Experimental knowledge making through eTextile prototyping

17.1.2022

Intro

Emmi Pouta

- MA in textile design
 - Woven textiles, eTextiles
- Doctoral student, September 2017 -
 - ARTS DoD / ELEC Comnet

Agenda

- Touch interwoven PhD research
 - RQs and framework
- eTextile weaving in smart material development
 - Prototypes
 - Weaving process and woven prototypes in knowledge creation

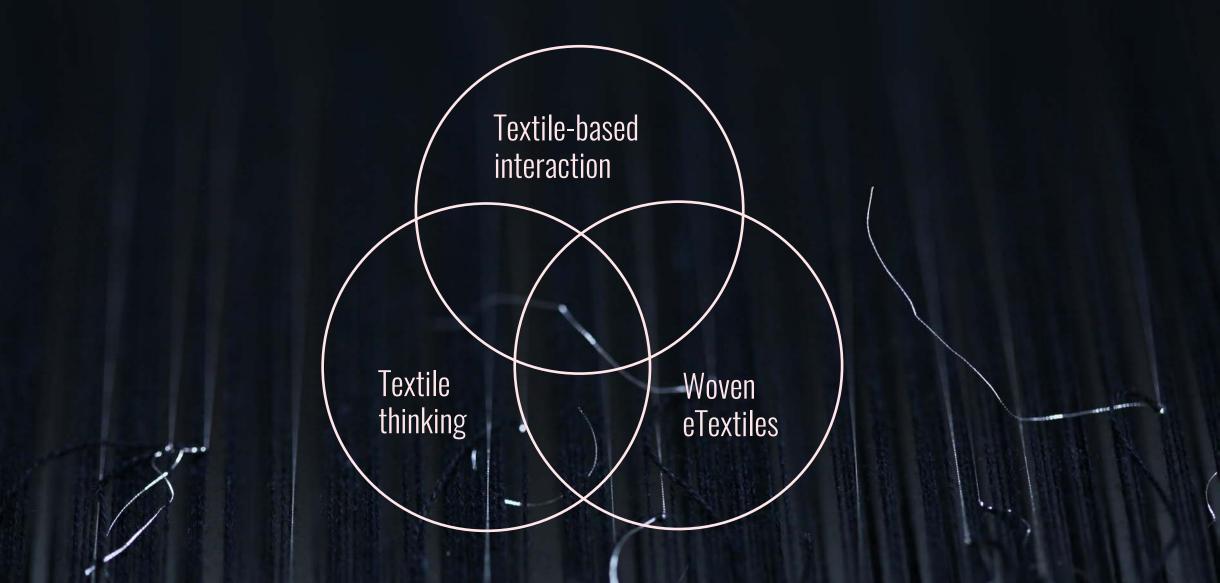
Touch Interwoven

Interactive Textile as an Interface Between Physical and Digital Worlds

Questions driving my research

- How can the electrical and sensorial properties of eTextiles be merged in complex woven structures to expand the experiential qualities of woven smart materials?
- How can the sensorial properties of textile materials be utilised in textile-based interaction design?
- How can textile designer's knowledge be utilised in smart material development?

Research field intersection

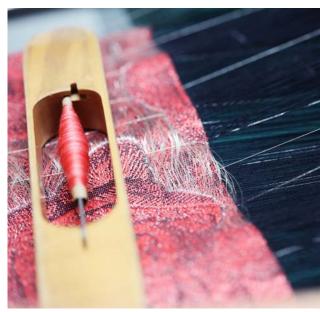


Approach: Research through design







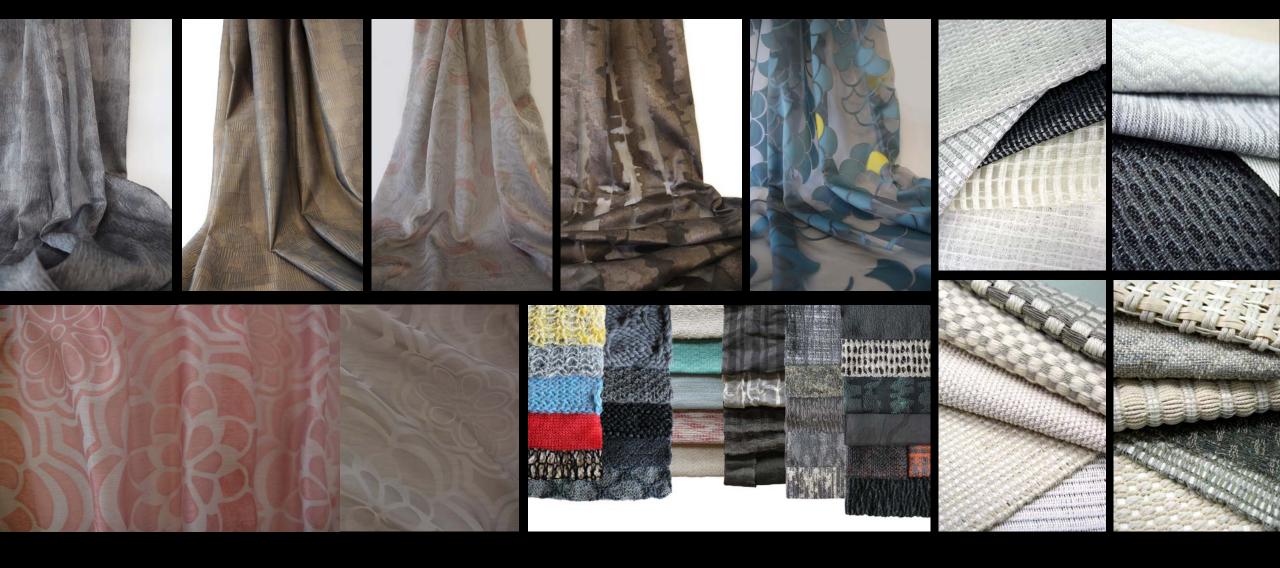


My own textile design practice, and the knowledge gained through the previous experiences, is the foundation of the research.

