RIB AND PURL KNITTED FABRICS WITH TRANSFERRED STITCH PATTERNS

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Abstract
The paper targets the valorisation of rib and purl evolutions in creating knitted fabrics with transferred stitches with new surface/ structural effects for garments.
Five structural variants are described in the case of rib evolutions, of different alternating sequence (1x1, 1x2, and 2x2) and with different patterns, determined mainly by the succession of transfer direction.
The purl variants are produced using 4x4 purl, fancy purl and 1x1 purl on selected needles.
All fabrics are produced on a flat knitting machine, gauge 5 E.
The fabric description is based on the analytical representation and the knitting sequence, in order to emphasise the knitting – transfer sequence. The aspect of the fabric effects is presented using photos. The photos show that in the case of rib fabrics the presence of the transferred stitches diminishes the wale tendency of being tangent. For purl fabrics there are two types of effects coming together – the 3 D geometry specific to purl evolutions and the surface effect caused by the transferred stitch patterns.
Keywords: *Rib, purl, transferred needle loop, patterns and effects.*

1. Introduction

The knitted garments with patterns based on transferred stitches (ajour, cable and aran patterns) [1, 2] are in demand on the market as part of the current fashion trend.
The stitch transfer technique is used on flat knitting machines to produce patterned structures or to fashion the panel shape. The development of integrated knitting systems as well as the use of devices to decrease the yarn tension for both knitting and transfer compensates the low productivity caused by the transfer stages.
New effects based on stitch transfer patterns can be generated not only through the change in pattern type and dimensions, but also by using with other basic evolutions than jersey (rib and purl).
The knitted fabrics with stitch transfer patterns represent an important group of structures to be used when designing garments. Their large range of characteristics for both open structures and closed ones, net like open structures with different shapes and dimensions makes them attractive for different types of clothing, especially for women. They also can be used in technical applications, with specific type of raw material.

2. Theoretical considerations

The transfer technique [3], specific to flat knitting machines, can be used to produce a large range of fabrics, with different types of patterns with yarn geometry modifications. In this direction, the stitch transfer patterns can be developed to generate new surface effects.
The transfer technique is used to produce transfer patterns, basic evolutions (purl), tubular ribs and cable/aran patterns. It considers the transfer of the following structural elements:

- Stitch elements (needle loop, sinker loop and arms)
- Loops – split loops or beginning loops, produced in the first cycle a needle works

The structural variants of the patterns obtained based on the transfer of needle loops (stitch transfer) are determined by [4]:

- The transferred stitches or loops are placed in different wales
- The transfer is carried out on a needle that has a stitch or a loop
- The transfer direction varies along the pattern height

Considering the transferred elements, there are the following structural possibilities: a stitch transferred to a stitch, a stitch transferred to a loop and a loop transferred to a stitch. The paper presents pattern variants with transferred stitches (stitch to stitch) with transfers in both directions and in only one direction.
The basic evolution used for the fabric is another important aspect, influencing the yarn geometry, the surface covering and the fabric behaviour. In practice, almost all knitted fabrics with transferred stitch

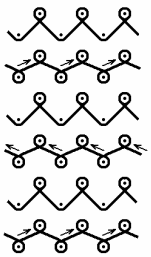
patterns are produced using the jersey evolution. However, there is also a possibility to develop new patterns using rib and purl evolutions.

