Transferring Patterns: From Twill to Peyote Stitch

Eva Knoll
Faculty of Education
Mount Saint Vincent University
Halifax, Nova Scotia, Canada
E-mail: eva.knoll@msvu.ca

Abstract

Crafts are generally known for pieces whose structure and geometry are derived from the constraints of the techniques used. In particular, the look of specific patterns and textures are the natural product of the structure of the specific medium and technique applied to their production. The transfer of a pattern from its natural medium to another whose constraints may differ can sometimes present interesting mathematical challenges. In this workshop, this is exemplified through the transfer of a classic pattern resulting from Twill weaving, the Hound's-Tooth Check as it is transferred to a different medium, known as Peyote, Gourd or Twill Stitch, whereby beads are strung in a traditional bricklaying pattern using an off-loom beading technique. This transfer presents the challenge of adapting a structure so that the transferred pattern still resembles the original, in as simple a way as possible. In the workshop, several possible result of this transfer are compared and materials are made available to both design and create Peyote-stitched hound's tooth surfaces, thereby introducing the participants to some of the mathematical constraints of this type of transfer.

Introduction

The patterns displayed on a handcrafted object are often a natural result of the constraints of the specific technique applied to its creation. In particular, the use of Twill as a weaving technique can produce a variety of patterns including Tartans as well as the Hound's-Tooth Check [1]. Although from a purist perspective a pattern belongs to the technique that produces it, a mathematically interesting problem emerges from the exploration of how it could be produced in a different medium, whose constraints are different. The appearance of the texture produced by Twill weaving is determined mainly by the colour and quality of the threads used, the thread count or sett and the way the loom's harnesses are threaded [2, 3]. The appearance and disappearance of each thread is then predetermined and the finished weave makes the path of the threads intermittently visible.

There is an off-loom beading technique, which produces surface coverings, that is also known as 'Twill' as well as 'Peyote' or 'Gourd Stitch' [4, 5, 6]. This beading technique is more versatile than Twill weaving in that the colour of each bead is completely independent from that of any other bead on the finished surface, unless specified in the design. In addition, the relative position of the beads presents a different basic pattern. Under these conditions, transferring a Twill pattern from weaving to beading necessitates some mathematical reasoning, the process and results of which are presented here and in the workshop, focusing specifically on the application of the Hound's-Tooth Check to Peyote Stitch beading.
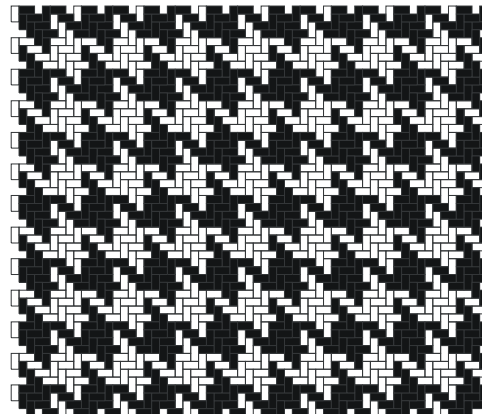
Twill Weaving

The Twill weaving method results in a Herringbone pattern, as shown in Figure 1, below, similar to one that is sometimes used in bricklaying. The resulting surface shows diagonal bands of translated, parallel and adjacent 'tiles' and emphasises a single diagonal direction, as determined by the direction of the translation of these parallel 'tiles'. In the case of figure 1, this emphasised diagonal runs from top-left to bottom-right. In addition to translations in two distinct directions, the pattern has 2-fold rotational symmetry and glide reflection symmetry but no reflective symmetry. Unlike in masonry, however, in weaving some of the 'tiles' are connected and their relative colour is determined by the threading: all collinear 'tiles' will have the same colour, and the sett determines the order of the colours along the 'bands'. Visually, therefore, the pattern emphasises three 'axes': that determined by the warp (the

collinear vertical 'tiles' are all of the same colour), that determined by the weft (the collinear horizontal 'tiles' are all of the same colour), and the diagonal determined by the translation of a tile from row to row.
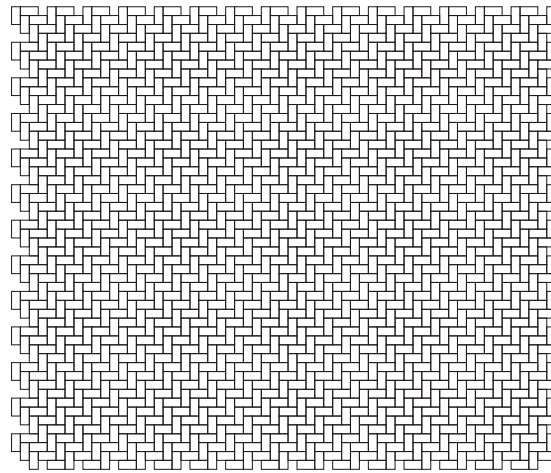
Figure 1: Herringbone pattern with one-by-two tiles

