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HER MAJESTY THE KNIT. FASCINATION WITH STRUCTURE. AUTHOR'S DESIGN ACTIVITIES IN THE CONTEXT OF THE TECHNOLOGIES USED

Art research paper

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Abstract

The present article concerns the increasingly popular technique of production of knitted fabrics that has been known for a thousand years and is still developing. Throughout history, we can observe the astonishing evolution of knitting: from the artisanal, manual way of making uncomplicated products to the industrial, fully computerised, innovative production of very diverse offers. Knit works great in interior design and is used to make a variety of furnishings and decorations for living spaces. It is also successfully used to create sculptures, installations and unique artistic objects presented in museums and galleries.

Thanks to technical and technological progress, the production capacity of the knitted clothing industry has increased significantly. Nowadays, close-fitting and even seamless clothes are in common use. Computerised machines working together with modern design studios provide the conditions for producing complex, spatial structures and multi-coloured knitted patterns. The author of the article presents on the examples of two collections of outfits the use of selected weaves with specific properties, the appropriate combinations of which determine the form and texture of knitted garments. The collections were created using a variety of knitting technologies and with diverse equipment. The structural potential of knit allows it to be used both in the production of utility garments and in creative artistic initiatives.

Keywords

knit, knitted fabric, structure, design, fibre, new technologies, craftsmanship, clothing, interiors, artistic objects, tailored clothes, seamless products

Introduction

The structure, as an important factor in the construction of a knit, is the element which distinguishes it from woven fabrics, influencing the properties, as well as the visual and functional characteristics of the textile material created as a result of the knitting technique. This enables treating this matter in a special way, emphasising its almost unlimited creative potential. Knit is an exceptional material with unique, ‘sculptural’ qualities. The inextricable interdependence of knitting and the applied technology makes it a specialised discipline with enormous design and implementation potential.

The essence and beauty of knitwear lies in the fact that the designer invents everything from the scratch by creating the weave, the feel, the thickness, choosing the colour, deciding on the texture and shape, while at the same time developing original finishes and details.¹

The words of renowned Dutch trendsetter Li Edelkoort² perfectly illustrate the complexity of knitting. Being able to influence so many factors, shaping not only the form but also structure and pattern, can make it difficult for a knitwear designer to master them all at the same time; however, at the same time, it provides enormous freedom and design autonomy. There are many different types of knitting machines, each with its own purpose and technical capabilities, ranging from simple hobby models to advanced computerised systems prepared to create garments with a very complex structure, including seamless clothing, which completes the extremely rich offer of the knitting industry. The creative application of these technologies definitely influences the design potential. Each of the methods of production brings specific design effects, the proper understanding and application of which results in phenomenal solutions. Exploring artisanal ways of making knitwear offers an opportunity to get in touch with the surface. Pioneering methods of knitting with easy-to-use equipment are often only a prelude to discovering and using more advanced technologies. However, let us not forget that technology is not everything. There is a need for someone to give it meaning and significance by presenting their own artistic ideas or by following the need to preserve and develop the utilitarian aspects.

1. Specificity and versatility of knit

The construction of knit and the constantly developing methods of its production, the enormous structural and design potential, as well as the properties based on the elasticity of yarns and weaves, create a very broad field for creators of various specialities. Knit provides enormous design opportunities for designers working in the areas of clothing, fibre art or interior design and furnishing. Artists use the medium of knitting to create installations presented in museums and art galleries; they present the visual richness of knit and its unusual structural properties. Designers draw on the qualities of knit,

1 J. Sissons, *Basics, Knitwear, Fashion Design 06*, 2010, s. 65 (retranslation).

2 Lidewij Edelkoort (b. 1950) – one of the world’s best-known trendsetters (persons involved in the evolution of trends). She creates trend studies that are tools used by strategists, designers and marketing professionals working for international brands, <http://www.edelkoort.com/lidewij-edelkoort/>.

work with unusual fabrics and constantly experiment with new and unconventional raw materials and technologies. Innovative yarns include wire, paper and plastic, knitted fabrics are printed, laminated, rubberised, felted, heat formed and subjected to many other processes.³ The integration of electronics and knitting processes gives knitted fabrics that are increasingly used as technical and medical textiles or as geotextiles.⁴ New technologies offer great opportunities in the creation of innovative concepts for material structures and artistic ideas.

Knitting plays a special role in the clothing manufacturing sector. Because of its structure, knit is an extremely plastic material, making it possible to shape the designed garment in a variety of ways. Knitted garments can take the shape of the human body or build space around it, taking on sophisticated three-dimensional forms. In the work of many designers, knit and the creative possibilities associated with its properties have become important elements in the process of creating clothing. The realisations of the leading fashion designers of the 20th century: from the sporty elegance of Coco Chanel,⁵ the artistic knitwear of Elsa Schiaparelli⁶ and Sonia Delaunay,⁷ through the *knit dressing*⁸ by Sonia Rykiel,⁹ the colourful zigzags and stripes of Missoni,¹⁰ to the pioneering work of Rei

3 S. Black, *Knitwear in fashion*, London 2002, p. 66 (retranslation).

4 Geotextiles – polymeric textile materials (fabrics, knitted and non-woven fabrics, textile composites) used in the construction of road surfaces, as well as land and water structures; they are used for drainage (e.g. collecting precipitation, subsoil water), filtration (retaining soil while maintaining the flow of liquids), as well as limiting or preventing damage to surfaces or structures (e.g. embankments) under the influence of water courses, improving the mechanical properties of soil and preventing mixing adjacent soils with different structures; geotextiles in the form of geofibres laid under the road surface improve the durability of the road and driving comfort.

5 Coco Chanel, actually Gabrielle Bonheur Chanel (1883–1971) – French fashion designer; from 1915, she revolutionised women's fashion, promoting clothes with simple sports cuts and short dresses devoid of embellishment, becoming an icon of Parisian haute couture for six decades.

6 Elsa Schiaparelli (1890–1973) – Italian fashion designer. Her debut collection, with which she managed to attract the attention of critics and fashion magazines, consisted mainly of jumpers with surrealist motifs. It is this innovative, humorous approach to fashion that became the designer's trademark and enabled her to make a name for herself in the industry.

