TEXTILE + DESIGN LAB

Case Study Number: 01/2016

Project Title: Parametric modelling and digital manufacturing for better bra fit

Researcher/People Involved: Ariya (Xuxu) Amoozegar-Montero; Edgar Rodriguez Ramirez (Supervisor); Gordon Fraser (TDL Senior Technician)

Contact: Xuxu Amoozegar-Montero   xuxu@xu2.nz

Project Period: July 2015 to July 2016

Project Description:

This was a student research project conducted as part of a Master's thesis at Victoria University of Wellington, School of Design.

This research was part of a larger study that focused on developing an overall system for a more accurate bra design and fit. Current bra fitting techniques do not appropriately address individual and unique breast characteristics to improve bra fit; this critical flaw can lead to discomfort, pain and chronic health issues. Research has shown that for an accurate fit of a bra, detailed measurements of the breasts and understanding of breast geometry are critical. This research focused on developing an overall system for a more accurate bra design, instead of focusing on the product alone. Due to the symbiotic relationship between bra fit and bra design, Xuxu designed a parametric system, in order to digitize the measuring process. This has resulted in personalised designs where taste, preference, and aesthetics are considered, and inherent breast shape, structure, contours, and asymmetry are incorporated.

This project used technologies including 3D scanning, to consider additional factors that are not currently considered, such as breast outline, shape, and asymmetry. Additionally, a major part of the research was dedicated to the investigation of the role of 3D knitting to address the potential of customization and individualization at a mass production level, as well as providing

an innovative approach to respond to bra fitting and design issues.

Background:

In earlier projects, integration of technology within bra design was explored, which led to this current Master's project research. One of the key insights from this research was the lack of documented inclusion of female contribution and involvement in the commercial bra design and marketing, specifically regarding sizing and fit. Although there has been a recent awareness of this issue, the researcher identified that there is still tremendous room for improvement, to allow greater input by women for a product that is essentially designed for women. The research is framed by Xuxu's question: "how can women take back the bra so that women are no longer forced to fit into a designated shape, or a shape that has been already designed for them, and instead have a relationship with a bra that moulds to the woman just how she desires it to fit?"

The search to answer this question led to a design process primarily based in digital technologies in order to develop a bra system that is unique to the individual. The process of 3D knitting has the ability to address some of the limitations found in traditional bra manufacturing methods. But also, since the breast imaging, measuring and design of the bra were all conducted in a digital manner, using 3D knitting as the manufacturing method had the advantage of translating the data gathered from the breast measurements to bra design developed on the digital knitting programme.

Process:

The iterative process of developing knitted bra prototypes was undertaken at AUT's Textile and Design Lab in conjunction with Senior Technician, Gordon Fraser. Over twenty iterations were developed to reach an understanding of the Shima Seiki knitting machine's capabilities in developing a knitted bra piece with innovative features. The bra prototype was based off a seamless design, although hooks were still considered separately to close the bra band. The prototype bras were knitted flat but allowed for unique designed knitting features. For example, a tubular knit structure with merino and Pemotex was applied for a seamless underwire design feature. Vertical seam structure and experimental knitting techniques were used for the development of a 3D shaped form within the bra for structured cup designs.

Project Outcomes:

Currently, commercial seamless knitted bras have focused on flexibility, softness and smoothness as features of the knitted fabrics' properties. However, the compression, or flattening, of the breasts is identified as one of the most critical limitations to seamless knitted bras due to the lack of 3D form and 3D structure. This project hoped to address this limitation through the development of a 3D knitted bra with additional knitted complexities, such as the addition of a 3D formed underwire line and cup shapes.

The current digital knitting design software is setup so that the user selects a template form and adjusts or alters it as needed to generate their individual design. The 'template' system establishes an easy translation between designing in the software and the capability to knit it using the machine. However, these templates do not incorporate the development of 3D form (though the machine has the capability to knit this way). Therefore in order to achieve the 3D form and shape that was desired for the bra prototype, a great deal of trial and error was part of the design process. Simultaneously, since the measurements acquired for the bra design were based off actual 3D curves of breast shapes, being able to translate these 3D curves to the 2D design system of the knitting machine was found to be quite difficult. Xuxu found that "with lots of patience, time and the expertise of Gordon Fraser, this project was able to make considerable strides in knitting this complicated form".

