ELECTRO-MECHANICAL LOOM

Principles of design and operation

Part of the I_C project in Chile
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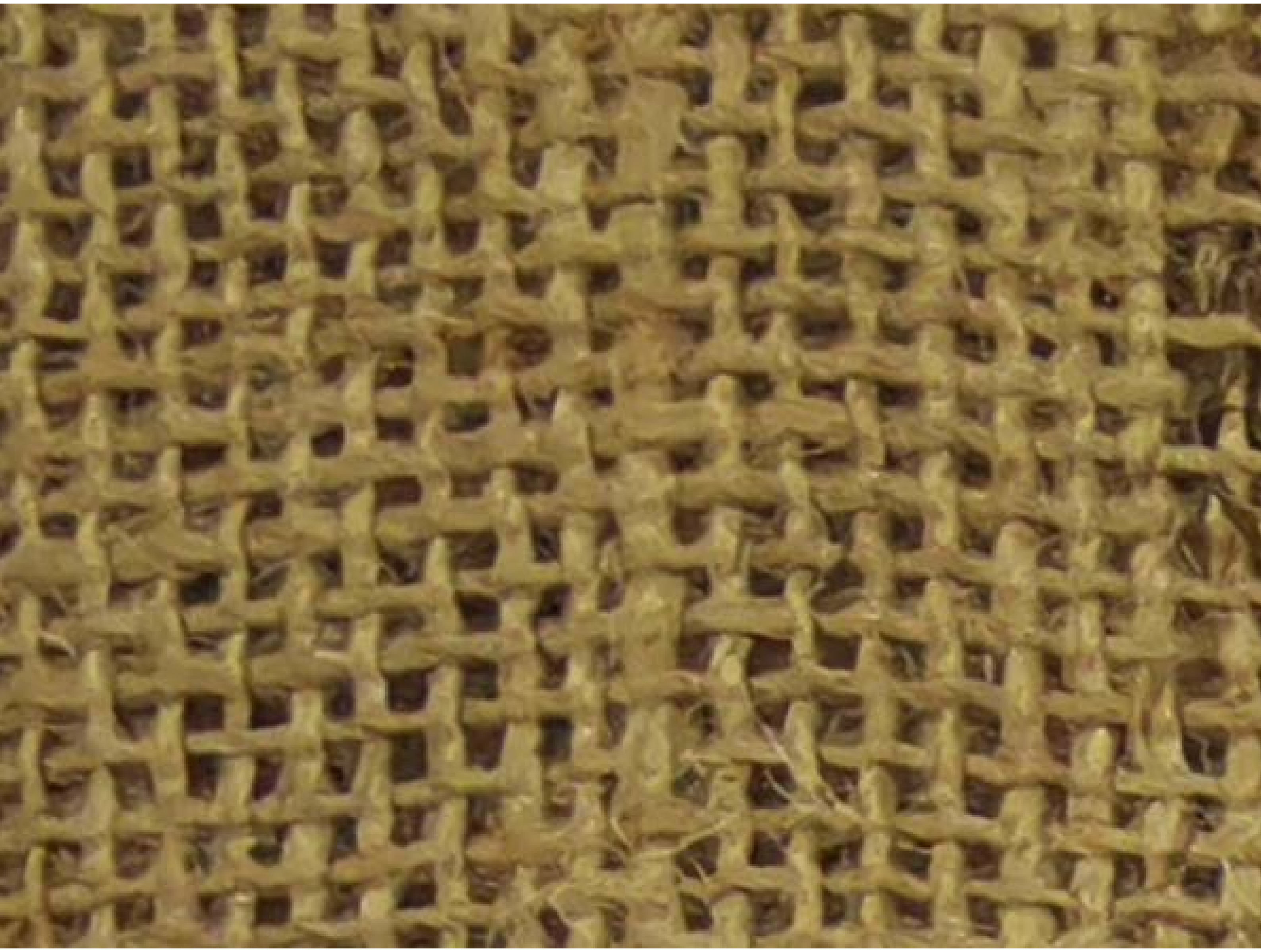
We have a structure based on the mechanical interactions of the fibers, friction and tension forces that allow the construction of a surface (and ultimately, other typologies)

