POLITECNICO DI TORINO
Repository ISTITUZIONALE

Rethinking Architecture in the Digital Age: From Parametric Design Thinking to Philosophical Perspectives

Original
Rethinking Architecture in the Digital Age: From Parametric Design Thinking to Philosophical Perspectives / Wu, H. (SPRINGER SERIES IN DESIGN AND INNOVATION). - In: School of Architecture(s) - New Frontiers of Architectural EducationSTAMPA. - Cham : Springer Nature Switzerland, 2025. - ISBN 9783031719592. - pp. 306-313 [10.1007/978-3-031-71959-2_33]

Availability:
This version is available at: 11583/2993493 since: 2024-10-24T12:53:44Z

Publisher:
Springer Nature Switzerland

Published
DOI:10.1007/978-3-031-71959-2_33

Terms of use:

This article is made available under terms and conditions as specified in the corresponding bibliographic description in the repository

Publisher copyright

(Article begins on next page)

08 November 2026

Rethinking Architecture in the Digital Age: From Parametric Design Thinking to Philosophical Perspectives

Hongye Wu(✉)

Department of Architecture and Design (DAD), Politecnico di Torino, Viale Mattioli 39, 10125 Turin, Italy
hongye.wu@polito.it

Abstract. We are currently living in an age where the advancement of digital technologies has been rapidly progressing. Simultaneously, the digital avant-garde has been flourishing in the field of architecture for decades. The emergence of design thinking has been significant in this era, especially with the rise of parametric design thinking in contemporary discourse due to the advancements in digital technology. In this context, particular attention is given to parametric design thinking in this paper, with a specific focus on the current trend and the concept of "social performativity". Moreover, the current tasks in architecture are more challenging in dealing with its relationship with social diversity and even conflicts. Hence, this contribution questions the positionality of architecture in multiple interactions and explores the state and impact of architecture in the digital age, considering both material and immaterial aspects. To investigate this, the study unfolds philosophical perspectives on the relationship between humans and space by expounding on several fundamental ideas from Taoism and the philosophy of Martin Heidegger. The study's results contribute to a deeper comprehension of the relationship between humans and space, shedding light on both the potential and the complexities inherent in architecture within the realm of parametric design in the digital age.

Keywords: Architecture · Parametric Design Thinking · Philosophy · Space

1 Introduction

We are living in the digital age where the digital technology is playing a much more important role. This is an age where the digital avant-garde has been blooming for almost three decades in the practice of the architectural discipline. This is an age when the inevitable march of digital technologies has increasingly gained momentum, whereas it is also even more challenging for architects and researchers to tackle their roles in this tendency. Nowadays, the tasks in architecture are more demanding on dealing the relationship with social diversity and even conflicts, which are becoming more and more complex. In responding to the call of EAAE Annual Conference 2023 "not just Architecture but Architecture(s)" in terms of the interdisciplinary dimension of architecture,

© The Author(s) 2025
M. Barosio et al. (Eds.): EAAE AC 2023, SSDI 47, pp. 306–313, 2025.
https://doi.org/10.1007/978-3-031-71959-2_33

meaning that it is time to reflect the positionality of today's architecture, the paper comes up with the question "what is the state and impact of 'architecture' in our digital age?".

In parallel with the development of digital technology, the model of design thinking has transitioned from cognitive models to computational models to the model of parametric design thinking [1]. In this light, parametric design thinking has been given particular attention in this paper. However, can parametric design approach respond to the demands of contemporary social challenges? Consequently, the current work tends to revive the self-consciousness and self-reflection of architecture, by drawing on Patrik Schumacher's idea of architecture's "social performativity" as well as the well-known "parametricism".

Furthermore, from sociological aspect, architecture is not only about inhabiting people physically but also inhabiting the full sense of people whoever involved in. Wherever social activities take place, there is a sort of architectural and urban spaces, that is to say, space is always connected with society and people. Hence, another purpose is to reflect on the relationship between human experiences and the physical environment, by turning back to the fundamental ideas in the field of philosophy. This involves seeking philosophical engagement in architecture, focusing not only on the materiality but also on the immateriality.

