BEYOND GRAPHICS: INFORMATION
An Overview of Infovis Practices in the Field of the Architectural Heritage

J. Y. Blaise and I. Dudek

UMR CNRS/MCC 694 MAP – 184 av de luminy 13288 Marseille cedex 09, France

Keywords: Architectural heritage, Information visualisation, Graphic representation.

Abstract: Understanding and representing the evolution of architectural artefacts over time requires a careful examination of heterogeneous, questionable pieces of data. Accordingly, our position is that computer graphics can and will support such investigation if and only if they are designed, above all, as information visualisation disposals (may the visual result be realistic or not). But contemporary practices often fail to reach this goal. In this paper, we propose possible explanations, and argue why we believe the problem has more to do with a lack of appropriate methodology than with technologies. As an answer, we introduce a global methodological framework that claims to be at the intersection of figurative architectural representation and of information visualisation. We finally back up this claim by presenting past and contemporary examples showing there can be a bridge between the above mentioned fields.

1 INTRODUCTION

Computer graphics, and VR in particular, have had in the past decade a growing influence on how results of investigations about heritage architecture can be presented. Their use has constantly widened, with applications ranging for instance from the exploitation of archaeological studies (Ando, 2003), to survey processes engineering (De Luca, 2005); and with various scales observed (ranging from cities (Lerma, 2004) to architectural interiors (Perkins, 2003). However in numerous research works architecture has served mainly as a test bench.

When looking at architectural-heritage centered expriments, one can observe that 3D models have been widely used to portray "how a site could have looked like in the past". Their application to virtual reconstruction (a questionable wording since reconstruction implies more than bare re-drawing), clearly has had an impact in terms of communication. However, at this stage they remain criticised and raise a number of questions among researchers and practitioners. Two points can be mentioned:

- a lack of readability (inferences made are obscured in the final image);
- a lack of efficiency: researchers put time and means into producing realistic 3D models which remain an edge effect of their study.

And indeed, recent experiments with realistic 3D modelling of heritage architecture like the " Krakow 1650 3D model" (MHK, 2007) show there is a growing concern, even in the context of scientific popularisation, for less assertive visual results. Considering the variety and powerfulness of tools available, and the number of experiments carried out, we believe it is time to sit and analyse where and why, when applied to heritage architecture, computer graphics often fail to be effective investigation tools for scientists in the long run. In this paper's first section we propose two possible explanations.

We also intend to show that, with the growing influence of computers on their activity, researchers in the field of the architectural heritage now need to innovate in terms of method. In this paper's second section we introduce a possible methodological framework called "informative modelling" that integrates legacies from the fields of architectural modelling and of information visualisation. But to which extent are these a-priori distinct fields compatible?

Our second claim will be that those two fields can fruitfully complement one another when dealing with what is at the heart of historic artefacts : partial evidences. So in this paper's third section we will try to demonstrate through historic as well as contemporary graphic designs that it is so.

2 APPLICATION FIELD SPECIFIC BOTTLENECKS

So are solutions from the field of computer graphics (partly) ill-suited to the field of the architectural heritage? In this section we discuss two arguments that we believe help delineating more accurately the actual difficulties.

2.1 Partial Data vs Exhaustive Geometry

Studying how an edifice or a site has changed over time is primarily an information uncovering and analysis task. Researchers carrying out this task are faced with partial, heterogeneous, often questionable evidence. An in-depth analysis of the various pieces of evidence one can gather may help understanding scraps of its history, with ever less density as we go backwards in time. In other words, when the time has come to recount visually the evolution of a site, numerous shortages remain in the information set. In parallel, a 2D/3D modelling solution will require an exhaustive description of the site. A given x,y (z) is needed for each point, a given shape needs to be drawn ,etc.

And so ultimately, researchers are faced with an incontrovertible fact: they are most often asked to draw more than they really know. This observation is corroborated in (Lecuyot, 2005): the archaeologist commenting a virtual reconstruction produced for television says "*images are more demanding than text of publications since they do not allow for architectural omissions..*". With subjectivity, one could read "*even when we don't know what we have to draw*". Of course the popularisation of research result may be a valuable objective. But (Alkhoven, 2006) underlines the danger of graphics-that-don't-say-that-they-cheat when she writes "*documentation of choices for 3D modelling is a pre requisite for scientific research because these images will lead their own life and others will base their research upon these images*".

