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Making fish skin pattern-based garments: developing digital tools for the fashion industry based on Ainu fish skin robes and Japanese Kimono Patterns

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Abstract

Before the invention of synthetic fibres, people dressed in natural materials available in their environment such as skins and hides from local wildlife. The use of fish skin to create articles of clothing is an ancient tradition shared by Arctic societies along rivers and coasts, amongst them the Ainu Indigenous Peoples of Hokkaido Island (Japan). In this research we propose to use fish skin, a waste product of the food industry, as raw material for the fashion industry under the principles of zero waste. Throughout this project we recreated an Ainu fish skin robe, using digital tools and the material itself, as a means for gaining knowledge and experimenting with the use of fish skin for garment construction. The idea behind the project draws on the Ainu Indigenous Peoples' subsistence resourcefulness and their heritage, with regards to traditional fish skin craft practices. The project thus connects between anthropology, ethnography, and craftsmanship with current interest in fashion sustainability, advanced digital technologies, and contemporary production processes in fashion.

The Ainu garment is part of a study that hypothesises what would have happened if, during the Meji era, the Japanese, instead of making the Ainu shift from fishing to farming, had brought their own traditions, such as Katazome indigo dyeing, and blended them with the Ainu tradition of creating clothing from fish skin. The projects presented in this paper include a combination of different digital technologies and applications which were used to create a contemporary replica of an Ainu fish skin robe using a Japanese katazome indigo pattern. Firstly, we used the shape of an Ainu robe to create a fish skin module as a building block, and tested its relevancy for contemporary pattern making, and later introduced parametric design tools to test zero waste principals. We then used digital animation software to create an Ainu avatar and to recreate the fish skin garment situated in a virtual digital context. Finally following the digitally created garment, we have physically dyed in indigo the fish skins with Katazome stencils and lastly sewed a replica of the fish skin robe.

The project aims to preserve traditional Ainu fish skin knowledge and introduce new advanced digital technology to enable the design and production of zero-waste fish skins for fashion.

Keywords: Ainu Indigenous Peoples; Fish Skin Craft; Traditional Knowledge; Katazome Indigo Dyeing; Digital Pattern Cutting; Module Based Design; Zero Waste.

Ainu Indigenous Peoples of Hokkaido Island, Japan

The word Ainu means “human being” in the Ainu language. Long before the Ainu were incorporated within any nation state, their land, which they called Ainu Moshir (“the Land of Men”) originally encompassed the North Pacific islands (Hokkaidô, Sakhalin and Kuril Islands) Southern Kamchatka and the Amur River estuary region (Godefroy, 2011). According to archaeological findings, the Ainu (Figure 2) have lived for three thousand years (Takasami, 1998) mainly along Hokkaido’s warmer southern coast and they traded with the Japanese. From the first millennium AD, under the pressure of the newcomers from the south, the Ainu have been pushed increasingly northwards, and it is presumably for this reason that some of them settled on Sakhalin, on the Kuril Islands and on the southern tip of Kamchatka (Cevoli, 2015).

The nomadic Ainu economy is based on hunting animals and fishing for salmon in their local rivers (Cevoli, 2015). Despite the importance of salmon to the Ainu, during the colonization of Hokkaido, the Japanese government banned their salmon fishing in the 1870s, as part of the Meiji regime’s enforced assimilation policies (Ichikawa, 2003). Ainu were forced to shift from hunting and fishing to agriculture and they were discouraged from using their native Ainu language along with nearly all aspects of indigenous culture. Forced into agriculture, they could no longer fish for salmon in their rivers.

The Ainu Fish Skin Robe

The *Attush* is a traditional Ainu costume, made from the soft inner fibres of elm bark, and was worn by both genders. In the nineteenth century, the Ainu gradually replaced elm bark fibre by more convenient cotton, often using old Japanese kimonos like the one on the picture (Figure 1). Cotton, a wondrous and luxury item was traded from the Japanese and used by the Ainu to create appliqué robes to which they added dark strips around the neck, front opening, sleeves, and hem (Figure 1). This kind of attire only began to appear during the Meiji era (1868-1912) because it was only at around that time that cotton fabrics became available at a reasonable cost to many Ainu people (Hays, 2009).

Figure 1 Ainu robe with Indigo Katazome dyed cotton from an old Japanese kimono. Smithsonian National Museum of Natural History. Washington DC

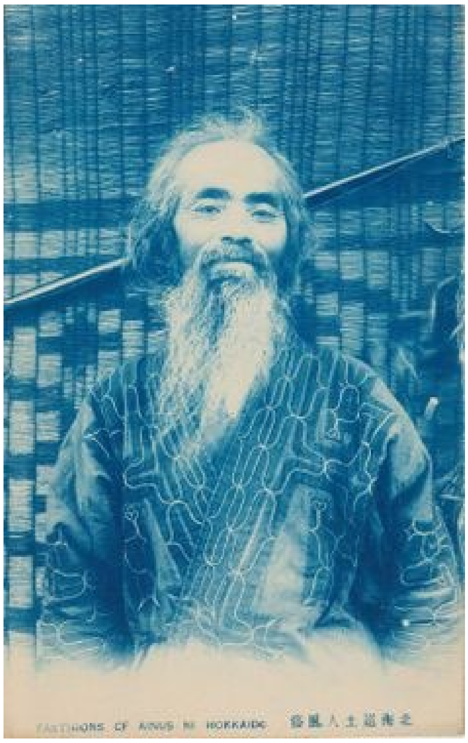

Figure 2 Old Ainu Man from the series Fashions of Ainu in Hokkaido. Leonard A. Lauder Collection of Japanese Postcards

Cultural and resource borrowing has long been a response to changing climates and ecosystems amongst Indigenous Peoples (Lewallen, 2016). Ainu Indigenous Peoples have always maintained flexible relations with their neighbours and Ainu women used new materials sometimes borrowed from neighbour countries such as sealskins and cotton fabrics while following Ainu aesthetics and cultural codes to produce their robes.