2 Parametric Design Thinking

2.1 State of the Art: Parametric Design Thinking

Parametric design thinking, the earliest could be traced to 1st century BC and the medieval age. Mario Carpo emphasizes that there was a class of objects defined by generative rules mathematically, because some of Vitruvius' rules were like "procedural algorithm" what we would call today [2]. Parametric design thinking can be found in the work of Antoni Gaudí. Gaudí used to design by his exacting use of geometry and had a revolution on the fusion of intersecting hyperbolic paraboloids with hyperboloids. In this sense, his design was parametrically variable, flexible architectural design [3]. For Patrik Schumacher, Frei Otto is the only true precursor of parametricism, who applied physical processes as a design engine and simulations to find out forms rather than to draw invented forms [4]. Until then, parametric thinking is a logical approach on design regardless of the aid of digital techniques. The Italian architect Luigi Moretti was probably the first who conducted the approach of parametric thinking in architectural design and created three-dimensional architectural form using a complex set of parametric relationships resolved by digital computation. Moretti also coined the term "Architettura Parametrica (Parametric Architecture)" in the 1940s [5].

Nowadays, the explosion of parametric design trend in the field of architectural design is highly related to the aid of the widespread use of parametric modelling techniques and software. As a matter of fact, in the digital age the advanced computational techniques not only empower designers' abilities to realize but also arouse their ideas by simulating endless potential solutions and overcoming the constrains in the simulation of complex forms and patterns in the earlier age. In the recent fifteen to twenty years, parametric design approach has become a more attractive topic in architectural

design and research, especially when Patrik Schumacher, architect, and architectural theorist, unleashed "parametricism" to the world, at the Dark Side Club, 11th Architecture Biennale, Venice (2008), which can be seen as an avant-garde architecture and design movement [6]. Since then, parametric design became more and more fashionable.

2.2 The Social Performativity of Parametricism

The concept of social performativity in parametric design emphasizes the importance of considering the social functionality and performance of architectural designs. Patrik Schumacher, the proponent of parametricism, argues that the movement should shift its focus from foregrounding formal principles and design processes to the foregrounding of design research that is more strategic, applied, and performance-oriented, with a strong emphasis on social performativity [7]. This involves simulating the social functionality in design as a key aspect of architectural design. The performative design strategies in architecture also highlight the importance of considering social, environmental, and economic performances in the design process [2]. Parametric modeling is seen as a tool that allows for the streamlined testing of different values for variables, which can contribute to the consideration of social performance in design [8].

Patrik Schumacher calls Parametricism as a new style, which is "architecture's answer to contemporary, computationally empowered civilisation, and is the only architectural style that can take full advantage of the computational revolution that now drives all domains of society" [9]. In 2016, "Parametricism 2.0" as a "self-critical redirection" was relaunched, aiming to reverse the increasing marginalisation of Parametricism. Schumacher argues about "anti-icon polemic" and "neo-rationalism" in his article. For him, the anti-icon polemic misunderstands that "parametricism" as an architectural new style that is rigorously developed on the basis of radically new, innovative principles becomes conspicuous by default rather than by intention. "Both the anti-icon camp and the neo-rationalist camp fail to understand that urban and architectural complexity are called for by the new societal complexity" [9]. Schumacher states that "Parametricism 2.0" not only covers up various infrastructural, economic and environmental parameters, but offers the promises of social functionality [7, 9, 10]. He points out parametriscism's obvious superiority, in terms of the build environment, is "social functionality" rather than technical functionality. "The built forms are not speaking their structural performance (which is of no interest to users) but about their social purposes, and this communication facilitates these very purposes" [7].

