

# Abstraction and Complexity

Lev Manovich

What kind of images are appropriate for the needs of a global informational networked society – the society which in all of its areas needs to represent more data, more layers, more connections than the preceding its industrial society?<sup>1</sup> The complex systems which have become super-complex<sup>2</sup>; the easy availability of real-time information coming from news feeds, networks of sensors, surveillance cameras; more fragmented and limited access to the senses of any subject in a consumer economy – all this puts a new pressure on the kinds of images human culture already developed and ultimately calls for the development of new kinds. This does not necessary mean inventing something completely unprecedented – instead it is apparently quite productive to simply give old images new legs, so to speak, by expanding what they can represent and how they can be used. This is, of course, exactly what computerization of visual culture has been all about since it begun in the early 1960s. While it made production and distribution of already existing kinds of images (lens-based recordings, i.e. photographs, film and video, diagrams, architectural plans, etc.) efficient, more importantly the computerization made possible for these images to function in various novel ways by “adding” interactivity, by making turning static images into navigable virtual spaces, by opening images to all kinds of mathematical manipulations which can be encoded in algorithms.

This chapter of course will not be able to adequately address all these transformations. It will focus instead on a particular kind of image – software driven

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<sup>1</sup> I rely here on the influential analysis of Manuel Castells who characterizes new economy that emerged in the end of the twentieth century as Informational, global and networked. See Manuel Castells, The Rise of the Network Society. The Information Age; v. 1, second edition (Blackwell, 2000), p. 77.

<sup>2</sup> Lars Qvortrop, Hypercomplex Society (Peter Lang Publishing, 2003.)

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abstraction. Shall the global information society include abstract images in its arsenal of representational tools? In other words, if we take an abstraction and wire it to software, do we get anything new and useful beyond what already took place in the first part of the twentieth century – than the new abstract visual language was adopted by graphic design, product design, advertising and all other communication, propaganda and consumer fields?

### **After Effects**

Let us begin by thinking about abstraction in relation to its opposite. How did computerization of visual culture have affected the great opposition of twentieth century between abstraction and figuration? In retrospect, we can see that this opposition was one the defining dimensions of the twentieth century culture since it was used to support so many other oppositions – between “popular culture” and “modern art,” between “democracy” and “totalitarianism,” and so on. Disney against Malevich, Pollock against Socialist Realism, MTV versus Family Channel. Eventually, as the language of abstraction took over all of modern graphic design while abstract paintings migrated from artists studios to modern art museums as well as corporate offices, logos, hotel rooms, bags, furniture, and so on, the political charge of this opposition has largely dissolved. And yet in the absence of new and more precise categories we still use figuration/abstraction (or realism/abstraction) as the default basic visual and mental filter through which we process all images which surround us.

In thinking about the effects of computerization on abstraction and figuration, it is much easier to address the second term than the first. While “realistic” perspective images of the world are as common today as they were throughout the twentieth century, photography, film, video, drawing and painting are no longer the only ways to generate them. Since the 1960s, these techniques were joined by a new technique of computer image synthesis. Over the next decades, 3D computer images gradually became more and more widespread, gradually coming to occupy a

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larger and larger part of the whole visual culture landscape. Today for instance practically all of computer games rely on real-time 3D computer images - and so are numerous feature films, TV shows, animated features, instructional video, architectural presentations, medical imaging, military simulators, and so on. And while the production of highly detailed synthetic images is still a time consuming process, as the role of this technique is gradually expanding, various shortcuts and technologies are being developed to make it easier: from numerous ready-to-use 3D models available in online libraries to scanners which capture both color and shape information and software which can automatically reconstruct a 3D model of an existing space from a few photographs.

