

Painting with light: generative artworks or “setting in motion” the fourth dimension

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The Camera and the Visible

"I'm an eye. A mechanical eye. I, the machine, show you a world the way only I can see it. I free myself for today and forever from human immobility. I'm in constant movement. I approach and pull away from objects. I creep under them. I move alongside a running horse's mouth. I fall and rise with the falling and rising bodies. This is I, the machine, manoeuvring in the chaotic movements, recording one movement after another in the most complex combinations.

Freed from the boundaries of time and space, I co-ordinate any and all points of the universe, wherever I want them to be. My way leads towards the creation of a fresh perception of the world. Thus I explain in a new way the world unknown to you."

Dziga Vertov, 1923¹

Abstract

The word “Photography” comes from two Greek words, Photos (light) and Graphos (writing, painting), so “drawing with the light”. Taking pictures needs some devices and a particular process in Space and Time. According to Einstein the basic structure of our world is SpaceTime and things exist in a spacetime continuum, a world of four dimensions: height, width, depth and time. A generative process is usually referred to as “setting in motion”. Motion is the essence of Life. To be alive is to move. Selecting particular initial conditions, adding a fourth dimension and photographing motion by means of randomised generative processes can give rise to very expressionistic results, in full agreement with Galanter’s definition of Generative Art (“any art practice where the artist uses a system [...] which is set in motion with some degree of autonomy contributing to or resulting in a completed work of art”).

A very simple yet effective installation was exhibited during Generative Art 2007 Conference. It was basically composed of several light sources of different colors, in a dark room. People were invited to participate at different levels. The result was a generative installation and generative shots, that will be published on the web. A physicist (one of us, MF) was also there to give scientific explanations about light phenomena and Maxwell’s and Einstein’s theories of Electromagnetism, Relativity and SpaceTime. In addition, a selection of light paintings were exhibited during the conference.

¹ Quoted in John Berger, *Ways of Seeing*, Penguin, 1972.

0. Introduction

Starting from the laws of Visual Perception, from the anatomy and physiology of the eye to the cerebral cortex and the elementary laws of Optics, several devices using these properties have been built. Already known at the time of Aristotle, the “Camera Oscura” is an optical instrument the principles of which are at the base of Photography and Cinematography. Optics is that part of Physics that studies light, describing its phenomena of emission, propagation and absorption. Light is thus a physical phenomenon of electromagnetic nature; emitted by some sources (for example, the Sun, fire, lamps, etc.) it propagates into transparent media and is reflected, diffused or absorbed by matter, following Maxwell’s physical laws, which, in particular, predict a transport of “electromagnetic energy” through “waves”. The spectrum of irradiating energy goes from the gigantic radio waves, the length of which is million of kilometres, to the tiny gamma rays, millions of times smaller of an atomic nucleus. This electromagnetic spectrum is usually divided into families, that overlap at the extremes, called microwaves, ultraviolet, infrared, etc. This subdivision is basically due to teaching reasons and it is important to consider the unifying nature of radiating energy.² In the Physics of XX Century there is also, besides the wave-like nature, also a corpuscular aspect, the so-called “wave-particle duality”.

Human retina is sensible to electromagnetic waves with frequency in the range $\nu_r \approx 4 \times 10^{14}$ Hz and $\nu_v \approx 8 \times 10^{14}$ Hz (corresponding to wavelengths between $\lambda_r = 780$ nm and $\lambda_v = 380$ nm)³ : the term “light” is usually referred to electromagnetic wave-frequencies within these intervals. Thus *visibile* light is a very small region of the electromagnetic spectrum (see Figure 1). A light wave, irradiating into space at the constant velocity of about 300.000 kilometers per second, can therefore “energetically” interact with a detector, that could be a film, a retina or a photoelectric device.⁴

² Eugene Hecht, *Ottica*, Milano, ETAS libri, 1993, (Collana Schaum, Teoria e Problemi; 34), p. 27 and following.