7 Sonia Delaunay (1885–1979) – French painter and costume designer of Jewish descent, representative of Orphism. She was fascinated with colour and colourful structures, which became the form and motif of her art. After 1914, this new visual language led to abstract painting, the feature of which became the perceptual vision of the life of modern society. Delaunay developed her own style, which she also used in the design of clothing, fabrics and everyday objects.

8 Knit dressing – dressing in knitwear 'from head to toe'.

9 Sonia Annette Rykiel (1930–2016) – French fashion designer, actress and writer. Founder of the fashion house signed with her name. Voluminous models, reversible garments, pullovers and, above all, her love for knitwear have brought her to the top of the fashion industry.

10 Missoni – Italian luxury fashion house based in Varese, known for colourful knitwear designs. The company was founded by Ottavio ('Tai') and Rosita Missoni in 1953.

Kawakubo¹¹ and Yohi Yamamoto,¹² the avant-garde deconstructions of Martin Margiela¹³ and the revolutionary clothing concept of A-POC¹⁴ by Issey Miyake¹⁵ all present how the best designers have put spectacular ideas into knitted clothing forms. The soft sculptures of Sandra Becklund¹⁶ and Johan Ku¹⁷ enable to see that structural characteristics of knit constitute a truly valuable and inexhaustible basis for solutions and inspiration in the design of forms and surfaces of knitted products.

1.1. Knitting medium in interior design

Knitting technique is also used by designers in the process of creating various elements of interior design, such as lamps, carpets, furniture, curtains, blankets or upholstery materials. Knit creates great design opportunities for creators of interior design objects who wish to achieve an original visual effect. These utilitarian aspects of knit have been exploited by members of the design studio Ariel Design, who created a series of light fittings. They presented a concept based on the use of a handmade knitted tunnel, at the end of which they placed an industrially manufactured glass ball with a light bulb. Due to its ability to stretch in all directions and its elasticity, knitted material is ideal as a decorative and practical cover for the ball. As a result of the characteristic openwork weave, the lamps appear very light and delicate, while filtering the light appropriately¹⁸. Equally interesting is the collection of soft, colourful knitted lamps with long striped 'tentacles' that can be shaped in many ways - tied in knots, hung on other furniture, plaited to form a bundle. Their author creates imaginative

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- 11 Rei Kawakubo (b. 1942) – Japanese fashion designer, based in Tokyo and Paris. She is the founder of Comme des Garçons (CDG) and Dover Street Market brands. Influential designer of the late 20th century known for her avant-garde clothing designs. She experimented with knit, modifying the form and function of the garments designed. She used the properties of knits to create conceptual, visionary, stereotype-breaking collections, challenging Western ideals of the human body shape and garment structure. Her 'strange' clothes, invariably black, grey or navy blue, were swathed in extra sleeves, contained controlled loose stitches and folds arranged like origami.
- 12 Yōji Yamamoto (b. 1943) – Japanese fashion designer, winner of the French Chevalier de l'Ordre des Arts et des Lettres award. Collections created by Yamamoto stand out by very baggy clothes and the dominance of one colour, usually black. He is known for using multiplication of layers in clothing. Knitwear in his collections often include a space between the garment and the body, allowing the wearer to 'inhabit' the garment from the inside.
- 13 Martin Margiela (b. 1957) – Belgian fashion designer. He proposed design solutions the innovation of which consisted primarily in modifications to the cut and attention to textural variation. These included frayed, crookedly cut, unfinished garments with far too long sleeves and wide shoulders. His dresses were made from plastic bags and ribbons, and his jumpers from recycled socks and sleeves of pre-existing garments.
- 14 A-POC (*A Piece of Cloth*) – innovative clothing system created by the Japanese designer Issey Miyake in collaboration with textile engineer Dai Fujiwara, developed in 1999. The knitting structures used make it possible to obtain round forms in cross-section, which after being cut made the garment three-dimensional.
- 15 Issey Miyake (b. 1938) – Japanese fashion designer, awarded the Order of Culture. Like no one else, he combines tradition and avant-garde, colour, craftsmanship and technology to create custom clothing. His knitwear is boldly innovative, yet extremely utilitarian. Author of the innovative Pleats Please and A-POC concepts.
- 16 Sandra Becklund (b. 1975) – fashion designer. She is the author of spatial knitted garment-sculptures, in which the effects resulting from the use of structures are integrally connected with the form and texture of the garment.
- 17 Johan Ku (b. 1979) – he set up a design studio in 2005. He graduated with a master's degree in fashion and textiles from Central Saint Martins. His *Emotional Sculpture* collection features distinctive sculptural silhouettes with unique structures made from extremely thick knit.
- 18 <http://ariel-design.com/knitted.html> [accessed: 02/06/2017]).

products based on archetypal shapes and simple striped patterns. The LED bulbs used here do not heat up, and the whole project *I like it. What is it?* proves that lamp can be soft, cosy and plastic.¹⁹

The unusual properties of knitted weaves are used in the design work of the Dutch designer Bauke Knottnerus, author of a series of objects for interiors called *Phat Knit*, which consists of scaled up knitted items that perform different functions. They are made of giant foam threads-ropes, which can be braided and arranged in a variety of ways depending on their thickness. Each modular piece has a number of possible uses: it can take the form of a giant knot and serve as an armchair or seat, it can be a bed or sofa, and, in the smaller scale of weave, it can also serve as a rug.²⁰ These utilitarian objects obtain a unique character thanks to the properties of the soft material from which they are made and the structural interlacing which gives them their form. Another Dutch artist who exploits the utilitarian aspects of knit is Christien Meindertsma, who creates various interior design elements out of natural sheep's wool prepared on her own. Working with knit, she has made a range of rugs and pouffes, which stand out with their distinctive surface and properties such as softness and cosiness. Knit became the basis for a series of chairs and seats designed under the name *Biknit* by the well-known Spanish designer Patricia Urquiola. Knitting elements in the form of long tunnels were braided on a metal frame supported by a wooden base. Tunnels knitted circularly from woollen or polyester yarns are filled with polyurethane foam. Such a combination of materials resulted in a comfortable seat with a distinctive structure. The scaled-up weave determines the creation of an innovative, comfortable piece of furniture that gives the interior a modern vibe. The designer has also shown her interest in knitted structures in her carpet designs launched under the name *Mangas rugs*. Although they are made with the use of weaving methods, these carpets have visible elements showing inspiration from the construction of the weaves in knitwear. Their shapes resemble knitted sleeves.²¹

