Digital anonymity
Human-machine interaction in architectural design

Giuseppe Bono[a], Pilar Maria Guerrieri[b],
[a] The Bartlett School of Architecture, University College London, United Kingdom
[b] Dipartimento di Architettura e Studi Urbani, Politecnico di Milano, Italy

ucbqono@ucl.ac.uk
pilar.guerrieri@gmail.com

Abstract. The paper seeks to define the concept of *digital anonymity*. *Digital anonymity* is defined as the autopoietic condition of architectural design in the digital era, a state in which the combination of decontextualisation and depersonalisation of the design process leads towards emergent and anonymous design results.
Starting from the analysis of principles coming from the architectural world and then extending their definitions to considerations relative to other disciplines, the paper tries to delineate a new ethic of human-machine interaction and integration in the current architectural discipline.
The evidence suggests that *digital anonymity* is the touchstone of an ongoing evolutionary process, which is translating architectural design into its new digital realm.

Keywords: Algorithmic Design; Architecture; Authorship; Creativity; Digital Architecture.

Introduction

The modernity of our era is characterised by the dichotomy between what is real and what is virtual. The traditional design approach based on acquisition and sedimentation of knowledge is now more frequently substituted by algorithms, which can autonomously produce endless variations starting from a given set of data. The debate on mathematical computation and its relationship with human creativity offers the opportunity to reflect deeper on the new autopoietic status of architecture in which design can potentially be reproduced in an independent way compared to human creativity. There are significant cultural implications related to the fact that, nowadays, new software and plug-ins are able to partially substitute human creativity. This shift is changing the profession consistently, the overall built environment, design and production processes as well. The topic is of interest not just for architects, but also for specialists in other disciplines in which ongoing digital progress plays an important role in the production of final results.

This paper seeks to define the concept of *digital anonymity* as the autopoietic condition of contemporary architectural design, a state in which the combination of decontextualisation and depersonalisation of the design process leads towards emergent and anonymous design results. In order to define the concept of *digital anonymity*, the paper critically analyses specific cases, which provide evidence of the ongoing shift from human creativity towards artificial creativity. The examples are taken from three specific areas related to architectural design and the built environment, such as structural design, environmental design and morphogenetic design, i.e., the use of algorithms for structural optimisation and form-finding techniques, environmental building design, and morphogenetic design strategies for material synthesis.

Methodology

The methodology adopted is based, on the one hand, on the selection of the most recent case studies from the most advanced international research centres and, on the other hand, on a critical reinterpretation of historical references, which clarify the transition towards anonymity within the architectural field.

Concerning references, in terms of research centres, the work developed by institutes and laboratories referring to leading universities, such as MIT (Massachusetts Institute of Technology), ETH Zurich (Eidgenössische Technische Hochschule Zürich), UCL (University College London) and University of Stuttgart, is particularly important. In this regard, research groups, such as the Design Computational Lab at The Bartlett School of Architecture (UCL) or the Institute for Computational Design and Construction (ICD) at University of Stuttgart, are research clusters in which the most advanced studies in architecture are conceived and developed. Furthermore, journals such as AD (Architectural Design) and the work done by specialist groups in renowned architectural firms – i.e., ZHACode (Zaha Hadid Architects Code) at Zaha Hadid Architects, and ARD Group (Applied Research + Development Group) at Foster+Partners – are other pivotal references used for the development of this paper.

The digital measure of anonymity

The rise of artificial creativity over human creativity is the first step to take into consideration to understand the digital measure of anonymity. Talking about the primacy of artificiality over humanity means believing in the fact that computers are creative in themselves, and that their creativity is in some way independent from any human input. Although the genesis of artificial creativity lies in the similitude between the human brain and the computational machine (Von Neumann, 1958), the current evolution of computational design is giving life to artificial processes, which have their starting point in human inputs, while at the same time assuming their independence through a level of complexity that only computational calculation can reach. The evolution of Big Data analysis is a clear example of this. Furthermore, the level of novelty created through this computational complexity is unique and independent from the human input. For instance, the work of the British artist Harold Cohen and his pioneering AI system AARON is quite significant in this regard, since the entire concept of computer-generated art gives evidence to the fact that computers can produce unique and unexpected design results from a set of rules created by human beings.