³ The nanometer - unit adopted by CIE – is a submultiple of the meter: one billion of nanometers (nm) equal one meter: $1 \text{ nm} = 10^{-9}$ m measures the standard wavelengths in vacuum.

⁴ Eugene Hecht, *op. cit.*, p. 24

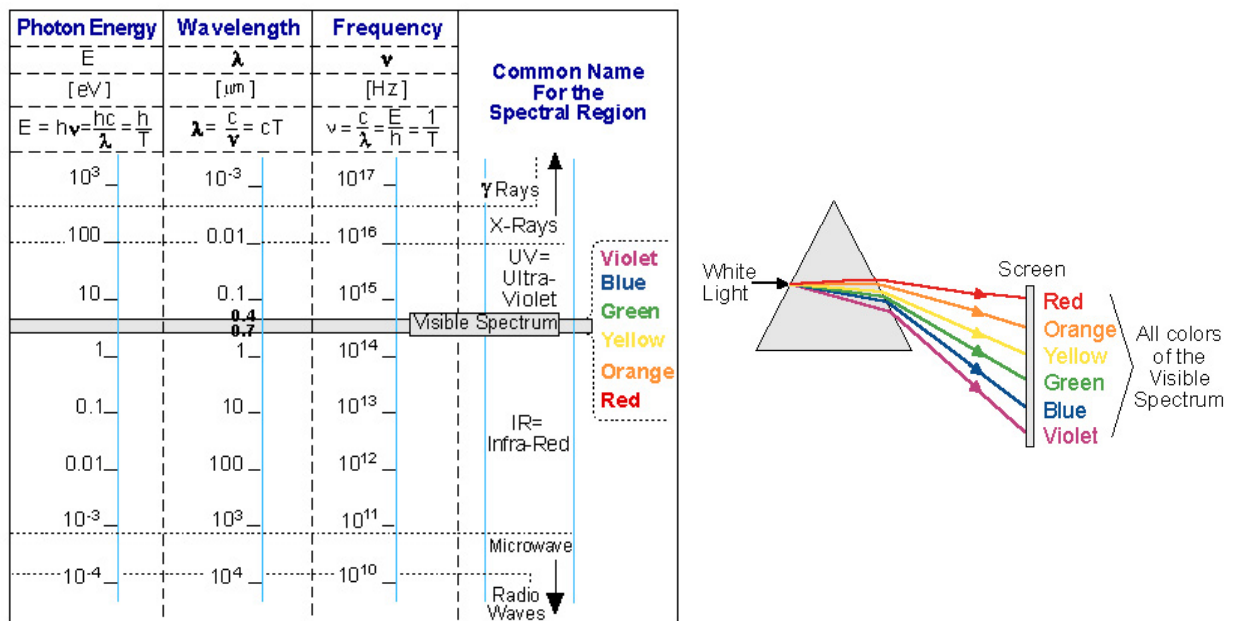


Figure 1: Electromagnetic Spectrum and visible light.

From its inception, Photography had an identity crisis: the chemical registration of light as an optical phenomenon was simultaneously invented by an artist and by a scientist.⁵

The invention of chronophotography – from the Greek “*writing, painting of time*” will lead to the rise of Cinematography – from the Greek “*writing of movement*”. The animation techniques, that consent to produce the illusion of movement in inanimated objects, have preceded the cinematographic shots on film. Muybridge’s work in fast motion photography led to major developments in still photography and painting plus the invention of motion pictures, directly affecting Marcel Duchamp and others at the turn of the XX Century. His images of people and animals in motion forever changed the way these figures were viewed.

“I often think the night is more alive and more richly coloured than the day.”

Vincent van Gogh to his brother Theo Letter 533, Arles, 8 September 1888

1. Photography: it’s all about light

Many people do not realize and even experienced photographers can forget, that Photography is all about light. The word “Photography” comes from two Greek words, *Photos* (light) and *Graphos* (writing, painting), so “*drawing with the light*”. Photography is not about objects or people or scenery, rather it is about how the light reveals those things. The action of light on a light-sensitive material (film or electronic devices) creates the image. An object can be lighted so that it almost disappears or so that it is virtually three dimensional.