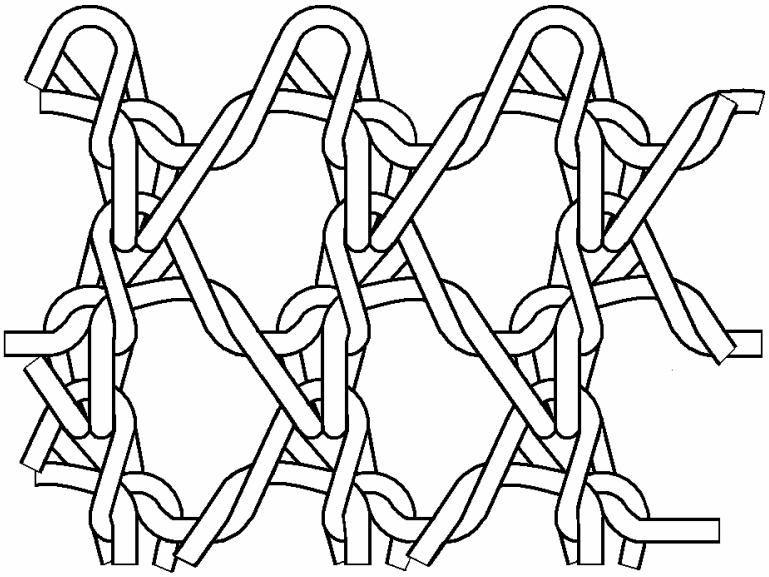
3. Experimental part

The diversification of knitted fabrics with transferred stitch patterns (lace patterns) on flat knitting machines is exemplified with different structural variants (basic evolutions) that are described below. The fabrics were produced on a flat knitting machine; gauge 5 E, using 100% acrylic yarns, count Nm 36/2/3.

3.1 Rib fabrics

Variant V1 is a 1x1 rib fabric with a lace stitch pattern characterised by stitch to stitch transfer in two directions. All front stitches are transferred to the rear needles, first to the left and then to the right, as presented in Figure 1. The pattern dimensions are 4 courses and 2 wales.
In the relax state, the fabric geometry shows that the rear stitches 'receiving' the transferred stitches are inclined in opposition with the transfer direction. The rear stitches are covered by the transferred front ones.
In comparison to 1x1 rib fabrics, the high winding angles of the structural elements restrict the normal wale tendency to get close, thus increasing the fabric width. The pattern contains openings (zones without yarn), placed between the rear wales. The fabric is considered to be semi open.





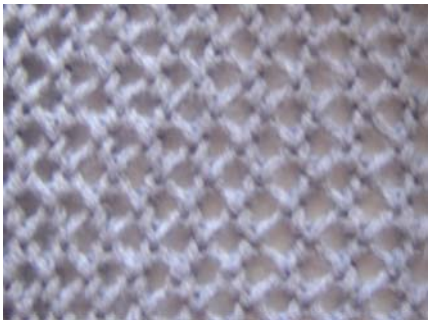


Figure 1: Fabric knitting sequence, structural representation and aspect - variant V1

Variant V2 (see Figure 2) is a 1x1 rib with transferring stitches alternatively on both beds, in opposite directions. Each needle receives and then transfers a stitch. The fabric aspect is the same on both sides and is characterised by:
- Diagonally placed openings
- A diminishing in the rib aspect of the fabric due to the fact that the front stitches (transferred and normal) cover the rear ones.