Having specified that the primacy of artificial creativity over human creativity is legitimated by the new level of complexity and novelty, which exclusively belongs to the artificial world, it is more appropriate to say that such primacy is complementary rather than opposite to the human one. In fact, as Margaret Boden clearly explains in her book *The Creative Mind. Myths and Mechanisms* (Boden, 1990), computational processes – including scripts, frames, and semantic nets – are helpful to understand how the brain works and how some aspects of human creativity are possible. The reason is «because symbolic and representational structures and transformations are the focus of computer programming, the essence of creativity may not be so far removed from computational processes as is usually as-

sumed» (Boden, 1983). Margaret Boden herself – commenting the work of Harold Cohen and his AI system AARON – provides the interpretative key to read the complementary relations between human and artificial creativity:

A functioning program has its own inbuilt dynamism. Its activities can be both flexible and constrained, and a proper amalgam of flexibility and constraint is central to creative intelligence (Boden, 1983). Hence, flexibility and constraint are the two main qualities to understand the real measure of complementarity between human and artificial creativity, a balance that can only be fully appreciated through the awareness of an «inbuilt dynamism». Such inbuilt dynamism represents the appropriate measure through which anonymity should be viewed in the current digital era, intending anonymity not merely as a lack of human authorship, but rather as its transformation due to the complexity and novelty promoted by the current process of mathematisation and, more in general, by the influence of artificial intelligence over human intelligence. For this reason, human creativity interacts with the artificial one through a model based on inbuilt dynamism. This factor can be considered as the most appropriate measure for digital actualisation of the concept of anonymity.

Three examples of digital anonymity

In addition to the relationship between artificial and human creativity, reading the main literature and looking into design processes referring to the last twenty years of architectural history is another important step towards understanding digital anonymity. After all, architecture has played a central role in the construction of the new digital society since its very beginning, designing spaces not only for the consolidation of static identities, but rather for the rise of new dynamic ones. The invention of digital mass customisation is particularly significant in this regard: «Digital mass customization is one of the most important ideas ever invented by the design professions […]. It was developed, hosted, tested, and conceptualized in a handful of schools of archi-

tecture in Europe and the United States in the 1990s. To this day, designers and architects are the best specialists in it» (Carpo, 2017). Apart from being at the forefront of the digital revolution, architects and designers are constantly extending the boundaries of architectural design through the introjection of external references into the architectural discipline. Such an endless extension is a distinctive feature in the current digital era, and some of the results obtained with such an attitude represent pertinent examples of *digital anonymity*.

Three design areas can be considered of particular importance to better understand the existence of *digital anonymity* in contemporary design practice. Such design areas are structural design, environmental design and morphogenetic design.

The first design field in which traces of *digital anonymity* can be found is structural design. In this case, the use of custom algorithms and software applications plays a fundamental role in the creation of the final design results, in particular through the use and development of optimisation and form-finding techniques. As explained by Mark Burry in his description of the works of Antoni Gaudí and Frei Otto as main precursors of computational design in terms of form-finding and structural optimisation (Burry, 2016), nowadays such techniques are widely used in contemporary design conception, and they are based on several software applications. For instance, Kangaroo is one of the most popular plug-ins in the Grasshopper platform; it allows to modify design in response to engineering analyses simulating aspects of the behaviour of real-world materials and objects. Always regarding structural design, the work of the Digital Structures research group at the MIT is an important example in terms of structural optimisation and the different design configurations generated from it. Group leader Caitlin Mueller pays particular attention to the relationship between structural optimisation and design conception in her article Distributed Structures: *Digital Tools for Collective Design* (Mueller, 2017). Highlighting the fact that the creation of new computational tools is shifting the role of computation itself from representation and analysis to creativity and the gen-