1.2. The use of knit in the sphere of fibre art

Many fibre artists use the medium of knitting to create unique works. Knitted matter can be shaped in a variety of ways, it can take a variety of forms, create diverse patterns, arrangements and three-dimensional constructions. These works can range from very light, filigree, translucent objects on a micro scale to huge, massive, seemingly heavy works on a macro scale. Depending on the technology used, knitwear can be perceived in both traditional and innovative style. Usually, the artists use manual working methods, so that the knitting process is seen as an art in itself. Sometimes, however, they use machine knitting, so to show the results representing a high, advanced technical level. The creators are often inspired by the visual and light-filtering qualities of knitwear, working with unusual raw materials, constantly experimenting with traditional as well as unconventional materials and

19 <http://www.annebetphilips.blogspot.com> [accessed: 02/06/2017].

20 <http://trendland.com/phat-knits-by-bauke-knottnerus> [accessed: 03/06/2017].

21 <http://patriciaurquiola.com/design/mangas> [accessed: 26/05/2017].

technologies. Knitted material is sometimes the basic building material of artistic works, and sometimes constitutes a kind of ‘shell’ for the already existing objects. When used as a cover, knit changes their outward appearance, camouflages, provides a surprising and sometimes humorous accent.

American artist Arline Fisch presents colourful, hand-crafted fibre art works, which demonstrate the precision of jewellery-making techniques. Her works are made of thin metal wires. The material used, when combined with the properties of the knitted fabric, gives unique effects such as translucency, stiffening, three-dimensionality and the possibility to form organic shapes. The artist creates spatial forms inspired by the natural world, for which the knitting technique is an irreplaceable medium. Using the same methods, she also creates knitted jewellery. The unique jewellery objects are created by combining elements obtained using the circular knitting machine, with which the artist creates the basis for the spatial, organic forms of necklaces and bracelets.²² Metal wire, an unconventional material for knitting, is also used by many other artists in their experiments with crocheting. Xawery Wolski, Anne Mondro or Ruth Asawa create subtle, light objects which, due to their translucency, partly let the light through and give the impression of disappearing in space. At the same time, these installations cast a shadow, which is an additional interesting visual element. The works of these artists delight with their transience, fragility and plasticity.

Isabel Berglund, a Danish artist who often uses knitting materials in her work, also opts for handicraft methods. Her sculptures and installations are monumental works that organise a new space. In 2015, she created the *City of stitches*, a project which aim is to provide audiences with the opportunity to experience form and texture through a specially created space and its scale. The interactive site invites visitors to come inside and dress in the garments built into the walls.²³

Creative freedom, the ability to produce in different directions, easy colour variation and quick assembly are the advantages of using knitted structures in the form of street art, also known as guerilla knitting, knifitti or urban knitting. In this type of activity, coloured yarns are used instead of paint or chalk in order to reclaim and personalise sterile or unfriendly public places. Polish-born Agata ‘Olek’ Oleksiak, a permanent resident of New York, is the representative of knifitti. She creates sculptures and installations, making colourful knitted yarn covers for architectural elements – benches, monuments, street signs, cars, lanterns. Her works have been presented in many galleries and open urban spaces in different parts of the world (USA, Italy, Turkey, Brazil, Poland). During the Tuwim Year celebrations in 2013, she covered with yarn a locomotive standing in the market square of the Manufaktura mall in the city of Łódź.²⁴ Invited by the Polish Institute in India, the artist participated in the second edition of St+art Delhi Festival organised by St+Art India Foundation in March 2015. As

22 <https://artjewelryforum.org/arline-fisch-hanging-gardens> [accessed: 03/06/2017].

23 <http://www.isabelberglund.com> [accessed: 25/05/2017].

24 <http://www.oleknyc.com> [accessed: 26/05/2017].

part of the festival, she covered, along with 60 female volunteers, a homeless night shelter at Sarai Kale Khan in New Delhi with knitted fabric. Led by Agata Oleksiak, the Delhi women transformed this building into an art object. The project is intended to draw attention to the everyday undervalued manual work carried out at the home.²⁵

Multicoloured nylon knitting structures are also the basis for creating interactive textile playgrounds for children. Hand knitting with a crochet enables building up the knit in any way and also allows to change the colour of the yarn at any time. The stretchability of the weaves and yarns makes it possible to create flexible trampolines with additional movable elements: visually attractive installations with functional use. These distinctive properties of knit are used by the Japanese artist, now based in Canada, Toshiko Horiuchi MacAdam. her structures are installed in public spaces, parks, kindergartens and schools, but also in open museum spaces. They are designed for children to develop through play, taking risks in a safe environment. The artist explores how the human body interacts with space and matter.²⁶ Orly Genger, an artist based in New York, uses knitting techniques to create amazing large-scale sculptures and installations. She creates her objects from climbing rope or recycled used fishing nets by braiding them with an awl or her hands. Using such scaled strands of knitted material, she makes a variety of forms, often taking the shape of giant walls, organic piles or cubist blocks of winding ropes.

2. Contemporary knitting technologies

Tracing the historical development of knitting skills, we can see the remarkable development of knitting technique, which has transformed handicraft into modern production technology. Initially, hand-made knitted goods were rare, highly prized and used to complement the outfit. Improvements in this field and technical developments, both in the manufacture of machinery and yarn, brought this textile material into wide use in clothing and helped to significantly increase the possibilities and speed up the production of knits and knitted garments.

The latest technological innovations used in the knitting industry, combined with the computer revolution, made knitwear enter all the sectors of the fashion market: the mass industrial production of garments of various ranges, from outerwear and sportswear to hosiery, underwear and accessories such as headwear, bags, footwear and jewellery. Innovative solutions have made it possible to introduce or improve many ways of knitting structures, colour patterns: jacquard²⁷ and intarsia²⁸ techniques, as well as garment forms and knitting technologies for fully fashioned fabric or seamless products. Fully

25 <https://culture.pl/pl/wydarzenie/agata-oleksiak-szydelkuje-w-indiach> [accessed 18/02/2022]).

