# Updating traditional hand made artistic industry with an adaptive - generative approach.

## *Actualización de la industria artística tradicional hecha a mano con un enfoque adaptativo - generativo.*

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ABSTRACT: The paper aims at demonstrate the adaptive value of the digital crafts, regarding design and realization methods. In order to achieve some outcomes from a practical approach, some experiments are described. The discussion focuses on the relationship between the parametric tools supporting the design process, (devoted to textile design and colour theory) and the aesthetical and technical outcomes. The typical way in which the craftsman "makes" - based on the informal transfer of models to production - shares the adaptive and repeatable approach of the parametric design. Therefore, through the specifications of the materials, the techniques and the realization tools, the seamless process is achieved.

KEYWORDS: Artistic industry, parametric design, parametric colour, digital design, digital craft

RESUMEN: El documento tiene como objetivo demostrar el valor adaptativo de la artesanía digital, con respecto a los métodos de diseño y realización. Para lograr algunos resultados desde un enfoque práctico, se describen algunos experimentos. La discusión se centra en la relación entre las herramientas paramétricas que respaldan el proceso de diseño (dedicado al diseño textil y la teoría del color) y los resultados estéticos y técnicos. La forma típica en que el artesano "hace" - basado en la transferencia informal de modelos a la producción - comparte el enfoque adaptativo y repetible del diseño paramétrico. Por lo tanto, a través de las especificaciones de los materiales, las técnicas y las herramientas de realización, se logra el proceso continuo.

PALABRAS-CLAVE: Diseño paramétrico, color paramétrico, diseño digital, arte digital

# 1. Introduction

Parallel to the history of the industrial product, developed through the definition of principles of useful form, serial production, ergonomics, etc., the industrialization of the production processes and the evolution of the tools for the realization, in the aftermath of the second industrial revolution, have played a crucial role also in the fields of the artistic industry. Evidence of this is the cultural debate of the late nineteenth century, centred on the relationship that art and technique establish in relation to the theories that pertain to the form, colour, methods and techniques of production. The development of the technical-creative tools and of the prototyping and digital production systems creates in the computerized logic a new relation between project theory and production and reproduction practices (Di Roma, 2008): the technique no longer resides exclusively in the finished object, but in its conception pre-formal. In fact, the management of form and colour in the ancient art industry did not assume mediation between the design phase and the realization phase; the author of the conformation of the product often identified himself with those who technically carried out its production. The division into phases, already within the development of the serial processes of realization of the artistic industry, has made it necessary to elaborate geometric models to support the transmissibility of the idea to the different material performers.
Digital modellers, who in the last twenty years have made possible the so-called digital revolution as a question related to the representation and communication of the project, through its virtual restitution, today assume a central role in the prefiguration process of the artifact, as demonstrate technical-formal control tools able to synthetically manage all the main phases of conception and prototyping, providing key decision-making for the optimization of the form and its realization process. The geometric definition of shape and colour values, together with the implementations of parametric software and the generative logic of some cad and raster applications, favour the development of new formal expressions; the ideation process thus becomes«un vero e proprio sistema di informazioni: informazione culturale del prodotto, informazione sul suo uso, informazione linguistica e informazione visiva». (Branzi, 1984, p. 117).

# 2. Problem

The translation of the ideal form into a technical material form within the artistic industry has always been expressed through the use of tools able to realize the conceptual model and make the craftsman's gesture repeatable in the series of objects to be reproduced, adapting from time to time the ideal model to