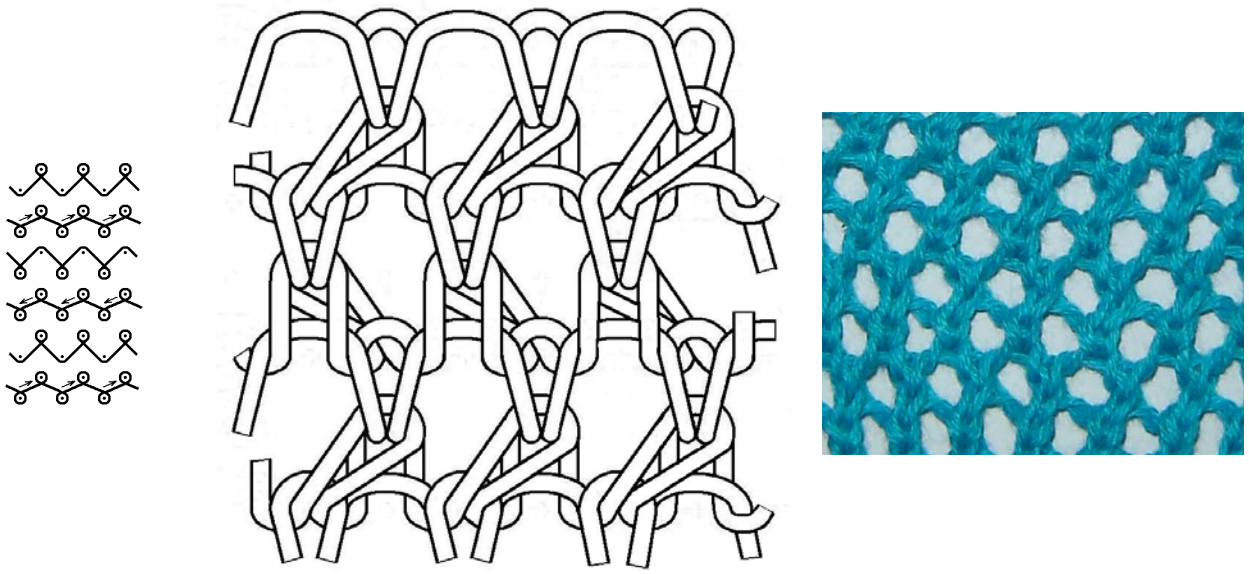


Figure 2: Fabric knitting sequence, structural representation and aspect- variant V2

Variant V3 is also a 1x1 rib fabric, with successive transfer of the front and rear stitches in the same direction. In each pattern course (Figure 3) there are front and then rear stitches transferred on neighbouring needle from the opposite bed, determining a diagonal placement of the loops formed after transfer. The effect generated in the fabric is the same on both sides, the stitches presenting an inclined geometry. This is a semi open structure, with an equal number of normal and transferred stitches. The rib aspect is diminished due to the fact that the front stitches cover the rear ones. The fabric extensibility is high on both wale and course direction, as well as along the diagonal direction.

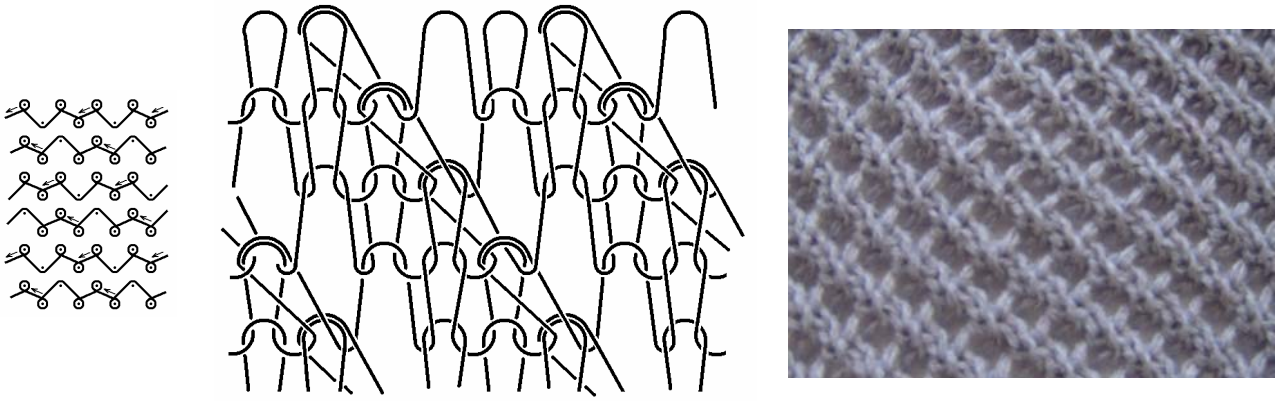


Figure 3: Fabric knitting sequence, structural representation and aspect -- variant V3

Variant V4 is a 1x2 rib, with transferred rear stitches on needles from the same bed, successively in opposite directions, as presented in the knitting sequence in Figure 4. As a consequence of the tensions generated within the structural elements with modified geometry, the front stitches are inclined in opposite direction to that of transfer. The openings are defined by the transferred stitch and the following loop and by the neighbouring rear stitch. The front and rear stitches are placed in different plans, causing a relief transferred pattern, illustrated in Figure 4.

A small dimensions transferred stitch pattern was also obtained by working on selected needles for only two cycles (**variant V5**), as presented in Figure 5. In the first pattern course, the loop is formed because the needle has no previous stitch to complete the cycle. The succession of the structural elements is therefore reversed: first the loop and then the transferred stitch. Even though the number of rib stitches is lower then the jersey stitches, the presence of these rib stitches gives the fabric stability. The pattern is characterised by the diagonal placement of the openings and by the uniform distribution of the structural elements with modified geometry. The opening shape (see Figure 5) is circular and is defined vertically by the sinker loop and the loop formed after transferred.