To face the increasing societal complexity, Schumacher emphasizes the importance of the supporting from new methodology and tools. With the concern of this, the design approach has shifted from foregrounding formal principle and design processes to "more strategic, applied and performance oriented, with a strong emphasis on social performativity [7, 10]". Moreover, Schumacher and his group worked on this enhanced capacity—social performativity by semiologically empowered life-process simulations [7]. Therefore, the computational capacity of parametric modelling today would suggest a more potent opportunity for parametric design thinking to integrate with the societal complexity by ongoing research and practice.

2.3 Possible Social Impact Through Parametric Design Approach

In terms of social impact, parametric design can influence architecture by enabling the creation of innovative and sustainable buildings that reflect the values and culture of a city and its inhabitants [11]. Schumacher introduces the concept of design processes using evolutionary algorithms and agent-based life-process simulations with social interaction frequencies as success measures to optimize social functionality [7, 12]. This research, conducted at the University of Applied Arts and Zaha Hadid Architects, aims to expand the formal repertoire available to architects, leading to better design solutions [12]. In this study, Schumacher discusses the possibility of applying scientific methods to architectural design through simulations of social functionality. By simulating a design's social functionality, parametric design can contribute to a more performance-oriented approach in architecture, considering factors such as user interaction, urban setting integration, and spatial-social relationships [12]. The simulation process allows for the assessment of a design's social performance relative to alternative options, emphasizing the importance of understanding how occupants interact with parametric-based spaces and their impact on the built environment [12].

3 The Relationship Between Human and Space

In the digital age, the implications of digital technologies on human perception and the blurring of boundaries between the physical and digital worlds, have led to a reevaluation of architectural materiality and subjectivity [13]. This shift involves a renewed focus on environmental factors, as well as a redefinition of the human experience in the built environment [13]. In this context, Antoine Picon emphasizes the disconnect between digital avant-gardes and environmental concerns, highlighting the need to integrate the two domains for a more holistic approach to architecture [13]. Consider how parametric approach can be used to respond to socio-cultural contexts and diverse human experiences and how designers can employ parametric strategies to create spaces that reflect the values, traditions, and identities of different communities, thereby, it is essential to foster a sense of belonging and cultural continuity.

3.1 The Perspectives from Taoism and Heideggerian

Derived by Martin Heidegger's essay *Building, Dwelling, Thinking,* published in 1951, which centers on the question"what is the state of dwelling in our precarious age?", this paper questions "what is the state and impact of 'architecture' in our digital age?" Heidegger defines dwelling as more than just a physical structure, a place to live. Dwelling is an essential aspect of human existence and involves a deep relationship between humans and the world around them. In Heideggerian philosophy of dwelling, the "fourfold" refers to the interdependent relationship between the four fundamental elements of being-in-the-world: earth, sky, divinities, and mortals. Heidegger argues that these elements are not separate entities but are inseparable and interconnected, forming a holistic understanding of being and dwelling [14]. However, Heidegger did not originate with the idea of contemplating the relationship between humans and the world. One

might encounter a comparable notion in the *Tao Te Ching*, a seminal work of Daoism, established by the Chinese philosopher Lao-tzu but written down by later generations. In Taoism, four elements are human, earth, heaven, and Tao, following a fundamental principle: "Human follows the earth, the earth follows heaven, heaven follows Tao, and Tao follows nature [15]". This principle emphasizes the importance of living in harmony with nature and following the natural order of things. By following the rules of nature, one can achieve balance and peace in life. Moreover, it suggests that everything in the universe is interconnected and should be respected and treated with care. In essence, this phrase encourages people to live in harmony with nature and to respect the natural world around them. The importance of the relationship between human and external space in terms of nature, has been addressed both in Taoism and Heidegger's fourfold.