⁵ David Travis, *At the Edge of the Light: Thoughts on Photography and Photographers, on Talent and Genius*. David R Godine, Boston, 2003, p. 51.

The acceptance of Photography as an art was hotly debated during the the Nineteenth Century. The Photography we have seen for the last 160 years has been created within a very narrow spectrum of the range of imagery that a camera could create. The sharp picture capability of Photography is both so powerful and useful that it has been easy to ignore the other possibilities. In general photographers have concentrated on perfectly exposed, fast shutter, well focused pictures of people and scenes in the real world. There certainly are exceptions such as the work of Man Ray, but in general a convincing illusion of the real world has been Photography's goal.⁶

As early as 1859, Alphonse de Lamartine wrote defensively: *"Photography is an art. Photography is more than an art. It is a solar phenomenon, where the artist collaborates with the Sun."* Almost a century later, in *Vision and Motion*, Moholy Nagy wrote *"It is unprecedented that such a 'mechanical' thing as a photography – regarded so contemptuously in the creative sense – should have acquired in barely a century of evolution the power to become one the primary visual forces in our life."* Paradoxically, it was greatly helped by painters such as Degas, Vuillard, Man Ray and Moholy Nagy, and writers like the zealot Zola, who purchased a dozen cameras and took thousands of photographs which he developed in the three labs he had built.⁷

Color photography is a relatively recent invention, so it is not only the intensity of the light, but also the color of the light that creates the image. This complicates things: for example, a scene may include different light sources which have their own particular color (color temperatures and wave lengths) and subtleties of color that may be seen differently by the camera than by the human eye. In the middle of this Century, the single lens reflex (SLR) camera was a technical breakthrough. For the first time the photographer could see exactly what the lens saw. Digital Photography goes one step further and lets the artist see what the camera is seeing in "real time" on a LCD screen. The LCD screen is an approximation, however, it is good enough so that a photographer can learn to work with it, with no need to guess how the final image will turn out.⁸

There is another useful aspect of the LCD screen: it allows a photographer to review pictures that he or she just shot. This immediate feedback allows an artist to learn quickly in new situations, experimenting unusual pictures. There are many, many ways to experiment.⁹

Today scientists no longer limit themselves to the three dimensions of Euclid. The painter have been led quite naturally, one might say by intuition, to preoccupy themselves with the new possibilities of spatial measurement which, in the language of modern studios, are designated by the term: the fourth dimension.

Regarded from the plastic point of view, the fourth dimension appears to spring from the three known dimensions: it represents the immensity of space eternalizing itself in all directions at any given moment. It is space itself, the dimension of the infinite.

Guillaume Apollinaire, from the Cubist Painters, 1913

⁶ Rick Doble, *Truth-to-materials in photography. Painting With Light*. 1999 <http://www.rickdoble.net/>

⁷ Ida Ely Rubin, preface to *Yulla*, edited and produced by Vittorio Benedetto, Camex International, New York, 1998.

⁸ Rick Doble, *Is digital photography the new expressive visual art?* 1999 <http://www.rickdoble.net/>

⁹ *ibidem*

2. Painting with light

Therefore if in the past “still Photography” couldn't get no respect - “color Photography” in particular, being thought of as a mechanical process having any potential for an artistic vision, rarely considered as a valid art form - now with Digital Photography, those with artistic ideas can realize their imagery in strikingly individual and unique ways. A full understanding of light and color means that, in the hands of a master, modern Photography is a rich, complicated, sophisticated and expressive art form. Already in the Nineties, in his essay *“Is digital photography the new expressive visual art?”* Rick Doble affirmed: *“Digital photography could be a major art form in the next century. It may be the culmination of the development of photography. Digital cameras may give us the power to set photography loose.”*¹⁰ Can an art form, which has been committed to creating high resolution images of the real world, find happiness as a contemporary art form that includes things that photography has been avoiding up to now, such as blurriness, overexposure, underexposure, camera movement, subject movement, graininess and long exposures in which the unexpected happens? *“In a sense we (photographers) will have to learn how to be ‘bad’ photographers, to deliberately go after blurred, unsharp, oddly exposed images - in other words to do all those things we have learned to avoid.”*¹¹ These images are, at best, very difficult with traditional film. The immediate feedback of the digital camera, however, means that we can try a lot of different things and quickly see the results without spending a fortune.

