3D Printing for Apparel Design: Exploring Apparel Design Process using 3D Modeling Software

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Since the birth of 3D printing technology in 1984, it has long been used mostly for industrial prototyping. As rapid manufacturing technology evolves and becomes more readily available today, the 3D printing technology has advanced into medicine, surgical instruments, music instruments, and even the culinary industry. In the last few years, 3D printing technology is also quickly entering the product customization market to meet consumer's demand for personalization through development of small-scale 3D printer for personal home use and 3D printing services. Such technologies driven phenomena and the rapid advancements in 3D printing have brought us to a time when a new design and manufacturing paradigm is required (Delamore, 2004). It has been considered as the third industrial revolution, especially through increasing production efficiency (Lipson & Kurman, 2013). In the world of fashion, 3D printing technology is becoming a new and rather trendy focus for many. Due to the limited printing materials and technologies currently available, apparel design using this technology is not yet feasible in the mass market. For most 3D printing fashion pioneers, the most feasible categories are in accessory and footwear design. A few others in the couture fashion sector are exploring innovative 3D printed apparel as a conceptual art form. However, 3D printing experts believe the immediate concern in applying 3D printing technology is the process of 3D modeling, using specialized computer aided software. According to Lipson and Kurman (2013), one of the biggest barriers in transitioning 3D printing technology into wider adoption is the lack of a "killer app." Thus, the adaptation of 3D modeling software to a designer's modeling processes and interaction with the software is crucial.

For designers trained in traditional apparel design programs, designing involves hands-on experience in applying 2-dimensional patternmaking and 3-dimensional draping techniques in order to manipulate the material to fit the body using a dress form and/or fit model. Designing using 3D modeling software requires one to efficiently transfer apparel design knowledge, experience, as well as design ideas into the virtual dimension in order to create the design as a digital 3D object. Potential barriers may exist in visualizing the design in the 3D modeling process. Considering the limited application of 3D printed fashion in the industry and the lack of knowledge sharing, much research is needed in 3D apparel modeling processes. This case study has taken a practice-led approach and naturalistic inquiry concept to reflect the designer's 3D modeling experience using selected software, 3ds MAX®, to develop a wearable woman's waist-forming accessory. Previous exploration in modeling a woman's neck accessory using beginning level 3D modeling software, and applying only limited number of reference points and measurements in modeling, created challenges in sculpting a properly fitted design around a space that represented an accurate body shape. To better visualize the virtual body, this investigation focused on exploring ways of designing or sculpting apparel using 3D body scans

developed using the TC^2 system and an understanding of the designer's tactile experience, visualization, in addition to the impact of tacit knowledge in the virtual design process. Treadaway suggests that visualization and tacit knowledge, or past experience, are crucial aspects in digital imaging as a component of design practice (2006). The entire process was screen recorded, and applied the idea of reflexivity to document personal thoughts. Memos and sketches made during the process were recorded in a reflective journal.

The outcome of this study resulted in a digital artifact of an architecture inspired asymmetric 3D waist-forming accessory for women. There were four main stages involved in the 3D modeling process. The first involved developing a 2D polygon shape for both front and back of the waist accessory. The second stage was focused on contouring the 2D polygon, with desired thickness in editable mesh form, against the front and back waist areas of the 3D body scan, adjusting specific mesh components to fit the body form. The third stage focused on joining the front and back pieces to the body scan and was followed with the final stage of chiseling out design detail on the accessory surface by incorporating geometric hollow spaces and defining the outline edge of the accessory. The finding suggests that the 3D modeling process requires a high level of tacit knowledge in apparel design in a design process, in which high mental visualization ability was needed as limited tactile experience was present with only a mouse and keyboard as moving instruments. The process does not provide the traditionally trained apparel designer with the natural tactile action of typical clipping, pinning, and turning the dress form using both hands and/or body to reach out and touch and intuitively evaluate the closeness of fabric to the dress form. For object rotation, it also requires one to consider the unique three-dimensional coordinate environment, commonly seen in such program and represented by x, y, z planes. Thus, much tacit knowledge, gained from both traditional apparel design education and experience, was needed to aid in better 2D and 3D visualization of the object in mind and in making appropriate decisions when editing the object virtually.

Further, major challenge exists in the stage of contouring the 2D polygons to the 3D body scan surface was time consuming and rather challenging in evaluating the closeness of the accessory surface to the body form, such as inclusion of fitting ease. Future research will include examining various instruments and program options available for 3D modeling for apparel, such as a 3D mouse, to simulate more true to life tactile experiences in order to improve the efficiency of 3D modeling and more adaptation ease for traditionally educated apparel designers.

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