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Data Visualisation as New Abstraction and Anti-Sublime

Visualization and Mapping

Along with a Graphical User Interface, a database, navigable space, and simulation, dynamic data visualization is one of the genuinely new cultural forms enabled by computing.[1] Of course the fans of Edward Tufte will recall that it is possible can find examples of graphical representation of quantitative data already in the eighteenth century, but the use of computer medium turns such representations from the exception into the norm. It also makes possible a variety of new visualization techniques and uses for visualization. With computers we can visualize much larger data sets; to create visualizations which are dynamic (i.e. animated and interactive); to feed in real-time data; to base graphical representations of data on its mathematical analysis using variety of methods from classical statistics to data mining; to map one type of representation into another (images into sounds, sounds into 3D spaces, etc.)

Since Descartes introduced the system for quantifying space in the seventeenth century, graphical representation of functions has been the cornerstone of modern mathematics (if you need to remember how it works and you have a Mac, start Graphing Calculator and run the demo.) In the last few decades, the use of computers for visualization enabled development of a number of new

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[1] Graphical User Interface itself includes a set of techniques: interactive control, direct manipulation, multiple views, and others. Used not just for data access or computer control but also for media access and manipulation, each of these techniques itself opens up a new paradigm in cultural representation. For the discussion of a database and navigable space, see my The Language of New Media (MIT Press, 2001). Simulation (as in The Sims) will be discussed in my next book Info-Aesthetics.

scientific paradigms such as chaos and complexity theories, and artificial life. It also forms the basis of a new field of scientific visualization. Modern medicine relies on visualization of body and its functioning; modern biology similarly is dependent on visualization of DNA and proteins. But while contemporary pure and applied sciences, from mathematics and physics to biology and medicine heavily relies on data visualization, in the cultural sphere visualization until recently has been used on a much more limited scale, being confined to 2D graphs and charts in the financial section of a newspaper, or on occasional 3D visualization on television to illustrate the trajectory of a space station or of a missile.

I will use the term visualization for the situations when quantified data which by itself is not visual – the output of meteorological sensors, stock market behaviors, the set of addresses describing the trajectory of a message through a computer network, and so on – is transformed into a visual representation.[2]
The concept of mapping is closely related to visualization but it makes sense to keep it separate. By representing all data using the same numerical code, computers make it easy to map one representation into another: grayscale image into 3D surface, a sound wave into an image (think of visualizers in music players such as iTunes), and so on. Visualization then can be thought of as a particular subset of mapping in which a data set is mapped into an image.

Human culture practically never uses more than four dimensions in its representations because we humans live in 4D space. Therefore we have

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[2] Of course, if we also think of all 3D computer animation as a type of data visualization in a different sense – after all, any 3D representation is constructed from a data set describing the polygons of objects in the scene or from mathematical functions describing the surfaces – the role played by data visualization becomes significantly larger. After all, 3D animation is routinely used in industry, science and in popular culture. But I don't think we should accept such an argument since 3D computer images closely follow traditional Western perspectival techniques of space representation, and therefore from the point of view of their visual appearance do not constitute a new phenomenon.

difficulty imagining data in more than these four dimensions: three dimensions of space (X, Y, Z) and time. However, more often than not, the data sets we want to represent have more than four dimensions. In such situations designers and their clients have to choose which dimensions to use and which to omit, and how to map the selected dimensions.

This is the new politics of mapping of computer culture. Who has the power to decide what kind of mapping to use, what dimensions are selected; what kind of interface is provided for the user – these new questions about data mapping are now as important as more traditional questions about the politics of media representation by now well rehearsed in cultural criticism (who is represented and how, who is omitted). More precisely, these new questions around the politics of quantified data representation run parallel to the questions about the content of the iconic and narrative media representations. In the later case we usually deal with the visual images of people, countries, and ethnicities, in the former case, the images are abstract 3D animations, 3D charts, graphs, and other types of visual representation used for quantified data.