26 <http://www.archdaily.com> [accessed: 25/05/2017].

27 Jacquard – knitting technique that produces a multi-coloured colour pattern in which all the yarns where not visible on the right side of the pattern are spun on the left side.

28 Intarsia – knitting technique that allows a colour pattern to be achieved by using one type of yarn in a given knitting area.

fashion,²⁹ used for producing shaped garments, is currently one of the most widely used technologies in the knitting industry. Tailoring is mainly achieved by means of stitch transfer, which creates a form that would otherwise be achieved by cutting. Shaping can be used to create an outer edge: widening and narrowing the form by modifying underarms, sleeves, shoulders and necklines. As a result of repeated stitch transfer along the outer edge of the element, a selvedge line is created: an aesthetic finishing touch to the fully-fitted garment. This increases the cost-effectiveness of production, as the yarn consumption needed to produce one piece of clothing is reduced. The offcuts that would remain after cutting from a rectangular piece of knitted fabric can thus be avoided.

The next, highest level in the development of knitwear include seamless products with shapes designed in an engineered way; their quality is incomparable to cut and stitched garments produced before. Already in the 1970s, first methods for mechanised knitting of products of this type emerged. In the following decades, innovation in this field progressed rapidly. Seamless knitting, professionally called knit and wear³⁰ or whole garment,³¹ involves creating fully formed garments and is one of the most technologically advanced processes in industrial knitting. Seamless knitting involves creating and combining the components of a garment into one three-dimensional whole in one single knitting cycle. This very complicated process is possible with the help of specialised machines equipped with computers and cooperating with design studios. These devices have almost unlimited design possibilities. They can be used to create garments that do not require further fabrication, which means that the work needed to finish them is greatly reduced. Multi gauge machines are used to create spatial seamless forms.³² Such machines have beds with doubled density of needles, which means that when the knitted fabric is formed on every other needle, the resting needles are used to transfer the stitches and knit additional layers.³³ Result of technological development, the computer-aided ‘total-knitting’ system makes it possible to produce complete knitted garments, including trims and details such as collars and pockets.³⁴ The development of technology enabling the industrial production of seamless garments, requiring little effort at the stage of finishing, has become a kind of mission for machine manufacturers. The first electronic machine to produce seamless work gloves in a fully mechanised process was launched by the Japanese company Shima Seiki,³⁵ which has remained at the forefront of integral knitting technology ever since. Another company counted among the leaders in flat knitting machines is Stoll from Germany. Both companies have developed CAD/CAM design systems directly related to the machine knitting production. CAD/CAM is a group of programmes used to design

29 Fully fashion – term used to describe a fully-fitted garment with forms to be sewn together, shaped in the knitting process.

30 Knit and wear – term introduced by the German company Stoll for seamless garment.

31 Whole garment – term introduced by the Japanese company Shima Seiki for seamless garment.

32 Multi gauge – term used to describe the possibility of obtaining two stitch sizes in one knitting surface by means of needles placed with double density in the bed of a knitting machine.

33 Information obtained from Stoll GmbH&Co representative for Poland.

34 S.J. Jones, *Moda. Projektowanie*, London 2005.

35 S. Black, *Knitwear in fashion*.

knitted fabrics with simultaneous programming of a specific type of knitting machine.³⁶ These are extensive software packages developed by machine manufacturers to work with their proper devices. These packages are usually offered as part of the equipment of special computer studios for the design and programming of a particular manufacturer's machines. M1 Plus is the latest design studio of the Stoll company, while Shima Seiki offers SDS Apec 4. The electronically controlled individual needle selection has made the process of complex patterning and shaping of knitted garments easier. Other technical advances provided improved drive mechanisms in knitting machines.³⁷

After nearly five decades of evolving seamless garment technology, the next generation of knitwear manufacturing equipment is emerging, bringing new possibilities for the structure, surface and form of clothing. Machines with multiple needle beds, each with individual needle selection, provide broad opportunities for the creation and regrouping of individual weaves and groups of weaves. The latest knitting machines also have the technical parameters to control the guide separately from the moving machine head. Currently, technological advances in knitting are outpacing the ability of recipients to use it. The production of outer knitwear made with the use of seamless technology is still not that widely used.³⁸ This way of manufacturing can bring economic benefits due to the elimination of garment fabrication operations. However, in some situations stitching is still more cost-effective than the seamless technology. Similar effects can be achieved by obtaining fully fashioned pieces and then joining them by sewing, which gives a very similar visual effect.

Currently, the programming of products in the total knitting technology is a very difficult task even for specialised programmers. It requires a lot of time and commitment. The time-consuming process of producing garments, resulting from the constant transfer of stitches, indispensable in this technology, and the fairly frequent generation of errors in the knitted fabric, discourage manufacturers from producing seamless garments. However, they do use this type of equipment but to produce quite complex forms and spatial structures not necessarily within the seamless garments. Improved, computerised knitting machines and the second generation of synthetic fibres have helped to raise the level of knitted garment design. Electronic selection of needles and computer control of the production process make it possible to obtain products of a very high technical and design level. The key developments in current knitting processes include not only the possibility to work out the shape of the edges of garment parts, but also the possibility of internal spatial shaping of the knitted fabric, creating holes, overlocks, multi-layer structures and other three-dimensional effects.

36 Fogg Marnie, *Vintage fashion knitwear*, Carlton Books Limited, London 2010.

37 Information obtained from Stoll GmbH&Co representative for Poland.

38 M. Fogg, *Vintage fashion knitwear*, London 2010.

3. Technological and implementation conditions in the context of author's design activities

As artist and designer, I use theoretical and practical knowledge from both design studios in which I have studied,³⁹ combining activities related to clothing design with creative work in the field of fibre art. The common denominator of all my activities is knitting technique, the versatility of which offers a wide range of possibilities for creation.