the contextual needs of specific sizing or functionality (Di Roma, 2016).
At the base of the informal process of interaction between ideation and production was the mathematical model that managed the proportion between the parts, the variation of the rays and the continuity of tangency of the curves, the symmetry groups of the plane. It is no coincidence that in the field of ornamental art (Carboni, 2000, p.79) the different historical civilizations have expressed the language on the basis of their own mathematical code.
On the instrumental level the question of technical reproducibility is characterized by the use of shapes, models, seals (of repertoire or designed ad hoc by the same architect of the work) necessary for the transfer of the "form"; or from those mechanical aids (such as the lathe, the drill and the wheels of the potters) useful for the mass production process (Benjamin, 1955, p.20). This mingling between the possession of the mathematical model and the knowledge of how to produce is at the basis of the freedom of artistic will (Riegl, 1893; Focillon, 1939; Panofsky, 1961) and expresses itself through the extreme flexibility of the production methods of the artistic industry.
In reference to the aesthetic intention of the artisan-artist, Hauser states that "the technical solution is itself part or variant of the visual aesthetic solution" (Hauser, 1978, p.95). Therefore, the instrumental technical evolution of contemporaneity, in the digital field, favours a new relationship between art and technique, between formal ideation and realization, re-enacting those processes of limited craft series, interrupted in their millennial tradition by industry (Branzi, 2008, pp.10-11), within the so-called 2.0 craft.

# 3. Methodology - Parametric Design digital craft

The generative modelling, thanks to the contribution of coding, has given great development to the theme of the new design concept and to the same digital craftsmanship. This new modelling process has the characteristic of approaching computer programming, but with an easy approach thanks to visual components. The system allows to implement the normal operations of generation, transformation and even substantial evolution of the models through reversible processes, preserving the memory of the original geometries.
Algorithms allow designers to overcome the limitations of 'traditional' software and achieve a much higher level of complexity and control.
In the algorithmic modelling the user has the possibility to create three-dimensional objects through the description of the system of relations at the base of any complex geometry. This description takes place through the development of a node diagram (visual algorithm) according to an associative logic, within specific editors that operate in parallel with the modelling software. Therefore what is manipulated is not the object, but its construction process and its data.
The algorithmic modelling tools allow the generation and control of complex shapes at any scale: from architecture to design. The parametric design systems are dynamic modifiable in real time, through the variation of the parameters defined during the construction of the diagram: this leads to immediate advantages in relation to formal exploration, control and rationalization of the shape.