01 |

| 02
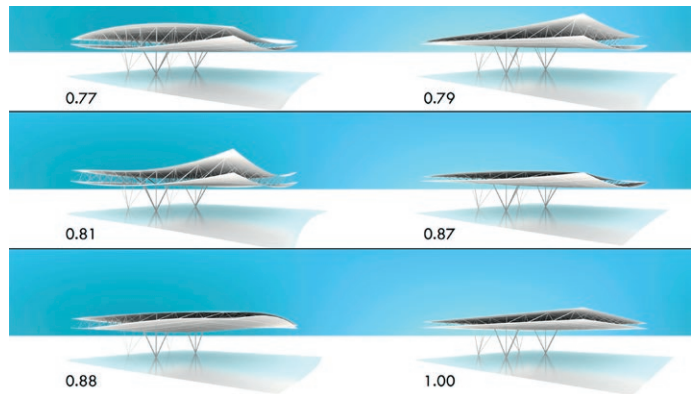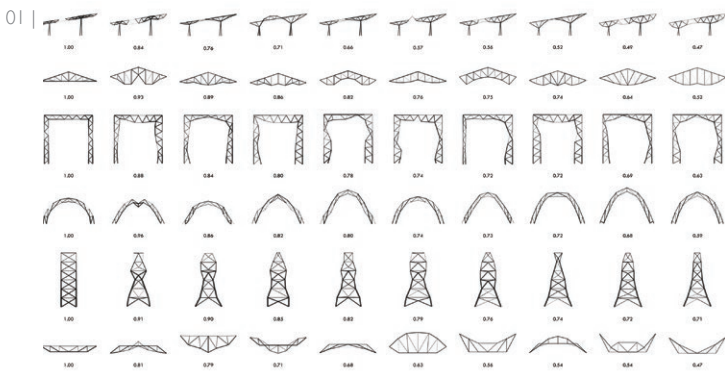
eration of ideas, Mueller provides a series of examples in which the use of multi-objective optimisation techniques offers the opportunity for the designer to choose between different options generated during the optimisation process. For instance, the Web-based design application StructureFIT allows designers to explore new design typologies and forms with a high level of structural feasibility. It is interesting to note the significant difference between the initial condition set by the human author and the final results generated by the computational machine. Between the two there is a design process in which human creativity is substituted by computation, and the end results and configurations are led by the artificial intelligence, rather than by the human one. Such a complementary primacy of artificial intelligence in relation to the human one leads towards new forms of artificial creativity, new forms of *digital anonymity* (Figs. 1-2).

Another important design area in terms of *digital anonymity* is environmental design. Nowadays, the increasing global awareness over climate changes is promoting the use of new computational tools capable of optimising design solutions according to several aspects, such as internal comfort, energy efficiency, CO_2 emissions and so on. Such optimisation refers to several parameters, such as daylight, thermal exposure, airflow, turbulence, wind, space syntax and traffic flow. Although the consideration of these parameters and the use of complex computational techniques might suggest a more technical engineering approach to architectural design, an optimistic point of view to sustainable design is able to produce an independent architectural language in which buildings are shaped by environmental forces combined together with parametric and generative design procedures. The level of complexity and novelty generated by the use of such procedures produces design options and configurations, which are independent of the human author who initially set up the input parameters. Environmental building design can, therefore, also be considered an appropriate example of *digital anonymity*.
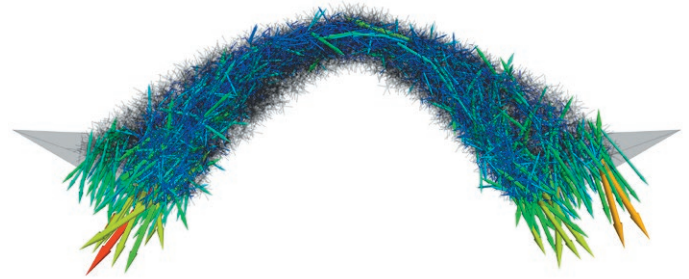
In terms of environmental design, the work conducted at BIG Ideas is particularly significant. BIG Ideas is the specialist group of environmental consultants at the architectural firm BIG (Bjarke Ingels Group), currently one of the most successful offices in the world with ongoing projects across five continents. As explained by Brady Peters in his essay *BIG Ideas: Information Driven Design* (Peters, 2018), by combining expertise in design, computation and performance simulation, the team develops its own computational tools to generate design solutions in relation to social and environmental conditions. For instance, the façade system designed for the Museum of the Human Body (Montpellier, France) is based on a Louvres system with geometry varying from horizontal to vertical orientation according to the side of the location and the direction of sunlight. In other projects, such as Stettin 7 Residences (Stockholm, Sweden), King Street West (Toronto, Canada) and VTC Tower
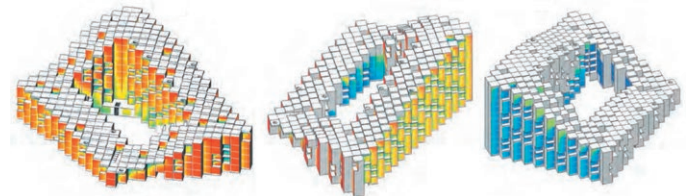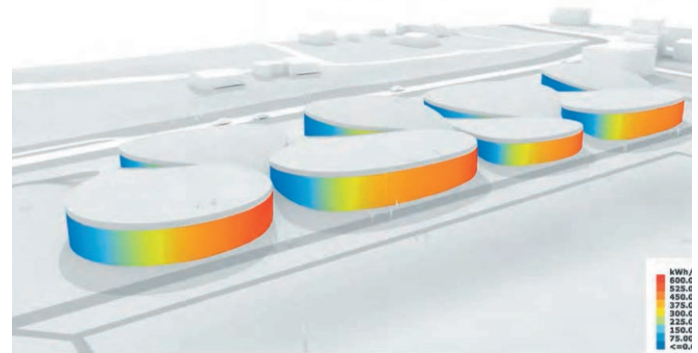
(Copenhagen, Denmark), the entire building geometry is designed according to neighbouring building parameters (height, distance to boundaries, building typologies), direct sunlight requirements, noise reduction and other factors. The work of BIG Ideas represents a clear example of the fact that building design can be generated by new digital tools rather than by human creativity. The role of human designer is, therefore, translated into the role of creative organiser of environmental parameters rather than intuitive thinker of top-down ideas (Figs. 3-4).

