Chapter 12


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ABSTRACT

This chapter critically analyses free-form generative parametric design techniques to evaluate the effectiveness of VPL (Visual Programming Language) systems, applied to existing high-geometric/formal complexity artefacts. The paneling of the South facade of the Institut du Monde Arabe (IMA) in Paris, designed by J. Nouvel, was chosen as a case history. This is to examine how through a complex kinematic modelling, the sunshine of indoor environments can be effectively controlled. The chapter focuses on reproduction, through reverse engineering techniques of the façade-type panel, through the most widely-used VPL platforms that determine algorithmic relationships. The generative parametric algorithms developed for the IMA Moucharabieh, indicate that identical rules can govern different geometries; in contrast, identical geometries can arise from completely different algorithmic formulae. Finally, the integration with the most widely-used BIM applications, is used to critically evaluate interoperable workflows.

INTRODUCTION

In the famous Parametricism as Style - Parametricist Manifesto, presented at the Venice Biennale in 2008, Patrick Schumacher [1] supports parametric design in all its forms, arguing that it is, by now, “…penetrating into all corners of the discipline. Systematic, adaptive variation, continuous differentiation

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(rather than mere variety), and dynamic, parametric figuration concerns all design tasks, from urbanism to the level of tectonic detail, interior furnishings, and the world of products…” (Schumacher, 2011). A few years ago, we looked with great interest and curiosity to parametric architecture, designed by the architect as a new global style, and characterised by a strong softening of the project in which there exist many correspondents between measures and context. Each instance can be associated or related to any other property for each element of the project.

Doing this established a cause/effect system, in which, everything is related. Thus, it is easy to imagine linear processes, translating these innovations. Starting from an abstract formulation of the project, and then, continuing the development of a number of automation, the system will gradually generate details according to the parametric components’ logic.

Before going into parametric design, by critically analysing both form and morphogenesis of an exemplary case study of contemporary architecture, it is necessary to quickly trace some essential steps that strongly address the generic approaches. This is based on a set of rules, that in the past could not be systemised with the help of a personal computer.

In order to trace a brief history of the relationship between the body and the built environment, it is important to first mention the work of Alexander Klein and several other German functionalist architects. At the beginning of the 1900s: researchers started with the standard dimensions of the human body and, after establishing the room needed for movement and the performance of the principal motor and occupational activities, concluded with a hypothesis of the minimum spatial configuration for environments. In this context, the “modulor” designed by Le Corbusier, represents the summary of knowledge of arithmetic (from irrational numbers to the Fibonacci series), geometry, ergonomics, and anthropometrics.

The wish to give rigor to form generation is the main reason of the initiative taken in the post-war period by Luigi Moretti (Moretti, 1971), who, together with Professor Bruno de Finetti, founded the Institute for Mathematical Operative Research in Architecture and Urban Design (IRMOU). That was the official starting point of the research around the subject of Parametric Architecture defined at the time. At the architectural scale, the group produced designs of stadium for soccer, tennis, swimming or movie theatres, that all followed a similar procedure. The research group starts from an analysis of the topic, that is then followed by the formulation of the needs, as geometrical relations between the quantities defined as parameters. The definition of the actual form of a seating layout, for instance, is driven by the interaction between the data that help draw lines defined as “visual equi appetibility” (Figure 1).

In the study done by the authors, the variation of the relations between the parameters (i.e., the maximum angle of the diagonal, vertical, or horizontal views, the perimeter of the most interesting areas on the field, and the distances) generated not one but several solutions. However, his aim in establishing the Parametric Architecture method was to avoid what he called the “empiricist approach” to design, popular and common among architects of its time (Lo Turco, 2012). As the research progressed, the group started to use the first computers, bringing work onto the scene that can be seen as a pioneer of today’s parametric design software (Moretti, 2000).

At the same time, between the 1960s and 1970s, the architect and mathematician Christopher Alexander, performed detailed investigations into “functional requirements”, investigating to the finest degree of detail possible. The consequence was a lattice structure with branching possibilities, and a reciprocal give and take, in which – with the help of the first computers – knowledgeable choices could be processed. In agreement with this approach, the object model, therefore, became a performance model (Saggio, 2007).

On the contrary, the studies of Sergio Musmeci are characterised by a different approach. Though tending to the same goal of offering more performative solutions, his research field was related to forces...