Print design



Woven textile design

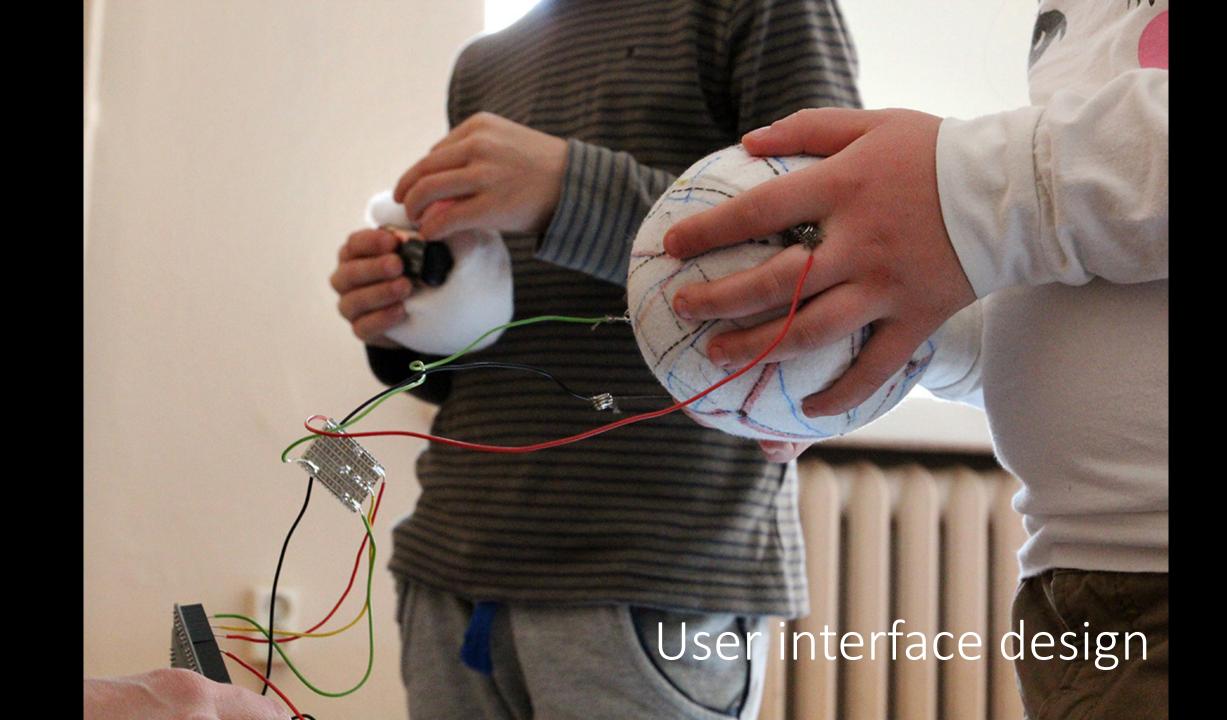










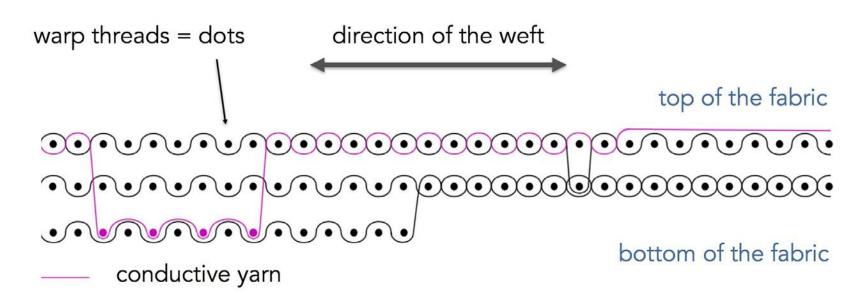




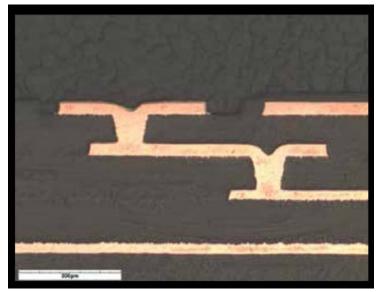
Starting point - a circuit board

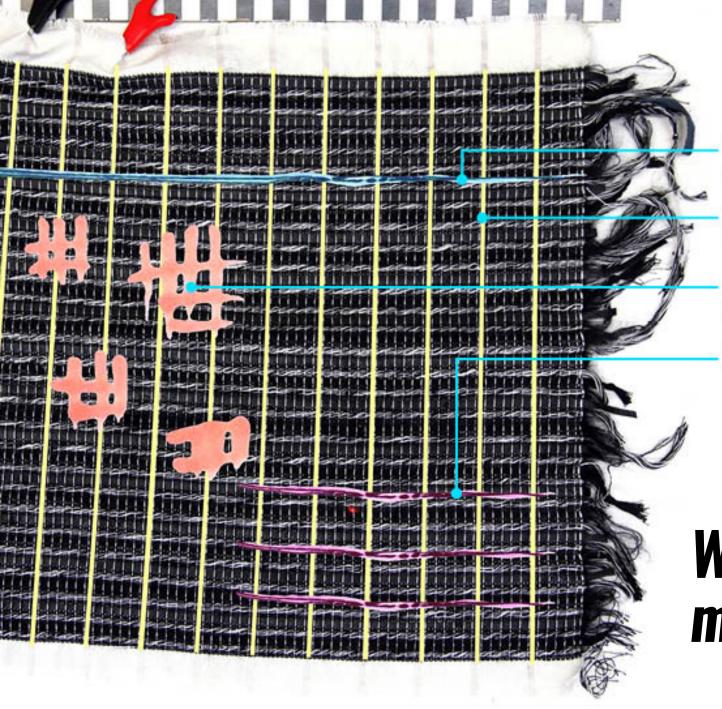


Applying woven structures into electronic circuit design



non-conductive yarn





Computational power integrated into the fabric, e.g. processor suitable for soft structures