3.2 The "Bridge": a Symbolic Connection Between Human and Space

In the essay *Building, Dwelling, Thinking*, "bridge" is well explicated by Heidegger as more than a location but a symbol that connects both material and immaterial things. Thus "bridge" answers to the question "what is the relation between human and space?" In Heidegger's words, the bridge is "about the relationship between location and space, but also about the relation of humans and space… The bridge is a thing of this kind. The location lets the simple onefold of earth and sky, of the divinities and the mortals, into a site by erecting the site in spaces" [14]. He argues that a bridge serves as a symbolic connection between human and space. This notion resonates deeply within Chinese culture, where the concept of the lounge bridge embodies such philosophical depth.

Originating from the Song Dynasty, the lounge bridge or arched wooden lounge bridge *木拱廊桥*, with its special form, served as more than a mere crossing point. In Zhejiang and Fujian provinces, the lounge bridge is a specific type of arched wooden bridge covered with a roof, and in some cases is also covered with wooden shadow claddings from top to bottom. Initially, the lounge bridge was designed to host and rest people who had to travel in mountains for long days in the past, while also serving as a temporary shelter from harsh weather conditions. Often, the timber structural elements of the lounge bridge, like beams and pillars, are frequently adorned with paintings and poems that convey the sentiments and dispositions of the travelers. Nowadays, lounge bridges, suspended between lush greenery on two banks, are still fully functional and present in everyday life. For instance, an ancient lounge bridge located in Zhejiang, China, known as the Lan Xi Lounge Bridge *兰溪桥*(Fig. 1) exemplifies the concept of Heidegger's "bridge" by displaying numerous significant characteristics of a lounge bridge. Specifically, various window opening on the shadow claddings (hand fan-shaped or round) provide aesthetically pleasing frames for the views of the surrounding landscape. The lounge bridge presents both the materiality and immateriality of a space, as well as the relation between humans and the environment, in terms of tectonics, aesthetics, the use of local materials.

Fig. 1. Lan Xi Lounge Bridge, Zhejiang, China, 2023 (Photograph by Hongye Wu)

4 Conclusion and Discussion: Immateriality and Materiality of Architecture in Digital Age

The purpose of bringing Taoism and Heideggerian philosophy together is not to interpret the similarity on their thoughts but to bring out the importance of the relationship between nature and people, between space and people, from different cultures but with the same concern in a sense. The exploration on the question of the interaction between human and space aims to bring up that architecture has a profound impact on emotions, memories, and overall well-being, and should be designed with a deep understanding of human experience. "The architect must act as a composer that orchestrates space into a synchronization for function and beauty through the senses–and how the human body engages space is of prime importance. As the human body moves, sees, smells, touches, hears and even tastes within a space–the architecture comes to life [16]". Consequently, the paper revisits several relevant fundamental ideas from Taoism and Heideggerian philosophy, such as 'dwelling', "fourfold", "bridge" from Martin Heidegger on the one hand, four basic elements from Taoism on the other hand, aiming to reinforce the foundation and reveal the fog for the "architecture" for the future. Heidegger emphasizes that "the spaces, which we go through every day, are made for by locations; whose nature is grounded in things of the type of buildings. If we pay attention to these relationship between location and spaces, between space and space, we gain a clue to help us to think about the relationship between human and space [14]". This is a hint in a way on design thinking and on how to concern about the environment, as well as the relationship between human and its context. Digital architecture has played a significant role in redefining human experience and understanding of the physical world by transforming sensory perceptions, challenging traditional distinctions, and raising questions about the human condition in the digital age [8].