Besides using the fibers of elm bark, Ainu people also made clothing from furs, bird skins, and salmon skin (Figure 3). Fifty or more salmons could be used to make a single fish skin coat (Batchelor, 1892). In the homes of these hunters and gatherers, these raw materials were transformed by a sort of textile alchemy into gold (Watson, 2019). Ainu artefacts made of salmon skin were highly prized for making strong, light, durable robes and shoes. Sakhalin Ainu decorated fish skin garments with delicate appliqué, as did their neighbours in the lower Amur River region (Fitzhugh, 1999).

Figure 3 Ainu fish skin robe 19th century Sapporo University Museum. Sapporo, Hokkaido, Japan

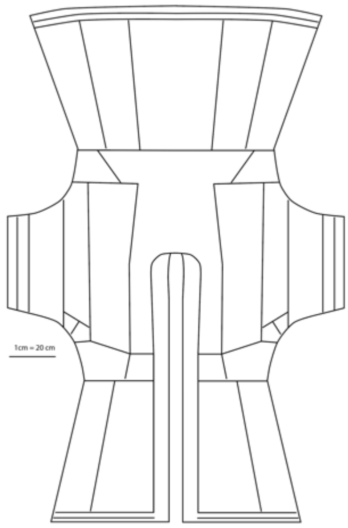

Figure 4 Ainu fish skin robe pattern

The work presented in this paper includes the reproduction of an Ainu fish skin robe in a digital context. The aim was studying closely the construction logic of the robe, its aesthetical value and appearance, and its relevancy for contemporary fashion. The digital environment allows us to animate the historical robe in a new context, maintain historical accuracy, while enabling material, geometrical and print manipulation.

The robe reproduced in this project, is an Ainu man's fish skin robe from Sapporo University Museum in Hokkaido, Japan (Figure 3). This coat has wide kimono-like sleeves and reaches to the knees. It is constructed of rectangular rows of nearly whole salmon skins. Despite the many pieces of fish skin used, a careful effort at matching has assured a uniform colour for the garment.

Resourcefulness of Ainu Indigenous Peoples

Ainu Indigenous Peoples lived in Sub Arctic regions thriving in subsistence economies where materials were precious, and they used fish skins in a resourceful and efficient manner. This was also an ethical position made out of respect to the animal (Palomino, 2020). Subsistence living in a harsh climate requires that nothing is wasted – because waste could be a matter of life and death. Throughout the centuries, fish were the main bounty of the Ainu land. The Ainu placed primary importance on fish as a food resource. Depending on location and local climate, the Ainu employed a number of locally available natural resources in providing their everyday clothing (Williams, 2017). This delicate balance was at a peril with the growing dependency of the Ainu people towards Japanese commercial goods, and the growing intrusion of the Ainu territory by merchants and hunters during the second half of the Edo period (Godefroy, 2011).

Fish skin clothing is a feast of high fashion, combining economy and harmony of materials and textures. Ainu seamstresses prepare and assemble skins of different species, with ancestral know-how. Ainu fish skin robes (Figure 3) were constructed according to the fish skin shape and each skin fitted to the next like a puzzle without leaving any leftovers (Palomino, 2021). The pattern was made according to the skins length and shape and not by cutting a pattern out of a flat continuous sheet like in current fashion industry. Each garment was made from the remains of several weeks of fishing; processing and sorting of skins of an entire family or tribe. These ancestral artisans were unwittingly enacting contemporary concepts of zero waste that are nowadays getting the fashion's world attention and respect. When it comes to working with waste materials, the importance of implementing zero waste is extremely important.

According to Dorothy Burnham (Burnham, 1973) going back to prehistoric time, various factors affected pattern cutting—the body, climate, geographic terrain, social status—they were all important, but the material from which a garment is made is the factor that has the most influence on the particular shaping of it. Garments made of animal skins are based on the shape of the animal. The first garments worn by humans were skins draped over the body. Ainu fish skin robes were made in a more complex fashion, where multiple fish skins were joined together and shaped to the body. Tanning a fish skin was so labour intensive to create, that every bit that could be used was used. That, and the width of the skin that a salmon provided, put limits on the design that were ingeniously worked around.

Integrating Fish Skins in Contemporary Fashion Using Computational Tools

Today, the consumption of fish for food is growing massively worldwide. Anticipating large quantities of fish skin waste, which could become new raw material for fashion, requires developing and customising existing production tools for fashion, so that they can complement the necessary work process. This task entails two quests: to understand the best way to connect fish skin pieces into continuous sheets, and garments and to understand the production tools of the fashion industry such as patternmaking, cutting, sewing, and printing which would need to accommodate the inclusion of fish skins as a new material for fashion. Integrating the use of fish skin in fashion has the opportunity to create a big impact, as tons of fish waste will be recycled instead of being thrown away. Additionally, a newly found implementation for fish skins, which is currently considered a waste product, has the potential to create a new market and incur economic benefits. The development of processes to transform post-consumer and industrial waste into new materials reduces pressure on excess materials consumed. Recycling waste minimises landfill and keeps resources in use for longer (Palomino, 2020).

Zero waste is defined as a waste prevention and reuse system, it aims to tackle the waste created by humanity. McQuillan (2021) argues that in the fashion industry we currently waste about 35 percent between the raw materials to the finished garment, from the material processing, cutting the garment and constructing it, until it is a finished piece. That does not include water, energy, and chemicals, just the raw material. If we include post-consumer waste that is produced after the garment has been sold, then that amount goes from 35 percent to about 66 percent within one year. In addition, two-thirds of all the raw materials we used to make garments are back in landfill within one year (McQuillan, 2020).