Soft conducting wires for connecting different components

Soft, textile-made sensor and actuator structures

Other input / output components

What could this mean in practice?

eTextile weaving in smart material development

Methods and approach

- **Approach**: Research through design underlines the role of design practices and design artefacts in knowledge creation
- **Methods**: prototyping, reflective weaving, qualitative user study methods (e.g. semistructured interviews, wizard of oz, fabric handling and sorting tasks), subjective, structural and technical evaluation











Role of prototypes in RtD

In research through design, prototypes can play a number of roles (Stappers 2010).

- Prototypes evoke a focused discussion in a team, because the phenomenon is 'on the table'.
- Prototypes allow testing of a hypothesis.
- Prototypes confront theories, because instantiating one typically forces those involved to consider several overlapping perspectives/theories/frames.
- Prototypes confront the world, because the theory is not hidden in abstraction.
- A prototype can change the world, because in interventions it allows people to experience a situation that did not exist before.

Elizabeth B.-N. Sanders & Pieter Jan Stappers (2014) Probes, toolkits and prototypes: three approaches to making in codesigning, CoDesign, 10:1, 5-14, DOI: 10.1080/15710882.2014.888183







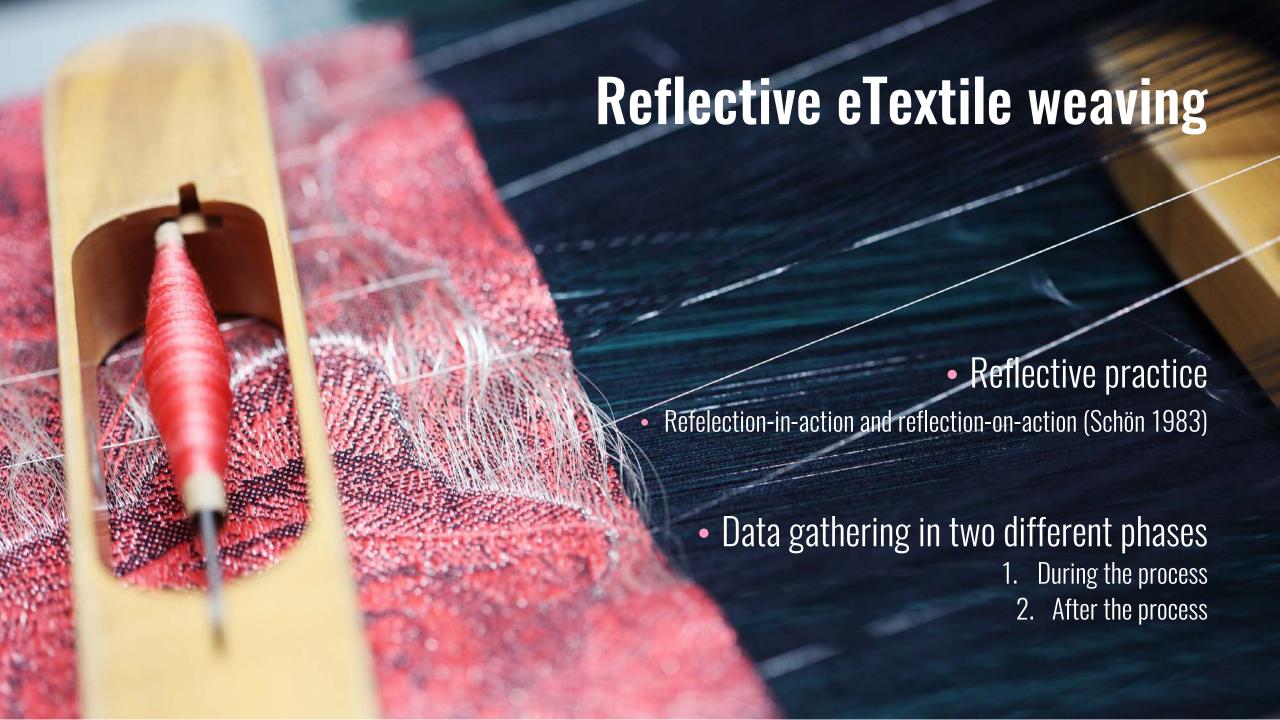


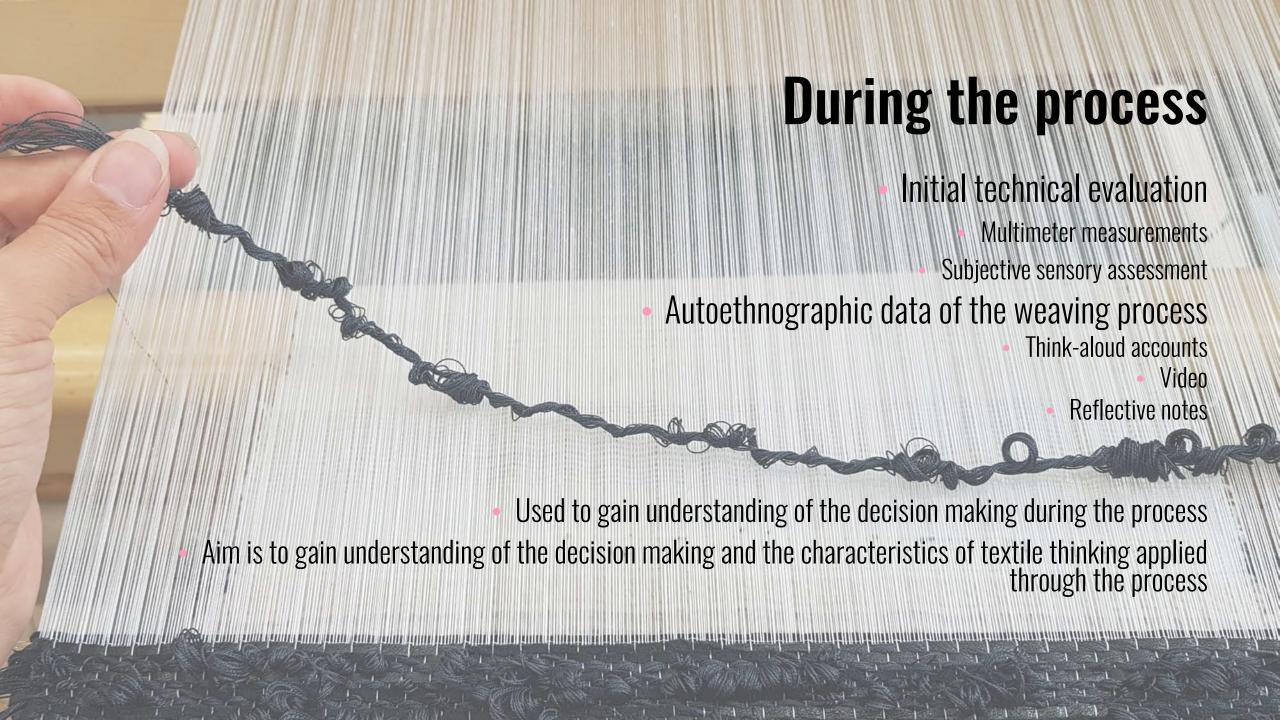


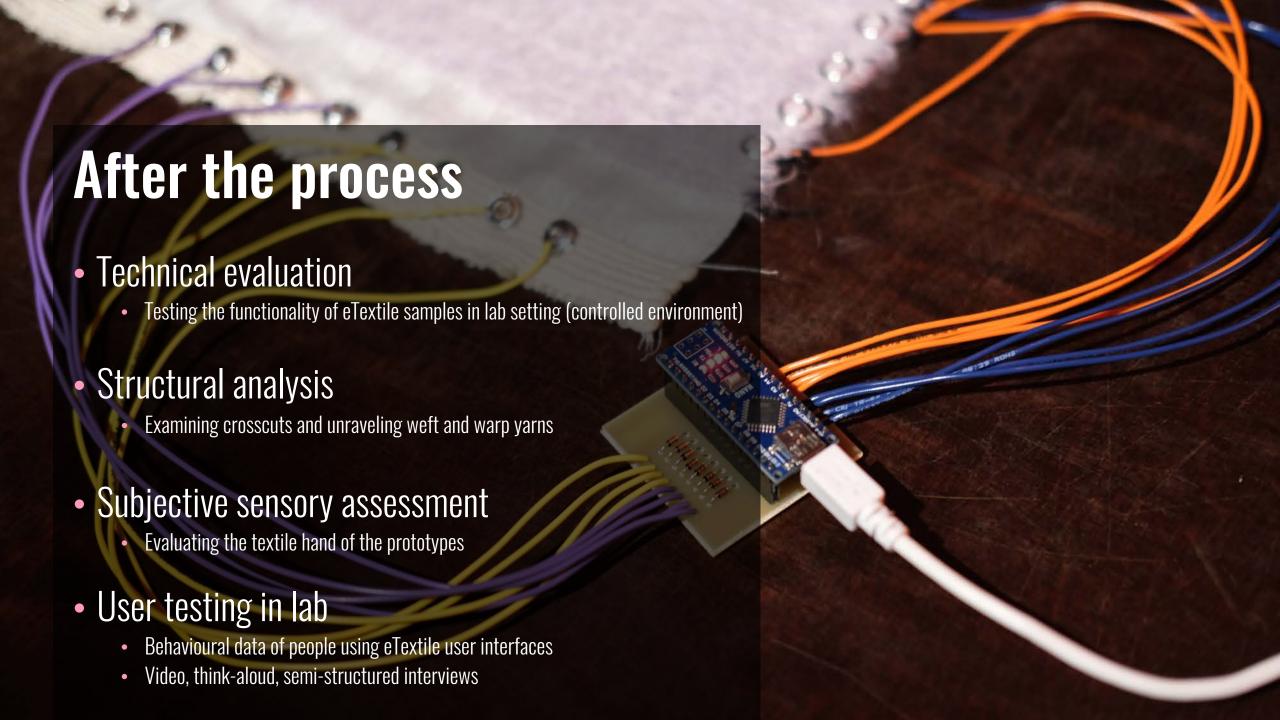




Prototypes are many things







Knowledge creation

How complex weaves can be used to expand the electrical properties of woven eTextiles?

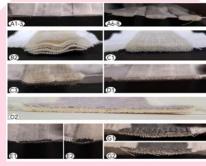




Design experiment 1:

How can woven sensor structures and visual characteristics enabled by jacquard weaving be merged in woven eTextile user interface?

How can sensorial properties of woven eTextiles be designed for tactile interaction?



