively respond to performance demands.

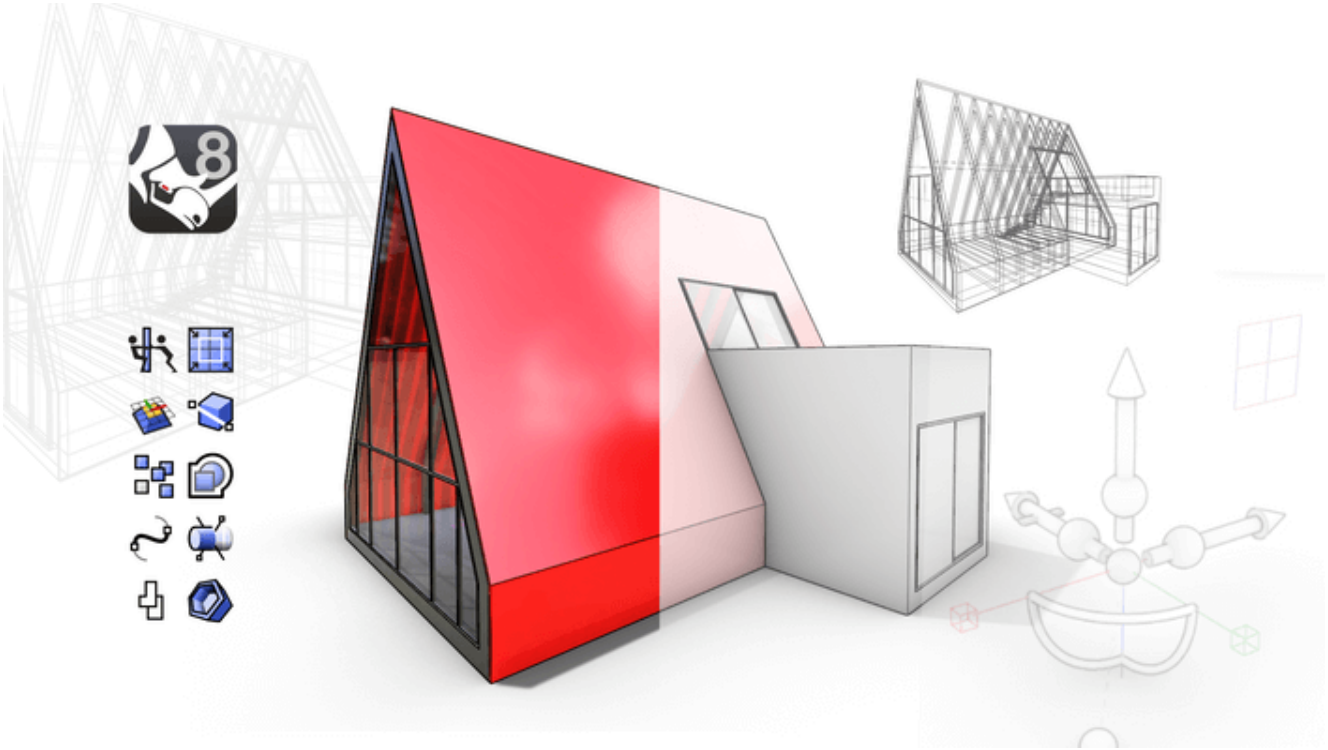


Visualization of the three layers composing the garment

METHODOLOGY: A TWO-PHASE RESEARCH

Adaptive Fashion unfolds in two main phases:

- **Phase One:** Design development through body data, culminating in PolyJet 3D printed as first prototype application.
- **Phase Two:** Bio-based material research, tailored to specific body function requirements and to be used on Liquid Deposition Material(LDM) for a second prototype application.