So how can we bridge the gap between incomplete, imprecise data sets and exhaustive 3D modelling? Documenting choices is here vital, and beyond this visualising and giving access to these choices on the long run (Dudek, 2007).

In his analysis of Minard's contribution to statistical graphics (C.J Minard, XIXth century pioneer of thematic cartography), M.Friendly (Friendly, 1999) gives us yet another hint when he writes "*Minard almost invariably chose accuracy of data over the tyranny of precise geographical position when*

conflict arose". And this is in a way what the XIXth century architect Choisy (Choisy, 1899) does in his explanation of how ancient Greeks handled visual effects in the composition of porticos (Figure 1).

Figure 1: Choisy's drawings do not correspond to the real geometry of Greek compositions, but provide a real information to the reader: top, right, the illusion of divergence that the human eye naturally perceives, bottom, the corrective disposal adopted by ancient Greeks.

And so the point is that whatever tools we are given, may they be those of the XIXth century or those of the XXIst century, it is our responsibility as users of those tools to invent methods that will allow us not to draw what we don't know in a way that could let others think that we know, but to draw all of what we know in an information-enhancing way.

2.2 Representation vs. Visualisation

When facing the necessity to provide visual results of an investigation, researchers or practitioners in our application field will most often end up using a 3D modelling software. Our position is that prior to using this or that tool, superseding other issues, is this question: representation or visualisation?

In the tradition of architectural drawing, representations are most often figurative. On the contrary, visualisation is for (Spence, 2001) a *cognitive activity*, wherein the objective is a *gain of insight*. But looking at it from closer, this may not be an opposition. When E.R Tufte (Tufte, 1990) writes "*we envision information to reason about knowledge, to document, to communicate and preserve this knowledge*" he undoubtedly covers the activity of researchers involved in our field. Furthermore, J.Bertin defines graphic representation as a "*system of signs that humans have developed to retain, understand and communicate the observations that they need*" (Bertin, 1998). Thereby the key is given: finding a system of signs that would be suited to our observations.
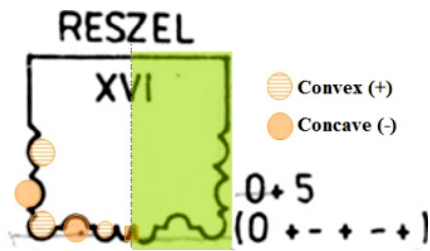
Figure 2: A brilliant integration of figurative drawing with abstract visualisation from (Tajchman 1989) : a specific ceiling beam observed in the town of Reszel (Poland) is described as alternate convex/concave mouldings (on its half-section). Zero identifies a flat zone on its axis. The beam is a "O+5", an easier formalism for data treatment.

3 A METHODOLOGICAL FRAMEWORK

In the previous section we hope to have demonstrated that, when visualising information about artefact changes, tools do not forbid nor encourage good practices (although computer tools do have a strong influence which we wish not to detail inside this contribution): So if the blame cannot be put on the tools, then maybe on lacking methods? As an answer, we have introduced in (Dudek, 2005) methodological framework called informative modelling. We perceive informative modelling as a bridge between information visualisation and architectural modelling. From the latter it inherits a priority given to 2D/3D space-enabled disposals. From the former it inherits an ambition to *amplify cognition* (Kienreich, 2006) about the artefact. But informative modelling applies to the study of historic architecture, where objects have most often been transformed, and consequently where what is known about objects remains partial.

