Mind the Gap: Reconciling Formalism and Intuitionism in Computational Design Research

Zeynep Mennan

The relation between computational research and complexity can be argued to be one of mutual promotion and sustenance. If the twentieth century's task can be said to have reduced the methodological and phenomenological complexity of design problems, one may observe that recent computational research situated within the complexity paradigm reverses the task. The last century's preference for simplicity was mainly related to the shortcomings or impossibility of dealing with complexity using existing methods and tools. Computational research is now in possession of advanced and improved tools and methodologies that remedy such deficiencies, yet at the same time increase the complexity of design problems. Hence, the computational paradigm both creates and sustains complexity. Complexity bears a non-linear relation to information transmission and processing technologies: improved means and methods used in complexity management do not reduce but rather increase the complexity of design problems.

Complexity management is undeniably becoming a major issue in current computational research, sustaining and promoting naturalisation and formalisation as the two main operational forms encountered in the management of this complexity. In computational design research, as in other fields, the realisation of a growing complexity contributes to an extensive use of formal languages and quantitative/computational tools that rely increasingly on the translation of complex structures into a formal, natural idiom. In the field of architecture and design, technologies and methodologies which allow for such complex formal and structural explorations introduce a complete change of environment that is indicative of an interesting epistemic and methodological shift towards naturalisation and formalisation, which owe their success to their claim to a superior operational efficiency in the management of complexity.

A Process of Formalisation and Naturalisation

When discussing naturalisation, Jean-Michel Salanskis notes that the 'natural' is generally defined as that which has the power to evoke a scientific language of reference, whereas the 'non-natural' is defined as the 'spiritual' or the 'cultural', which evades the control of the scientific idiom.[1] Naturalisation and formalisation are both related to research within the analytical-cognitive sphere: naturalisation accounts for an objectification of cognitive and spiritual processes expressed in an ever-growing accuracy of translation into formal languages. The naturalisation project that finds its fulfilment in an increasing process of formalisation is oblivious to the phenomenological dimension, which is consistently ignored by cognitive science: 'basically arguing that this dimension is either irrelevant or inherently unreliable'.[2] Zahavi notes that by disregarding subjectivity and the first-person experiential perspective '[C]ognitive science faces what Joseph Levine has called "the explanatory gap": […] we seem to be unable to bridge the gap between the neurophysiological processes that we can describe and analyze scientifically from a third-person perspective, and the experiences that we are all familiar with from a first-person perspective.'[3]

The historical incompatibility of naturalistic and phenomenological traditions and the problem of their improbable reconciliation seems to be given a new direction and a new focus within the context of an increasing process of formalisation, launched by the complexity paradigm and endorsed in the field of computation. Current computational design research inscribes itself within such a project of naturalisation; it introduces a complete change of environment that substantially affects the ways in which we design and research, and it presents important implications at the methodological, epistemological and cognitive/perceptual levels.

Change in the Nature of the Support of Inscription

When considering the ontological and methodological implications and consequences that a naturalised environment presents for design research, reference can be made to a compelling discussion introduced by Bruno Bachimont in his epistemological study of the notion of a 'material hermeneutics', developed as a critique of formalism in artificial intelligence.[4] Bachimont's reflection departs from a consideration of the formal representation of information to question the cognitive or phenomenological contribution of formal calculation to knowledge, and the ways in which calculated representations induce a particular rationality.

Formalism, acting as the epistemological frame of reference for computation, is defined as a mode of reasoning preoccupied only with form, and disinterested in content and meaning. This mode of reasoning, which Bachimont defines as 'computational rationality', is a product of calculated representations that come in the form of numerical inscriptions. While formal inscriptions owe their success to their efficiency in calculation, Bachimont's discussion entails the problem of their intelligibility and interpretability, in other words, the possibility of their actual user attributing meaning to them.[5] To this end, Bachimont adopts a phenomenological approach, a mobilisation of Husserlian phenomenology to assert that all knowledge proceeds from a material support of inscription of which it is the interpretation: Bachimont poses the problematic of material hermeneutics as a philosophical reflection on the play between calculation and interpretation, drawing simultaneously on hermeneutics and the formal representations of knowledge to model the conditions for the intelligibility of formal inscriptions.[6]

