Seamless garment: Needle selection techniques and applications

by P. Kanakaraj and R.Ramachandran, PSG College of Technology.

Knitting is the process of intermeshing loops of yarns thereby forming fabric and is classified as warp and weft knitting. Weft knitting can be further classified into Circular and Flat knitting. Flat knitting machines have greater versatility in loop structure combinations and designing. This is because of their machine cams structure and their ability to stitch one or both beds easily. As machines improve with the evolutionary technology, higher productivity, increased efficiency, lower material costs and better consistency and quality are attained. With industrial progress and subsequent development in mechatronics technology, the advancements in garment manufacturing have evolved from cut & sew to complete garment knitting, which produces one entire garment without sewing or linking process. This technology was introduced in 1995 at ITMA (International Textile Machinery Association) .V-Bed knitting process has more flexible needle selection capability and more design possibilities through computerized system (DSCS – Digital Stitch Control System) compared to warp knitting process. Eventually, the seamless garment process puts less stress on the environment by minimizing waste disposal.

Evolution of knitting production

Cut and sew process

Panel knitting involves knitting an entire panel of fabric to accommodate the front body, back body and sleeves. This conventional method requires the patterns for the bodies to be cut out from the fabric and sewn together involving several post-knit processes. With this process, up to 40% of the original fabric may go as waste or cut-loss.

Fig. 1: Cut and sew process.

Shaping

Full fashioning allows the front and back bodies and sleeves to be knitted according to specific pattern shapes for each piece. Each pattern is shaped using only the amount of yarn necessary to knit that piece, with added seam allowances. So cut-loss is eliminated. Trimmings and pockets still must be knit separately. Post-knit linking and sewing are required to complete the cardigan.

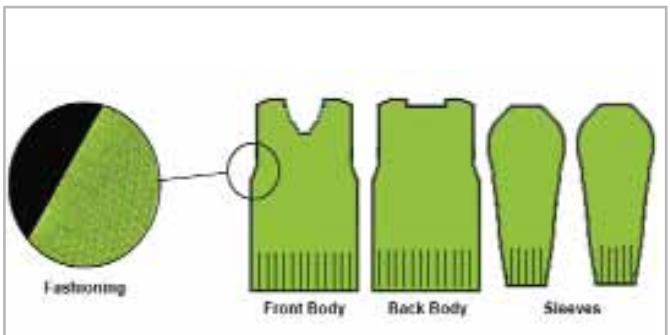

Fig. 2 Shaping.

Fig. 3: Integral Knitting

Integral knitting

The integral knitting entails the use of shaping technology to knit pattern-shaped pieces. It improves upon shaping by knitting-in or integrating trimmings, pockets and other accessories, such as buttonholes to avoid sewing together these items. Great savings can be obtained in post-knit processing. The quality and consistency are vastly improved.

Seamless Garment knitting

Fig. 4: Seamless garment.

In knit-wear production, complete garment can be referred as "whole garment" or "complete garment". The garments can be produced either in circular knitting machines or flat (V-Bed) knitting machines. Production is by using several different feeders with minimal or no cutting and sewing processes. The type of production varies in both circular and flat knitting.

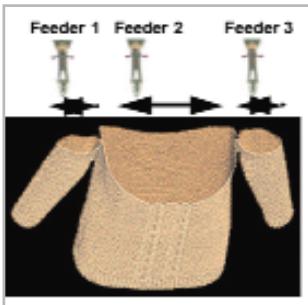

Fig. 5a: Complete garment knitting until Underarm point. (Shima Seiki's)

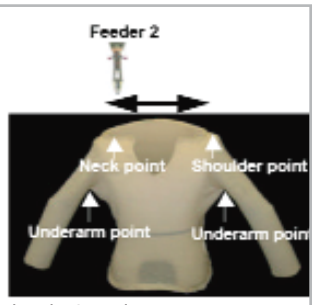

Fig. 5b: Complete garment knitting after Underarm point. (Shima Seiki's)

In circular knitting, it creates a single tubular type of garment and then tubes are joined together on the machine. This ensures minimized cutting and seam joining on one body tube and two sleeve tubes as well as the finished edges. Consequently, seamless knitting on circular machines is not true seamless knitting. Flat V-bed knitting creates complete garments, which do not require any kind of cutting or sewing process. Here three separate tubular parts formed by knitting is shown in Fig.4, one wider tube for the body part and two narrower tubes for the sleeve parts by alternate knitting of front and back beds. Moreover, various structures like plain jersey, rib and purl can be created within the seamless garment at the same time.