As a consequence, whereas in traditional architectural modelling a realistic representation of objects is considered as an end, in the informative modelling methodology the representation of architectural objects is used primarily as support for information search and visualisation, and does not strive for realism. Abstraction (the infovis legacy) and figuration (the architectural representation legacy) are integrated as alternative/mixable modes of representation, allowing partial knowledge to be communicated and notions such as data uncertainty to be conveyed graphically. In (Dudek, 2007) we have introduced a grid of fourteen modelling rules (plus one), designed as safeguards helping researchers to support their activity with sustainable and information-effective graphics. These rules are

nothing more than a best-practice grid, but encompassing a wide range of issues (information, models, representations, abstractions). The fifteenth rule will give the reader an idea of what informative modelling is all about: **If a 2D/3D model does not produce a gain of insight into the underlying information - it should be considered worthless.**

In this contribution we wish to conclude by presenting examples showing where architectural representation and information visualisation have met in past practices, and can still meet. E.R Tufte's *layering and separation* (Tufte, 1990) in graphic design gives us here a good thematic frame.
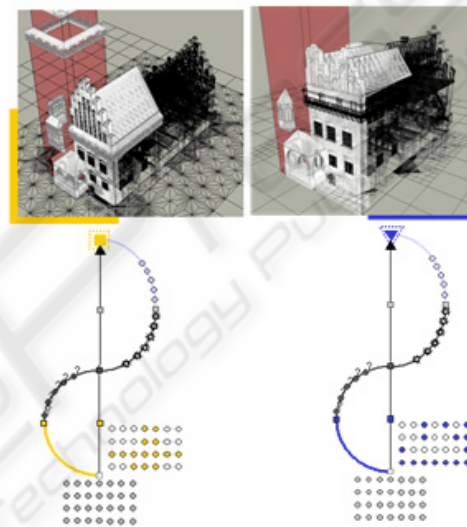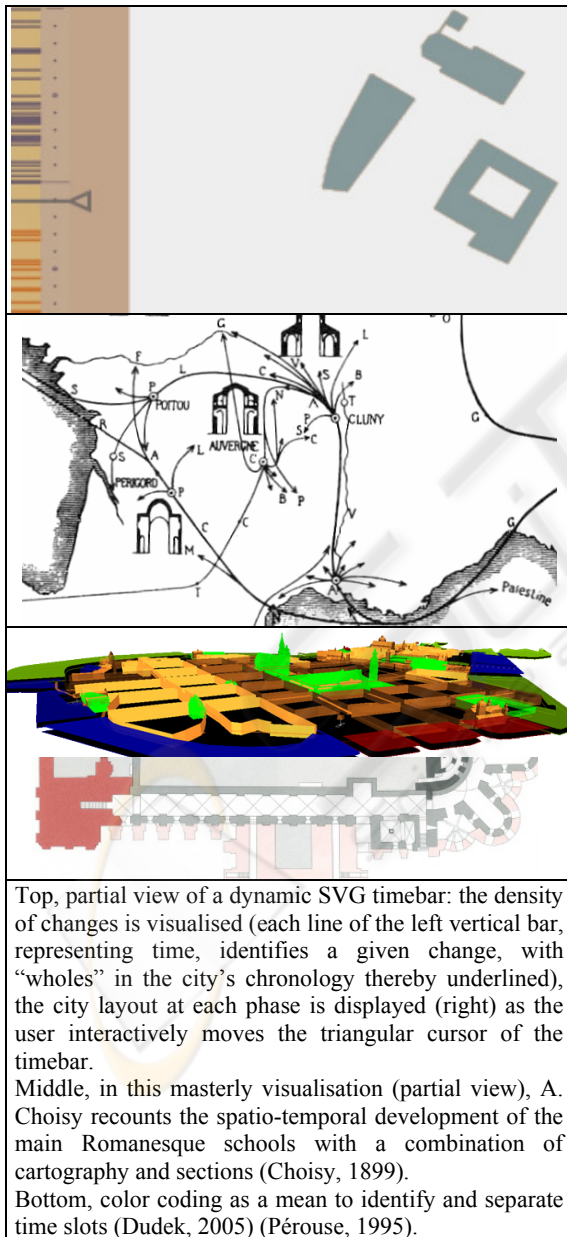

Figure 3: An illustration of rule Number 2: "*The representation of an object will allow the user to retrieve data and information that justify the presence of the object at the time and date the representation shows.*" From various information sub-sets various layouts can be derived (note transparency/color coding for uncertainty handling). Shown here three layouts corresponding to three selections inside the information set on Kraków's old town hall. (from the left to right : reconstructions by F. Christ (1950) and A. Essenwein (1869), survey by S. Von Livonegg (1802)).