The opposition of formal and natural languages constitutes the very interface of this problematisation: Bachimont notes that in natural languages meaning is appropriated by the reader, whereas formal languages dispose of the reader and the question of meaning. In his critique of computational reason, defined as the mode of thinking associated with numerical notations – in other words, a reasoning that is not preoccupied with meaning – Bachimont notes that material tools and instruments are assigned intellectual operations that unload the mind, letting it direct its interest to other tasks. These intellectual tasks then change character, and when the mind re-appropriates them, it is confronted with something different from what would have existed if it had performed the task itself.[7]

Extending this observation to the discussion of the constitution of knowledge as authorised by formal/numerical inscriptions, Bachimont concludes that the intellectual tools we use help us to think in different ways depending on their nature and properties, just as mechanical tools allow the fabrication of different material objects: this would mean that we can constitute new intellectual objects and elaborate new concepts that would remain inconceivable without such a numerical mediation.[8] But Bachimont

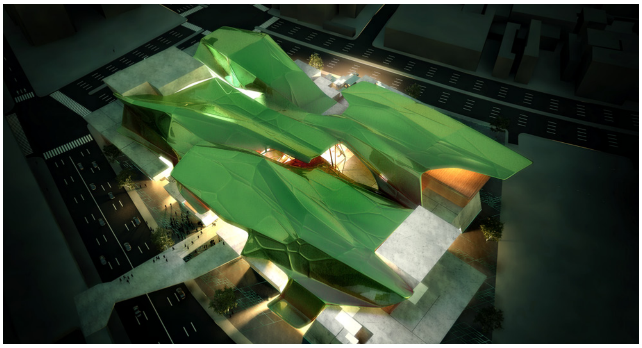

Fig. 1

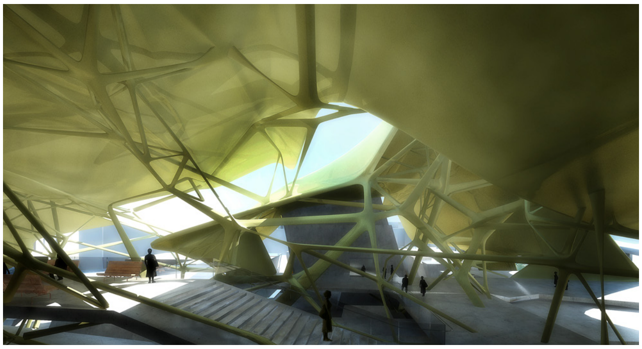

Fig. 2

Figs. 1-2: Taipei Performing Arts Centre, Taipei, Taiwan, 2008. Project Team: Roland Snooks (Design Director), Robert Stuart-Smith (Design Director), Brad Rothenberg, Elliot White, Matt Howard. © Studio Roland Snooks.

also notes that this does not necessarily lead to an extension of the cognitive field, it can also manifest itself as disorientation or a loss of meaning.[9]

A New Epistemic, Methodological and Representational Regime

Bachimont's discussion is crucial in its introduction of a new perspective through which the nature of the support that carries information is seen to induce a particular type of rationality. This means that the current preference in the computational paradigm for privileging formalist procedures and approaches in design and research would extend beyond being a matter of mere methodological choice on the grounds of efficiency, if it is agreed that the nature of the support is fundamentally affecting the ways we understand, conceptualise and interpret data.

The change in the nature of the supports is a consequence of an on-going process of naturalisation that operates through an enhancement of formalism and formalisation. These supports can be observed to have shifted from the conventional graphic medium of the drawing to the mathematical medium of calculation. Following Bachimont, this shift in the nature of notations and representations has also induced a shift from a graphic to a computational rationality. This condition, to which we have already become accustomed, has important implications that need to be questioned. Numerical notations expressed in a formal language have already gained a privileged place in current design research due to their efficiency in reducing complexity, equally fostered by the multi-disciplinary nature of such design research which requires the accessibility of formal representations across different fields and disciplines. Such supports may claim superior efficiency in complexity management, but the epistemological/ontological consequences of this shift have not yet been addressed or explored today by any design research agenda, either intentionally or otherwise.