While computerization has “strengthened” the part of the opposition occupied by figurative images by providing new techniques to generate these images – and even more importantly, making possible new types of media which rely on them (3D computer animation, interactive virtual spaces) – it simultaneously had “blurred” the “figurative” end of the opposition. Continuous developments in “old” analog photo and film technologies (new lenses, more sensitive films, etc.) combined with the development of software for digital retouching image processing and compositing eventually completely collapsed the distance which previously separated various techniques for constructing representational images: photography, photo-collage, drawing and painting in various media, from oil, acrylic and airbrush to crayon and pen and ink. Now the techniques specific to all these different media can be easily *combined* within the metamedium of digital software.<sup>3</sup>

One result of this shift from *separate representational and inscription media* to *computer metamedium* is proliferation of *hybrid* images - images that combine traces and effects of a variety of media. Think of an typical magazine spread, a TV advertisement or a home page of a commercial web site: maybe a figure or a face of person against a white background, some computer elements floating behind or in

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<sup>3</sup> The notion of computer as metamedium was clearly articulated by the person who, more than anybody, was responsible for making it a reality by directing the development of GUI at Xerox Parc in the 1970s – Alan Kay. See Alan Kay and Adele Golberg, “Personal Dynamic Media” (1997), in Noah Wardrip-Fruin and Nick Monfort, *The New Media Reader* (MIT Press, 2003), 394.

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front, some Photoshop blur, funky Illustrator typography, and so on. (Of course looking at the Bauhaus graphic design we can already find some hybridity as well similar treatment of space combining 2D and 3D elements – yet because a designer had to deal with a number of physically distinct media, the boundaries between elements in different media were sharply defined.)

This leads us to another effect - the liberation of the techniques of a particular media from its material and tool specificity. Simulated in software, these techniques can now be freely applied to visual, spatial or audio data that has nothing to do with the original media.<sup>4</sup> In addition to populating the tool pallets of various software applications, these virtualized techniques came to form a separate type of software – filters. You can apply reverb (a property of sound when it propagates in particular spaces) to any sound wave; apply depth of field effect to a 3D virtual space; apply blur to type, and so on.

The last example is quite significant in itself: simulation of media properties and interfaces in software has not only made possible the development of numerous separate filters but also whole new areas of media culture such as *motion graphics* (animated type which exist on its own or combined with abstract elements, video, etc). By allowing the designers to move type in 2D and 3D space, and filter it in arbitrary ways, After Effects has affected the Gutenberg universe of text at least as much if not more than Photoshop affected photography.

The cumulative result of all these developments – 3D computer graphics, compositing, simulation of all media properties and interfaces in software – is that the images which surround us today are usually very beautiful and often very stylized. The perfect image is no longer something which is expected in particular areas of consumer culture – instead it is an entry requirement. To see this difference you only have to compare an arbitrary television program from twenty years ago to one of today. Just as the actors that appear in them, all images have been put

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<sup>4</sup> In The Language of New Media I describe this effect in relation to the cinematic interface, i.e. the camera model that in computer culture has become a general interface to any data that can be represented in 3D virtual space. But this is just a particular case of a more general phenomenon: simulation of any media in software allows for the “virtualization” of its interface. Lev Manovich, The Language of New Media (MIT Press, 2001.)

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 through a plastic surgery of Photoshop, After Effects, Flame, or similar software. At the same time, the mixing of different representational styles which until a few decades ago was only found in modern art (think of Moholy-Nagy photograms or Rauschenberg's prints from 1960) has become a norm in all areas of visual culture.

### **Modernist Reduction**

As can be seen even from this brief and highly compressed account, computerization has affected the figurative or "realistic" part of the visual culture spectrum in a variety of significant ways. But what about the opposite part of the spectrum – pure abstraction? Are the elegant algorithmically driven abstract images which started to populate more and more web sites since the late 1990s have a larger ideological importance, comparable to any of the political positions and conceptual paradigms which surrounded the birth of modern abstract art in the beginning of the 1920s century? Is there some common theme can be deduced from the swirling streams, slowly moving dots, dense pixel fields, mutating and flickering vector conglomerations coming from the contemporary masters of Flash, Shockwave, Java and Processing?<sup>5</sup>