On the one hand, it allows me to design clothing forms that follow the rules of utility and are addressed to a specific customer, produced on a large scale, and on the other hand, it enables me to achieve unique, artistic effects. In my activity, I am driven by the need to present full resources offered by the knitting technology. It is impossible to deny the utilitarian function of knitwear; on the contrary, I even emphasise it in many of my industrial garment design projects. At the same time, however, I would like to draw attention that it can also function as a matter of enormous creative potential, a carrier of artistic values. For me, knitwear is an exceptional material with unique construction characteristics, which allows to treat it in a special way, emphasising its potential both in terms of use and in the sphere of artistic activity.

I belong to a group of artists who base their design and artistic activities on the use of the properties of knit seen as a matter. For me, the scope of my creation is defined to a large extent on the basis of mastering the methods of production, perfecting my skills and broadening my knowledge, resulting from the applied techniques and knitting technologies. However, the essence of my design work is not limited to technique as such. It is extremely important for me to explore the artisanal secrets in such a way as to identify new possibilities of realisation and show the potential inherent in knitting. I perceive as my key issues exploring the relationships between matter, structure, form and the way a garment is arranged in space, as well as the relationship between these elements and the body, which determines the final shape of the works created. All my works are deeply inspired by my fascination with structure. My activities leading to the discovery of the variety of forms that knitwear can take are centred around its structure. This diversity is determined by a number of factors. The effect results from the weave used, the technique employed, the specifics of the machine on which it was created and the choice of raw material.

I see my creative journey so far, both in the field of industrial clothing design and one-off activities, as a multi-threaded process in which many factors influence each other and create a multi-dimensional system that can develop in several spheres of design. Having finished my studies, I worked in the clothing industry for many years as a dress designer. This job allowed me to learn the rules governing the fashion market, to learn and understand the principles of design in the dressmaking companies. It

39 In 2001, I graduated from the Academy of Fine Arts in Łódź.

enabled me to gain practical professional knowledge as well as understand the complexity of fashion issues. In parallel with my professional work, I continued to be active as an artist, producing works in the field of fibre art in knitting technique. I focused on exposing the softness and plasticity of the matter while depicting certain thematic content linked to my own, often intuitive interpretation of it.⁴⁰

Among artists, there are many who create artistic textiles as well as those who only use textiles as a matter for their works.⁴¹

These are the words of the well-known artist, Professor Włodzimierz Cygan,⁴² who refers to the field of artistic textiles. I think a similar division can be made with regard to knit. There are designers who use knitted material in their work without exploring its essence, having other objectives in mind. However, we will also find others, such as Issey Miyake, Sandra Becklund, Johan Ku, Mark Fast⁴³ or Julien Macdonald,⁴⁴ who express through their spectacular designs a great understanding and respect for the structure of knit and who draw ideas from its diversity. They use and emphasise in an original way the essence of the weaves and the wealth of design solutions specific to knit, highlighting their paramount role in the presented models. Such ideas and experiences stand behind of my perception of the knitted medium as well.

3.1. The machine-manual system of knitting in creative activities⁴⁵

In 2018, I created my original collection *Hybrids*, which reflects my considerations on the intersection of design and artistic disciplines, influencing the emergence of new areas of activity with overlapping scopes. It is an expression of the emotions that accompanied me while working on the project. Garments have evolved from clothing forms to objects of a visional nature. Proportions, shapes, surface textures, resulting from the internal structure of the knit, are manipulated, which results in the creation of spatially diverse structural configurations. The main design premises of the *Hybrids* collection include direct references to the theme relating to the multi-faceted use of knitting technique and the desire to express an artistic idea set in a specific technology, based on experiments with the

40 Chapter „3. Technological and implementation conditions in the context of author’s design activities” to this point is an excerpt from Anna Kuźmitowicz’s summary of academic and artistic achievements (Annex no. 1 to the application for habilitation proceedings), https://www.asp.lodz.pl/images/dzialalnosc-naukowa/stopnie-tytuly/postepowanie-habilitacyjne/kuzmitowicz-anna/191029-autoreferat-pl_e39f8.pdf [accessed: 22/04/2022].

41 Włodzimierz Cygan, “Integracja sztuki i nauki w dobie sztucznej inteligencji”, *Powidoki*, 4 (2020), p. 183.

42 Włodzimierz Cygan (b. 1953) – Polish artist (main area of activity – artistic textile), educator, professor at the Academy of Fine Arts in Gdańsk and the Academy of Fine Arts in Łódź. His main area of interest is artistic textiles; he focuses on tracing the possibilities of obtaining means of artistic expression in unconventional warp systems and specific relations between fabric and light. His artistic works have been presented at numerous exhibitions at home and abroad.

43 Mark Fast – world-renowned designer of luxury knitted products. He studied at Central Saint Martins and obtained his undergraduate degree there. Fast makes knitted garments using manual knitting machines, which allows him to experiment and create his own openwork weaves-networks.

44 Julien Macdonald (b. 1971) – Welsh fashion designer, recognised British Fashion Designer of the Year in 2001; he is especially renowned for his glamour style designs; he works in knit to create sensual luxury garments.

45 This chapter is an excerpt from Anna Kuźmitowicz’s summary of academic and artistic achievements (Annex no. 1 to the application for habilitation proceedings), https://www.asp.lodz.pl/images/dzialalnosc-naukowa/stopnie-tytuly/postepowanie-habilitacyjne/kuzmitowicz-anna/191029-autoreferat-pl_e39f8.pdf [accessed: 22/04/2022].

raw materials used. The final result takes the form of an original garment-object, a hybrid combining fashion, sculpture, architecture and artistic craftsmanship, which blurs the boundaries between all these fields. The technique used is hybrid knitting with a thread, which combines knitting and weaving methods. This collection expresses the search for innovative solutions in terms of showing the interdependence between the materials used and the way they are applied in the knitting process, as well as the influence of these elements on the form of the garment. My previous experiences made me look closely at the very matter of knitwear, the basis of all its properties: the inner construction that allows the knitting technique to be exposed as an extremely creative, multidimensional medium.