See Also

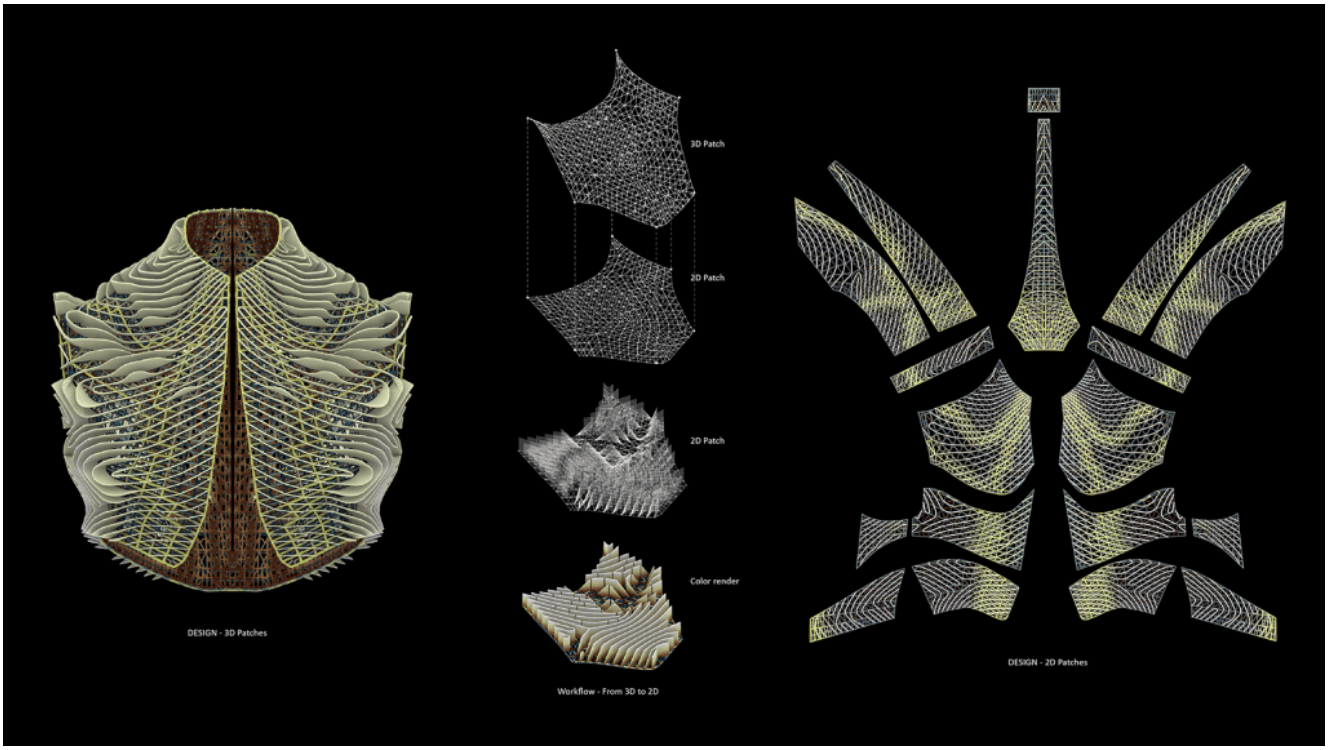
INTRODUCTION TO RHINO 8

WORKFLOW: FROM CLO3D TO GRASSHOPPER

The design process begins in CLO3D, where a base model is prepared, then subdivided into parts to respect anatomical curvature. These surfaces are then imported into Rhino, where Grasshopper becomes the central engine of computation.

Functional data is extracted through color maps representing curvature, ventilation, and stress zones. These maps feed into algorithms that translate values into geometric instructions. Using plugins such as Shortest Walk for mesh subdivision and Dendro for coherent surface generation, patterns are locally modulated: denser meshes are used for areas requiring rigidity, while expanded geometry is employed for flexibility.

