The volume-spatial origami structure as a formative and decorative factor of the modern world and Ukrainian costume

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Abstract: The most interesting scientific publications of world and Ukrainian researchers in the modern costume design field and the fashion design innovations and technologies usage have been analysed. The features of tectonic costume design have been studied. The basic principles of the origami techniques usage in the modern clothing design have been formed and illustrated based on the world and Ukrainian designers' experience. The principles of volume-spatial structural elements formation have been examined based on the practical examples. Different types of relief costume finishing elements based on origami systems have been analysed. The visual signs of structural forms expressiveness, their transformational dynamic properties, decorative and utilitarian application have been determined. The differences between the world and Ukrainian design with the volume-spatial structures inclusion in the costume designs have been evaluated. The possible further development of clothing design with the current technologies and scientific achievements usage have been predicted according to the scientific literature basis and the origami tools practical application in the designers work.

Keywords: clothing design, origami, texture, pleated systems, volume-spatial structures

Introduction

The interaction with space and the transformation of the plane in modern design and conceptual art is a field for various kinds of experiments, involving a wide range of methods, techniques and technologies. Nowadays it's hardly possible to clearly distinguish the types of design and avoid the intersection line between them. Volume-spatial designs or structures can be observed in book printing, industrial construction, consumer goods production, environmental

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design, interior design, crafts, etc. The future of art and science is created by borrowing, cross-applying techniques and technologies, stimulating their development and accelerating their positive changes. The origami usage in various construction areas is one example of this interaction. This Japanese technique of paper folding, in such a way transforming the plane, was originally just fun and play, but it retains a considerable potential for visual, utilitarian form-making, dynamics, and potential movement of the form. The construction of an object or modification of a plane based on the origami principles can be found in modern urban planning, architecture, the latest technologies, mechanical engineering, household items design, and in particular in the design of clothing.

Modern costume design has long gone beyond its utilitarian and daily usage, turned into a self-expression language for fashion designers, crossed the subjectivity boundaries and became an object of creation, the embodiment of the artist’s intention, and a visual and material reflection of the designer's feelings. Modern costume design should be perceived as a complex mechanism of interdependencies and interactions. The creation of a modern costume is associated with many factors: the silhouette of the image, the structure of the material, the texture and rhythm, the context of application, etc. The volume in general and its elements that change the structure of the outfit one way or another are a separate formative factor.

The designer is confronted with various peculiarities of performance, the specifics of material plasticity and the undeniable constructive and visual features of the created form, borrowing the principles of origami techniques in the process of the clothing design. Objects of truly extraordinary transformations emerge by active incorporation of utilitarianism into the design system. The costume acquires an ephemeral design with the possibility of programmed movement, using the dynamic pleated or mesh structures that give both fluidity and impermanence to the shape. The framing of the structure makes it possible to create a volumetric form of almost unlimited configuration of zoomorphic, anthropomorphic, bionic or abstract nature. The modular system ensures rhythmic and predictable shaping with maximum texture effect, but a rather static overall shape.

The active use of the modular origami principles, pleated and mesh structures of different rhythms and complexity, transformation of framed forms, and segmental formation of spectacular textures to gain enhanced expressiveness, and imagery, facilitate movement, and reveal

the author's intention can be observed by referring to modern costume design. From a simple fold and its various combinations up to an architectural structure that significantly changes the silhouette - all this is created with the help of the origami principles implementation. The rigid structure set by the pleated systems emphasises or completely changes the shape, enhances the decorative effect of any composition, even the simplest one.

Methodology

The analytical method has been used in the article to review Ukrainian and foreign scientific publications and to highlight the main differences according to the authors' opinions. The systematic method has been implemented in order to form the general context of scientific thought and identify the specifics of views. The descriptive method has been applied for illustration of the foreign and Ukrainian designers' practices in the origami tools usage, while the comparative method allowed identifying differences in the creative achievements of Ukrainian and foreign fashion designers. All available scientific and practical information has been analysed with the help of the systematic analysis method; a view on the further development of the modern costume design field regarding origami tools usage and the latest technologies incorporation has been formulated based on the systematic data using the prediction method.

