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Basics of Parametric thinking and workflow

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Abstract - There was been a rapid technology advancement in all fields after that 20th century thus architecture needs to use advance design forming technology to improve and detail out the aspects of design efficiently therefore Parametric Design is a set of parameters provided by the site converted into an algorithm which a computer software then create a responsive design that can be tweaked to the designer's requirement and Fluidity is a state of being unsettled or a form that is smooth and creates a sense of motion. Patrik Schumacher, who at the time was a partner at Zaha Hadid Architects, coined the term 'parametricism'. Parametric design has particularly rebelled against long-established guidelines. Due to the idea that "form follows function", modern architecture is more of a science than an art form, which creates a monotonous skyline with straight lines and box shapes. Parametricism, on the other hand, focuses on free-form architectural concepts. Sweeping lines, curves, and irregular shapes give each building character. Such designs might appear futuristic or otherworldly. In the study, I aimed to understand and apply parametric as a design tool, as well as learn about parametric design thinking Computer aided Geometric design, and methods for applying parametric in different fields of design.

Keywords - parametric design, research methods, digital design, computer aided design, design automation,architectural design, software design

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INTRODUCTION

Parametric design is growing as a separate and unique design concept, rather than just another tool for modelling complicated structures. The formation of parametric design theories is influenced by both research and practise in parametric design, which is now experiencing a reformulation and epistemological change. Parallel to this, the evolution of existing parametric design tools and techniques is beginning to influence parametric design thinking (PDT). Under the influence of a new generation of scripting languages and techniques (Burry, 2011), relational topological schema, associative geometries, and re-editing processes (Woodbury, 2010; Jabi, 2013), and computational process models of digital design, current parametric design systems are adapting to changing context (Oxman, 2006). The purpose of an architectural research is to simplify the practice in digestible sizes for uses who are non-related to construction or architecture. This paper will highlight on topics of parametric design thinking, Computer aided Geometric design and to do architectural case studies on types and forms of differentiation patterns in PDT

MATERIAL AND METHODS

Literature review, impediments and issues, and recommendations are the three parts of the study's methodology. We need to understand the basis of what parameter design thinking and aspects design thinking is create a concrete understanding of why parametric as a concept is unique and advance to other design modelling tool because a form generated virtually and visible is much more efficient than thinking of a form and solving the issues with our cognitive skills does have users to create more complex working design efficiently.

PARAMETER DESIGN THINKING

Parameter design thinking (PDT) and the definition of the concept and principles in design can be defined by the intersection of the three-principle illustrated in (fig 1). The three major components are 1. Parametric models to understand algorithm, 2. Cognitive models to architecture workflow and 3. Computation models of how different software provide certain computational functions. This article explains the advantages of form for design through parameter thinking inspired from the computation and design group of Zaha Hadid Architects. There would be detailed explanation on cognitive modelling and information processing in further.

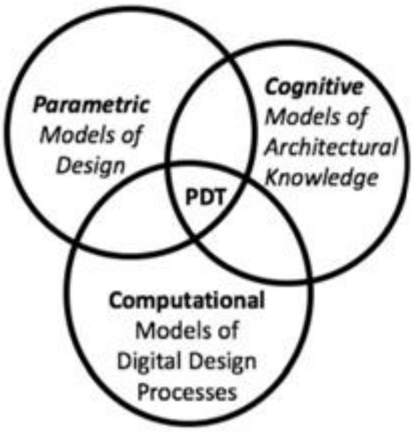

Figure 1: Diagram of intersecting fields of research in PDT

COGNITIVE MODEL: DARWINISM IN DESIGN

Philosopher Daniel Dennett explain the Darwinian Evolutionary model that is from evolution is creation that is every new creation there is a essence or a part of its predecessor which it evolved from known as the mimetic approach exposed by Richard Dawkin (in his book The Selfish Gene). In compared to the fields of architecture as no form is created by itself but evolved from a point to a curve to become a shape which then has depth to become a form. Daniel Dennett compare nonlinear, slow, uncertain Darwinian Evolutionary model to rigid talk to bottom definitive design process specifically such similar examples provided in fig 2 and fig 3.

