TEMPERA

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Abstract. This paper explores the characteristics of painting developed during the Nineteenth century, and specifically updates the use of matter and brushing techniques invented by a group of painters called “Impressionists”. In that period, impressionist artists began to brush “tempera” on a canvas as a malleable matter able to emphasize an accurate depiction of light in its changing qualities. Thick brush strokes left on the painted surface revealed the master’ gesture and completely changed the way to represent reality. Stimulated by the recent advancements in digital technologies, this paper looks for methodologies able to transfer impressionistic painterly innovation into a contemporary digital 3D environment and investigates how paint behaves when morphing from a photorealistic depiction of Nature to a disfigured one. In particular, reality-based 3D information, first frozen by a laser scanner into a digital geometry, slowly melts into liquid paint on a colour palette. While colours mix, the geometrical matter that constitutes the photorealistic scanned reality and its details disappear into primitive paint clog that are mixed and brushed into new colours and shapes able to create novel atmospheric and chromatic effects.

Keywords. Tempera; laser scanner; 3D painting effects; design creativity.

1. Introduction

Through centuries the achievements in scientific research have often been accompanied by cultural renovations that generally required different means of communication of new visions and ideas. In some cases, these achievements were transferred from one field to another, such as, for example, from Physics to Arts,
that therefore became a fervent context to experiment new means of representation and expression.

During the Renaissance, for example, scientific research developed new methodologies and tools that allowed a deeper and wider observation of reality. In that period, Nature offered a wide variety of case studies in which investigations were conducted using these new technologies. Botany, Anatomy and Astronomy became the first privileged fields in which scientific research experimented and developed new codes and techniques of graphic representation. The rigor of scientific illustrations was generally obtained by the extreme faithfulness of each single detail that conferred objectivity to the entire image.

But if on one hand the circulation of these drawings contributed to spread knowledge, it is true that the beauty and fascination of these realistic representations soon was able to display scientific illustrations under a different light and provided a new iconic repertoire that inspired and influenced different artistic fields. In some cases, for example, these drawings quickly became independent from the treatises in which they were collected and indeed became paintings. In particular, the collection of objects derived from Nature and their compositions expressly created in the studios of painters willing to perfect their technique of faithfully reproducing reality, charged these representations of expressivity and symbolic meanings and gave rise to the birth of Still Life. This last was conceived as a specific genre of painting that manifested itself in different variations, ranging from “florilegi”, where natural elements were isolated from their contexts, to the representation of landscapes, where they were included inside wide settings.

Four centuries later, Nature was chosen as a privileged subject of impressionist paintings in which a completely different language was investigated. Within this movement, representation techniques and matter became the instruments through which investigations where conducted with the aim of exploring new possibilities of communication where human perception and experience were crucial elements.

If compared with the techniques adopted by Renaissance painters that aimed at objectively reproducing reality, the realism of impressionist paintings was not guaranteed by the faithful representation of each single detail of a scene, but it was instead the result of the transposition of a sensorial experience on canvas.

2. The Tempera Project

2.1. PROJECT AIMS

These remarks gave impulse to the present research that continues a former project called “Synthetic” (Manferdini and Manferdini, 2011). Starting from the
digital 3D acquisition of natural elements, that project explored the potential of digital technologies in the survey of micro-scale details, as well as in the magnification, manipulation, management and fabrication of the developed information. Within that research, natural materials were considered the sources that inspired new hyper-realistic sensory effects to be reproduced on surfaces in architectural contexts.

The resulting methodology developed by that workflow led to the present research, in which representation methodologies and techniques derived from painting are transposed to 3D digital environments using digital technologies in order to create novel atmospheric and chromatic effects to be used in architectural envelopes.

2.2. MOTIVATION

The interest in this research is to update the contribution to communication offered by painters in the 19th century, transferring their technical innovation into a contemporary set of digital tools. In that period, Art and Science were strictly connected. For instance, the corpuscle theory of light developed by Newton in the 18th century was the background on which the impressionist movement grew (Newton, 1704). One century later, scientific observations of physical phenomena gave impulse to different theories about matter and energy (Buchner, 1864; Janet, 1866; Le Bon, 1905) that gave substance to the new conception of matter that gradually evolved from its traditionally static characteristic into a more fluid and intangible one (Adhemar and Clark, 1974). Within the impressionist movement, painters began to measure themselves with their ability to observe the changing physical properties of matter and light and started dealing with the problem of the reproduction of colour and radiometric characteristics of matter.

In addition to these aspects, in that context the relationship between pictorial art and scientific research was also influenced by other aspects. In that period, for example, a new range of pigments were produced by the chemical industry that gave new consistency and brilliance to paints. Furthermore, the possibility to use portable tubes of oil paintings contributed to the spread of the “en plein air” painting and to the extensive use of “alla prima” techniques. As a consequence, the rapidity and thickness of brush strokes gave plasticity and sculptural characteristics to paintings; colours were therefore not considered just for their pigment characteristics, but they became the result of changing lighting effects on canvas. Taking advantage of the achievements in the optical research, impressionist painters analyzed illumination processes and reproduced natural lighting effects by splitting the micro phenomena that they observed and by creating an overall vibrating impression of colour, natural light and weather conditions. This final
result was generally achieved by adding and overlaying single brush strokes whose tint was determined by the direct observation of the amount and quality of rays of light that each substance absorbs and reflects.

This renovated language progressively abandoned the faithful imitation of reality determined by the accurate reproduction of every single detail of a composition and moved towards a more eidetic representation where subjective perception and experience became protagonist of the canvas.