Design experiment 2:

Literature review Woven exploration

- 30 woven eTextile samples
- Reflective documentation

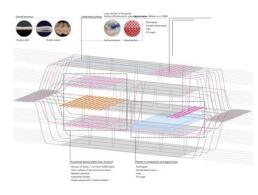


Design experiment 3:

Design space definition Woven exploration

- 15 woven eTextile samples to exemplify the design space

Key findings regarding woven structure design for tactile interaction, and current state of art in woven eTextiles for HCI



Main contributions:
practical methods for designing inner structures
and surface properties for tactile interaction
--> guidelines for interaction-driven woven eTextile
design

Key findings regarding relevant variables for woven surface design for tactile interaction





Interactive hand puppet

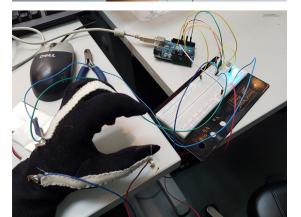
Synthesis of woven eTextile design, consisting of user interface design, pattern design, sensor structure design and textile layout design.

The interactive hand puppet is intended as a tool for interactive storytelling, to support child-adult-interaction with a thoroughly soft and textile-made object. The hand puppet consists of two layers: an inner sensor glove, designed to detect the movements of the user's fingers, and a woven outer layer that has a touch sensitive user interface integrated into its woven structure.

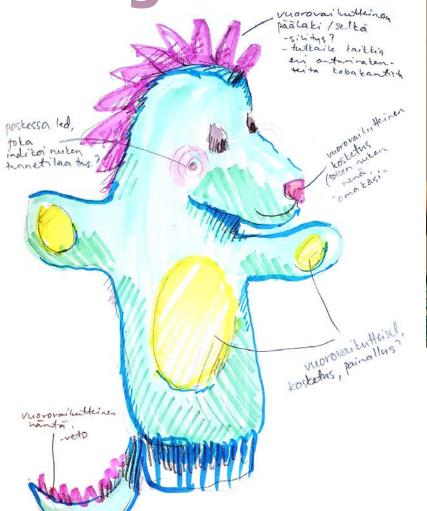
Pouta & Mikkonen, 2019. "Hand puppet as Means for eTextile Synthesis."







Interaction & UI design





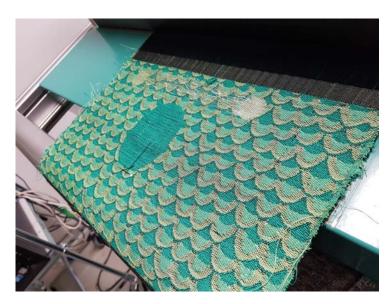


eTextile construction











Proof of concept-prorototype

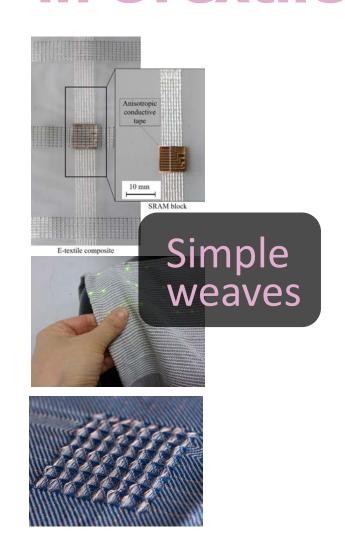


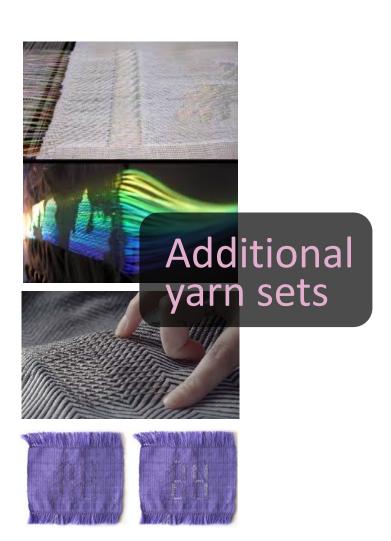


eTextile synthesis Interaction design Pattern design Woven textile UI layout SLIDERY TIED layout design Sensor structure design PRESSURE 1 TCAPACITIVE 2 CAPACITIVE 1 SLIDER 1,2,3,4



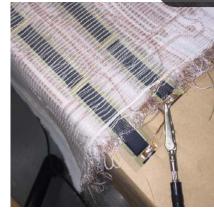
Simple & complex woven structures in eTextiles







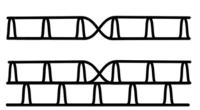


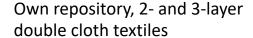


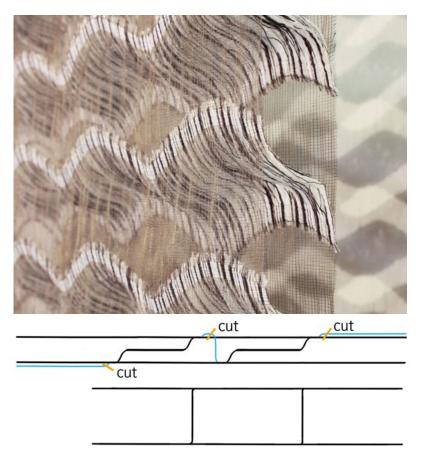
Towards more versatile woven eTextiles

- multi-layer structures in textile design



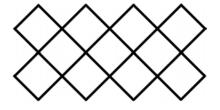






Paavilainen, 2015. "Floating and Clipping – Woven Textiles with Weft Floats and Finishings by Clipping."