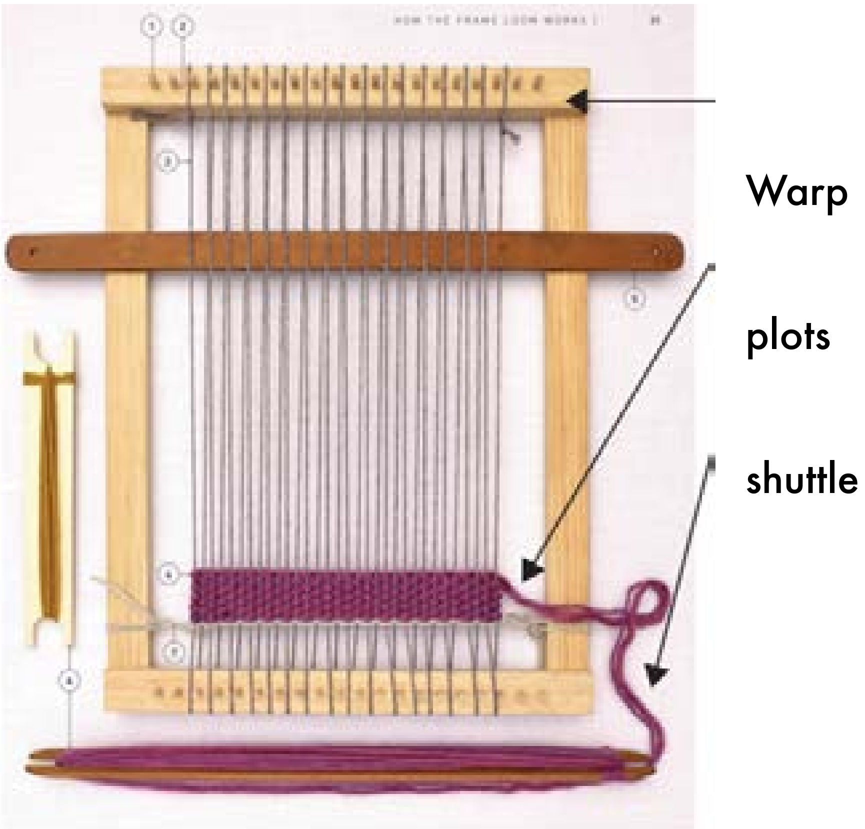


The tissue understood as a network of fibers, of common or diverse nature, could be thought of in stages:
First, a unidirectional interaction, where the fibers basically intertwine to give uniformity, mechanical
consistency to the fibers (spinning).

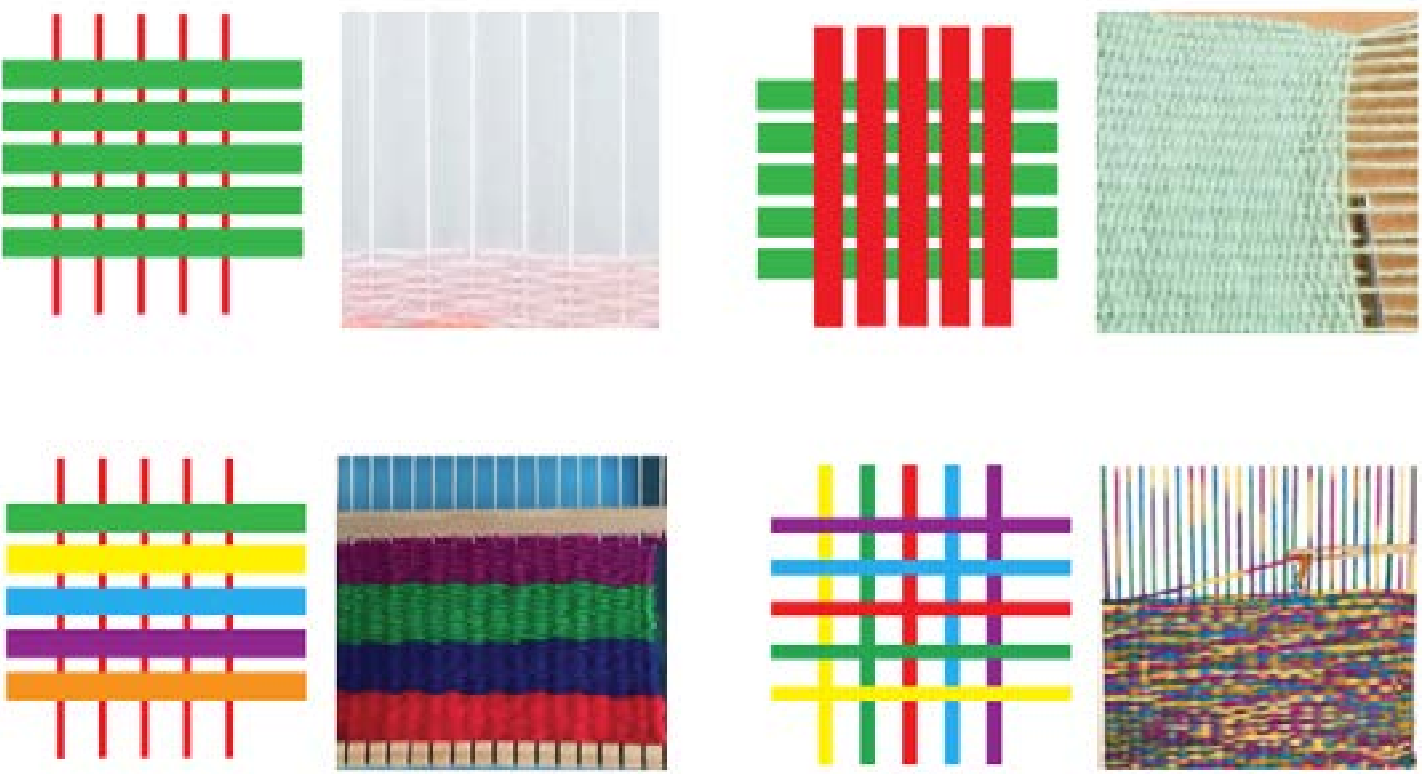
Second, an interlacing in the form of straight grids, a framework between perpendicular tensions, almost like a grid that ensures a good final structure, which finally develops a continuous plane

Third, the union of planes that make up a volume, and from there we are talking about a design and a preparation.