The advanced digital tools enable designers to visualize the design ideas in short time so that designers can better modify, rethink, realize their ideas, by reviewing the result of the variations. In terms of parametric design, generally, it implies that the parameters as key elements and variations in the process of design, architectural design in this case. As Schumacher argued that parametriscism's superiority is "social functionality/performativity" rather than technical functionality [7], Mark Burry suggests that the parametric inputs of architectural design should include multiple parameters, such as "environmental, political, social, cultural, practical, economic, theoretical, philosophical and behavioural parameters", and better to work parametrically across the full gamut of inputs so that there are abundant opportunities to enrich individual practice [3]. This contribution points out that, on the one hand, parametric design thinking has been practicing before the digital age, and on the other hand, parametric design approach in architecture can be both quantitative and qualitative. The advanced value of parametric design thinking, in this sense, is worthy of further exploring and sharing. Here, the purpose is to call for an interdisciplinary design approach, as well as to think differently, from different but interrelated fields. As Rivka Oxman emphasizes that, "parametric design thinking should exist as a shared design paradigm among all specific domains, producing holistic conceptual thinking processes from conception to fabrication. This is a new horizon of theory and pedagogy for the future of design thinking" [1]. In this sense, therefore, the model of parametric design thinking could be seen as a promising approach to future architectural design.

References

1. Rivka, O.: Thinking difference: theories and models of parametric design thinking. Des. Stud. **52**, 4–39 (2017)
2. Carpo, M.: Parametric notations: the birth of the non-standard. Archit. Des. **86**(2), 24–29 (2016)
3. Burry, M.: Antoni Gaudí and Frei Otto: essential precursors to the Parametricism manifesto. Archit. Des. **86**(2), 30–35 (2016)
4. Schumacher, P.: The Autopoiesis of Architecture, Volume I: A New Framework for Architecture. John Wiley & Sons (2011)
5. Davis, D.: A History of Parametric. www.danieldavis.com/a-history-of-parametric/ (2013). Accessed 14 Mar 2023
6. Schumacher, P.: Parametricism Style - Parametricist Manifesto. https://designmanifestos.org/patrik-schumacher-parametricism-as-style-parametricist-manifesto/ (2008) Accessed 13 Mar 2023
7. Schumacher, P.: Parametricism: The next decade. A+ u Archit. Urbanism **595**, 40–47 (2020)
8. De Wilde, P., de Souza, C.B.: Performative design strategies: the synthesis process of a woven complexity. In: Kanaani, M. (ed.) The Routledge Companion to Paradigms of Performativity in Design and Architecture, pp. 403–415. United Kingdom: Routledge, New York (2019)
9. Schumacher, P.: Parametricism 2.0: gearing up to impact the global built environment. Archit. Des. **86**(2), 8–17 (2016)
10. Schumacher, P.: Social performativity: architecture's contribution to societal progress. In: Kanaani, M. (ed.) The Routledge Companion to Paradigms of Performativity in Design and Architecture, pp. 13–31. United Kingdom: Routledge, New York (2019)
11. Gaha, I.S.: Parametric architectural design for a new city identity: materials, environments and new applications. J. Contemp. Urb. Aff. **7**(1), 122–138 (2023)

12. Schumacher, P.: From Intuition to Simulation. Positions: Unfolding Architectural Endeauvors. Edition Angewandte. Birkhaeuser, Basel (2020)
13. Picon, A.: Beyond digital avant-gardes: the materiality of architecture and its impact. Archit. Des. **90**(5), 118–125 (2020)
14. Heidegger, M.: Bauen Wohnen Denken: Vorträge und Aufsätze. Klett-Cotta (2022)
15. Tzu, L.: Tao Te Ching : A New Translation. Shambhala Publications Inc, William Scott Wilson (translator) (2013)
16. Spence, C.: Senses of place: architectural design for the multisensory mind. Cognitive research: principles and implications, **5**(1) (2020)

Open Access This chapter is licensed under the terms of the Creative Commons Attribution 4.0 International License (http://creativecommons.org/licenses/by/4.0/), which permits use, sharing, adaptation, distribution and reproduction in any medium or format, as long as you give appropriate credit to the original author(s) and the source, provide a link to the Creative Commons license and indicate if changes were made.

The images or other third party material in this chapter are included in the chapter's Creative Commons license, unless indicated otherwise in a credit line to the material. If material is not included in the chapter's Creative Commons license and your intended use is not permitted by statutory regulation or exceeds the permitted use, you will need to obtain permission directly from the copyright holder.