The study results

Origami is a method of a plane transformation by means of numerous bends, curves, turns, twists, or other deformations. Modern design construction is familiar with various principles of object formation by means of origami. The main origami methods are classical, sectional, modular methods and kirigami. The classical method is based on the formation of the object's body by simple folds, corrugated surfaces, and pleated structures, which, depending on the task, can form a static or dynamic figure. The sectional method involves stylising and geometrization of a basic shape and creation of a low polygonal object by dividing it into sections. The modular method represents the formation of an object from separate, often identical, segments, which are combined to form a textured object, but mostly static, as the fixation of the segments together often limits any factors of movement. The grid structures, which are sometimes distinguished into a separate subspecies of origami – kirigami –, also should be mentioned.

Predefined rhythmic cuts in the material give a greater tendency to dynamics and modification of the material, due to which the plane can acquire an illusory volume and adapt to a given object.

Nowadays, the potential of origami techniques also depends on the materials used for its creation. Paper as a base material, from one point of view, is quite soft and suitable for manipulation, and, from another, despite its plasticity, it has a dense enough structure to hold a given shape. Metal, meanwhile, being durable and less adaptable, has its own specific of techniques applications, as well as flowable concrete. The principles of origami are now being used for the design and creation of objects in 3D printing. Origami can be used both as the main shaping factor and as a finishing and decorative factor in work with fabric and in the clothing design. Fabrics can have different features depending on the complexity of the weave, thread density and the specifics of the subsequent surface treatment. For example, in thin fabrics, origami tools often play a decorative role, while shaping can only be done with the use of additional rigid frame elements. Dense fabric, on the contrary, is suitable for holding a specific, not too large, shape due to certain factors.

Origami techniques have become a part of the basic fundamentals of 3D object design long time ago. In graphic design, it helps to understand spatiality, which affects the development of books with volumetric content ('Pop-Up' books), design of product packaging and other creative paper forms. Interior or landscape design, architectural design cannot be imagined without the use of origami techniques - corrugated folded structures, segmented frame forms, modular systems are the basis of any solution to the proposed space. Similarly, these principles are also applied to the design of modern fashion clothing.

A considerable importance of clothing tectonics can be determined based on the basic sequence of costume design, which are identified by the scientists as follows: the basic shell sketching, development of a sweep taking into account the main structure, further design of the structure, creation of patterns, fabric cutting and direct sewing (Pashkevych and Yakovliev 2020). According to Pashkevych and Yakovliev, costume tectonics is: "the design of clothing taking into account the features of materials, the rationality of their usage through visual reflection in the external form and design of parts." (Ibid.) Thus, the tectonics of clothing is directly related to the social characteristics, utilitarian purpose of the product, and the author's idea and intention. The designer considers not only the aesthetic or practical function

while creating a costume with volume-spatial elements, but also expresses his or her own thoughts, reacts to social situations, concentrates and manifests mass moods. The same idea of tectonic or structured clothing design is expressed by Xiaoli Cheng (2018), the author of the article "Application of Structural Design in Advanced Clothing", who defines the most important thing in the design of a costume as the orderliness and consistency of development processes, which directly affects the innovation and creativity of the final product.

The global scientific community is very interested in the development of modern technologies and pays a lot of attention to the implementation of the latest developments into everyday life, already known and positive production practices, consumer goods, etc. Nowadays the textile industry is still incredibly necessary and relevant, so the scientific achievements and technological findings involvement in this industry is extremely important. A lot of scientific works have been dedicated to the textile technologies improvement, the formative methods and search of design solutions.

Many reflections on the design of 3D architecture, taking into account various trends in numerous industries such as fashion, cooking, jewellery, etc. can be found in the "3D-Printed Body Architecture" (2017) collection. The authors also touch upon the issues of the objects framed construction that correlate with the scale of the human body. 3D printing of objects is a leading area of science and design in the modern world. 3D production technologies are the future of the manufacturing industry in various areas of our lives, including clothing. A straightforward evidence of this fact is the practical experience of designers' collections demonstrated on the world podiums. Asim Kumar and Roy Choudhury (2017) discuss the modern principles of fabric finishing on a production scale, the properties of materials and their modifications, defining the basic principles and types of textile finishes in his book called "Principles of Textile Finishing". This knowledge is now widely used by fashion designers.