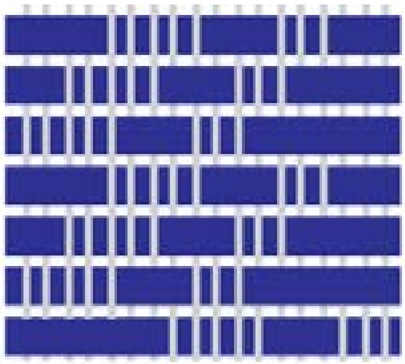
In the traditional loom, the base is formed by a series of parallel tensioned lines (warp) and a shuttle that weaves a weft by inserting the fibers perpendicularly.

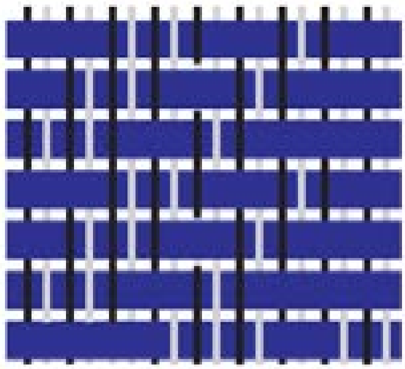


In these schemes we see the relationship between the thicknesses and colors of the weft and the warp, in some cases one hides the other, and in others they interact.

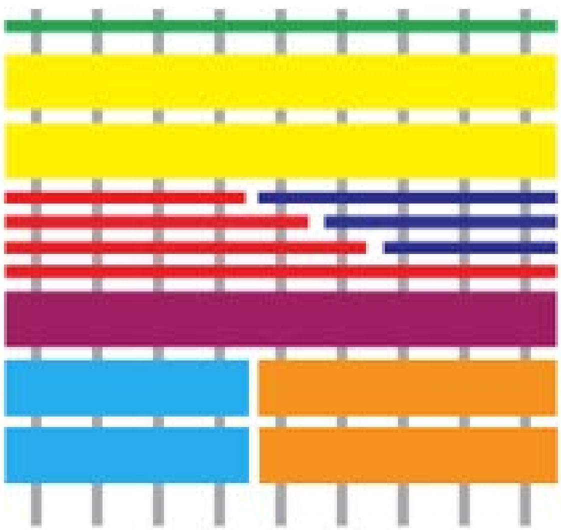


The warp and weft can develop a homogeneous weave by maintaining the relationship between fibers that lie above and below one another. You can also alter that relationship and build more elaborate patterns, keeping the same materials, and only altering the way they are interspersed.





The plot could also be interrupted, with the intention of creating unique patterns or figures. In these cases presented, the warp and weft are structural elements, they are not accessories.



The industrialization and automation of the loom-weaving process allowed the development of systems to program these alterations in the interleaving of warps for the weft. The best known system is the Jaqard Loom, which controls the lifting of warps using punched cards, which directly represent the movements of the machine, so the design of patterns is directly related, which makes it easy to preview the results.

In this fabric we can include materials and colors not present in the initial construction of the surface, it is thus, that they are two independent processes, for the same reason they are also two different jobs.