Data Modernism

Mapping one data set into another, or one media into another, is one of the most common operations in computer culture, and it is also common in new media art.[3] Probably the earliest mapping project which received lots of attention and which lies at the intersection of science and art (because it seems to function well in both contexts) was Natalie Jeremijenko's "live wire." Working in Xerox PARC in the early 1990s, Jeremijenko created a functional wire sculpture which reacts in real time to network behavior: more traffic causes the wire to vibrate more

[3] Most mappings in both science and art go from non-visual media to visual media. Is it possble to create mappings that will go into the opposite direction?

strongly. In the last few years, data mapping has emerged as one of the most important and interesting areas in new media art, attracting the energy of some of the best people in the field. It is not accidental that out of 10 Net Art projects included in 2002 Whitney Biennale, about a half presented different kinds of mapping: the visual map of the space of Internet addresses (Jevbratt), 3D navigable model of Earth presenting a range of information about the Earth in multiple layers (Klima), another 3D model illustrating the algorithm used for genome searches (Fry); the diagrams of corporate power relationships in the United States (John On & Futurefarmers). [4]

In order to ground my general observations about data mapping in art in concrete material, I would like now to briefly discuss a few projects by some of the best artists dealing with data visualization. One of my favorites is John Simon (New York). His work is unique for a number of reasons. First of all, he makes explicit connections in his pieces between the new ideas of new media and various traditions, movements and figures of modern art, in particular Mondrian, Klee, and Sol Levitt. Given that art world and culture at large are still largely treating new media as a phenomena in itself which has no connections to the past, Simon's explicit and systematic explorations of conceptual linkages between new media and modern art is very important. In addition, while new media art field has been rapidly growing in size over the last years, and while artists in all disciplines are now routinely computer as a tool in their work, there are still literally only a few artists out there who focus on one of the most fundamental and radical concepts associated with digital computers – that of computation itself (rather than interactivity, network, or multimedia). Simon systematically researches how real-time computation can be used to create engaging artworks which are both conceptual and strongly material, offering the viewer rich visual experiences. In his earlier work online piece Every Icon (1998) and his wall-mounted pieces included in Bitstreams exhibition at the Whitney Museum (2001) Whitney uses

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[4] http://artport.whitney.org/exhibitions/index.shtml.

real-time computation to create artworks that have a starting point in time but no end point; as the time progresses, they constantly change. While we can find certain precedents for such artworks in modern art (for instance, kinetic art, early computer art of the 1960s, and conceptual art), Simon pursues a unique strategy of his own: he uses artificial life, cellular automata and other computational techniques to create complex and nuanced images which combine figurative and abstract and which explicitly insert themselves within the history of modernist visual research.

If Simon's images are the result of real-time computation internal to a work itself, whose of Lisa Jevbratt (Santa Barbara) often are driven by the Internet data. Jevbratt received her training at CADRE.[5] This program was created Joel Slayton at San Jose State University who was able to strategically exploit its unique location right in the middle of Silicon Valley to encourage creation of computer artworks which critically engage with commercial software being created in Silicon Valley for the rest of the world: Internet browsers, search engines, databases, data visualization tools, etc. With his ex-students, Slayton formed a "company" called C5 to further develop critical software tools and environments. Jevbratt is the most well known artist to emerge from the C5 group. While "software art" has emerged as a new separate category within new media field only about two years ago, Jevbratt, along with other members of CADRE community, have been working in this category for much longer. In their complexity and functionality, many software projects created at C5 match commercial software, which is still not the case for most new media artists.

In her earlier well-known project 1:1 Jevbratt created a dynamic database containing IP addresses for all the hosts on the World Wide Web, along with five

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5 http://cadre.sjsu.edu

different ways to visualize this information.[6] As the project description by Jevratt points out:

> When navigating the web through the database, one experiences a very different web than when navigating it with the "road maps" provided by search engines and portals. Instead of advertisements, pornography, and pictures of people's pets, this web is an abundance of non-accessible information, undeveloped sites, and cryptic messages intended for someone else…The interfaces/visualizations are not maps of the web but are, in some sense, the web. They are super-realistic and yet function in ways images could not function in any other environment or time. They are a new kind of image of the web and they are a new kind of image.

In a 2001 project Mapping the Web Infome Jevbratt continues to work with databases, data gathering and data visualization tools; and she again focuses on the Web as the most interesting data depository corpus available today.[7] For this project Jevbratt wrote special software that enables easy menu-based creation of Web crawlers and visualization of the collected data (crawler is a computer programs which automatically moves from a Web site to a Web site collecting data from them). She then invited a number of artists to use this software to create their own crawlers and also to visualize the collected data in different ways. This project exemplifies a new functioning of an artist as a designer of software environments that are then made available to others.