For a variety of reasons the real time LCD screen lets a photographer “paint with light” - light that is in the real world – by simply using the traditional photographic controls of adjusting brightness, contrast, color balance and range. While some of these effects could be approximated with the aid of a computer, images created in the real world have a vitality to them that a computer manipulated image cannot approach. It is the difference between the real and the artificial. This vital instant is the “decisive moment” of snapping the shutter as stated by Henri Cartier-Bresson.

The photograph can be used to record a passage through time, a movement through a space, even an emotion characterized by the movement of the camera. The elusive change of light, the fleeting expression, the ephemeral form – all could be captured by the camera, *“an instrument for working both in time and space”* as the English painter John Piper pointed out. Indeed taking pictures needs some devices and a particular process in Space and Time.

According to Einstein the basic structure of our world is SpaceTime and things exist in a spacetime continuum, a world of four dimensions: height, width, depth and time. A generative process is usually referred to as “setting in motion”. Motion is the essence of Life. To be alive is to move. It seems that both Cubism and Futurism were deeply affected by Einstein's Special Theory of Relativity, which was published in 1905. The goal of the Futurists was to include motion (and therefore Time) in a painted image, much like the cubist wanted to include multidimensions in a portrait.

“Light painting”, also known as “light drawing”, is a photographic technique in which exposures are made usually at night or in a darkened room by moving a light source or by moving the camera. In the former case, light can either be used to selectively illuminate parts of the subject or to “paint” a picture by shining it directly into the

¹⁰ *ibidem*

¹¹ Rick Doble, *Truth-to-materials in photography. Painting With Light*. 1999 <http://www.rickdoble.net/>

camera lens. Light painting requires a sufficiently slow shutter speed, usually a second or more. Like night photography, it has grown in popularity since the advent of digital cameras because it allows photographers to see the results of their work immediately. Light painting can take on the characteristics of Tableaux Vivant or a quick pencil sketch. Flash lights or light pens can also be used to create Full Bleed images. The different colored light are used to project an image on the CCD. Light painting by moving the camera is the antithesis of traditional Photography. At night, or in a dark room, the camera can be taken off the tripod and used like a paintbrush. An example is using the night sky as the canvas, the camera as the brush and cityscapes (amongst other light sources) as the palette. Putting energy into moving the camera by stroking lights, making patterns and laying down backgrounds can create abstract artistic images. A variety of light sources can be used. Manual focus is often used since autofocus systems may not perform well in low light. In addition, photographers often use a slow film speed or low ISO setting on a digital sensor to minimize grain (or digital noise) and increase exposure tolerance. When moving the camera, longer exposures can create more intricate images.¹²

One of the first experimenter with light painting, in the Eighties - thus before digital cameras, is Yulla, who describes her work as follows: *"The eyes within the camera shift and capture each moment. This act of perception transmutes and transfigures each object perceived creating a montage of unique and pivotal images."* It is interesting to notice some kind of coincidences, that Yulla Leben's education focussed on the study of Mathematics and Physics and that, when she was sixteen, she met Einstein for the first time, being impressed by him and his suggestions.¹³

I suppose I am interested, above all, in investigating the golden ability of the artist to achieve a metamorphosis of quite ordinary things into something wonderful and extraordinary...
Eduardo Paolozzi, *The Metamorphosis of Ordinary Things*, 1959

3. Generative Artworks: setting in motion the fourth dimension

So, if as said before a generative process is usually referred to as "setting in motion", definitions of Generative Art refers to *"art that has been generated, composed, or constructed in an algorithmic manner through the use of systems defined by computer software algorithms, or similar mathematical or mechanical or randomised autonomous processes"*¹⁴ or "a widely used artistic method inserting an automated system between the artist and the artistic expression".¹⁵ In a well-cited text, Philip Galanter formulates the following definition: *"Generative art refers to any art practice where the artist uses a system, such as a set of natural language rules, a computer program, a machine, or other procedural invention, which is set into motion with some degree of autonomy contributing to or resulting in a completed work of art."*¹⁶