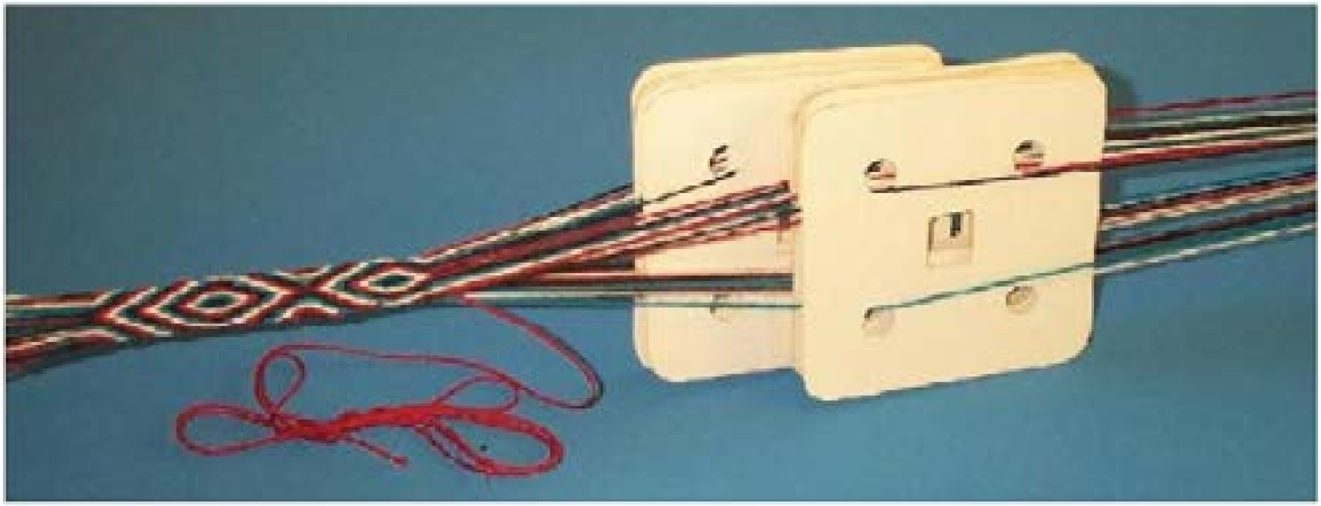
base fabric

back embroidery

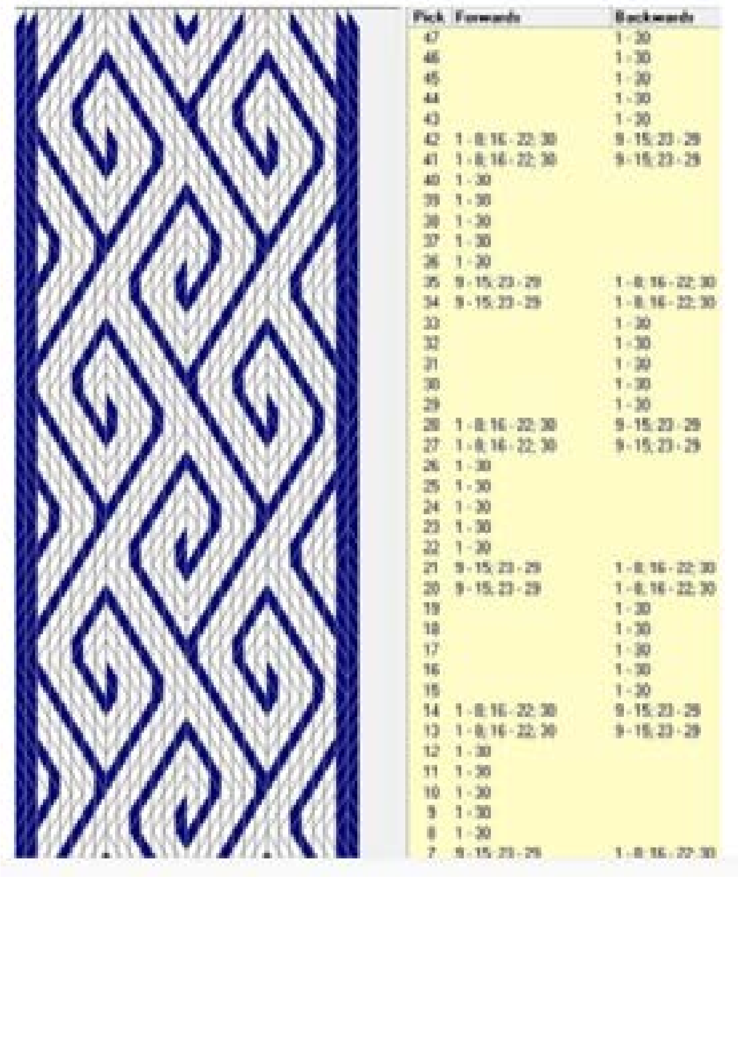
Industrially, there are processes that mix these two techniques and allow a final product with these characteristics to be obtained.

In the examples below, we see how the black base fabric is accompanied by a second warp, which appears on the base or is hidden under it, to build the desired motifs, and at the same time it is evident how this component it is not structural, as can be seen on the back of the tapes

There are several other methods with components similar to those described above, and we also find some that originate from other logics, for example the card loom.



We can understand this method as a series of warps that are intertwined, and the weft helps to build the structure, the alternating twist between warps that builds the final fabric.