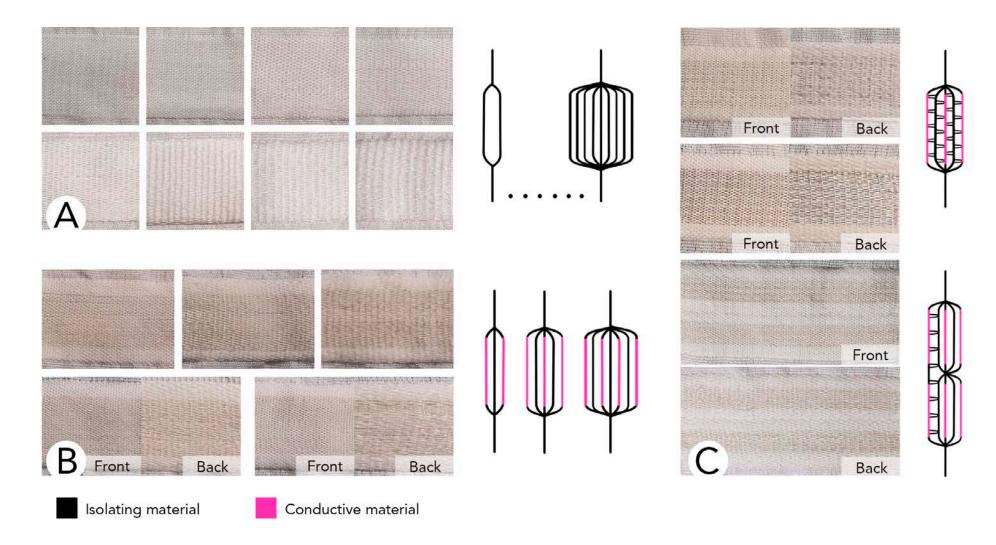




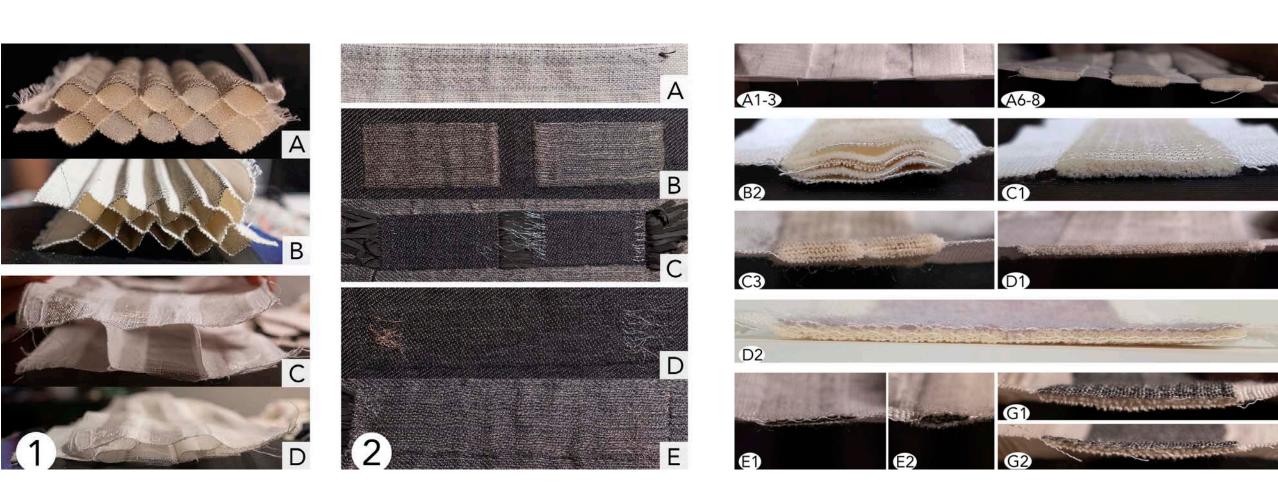
Schuylenbergh, "Bloom". https://esthervanschuylenbergh.squarespace.com/#/bloom/

