Digital Knitting: Connecting Technology in Craft through Process
Keywords: Digital Knitting, Material Study, Craft, Textile Design, Technology

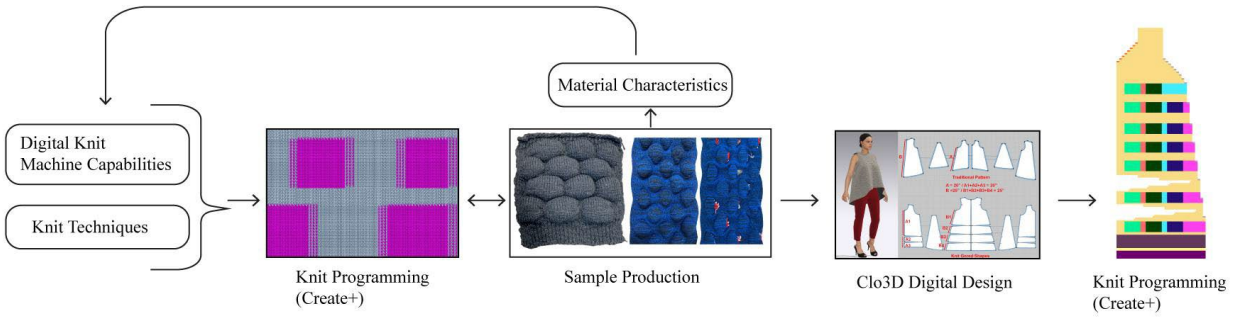
Krissi Riewe Stevenson, Kent State University
Jennifer Meakins, University of Kentucky

The purpose of this paper is to analyze the importance of a working relationship between craft practice, material knowledge, and digital fluency to advance digital knit scholarship and the use of this technology for innovative transformation of the creation of textile soft goods. This creative scholarship will be explored through a knowledge through practice methodology (Bye 2010) in the development of a shaped, 3D knitted vest utilizing the Stoll CMS 520 1.5.2 gauge digital knitting machine, the accompanying proprietary programming software Create+, and CAD apparel design software Clo 3d. Working through the craft and making process, we identify key characteristics and parallels between knit research and product development that embodies the relationship between digital technology and craft principles. Digital knit technology is a unique application of technology directing the use of physical materials; as a result it cannot be used in innovative ways without the direction of a skilled craftsperson. Previous applied scholarship focused on challenging the boundaries of the application of digital knitting through an interdisciplinary collaboration between apparel and architecture design, which, along with extensive research on the technology, materials, and both craft and industrial uses of the technology, led to this analysis.

While knitting production is mechanized and now digitized, the development and programming of the object to be knit remains a largely analog process relying on conceptual knowledge of the underlying craft methods. The process of programming requires a direct understanding of the material process of knitting yarns in a continuous, unbroken path. Different stitch actions, loop lengths, number of needles activated, and partial knitting are used to develop 3D shapes (Liu et al. 2021); this combined with the material characteristics of the yarn selected introduces extensive possibilities for exploration. This highlights the importance of all components of the process: knit design, technical program, and material characteristics. There exists a significant gap between soft goods knitwear designers, who often rely on cut and sew processes to design knitted goods, and technical programmers, who understand the technical process and structural capabilities of digital knitting, contributing to inefficiency and missed opportunities. (Gorea et al. 2021)

This project, in contrast to typical applications of digital knitting focused on production and predetermined forms, begins with the basic knitting process, which requires an iterative digital design workflow that allows for consideration and incorporation of the constraints of the knitting technology and programming. The expanded application and use of digital knitting is limited by this focus on mass production. When technology is solely focused on the solution of problems instead of including creative exploration, it becomes merely a tool with a means to an end (Parsons & Campbell 2004, McCullough 1996). This highlights the value of applying practice-based methodology to seek out innovative processes

using “making as a way of generating design knowledge.” (Loh, et al., 2016, p190) This allows the process to operate in a responsive, networked system that can expand on discovery. “open system, one that is networked, responsive, and expanding.” (Vaughan, 2019, p 12) The typical knit production process begins with extensive iterative material testing, repeatedly moving between file programming and knitting, in order to test a range of variables focused on final output or pre-determined product. The iterative process is done through “gauge swatches”, small-scale pieces that represent the final knit structure to be used in the final product. These swatches inform constant changes in yarn choice, file size, knit structure, and stitch length and each change directly influence the possible design outcome (Munden 1959).