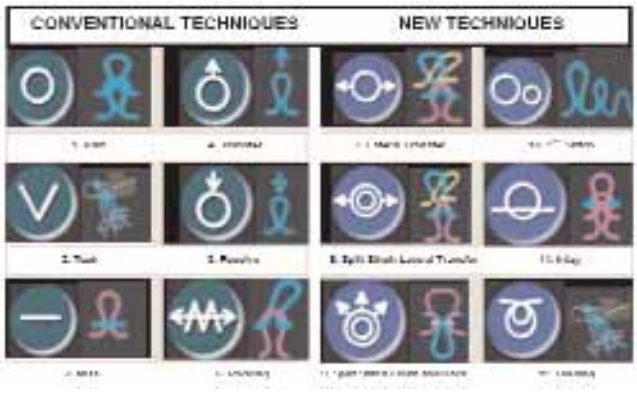

Fig. 6: Stitches from Shima Seiki machine.

The flat knitting machine, knits and transfers loops between the front and back needle beds with different yarn carriers; one body tube (feeder 2) and two sleeves tubes (feeder 1 and 3) as shown in Fig.5a. At the underarm point, the two carriers feeder 1 and 3 knitting sleeve parts are taken out from the knitting zone. Feeder 2 knits the main body part also knitting together the three tubes into one (Fig.5b). However, in order to make loop transference for performing the shaping or design structures loops should be formed by selecting alternate needles.

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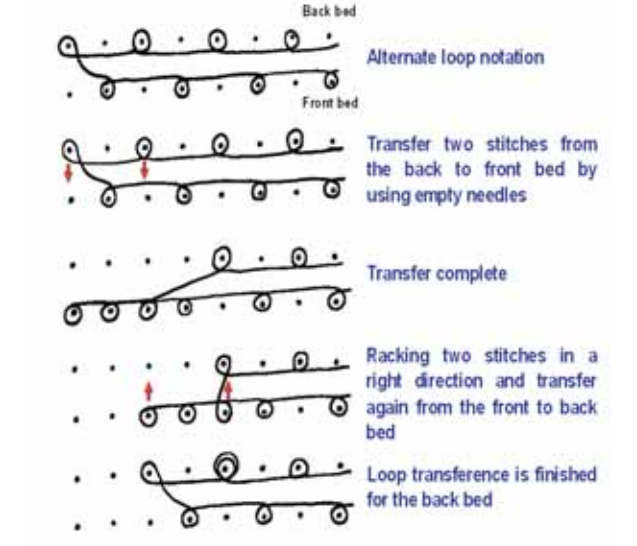

Fig. 7a: Needle representation for the loop transference.

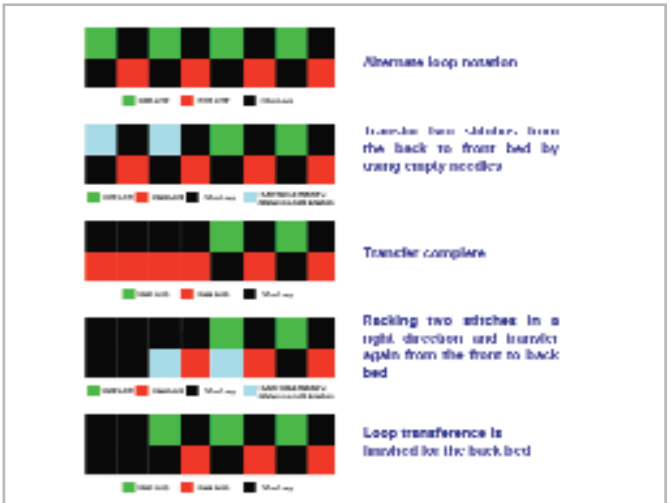

Fig. 7b: DSCS representation for the loop transference.

Feeder 2 knits the main body part also knitting together the three tubes into one (Fig.5b). However, in order to make loop transference for performing the shaping or design structures loops should be formed by selecting alternate needles.

Shima Seiki has introduced 12 stitch techniques for the production of whole garment. For patterning in weft knitting, the selection of needles is very important which can be achieved in any one of the following method.