"Smart Clothes and Wearable Technology" 2022 edition represents publications devoted to the incorporation of the latest technologies into textiles, a deeper study of traditional fabrics and their properties, interaction with the latest scientific achievements, smart clothing, wearable electronic fabric, adaptive fabric and other aspects of textile innovation. Specific practical findings are offered by the authors of the articles, which opens up a wide range of opportunities for the modern costumes development.

Many scientists study the development of existing technologies and the involvement of fresh developments, new technologies, and innovations. Thus, the possibilities of the origami and kirigami techniques usage in nanotechnology for shaping and dynamic deformation of crystalline inorganic materials structures are discussed in the article by Francesca Cavallo, Max G. Lagally "Nano-origami: Art and function" (2015). The consideration of origami tools as a shaping factor is also proposed by Kyung-Hee Choi (2016) in the "Practice-led origami-inspired fashion design: out of the frame: flight by paper plane" publication, which reveals the usage of origami methods in almost any type of design, with a special focus on costume design practices. The authors Chenlu Wang, Chen Yang, Junlan Li, Mingxuan Zhu (2022) suggest origami as a means of modern costume decoration in their work "Research on the Creative Application of Origami Performance Techniques in Clothing". The attention is focused on applicative variations, the formation of texture through ironing, corrugation, stitching, and the formation of complex modular structures. Origami and kirigami tools as methods of children's clothing shaping, the introduction of a creative aspect into the design through these techniques is considered by Amany El-Dosuky in the article called "Benefiting from the Art of Japanese Kirigami in Creating Contemporary Children's wear" (2023). Origami is also considered as a source of creative search by Angela Burns and Arzu Vuruskanin (2019) the "Using origami for creative design and pattern development in fashion education" article.

The importance of information technology in 3D visualisation of objects definitely need to be considered in the process of costume design with the help of modern technologies. These software developments provide a visualisation of the costume creation process in the smallest detail, ensuring the possibility of the object`s entire architecture reconstruction in a 3D model. The surface of the costume is recreated based on the example of building a three-dimensional body, demonstrating the acceleration of the clothing design process through the use of computer volumetric visualisation in the article by Jing Jing Li (2016) called "Research on Virtual Three-Dimensional Clothing Styles and Fold Effect Show". The pleated clothing pattern is formed in volume with the help of computer animation technology in the "Design of Three-Dimensional Pleated Clothing Pattern Based on Computer Animation Technology" publication by Wenbo Sun and Dugang Guo (2022). Researchers thus consider the computer

technology as a tool for the modern costume design, involving innovative technologies in the clothing design, also for the product presentability, the consumer adaptability.

Ukrainian scientists are also interested in the innovative technologies usage in the costume design, incorporating modern fashion trends and creative design solutions. The monograph "Fashion Design in a Multicultural Space" (2020) by the Kyiv National University of Technology and Design is dedicated to the basic, new and relevant problems of modern clothing design. It contains publications on research in the fields of aesthetics and tectonics in costume design, current style trends in fashion design, eclecticism and bionics in design, integration of technology into fashion design, etc. The authors of the monograph reflect on both well-known clothing technologies and propose innovative methods of the existing industries synthesizing with science and technology. Ukrainian researchers are paying considerable attention to the shaping and texture issues. O.V. Kolosnichenko (2015) in her article "Improving the design and ergonomic design of women's clothing of modern forms" discusses in detail the formative methods of clothing design based on the "person-clothes-environment" system. Formative methods of clothes design based on the "person-clothes-environment" system are explicitly analysed by O.V. Kolosnichenkoin. The researcher studies combinatorial methods, in particular kinetics, deconstruction and modular methods. D. Sazhyienko (2020) in the "Designing clothes of complex volumetric and spatial forms" publication also refers to the issues of complex volumetric forms formation and suggests to applying 3D visualisation technologies in the process of costume development.

Ukrainian scholars specifically consider methods of textures creation in modern costumes. The principles of overlay textures formation in a costume are structured and the classification into solid cut, patch and embroidery shaping, origami textures is derived by M. Kysil in the article "Texture Shape Formation in Modern Fashion Design" (2016). In this publication, the author considers origami tools from the point of the costume design decoration view. Also, unlike others, she considers only modular origami and kirigami methods to be origami tools.