If we compare 2004 with 1914, we will in fact see a similar breadth of abstract styles: strict northern diet of horizontal and vertical lines in Mondrian, more flamboyant orgy of circular forms in Robert Delaunay working in Paris, even more emotional fields of Wasily Kandinsky, the orgy of motion vectors of Italian futurists. The philosophical pre-suppositions and historical roots which have led to the final emergence of "pure" abstraction in the 1910s are similarly multiple and diverse, coming from a variety of philosophical, political and aesthetic positions: the ideas of synesthesia (the correspondence of sense impressions), symbolism, theosophy, communism (abstraction as the new visual language for the proletariat in Soviet Russia), and so on. And yet it possible and appropriate to point at a single paradigm

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<sup>5</sup> Processing is a high-level programming language for computer graphics that was developed within John Maeda's group at MIT Media Lab. See [www.processing.net](http://www.processing.net).

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 which both differentiates modernist abstraction from realist painting of the nineteenth century and simultaneously connects it to modern science. This paradigm is *reduction*.

In the context of art, abstraction of Mondrian, Kandinsky, Delaney, Kupka, Malevich, Arp and others represents the logical conclusion of a gradual development of a number of preceding decades. From Manet, impressionism, post-impressionism, symbolism to fauvism and cubism, the artists progressively streamline and abstract the images of visible reality until all recognizable traces of the world of appearances are taken out. While in general this reduction of visual experience in modern art was a very gradual process which begins already in early nineteenth century<sup>6</sup>, in the beginning of the twentieth century we often see the whole development replayed from the beginning to the end within a single decade – such as in the paintings by a tree created by Mondrian between 1908 and 1912. Mondrian starts with a detailed realistic image of a tree. By the time Mondrian has finished his remarkable compression operation, only the essence, the idea, the law, the genotype of a tree is left.

This visual reduction that took place in modern art perfectly parallels with the dominant scientific paradigm of the nineteenth and early twentieth century.<sup>7</sup> Physics, chemistry, experimental psychology and other sciences were all engaged in the deconstruction of the inanimate, biological and psychological realms into simple, further indivisible elements, governed by simple and universal laws. Chemistry and physics postulated the levels of molecules and atoms. Biology saw the emergence of the concepts of cell and chromosome. Experimental psychology applied the same reductive logic to the human mind by postulating the existence of further indivisible sensorial elements, the combination of which would account for perceptual or mental experience. For instance, in 1896 E.B. Titchener (former student of Wundt who

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<sup>6</sup> See, for instance, the exhibition The Origins of Abstraction, Musee d'Orsay, Paris, Nov 5 2003 – Feb 23 2004.

<sup>7</sup> For a detailed reading of modern art as the history of reduction that parallels the reductionism of modern science and in particular experimental psychology, see little known but remarkable book Modern Art and Modern Science. This section is based on the ideas and the evidence presented in this book. Paul Vitz and Arnold Glimcher Modern Art and Modern Science: The Parallel Analysis of Vision (Praeger Publishers, 1984).

brought experimental psychology to the U.S.) proposed that there are 32,800 visual sensations and 11,600 auditory sensory elements, each just slightly distinct from the rest. Titchener summarized his research program as follows: "Give me my elements, and let me bring them together under the psychophysical conditions of mentality at large, and I will guarantee to show you the adult mind, as a structure, with no omissions and no superfluity."<sup>8</sup>

It can be easily seen that the gradual move towards pure abstraction in art during the same period follows exactly the same logic. Similarly to physicists, chemists, biologists and psychologists, the visual artists have focused on the most basic pictorial elements – pure colors, straight lines, and simple geometric shapes. For instance, Kandinsky in Point and Line to Plane advocated "microscopic" analysis of three basic elements of form (point, line, and plane) claiming that there exists reliable emotional responses to simple visual configurations.<sup>9</sup> Equally telling of Kandinsky's program are the titles of the articles he published in 1919: "Small Articles About Big Questions. I. About Point," and "II. About Line."<sup>10</sup>

While the simultaneous deconstruction of visual art into its most basic elements and their simple combinations by a variety of artists in a number of countries which has taken place in the first two decades of the twentieth century echoes the similar developments in contemporary science, in some cases the connection was much more direct. Some of the key artists who were involved in the "birth" of abstraction were closely following the research into the elements of visual experience conducted by experimental psychologists. As experimental psychologists split visual experience into separate aspects (color, form, depth, motion) and subjected these aspects to a systematic investigation, their articles begin to feature simple forms such as squares, circles, and straight lines of different

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<sup>8</sup> Qtd. in Eliot Hearst, "One Hundred Years: Themes and Perspectives," in The First Century of Experimental Psychology, 25.