In the case of the Hound's-Tooth Check, the sett for both the warp (the threads that are mounted onto the loom), and the weft (the threads that are passed through with the shuttle) are of the same colour and order and generally the same frequency, namely: x black threads + x white threads. Where the black threads cross each other, the result is a completely black square, and the same is true of the white threads. Where the two colours cross, a square containing a diagonal pattern is produced, with the vertical 'tiles' in one colour and the horizontal 'tiles' in the other. Overall, this results in a checkerboard pattern in which the solid-coloured squares alternate with the striped squares. However, because each striped square is adjacent to both white and black squares, visually, the diagonal bands are read as being attached to the appropriately coloured adjacent square, giving the Hound's-Tooth Check its distinctive character, as shown below.


Figure 2: Applying the Hound's-tooth sett to the herringbone pattern

The Hound's-Tooth Check is one of the simplest that can be applied to the Twill weaving short of making it completely flat by only using one colour, or using one colour for the warp and one for the weft. It uses two contrasting colours, resulting in homeomorphic spaces[1]. It shows with great contrast how the areas of colour combine to emphasise the structure of the weaving method and the way the areas of colour play off each other.

---

[1] This means that the white areas are of the same shape and size as the black areas, and that one can be transformed into the other by simple symmetry transformations, in this case a translation.
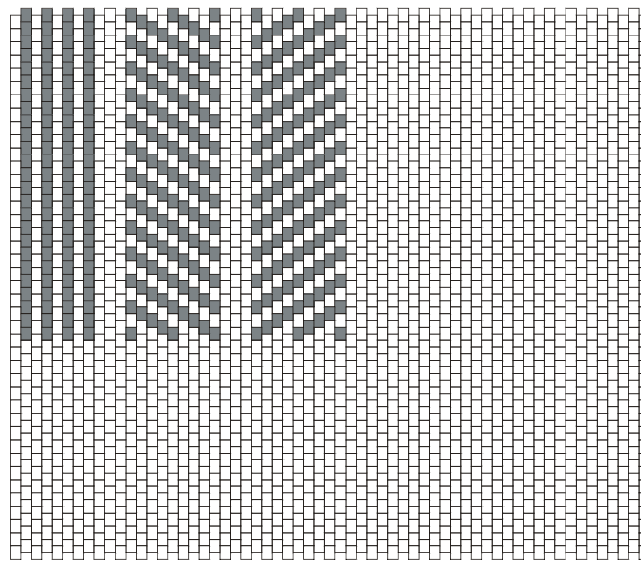
The Peyote Stitch

The Peyote Stitch is an off-loom beading technique that produces flexible surfaces of interconnected beads in the basic form of rectangles, discs or tubes. These forms can be combined to create craft objects such as tubular ropes, pouches, banner-like talismans and to cover most shapes, including bottles, buttons, etc. Its name derives from the fact that many objects used in the Peyote ceremonies of the Native American Church are decorated using this technique [4]. It is also known as the Gourd Stitch and, curiously, the Twill Stitch [5]. It can be found in artefacts from many civilisations, including Ancient Egypt and Native North America [4]. The type of Peyote Stitch of interest here is the flat, rectangular design. Its structure resembles a traditional brick pattern, laid on its side, in that parallel rows of beads are shifted by a half bead width, as shown below:
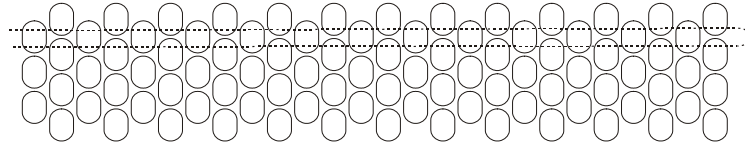
Figure 3: Bead placement in a rectangular Peyote Stitch sample