In general, tectonic formation with the help of origami techniques has been examined in numerous publications. For example, N. Orlova in her work "The use of tectonic shaping for the modern clothing

design" (2019) suggests that exaggeration, destructiveness of forms in relation to the parameters of the human body is antitectonic: "The antitectonic approach to clothing design is based on unconventional combinations of materials, changes in their properties, experiments with the shape of clothing, deliberate violation of composition rules, and the use of unconventional methods". The main characteristics of the tectonic clothing form such as volumetric shape, silhouette, geometric appearance, plasticity, surface type, system mobility, degree of weightiness have been defined by K. L. Pashkevych, M. V. Kolosnichenko, I. V. Frolova, O. D. Herasymenko, A. H. Skrypchenko in the article called "The design and projecting of clothing systems based on the tectonic approach". Four types of tectonic systems have also been proposed to distinguish: the size of the form, proximity to the silhouette, softness and stiffness of the structure, dynamics or statics, etc. (Pashkevych et al. 2017).

Therefore, in the world and Ukrainian scientific practice, origami tools are surprisingly relevant and modern. The fashion industry also uses the principles of folding material in a kind of way in obedience to scientific interests, technological development and modern social needs. In design, the interest in origami techniques lies in the creative component, spectacularity and shocking nature of the images. The potential of the folded form is almost unlimited and dictates immense motifs and horizons.

A lot of modern fashion designers have referred to origami in their creative pursuits. The evidence of this fact can be found in the work of Junya Watanabe, a Japanese designer who uses origami shaping tools in most of her collections. Constructive repetitive elements of geometric structures that form an active surface texture in the interaction system appear in his designs. Many of the dresses and tunics in the 2015-2017 collections are made of mesh structures, which make them as adaptable as possible to the model's body shape. Nevertheless, the mesh structures have also been represented as a rigid frame system reminiscent of paper decorations in the 2015 collection. The spectacularity of these clearly defined images structures the silhouette of the costume, making it sometimes disproportional and destructive in terms of the anatomical structure of the human body, but emphasising the artist's intention.

The author's collections of 2022-2024 are marked by increased emotionality, aggressiveness and abstractness of forms. The dynamism of the images is achieved by a combination of silhouette and contrasted

framed design. Large textile elements in the designer's costumes are made in emphatically edgy, sharp shapes, which activate the emotional mood. The collection's sparse, mostly monochrome colour scheme reinforces the rebellious and tough theme, which correlates with the madness of the modern world (Figure 1).

Figure 1. Junya Watanabe. Collection 2024. Active modular origami

The author uses mainly dense, opaque, monochromatic and dark fabrics to build the image and silhouette. In volume, they enable the light and shadow play of texture that reflects the structure effectiveness. The opacity of dark fabrics adds a certain mystique and danger to the perception of the costume. Transparent fabrics are much less common, but even in such rare cases, the material's properties are advantageous in presenting the idea of the clothing design. Thus, the designer expresses himself in his designs through the combination of almost all origami tools, the light and shadows features, and the chosen materials texture in the costume designs. Nevertheless, the frame designs and mesh structures that dominate in images created by Junya Watanabe, filling the costumes with a special charm and active texture, worth to be noted as predominant (Junya Watanabe A/W 24 Womens wear).

Contrastingly, Iris Van Herpen is a designer who relies on modular systems and pleated structures in her work. A striking example is the

2021 collections, where dresses have defined spherical shapes of different diameters, consisting of curly vertical segments. The author is fond of the layering principle. She creates voluminous forms and smooth dynamic structures using this principle in a variety of ways. The designer achieves destabilisation or stabilisation of shapes, modulating them by shape depending on the main idea. The softness of the modules in her designs, layered on top of each other, create a specific, soft, mesmerising vibration, a smooth wave that resembles either the flaps of a butterfly's wings or the movements of a magical fish underwater... The movement became an essential part of the costume's representation, an element of spectacle and epatage (Iris Van Herpen. Surrealist Illusions. Figure 2).