<sup>9</sup> Wassily Kandinsky, (1926), Point and Line to Plane (New York: Solomon R. Guggenheim Foundation, 1947).

<sup>10</sup> Yu. A. Molok, "'Slovar simvolov' Pavla Florenskogo. Nekotorye margonalii" (Pavel Florensky's 'dictionary of symbols.' A few margins), Sovetskoe Iskusstvoznanie 26 (1990): 328.

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orientations, often in primary colors. Many of the abstract paintings of Mondrian, Klee, Kandinsky and others look remarkably similar to the visual stimuli already widely used by psychologists in previous decades. Since we have documentation that at least in some cases the artists have followed the psychological research, it is appropriate to suggest that they have directly copied the shapes and compositions from the psychology literature. Thus abstraction was in fact born in psychological laboratories before it ever reached the gallery walls.

## **Complexity**

Beginning in the 1960s, scientists in different fields gradually realize that the classical science which aims to explain the world through simple universally applicable rules (such as the three laws of Newtonian physics) cannot account for a variety of physical and biological phenomena. Soon after, artificial intelligence research that tried to reduce human mind to symbols and rules, also run out of steam.

The new paradigm begins to emerge across a number of scientific and technical fields, eventually reaching popular culture as well. It includes a number of distinct areas, approaches, and subjects: chaos theory, complex systems, self-organization, autopoiesis, emergence, artificial life, the use of the models and metaphors borrowed from evolutionary biology (genetic algorithms, “memes”), neural networks. While distinct from each other, most of them share certain basic assumptions. They all look at complex dynamic and non-linear systems and they model the development and/or behavior of these systems as the interaction of a population of simple elements. This interaction typically leads to emergent properties - a priori unpredictable global behavior. In other words, the order that can be observed in such systems emerges spontaneously; it can't be deduced from the properties of elements that make up the system. Here are the same ideas as expressed in somewhat different terms: “orderly ensemble properties can and do arise in the absence of blueprints, plans, or discrete organizers; interesting wholes



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can arise simply from interacting parts; enumeration of parts cannot account for wholes; change does not necessarily indicate the existence of an outside agent or force; interesting wholes can arise from chaos or randomness.”<sup>11</sup>

According to the scientists working on complexity, the new paradigm is as important as the classical physics of Newton, Laplace, and Descartes, with their assumption of the "clockwork universe." But the significance of the new approach is not limited to its potential to describe and explain the phenomena of the natural world that were ignored by classical science. Just as the classical physics and mathematics fitted perfectly the notion of a highly rational and orderly universe controlled by God, the sciences of complexity are appropriate for the world which on all levels – political, social, economic, technical – appears to us to be, more dynamic, more complex, and more interconnected than ever before. (As Rem Koolhaas has put it recently: “Globalization is growth not by proliferation but by integration. Globalization is based on connectivity – through transport, agreements, standards, consumer goods and cultures, information and media.” about connecting everything to everything else.”)<sup>12</sup> So at the end it does not matter if frequent invocations of the ideas of complexity in relation to just about any contemporary phenomenon – from financial markets to social movements– are appropriate or not.<sup>13</sup> What is important is that having realized the limits of linear top-down models and reductionism, we are prepared to embrace a very different approach, one which looks at complexity not as a nuisance which needs to be quickly reduced to simple elements and rules, but instead as *the* source of life – something which is essential for a healthy existence and evolution of natural, biological, and social systems.

Let us now return to the subject this text is about – contemporary software abstraction and its role in a global information society. I am now finally ready to

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<sup>11</sup> See <http://serendip.brynmawr.edu/complexity/complexity.html>.