Woven multi-layer structures

- layer count and electrical qualities



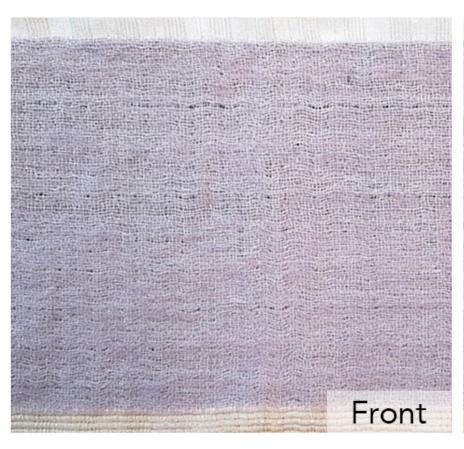
Structural findings



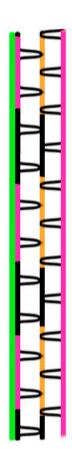
Cross-section pictures of woven samples

Woven multi-layer structures

- intertwining electronic and experiential qualities







Piezoresistive sensor grid

Isolating material

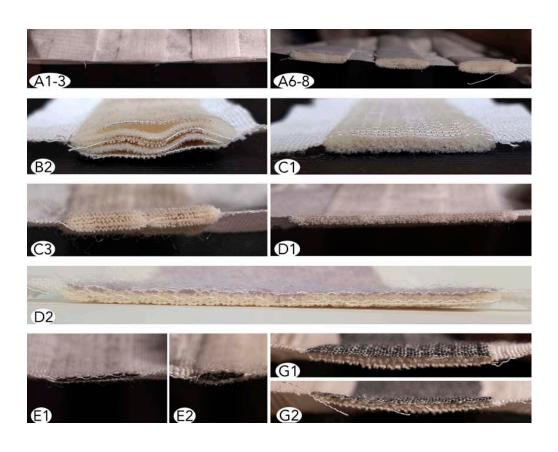
Piezoresistive material

Conductive material

Additional weft

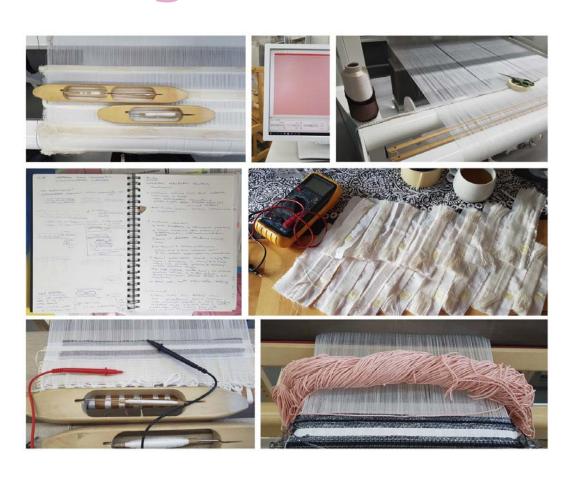
Inner structure of the material

- from multi-layers to multi-surfaces



- Guidelines for designing the inner structures
- All layers of a multi-layer weave can be designed with relative independence from each other
- How the previously mentioned properties can be "located" in the multi-layer structure

Electrical and sensorial properties as design variables

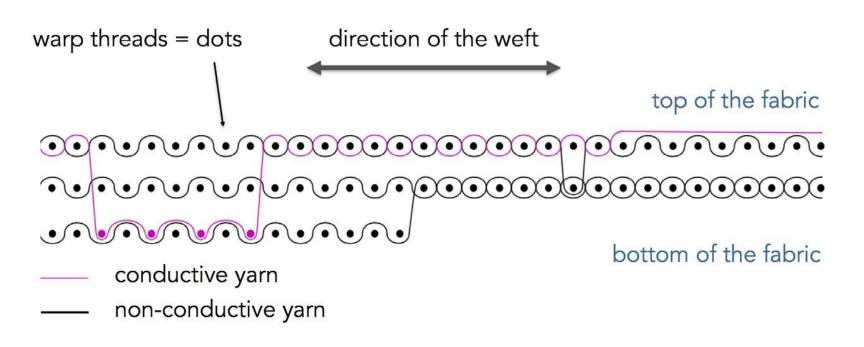


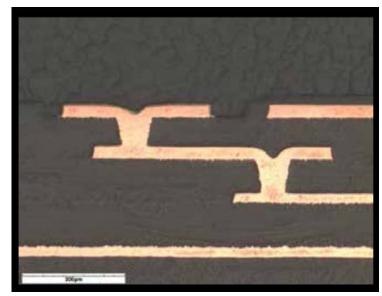
Controlling design variables, new forms of evaluation

- Sensory assessment meets technical testing
- How to navigate the area of designing multilayer weaves with different properties
- How to evaluate the structures during the process