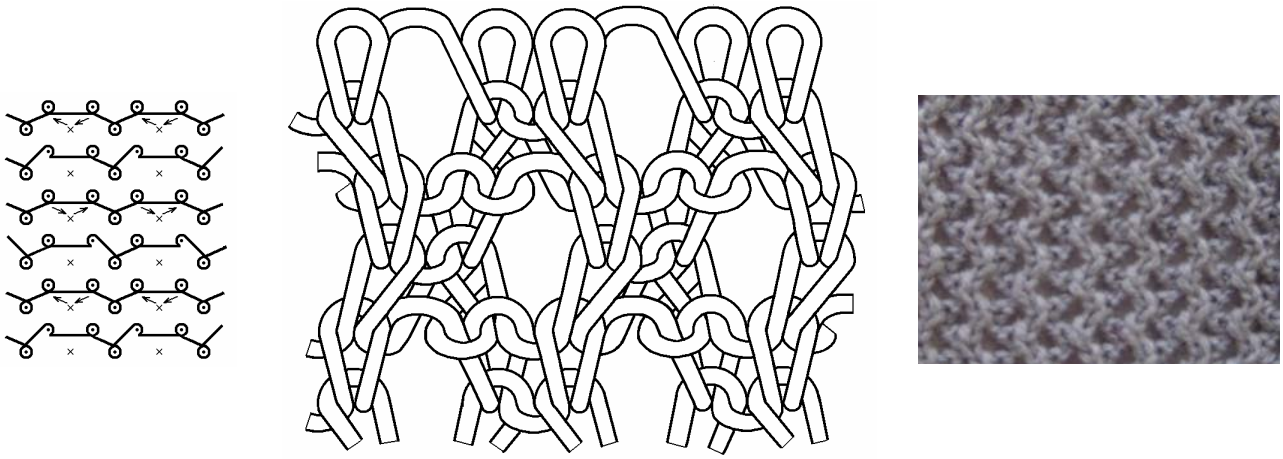


Figure 4: Fabric knitting sequence, structural representation and aspect - variant V4

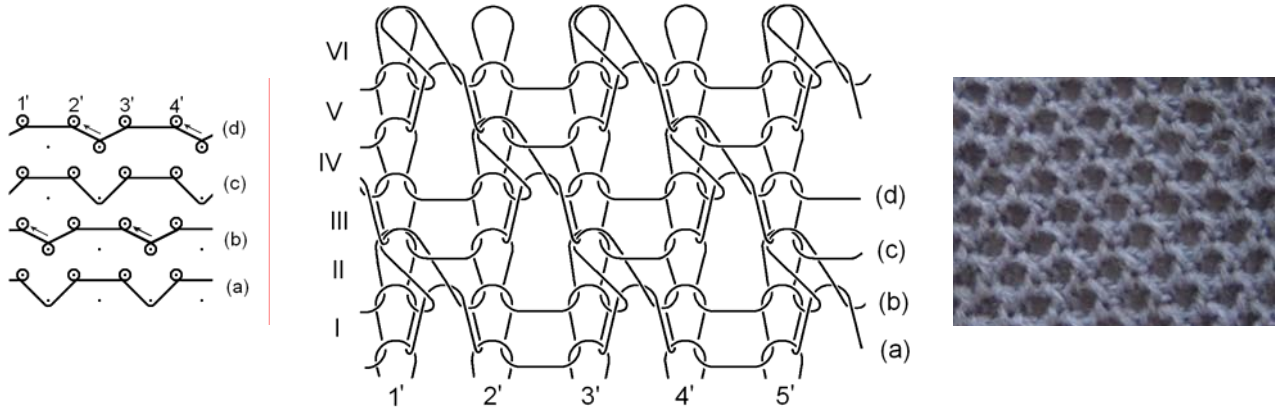


Figure 5: Rib on selected needle - knitting sequence, structural representation and aspect - variant V5

3.2 Purl fabrics

In the case of purl fabrics, it was considered that it would be of more interest to use a purl evolution different from 1x1 purl, namely a 4x4 purl. A higher purl dimension increases the 3D effect of the fabric specific geometry. Figure 6 presents **variant V6**, characterised by the stitch transfer on both beds, successively in opposite directions. The uniform distribution of the openings generates an identical effect on both sides of the fabric.