Looking for new means of artistic expression, I experiment with the material, I 'listen' to the natural structure of the knitted fabric and at the same time I consciously change and shape it through the used material. Based on traditional technologies, I develop my own original designs, enriching and extending the range of materials used, which significantly determine their specific shape. The *Hybrids* collection consists of two parts. In the first one, I expose the possibilities of creating garments with different spatial arrangements using mostly standard yarns. The raw materials and knitting weaves used determine the shapes and textures of the garments and offer the possibility to create three-dimensional arrangements based on forms derived from vertical and horizontal schemes: rows and columns, the elements underlying the construction of the knit. They offer the possibility of composing clothing forms that go beyond space, create an inner area between the human body and the clothes, boldly expanding the area belonging to the wearer. They build tension by juxtaposing forms with strong lines and clear directions in rhythmic arrangements with rounded, oval forms and circular cut-outs. In line with my intention, the material that makes up the garment, behaves in different ways: it partly stands out, partly succumbs to the force of gravity and falls softly, depending on the wearer's movement; it gains new values and the possibility of creating variable compositional arrangements. The first part of the collection presents the process of exploration and experimentation, while the second results from the consistent development of an artistic concept. In this second part of the collection, I put more emphasis on the use of self-knitted structures accompanied by a variety of raw materials. These elements, which in the first part are only an addition, in the next stage become the basis of my actions. Using in the creative process varied materials and techniques of knitting with a thread, I can obtain spectacularly working forms, textures, spatial arrangements in which light, translucent parts intertwine with heavy and massive ones, while those derived from geometry are combined with organic ones. When observed under magnification, you can see the inner, intricately constructed world. The major role is played by the variety of textile material that I use to create my original knit concepts. I reach back to the basics, to the elementary principles of the structure of the knitting matter. The same weave made of a different type of yarn may give a different visual impression and have different properties that determine the function of use. As a result, the knit in my designs partly takes on

the characteristics of the yarns from which it is made, and is very varied; it can be light, soft, heavy, springy, stiff, shiny and metallic, matt, translucent or consolidated and compact.

As a designer of knitted garments, I make decisions at many stages of creation: from the identification of the basic material of the knitted garment to the selection of the arrangement of yarns through weaves and the knitting techniques. By being able to control so many factors at all stages of the project, I have the influence on the final, broadly defined structure of the garment. Regarding the possibilities of working with knitting techniques, I share the opinion of clothing designer Sandra Becklund:

This means the freedom to create your own material as you work. For me it is an absolute challenge.⁴⁶

Jean Merrill says:

The knitter must think in a three-dimensional way using a single yarn.⁴⁷

When choosing raw materials, the way they are arranged in the knitted element, their size, and, in the final stage, also the form of silhouettes, I moved between artistic creation and workshop requirements, combining my own design vision with several technical conditions.

In the *Hybrids* collection I use a variety of raw materials: typical, standard knitting yarns with a simple structure, cotton yarns, acrylic mixed with polyamide, as well as a wide range of unconventional materials which are not standard to knitting, with different technical parameters: raw materials such as polyamide monofilament, braided elastic, cotton and polyester cords or ribbons. In order to be able to use these unusual raw materials, I deliberately opted for an unusual way of realisation, namely knitting with a thread. This method has been known for many years but is not very widely used. The technique of knitting with a thread is mostly used to obtain a reinforced surface, not as elastic as a knit without the thread. In a sort of a way, it is a combination of knitting and weaving techniques. I use this technique in my works to increase the possibility of using diverse starting materials, and this directly contributes to expanding the range of possibilities for artistic creation. I use for the thread raw materials which, due to their lack of stretch, cannot be used in knitting with machines, or the elasticity of which is so great that it would cause the yarn to clamp on the machine's needles and disable further work. In some cases, the effect is affected by uneven shrinkage of the yarns, especially the braided elastics. They are able to shape, to some extent, the texture of the surface and the spatial arrangement of the knit and the garments themselves. This is especially noticeable when the knitted items are removed from the machine and undergo relaxation, i.e. the process of obtaining natural sizes and volumes not forced by stretching on the machine. It is then possible to almost see their 'movement' and 'life' consisting of their own formation, the appearance of spots with unevenly dispersed loops on the surface. The variety of materials-yarns used as a thread causes layering, thickening

46 J. Sissons, *Basics, Knitwear, Fashion Design 06*, p. 9 (retranslation).

47 J. Merrill, G. DeMeyere, K. Ben-Horin, *The Sweater. A history*, Atglen 2017, p. 184.

and rearrangement of areas of stronger or weaker consolidation of the knitting matter, which in turn affects the spatiality of the obtained elements, and, ultimately, the specific texture and form of the garment as a such. Depending on the selection and arrangement of raw materials and the separation of needles in the bed of the knitting machine, I differentiate the surface of the knitted fabric by placing variable compositions of rhythmic strip arrangements. In most of my models, I also apply the surface sections of the knitted fabrics in which I use polyamide monofilament as the base yarn. This treatment creates semi-transparent surfaces in which the introduced thread is visible in the form of line arrangements. This is particularly noticeable in the models, where the stripes of thread used in the elements of a garment put together in a spatial construction create overlapping 'drawings' built of intricate 'lines' of varying directions, courses, thickness and properties. They sometimes reveal what is inside the garment: the wearer's body, and sometimes cover it with a tangle of ephemeral knitwear tissue.

The thread ends visible at the edges of the completed knitted elements are also important visual elements resulting from the technique used. Each time, the hand-cut and transferred thread can be shaped in a variety of ways. In my projects, it sometimes flows loosely and in long stripes, falling down to create further spatial arrangements, and sometimes it is cut shorter, visible in the form of characteristic prominent ends. I am deliberately highlighting this phenomenon, as it generates new visual effects, thus increasing the expressiveness of the overall garment. These are not 'artificially' added elements, but a direct result of the technique used and the integral elements of the knitting process.