Figure 2: Comparison of a termite mound (left) versus that of Antonio Gaudi's Sagrada Familia (Right). Images: courtesy of Zaha Hadid Architects

Figure 3: Comparison of a limestone outcrops from great lakes region (left) versus that of Studio Gang's Aqua Tower (Right). Images: courtesy of Zaha Hadid Architects

The acceptance of a cognitive model or a communal understanding of the activity everyone is engaging in helps enormously in projects and research strands where numerous authors contribute. In addition, as the project progresses, such a model naturally leads to the development of a genetic tree of ideas, forms, and processes (Fig 4). Because practically all digital information generated is directly governed by a handful of parameters, recurring instructions and operations, the computational medium is intrinsically well adapted for such an evolutionary process (Fig 5). Even if the forms are made'manually,' this is true (Fig 6). As a result, one of the most important characteristics of such a cognitive model is that the iterative design process must incorporate and balance both exploratory and exploitative stages - a characteristic that this cognitive model possesses. This is true even if the forms are created "manually" (Fig 6). As a result, one of the most important features of such a cognitive model is that the iterative design process must incorporate and balance both exploratory and exploitative stages - a characteristic that is typically seen in effective algorithms based on biological evolution (Crepinsek, Liu, & Mernik, 2013). The reason for this is that an insufficiently broad search increases the chances of missing better solutions, while an insufficiently active optimization of competing solutions can also lead to sub-optimal results. While the precise timing of transitioning from exploratory to exploitative mode is a function of experience and available time, the cognitive model allows the design team to recognise the need and predict the transition.

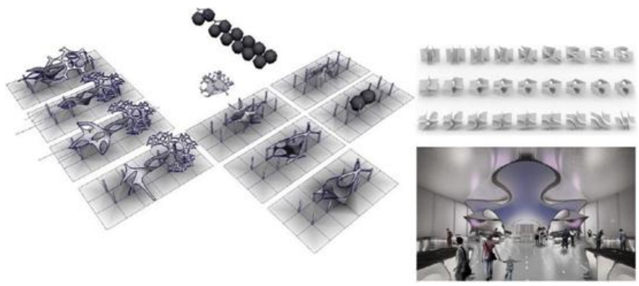

Figure 4: Darwinism in design Left Exploratory search of topological variations Right-Top Exploitative, parametric search of topological variations. Right Bottom submitted design. Images: courtesy of Zaha Hadid Architects

Figure 5: Directed Search of solution space Top exploratory search and exploited, refined option for Volu Bottom exploratory search and exploited, refined option for the Mathematics gallery project. Images: courtesy of Zaha Hadid Architects and exploited, refined option for the Mathematics gallery project. Images: courtesy of Zaha Hadid Architects

DESIGN METHOD: DIRECTED SEARCH OF DESIGN-SPACE

The cognitive model's natural design technique can be thought of as a directed search of design space. A guided search looks for a solution that is efficient in design and manufacture, as well as harmonious for human habitation, among all conceivable possibilities. Until recently, the study of architecture's societal purpose was left to the designers' accumulated intuition: an intuition to "reproduce social circumstances in the architectural form," as Hillier and Hanson (1989) put it.

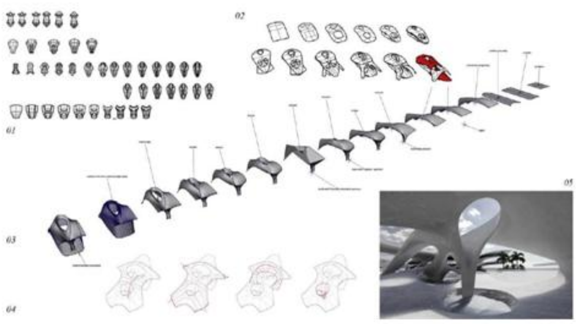

Figure 6: Searching the solution space with a certain goal in mind. 01 A phylogenetic tree of designpossibilities 02, 03 A set of geometric procedures thatmay be used to combine alternatives. 04 Structural Behavioral heuristics 05 A solution that has been synthesised.

