

Illusion Raindrops- A 4D Knitting Exploration

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Keywords: knitwear design, 3D knitting, illusion knitting, dress

Contextual review. It has been established that, one efficient technique capable of changing a woman's perception of her body appearance is using optical illusion textile patterns (Ridgway et al., 2017). Fashion designers often use color blocking to emphasize certain areas of the body and balance proportions. The *trompe l'œil* technique has been often used in knitwear over the years and refers to “works of art designed to deceive the viewer, if only momentarily, into believing that the artist's fictitious representation is real” (Seckel, 2004, p.9). More complex knitwear design techniques for optical illusion use multicolored jacquard and intarsia patterns, along with textured surfaces and 3D shaping, achieved by increasing and decreasing the number of stitches at different locations on the garment, changing the knit stitch length, or by partial knitting (Liu & Yuan, 2021). When combining 3D textures and shapes with optical illusion patterns, an interactive 4D effect can be achieved, an interdisciplinary research area of growing interest for the author and many other scholars (Kooonavard, 2015; XXXX, 2023; Manaia et al., 2023; Ndure, 2024).

One optical illusion knitting technique lesser known originated with a Japanese teacher named Mieko Yano who, in the early 1980s, moved to Sweden and brought with her a slim booklet that explained how to make what she called “magic knitting patterns” (Hoxbro, 2004, p.4). The mysteries of this simple technique of alternating rows of dark and light-colored yarns knitted with a textural garter stitch to produce subtle patterns that appear and disappear depending on the angle from which the fabric is viewed, attracted a slew of creative experimentations from many artists and hand-knitters. Besides Vivian Høxbro, who went on to publish her own book about this technique, called *Shadow Knitting*, the British math teacher Steve Plummer, who uses knitting and crochet to explain math concepts, is credited with making significant contributions to illusion knitting scholarship through his large rectangular art hanging pieces (Plummer, n.d.).

Recently, Paolina Russo, a Canadian fashion designer, elevated this hand-knitting technique by using advanced knitting technologies to incorporate illusion knitting panels in her 2024 collection, via cut-and-sew production of rectangular pieces and strictly for aesthetic purposes (SSense, n.d.). Moreover, a gap was found in knitwear designs combining illusion knitting with other 3D knitting garment shaping techniques for innovative silhouettes. Therefore, the purpose of this project was to creatively explore how the illusion knitting technique can be manipulated into a shaped garment using various 3D knitting techniques for an optical illusion slimming 4D effect, advancing the scholarship of knitwear design aimed at improving women's body perception.

Process, technique, and execution. After hand-knitting dozens of swatches to learn the mechanics of illusion knitting technique, a simple pattern and shape was deemed to be feasible for machine knitting the technique into a contemporary garment silhouette that would integrate 3D shaping around the breasts, armholes and back. Raindrops on the car window while driving at night ignited the designer's imagination about what simple optical illusion imagery could be for this project. A search of various photo databases brought up the image shown in Fig. 1a, that served as a visual prompt for silhouette sketches as well as color direction for yarn selection.

For a smooth transition of colors that would replicate water immersion, space dyed colored yarns have been sourced, with added metallic yarns for a shimmering, wet effect. The final lace weight yarns used were: (1) 57%Cotton 38%Acrylic 5%Lurex Polyester color Frosted Whirl from Scheepjes, (2) 35%Polyester 65% Viscose color Black from Silk City Fibers, and (3) 100% Bamboo color Black from Silk City Fibers. Gauge swatches were knitted on a standard gauge

Silver Reed SK860 machine to find the feasible stitch length range for 3D shaping as well as to establish the physical measurements of the resulting fabric knitted using illusion knitting technique. The concept of raindrops was interpreted first as watermark type of circles for illusion knitting, and graphs were created in DesignaKnit 9 software (Fig. 1b,c). The illusion knitting technique was used to create the bottom of the dress, as one large sideways placed panel, with one side seam, scaling the circles from smallest at center front to larger at center back by using graduated stitch length, and separating the yarn into sections of colors to create a slimming vertical center front focal point. The limited number of needles on the machine required to split the dress construction in top and bottom panels, to make a longer dress that is more slimming.

A second knitting machine with a SRP60N ribber bed attachment was used to create the top of the dress with floating 3D shapes reminiscent of raindrops. The background had to visually mimic the look of the illusion knitting that was placed vertical, so a two-color 1x1 corrugated rib pattern was developed. The 3D black shapes are flat at the top of the front panel, then gradually increase in fullness towards the last one between the breasts, to mediate the circle shape distortion that occurs due to ribbing pattern when the fabric is stretched on the body. Partial knitting was used to shape the breast cups, as well as to shape the back flared piece. Intarsia technique was used to engineer a water immersion effect around the breast cups, using three different areas of transitioning color from yellow to dark yellow then blue. The top and bottom of the dress were knitted in parallel, often dropping the work from the machines to drape on the dress form, coordinating the placement of the 3D shapes and aligning the color panels, then rehanging the work on machine or starting the knit pieces again. Horizontal ribbing along with intarsia technique were used to create a textural band that connects the top and bottom of the dress, wraps around the armholes, and adds extra flare to the back top piece hem, further creating a waist slimming effect and a creative silhouette reminiscent of the back of a raincoat (Fig. 1d).

Cohesion and aesthetics. The concept of optical illusion has been carried throughout the design process, material selection and techniques, from the slimming transition of colors, combination of textures through yarns and knit stitches, circle shape variation through scale and 3D profiles, to the overall silhouette of the dress that is slightly longer at bottom center back, harmonizing with the top flared hem. The dress has a strong frontal focal point emphasizing the use of 3D knitting for the black raindrops and breast cups, guiding the eyes through the illusion knitting panel where the vertical rows of black circles appear to slim the silhouette all around in a seamless 4D manner (Fig. 1e). The water immersion color effect smoothly transitions from vertical to horizontal direction, and the color contrasts accentuate desirable areas of the body.

Design contribution. This creative scholarship, combining techniques from old craftsmanship with current knitting technologies, elevates the use of illusion knitting from purely aesthetic means to a functional 4D effect aimed at optically slimming the silhouette, adding to the design scholarship on improving the body image of women. This machine knitting work advances the designer's research into innovative techniques for 3D to 4D design, serving as an inspirational reference that can be further developed for market using digital knitting technologies. The author's continuous engagement with hand-knitting techniques and their translation through machine knitting creates a bridge for cultural inclusion, fostering material innovations applicable beyond fashion discipline.

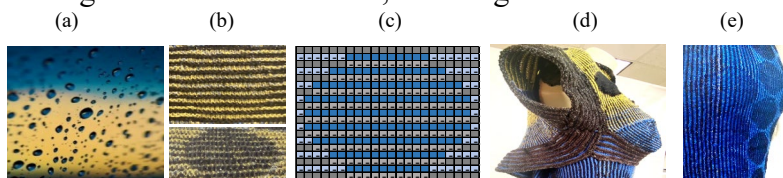


Fig. 1. (a) Inspiration image (Dreamstime (n.d.)), (b) illusion knitting front and side view, (c) knitting graph for a circle (each row is 2 knitting rows), (d) sleeve detail, and (e) body slimming optical effect at back.