Figure 2. IrisVan Herpen. Collection 2022. Plastic sectional origami made of thin fabrics on a frame basis

Pleated structures are another formative principle actively used by the designer. Simple corrugated systems based on lightweight fabrics and not burdened with complex elements look laid-back, airy, yet textured. Smooth lines, intense fine pleats on transparent dresses are a surprisingly elegant solution, creating a subtle vibration like a gust of wind or a ripple on the water.

Iris Van Herpen masterfully uses colour, its intensity, transparency, light and the vibration of the model's movement. She skilfully manipulates shapes to achieve the maximum effect of variability,

fragility, non-static, and "shimmering" form in her designs. The feeling of airiness, ease and even a certain fairy tale is achieved by the light transparent fabrics' application. The author reinterpreted the light shades of dresses, modular systems and folded origami structures in combination with the materials specificity, creating unique images full of emotions and volatile dynamics. The combination of modular origami and pleated structure in one costume looks harmonious in Iris' designs. The modular system is mostly dominant and accentuated in her dresses, and the corrugated surface complements and supports the overall image, giving the effect of relaxation, tension, calmness and thus completeness of the image. (Dutch Designers. Iris Van Herpen 2023)

Pleated structures look extremely expressive in a costume. Implementation of such structures in any clothing balances and streamlines the image, making it neat, official and solemn, and at the same time festive. Many designers today are experimenting with pleated structures of varying complexity and rhythmic. Jule Waibel is one of the most striking designers whose work experience is definitely considered as successful. Her practice obviously began with paper craft and reproduction of origami principles directly on paper, and she later transferred her skills to clothing design.

Jule Waibel's designs are characterised by a complex pleating system. The rhythm, the height of the formed relief, the vertical and horizontal directions of folding, the vertical and horizontal structure dynamics of her designs differ from dress to dress. Quite simple silhouettes of the forms nevertheless fascinate with the structures dynamics, their combinations, compositional arrangement, etc.

The folded structure itself contains the potential for dynamic movement – compression and decompression. Jule Waibel skilfully uses this feature in her designs, compressing and decompressing the structure to achieve the necessary volume, adjusting the plane of the structure to the desired shape for tightness, or vice versa, exaggerating and artificially "inflating" it, manipulating it as much as the structure allows.

The soft images demonstrated by this designer are achieved by using light, thin, translucent fabrics. It is quite technically challenging to keep the shape for a long time for such complex pleated structures, but Jule Waibel prefers lightness and translucency despite the expediency of using heavier fabrics in this case. Her designs are made in light shades, sometimes with a certain play of colour in the structure

deepness. Such features help to create additional visual depth and mystique. The use of a gradient in a pleated structure is a rather unusual solution and a distinctive feature of the author's colour design, which makes her clothes even more unique (Jule Waibel. Figure 3).

Figure 3. Jule Waibel.Collection 2017.Intense folded structures

The designs by Croatian designer Morana Kranjec are distinguished by a complex, dense, geometric pleated structure. The basic means of origami – a folded, corrugated structure with a fixed rhythm, reinforced by fixation, which directly affects the curves of the shape – constitute the basis of the designs. The structure used by Morana bends strictly vertically and horizontally, forming rather rigid symmetrical lines which are not very amenable to plastic changes. The fractures of the shape, however, are favourably adapted to the tasks of the costume. The clothes appear heavy, thick and durable due to the multi-layered folds, dense and even rhythmic. Dark colours also reinforce this impression of the costumes, making them look like warrior's armour, like protective armour (Figure 4). In such a way, the designer subordinates the pleated structure to the conceived form, involves it in the shape formation process, using its visual and decorative features at the same time (Morana Kranjec).

Origami tools are rather not very common in the Ukrainian design field. The methodological principles of folding a plane or its segmentation are not so widespread, perhaps due to the nature of Ukrainian culture. Here, the principles of origami are perceived more in their original way – paper folding, so the whole design with the origami techniques application has a clear Asian vibe. Nevertheless,

there are practices of origami elements incorporation into Ukrainian design projects, where they do not dominate, but rather set off the general forms, remaining accent elements.

