Towards a “Leonardo da Vinci approach” of GIS for Spatial Design

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Foreword

At the very beginning of the 1990s, a student happened to use a pen in a pen plotter that was smaller than the required size to fit the holder, which produced squiggle line drawings very similar to hand-generated plots. Taking advantage of this “accidental” discovery, and so as to establish the impact of this “technique,” Van Bakergem and Obata decided to voluntarily use this particular process to produce various plots, and to show them to architects and architecture students in order to test their respective reactions. Two sets of pen plotted perspective drawings were presented. The first set was printed with precise lines, and the second one revealed the results of the “new technique” simulating hand-sketching. The first set was judged as a final closed image that dampens creative ideas; whereas the second one was considered as interesting and stimulating. This experiment gave birth to a new technique for producing non-photorealistic images from photorealistic images.

Spatial representations in GIS and Spatial Design

Spatial representations, whether physical (maps, pictures, models…) or mental (cognitive models, mental maps…), constitute the main components of spatial design processes. Such representations can be seen as the products (intermediary and most of the time final) of those processes. But, like boundary objects (Latour, 1995) or intermediary objects (Vinck, 1999) they can also be considered as the “fuel” to carry out these processes, taking various forms depending on the phase of the processes and on the nature of the processes themselves.

Based on this assumption, my position paper will try to explore the intersections between GIS and spatial design through their respective relationships with spatial representations. The first section provides a brief overview of the spatial commonalities between GIS and spatial design from the perspective of creating and manipulating spatial representations. Secondly, I will give some facts to explain to what extent current GIS are not built for spatial design and, more specifically, why spatial designers do not see themselves reflected in GIS spatial representations. Last but not least, the third section raises some questions based on current research projects running at the Centre for Research in Geomatics, Laval University (two potential demos for the specialist meeting).

1. GIS and Spatial Design seem to have many spatial commonalities

With respect to the basic spatial concepts embedded in GIS, and regarding the production, management and use of physical GI spatial representations, it clearly appears that GIS and spatial design have many spatial commonalities. The following concepts are especially available in GIS as spatial analysis operators or tools, and all these concepts refer to basic spatial skills for GIS users:

- spatial references (coordinate, linear, punctual…),
- multiple scales (zooming),
- multiple views (place, time),
- multiple sources (interoperability),
- spatial move (panning),
- multiple granularity (generalization),
- etc.

Wikipedia defines Spatial Design as a “relatively new discipline that crosses the boundaries of traditional design disciplines such as architecture, interior design, landscape architecture and landscape design as well as public art within the Public Realm. The emphasis of the discipline is upon working with people and space, particularly looking at the notion of place, also place identity and genius loci (the spirit of a place). As such the discipline covers a variety of scales, from detailed design of interior spaces to large regional strategies.” Even if this definition is disputable and lacks some notions, especially the connection to Urban Design, it shows that the GI spatial concepts mentioned above are explicitly or implicitly included in spatial design: scale, place, time, multiple representations…

Forrester (1999) mentions that urban design process is four-fold: making a diagnosis, analysing possible areas of intervention, planning local solutions, combining the local solutions together to generate a global solution. GI literature has widely demonstrated to what extent GIS could provide efficient and relevant solutions for each of those four steps (Roche and Hodel, 2004). Consequently, GIS should theoretically fulfil spatial design requirements. Yet, in practice, the
situation seems to be quite different and more complex. A recent research achieved by one of my graduated students (Ciobanu, 2006) in collaboration with the school of planning (faculty of visual arts, architecture and planning) has revealed that spatial designers do not see themselves reflected in GIS, and especially in GI spatial representations. The main reason given by designers is that GIS are not built at all to meet spatial design needs and requirements. More fundamentally, exploring the way spatial representations are produced and used by designers, as well as the nature of such spatial representations helps to better understand this situation. The example of the Preamble is a good starting point to do so.

2. Some facts: GIS versus Spatial Design

Forester (1999) specifies that the main interest of urban spatial design is the flexibility of the process, its adequacy to creativity, its ability to integrate non- (or little-) formalized aspects. Indeed, spatial design is based on a complex creative process (mixing artistic, scientific, technical, legal, economic aspects …). Spatial design, and more particularly urban design, is also based on a deliberative approach; that is to say designers find solutions through talking. A detailed analysis of this type of process emphasizes the following elements:

These “deliberative rituals” (Forester, 1999; Innes, 1996) place emotions at the very core of the motivations of the design process. From a spatial point of view, these emotions translate into “verbal spatial representations” at every stage of the process. When they translate into some physical form, they appear as spatial representations with open and unstable features, both regarding the shape of the represented objects and phenomena, and their localization (Brown, 2003). On the contrary, GIS are characterized by stable and closed representations (Lardon et al., 2001).