The Fish Skin Module in Contemporary Patterns

Fish skins have a unique trapezoid shape, with two long sides and two short sides (one longer than the other). As each fish has two sides to its body, fish skins usually come in pairs of left and right, which can create a symmetrical repetition between the two sides of the body (Figure 15). The team of designers from Shenkar used the methodology of the Ainu Indigenous Peoples, who used the fish skin module as a recuring building block for constructing their designs. This was a key point in developing the use of the fish skins for contemporary fashion design purposes, using the trapezoidal module to form a continuous semi-circular or rectangular surface, depending on the logic of assembly.

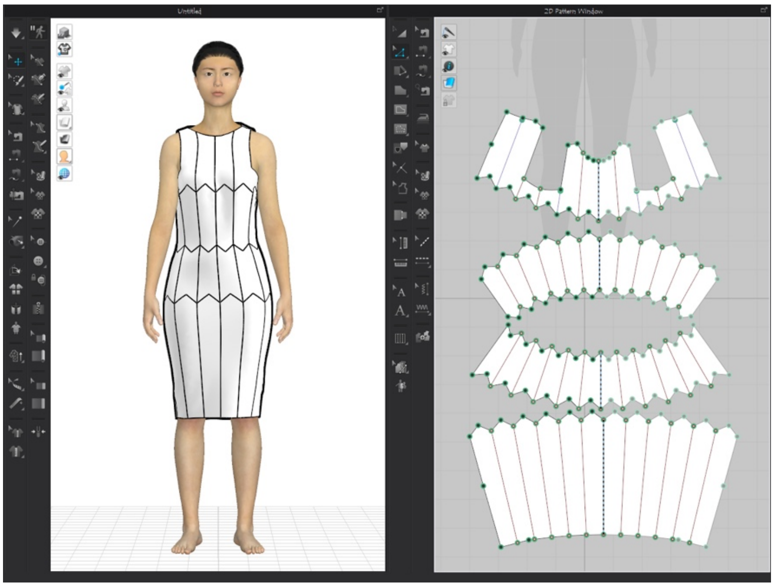

Figure 5 Digital interface of fish skins which ensures zero- waste designs by Ana Solo.

Advanced digital tools, which are used by the contemporary fashion world, enable designers to create endless variations. Companies such as Browzwear, Clo3D (Figure 5) and Optitex (*Browzwear*, 2021; *Clo3D*, 2021; *Optitex*, 2021) created a complete digital workflow, including pattern making, fabric management, pattern (print) design, cutting table and fully rendered 3D simulating tools for the designed garment. This pattern cutting system is fully computerized, digitized and with 3D supported visualization capabilities.

In our research we have focused on two things: looking for aesthetic and compatible ways to connect between the trapezoid shape of the fish skin for contemporary pattern making techniques, and to use the digital tools that are at our disposal for further developing the feasibility of the fish skin as a modern building block in garment design. It was important for us to be inspired by the Ainu traditional pattern making and establishing a connection with current pattern cutting technology as the basis for successful implementation of fish skin into contemporary fashion.

All contemporary pattern-cutting, could be considered as a process of flattening a three-dimensional (3D) volume to enable a system of production. The translation of a desired 3D garment, enveloping a volumetric body, into a 2D pattern that can be cut from a flat material requires the planning of seams, gathers, and darts in order to construct the 3D form. In the digital environment the 3D volume can be automatically 'undone' and flattened to form the various pattern pieces. The simultaneous flattening and its corresponding forming actions are the core of most pattern cutting methodologies (McQuillan, 2020).

In our work process, a number of classic garments were chosen as case studies to show the potential implementation of the fish skin module as part of modern pattern making, with particular focus on: (1) the classic fitted dress, (2) the panel flared skirt, and (3) the godet skirt. Historically, skirts were made of a rectangle fabric which was defined by the width of the hips, with the excess material gathered and tucked at the waistline (Phyllis G. Tortora, 2014). Eventually the gathering was formed by creating darts that narrowed the skirt at the waist. Examining a classic pencil skirt reveals that it has two darts and a curved side seam that is responsible for the reduction in circumference between the waist and hip lines. In the Ainu fish skin robe pattern (Figure 6), the narrow parts of the skins face the waistline, and form empty triangular voids in-between. These voids are accurately filled with sewn-in fish skins triangles, which complete the surface into a continuous large flat sheet of connected fish skins.

For our new design we used the software Clo3D, to form the skirt with similarly patterned voids, which were left empty and were not filled with additional material. When the triangular voids were sewn as darts, a three-dimensional volume was created (Figure 6).

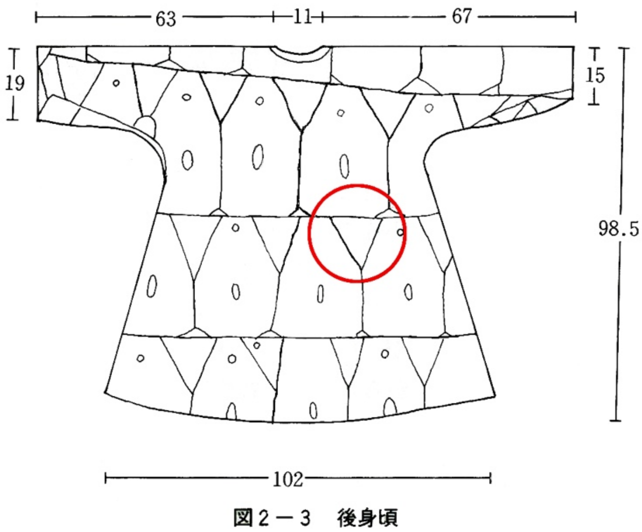

Figure 6 Ainu fish skin robe pattern. Kushiro city Museum. Hokkaido, Japan

Figure 7 2D (left) and 3D (right) modeling of triangular voids sewn as darts

Skirts that have a flare at the bottom differ from one another by the amount and form of flare created when the skirt is draped around the body. The fish skins in the Ainu garment construction are positioned to create a deliberate flare. The narrow parts of the skins are consistently positioned so that they face the waistline, whereas the wider parts face the bottom. In-between, some skins are deliberately integrated to create additional flare. In addition, flared parts at the upper torso give room for the shoulder and the kimono sleeve. These construction principals are relevant for contemporary garment construction and were used by us to form new designs. The fish skin panel skirt demonstrates the compatibility of fish skins trapezoids to create the flared form of the skirt (Figure 8).