Pick	Forwards	Backwards
47		1 - 30
46		1 - 30
45		1 - 30
44		1 - 30
43		1 - 30
42	1 - 8, 16 - 22, 30	9 - 15, 23 - 29
41	1 - 8, 16 - 22, 30	9 - 15, 23 - 29
40	1 - 30	
39	1 - 30	
38	1 - 30	
37	1 - 30	
36	1 - 30	
35	9 - 15, 23 - 29	1 - 8, 16 - 22, 30
34	9 - 15, 23 - 29	1 - 8, 16 - 22, 30
33		1 - 30
32		1 - 30
31		1 - 30
30		1 - 30
29		1 - 30
28	1 - 8, 16 - 22, 30	9 - 15, 23 - 29
27	1 - 8, 16 - 22, 30	9 - 15, 23 - 29
26	1 - 30	
25	1 - 30	
24	1 - 30	
23	1 - 30	
22	1 - 30	
21	9 - 15, 23 - 29	1 - 8, 16 - 22, 30
20	9 - 15, 23 - 29	1 - 8, 16 - 22, 30
19		1 - 30
18		1 - 30
17		1 - 30
16		1 - 30
15		1 - 30
14	1 - 8, 16 - 22, 30	9 - 15, 23 - 29
13	1 - 8, 16 - 22, 30	9 - 15, 23 - 29
12	1 - 30	
11	1 - 30	
10	1 - 30	
9	1 - 30	
8	1 - 30	
7	9 - 15, 23 - 29	1 - 8, 16 - 22, 30

The main limitation of this system is that it requires constant card rotation. On the other hand, the complexity of the tissues that can be developed with this system is interesting, although some type of specific notation is necessary to keep track of the required movements.
The notation system for the card loom is similar to that of the punched cards, but also considers the way in which the warp is established, considering colors and threading direction, and each step also indicates the direction of the cards.

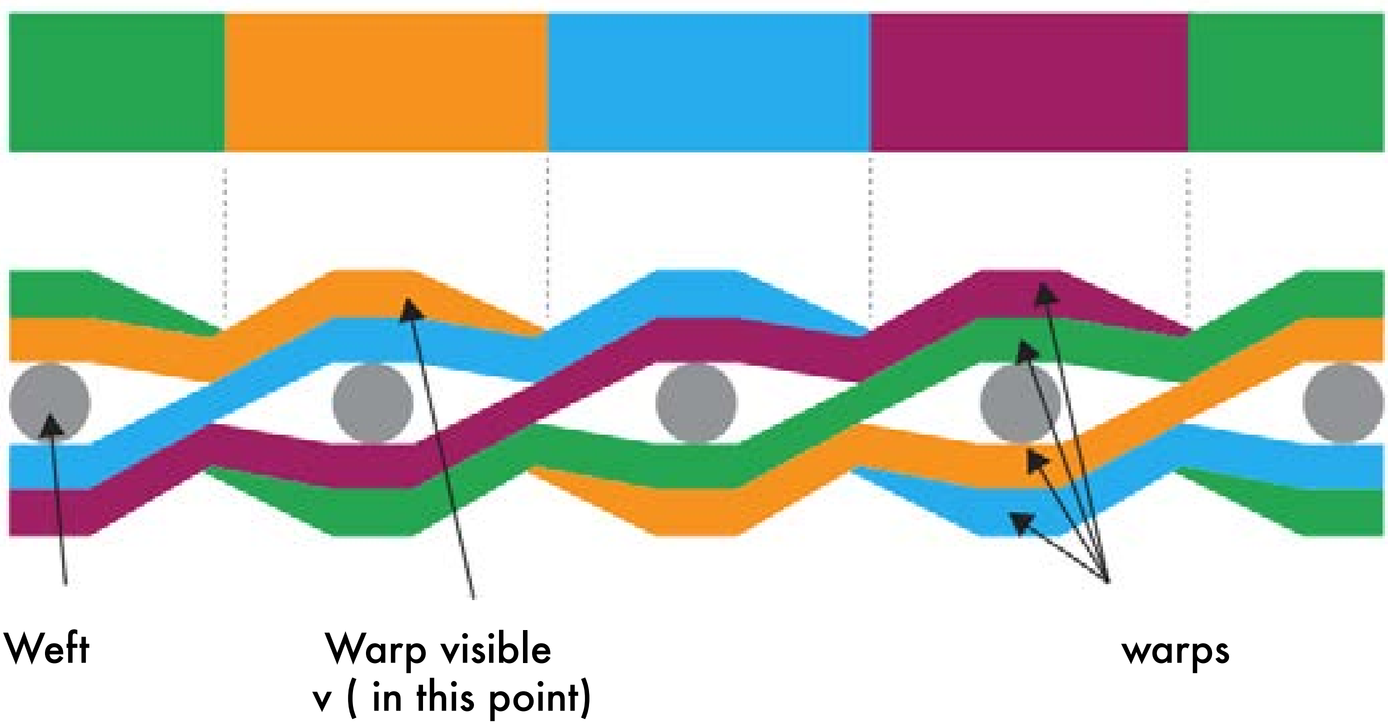
For this project, we have proposed to design a mechanism based on the previous examples, and to build an electromechanical loom, programmable from the interpretation of digital images.

A first approach consisted in the analysis of the construction system of each system, considering the basic frame of the traditional loom and the ability to alternate warps of the card loom, and the analysis was as follows:

- The rotation of cards basically allows one of the warps to be placed in the visible part of the fabric, the cards can control the movement of 3 or more lines together, which is more comfortable and faster than selecting the warps separately to change their position.