If the conditions governing the intelligibility of formal notations vary with respect to the distinction Bachimont makes between a graphic and a computational rationality, then the increasing replacement of spatial analysis in architectural design by numerical analysis, and the corresponding displacement in the nature of representations, can be expected to indicate an interesting tension affecting both cognitive and interpretive faculties. When subjected to a numerical regime of interpretation, the qualities of phenomena are displaced and extended to new and unfamiliar kinds of supports, provided by a new, syntactical numerical language for representing design problems and solutions. The alienation which formal notations produce in architecture, grounded mainly in graphic rationality, is a problem that needs to be reflected upon within the context of naturalisation, and with respect to the changing nature of notations/representations on which knowledge is inscribed.[10]

Translation into a natural idiom brings forth a dematerialisation; this figures most intensely within the context of new technologies and leads to a virtualisation where the visible is quantified in a numerical language, thus becoming intangible to the senses. It can be noted that virtualisation, like formalisation, is also rendered operational within the context of naturalisation. As the limits of computation extend, the limits of sensory experience seem to shrink. Commenting upon the implications of the 'evanescent and mercurial' nature of digital forms on visual culture, Mario Carpo notes that 'in a digital production process one algorithm alone can generate an infinite number of mathematical functions as well as various forms or surfaces, all of which will share this invisible originating algorithm and, in most cases, carry some visible attribute that denotes their common matrix'.[11] Noting that the limits of computer programming are of an epistemic nature, and commenting on this common algorithmic matrix, Carpo argues that:

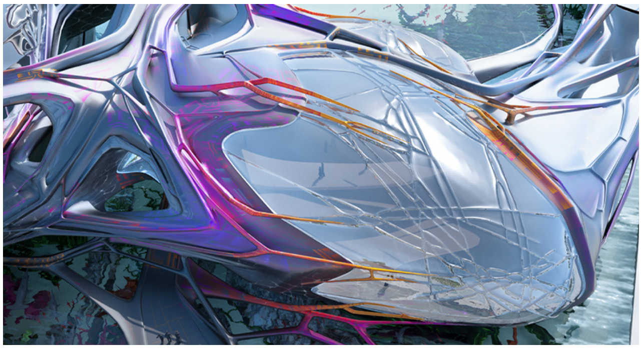

Fig. 3

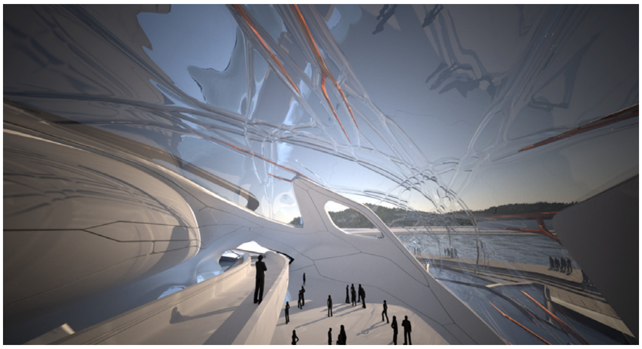

Fig. 4

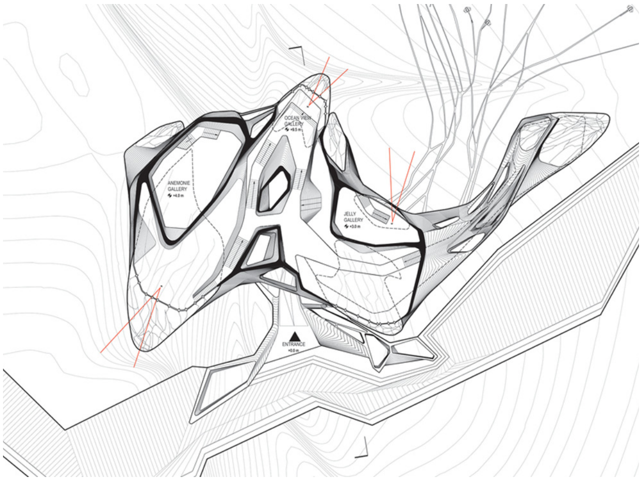

Fig. 5

Figs. 3-5: Yeosu Pavilion, Yeosu, South Korea, 2010. Design Directors: Roland Snooks and Tom Wiscombe. Project Team: Pablo Kohan, Fleet Hower, Ricardo Sosa (Studio Roland Snooks), David Stamatis, Chris Eskew, Brent Lucy, Graham Thompson, Zeynep Aksöz (Tom Wiscombe Design). © Studio Roland Snooks & Tom Wiscombe Design.