Figure 4. Morana Kranjec. Collection 2012. Equally rhythmic, symmetrical folded structures

Origami tools in Ukrainian fashion design usually appear in the simplest variations of pleated structures – corrugation, pleating – and play a finishing role rather than a formative one, being included in the costume decor. The Japanese design features can be clearly traced in the case of the origami tools formative usage. Origami in this case hardly undergoes any transformations and technological changes. Nevertheless, some collections of designers, who prefer to follow the fashion trends, contain some elements of constructive or folded structures.

Inspiration by Japanese culture is strongly reflected in the Pre-Fall 2021 collection by Yuliia Yarmoliuk (2021), designer of the J'amemme brand, as she herself notes: "...this collection also contains a fusion of elements of traditional Japanese costume and European medieval decoration details..." Origami tools in the designs of this collection can be seen in simple corrugated shapes, pleated low-relief surfaces of soft translucent fabrics. Silhouette shapes of some designs slightly resemble the features of corrugation, forming curved tubular

structures. Small pleating in these designs looks bold, extraordinary and stylish. Large areas of the fabric are dedicated to a single, evenly rhythmic pleated structure, which is perceived calmly and monolithically due to the solid light colour (Figure 5).

Figure 5. J'amemme.Collection 2021. Corrugated folded structures

Similar methods of origami usage can be seen in the SS22 'Physique' (2022) collection by Iryny Dzhus, art director of the DZHUS brand. Origami tools act as formative factors in this collection and the main purpose of these tools` implementation is related to the possibilities of transformation, the costume elements adaptation for different wearing needs. For example, the inclusion of zips and buttons in the basic corrugated structure makes it possible to modify not only the shape of the product but also its purpose. Thus, the elegant collar of the dress turns into a hood, the size of which, due to the evenly rhythmic pleated structure, is also variable (Figure 6).

Figure 6. DZHUS. Collection SS22 “Physique”. Dynamic form of folded structure

This collection, in particular, is characterized by anatomical discrepancies in silhouettes. Exaggerated shapes, objects imbalance, simple straight shapes are combined with hemispherical ones. They are based on origami techniques and architectural monumental principles. This trend is emphasized by the monochrome colours chosen by the author. White, black, ocher shades make these designs even more similar to architectural forms.

The monochrome and folded structure in the designer’s 2024 collections are marked by a formative orientation. In such cases, a simple corrugated structure is not subordinated to the form and does not serve its dynamic change of purpose. It is independent, textured and self-sufficient. The relief of the evenly rhythmic pleated structure serves as the texture of the clothing, its expressiveness, while setting the silhouette and merging into the designer's idea. Black and white colours, which Iryna prefers, on the one hand, give the costume a strict structured look, subordination to monumental and architectural traditions, and on the other hand, encourage free thinking and subjective interpretation of the designer’s idea (Modnyisiuzhet: Rozmova with Ukrainian designers 2021).

Simple pleated structures prevail in Ukrainian fashion design. Sometimes they serve as a formative basis, but more often they are

represented as decorative elements, an impressive decor. Corrugation is used in this way in the designs of the Nadya Dzyak Bridal brand. Transparent fabrics pleated in a rhythmic manner are often layered on top of each other. The depth and volume, which forms a certain mysterious charm, is created by the colour combination. In some Nadya's dresses, the pleated folds have a black welts, which plays the role of a certain contour, a rim in the composition, and in combination with transparent materials acts as a contrast to the product overall shape, emphasising the ephemerality and airiness of the pleated structures.

The active use of colour creates a unique decoration for Nadya Dziak's clothes. A transparent, brightly coloured pleated structure is layered over the overall shape. Optically blended colours form accent decorative elements that to some extent resemble floral motifs (Figure 7). The layers of non-transparent, dense structure in some of the designer's creations, on the contrary, evoke the imagination and direct the thought to paper origami.