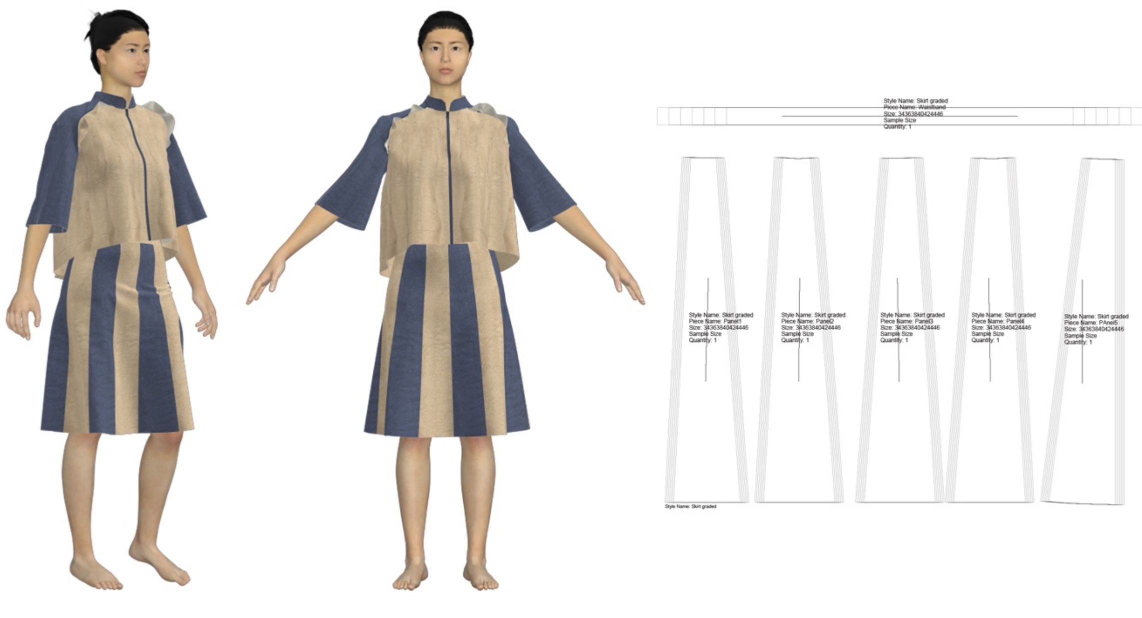

Figure 8 Use of software Clo3D, to form a skirt with similarly patterned voids to the Ainu robe.

In a classic fitted dress (Figure 9) the trapezoid panels create multiple vertical lines, which enable to add and subtract excess material, and construct the form of the dress according to the differentiating lines of the hips, waist and bust.

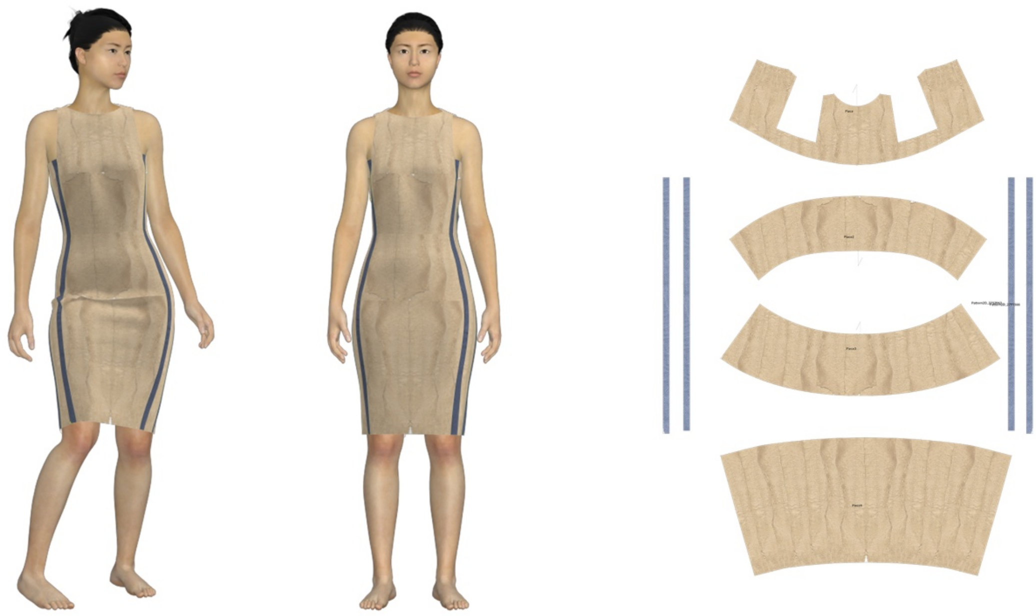

Figure 9 A classic fitted dress where the trapezoid panels create multiple vertical lines, enabling to construct the dress according to the lines of the hips, waist and bust

The direction of fish skins layout has further implications for the drape of the overall surface formed, which stems from the directionality of the skins. When using regular textiles, the length, cross and diagonal grain of fabric have great influence on the behaviour of the textile when the garment is assembled. With leather and skins, the elasticity and thickness of each skin piece is considered when choosing the function and location of the pieces within the garment or product. Fish skins are much thinner than hides but maintain a difference in flexibility between the belly and the backbone sides. Based on these considerations we explore various ways of connecting skins – back-to-back, belly-to-belly or belly-to-back. In addition, we explore adding a middle cutting line to the width of the skin which allows for better tiling of the skins, like in the godet skirt in Figure 10.

