Descriptive Geometry and Computer Graphics: Towards the Formulation of an Algorithmic Thinking of Graphic Action

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Abstract

The cultural heritage embodied in the discipline of descriptive geometry – combining scientific knowledge, technical and artistic skillfulness – is today neglected through the increased use of digital drawing tools. By conducting a study of the old and the new, the research project seeks to integrate the inherited graphical methods of descriptive geometry into contemporary design tools, not to revive bygone days but to arrange an encounter between times and generations in the continuous transformation of the "mediating artifacts" invented by architects to realize significant architecture.

By taking the discipline of descriptive geometry and computer graphics as joint study objects, the research focuses on the possible relations between a technique of graphical representation, still considered at present as a fundamental branch of architecture, and the digital tools through which the contemporary architectural practice is evolving. The increasing use of "infography" – i.e. the association of information science and graphical representation – within the design practice manifests the architects’ fascination for a tool that excludes in its use the knowledge and methods of descriptive geometry. This "illiteration" of the architectural practice is due to both the intangibility of the algorithmic principles constituent of the computer machine and the increasing demand to eliminate a maximum level of uncertainty in the design process. The research’s objective is thereby to reunite the fundamental principles of drawing, which is the essence of architectural design, with the digital tools of computer graphics in order to challenge infography's inherent tendency to conceal these same principles. This unique method allows us to preserve the cognitive qualities conveyed in descriptive geometry while fully integrating the new potentials of computer tools. The research seeks to enhance the capacity of the architectural discipline to develop its specific graphical techniques, confirming a creative singularity within the architectural design process.

Keywords

Architecture / Architectural Representation / Computer Graphics / History of Science and Technology / Descriptive Geometry / Algorithm
Introduction

By taking the discipline of descriptive geometry and computer graphics as joint study objects, the research contributes to the exploration of possible relations between a technique of graphic representation and the digital tools through which contemporary architectural practice is evolving. The neologism *infography* defines the association of information science with the practice of graphic representation, of which the most common forms are computer programs with visual user-interfaces employed in architecture schools and offices [Estevez, 2011]. These tools can be perceived to be in line with a historical tendency of instrumentalizing architectural representation in order to be operated as an agent of control [Pérez-Gómez, 1983]. Although infography undoubtedly increased the possibility of controlling the conception process, one could observe in parallel the architect's loss of power over the architectural production of which they could no longer claim authorship [Carpo, 2011]. As highlighted by Joël Sakarovitch, today's calculating capacity of computer graphics and modelling tools is substituting scientific knowledge: it imposes on the architect a medium that illiterates its operator, both by obscuring the functioning of the tool itself and by restricting the use of descriptive geometry as a formal language on which the architectural discipline strongly relies. Introduced by its author Gaspard Monge (1746 - 1818) descriptive geometry is the method for “representing on a sheet of paper which has only two dimensions [...] the forms of solid bodies which have three” and to “deduce all the truths resulting both from their forms and respective positions”. A more recent study on descriptive geometry examines it as less of a positive scientific progress formulated by theorems, than as an actual systematization of ancient architectural drawing techniques and stereotomic methods into a corpus of precise graphic operations. Under this light, descriptive geometry is a mathematical theory emerging from artistic concerns and thereby combining scientific rigorousness with the gestures of art. Thus, it is a technique of representation and of design that is placed as a useful counterpoint to infography as it embodies qualities which the later conceals. These are precisely descriptive geometry’s characteristics: to purge the representation of complex forms, to consider the marks of performed operations as an integral part of the image, to enact a constant crossing between a spatial and a planar reasoning, and finally to have a propensity for the materiality of the depicted objects [Sakarovitch, 1998]. The research’s innovation is to reunite and reconnect the essentials of drawing, on which architecture design was founded, and contemporary infographic tools, which however have the tendency to elide those same essentials. The originality of the project is in its actualization, effectively a body of knowledge and methods of spatial-geometric representation incepted at the beginning of the 19th century. Furthermore, it involves a more recent approach towards the history of science, which reconsiders the materiality of its gestures and which is, from an architectural perspective, a compelling bond between art and science [Alunni & Brian, 2002].

Hypothesis, Research Objectives and Envisaged Methodology

The technical intangibility of the infographic tool seems to draw a conceptual limit, implying that its algorithmic essence excludes descriptive geometry as a substantial thinking mode for a
speculative design process. This presumption highlights a dissonance between a creative working method of architectural thinking and the constituent computational principles of the infographic tool. The hypothesis can be explained thus: as a confrontation between infography and the discipline of descriptive geometry, which challenges the canonical boundaries of the infographic tool.

The research will follow an iterative and experimental approach. The two polarities of descriptive geometry and infography will be scrutinized in parallel and put in contiguity through experiments consisting of graphic investigations. In this way, the research project analyses the practice of architectural representation by revolving around two rarely combined axes. The first historic axis reinterprets a traditional knowledge and the second computational axis revisits infographic tools. Thereby, the research aims to study methodologically the discipline of descriptive geometry towards the domains of algorithms and infography.

The first research phase consists of a historical reading of descriptive geometry, reformulated as a technique composed of graphic algorithms – the algorithm is being here conceptually decoupled from the computer machine [Grier, 2013]. The research will address the lessons and the taught applications of the Paris polytechnic school in the 19th century, specifically through the study of the teachers’ manuals and the students' work portfolios present in the related archives in Paris. The second phase consists of exploring the graphic algorithms of descriptive geometry by coding experimental prototypes. The purpose of this is to use the means of computation in order to make them converge with a geometrical language. This unique method allows us to preserve the cognitive qualities conveyed in descriptive geometry while fully integrating the new potentials of computer tools. The third phase is of an architectural action and scrutinizes the previous developed prototypes by integrating them in the context of formal analysis or conception of architectural projects. As highlighted in the previous phases, the focus is on the potential for disrupting and transgressing conventional infographic tools. Currently, these are considered as guarantors of order and coherence in the design process, but nevertheless we observe that they also lead to certain contradictions related to the conceptor. The infographics’ protocol forces the designer to establish his project as a three dimensional numeric model; in other words, as an object of full synthesis. Yet, the prevalent practice favours a bi-dimensional and fragmented representation – best illustrated by the drawings of a plan, section and elevation – and it is precisely these constraining characteristics which enable and enrich the three dimensional understanding of the designed object. That contradiction essentially questions the relationships between formalized functions and improvisational practice, between protocols and transgressions, between technical assistance and emancipation [Estevez, 2017].

Pushing forward the analysis through the study of descriptive geometry, the research explores new graphical representation practices capable of strengthening contradictory tensions in order to empower the architect’s capacity to graphically “associate and dissociate” his object by the means of genuine infographic tools [Rancière, 2008].
**Expected Outcomes**

The research project positions itself within the domain of the history of science and technology and contributes to what can best be called an epistemology of architectural techniques. The ongoing interrogation about the position of the computer within design practice has in its recent iteration concentrated on the theoretical re-assessment of techniques, with regard to architectural invention [Guillerme, 2008; Simon, 2008].

The study goes even further by not only investigating this factor on a conceptual level but also by conducting experiments by coding drawing-program prototypes, which means to operate the computer accurately – as a tool – while having the architectural discipline as a focal point. By challenging our relationship towards the tools we manipulate, the long run of the project will contribute to a meaningful creation – or reappropriation – of computer programs, which does not hide the complexities and (artistic) choices of drawing, thereby robbing the profession’s practitioners of the traditional knowledge in the field, but rather by retaining the important advantages of such programs.
Bibliography