Space is a very important factor in many of my projects. In relation to clothing, we can speak of space as the area that a given garment is able to contain within itself. It is also important to realise that the final shape of a garment is determined by the human body it covers. Knitted clothing is a particular example of this relationship: thanks to its structure, the knit easily adapts to the shape of the wearer, however, without internal support, it falls, succumbing to the force of gravity. Many clothing designers ask themselves how the two-dimensional plane of the fabric should be adapted to the three-dimensional shape of the human body. In the case of knit, thanks to its flexibility, it is possible to adapt the products to the user without complicated structural cuts and darts. My observations and experiences gained while working on the collection have shown that the behaviour of forms in space definitely depends on the parameters of the starting material, the type of weave, as well as the size of the knitted elements. When designing and realising garment models, I pay great attention to capturing and emphasising their spatiality. I do not cling, enslave or shape the body, on the contrary: I give it freedom, I allow the garment to form and shape itself naturally, to live its own inner life. I celebrate the Japanese *ma* – the essential element of perceiving a space that has its own shape and layout. To emphasise this effect, I use voluminous dress forms and emphasise the skilful use of appropriate materials and textile raw materials.

Human movement provokes movement of the whole clothing form, it is the reason for variation and shifting of the knitted parts in relation to each other. External and internal spatiality, exposed by the translucency of the surface and the form of the garment, gives the impression of the existence of other areas to which the observer gains access. The variability of the shape of the lump of the garment is closely related to the raw materials used, it results from its organic structure and dynamizes its spatiality to a large extent. This issue is well captured by the notion of “textile architecture” proposed by Professor Janusz Szosland. I often create three-dimensional, ‘architectural’ knitted constructions by layering, rhythmising and duplication, taking advantage of their natural shaping on individual silhouettes. With the human body as my main reference point, I work with knit, making individual panels, then multiplying them and attaching them to others until they become a considered and acceptable whole. I value working with knitted fabric by pinning it on a mannequin; this is how I created all the pieces in the *Hybrids* collection. I use the new possibilities resulting from direct contact with matter to create a variety of spatial arrangements of clothing elements, fully aware of the fact that it would be impossible to achieve them within design carried out without tangible contact. Only the observation of results obtained and reflection on them can lead to further solutions. The completed work does not always reflect the initially intended result and it often happens to me to change it several times during the creative process. I follow what the knit itself and my intuition tell me. Often guided by the ‘whispers’ that arise from the elements being realised, I reach further solutions that are the continuation of the existing ones. I try to see the potential in even a small sample of knit and try to find a new use for it.

The constructions of all the completed garments are inscribed in rectangular forms, respecting the internal structure of the knitted fabric and the resulting horizontals and verticals of the individual rows and columns. When working on the collection, I tried to maintain a certain order in composition, which is why the form of each of the presented models of clothing was built on the principle of starting from a simple initial shape, without any structural cuts. With this general principle for the construction of the entire collection, I wanted to draw particular attention to the richness of the surface texture and the form of the garment. I tried to achieve the right composition of garments by manipulating the weave combinations in the knit without changing the number of stitches in its width. The use of simple structural forms makes it possible to focus on the visual changes that occur as a result of the variety of raw materials and weaves that build up a given surface.

The effect of colour is well described by Katarzyna Kobro:

By introducing colour into a solid, we break it up. Colour dematerialises the solid [...]. When confronted with space, colour reflects the influence of its energy on it.⁴⁸

48 K. Kobro, W. Strzemiński, *Kompozycja przestrzeni. Obliczanie rytmu czasoprzestrzennego*, Łódź 1931 („Biblioteka „a.r.”, t. 2), p. 93.

At the very beginning of my work on the collection, I decided to consciously limit colour in order to be able to fully expose the variations in form and texture that I found most interesting. Giving up intense colour helps to bring out the qualities of the knit that are most important to me. To avoid the energy of the colour competing with the texture of the knits, I opted for white, which emphasises the uniformity of the realisation and gives the opportunity to draw attention to the structures of the garments.

I made all the models in the collection with my own hands using flat crochet machines, where the group selection of needles is manually controlled, combining machine and hand methods of dressmaking. These devices allow the creation of knit in an experimental manner, the free selection of yarns during knitting, the use of non-standard textile materials of different raw material composition, thickness, weight and specificity. Thanks to the use of this type of machine, it is possible to stop work at any time and intervene during the creation of the knit. It is also possible to use the method of knitting with a thread, which is an important procedure in the *Hybrids* collection, providing great opportunities for differentiation of design and realisation activities. I find these artisanal ways of knitting very valuable, creative and particularly beneficial for teaching purposes.

3.2. Latest technological developments – support in the design of original structures

Due to its interdependence on the technology used, knitting is a field where understanding the principles of the internal structure of the knit is crucial, and the acquisition of knowledge and mastery of skills in the technical area provides opportunities for creative interventions in the design process. Technological advances in the knitting industry have enabled huge improvements not only in production but also in the design aspect. Thanks to the research programmes implemented at my academy, it was possible to purchase a state-of-the-art electronic knitting machine, which has significantly modernised and accelerated the realisation of knitted fabrics, and part of the multi-stage process of developing surfaces and forms of garments could be moved to a specialised design studio. Studies of this type combine graphical software and specific technical coefficients used in knitting. The simplification comprises the possibility of using specific tools just like in a graphics programme: drawing, copying, duplicating, reporting, picking up or replacing colour and structure, etc. Other parameters determine the processes related to speed, accuracy, movements of the needle beds, knitting tension, report setting, etc. Skilful use of such software⁴⁹ provides enormous improvements, both in machine programming and in the realisation of knitted fabrics by optimising these processes. Benefits come from the possibility to use numerous built-in, ready-to-use, automatic knitting solutions – modules that can be downloaded from the database. Practical descriptions provide assistance on how use the individual modules correctly according to their function. Most modules can be freely combined with

49 Software – the entire information in the form of a set of instructions, implemented interfaces and integrated data intended for a computer to accomplish its objectives. The purpose of software is to process data to the extent specified by its author.

each other, building up new combinations. A large variety of predefined ready-made elements, which can be edited and customised to suit individual design needs, enables the creation of more complex solutions. Various views are also helpful: the programmer-designer can see in different windows the view on symbols, a simulation of the real view of the knitted fabric and a technical view. These diverse facilities help, for example, to evaluate the projected area and improve the programme if necessary; to check that each proposed pattern can be realised without error; or to calculate the knitting time and yarn consumption. Major innovations have occurred in the development of colour patterns. Complex, multi-coloured and multi-element design layouts can be implemented into the software without wasting time and energy on preparing them. A whole range of tools are already set up automatically, but individual specifications are often needed to create original solutions. The realisation of the knitted fabrics is also modernised: it is carried out by a device equipped with a separate computer, cooperating with the design studio, and it is completely mechanised.