The creative side of spatial design processes originates from the ambiguity (as March defined it, 1978), which increases at each stage. However, most of the works dedicated to developing GIS as spatial decision-making tools are based on the principle that any spatially informed decision should be built upon simple representations (and not simplistic). According to Lemoigne (1999), simplifying representations directly or indirectly exerts a reducing effect on the “clear and sharp” features. He also emphasizes the fact that Leonardo da Vinci’s “light and shade” technique remains the most efficient one to report effectively on any complex phenomenon (this is precisely what the example presented in the foreword revealed). It is specifically on the richness of this ambiguity of human perception that spatial designers develop their ideas. In the field of spatial design, ambiguity and “light and shade” effects in spatial representations stir up creative inspiration, whereas GIS are specifically developed to reduce this ambiguity to produce “clear and sharp” spatial representations, considered as being synonymous with quality.

A closer examination demonstrates that the debates between designers deal with spaces (Places) being studied that are progressively defined in the course of their discussions. Designers first develop a temporary local solution (realized in a verbal or physical spatial representation), and then they pursue with another space for which they propose another temporary solution (realized in another representation). Finally, they make the necessary adjustments to the first solution so that both solutions could work together (Figure 1). The steps are repeated until the end of the project. This type of dynamics makes analytical perspectives change at a rapid pace. Designers use this particular process to gather the local solutions all together (which in fact correspond to local perceptions) into one global solution or representation. These spatial, temporal and semantic perspective changes were highlighted for example by Tversky et al.
(1999). These changes are followed, with respect to spatial representation, by a constant evolution of the shapes of the spaces being studied during the design process (Figure 1).

![Dynamic evolution of the shape of the spaces being studied.](image)

The constant evolution of the shape of the spaces being studied is usually formalized through sketches that designers substantiate with photos or paper maps. However, as far as designers are concerned, this modus operandi is limited, and neither GIS nor CAD provide them with the flexibility they need. For instance, Goel (1995) asserts that the non discursive expression of thoughts using the symbolic dimension of sketching must remain hand-generated, since current computer-based representations are not rich enough to produce the same effect.
Finally, spatial representations produced and used for spatial design are most of the time based on qualitative spatial reference frameworks (as defined by Edwards and Ligozat (2004)). That is to say, designers usually provide spatial reference to their thoughts and representations not through using formal rectangular coordinates systems, X-coordinates curvilinear system, or Metric-point linear systems, but through using salient objects and relative positions. This type of spatial reference is not easy to formalize into a GIS, since it is based on an Euclidian view of space (quantitative spatial reference framework). Therefore, in order to adapt GIS to spatial design, it is necessary to move from a surveyor’s conception of space to a designer’s conception of place…


The above observations raise a number of questions. It appears clearly to me that if we want GIS to be really useful to spatial designers, some crucial issues have to be addressed:

- How to make GIS produce spatial representations that would be more open and flexible so as to free the creative process of spatial design?
- Is there any solution to use GIS to formalize verbal spatial representations (with the purpose to support the deliberative process)?
- In keeping with this idea, how could we improve GIS capabilities to ensure the spatial and semantic traceability of the spatial deliberative design process (rapid and constant perspective changes)?
- How to constantly and actively support such perspective changes?
- How to introduce and feed (with GIS) the minimal level of ambiguity required in spatial design? In other words, and focusing on spatial representations, how to move from a “clear and sharp” GI approach towards a “light and shade” approach of GI?
- How to build GIS spatial representations based on non Euclidian spatial reference systems?
- Considering Public Participation GIS - PPGIS and their new bottom-up evolutions, Volunteered Geographic Information – VGI, how could we feed the spatial design process (which is most of the time local-based) with more efficient and exhaustive local knowledge?

Two demos…

1. A dynamic mapping tool built to support and ensure the traceability of urban design deliberative process,

2. Spatially referenced and scalable sketch mapping – Geosketch: a sketch tool for designers, running on Tablet Pc and PDA.

Bibliographical orientation