Even though Generative Art is often reduced to merely a branch of software art, Galanter's definition proposes a view that does not restrict Generative Art strategies to its digital forms. There are many traditions for basing artworks on systems, procedures, and instructions in most fields of Art. John Cage, Yoko Ono and many other conceptual artists have worked with procedural and instruction-based work.

¹² http://en.wikipedia.org/wiki/Light_painting

¹³ Yulla, edited and produced by Vittorio Benedetto, Camex International, New York, 1998.

¹⁴ http://en.wikipedia.org/wiki/Generative_art

¹⁵ June 9th 2004: *Special - Generative art*. <http://www.artificial.dk/articles/generativespecial.htm>

¹⁶ Philip Galanter, *'What is Generative Art? Complexity Theory as a Context for Art Theory'*, New York University, 2003

The defining trait of Generative Art is rather that the artist establishes a system, which can generate a number of possible forms rather than one single finished form. The role of the artist is to construct, initiate or merely select the frame of procedures for the generation of possible expressions; the constructions of art-making systems substitute the making of static forms while in other cases the systems rely on input from human actors or information feeds.¹⁷

Selecting particular initial conditions, adding a fourth dimension and photographing motion by means of randomised generative processes can give rise to very expressionistic results, in full agreement with Galanter's definition of Generative Art. Rick Doble, who was by himself "action painting with a camera", proposed a new term for this Photography, namely "*photo-expressionism*". Generally speaking the most interesting effects will occur at extremes, because it is at these "edges" that the normal relationship between light and film breaks down and something unusual happens.¹⁸



Figure 2: *Flocks* (Eindhoven, 2004). Photo copyright Marcella Giulia Lorenzi

¹⁷ June 9th 2004: *Special - Generative art*. <http://www.artificial.dk/articles/generativespecial.htm>

¹⁸ Rick Doble, *A touch of the savage. Digital Photography and the Savage in Art*. <http://www.rickdoble.net/>



Figure 3: FOTOSORDIO 2005 International Contest. Lux Photo copyright Marcella Giulia Lorenzi

One of us (MGL) started experimenting with “Light Painting” since 1998. The first digital photographs (see Figure 2) were taken with a Creative PcCam 600. Recent ones are taken using a Canon IXUS 750. Some of them were selected for the “FOTOSORDIO 2005 International Contest” and exhibited at the GNAM National Gallery and in the Aula Magna at Tor Vegata University, both in Rome (see Figure 3). All the pictures were taken at night or in twilight, hand held and involved a lot of rapid camera movement (see Figures 4-8). Most images were created with a low ISO setting (usually 50) adjusted to suit lighting sources and conditions. Usually she carries her own camera, looking for the appropriate lighting conditions, especially the color and intensity of the light sources: neon public display signs, normal house bulbs, stop lights several different street lamps can produce a range of colors in one scene. There are now dozens of different lamps that put out wavelengths that are quite different from daylight or even household lights or fluorescents.

The LCD screen on the back of digital cameras has a number of advantages over a traditional viewfinder much of which remains to be explored. The immediate feedback means that a photographer can experiment and learn at an unprecedented pace, then making some decisions about how realistic or abstract the imagery to be. Camera movement combined with a slow shutter speed can create fluid images full of energy. At the beginning, starting experimentation in this way she was taking some fifty images before finding one that she really liked. As she became more experienced, that ratio went down a lot. This is not unusual for any kind of photography, but in the case of abstract photography is really important.