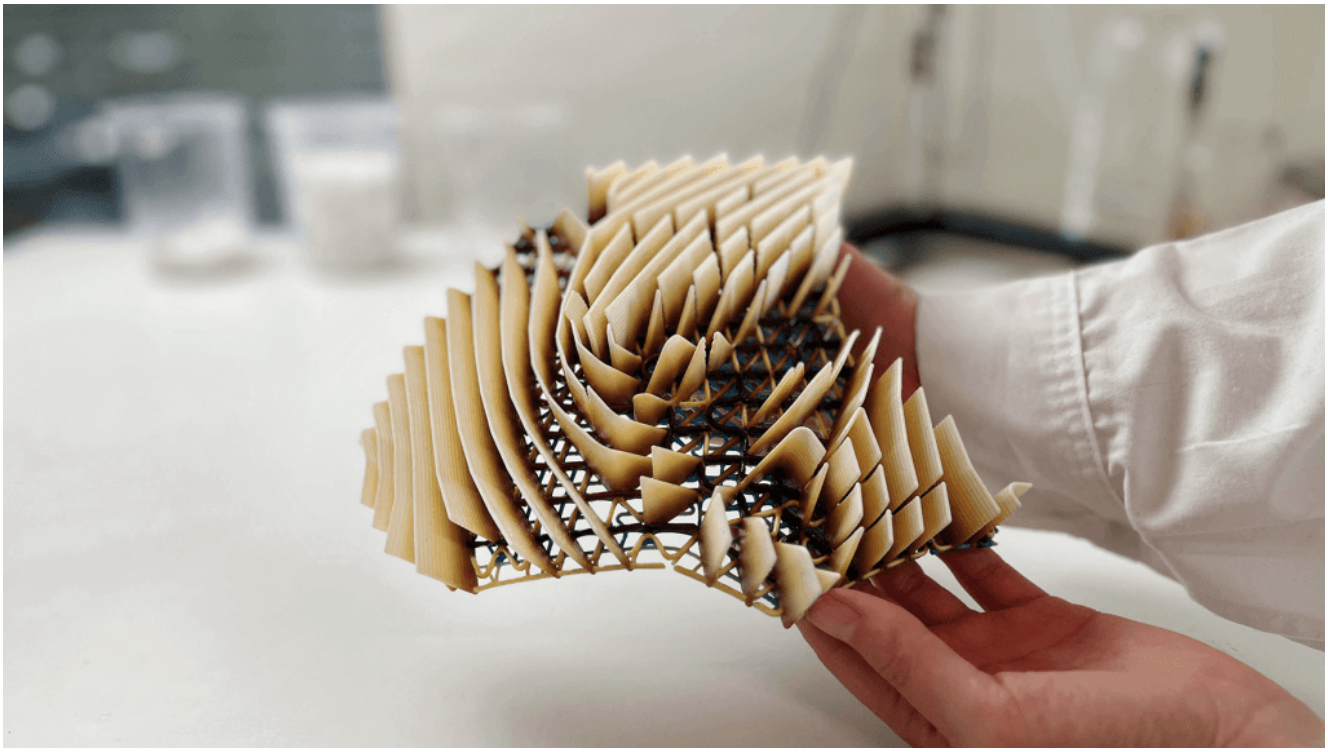
A custom algorithm was also developed to “flatten” 3D meshes into printable planar files, bridging the gap between computational design and additive manufacturing.



Workflow to make the 3D patch in 2D for the 3D printing process

PROTOTYPING WITH POLYJET

The first physical outcome of this methodology was produced in collaboration with Stratasys, using PolyJet 3D printing technology. This prototype explored areas of variable rigidity and flexibility, testing how computationally generated geometries translate into material performance. Although still in early development, the prototype confirmed the feasibility of adapting body data into manufacturable forms.