Finally, the third design area, which highlights the existence of *digital anonymity*, is morphogenetic design. As explained by Michael Hensel, Achim Mendes and Michael Weinstock (Hensel, Mendes and Weinstock, 2004), morphogenetic strategies for design introduce into architecture concepts and procedures from disciplines such as biology, physical chemistry and mathematics. Such strategies refer to evolutionary processes typical of natural systems, and their introduction in the architectural discipline implies the consideration of buildings as dynamic ecosystems rather than static entities. In doing so, the building itself becomes a body of irreducible complexity where the properties of the whole system cannot be deduced from the properties of the single parts, which compose such a system. This aspect of novelty produced by increasing levels of complexity reflects the definition of *digital anonymity* itself, and underlies an ongoing shift in architectural design from the production of iconic buildings – the so called "buildings from archistars" – to the creation of intelligent ecosystems.

Material synthesis offers an interesting example of the above. Combining morphogenetic strategies and computation within a new design approach driven by an expanded understanding of materialisation and the idea of material as «active matter» (DeLanda, 2015), material synthesis shifts the rule of the human designer from «the controller of the constructional system, to that of a forecaster of possible spatial and structural formations» (Dierichs and Menges, 2015). In this regard, aggregate systems and granular morpholo-

05 | Aggregate architecture: digital model recorded with laser-scanning techniques, University of Stuttgart, © Karola Dierichs and Institute for Computational Design and Construction (ICD), Annette Scheider and Institute of Engineering Geodesy (IIGS)

06 | Aggregate architecture: full-scale structure, University of Stuttgart, © Karola Dierichs and Institute for Computational Design and Construction (ICD)

gies are examples of the fact that even if the initial components are known, the final result can be totally emergent and independent from the human designer's intention. Aggregate systems are examples of how new advancements in additive manufacturing and emerging capabilities in materials science and synthetic biology nowadays allow design to move from top-down design procedures - led by the human author - to bottom-up digital and physical processes. Therefore, morphogenetic design is an appropriate example of the existence of *digital anonymity* in contemporary design practice (Figs. 5-6).

Conclusion The architectural examples summarily analysed contain principles that show the measure of human-machine interaction in the current digital era, a time based on complementation, augmentation and interaction between human creativity and artificial creativity. *Digital anonymity* emerges through decontextualisation and depersonalisation, giving life to a new emergent and autopoietic condition of architectural design. The traditional design approach based on acquisition, sedimentation and reinvention of knowledge – which characterises the intuitive approach of human creativity – is now substituted by

algorithms, which can produce endless variations starting from a given set of data. Such translation is based on the intentional approach of artificial creativity and, in this transformation, the context is condensed into a series of parameters. Moreover, the visionary work of human beings is substituted by endless – and potentially random – combinations produced by the generative independence of algorithms.