Thanks to the machine-controlled processes for creating the knit and knitted garments using electronically controlled machines with individual needle selection, the production of knit has been greatly improved. The time spent on making the samples needed for calculations and surface evaluation has been reduced, and thus the entire process of making the garment has been greatly accelerated. By using this type of machine, it is possible to juxtapose highly structurally differentiated, spatially acting surfaces next to one other. Such high-tech processes create the conditions for innovative design and are of great help at many stages of the design and implementation process. The possibility of free juxtaposition of pattern elements brings very diverse visual effects obtained by using many types of weaves and knitting techniques (very often in combination). These effects include, for example, welt, relief, openwork, jacquard, intarsia and multi-layer structures, three-dimensional 3D constructions, spatial additions, tailored cut garment forms and seamless garments.⁵⁰

I used this type of knitting machines to create the *Popit* collection, which includes my statement on the complex relationship between structure and form in knitted garments, exposing an experimental approach to colour, texture and raw materials, in particular highlighting the tactile properties of knitwear.

Design of the collection was initiated by the creation of original textural surfaces, the concept of which is based on similarity to sensory toys. The specific spatial structures and contrasting colours exude energy, stimulating the senses of sight and touch. The selection of different raw materials complements the haptic properties of the individual surfaces.⁵¹

50 https://www.stoll.com/fileadmin/user_upload/pdfs/Brochures_english/M1plus_15_gb.pdf [accessed: 10/02/2022].

51 Author's description of the collection, <https://cmwl.pl/public/aktualnosci/popit-prezentacja-kolekcji-mody,260> [accessed: 22/04/2022].

I subordinate the forms of clothes to structures, exposing the richness of combinations of design layouts, creating diverse visual combinations with oversized dimensions emphasising their unique character. Knit is inherently pleasant to the touch, it encourages the organoleptic contact.

Spatial textures are particularly appealing, both from the visual and tactile perspectives. The effects of intense textures are punctuated by colour and highlight them in a complementary manner. Oranges, pinks, amaranths, greens and reds, combined with the transparency of the textile line, create colour combinations based on contrasts, which dynamize the garments. The energy of colour has a positive effect, drawing the viewer's attention. Surfaces in the *Popit* collection are achieved by using several different ways of punctual knitting together with the superstructure of the knitted parts. This is exemplified by the conical convexities that form striped waves: a highly plastic and sculpturally spatial weave. Interesting effects are brought about by variously coloured highlights in the form of bands and points, knitted with yarn on a transparent background. They bring additional spatialisation and the impression of different layers permeating each other. Other suggestions include the experimental creation of sectional additions in knit that are fragments of the repp weave. The multiplication of these elements contributes to the massive character and emphasises the impression of being surrounded by knitted structures. Developing them with the help of a specialised design studio allowed for free reproduction, correction, scaling and positioning in appropriate sequences, while establishing the colour effect at the same time. These conditions allow for additional experimentation and greatly increase the speed with which ideas can be implemented. In all the garments, rhythms and repetitions are a very important element that unifies the collection. Controlling and organising them properly is possible both at the time of programming the patterns and at the time of their execution by the knitting machine. Repeat numbers can be adjusted on an ongoing basis, as items are knitted. Rhythmising is also manifested by the use of weaves with separated needles that give a pleating effect. Horizontal and vertical divisions in both structure and colour emphasise the dynamism and energy of the garment. I often use voluminous clothing forms to accentuate their natural layering and free-flowing behaviour on the figure. This time I am using standard knitting yarns and the design idea is based on differentiation of spatial structures highlighted by colour. Their haptic properties exposed by the accumulation of various highlights engage the sense of touch and offers sensual stimulation.

Summary

The activities presented are focused on the concept of increasing the range of design possibilities in knitted clothing and showing the complex relationship between design and art. Most of these activities, which take place at the interface between the artistic and utilitarian spheres, can be transferred into a universal design space and applied to much more functional garments. The experiments carried out also provide enormous opportunities for application in teaching, demonstrating the potential of knitting and broadening the base of design and implementation solutions.⁵²

The opportunity to learn by observing and experiencing the knitting process is truly useful in understanding the principles involved in technology and their original transposition into the language of design. The examples presented above are only a selection of the wide range of possibilities for achieving very diverse visual effects with the medium of knit. The structure of the knit enables designers, through its creative use, the achievement of much more than simply the imitation of fabric.

The knitting process allows the designer to have complete control over the type of material they want to obtain. Yarn, raw material, colour, pattern and weave are the basic elements of the resulting knit structure, which in itself provides endless possibilities for design inspirations.⁵³

New technological solutions are becoming increasingly accessible and adaptable to innovative ideas, and designers are increasingly using the knitting technology in their collections. The opportunities available today make fashion designers explore this technique, its potential and versatility; the technological advances have transformed knitting from a homespun craft discipline into the most innovative and exciting textile medium. In the future, the very high, or even royal in some respects, position of knit among textiles will certainly remain durable.

52 Excerpt from Anna Kuźmitowicz's summary of academic and artistic achievements (Annex no. 1 to the application for habilitation proceedings), https://www.asp.lodz.pl/images/dzialalnosc-naukowa/stopnie-tytuly/postepowanie-habilitacyjne/kuzmitowicz-anna/191029-autoreferat-pl_e39f8.pdf [accessed: 22/04/2022].

53 F. Spurling, *Designing Knitted Textiles*, London, 2021.

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Peer-reviewed article

Publisher: **The Academy of Fine Arts in Kraków,
The Faculty of Interior Design**

Editors: **Prof. Beata Gibała-Kapecka, Joanna Łapińska, PhD**

Translation PL-EN: Biuro tłumaczeń „Lingua Lab”

Graphic design: Joanna Łapińska

The „inAW Journal – Multidisciplinary Academic Magazine” was established owing to the financing from the project titled „Projektowanie przyszłości – program rozwoju Akademii im. Jana Matejki w Krakowie na lata 2008–2022”



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