## 3.1 Methodology - Color parametric design

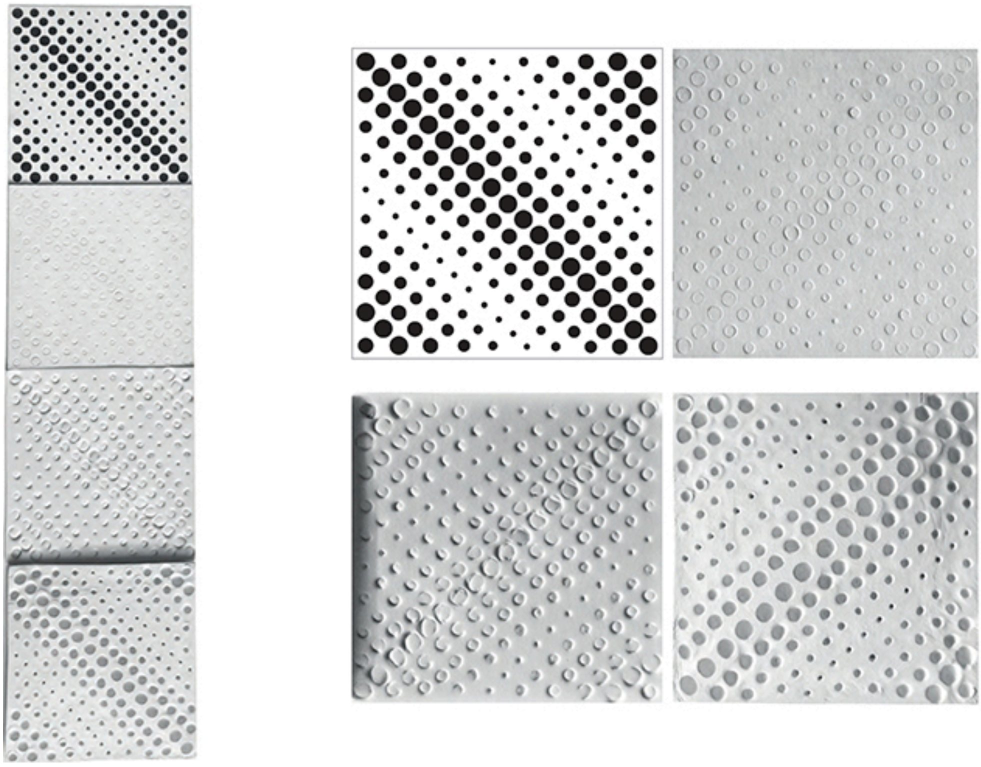
### 3.1.1. Color parametric design

In the design process of an artefact, the role of color has always been ambiguous (Batchelor, 2000), both for the complexity of a very elaborate theory , and for the instrumental difficulty in identifying and accurately reporting the selected colors. In traditional production processes (Scarcelli, 2016), following the development of the dyes chemical industry, the artisan chooses the color variations of his product from a range of dyes (or already colored semi-finished products) within a commercial catalog; even the designer has the same restrictions: he must choose based on a predefined range, influenced by the laws of the market, which condition those of taste (color matching), or vice versa .
It is not possible to identify and quantify existing colors. From the dawn of time, in order to classify colors, artists, physicists or chemists have introduced very heterogeneous systems: in the principles and in the shapes, plane or three-dimensional, more different, for example the Itten hue circle or the Munsell tree.
Nowadays, the choice of a color system over another depends essentially on the scope of application and transformation processes that attribute perceptual qualities to the material: dyeing of the material through dyes (plastic fibers and textiles) or surface deposition of pigments by paints or inks (printing and painting processes)
The adoption of computerized drawing systems has multiplied the management and control tools of the project, also from the chromatic point of view: each dedicated software has a color selector.
This tool associates each color with a numerical code, which identifies it and makes it unique and universally distinguishable, within its own coding system. In fact, the different systems adopt different languages, so the same color is associated with several codes: the HLS system has a triad of specific numbers, in the same way the RGB system and the Lab space; the CMYK attributes four values to each color; the Html hexadecimal system adopts an alphanumeric code instead.
The combinatorial possibilities associated with the various systems can return 16,000 colors (and even more). Absolutely many more than the human eye is able to distinguish.
The coding of a tint through a numerical code distinguishes the parametric character of the chromatic variation: by changing a single number it is possible to modify the superficial spectral quality of the artifact in its virtual definition. This process, now consolidated in the design practice of design, especially in the graphic area, undergoes continuous updates, due to the implementation of mathematical codes within the digital development environments.
Similar to the definition systems of shapes and patterns, susceptible to changes based on algorithms that control their geometries, color can also be managed digitally, by writing parametric codes that link each individual color value to a specific point/pixel of the physical/graphic space. In particular, using the parametric patterning tool, included among the cad application tools such as Grasshopper, it is possible to interpolate a predefined image with a geometric grid, so as to associate each RGB color value of the map with the corresponding point-position in the grid. The image, ultimately, is discretized in points with numerical values, and then translated into a vectorial geometry.
Another tool allows this association between the polygons of a reticular mesh - organic or geometric - with selected colors, with the possibility of parametrically varying the tonal, luminosity or saturation values. In this way both continuous and discrete results are possible, resulting in a raster graphic, no longer vector. This approach presents interesting developments concerning the transition operations between the different colors, which can occur by gradient, giving rise to organic matrices, or by contrast, with respect to discontinuous geometries. The parametric application adopted for the transitions is not only linear, but presents articulated solutions linked to the complexity of the mathematical codes used.
The size of the capability of color parametric systems in digital design processes can be found in the results of Digital Art: if the artistic culture abandons its work tools to test the opportunities of new IT tools, it is the sign of a change not only instrumental, but specially linguistic.