Images: courtesy of Zaha Hadid Architects and BlockResearch Group

COMPUTER AIDED GEOMETRIC DESIGN

In architectural design, computational representations of things can be divided into two paradigms: drawing-based and model-based. Computer Aided Design (CAD) is the drawing paradigm, whereas Building Information Modelling is the model paradigm (BIM). Each is based on Ivan Sutherland's (Sutherland, 1964, pp. 6e329) and Charles Eastman's key work (Eastman, 1975). Drawings and models both represent 2D and 3D geometry. A model, on the other hand, incorporates meta-information about the encoded geometry, such as material specifications, involvement in assembly processes, and so on. The drawing paradigm, particularly Computer Aided Geometric Design (CAGD), on the other hand, can facilitate the production of a wider range of arbitrarily complex geometries, as well as its processing for Computer A

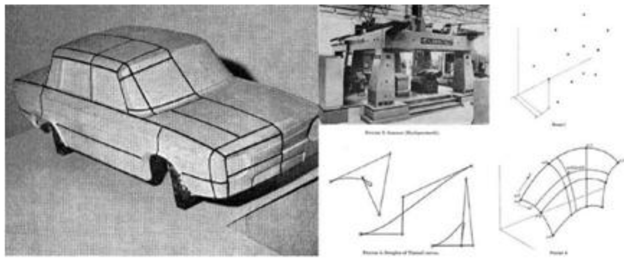

Figure 7: Computer-Aided Geometric Design is a term that refers to the use of a computer to Columns on the left and middle: Mark-upon clay master, 3D scanning, numerical input of points, and development of curve networks were all part of the digital reconstruction process of a master mould utilising the Unisurf CAD system, which wasin use at Renault Car Company circa 1970. Right column - British Aircraft Company uses a similar technique (images left and middle from e (Bezier, 1971). (Sabin, 1971) is the source for the right column

CASE STUDY

Gallery for mathematics, Science Museum London

The geometry and materialisation of the gallery's major organising aspects are the product of both practical cross-disciplinary knowledge transfer and a lineage of fabric constructions that ZHA has previously created. Frei Otto, a pioneering architect-engineer, explored the geometry of these structures, known as minimum surfaces. Physically, he investigated them as soap-films that develop against a wire border. These geometries have also been mathematically investigated (Brakke, 1992). The Force density approach (Schek, 1974) and the Dynamic relaxation method are commonly used in their computational creation or form-finding process. (Day, 1965). Research institutes such as Block Research Group (Adriaenssens, Block, Veenendaal, & Williams, 2014) and University of Bath (Bak, Shepherd, & Richens, 2012; Williams, 1986) have made these foundational methodologies more accessible to architects and engineers alike. Several architectural and engineering firms have researched its architectural materialisation as stretched cable and cloth shapes. Prior notable instances include Frei Otto's landmark Munich stadium, the temporary Serpentine Pavilion in London, the Magazine restaurant in London, Zaha Hadid Architects' interactive Parametric Space exhibit in Copenhagen, and so on. As a result, the gallery's most recent expression of such structures is the outcome of a lengthy history of preceding experience and historically assimilated and transmitted study (Fig. 8).

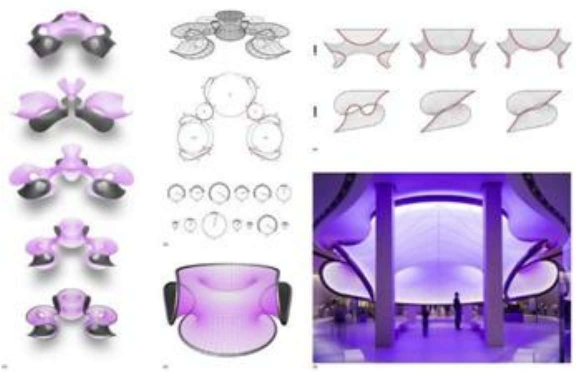

Figure 8: The mathematics gallery has eight fabric constructions. 01 A rapid CAGD methodology allows forseveral design revisions. 02 The edge-pipes might be bent physicallythanks to bespoke CAGD equipment. 03 Layout of seams (in collaborations with Base Structures and Mark White). 04 CAGD and Engineered Geometries are compared. 05 The structure has been completed. (Photo credit: Zaha Hadid Architects

In addition, the gallery contains a number of 'pause' points, including fourteen seats made of cast, ultra-high-performance concrete. Methods of Descriptive geometry, research in the related but more complex geometries of Curved-crease folding, and collaboration with a state-of-the-art robotic company specialising in hot-wire-cutting of foam (McGee, Feringa, & Sndergaard, 2013) to produce the moulds for the cast concrete benefitted the shape and physical production of this furniture (Fig. 9).