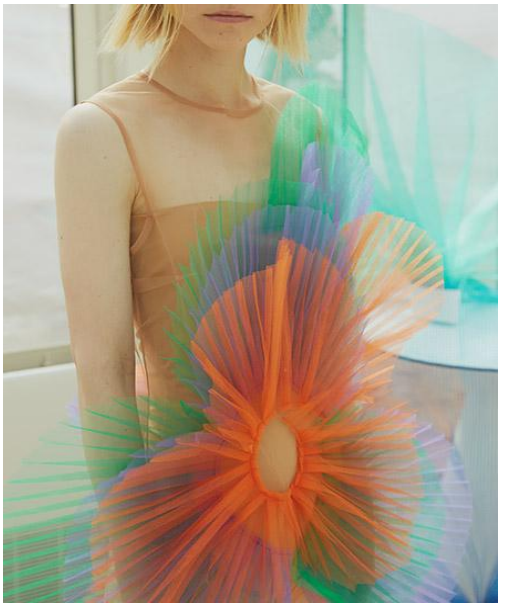

Figure 7. Nadya Dzyak. Collection 2021. Pleats as a decorative structure

The delicate pastel colours of The Secret Garden 2021 collection, accentuated by pleated decor, tend to be magnificent and at the same time simple, festive and casual. Thus, pleated corrugated structures are the main decorative highlight of this brand (Nadya Dzyak).

Many young designers presented collections with pleated structures in 2021 at the New Generation of Fashion young designers' competition in Kyiv. For example, a smooth rhythmic structure was a complementary element in Sofiia Zalisna's "DELIVERANCE" collection designs, where pleated structure became an accent element due to neutral elements, transparency of fabrics, and low relief. The pleated structure was also used as an accent in the costume by Viktoriia Vaniulina in the "LiRe" collection. Nevertheless, unlike the previous designer, Viktoriia used a more complex pleated structure in her models, with a different type of relief, convex surfaces, modified rhythm, and accentuated these elements by choosing brightly coloured, glossy satin fabrics. Structural moments also played a decorative role in her design, subordinating to the general idea, accentuating certain parts of the composition (Final 'POHLIAD u maibutnie' 2021).

Ukrainian designer Malva Verbytska, the founder of the Malva Florea brand, uses the active relief of pleated structures as a textural accent in her collections. Concave and curved complex pleated structures are presented in bright colours, contrasting with straight silhouettes in her 2022-2023 collection, dedicated to the work of architect Zakha Khadid. The active relief in dazzling white blends with the smooth fabric surface or the model skin colour, concentrates in one part of the costume and spreads out to the other. The pleated structure obeys the shape, has a variable height of relief, and is purely visual, vaguely reminiscent of architectural motifs, which is the designer's intention and should echo the architectural projects of the inspirer Zakha Khadid (Figure 8).

The bright orange colour activates the attention, playing with light and shadow differences and structuring the costume as a whole as does the pleated structure in dazzling white. The designer's strict and at the same time bright outfits demonstrate her affiliation with the architectural theme, the images orderliness and the origami folding structures usage are the precise means to achieve the goal (MALVA FLOREA FW22-23).

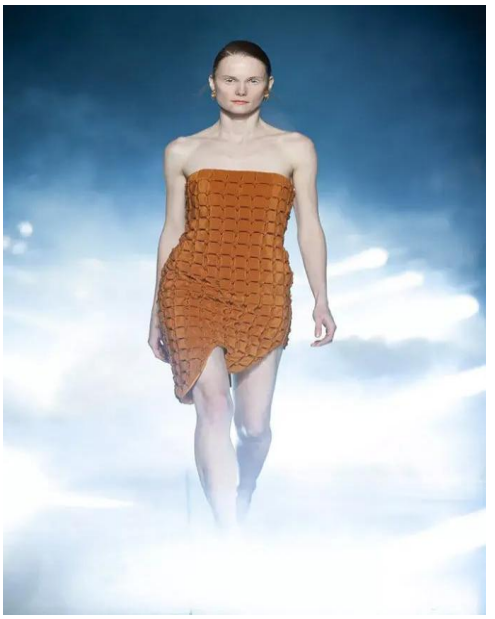

Figure 8. Malva Florea. Collection 2022. Structure of folded origami systems

Lesia Patoka, the creator and owner of the Patoka Studio brand, who has worked extensively with Ukrainian artists and participated in media projects, is an extremely effective experimenter in forms and structures in Ukrainian costume design. She is the author of the costume for the Ukrainian participant of Miss Universe 2022. The designer has created clothing designs with the help of origami, among other things for various projects. The ONUKA singer's costume, in which Lesia recreated a relief modular bird, is well-known in Ukraine, and for the KOLIR album presentation, the fashion designer created a long dress with smoothly rhythmic pleating. Such costumes are extremely expressive, unusual and perfectly match ONUKA's electronic music style. The volumetric modular elements of the bird dress are created according to the same pattern and attached to the main shape of the dress, making them part of the decoration without involving these elements in the form shaping of the costume. The pleated corrugated structures in another dress also act as a relief design of the overall elongated silhouette, but not as a shaping base, and the dynamic properties of the corrugated surface are not involved (How the ONUKA 2021 look changed).