# 4. Results

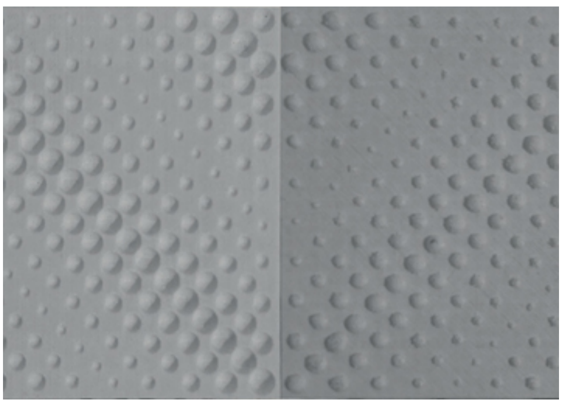
This section shows the results of some experiments aimed at the implementation of parametric information systems for the development of the decorative pattern and for the development of the colour gradient. In particular, the path has been focused on the understanding and innovation of artistic craft processes, mediating the scope of unique artifacts (or limited series) with the scope of large-scale industrial production.
In particular, with reference to the theme of the material and the conformation processes of the manufactured product, the interest in traditional production has been focused, reaching the integration of enabling technologies towards the artisanal productivity of type 2.0, through the use of 3D printing aimed at making moulds (excavation, embossy, graphic impression, etc.).
The experimentation theme was addressed to the aesthetic characterization of the surfaces made in ceramics, textile and leather; the methodology adopted has marked the process in five phases of planning and realization.
The approach adopted aimed at defining the expressive and communicative potentiality of a three-dimensional decoration through graphic-visual, tactile and chromatic considerations, in relation to the triad consisting of material, tools and production process. The graphic theme of "gradient" has been elaborated on the base of a parametric 3d model.
In the first phase a visual graphic composition is developed, responding to precise principles of perceptive nature such as "rarefaction and thickening", "direction", "order".
This concept is developed using digital computers, and then transferred for conceptual transposition into different material supports, with a modular size of 10x10cm.

**Fig 1** – The original compositional principle is thus implemented on a running surface, through module iteration operations, by reflection, rotation or transition.



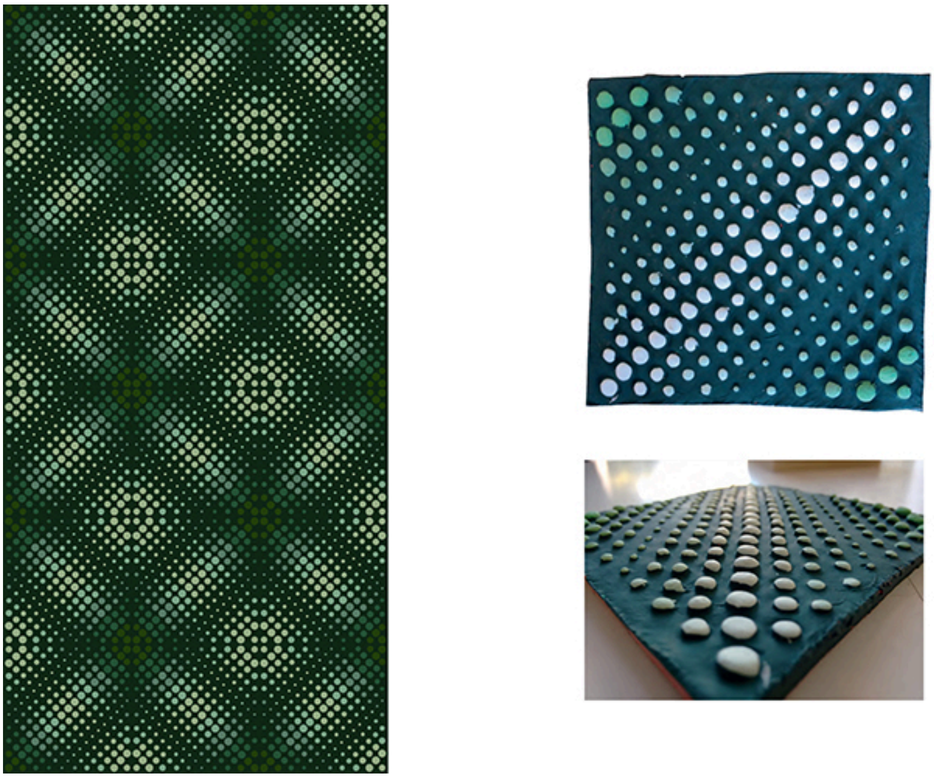
The original compositional principle is thus implemented on a running surface, through module iteration operations, by reflection, rotation or transition.