In the development of the knitted vest described here, the process began with the exploration of the three-dimensional capabilities of the double-bed digital knitting machine, through trial and error. From embedded pockets, knitted without the time-consuming cast-off process, to shaping of the textile without darts, using a short row goring technique instead, numerous samples with variations in fiber materials, machine gauge, as well as size and location of the pockets and shaped portions were produced. The digital file parameters were constantly updated to accommodate the results of each test, yielding an immediate feedback loop from material concept to digital program to physical object and back again. (Figure 1) This feedback and collection of samples and knit program files were then explored in application to a range of products. The design here began with the characteristics of the test swatches, leading to the development of a garment incorporating the embedded pockets throughout for a use beyond simply carrying things, to providing protection and insulation as well as the shaping of the final garment to utilize the shaping capabilities of the machine. The silhouette was inspired by the volume added to the textile through the knit structure. A “bubble” shaped vest was designed in Clo 3d, with the curve of the 2D pattern translated to digital knit through a gored shape, used in the knit program to create 3D textile goods. The garment was developed in three symmetric, mirrored pieces due to width limitations on the machine available to the researchers; these shapes were then imported into Create+, along with information from the knit gauge swatch, used to calculate size, and the front test file. The resulting knitted piece (Figure 2) directly reflects the knit exploration process, and the craft skill and technology fluency of the researchers,

showing that "cloth persists as a record of the process;" the physical knitted object embodies that "the program and the pattern are continuous." (Plant 1998 p 121)

Beginning the knit development process through pure experimentation and learning through testing rather than the explicit production of a set product, allowed for a creatively robust and immediately reflective research process. The final product is the direct result of both the knowledge of body and space as well as an understanding of the knit process, to construct a garment that, rather than rely on traditional ideas of flat patternmaking, utilizes "inherent potential in conceptualizing techniques as thought processes and systems (Lehmann 2012 p.155-156). Digital knitting requires craft making to challenge and expand the possibilities and requires connecting digital notations and language with material craft, as the "manner in which fabric and the garment are produced reflects a way of thinking. The making begets the knowing." (Lehmann 2012 p.157) There exists expansive opportunities to explore digital knitting through this lens.

References

Bye, E. (2010). A Direction for Clothing and Textile Design Research. Clothing and Textiles Research Journal, 28(3), 205–217. https://doi.org/10.1177/0887302x10371505

Parsons, J. L., & Campbell, J. R. (2004). Digital Apparel Design Process: Placing a New Technology Into a Framework for the Creative Design Process. Clothing and Textiles Research Journal, 22(1-2), 88–98. https://doi.org/10.1177/0887302x0402200111

Gorea, A., Baytar, F., & Sanders, E. A. (2021). Challenges and design opportunities in prototyping seamless knitted apparel: a case study. International Journal of Fashion Design, Technology and Education, 1–12. https://doi.org/10.1080/17543266.2021.1881170

Lehmann, U. (2012). Making as Knowing: Epistemology and Technique in Craft, The Journal of Modern Craft, 5:2, 149-164, DOI: 10.2752/174967812X13346796877950

Liu, S., Mao, S., & Zhang, P. (2021). Toward on integrally-formed knitted fabrics used for automotive seat cover. Journal of Engineered Fibers and Fabrics, 16, 155892502110065. https://doi.org/10.1177/15589250211006544

Loh, P., Burry, J., & Wagenfeld, M. (2016). Reconsidering Pye's theory of making through digital craft practice: A theoretical framework towards continuous designing. Craft Research, 7(2), 187–206. https://doi.org/10.1386/crre.7.2.187_1

Mccullough, M. (1998). Abstracting craft : the practiced digital hand. MIT Press.

Munden, D. L. (1959). 26—The geometry and dimensional properties of plain-knit fabrics. Journal of the Textile Institute Transactions, 50(7), T448–T471. https://doi.org/10.1080/19447025908659923

Plant, S. (1998). "Zeros + Ones: Digital Women and the New Technoculture," in T. Harrod (E.d) Craft (2018). MIT Press.

Vaughan, L. (2017). "Designer/Practitioner/Researcher." in L. Vaughan (E.d.) Practice-based Design

Research (2017). Bloomsbury Academic.