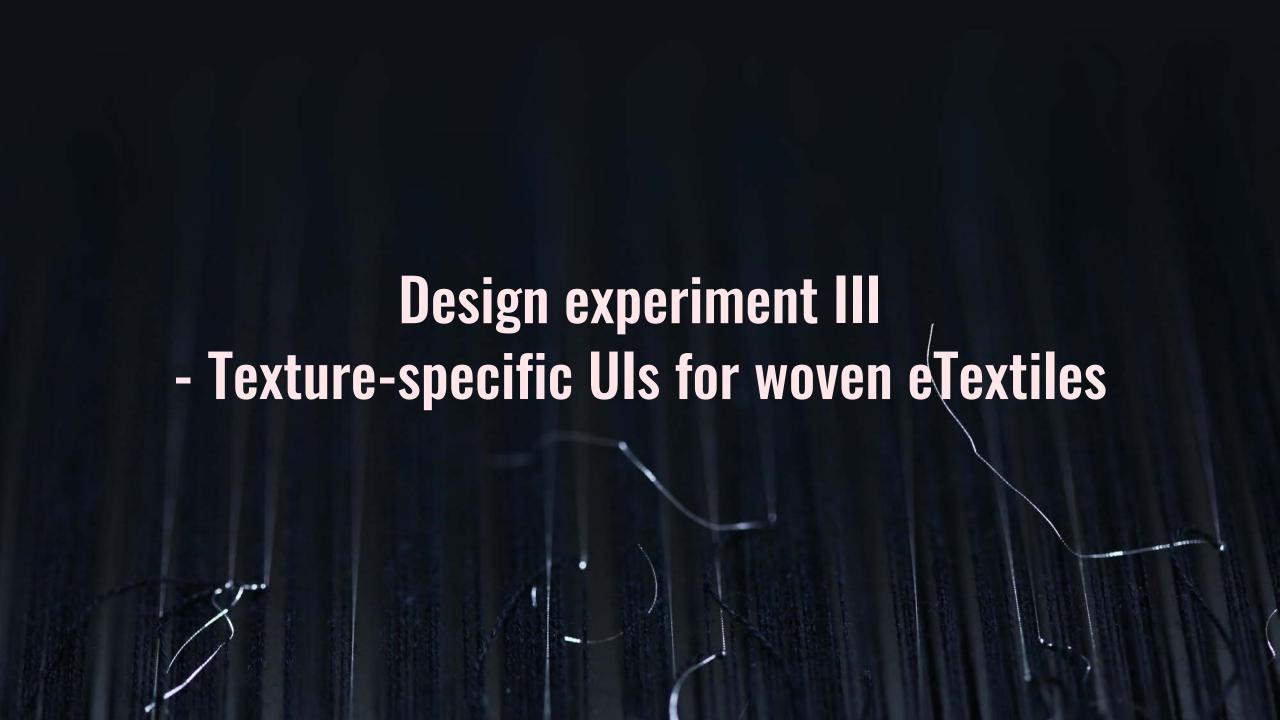
Towards interdisciplinarity

- implications for interdisciplinary cooperation

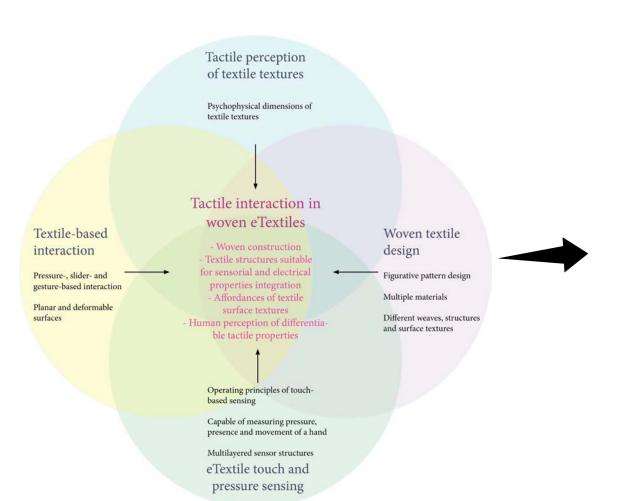




- How the reflective process and textile designer's knowledge benefit the smart material development?
- How the multidisciplinary discussion feed into the process?

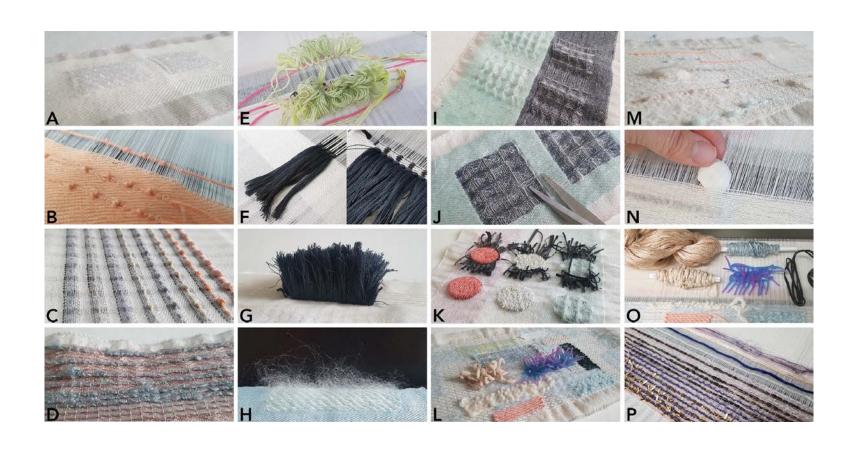


Design space for tactile interaction in woven eTextiles



Parameters for designing woven eTextile surface properties to afford tactile interaction

Woven eTextiles designed based on design space parameters

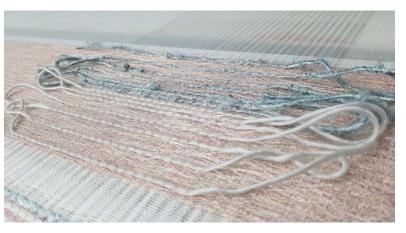


Future work

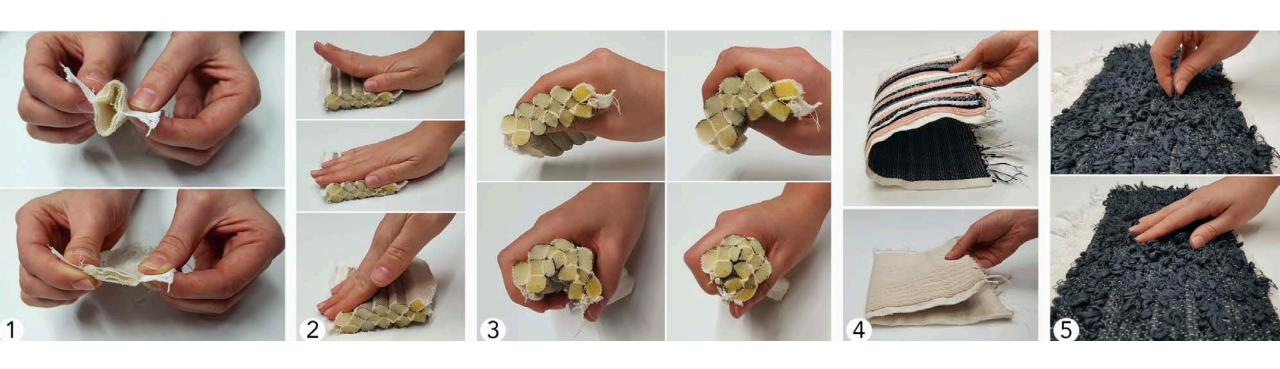
- touch-sensitive UIs for texture-specific interaction







Re-imagining HCI with multi-layer weaving



- What implications do multi-layer weaving have for textile material specific interaction?

Considering your own practice e.g. in fashion and textile design

- What kind of prototypes do you use, and how do those support your thinking in the design process?
- Think of a phenomena you find interesting (e.g. fashion for remote working, traditional craft skills in danger, etc.) how could you explore some aspects of it through your own design practice, and what kind of "drifting" methods could you use to increase your understanding of it?