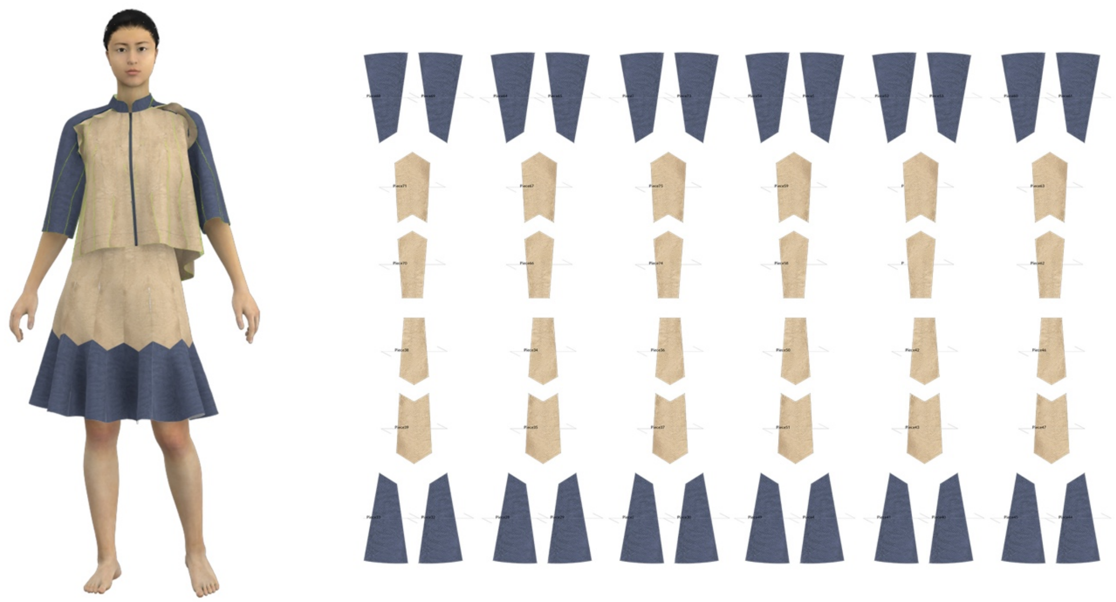

Figure 10 a godet panel skirt – exploring new possibilities which allows for better tiling of the skins

Using Parametric Tools Towards Resourceful Integration of Fish Skins in Fashion

Traditional pattern cutting is dependent on nesting, which refers to the practice of arranging as many irregular shaped pieces of patterns as possible onto a roll of continuous fabric, while occupying the least length, before cutting and assembling the pieces together to form garments (Heistermann & Lengauer, 1995). Nesting is of particular interest to our work, since it is directly related to material use, with accurate nesting leading to reduced amounts of waste and improved material utilisation (Fragapane et al., 2017). Nesting is dependent on the fabric nap, the directionality of the main design. Usually, pattern pieces can be rearranged at 180 degrees, in relation to the fabric boarders, without compromise in appearance. In addition, consistency in directionality has implication on the fabric drape and stretch, which are often uneven across all fabric directions (Baldacci et al., 2014).

According to the literature, an advantage humans have over nesting algorithms stems from experienced nesters intentionally using slight angles in order to achieve better alignment, i.e. fit more pattern pieces onto a fabric area on the expense of adhering to strict directionality. This slight variation is very hard to detect in the final garment and is reported as difficult to compute. In recent years many researchers propose new algorithms to optimize nesting heuristically (Alves et al., 2012; Crispin et al., 2005), yet it is still considered a technological challenge. Traditional leather nesting differs from fabric in that the leather is less susceptible to directionality as it does not have transverse and longitudinal grain stretch differences. Additionally, traditional leather boundaries are irregularly shaped, and leather needs to be scanned for natural blemishes and defects which are identified, evaluated and when substantial are avoided in the fitting process (treated as waste). Advanced leather nesting involves technology such as image scanning, analysis, and processing directly at the cutting table for better optimization of leather use (Jones, 2014).

In fish skins we identify a reversal of the problem – rather than cutting irregular patterns *out* of larger continuous sheets, we have small irregular shapes that need to be joined together to form larger pattern pieces. In line with the values of zero-to-minimum waste we look for: (1) identifying a recurring pattern within the small fish skin area that will be geometrically defined and repeatable, despite natural fish variations. (2) Look for productive and efficient ways to connect the pieces in a way that would result in workable continuous areas suitable for contemporary garment making, both in their aesthetics appearance and physical attributes such as drape and tensile properties. We propose to use parametric design tools (*Grasshopper*, 2021; *Rhino 3D*, 2021) for creating the initial studies for the two problems stated above. The work we present is based on scans of real fish leather pieces, originating from one type of fish examined so far: Salmon skins.