Publications:

Amoozegar-Montero, X. (2016). Parametric modelling and digital manufacturing for better bra fit (Master of Design Innovation, Victoria University of Wellington, Wellington, New Zealand).

Conference:

Amoozegar-Montero, X. and Rodriguez Ramirez, E. (2017 – Pending). Parametric modelling for better bra fit and design. Paper to be presented at the Western Decisions Sciences Institute, Vancouver, Canada.
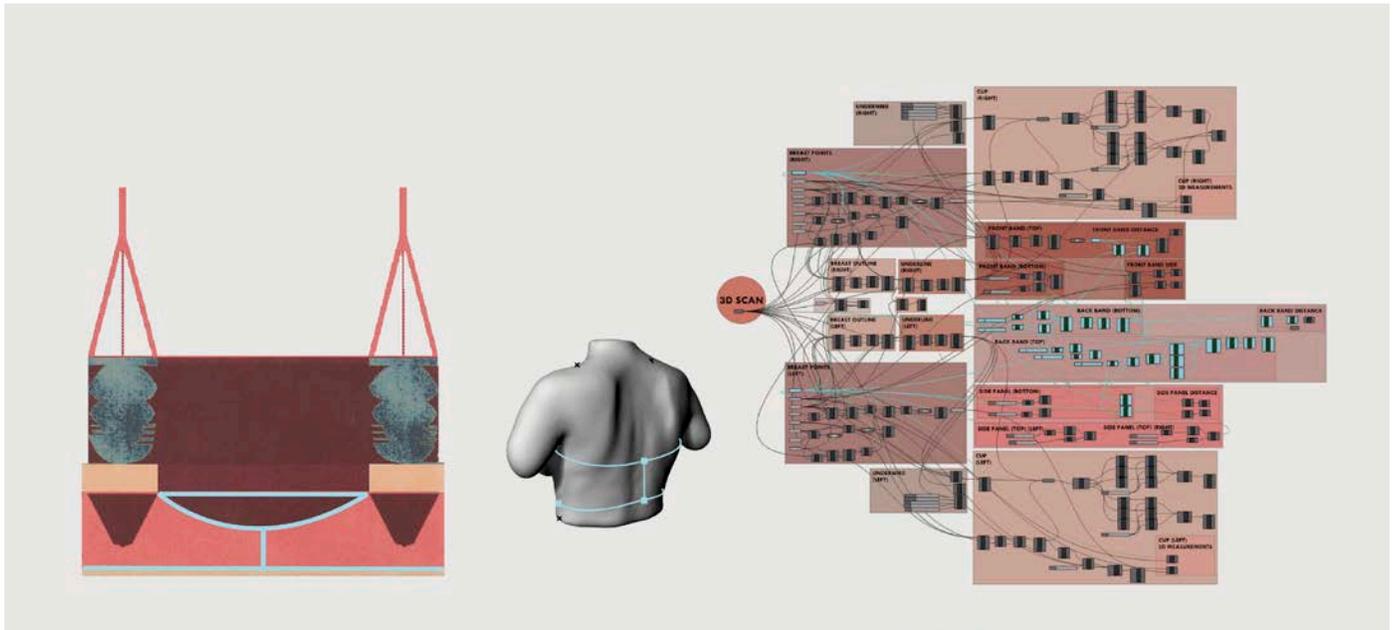
Images:

Figure. 1: Amoozegar-Montero (2016). Measuring 3D scanned model to design on 3D knitting software, parametric definitions for the design of the back band

Figure 2: Amoozegar-Montero (2016). Bra prototype iteration incorporating Pemotex yarn for underwire

Figure 3: Amoozegar-Montero (2016). Early bra prototype iteration combining merino and Lycra yarns