The 3D effect of the purl patterned fabric is emphasised by comparing the knitted fabric aspect in relax state and in stretched state, presented in Figure 7.a and b. The extended state eliminates the specific 3D geometry. This explains why the finishing process must be designed properly, in order to avoid obtaining a 2D fabric.

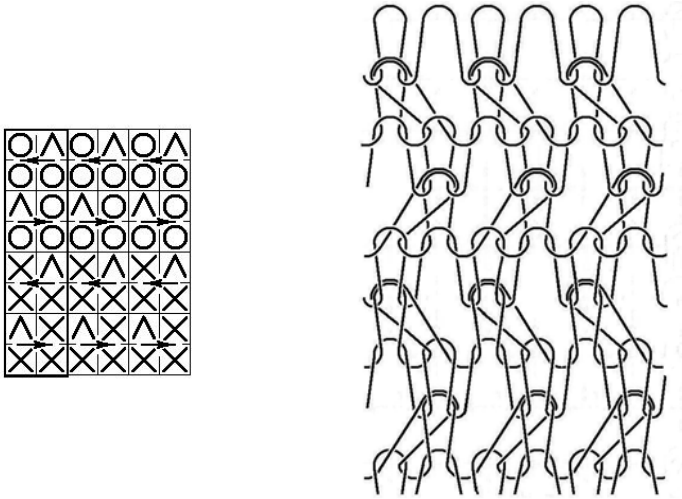
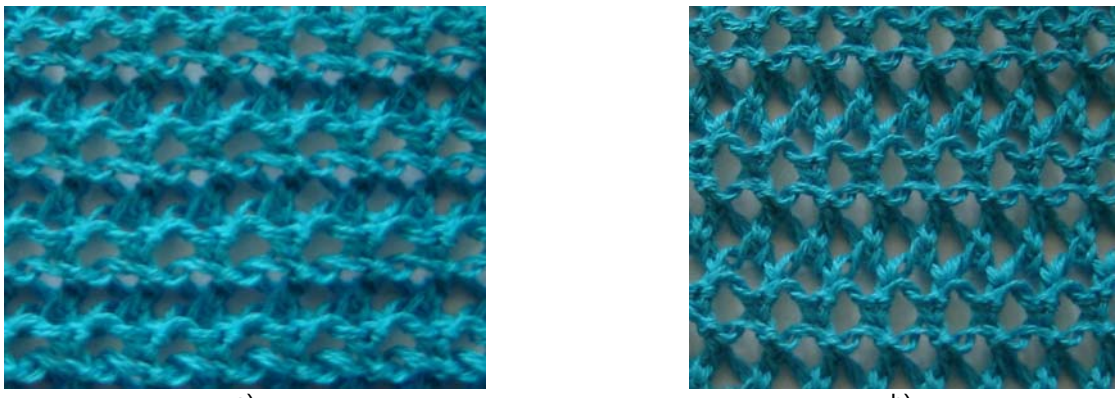


Figure 6: Fabric knitting sequence and structural representation - variant V6



a) b)

Figure 7: Fabric aspect in relax and tensile state

The fabric **variant V7**, presented in Figure 8 is a fancy purl with stitch transfer on both beds, at every second course. The fancy purl dimensions are 4 wales and 8 courses. The stitch transfer is alternatively in opposite directions. Apart the 3D geometry specific to purl structures, the stitch transfer also determines a relief effect that is clear from the fabric aspect illustrated in Figure 8.