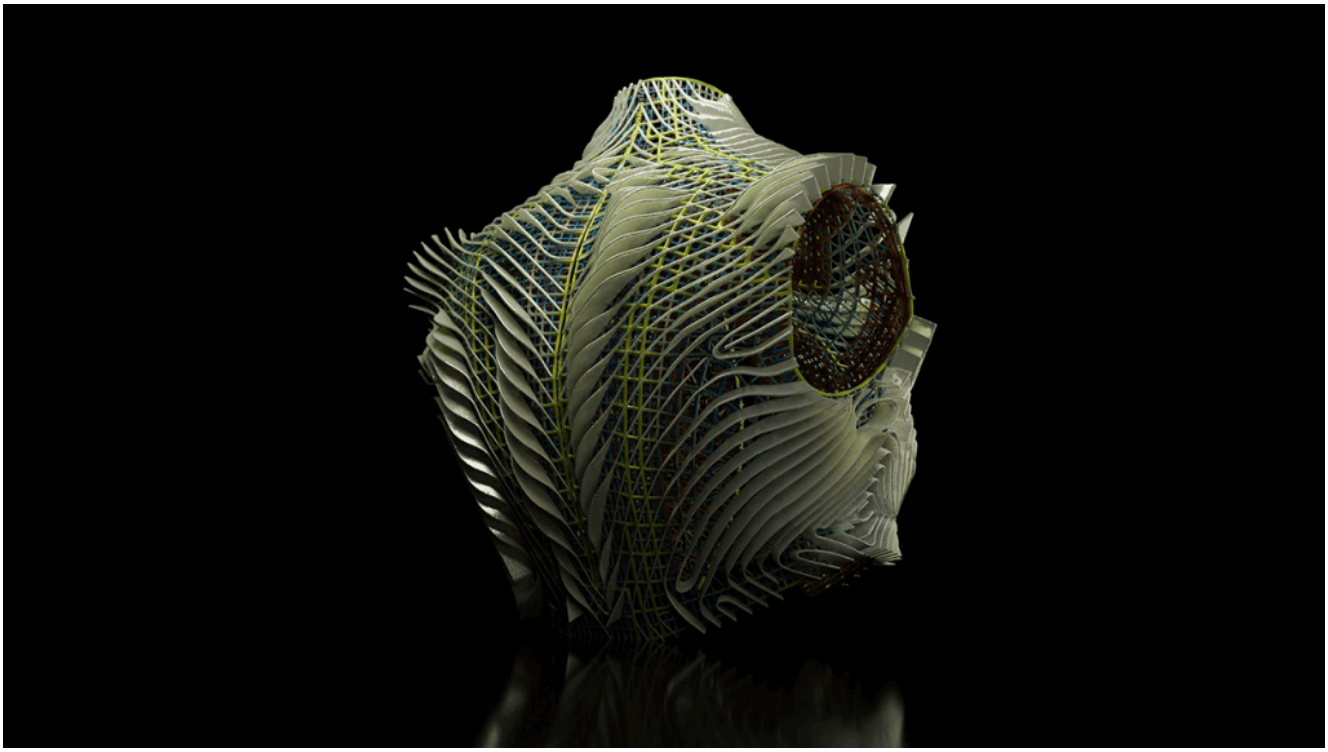
3D Printed single patch by Stratasys

BALANCING DESIGN, DATA, AND FABRICATION

Rigidity, flexibility, and density across the garment were not decided arbitrarily. Instead, they emerged from the interaction of three factors:

- **Body data** (functional maps of curvature, stress, ventilation)
- **Aesthetic criteria** (coherence with the design logic)
- **Production constraints** (thickness, height, inclination, manufacturability)

While some geometries aligned with the design concept but were too complex to fabricate, others were visually compelling but inconsistent with the data-driven logic. The final designs embody a negotiated balance across these factors.



3D model

TOWARDS INDUSTRY APPLICATIONS

After its initial presentation on the digital platform Parametric Architecture, which introduced the project to academic discussions in both design and fashion, it is now progressing into a validation phase involving mechanical and ergonomic testing.

The next step will be to apply this methodology to industrial fashion. An upcoming pilot involves scanning an athlete in motion, generating a garment designed to manage perspiration and optimize movement, and fabricating it via 3D printing for real-world testing. In the long term, the vision is to integrate material choice into the design process, enabling garments that combine biopolymers in precise multi-material compositions, produced through CNC-based methods such as 3D printing and knitting machines.

This approach positions Adaptive Fashion not only as a conceptual exploration but as a tangible technology for creating highly personalized, high-performance clothing, opening a new horizon for data-driven fashion.

CREDITS

Project: Adaptive Fashion
Designer & Researcher: Laura Civetti
Collaboration: Stratasys (PolyJet prototyping)
Tools: Rhino, Grasshopper, CLO3D, Shortest Path plugin, Dentro plugin
Institutions: ELISAVA University, NABA, IED, Domus Academy
Platform: Parametric Architecture