<sup>12</sup> CONTENT – Rem Koolahus/OMA/AMO, section on Prada stores, exhibition at Neue Nationalgalerie, Berlin, November 2003 – January 2004.

<sup>13</sup> For examples of works which apply the ideas of complexity to a range of fields, see Manuel de Landa, Thousand Years of Non-linear History (MIT Press, 1997); Howard Rheingold, Smart Mobs: The Next Social Revolution (Perseus Publishing, 2002); Steven Johnson, Emergence: Connected Lives of Ants, Brains, Cities, and Software (Scribner, 2003).

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name the larger paradigm I see behind the visual diversity of this practice – from stylish animations and backgrounds which populate commercial web sites to the online and offline works which are explicitly presented by their creators as art (a wonderful and carefully created selection of software works in the Abstraction Now exhibition represents this diversity very well). This paradigm is *complexity*. If modernist art followed modern science in reducing the mediums of art – as well as our sensorial, ontological, and epistemological experiences and models reality – to basic elements and simple structures, contemporary software abstraction instead recognizes the essential complexity of the world. It is therefore not accidental that often software works develop in a way that is directly opposite to the reduction that took place over the number of years in Mondrian’s paintings – from a detailed figurative image of a tree to a composition consisting from a just a few abstract elements. Today we are more likely to encounter the opposite: animated or interactive works that begin with an empty screen or a few minimal elements that quickly evolve into a complex and constantly changing image. And while the style of these works is often rather minimal – vector graphics and pixel patterns rather than an orgy of abstract expressionism (see my “Generation Flash” for a discussion of this visual minimalism as a new modernism<sup>14</sup>) – the images formed by these lines are typically the opposite of the geometric essentialism of Mondrian, Malevich, and other modernists. The patterns of lines suggest the inherent complexity of the world that is not reducible to some geometric phenotype. The lines curve and form unexpected arabesques rather than traversing the screen in strict horizontals and verticals. The screen as a whole becomes a constantly changing fields rather than a static composition.

When I discussed modernist abstraction, I pointed out that its relationship to modern science was two-fold. In general, the reductionist trajectory of modern art that eventually led to a pure geometric abstraction in the 1910s parallels the reductionist approach of contemporary sciences. At the same time, some of the artists actually follow the reductionist research in experimental psychology, adopting

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<sup>14</sup> Available at [www.manovich.net](http://www.manovich.net).

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the simple visual stimuli used by psychologists in their experiments for their paintings.

Since designers and artists who pursue software abstraction are our contemporaries and since we share the same knowledge and references, it is easy for us to see the strategy of direct borrowing at work. Indeed, many designers and artists use the actual algorithms from the scientific publications on chaos, artificial life, cellular automata and related subjects. Similarly, the iconography of their works often closely followed the images and animations created by scientists. And some people actually manage to operate simultaneously in the scientific and cultural universes, using same algorithms and same images in their scientific publications and art exhibitions. (One example is Karl Sims who in the early 1990s created impressive animations based on artificial life research that were later shown at Centre Pompidou in Paris.) What is less obvious is that in addition to the extensive cases of direct borrowing, *the aesthetics of complexity* is also present in the works that do not use any models from complexity research directly. In short, I argue that just as it was the case with modernist abstraction, the abstraction of the information era is connected to contemporary scientific research both directly and indirectly – both through a direct transfer of ideas and techniques and indirectly as being part of the same historically specific imagination.

Here are some examples all drawn from The Online Project part of Abstraction Now exhibition.<sup>15</sup> I decided to test my hypothesis by systematically going from piece to piece one by one rather than selecting only one a few works that would fit my preconceived ideas. I have also looked at all the accompanying statements – none of which as far I could see explicitly evoke the sciences of complexity. My experiment worked even better than I expected since almost all pieces in the online component of the show turn out to follow the aesthetics of complexity, invoking complex systems in natural world even more often and even more literally than I expected.

Golan Levin's *Yellowtail* software amplifies the gestures of the user, producing

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<sup>15</sup> <http://www.abstraction-now.at/the-online-project/>.

