# Soft Boundaries

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The purpose of this project is to use digital knitting technology to create textiles that explore human interactions with space through interdisciplinary collaboration between architecture and apparel design. Functionally, both architecture, as a spatial enclosure, and garments, as body covering, provide humans with protection from physical elements as well as psychological support to hide, protect, define, communicate, and take comfort within. (Albers, 1953) Clothing embodies a space around a body and can direct how this body moves within a space (Entwistle, 2001), while architecture and interior design create spaces through forms of enclosure that further define the body and its experience. Designers such as Hussein Chalayan and Rei Kawakubo have explored this intersection; here, a collaborative research process between architecture and apparel design resulted in digitally knitted items spanning scale and application to define space, personally connecting the user/wearer to their environment.

Following a research through practice framework from clothing and textiles (Bye, 2010) and the creative practice method from interior design (Vaux and Wang, 2020), initial inquiry into the capabilities of digital knitting to address functional, aesthetic, and sustainable needs of apparel and architecture was conducted separately, but the connections became apparent while the researchers worked alongside each other developing prototypes. (Fig. 1) The common needs were primarily sustainable processes, functional products, and aesthetic appeal. The visual appearance of the knitted goods needed to make the user feel supported yet comfortable. Digital knitting is an emerging technology capable of producing innovative products for apparel, architecture, and interiors, automotive, safety, and even medical applications. (Blaga et al. 2011; Choi 2005; Liu et al. 2017) This process allows textiles to be designed and created with 3d form, unlike woven goods that must be cut and sewn. By knitting exact shapes, waste is minimized or eliminated. Combined with specialized yarns, a wide variety of products can be developed.

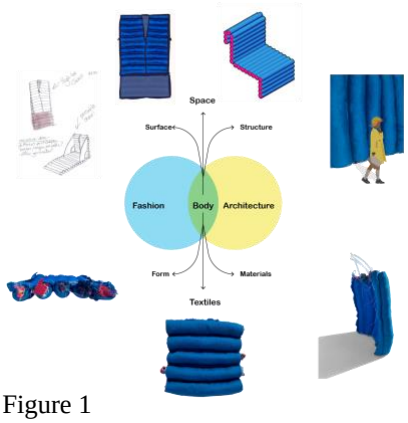


Figure 1

In this project, digital knitting technology was explored first through materials and knit structure exploration and used to produce a system of temporary enclosure and furniture produced from recycled materials coordinated with the use of the same knitted systems in apparel design. In contrast with existing research on knitting and architecture that implements digital knitting technology in service of the architectural form (Ahlquist et al. 2014; Davis-Sikora et al. 2020), the design process here began by testing knit textile structures through extensive prototyping. (Fig. 2) The iterative process is done by repeatedly

moving between file programming and knitting to develop gauge swatches. These swatches inform exploration of yarn denier and fiber content, file size, knit structure, and stitch length, and how each influences the possible design outcome (Munden 1959). Through this testing a 3-D textile form was developed which, through varied height of open channels between two layers of knit fabric, creates exaggerated stuffed tubes to increase the distance of the textile barrier off the skin. This structure was stuffed after knitting, providing a stiff yet soft textile product that could be used in a variety of applications, such as the wall panels, chair cover, and jacket. Sketches, including CAD and Clo 3d visualizations (Fig. 3) were produced in response to these swatches, and the digital file parameters were updated to better support product design in a constant, iterative feedback process. After many prototypes, a form of knitted structure with the appearance of a quilted panel or puffer jacket was chosen for the final product; using the prototype stitch gauge a pattern is calculated for production using set measurements for the final piece. (Fig. 2) For a garment, these measurements determine sleeve length, shoulder slope, etc., and for spatial objects the scale of wall panels, seat cushions, etc. Additionally, Repreve™ (Unifi) yarn, recycled from plastic bottles, was chosen to knit the goods. By responding to the materials and processes throughout the design research, both sustainability and aesthetic appeal were achieved in developing products. Furthermore, the products can be repurposed, moved, transformed, or recycled again to extend their use or become part of a circular design process.

Figure 2

Figure 3

Reflection on this research suggests that digital knitting and further interdisciplinary collaborations can be used to produce a highly tactile, transformable sense of space existing within a structure as well as an item of clothing. By working through process, values, and purpose within the design process a shift in approach to the use of materials and the relationship between the spaces we live within and the clothes we inhabit daily is formed; as Kate Fletcher states, we struggle to think beyond "our current experiences and imagine fabrics and garments in other configurations, with other agendas and possibilities." (p.240, 2014) Digital knitting introduces a combined process of textile and product production with multifunctional purposes in a near zero-waste manner. The "act of making textiles is more than a series of steps on the road to new product development and innovation," (Valentine et al, p. 973, 2017) and the use of digital knitting offers the potential to develop significant sustainable transformation to industries that use textile goods by allowing the designer to imbed values of function and aesthetics into the product throughout the process.

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