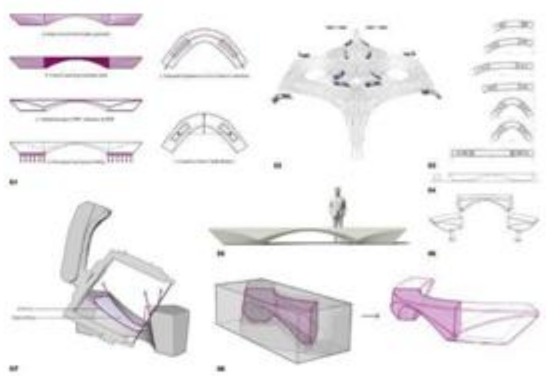

Figure 9: Designing using governed surfaces and cutting objects with a robotic hot-wire cutter 01 In CAGD, use ruled surfaces to determine the geometry. 03, 04, 06 Using abespoke BIM tool, design development, drawings, schedule, and so on. 02, 05 CG pictures of all the benches as well as a single person. 07, 08 Ruled geometry hot-wire cutting by robot. (Photo credit: Zaha Hadid Architects)

CONCLUSION

The essay emphasised the need of following a research programme in architectural design and practise, rather than improvising answers to design problems (Lakatos, 1978). Imre Lakatos, a philosopher of mathematics and science, used the phrase "research programme" in both pragmatic and philosophical senses. Furthermore, case stories were used to illustrate the three parts of parametric design thinking. The case studies themselves demonstrated how these characteristics enable a dense network of cumulative, collaborative research including academic institutions, professional businesses, and embedded research groups to successfully execute architectural ideas. To put it another way, the accumulated research is allowing the guided project to succeed. In other words the cumulative research is enabling a successful outcome to the directed search of design-space.

As a result, there are two advantages to adopting a study plan. It may be mentioned here that, as trivially evident as both elements would seem, it is far from de facto in current architectural practise. On the one hand, integrating practice-based research with established research pathways allows practitioners to concentrate their efforts on the social consequences of the built environment, which have gotten very little attention from designers despite their relevance and influence (Hillier & Hanson, 1989). The design of the mathematics gallery provides early evidence of this (Fig. 10). Furthermore, the researchers benefit from this alignment since their work may be inspired by and assessed against its implementation in the field.

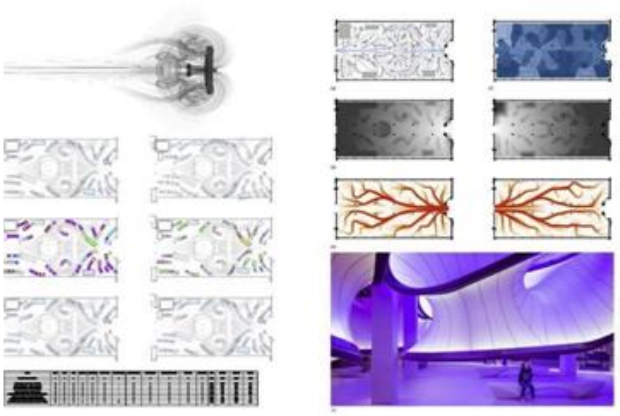

Figure 10: A computational approach to user navigation, occupation and ergonomics. 01 Concept diagram of air-flow around the aeroplane. 01, 02, 03, 04 Data driven approach to accommodate layout changesper curatorial vision and other constraints.05 Snippet of the detailed list of 130 objects. 05e09 Bespoke tools to analyse user, navigation and dwell experience 10 View of the gallery. (Images: courtesy Zaha Hadid Architects)

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