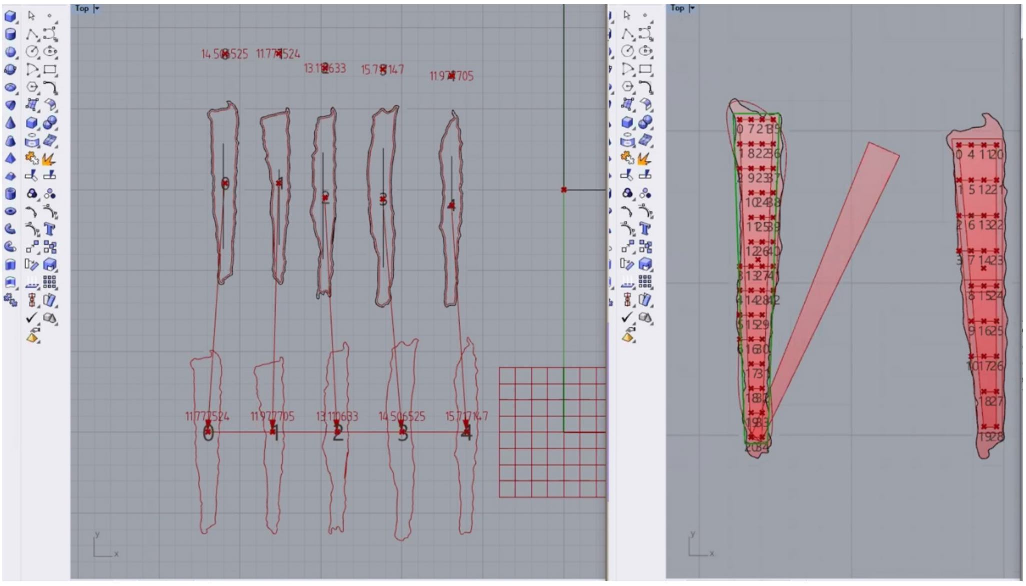

Figure 11 (Left) A code for automatic sorting by geometrical attributes (Right) Simplified trapezoid extracted from a fish skin outline, Rhino 3D Grasshopper

<u>*Fish Skin Trapezoids*</u>

We look at the traditional patterns of the Ainu fish skin robes to identify the trapezoid as a recurring geometry which lends itself particularly useful for garment pattern making. Variations in the trapezoids include different lengths of each face, and varying angles between faces. Although no two trapezoids (as no two skins) are identical, their recurring logic is identifiable. For each scanned irregular skin, we created a sampling grid for which an algorithm identifies viable edges that are within the skin surface. An outline is created, out of which corner points are defined, and a new simplified *trapezoid* outline is formed. Most often, with the skins studied so far, 4 corner points are identified, but depending on the skin geometry instances with more than 4 corner points are possible. The grid scale is parametrically controlled allowing to calibrate the sampling scale (see Figure 11 right image).

Joining Fish Skins

Prior to joining the newly formed trapezoids we look at various ways to sort the skins. Different sorting parameters for the skins are central to achieving zero waste. Whereas the Ainu approach to joining different fish skins was based on the symmetry of individual fish, and on carefully considered combinations of different pieces, in contemporary context this will not be possible. We are interested to tap into modern fish aquaculture and industrial food industry production where waste is a critical challenge, and where fish is already sorted by size and weight during cultivation. We propose to leverage computational tools in order to have the flexibility to manage a large-scale inventory of tanned skins. Sorting can easily be executed through calculating for example: total area, longitudinal length, angle variation of a particular face length, etc (see Figure 11 left image). We predict that different sorting approaches may be relevant to different applications and allow for parametric control over each sorting method. At the level of the single module, in which one fish skin is joint with another, two approaches were examined parametrically: (1) joining two skins back-to-back creating a fanned surface, and (2) joining belly to back in a flipped manner so that the resulting surface is more rectangle in nature. The work on parametric modelling presented so far in the research shows the potential to use computational technology to leverage the use of fish skins and open up an opportunity for more substantial intake of skins in fashion, so that their use can have a real environmental impact.

Animation Tools for Situating Fish Skin Designs in a Traditional Context

The implementation of computational design tools to facilitate the design of 3D clothing can be done using modern technological tools such as Clo3D in combination with the free software Blender (*Blender*, 2021). The convenient interface of Clo3D facilitates an automated process of constructing a drawing of flat polygonal patterns, which are then assembled into three-dimensional garments. Many companies are now using digital technologies such as Clo3D to plan and form the pattern for their garments without the need for samples or physical models of the items. With the aid of Clo3D software, the communication between the designer, pattern maker and production company has become much more straightforward (McQuillan, 2020).

The example shown here includes the integration of a 3D garment first assembled in Clo3d, then imported into the free software Blender, which was used to animate an Ainu avatar and situate it in a relevant context, which was put into motion as a short video. The goal of situating the avatar dressed in the garment, is aimed at highlighting the cultural and historical context to which the design is referring to. The Central Saint Martin's Fashion Print student Ana Cordoba Crespo was in charge to create the Ainu avatar. She used Blender to develop a personalized figure following the individualities of Ainu men. The Ainu (Figure 2) have always been renowned for their physical appearance (especially their hirsute bodies, beautiful beards and abundant wavy hair), which contrast sharply with the hairless Japanese neighbours (Cevoli, 2015). Ana created an elder Ainu avatar using Bender's multi-resolution digital sculpting. The full 3D pipeline was used from modelling, rigging, animation, simulation, rendering and compositing. Blender can be used to simulate hair and rigid bodies. She created the hair through particles that she supplementary added to the avatar and that she afterwards combed, cut, and made grow in a particular fashion.