**Fig 2** – The original compositional principle is thus implemented on a running surface, through module iteration operations, by reflection, rotation or transition. The tiles are produced using FD 3d print system.



The third phase concerns the association of colour values of tonal scale and contrast to the graphic-visual composition, and the subsequent transposition onto the material support.

**Fig 3 –** The third phase concerns the association of colour values of tonal scale and contrast to the graphic-visual composition produced using a parametric tool



The procedural implementation of tools takes place in the last two phases: the graphic composition is a 3d model for the production of files useful for the realization of negative - positive moulds, using three - dimensional printing processes with filament deposition in PLA. The moulds thus obtained will be used to define the surface quality of the physical panel, experimenting "mould" procedures on rigid supports.

**Fig. 4 –** From the graphic composition to the 3Dmodelling - to the 3Dprinted mould for the embossy of the tissue.

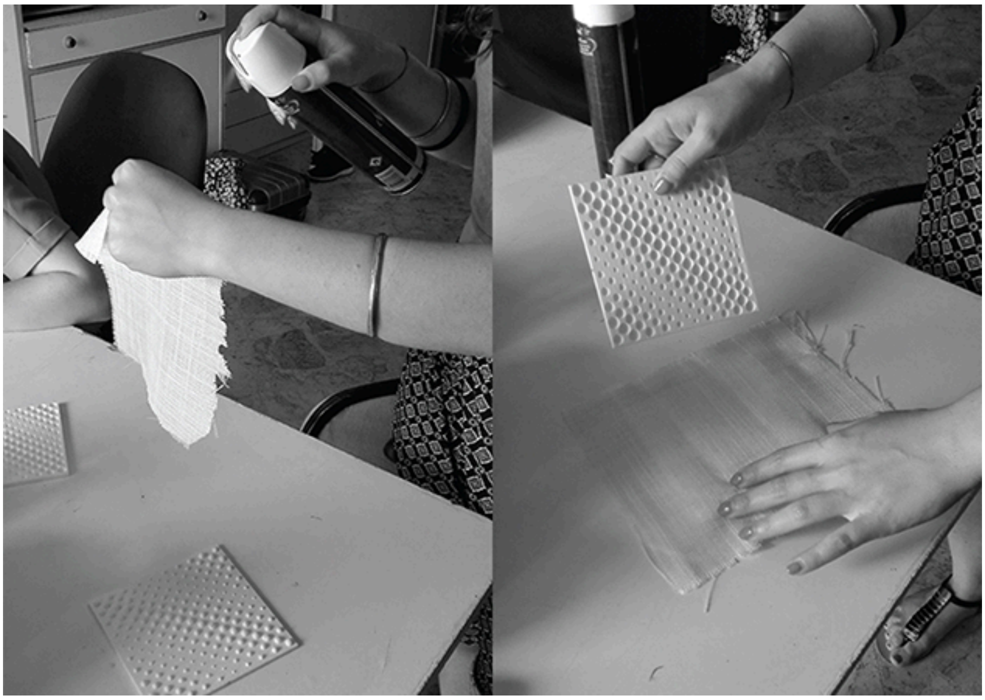
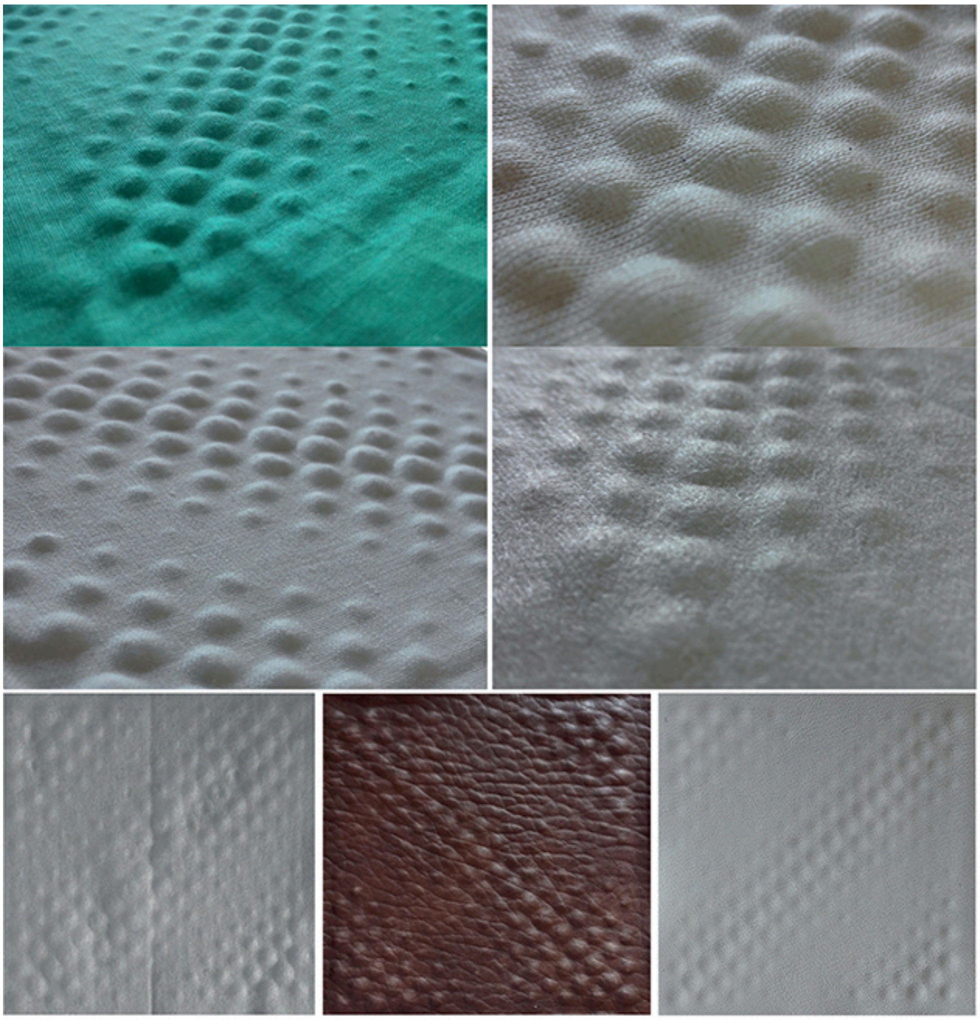