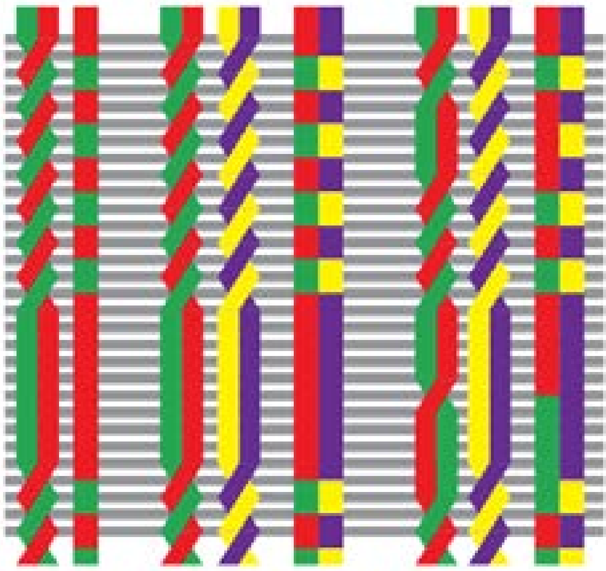
- The grouping of warps in groups saves space and components, thinking about the mechanization and automation of the system.

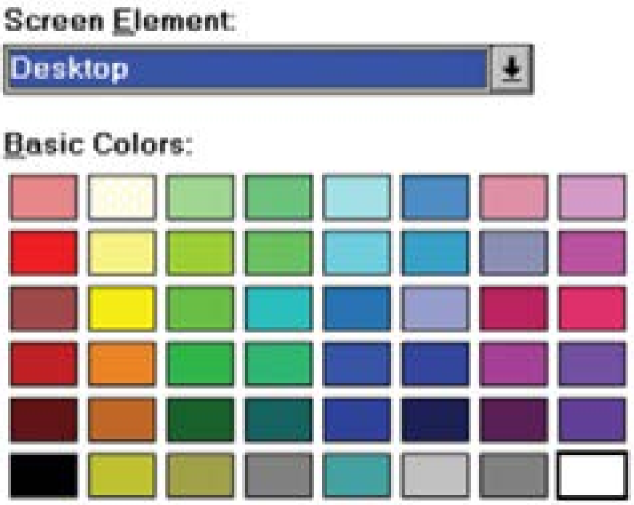
On the visible side of the fabric, the warp located in the highest part of the card predominates at each point, although there are two warps that remain behind the weft, one remains on top of the other, being the only one visible. The weft disappears completely, although its thickness is greater than that of the warp.