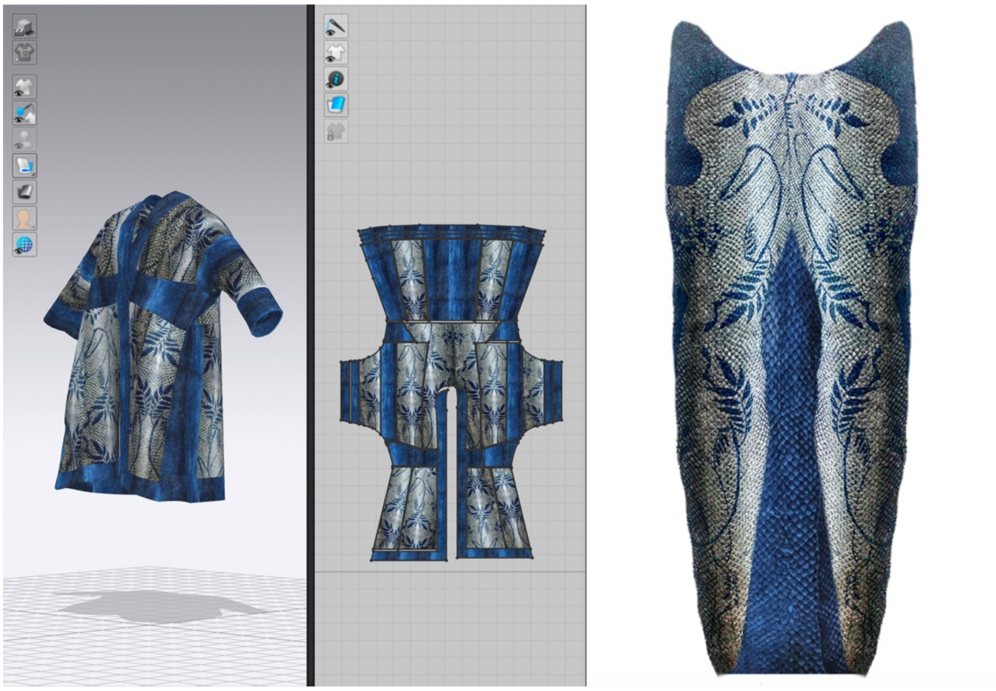

Figure 12 Left and center: Fish skin robe created in CLO 3D from a two dimensioned segmented pattern previously illustrated using Adobe. Right: A pair of Katazome indigo dyed fish skins, by Elisa Palomino

She developed the fish skin robe (Figure 12) from a two dimensioned segmented pattern of the piece, which she had previously illustrated using Adobe (*Adobe*, 2021). Blender allows procedural and node-based textures, as well as texture painting like the fish scale pattern. Generating a garment on a screen follows the same process of draping it with the physical fabric, but it elevates the piece to a different dimension, as the possibilities are endless. The boundaries and obstacles of the physical world become meaningless, as one can pin, sew, overlock or screen-print with a mouse click.

Figure 13 Ainu avatar robe created with Blender and CLO3D by Ana Cordoba Crespo

Figure 14 Ainu avatar created with Blender and CLO3D by Ana Cordoba Crespo

The Ainu avatar (Figure 13, Figure 14) is situated in a similar context to the traditional painting depicted by Ezotō Kikan, in his work form 1799 (Figure 15). Using Blender and Clo 3D the animation of the environment surrounding the avatar was enabled including the physical attributes of the surrounding ocean water, the wind impact on the avatar hair, and the sky above. Once all the elements were modelled, the scene was animated using motion tracking, video editing and 2D animation. https://youtu.be/_egusQhiPVg

Figure 15 Ainu fishing. Hata, Awagimaru, and Japanese Rare Book Collection. Ezotō Kikan. Japan 1799 Library of Congress. Washington DC

Figure 16 Ainu avatar created with Blender and CLO3D by Ana Cordoba Crespo

Katazome **Indigo Fish Skin Robe – the Design of a New Print inspired by Japanese Kimono patterns**

During the Fulbright scholarship of researcher Elisa Palomino at the Smithsonian National Museum of Natural History (NMNH), Arctic Studies Center, she was able to dive on the NMNH collection and access Arctic and Sub Arctic artefacts that have deeply influenced her artistic practice. Among the artefacts at the NMNH, there was a traditional Ainu robe made with a Japanese kimono cotton

Figure 17 Elisa Palomino with Indigo Master Takayuki Ishii at Fujino mountains, Japan.

Figure 18 Takayuki Ishii Indigo vats

fabric created with the *Katazome* indigo dyed technique. (Figure 1). This particular robe inspired Elisa to develop a series of *Katazome* indigo dyed fish skin samples (Figure 20) during her following fieldtrip in Japan's Kanagawa Prefecture, with Indigo Master Takayuki Ishii (Figure 17). These *Katazome* dyed fish skins are part of a study hypothesizing what would have happened if during the Meji era, the Japanese instead of making the Ainu shift from hunting, fishing, and gathering to agriculture had brought their own traditions like *Katazome* indigo dyeing and had blend them with the Ainu tradition of creating clothes and accessories with fish skin.

Figure 19 Traditional Katagami stencil

Figure 20 Indigo katazome dyed fish skin by Elisa Palomino

Japanese rural people have been using indigo blue dye "Aizome" for colouring their textiles for centuries. The indigo plant grew wild and was plentiful throughout most areas of the Japanese Islands and its dye was favoured for its ability to hold the deep blue colour in the fabric after many years of use (Austin, 2020). Takayuki Ishii (Figure 17) is an artisan running an indigo dyeing company using traditional techniques and materials. Takayuki is one of the six left artisans in Japan growing the indigo plants and producing sukumo to preserve the traditional method of indigo dyeing. He passes on his knowledge to many artists and young students and strives to preserve the traditional way of dyeing Japanese fabrics.

Katazome, is a traditional Japanese textile process using a *katagami* or stencil pattern for dying textiles used for printing Kimonos. The technique utilizes a resist paste made from rice flour that is passed through the *katagami* stencil onto fabric before dipping into the indigo vats (Figure 18). The paste resists dyes and once removed after dyeing the patterns and imagery from the stencil are revealed. *Katagam*i paper (Figure 19) is made from several layers of handmade mulberry paper lacquered together with fermented persimmon juice acting as a tannin to waterproof and strengthen the paper.