The existence of *digital anonymity* highlights the action of an ongoing digital progress, which is already producing a new «paradigm shift». The use of the expression «paradigm shift» refers to the evolutionary approach explained by Thomas Kuhn in his seminal book *The Structure of Scientific Revolutions* (Kuhn, 1970). Among a series of remarkable intuitions addressed towards a new vision of scientific revolution, Kuhn describes the period of crisis, which leads to scientific revolutions through the definition of four symptoms:
The proliferation of competing articulations, the willingness to try anything, the expression of explicit discontent, the recourse to philosophy and debate over fundamentals, all these are symptoms of a transition from normal to extraordinary research (Kuhn, 1970). Interestingly, all these symptoms perhaps belong to our current era too. The similarity is clear and it cannot be a simple coincidence.

It is more appropriate to say that nowadays all these symptoms of transition from normal to extraordinary research «may very well be linked to the confused feeling that we have entered a new enchanted realm» (Picon, 2010), a world characterised by the dichotomy between what is real and what is virtual.

Above all the theoretical constructions and critical considerations that can be defined, it is important to remember that architectural design is something real and – as Mark Wigley was already reminding us almost thirty years ago – «critical work today can be done only in the realm of building» (Wigley, 1988). Hence, the built environment is a field of action where our digital society can be shaped, a land to be constantly designed from scratch, a place characterised by *digital anonymity* and by the fact that – first and foremost – anonymity emerges only through alienation, manifested case-by-case, against a background provided by autonomy.

NOTES

[0] The paper, proposed by an under 35 researcher, has passed the acceptance phase of the abstract and consequently the "double blind review", obtained, on the part of the Techne Board, a positive evaluation for the publication with the No-Pay logic.

REFERENCES

Boden, M. (1983), "Creativity and computers", in Harold Cohen (Ed.), *Exhibition catalogue*, The Tate Gallery, London, pp. 18.

Boden, M. (1990), *The Creative Mind. Myths and Mechanisms*, Weidenfeld and Nicolson, London.

Burry, M. (2016), "Antoni Gaudí and Frei Otto. Essential Precursors to the Parametricism Manifesto", in Schumacher, P. (Ed.), *Parametricism 2.0. Rethinking Architecture's Agenda for the 21st Century*, AD Profile 240 (March-April 2016), pp. 30-35.

Carpo, M. (2017), *The Second Digital Turn in Architecture. Design Beyond Intelligence*, The MIT Press, Cambridge, USA, p. 4.

DeLanda, M. (2015), "The New Materiality", in Mendes, A. (Ed.), *Material Synthesis. Fusing the Physical and the Computational*, AD Profile 237 (September-October 2015), pp. 16-21.

Dierichs, K. and Menges, A. (2015), "Granular Morphologies. Programming Material Behaviour with Designed Aggregates", in Menges, A. (Ed.), *Material Synthesis. Fusing the Physical and the Computational*, AD Profile 237 (September-October 2015), p. 87.

Hensel, M. and Menges, A. and Weinstock, M. (2004), "Introduction", in Hensel, M. and Menges, A. and Weinstock, M. (Ed.), *Emergence: Morphogenetic Design Strategies*, AD Profile 169 (May-June 2004), pp. 6-9.

Kuhn, T. (1970), *The Structure of Scientific Evolution*, The University of Chicago Press, Chicago, pp. 91.

Mueller, C. (2017), "Distributed Structures. Digital Tools for Collective Design", in Tibbits, S. (Ed.), *Autonomous Assembly. Designing for a New Era of Collective Construction*, AD Profile 248 (July-August 2017), pp. 94-103.

Peters, B. (2018), "BIG Ideas: Information Driven Design", in Peters, B. and Peters, T. Computing the Environment. (Eds.), *Digital Design Tools for Simulation and Visualization of Sustainable Architecture*, AD Smart 06, Wiley, London, pp. 150-62.

Picon, A. (2010), *Digital Culture in Architecture. An introduction for the design professions*, Birkhäuser, Basel, p. 216.

Von Neumann, J. (1958), *The Computer and the Brain*, Yale University Press, New Heaven.

Wigley, M. (1988), "Deconstructivist Architecture", in Johnson, P. and Wigley, M. (Eds.), *Deconstructivist Architecture, Exhibition catalogue*, The Museum of Modern Art, New York, pp. 19-20.