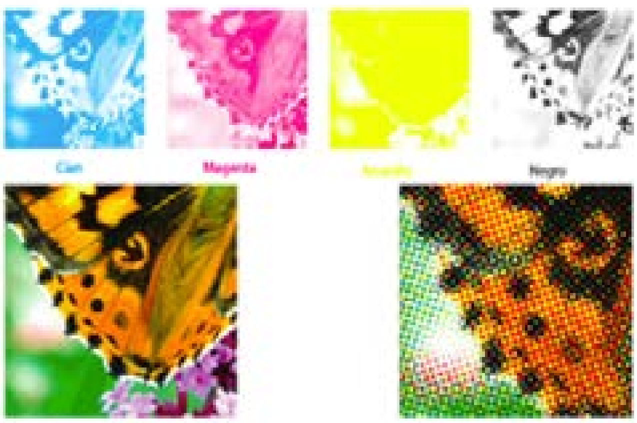


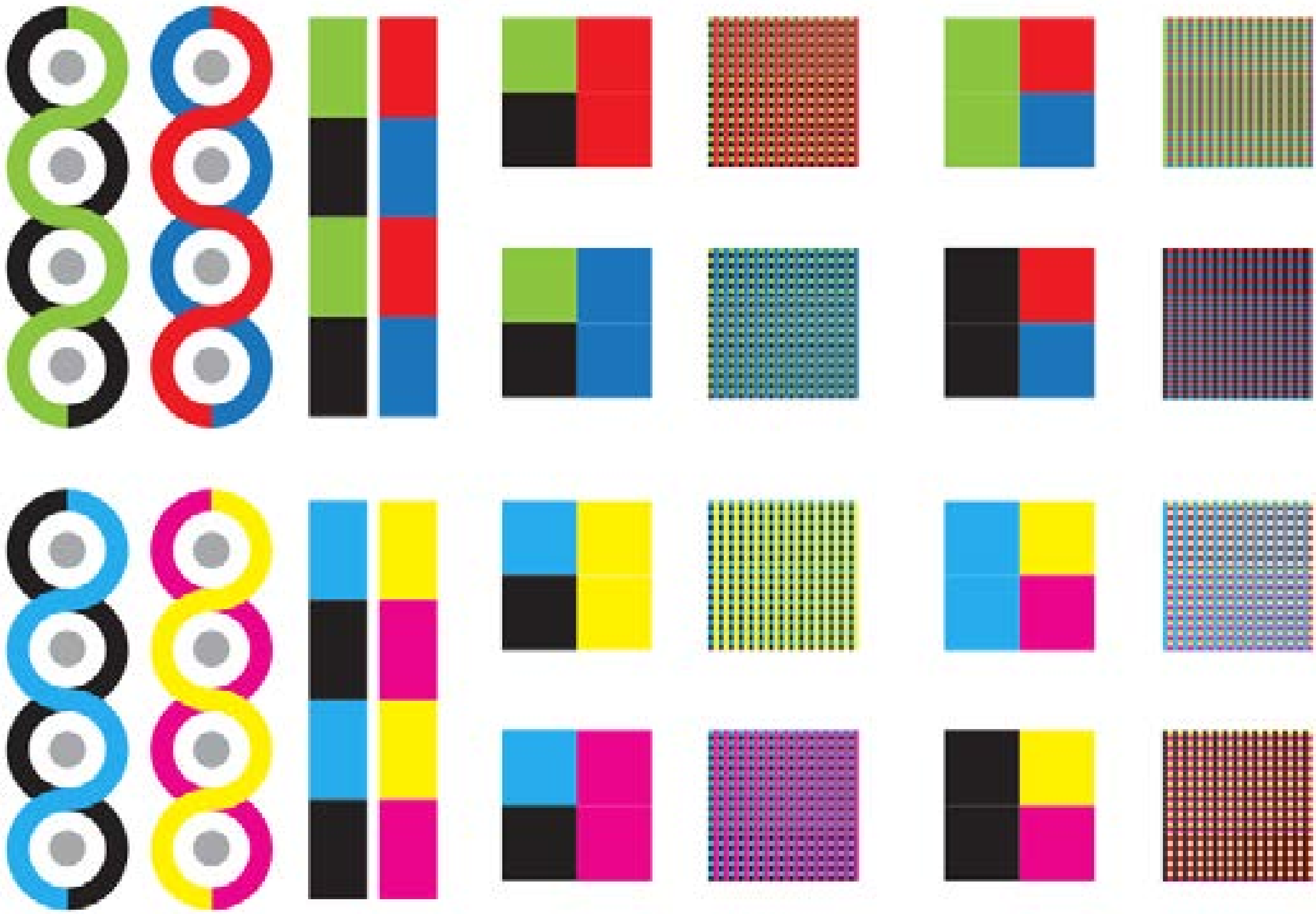
The variation of colors and closeness between warps could allow us to create color wefts that in turn serve as optical wefts, like those used in digital images, more used in old systems, before the availability of multiple color variations in each pixel.

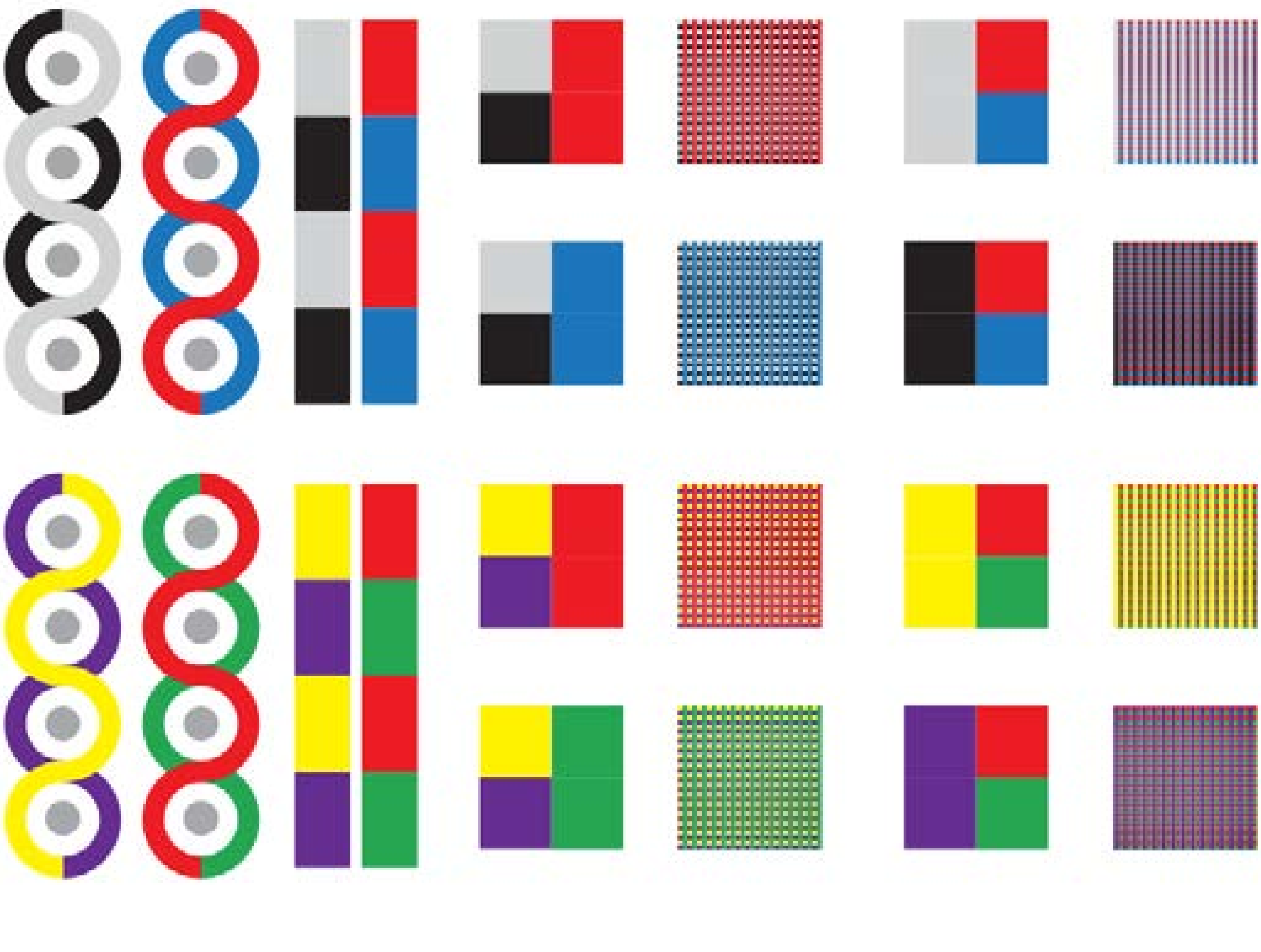
The lines between complementary colors produce visual effects such as MOIRË, a technique widely used in offset printing.