4 VISUAL STRATIFICATION

Due to the complexity and heterogeneity of related information sets, visualising evidences about artefacts – through 2D/3D models – can end up in confusion and disorder. Interfacing the information sets hereby raises a new methodological issue: operating selections and stratification in order to lighten the cognitive effort. In the field of information visualisation, E.R. Tufte (Tufte, 1990) acknowledges the importance of this information

stratification step (prior to the making of a representation) in those words: "[...] *among the most powerful devices for reducing noise and enriching the content of displays is the technique of layering and separation* [...]". Today's tools provide technical possibilities for layering and separating information, but give no hints on how to perform the selection itself with regards to the specificity of the information and/or of the geometric objects in charge of localising the information. We propose in the tables below one example (time handling) of how *layering and separation* contributes to widen graphic design options in our field of application.

Top, partial view of a dynamic SVG timebar: the density of changes is visualised (each line of the left vertical bar, representing time, identifies a given change, with "wholes" in the city's chronology thereby underlined), the city layout at each phase is displayed (right) as the user interactively moves the triangular cursor of the timebar.
Middle, in this masterly visualisation (partial view), A. Choisy recounts the spatio-temporal development of the main Romanesque schools with a combination of cartography and sections (Choisy, 1899).
Bottom, color coding as a mean to identify and separate time slots (Dudek, 2005) (Pérouse, 1995).

5 CONCLUSIONS

Among specialists of historic architecture, computer graphics, and VR in particular, are naturally considered as seducing, but also often needlessly verbose and assertive, and vain in terms of scientific result. We believe this view may change provided that we put methodological issues first. And our claim is that a good way to do so is to integrate concerns stemming from the field of information visualisation in the practice of architectural representation.

REFERENCES

Alkhoven, P, 2006. Less is more. Visual truth and the benefits of abstraction in 3D representations of buildings. *In Proc. MIA 2006, Mia journal vol0 n°1.*

Ando, M., Networked VR for virtual heritage, *in HCI International 2003 - vol. 3,* LEA publishers.

Bertin, J.; *Sémiologie graphique,* EHESS 1967/1998.

Choisy, A., 1899-1991 *(History of architecture) Histoire de l 'Architecture* Inter-Livres.

De Luca L, Véron, P, Florenzano, M, 2005. "Reverse engineering of architectural buildings based on a hybrid modelling approach", *Computers & Graphics. Vol. 30.*

Dudek I., Blaise, J.Y., 2005. From artefact representation to information visualisation: genesis of informative modelling In *LNCS Volume 3638/2005, Proc SmartGraphics 2005.*

Dudek I., Blaise, J.Y., 2007. *Informative modelling* Mia journal vol1S

Friendly, M, 1999. Re-visions of Minard *in Statistical computing and graphics newsletter vol 11, n° 1.*

Kienreich, W., 2006. Information and Knowledge Visualisation: an oblique view *MIA Journal Vol0 n°.1.*

Lecuyot, G, 2004. *La restitution 3D de la ville d'Aï Khanoum* in journal CNRS n°178

Lerma, J.L, Vidal, J, Portalés, C, 2004. *Three dimensional city model visualisation for real-time guided museum tours* The photogrammetric record 19(108).

MHK (Muzeum Historyczne Miasta Krakowa), 2007, Civitas Nostra Cracoviensis, A.D.1650 *CD Rom*

Perkins, A. 2003 The Cone Sisters' Apartments: Creating A Real-Time, Interactive Virtual Tour *in Proc. ICHIM 03 Paris France.*

Pérouse de Montclos, J.M, 1995, (Ed*.) Le guide du Patrimoine – Centre Val de Loire.* Hachette.

Spence, R., *Information vizualisation.* Addison Wesley ACM Press 2001

Tajchman J., 1989. *Stropy drewniane w polsce. Propozyca systematyki* Ośrodek dokumentacji zabytków.

Tufte, E. R. 1990. *Envisioning information,* Graphic Press, Cheshire, Connecticut