Within the communication process, the observation of those paintings represents the moment in which each single colour and radiometric effect is merged and the overall luminous unity and harmony of the iridescent colour that the painter scattered is re-established (Moffett, 1986).

Similarly to the cultural renewal that represented the background for the impressionist movement in the painting field, the digital revolution recently transposed the results of scientific research in the computer graphics field.

Taking advantage of these developments, the present project searches for methodologies to transfer impressionistic painterly innovation into a contemporary digital 3D environment (Meier, 1996; Daniels et al., 2001; Baran et al., 2011) and investigates how paint behaves when morphing from a photorealistic depiction of Nature to a disfigured one. In particular, the “Tempera” project takes on a classical exercise of Still Nature as a testing ground for the different representations of matter.

2.3. METHODOLOGY

As in the last two decades 3D laser scanning has completely changed the way we can access reality and has allowed us to manage 3D information and to run simulations within digital environments (Bernardini and Rushmeier, 2002; Blais, 2004; Lohr et al., 2010; Wang, 2011; Guidi and Remondino, 2012), the present project was organized following a workflow in which the acquisition of real data constitutes the first step.

The present case studies were chosen among a wide variety of natural elements derived from the plant kingdom. Such elements were selected because of their particular geometric characteristics. As far as spatial characteristics are concerned, geometric complexity is represented by the intricacy of small scale details or by the composition of single elements in clusters, while as far as their radiometric properties are concerned, the brightness of colours was one of the main peculiarities upon which the present case studies were selected.

The small dimension of details and the need to restore high definition 3D models aimed at being magnified for further manipulations led to the use of triangulation laser scanners. As a matter of fact, within the present project, this technology represents the best compromise in terms of portability, accuracy, detail
and management of data. In particular, both NextEngine and Minolta Vivid 900 were used within the present project (Figure 1).

Afterwards, the surveyed information was translated into 3D realistic geometry (Figure 2) and manipulated adding painting effects to reality-based 3D models (Figure 3). During this step, meshes slowly melt into liquid paint on a colour palette using the Pixologic ZBrush software. While colours mixed, the geometrical matter that constitutes the photorealistic 3D model of natural elements and their details disappeared into primitive paint clog that were mixed and brushed again and again into new colours and shapes (Figure 4).

Figure 5 shows examples of both analog brush strokes (top) and digital ones (bottom). The different geometries of these last depend on the movement, pressure and rapidity of mouse. The use of matter with particular radiometric characteristics, such as, for example, the iridescent, the metal or the glossy, highlights the details of brush strokes and creates novel lighting effects.

2.4. RESULTS

The results of these digital manipulations represent an expanded and hybrid nature whose depictions collapses reality and artifice and meanwhile insinuates that contemporary materials are often a mutation from the “original”, producing a world in which fact, fiction and fantasy co-exist.
Figure 2. Example of hyper-realistic reproduction of natural elements.

Figure 3. Example of transition from the hyper-realistic representation to the addition of painting effects.
Figure 4. Transition from a reality-based 3D model to new geometries and colours obtained using digital 3D brushes. Through the simulation of liquid paint, the detailed polygonal meshes are transformed into primitive paint clog.
Figure 5. Examples of analog (top) and digital 3D brush strokes (bottom).

Figure 6. Example of transition from hyper-realistic 3D modeling of natural elements to the manipulated one using 3D painting effects. This synthetic manipulation was expressively designed to be used in an architectural context.
Ideas about nature and its simulation are central to the present project, inviting the viewer to question what is “real” and what is not. Such depictions do not yield to clean judgments or bottom lines, especially not about what is living or non-living, organic or technological, promising or threatening, true or synthetic. As a matter of fact the boundary between true and artificial has become even more blurred since digital processes became sophisticated in hiding their procedures.

Even though these manipulations are made by relentlessly computational methods of production like 3D laser scanning of real objects, computer software like ZBrush and industrial fabrication procedures, like printing on vinyl, this project plays both sides of the argument between the machine and the hand. The materiality of the paint becomes the medium where both digital and analogue can be displayed as coexistent: the brush strokes of tempera (obtained by the click of a mouse on a flat screen) portray the gesture of the artist and prove themselves effective in insinuating the idea in the viewers that the paint was once fresh, sticky and was indeed brushed.

As a result, within the present project, manipulated nature becomes a synthetic matter that can be used, for example, within architectural contexts through the use of digital fabrication technologies. Figure 6 represents an application of these manipulations to architectural interior walls and floors.

3. Remarks and Conclusion

The present project investigates how the recent advancements in the digital technologies field are providing new tools for representing ideas in a more direct and intuitive way. As a matter of fact, for example, the possibility to carefully reproduce a human gesture and therefore act in a digital environment is becoming even more refined and similar to analogue behaviours.

In addition, during the last two decades, scientific research is constantly developing new algorithms able to improve the representation of reality mediated by the senses.

Moreover, since digital technologies have provided sophisticated instruments able to acquire the geometric and radiometric characteristics of real 3D objects and scenes and restore hyper-realistic reconstructions, the request of representation abilities in the faithful reproduction of reality can be fulfilled by specific skills in the use of calculation algorithms integrated in 3d modeling software. As a consequence, since digital tools have widened the range of matter with different geometric, chromatic, luminance and weather characteristics able to give consistency to 3d models and scenes and actually allow the imitation of different painting techniques, the “Tempera” project transposes the language renewal of the impressionist movement in the 3D digital context and represents an example of a
new iconographic repertoire able to create novel atmospheric and chromatic effects.

References