Certain differences in the world and Ukrainian design with origami tools can thus be traced. In fashion design outside of Ukraine, a much

greater degree of innovation and experimentation in the search for the shape, texture of the costume, the density of materials and their properties in combination with origami can be observed. Foreign authors design costumes that go beyond the silhouette space, varying volumes, looking for opportunities to translate their ideas into the language of clothing, provoking the consumer and society as a whole. Origami tools are actively involved in the formative aspects of clothing design. Different fashion designers focus on different tools, interpreting them in their own way. The principles of sectional origami, modular structures, mesh and pleated systems are used in the search for an extraordinary form, and variants of their combination and synthesis are modelled through the interaction of materials contrasting in handle, texture, and colour.

The experience of the foreign designers mentioned in this article demonstrates a wide range of origami tools. A completely unique individual significance is acquired in the work of each of these designers. The main difference from the Ukrainian costume design is the use of origami as a formative tool for expressing the author's intention, without basing it on the origin of techniques or their historical background. Only in a secondary sense, origami tools are used as decorative elements, as a complementary balance.

Ukrainian fashion designers are much calmer, more moderate and slightly less experienced in the origami tools usage, not very open to experiments. Here, origami is not mainly a formative factor, but rather is used as an accent, often bright, finishing element. In cases where origami tools are used in shaping, such designs have a bright thematic colour and associatively refer the viewer to the Japanese culture where origami originated. Simple folding systems are used as shaping and decorative tools. More complex, rhythmic texture systems are used less often, mainly as brightly coloured, contrasting accents of the overall image.

Thus, a significant difference in the design approaches of Ukrainian and foreign fashion design can be identified. Ukrainian design nevertheless exists within the framework of current trends in the human centredness study, social and environmental issues, economic and political events, the use of innovative technologies and alternative materials, etc. This can be clearly seen in the collections of Ukrainian designers in 2022-2024, which are represented, in particular, at Paris Fashion Week. Well-known Ukrainian fashion design experts also note

the development of native costume design in line with current innovations.

Conclusion

Numerous works by foreign and Ukrainian scholars reveal the modern principles of costume shaping with the use of various technologies, improvement of existing materials, their properties, visual value and ergonomic application. Foreign publications offer a wide range of origami techniques applications in the latest technologies as a shaping factor, including in the clothing design. Ukrainian experts in the modern costumes development are more conservative and advocate the principles of a moderate tectonic structure of clothing. However, they all agree that the new materials usage, in-depth study of the known raw materials features, the search for alternative design principles, and sources of a new creative approach to costume design are relevant areas for further research.

Foreign and Ukrainian designers illustrate the opinions expressed by scientists in their creative collections. In the global fashion space, creators have the opportunity to express themselves through almost any means. Therefore, foreign designers are more open to experiments than Ukrainian designers, who have to take into account the target audience and the practical implementation of their ideas. In their search for a form, foreign fashion designers actively use traditional techniques from other art forms and with different historical origins, perceiving them as means to achieve the goal. Ukrainian designers are more cautious about the manifestations of other cultures in their designs, and therefore use them much more delicately.

The conclusion about the further integration of technological developments into the field of textile production and costume design can be made on the basis of the information obtained and systematised. The use of computer technology will obviously simplify the design process, and further mechanisation of the processes of making patterns, cutting and fixing costume parts will lead to the spread and mass production of a product that could previously have been an exclusively unique design. The use of new materials and modern technological developments in textile production will expand the functionality of the usual costume in the future. It is quite possible that this will also affect the formative features of its design. Today we are already talking about incorporating medical metrics, smart material technologies, fabric adaptability to temperature, humidity, atmospheric pressure, etc. It is

obvious that a modern costume will be significantly different from the costume of the next decade. Not only the means of decoration, but also the formative principles are likely to change.

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