Alex Gallaway/RSG collective uses the similar approach in his nework visualization project Carnivore (2002). Like Jevbratt, RSG collective created a software system that he opened up to other artists to use. Physically Carnivore is styled like a morth between a non-distinct box for telephone surveillance such the ones used in GDR, and a modernist sculpture; connected to some point in the network, it intercepts all data going through it. This by itself does not make it art, since a number of commercial software packages perform similar functions. For

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[6] http://www.c5corp.com/1to1/

[7] http://dma.sjsu.edu/jevbratt/lifelike/

instance, Etherpeek 4.1 is a LAN analyzer that captures packets from attached Ethernet or AirPort networks and uses decodes to break these packets into their component fields. It can decode FTP, HTTP, POP, IMAP, Telnet, Napster, and hundreds of other network protocols. It performs real-time statistical analysis of captured packets and it can reconstruct complete e-mail messages from the captured packets. As it is often the case with the artist software (software by CADRE community being an exception), Carnivore only offers a small fraction of the capabilities of its commercial counterparts such as Etherpeek. What it does offer instead is the open architecture that allows other artists to write their own visualization clients that display the intercepted data in a variety of different ways.

Some of the most talented artists working with the Net have written visualization clients for Carnivore. The result is a diverse and rich menu of forms, all driven by the network data. Just as in the first decades of the twentieth century modernist artists of the mapped the visual chaos of the metropolitan experience into simple geometric images, data visualization artists transform the informational chaos of data packets moving through the network into clear and orderly forms. And if modernism reduced the particular to its Platonic schemas (think of Mondrian, for instance, systematically abstracting the image of a tree in a series of paintings), data visualization is engaged in a similar reduction as it allows us to see patterns and structures behind the vast and seemingly random data sets. Thus it is possible to think of data visualization as a new abstraction. But if modernist abstraction was in some sense anti-visual – reducing the diversity of familiar everyday visual experience to highly minimal and repetitive structures (again, Mondrian's art provides a good example) – data visualization often employs the opposite strategy: the same data set drives endless variations of images (think of various visualization plug-ins available for music players such as iTunes.) Thus, data visualization moves from the concrete to the abstract, and then again to the concrete. The quantitative data is reduced to its patterns and structures that are then exploded into many rich and concrete visual images.

Meaningful Beauty: Data Mapping as Anti-sublime

Having looked at the particular examples of data visualization art, we are now in the position to make a few observations and pose a few questions. I often find myself moved by these projects emotionally. Why? Is it because they carry the promise of rendering the phenomena that are beyond the scale of human senses into something that is within our reach, something visible and tangible? This promise makes data mapping into the exact opposite of the Romantic art concerned with the sublime. In contrast, data visualization art is concerned with the anti-sublime. If Romantic artists thought of certain phenomena and effects as un-represantable, as something which goes beyond the limits of human senses and reason, data visualization artists aim at precisely the opposite: to map such phenomena into a representation whose scale is comparable to the scales of human perception and cognition. For instance, Jebratt's 1:1 reduces the cyberspace – usually imagined as vast and maybe even infinite – to a single image that fits within the browser frame. Similarly, the graphical clients for Carnivore transform another invisible and "messy" phenomena – the flow of data packets through the network that belong to different messages and files – into ordered and harmonious geometric images. The macro and the micro, the infinite and the endless are mapped into manageable visual objects that fit within a single browser frame.

The desire to take what is normally falls outside of the scale of human senses and to make visible and manageable aligns data visualization art with modern science. Its subject matter, i.e. data, puts it within the paradigm of modern art. In the beginning of the twentieth century art largely abandoned one of its key – if not the key – function – portraying the human being. Instead, most artists turned to other subjects, such as abstraction, industrial objects and materials (Duchamp, minimalists), media images (pop art), the figure of artist herself or himself (performance and video art) – and now data. Of course it can be argued that data

art represents the human being indirectly by visualizing her or his activities (typically the movements through the Net). Here again I would like to single out the works of Simon who makes explicit references to the tradition of modernist abstraction (one of his works, for instance, refers to Piet Mondrian's Broadway Boogie-Woogie, 1942-43) – and also includes figurative elements in his compositions, such as outlines of Manhattan Midtown buildings and street traffic. In fact, Simon refers to this piece as a view from his studio window – a type of image that has a well-known history in modern art (for instance, views of Paris by the impressionists).

Another important question worth posing is about arbitrary versus motivated choices in mapping. Since computers allow us to easily map any data set into another set, I often wonder why did the artist choose this or that mapping when endless other choices were also possible. Even the very best works which use mapping suffer from this fundamental problem. This is the "dark side" of mapping and of computer media in general – its built-in existential angst. By allowing us to map anything into anything else, to construct infinite number of different interfaces to a media object, to follow infinite trajectories through the object, and so on, computer media simultaneously makes all these choices appear arbitrary – unless the artist uses special strategies to motivate her or his choices.