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ever-changing organic-looking lines of constantly varying thickness and transparency. The complexity of the lines and their dynamic behavior of the lines make the animation look like a real-time snapshot of some possible biological universe. The works perfectly illustrates how the same element (i.e. abstract line) that in modernist abstraction represented the abstract structure of the world now evokes instead the world's richness and complexity. (The piece by Manny Tan also can be used as an example here). In other words, if modernist abstraction assumes that behind sensorial richness of the world there are simple abstract structures that generate all this richness, such separation of levels is absent from software abstractions. What they show us instead is the dynamic interaction of the elements that periodically leads to certain orderly configurations.

*Insertsilence* by James Paterson and Amit Pitaru works in the same manner: a click by the user immediately increases the complexity of the already animated line cob, making lines multiply, break, mutate, and oscillate until they 'cool down' to form a complex pattern which sometimes contains some figurative references. While the artists' statement makes no allusions to complexity sciences, the animation in fact looks like a perfect illustration of the concept of emergent properties.

As I already noted, often software works deploy vector graphics to create distinctly biologically looking patterns. However a much more modernist looking rectangular composition can also be reworked to function as an analog to the complex systems studied by scientists. The pieces by Peter Luining, Return, and James Tindall evoke typical compositions created by students at Bauhaus and Vkhutemas (Russian equivalent of Bauhaus in the 1920s). But again, with a single click of the user the compositions immediately come to life, turning into dynamic systems whose behavior no longer evokes the ideas of order and simplicity. As in many others software pieces which subscribe to the aesthetics of complexity, the behavior of the system is neither linear nor random – instead we are witnessing a system which seems to change from state to state, oscillating between order and chaos – again exactly like complex systems found in natural world.

While some of the software pieces in Abstraction Now exhibition adopt the combinatorial aesthetics common to both early modernist abstraction and 1960s

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minimalism (in particular, the works by Sol Leavitt), this similarly only makes more apparent a very different logic at work today. For instance, instead of systematically displaying all possible variations of a small vocabulary of elements, Arp code by Julian Saunderson from Soda Creative Ltd constantly shifts the composition without ever arriving at any stable configurations. The animation suggests that the modernist concept of “good form” no longer applies. Instead of right and wrong forms (think for instance of the war between Mondrian and Theo van Doesburg), we are in the presence of a dynamic process of organization that continuously generates different forms, all equally valid.

If the works described so far were able to reference complexity mainly through the dynamic behavior of rather minimal line patterns, the next group of works uses algorithmic processes to generate dense and intricate fields which often cover the whole screen. Works by Glen Murphy, Casey Reas, Dexto, Meta, Ed Burton (also from Soda) all fit into this category. But just as with the works described so far, these fields are never static, symmetrical or simple – instead they constantly mutate, shift and evolve.

I can go on multiplying examples but the pattern should be quite clear by now. The aesthetics of complexity which dominates the online works selected for Abstraction Now show is not unique to it; scanning works regularly included in other exhibitions such as [www.whitneybiennial.com](http://www.whitneybiennial.com) (curated by Miltos Manetas, 2002), Ars Electronica 2003, or Flash Forward festivals demonstrates that this aesthetics is as central for contemporary software abstraction as the reductionism was for early modernist abstraction.

The space limitations of this chapter do not allow me to go into an important question of what is happening today in abstract painting (which is a very active scene in itself) and how its developments connect (or not) to the developments in software art and design as well as contemporary scientific paradigms. Instead, let me conclude by returning to the question that I posed in the beginning: the need for a new types of representations adequate for the needs of a global information society, characterized by the new levels of complexity (in this case understood in descriptive rather than in theoretical terms.) As I already suggested, practically all of

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the developments in computer imaging so far can be understood as the responses to this need. But this still leaves open the question of representing the new social complexity symbolically. While software abstraction usually makes more direct references to the physical and biological than the social, it maybe also appropriate to think of many works in this paradigm as such symbolic representations. For they seem to quite accurately and at the same time poetically capture our new image of the world – world as the dynamic networks of relations, oscillating between order and disorder – always vulnerable ready to change with a single click of the user.