Figure 21 and 22 Replica of an Ainu fish skin robe made with indigo katazome dyed fish skins

Figure 23 and 24 Replica of an Ainu fish skin robe made with indigo katazome dyed fish skins

The fish skin robe replica (Figures 21 to 24) was sewn by Vanna Bellini, former head of Valentino's Haute Couture atelier in Rome, a pattern maker and garment technologist with over 50 years' experience working for the ready-to-wear and Haute-Couture collections at Armani, Ferre, Versace and many others. The garment was constructed according to the fish skin shape; every skin fitted with the next and nothing was wasted. The natural appearance of the fish skins served as an inspiration in the sewing process of this fish skin robe. We used the contrast of the white skin of the fish belly against the dark skin of the dorsal area (Figure 24). Specific design references within the body of the garment, like belt and kimono sleeve, were created by contrasting the light and dark areas of the fish skin.

Methodologies of Land Acknowledgment

Issues of cultural appropriation were carefully considered during the research process. The intention was to preserve and disseminate the Ainu cultural heritage connected with fish skin, but in so doing, it was essential to try to avoid any form of cultural appropriation. This refers to the taking of someone else's culture— their intellectual property, artifacts, art form, style —without their permission (Vézina, 2019).

Fashion has been criticized for constantly taking inspiration from Indigenous communities, from materials to designs (Vézina, 2019). Fish skin knowledge sharing does have the potential to be seen as detrimental to Indigenous communities since it is their own traditional knowledge passed down by many generations.

The researcher Elisa Palomino used Shaginoff's methodologies of Land Acknowledgment (Shaginoff, 2021) publicly recognizing the Ainu Indigenous peoples whose traditional fish skin craft was studied. In her research, she covered: recognizing the Ainu Indigenous Peoples, consulting with Indigenous-led organizations and educating oneself on the Indigenous histories.

The researcher openly discussed the paper with Kenji Sekine, Ainu language instructor and curator of the Nibutani Ainu Culture Museum, and Maki Sekine, Ainu artist, instructor of Ainu decorative embroidery at the Nibutani Ainu Culture Museum and daughter of one of the last remaining elm bark weavers on the island of Hokkaido. In 2018 Kenji collaborated with Elisa Palomino to set up a fish skin tanning workshop in Nibutani with local artisan Shigehiro Takano and fashion students from Japanese universities to encourage students to produce fish skin artefacts using traditional skills used by Ainu ancestors, examining design practice within contexts of social innovation for sustainability.

Following Kenji's guidance a number of changes were made in the title of the paper, and the naming of Ainu artefacts mentioned, especially when different cultural references are used in conjunction such as Katazome indigo dyeing technique, which is a Japanese technique, and the fish skin robe which is Ainu.
The ongoing dialogue and relationship with Kenji Sekine and the Ainu community of Nibutani is a great example of how researchers can connect with local and international institutions that strengthen connections with people, cultures and history world-wide.

Conclusions

This paper explored the use of fish skin for the construction of contemporary garments inspired by ancient tradition shared by many coastal Arctic societies, and specifically by Ainu Indigenous Peoples of Hokkaido Island (Japan).

The global production of fish has been steadily increasing over the last decade and is expected to continue rising, producing a substantial amount of fish skin as waste. There is real urgency to find solutions for the use of fish skins; existing practices which include the disposal of skins in marine waters exposes local ecosystems to environmental risks such as disease outbreaks and oxygen depletion, both caused by the decomposing organic waste. Currently only a small percentage of these skins are processed into leather, whereas looking to the past we realize that tanning fish skins was a thriving ancient tradition, which can provide us with multitude of knowledge and inspiration. Our goal in this work is to show the potential of fish skins as a relevant new material for fashion, which has its roots in ancient tradition yet utilizes the most advanced technological tools available at our disposal. New materials coupled with a digital platform creates exciting opportunities for craft practitioners to forge new ways of working with traditional processes, while still honouring those traditions. The ever-increasing prevalence of technology enables information about traditional craft techniques to become easier to access and learn about.

Ainu Indigenous Peoples produced their fish skin robes with limited tools and materials, often crafting them by the light from an oil lamp. This may not resonate with contemporary fashion today, but the idea of creating the replica of an Ainu fish skin robe with the combination of different digital technologies and applications can appeal to young designers avid for combining traditional craft techniques and digital technologies.

The unique features of the software used throughout this work, were examined in terms of their integrated nature, which was shown to be used creatively in the fashion design process. In parallel to enabling us to closely study the ancient artefacts, digital tools were implemented to showcase the integration of fish skins in contemporary fashion. Initially, as distinct modules assembled to form continuous surfaces uniquely suited for garment construction. We then showed the potential of using parametric tools for material conservation, zero waste integration of fish skins in garments. We next used animation tools for situating fish skin designs in a traditional context to evoke the emotional and aesthetic values that are associated with these garments. Finally, a comparison was made between the digital garment and the analogical one. Experimentation in the fields of fashion design crossing digital tools with analogical activities are key to develop more sustainable fashion practices.

Designers need to implement emerging prototyping/manufacturing technologies. The integration of digital prototyping for product development does not only impact manufacturing processes, but potentially affects all stages of the industry, from design to consumption. Digital technologies do not substitute traditional technical fashion knowledge, they support each other and enable innovation, while traditional knowledge is highly needed. The fashion industry's future lies in implanting these digital technologies models, leading to a greatly improved ecological industry. Integrating technology like digital design systems with traditional craft techniques will improve the fashion cycle and facilitate the new business model. Designers will need to become part of this proposed change, seen as creative drivers for reshaping fashion in this way.

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