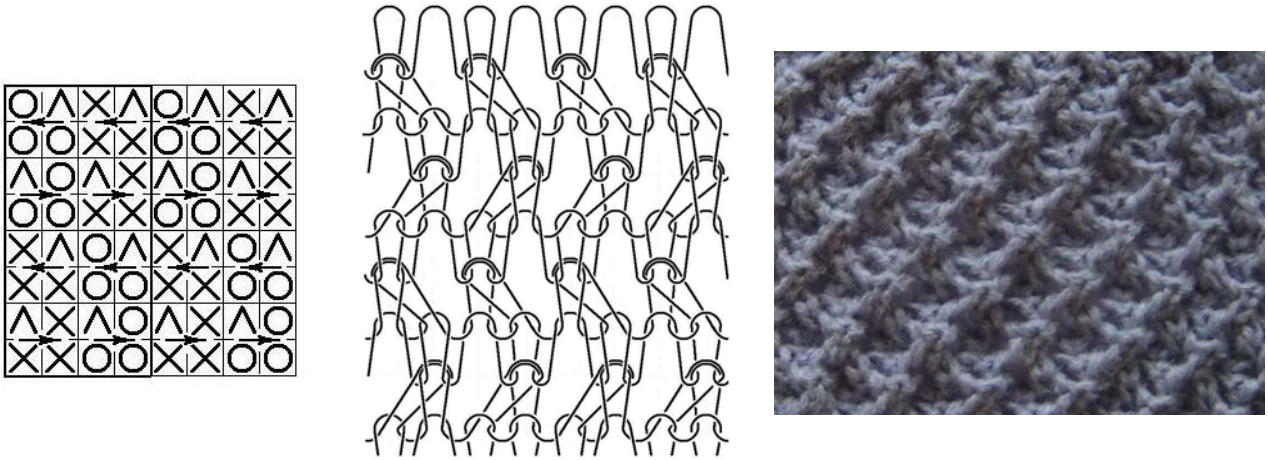


Figure 8: Fabric knitting sequence, structural representation and aspect - variant V7

Variant V8 presented in Figure 9 is a 1x1 purl fabric produced on selected needles. The number of working needles is kept constant. A variation in the number of working needles will determine a change in fabric width, thus allowing a higher degree of correlation between the shape of the human body and the garment, controllable from the design stage.

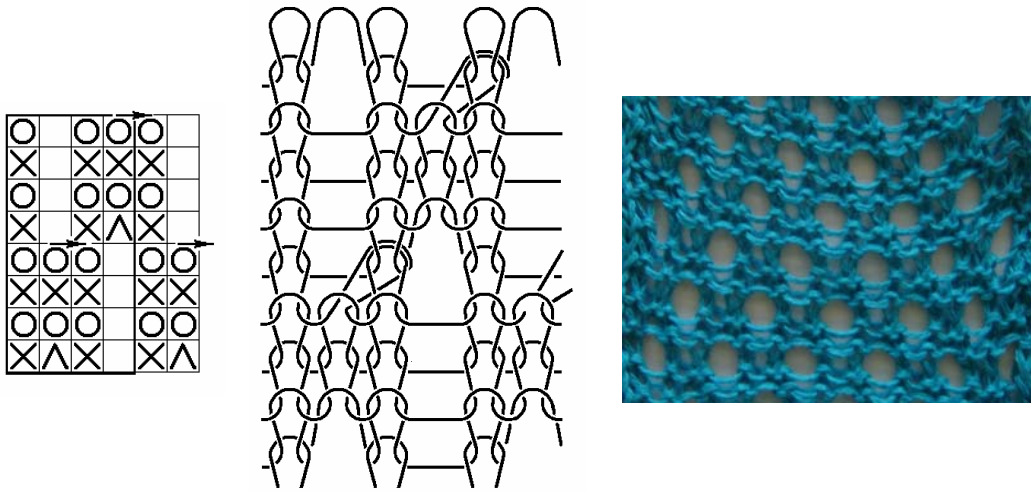


Figure 9. Purl fabric on selected needle - knitting sequence and structural representation

4. Conclusions

The rib and purl fabrics with transferred stitch patterns presented in the paper are characterised by:

- Uniform aspect, due the reduced pattern dimensions and the uniform positioning of the openings; the identical aspect makes that each fabric side can be used as the product front side;
- The surface covering capacity can be controlled through the evolution / pattern type and dimensions, leading to open and semi open structures
- The specific geometry of rib and purl fabrics can be either diminished or enhanced by the transferred stitch pattern; in case of the purl fabrics, the pattern creates a relief effect.

The followings must be emphasised in relation to the normal rib and purl fabrics (except 4x4 purl). There is an increase in fabric width and length that is determined by the structure flattening due to the stitch transfer. The structural variants loose the specific tendency of the courses/wales to become tangent. Also, there is an increase in extensibility, not only along the course direction, but also in diagonal direction.
Even if the number of rib and purl stitches is much lower than the number of jersey stitches, the fabrics are stable, with no rolling at the edges and without any changes in shape. This stability applies also to the fabrics where the transfer was in the same direction.
The use of rib and purl evolutions represents a way of developing the group of transferred stitch patterns, with new characteristics and enhanced properties.

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