**Fig. 5** – The present picture shows the different effects of the embossy produced on different surfaces: cotton, felt, polyester, leather.



## 5. Conclusions

The parametric design combined with the production of models through print output and electronically controlled processing represents a phase of evolution of the contemporary art industry linked to digital outcomes (Oxman, 2007). The vector and bitmap software applications through the generative logic offer new operative tools and possibility to elaborate innovative formal languages, coherent with the mathematical models that support them through the algorithms. In accordance with the Kunstwollen by Riegl, the instrumental technical equipment supports the will of art and configures new operating methods in which the designer, the computer technician and the machine operator share the artistic process of material transformation.

## Notes

[1] For a deeper understanding of the various theories of color, applied to the world of design, a comparison with the pioneering texts of Itten and Albers is fundamental, in which the critical apparatus is always accompanied by graphic experiments.

[2] «Il controllo qualitativo del colore è uno dei problemi centrali della cultura ambientale moderna. Prima ancora che della forma o della funzione di un oggetto, noi ne percepiamo l'identità cromatica, a tal punto che l'insieme dei colori che ci circondano costituisce uno specifico livello d'uso dell'ambiente stesso. All'interno di questa problematica, il colore deve essere oggi inteso come oggetto di una ricerca progettuale autonoma; fino ad ora il colore è stato l'ultimo attributo del prodotto industriale: il designer, dopo averne progettato la forma e la funzione, sceglie il colore come ultimo segno da collocare su di una struttura che possiede già tutte le qualità fondamentali.» (Andrea Branzi, La Casa Calda, pp. 102-103).

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