Lets look at one example of this problem. One of the most outstanding architectural buildings of the last decade is Jewish Museum Berlin by Daniel Liberskind. The architect put together a map that showed the addresses of Jews who were living in the neighborhood of the museum site before World War II. He then connected different points on the map together and projected the resulting net onto the surfaces of the building. The intersections of
The net projection and the design became multiple irregular windows. Cutting through the walls and the ceilings at different angles, the windows point to many visual references: narrow eyepiece of a tank; windows of a

Medieval cathedral; exploded forms of the cubist/abstract/supermatist paintings of the 1910s-1920s. Just as in the case of Janet Cardiff's audio walks, here the virtual becomes a powerful force that re-shapes the physical. In Jewish Museum, the past literally cuts into the present. Rather than something ephemeral, here data space is materialized, becoming a sort of monumental sculpture.

But there was one problem which I kept thinking about when I visited still empty museum building in 1999 – the problem of motivation. On the one hand, Liberskind's procedure to find the addresses, make a map and connect all the lines appears very rational, almost the work of scientist. On the other hand, as far as I know, he does not tell us anything about why he projected the net in this way as opposed to any other way. So I find something contradictory in fact that all painstakingly collected and organized data at the end is arbitrary "thrown" over the shapes of the building. I think this example illustrates well the basic problem of the whole mapping paradigm. Since usually there are endless ways to map one data set onto another, the particular mapping chosen by the artist often is not motivated, and as a result the work feels arbitrary. We are always told that in good art "form and content form a single whole" and that "content motivates form." Maybe in a "good" work of data art the mapping used have to somehow relate to the content and context of data - although I am not sure how this would work in general.

One way to deal with this problem of motivation is to not to hide but to foreground the arbitrary nature of the chosen mapping. Rather than try to always being rational, data art can instead make the method out of irrationality.[8] This of course was the key strategy of the twentieth century Surrealists. In the 1960s the late Surrealists – the Situationists – developed a number of methods for their "the

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[8] Read "against the grain," any descriptive or mapping system which consists from quantitative data – a telephone directory, the trace route of a mail message, etc. - acquires both grotesque and poetic qualities. Conceptual artists explored this well, and data visualization artists may learn from these explorations.

dérive" (the drift). The goal of "the dérive" was a kind of spatial "ostranenie" (estrangement): to let the city dweller experience the city in a new way and thus politicize her or his perception of the habitat. One of these methods was to navigate through Paris using a Map of London. This is the kind of poetry and conceptual elegance I find missing from mapping projects in new media art. Most often these projects are driven by the rational impulse to make sense out of our complex world, the world there many process and forces are invisible and are out of our reach. The typical strategy then is to take some data set – Internet traffic, market indicators, amazon.com book recommendation, or weather – and map it in some way. This strategy echoes not the aesthetics of the Surrealists but a rather different paradigm of the 1920s left avant-garde. The similar impulse to "read off" underlying social relations from the visible reality animated many left artists in the 1920s, including the main hero of my 'The Language of New Media – Dziga Vertov. Vertov' 1929 film A Man With a Movie Camera is brave attempt at visual epistemology – to reinterpret the often banal and seemingly insignificant images of everyday life as the result of the struggle between old and the new.

Important as the data mapping new media projects are, they miss something else. While modern art tried to play the role of "data-epistemology," thus entering in completion with science and mass media to explain to us the patterns behind all the data surrounding us, it also always played a more unique role: to show us other realities embedded in our own, to show us the ambiguity always present in our perception and experience, to show us what we normally don't notice or don't pay attention to. Traditional "representational" forms - literature, painting, photography, and cinema – played this role very well. For me, the real challenge of data art is not about how to map some abstract and impersonal data into something meaningful and beautiful – economists, graphic designers, and scientists are already doing this quite well. The more interesting and at the end maybe more important challenge is how to represent the personal subjective experience of a person living in a data society. If daily interaction with volumes of data and numerous messages is part of our new "data-subjectivity," how can we

represent this experience in new ways? How new media can represent the ambiguity, the otherness, the multi-dimensionality of our experience, going beyond already familiar and “normalized” modernist techniques of montage, surrealism, absurd, etc.? In short, rather than trying hard to pursue the anti-sublime ideal, data visualization artists should also not forget that art has the unique license to portray human subjectivity – including its fundamental new dimension of being “immersed in data.”

Berlin, August 2002