To create the rectangular Peyote Stitch, a craftsperson begins by stringing all the beads at the top of each column in the design, including both the 'up' beads and the 'down' beads. Then, on the way back, the thread is pulled through each existing 'down' bead from the first row, and a new bead is introduced below each 'up' bead, generating the second row. The pattern is continued in the same manner to create a rectangular surface with straight side edges and top and bottom edges showing a wavy finish. Structurally, this is similar to chain link fencing, except that the adjacent 'wires' or thread are not twisted around each other as in fencing, but share a bead instead. In addition to translation in two distinct directions, this pattern has 2-fold rotation symmetry, glide-reflection symmetry along a vertical axis between columns of beads and two perpendicular reflection symmetries corresponding to the reflection symmetries of a single bead.

Visually, the pattern also allows for the emphasis of three main axes: along a column (corresponding to a row of bricks), and, because of the adjacency created by the shifted rows, two diagonal axes, as shown in Figure 4, below. Note that the two diagonal axes are emphasised in a way similar to that in the Twill weaving pattern, by colouring tiles with common edges using the same colour.

Figure 4: Rectangular Peyote Stitch sample with emphasised axes

Transferring the Effect

In both the Twill weave and the Peyote Stitch patterns, there are three main axes that can be emphasised by the basic structure combined with the colour selection, and these are grouped into two similar and one different axis. In Twill weaving, the warp and weft axes have a similar impact on the design, and the diagonal axis stands alone. In the Peyote Stitch, the vertical axis stands alone and the two diagonal axes are equivalent under symmetry. To preserve this relationship, the warp and weft axes of Twill weaving are transferred to the two diagonal axes in the Peyote Stitch pattern and the diagonal of the Twill weaving becomes the vertical on the Peyote Stitch pattern, resulting in the beading pattern of Figure 5, below.
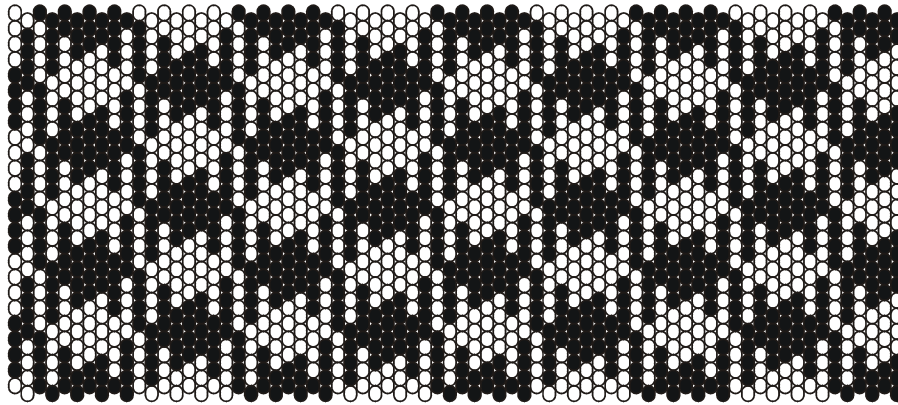
Figure 5. *The Hound's-Tooth Check transferred from Twill weaving onto the Peyote Stitch*

The workshop consists of three parts: a short explanation of the two craft techniques and the way designs can be transferred from one to the other, an activity focusing on the design of a Peyote Stitch rectangle, and a period of time devoted to creating a piece of Peyote Stitching using Pony Beads. For example, the above pattern produces the result of Figure 6, below.

Figure 6. *A sample of the Peyote Stitch version of the Hound's-Tooth Check, using 'Pony' beads*

References

[1] *Online Textile Dictionary*, retrieved January 2009 from www.resil.com/h.htm, n.d.
[2] Black, M.E, *New Key to Weaving*. New York: The Bruce Publishing Company, 1957.
[3] Margeson, F, Personal conversation, January 2009.
[4] Wikipedia, *Peyote Stitch*, retrieved January 2009 from en.wikipedia.org/wiki/Peyote_stitch, n.d.
[5] Vinson, G., *Guide to Beadwork: a Beaded Jewelry Primer,* retrieved January 2009 from
    www.guidetobeadwork.com/book/twill/TS7.html, n.d.
[6] Dean, D., *Beading in the Native American Tradition*. Loveland CO: Interweave Press, 2002.