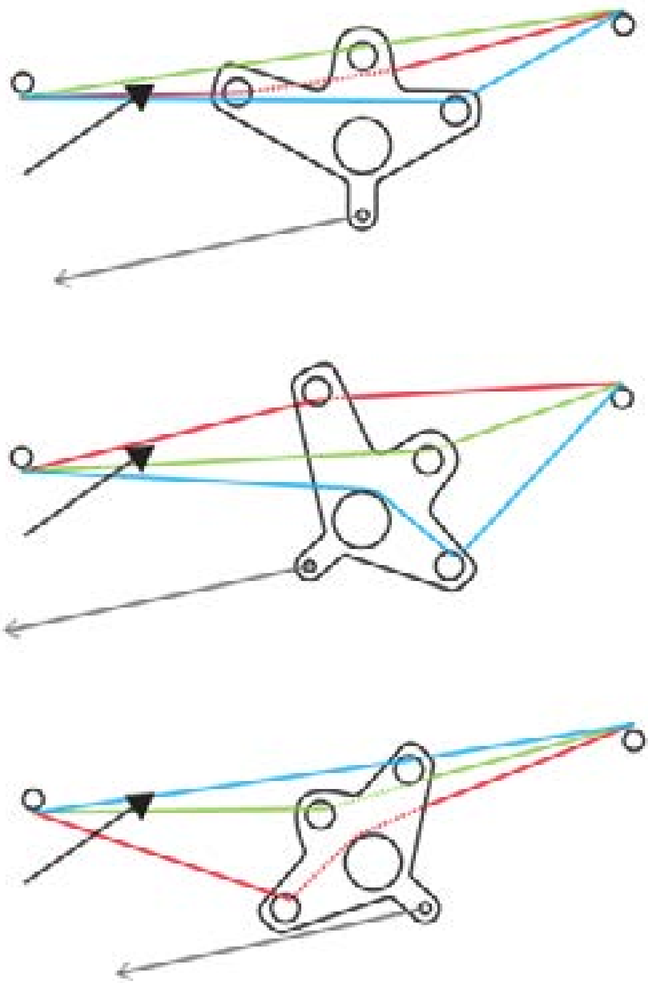








The design of the cards used must be adapted to the electromechanical devices considered for the system, in this case servomotors, these mechanisms allow to control the rotation of an axis in about 270 degrees with force and precision, in the loom, and in the loom of These cards rotate freely, and the design must be adapted to a much more limited rotation range.



In this design, 3 warps could be controlled by selecting which one takes the upper position, thanks to the rotation of the servomotor in a range of less than 180 degrees.

The space generated between the separation of the warp and the card allows the shuttle to slide, arming the weft.

In this prototype, we consider the following points:
- The cards control 2 base colors plus a support line, which together with the weft make up the base fabric.
- The support lines are of a considerably smaller diameter than the 2 main lines, and in this way designs of two visible colors can be assembled, maintaining a consistent structure.

The cards originally designed have 3 holes, are triangular in shape and move manually, being a prototype that was used for the later design controlled by servos.

The first prototype considers a group of servos that each control the rotation of the triangular card.