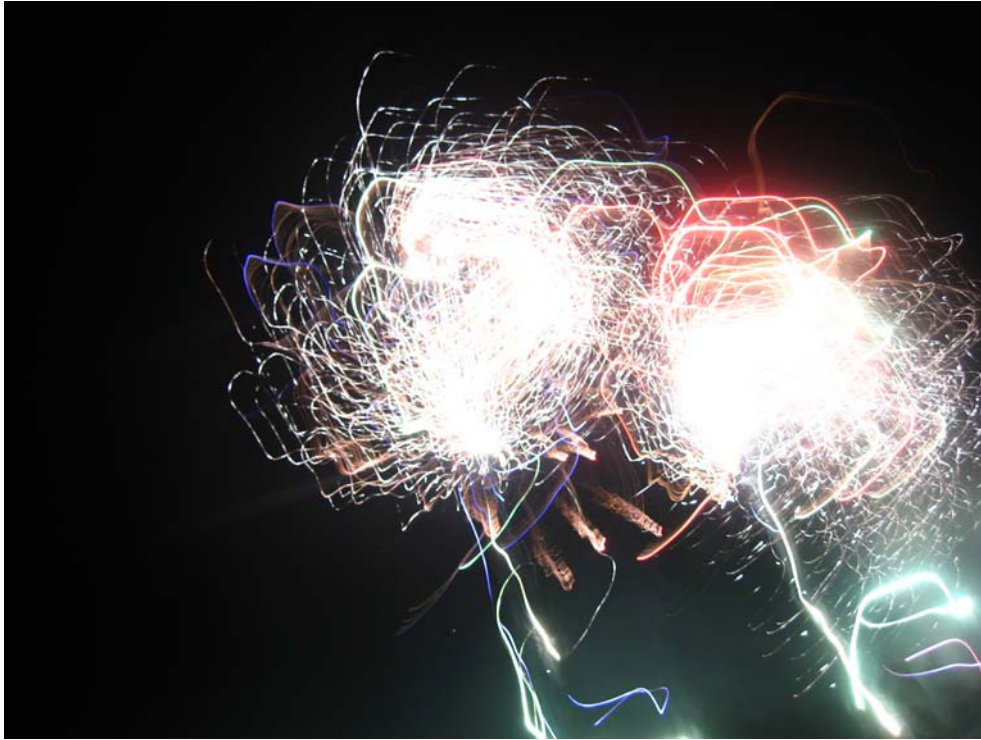


Figure 4. This picture reminds of two flowers, both for the form and the colors. It was taken in Lorica (CS-Italy) mid-summer 2007, moving the camera during some fireworks. Photo copyright Marcella Giulia Lorenzi.



Figure 5. This picture was taken in Torino (Italy), in front of the “Porta Palazzo Market”, to which a lot of neon signs were added, reproducing the terms for the concept “I love difference” in different languages, for the Christmas period event “*Luminarie – Luci d’Artista*”. Photo copyright Marcella Giulia Lorenzi

A very simple yet effective installation was exhibited during Generative Art 2007 Conference. It was basically composed of several light sources of different colors, in a dark room, put in apparently random positions. Visitors were invited to choose their favorite color source and change its position, move it and so on, following simple rules. People were also invited to take shots of the installation, experimenting with different shutter speeds and camera movements. They were also free to play with the lights, moving them in the air, while other people were taking pictures. The result was a generative installation and generative shots, that will be published on the <http://mars.unical.it/emc2> Website. A physicist (one of us, MF) was also there to give explanations about light phenomena and Maxwell's and Einstein's theories of Electromagnetism, Relativity and SpaceTime.

In addition, a selection of light paintings pictures were exhibited during the conference.



Figure 6. This picture was taken in Frankfurt airport (Germany 2006), along a connection gallery, where light continuously change color: the perfect location for Painting with light! Photo copyright Marcella Giulia Lorenzi



Figure 7. This picture was taken in Lisbon (Portugal 2006) from the ceiling of my hotel. Photo copyright Marcella Giulia Lorenzi



Figure 7. This picture was taken near Niagara Falls (Canada 2006). Photo copyright Marcella Giulia Lorenzi



Figure 8. This picture was taken in Montreal (Canada 2006) from a light exhibition. Photo copyright Marcella Giulia Lorenzi