(i) Direct needle control.
(ii) Indirect needle control and electronic control.

In case of direct needle control, the control is carried out by cam parts or pattern wheels, which directly acts on pattern knitting butts. In indirect needle control, one or several control sinkers/pins are arranged after the needle in the same groove of the needle carrier. Pattern drums battery selectors or sliders are such examples. Needle selection through film tapes, control magnets etc. comes under electronic control category.

In complete garment production, the CAD system interlinked with DSCS (Digital Stitch Control System) is a totally integrated knit production system that allows all phases including planning, designing, evaluation and production. CAD patterning is more complicated than that of the fully fashioned knitting, because of its alternate needle selection. Fig. 7a & Fig. 7b shows the loop transference in complete garment knitting at under arm point. For this, atleast two loops (even number of loops only) are transferred in a right or a left direction due to alternate needle selection.

Applications

Seamless garments are preferred for their comfortability, forgiving, non-binding, non-restrictive characteristics and tend to show fewer lines under clothes. In addition, seamless apparel will have no failures on waistband and side seam.

Manufacture fibers such as nylon with atmospheric garment dyeing offer greater durability. Fig. 8 shows a multi-color dyed complete garment created on computerized knitting machine.

Seamless technology has emerged into areas such as fashion, upholstery, industrial, automotive and medical textiles apart from apparel.

Upholstery

Three-dimensional seamless seat office chairs done using sophisticated CAD system. The fabrics possess stretch characteristics to follow contours of seat.

Fig. 8: Multi-color dyed complete garment created on computerized knitting machine. .

Fig. 9: Seamless glove.

Fig. 10: Medical seamless socks.

Engineered design related to knitwear performance in productivity involving various knit structures.

The recent models of computerized knitting machines provide technically as well as aesthetically advanced design possibilities to create garments. This recent development in upholstery manufacturing using knits enhances appearance, better seat trimming while eliminating ridges.

Automotive and industrial textiles

Automotive seat covers obtained by usage of predictive computer models with the possibility to alter the knitted tube size. It adds on quality, provides ergonomic seat design and 25% time saving.

KEVLAR offers seamless filament-knit gloves and apparel which are lightweight, flexible and comfortable for workers in electronics, food- handling, paint, plastics and other high-precision business sectors which require high levels of safety in addition to contaminant-free cleanliness.

Sports Textiles

Sports apparel demand high performing garments to enhance a consumer's performance. Seamless apparel construction focuses on supporting muscles and areas where it is needed the most. An engineered fit, micro massaging features and performance innovation, results with blending of various technical fibers and yarns.

These styles are developed for fitness and first layer. The development of advanced second-skin textiles has led to renewed interest in seamless garment construction. A diverse range of products such as hand gloves, hats, socks, are some of the obvious applications.

Medical textiles

The onset of seamless technology in the medical arena has been a boon. Applications include bandages, orthopedic supports, medical compression stockings and more. With the incorporation of high performance fibers and additional sensors or electronics, unique combination of fibers which are designed for comfort and purpose is achieved. Specialized aesthetics, wellness application and massaging properties are such benefits have improved recovery. Shape wear offers support for pre/post surgery. Certain medical procedures can be even delayed or/and avoided.

Intimate apparel

Intimate apparel produced on seamless machines gives seam-free, easy-care, silky-smooth, comfort and fit and gives a feel similar to one's second skin. This is suitable for today's lightweight apparel. In a bid to speed-up the development of the circular seamless innerwear market, Santoni has introduced a new single jersey machines for the production of under wear, swim wear and sanitary garments.

Conclusion

New advancements coming from fiber producers and yarn spinners will continue to provide innovation from the supplier side. Seamless garment knitting creates one entire garment by using several different carriers eliminating the need for additional cut and sew operations. By utilizing alternate needle selection one can also knit various design structures apart from shaped knitting. Complete garment knitting provides major benefits for the market as well as for technical production. It offers savings in terms of production times and cost, and it minimizes yarn consumption.

In addition, seamless garment knitting provides more consistent and homogeneous product quality, which gives lightness and comfort in the garments. It also offers more creative knit possibilities for knit designers. Three-dimensional seamless knitting with its diverse capabilities can be applied to numerous products such as apparel, fashion, upholstery, Automotive, aerospace, medical textiles, etc. Seamless knitting is forecasted to continue growing and could be one of the largest next generation knitting technologies.

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