> This condition of reproducibility implies an analogous and corresponding condition of recognizability: all products of a non-standard series are different but they are also in some way similar to each other. What do they have in common? Technically, a mathematical algorithm; perceptually, however, it is difficult to say. The similarity between two visual forms is a mystery that no technology can quantify, no cognitive science can describe and no philosophy can define.[12]

The versatility and efficiency of formal supports seems to leave open the problem of the methodological and epistemological estrangement brought forth by the counter-intuitive nature of such supports.

Bachimont reminds us that if calculation reduces complexity through the exploration of a space that is unintelligible to graphic rationality, the problem of the complexity of calculation itself and the intelligibility of its results remain.[13] This is precisely how computation gives rise to a paradox, in the sense that it offers new tools whose efficiency and success are manifested by the very difficulties they create.[14] A surfeit of information that cannot be rendered intelligible brings to the fore the question of interpretation as a necessity. Material hermeneutics explores precisely this possibility of a material support's encounter with an interpretation. It attempts to supply the productivity and efficiency of formal representations combined with new interpretive practices that surpass conventional hermeneutical ones.

Reconciling Computational and Phenomenological Traditions

The notion of a 'naturalised interpretation' seems controversial at first when considered within the context of the distinction between the human and the natural sciences. However, several recent attempts have explored the expansion of hermeneutics beyond the realm of the human sciences to its application in empirical inquiries. Criticising the incompatibility of phenomenological and naturalistic traditions and the self-investment of hermeneutics exclusively in the human sciences, such an expansion of naturalistic interpretive practices takes place at the interface of hermeneutics and science.[15] Naturalistic interpretive practices look for a combination of the operational efficiency and the interpretability of formal representations to bring about the possibility of reconciling formalist productivity with phenomenological hermeneutics.

Petitot, Varela, Pachoud and Roy, editors of the seminal work on this issue, *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science*, engage in the mathematical reconstruction of phenomenological descriptions and claim that 'the vague morphological essences (including those pertaining to the experiential dimension) are amenable to a mathematical account'.[16] What is at stake in such an enterprise is to bridge the so-called 'explanatory gap' mentioned earlier. Representation in the form of a mathematical objectivity produces a disembodiment that brackets phenomenological interpretations of the design object. The formalism and the counter-intuitive nature of computational notations/representations thus leaves a gap between the formal layer and the layer of reality which it is attempting to replace: the intuitive layer of categories which structure this reality, a layer which is bypassed in formalist approaches that claim to be exhaustive.

The project of naturalising phenomenology is less an attempt to reconcile formalism and phenomenology than one that neutralises the phenomenological dimension by translating its contents into the very formal medium, which seems ill-suited to design research as observed so far. On the other hand, the turn towards materiality and practicality experienced in the last decades can be situated and assessed within the context of such a reconciliation between formal representations and the phenomenological grounds of design

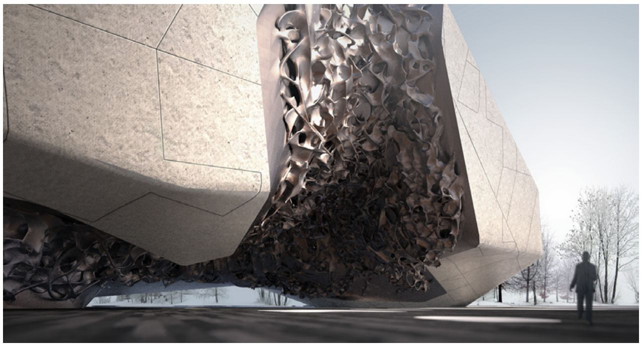

Fig. 6

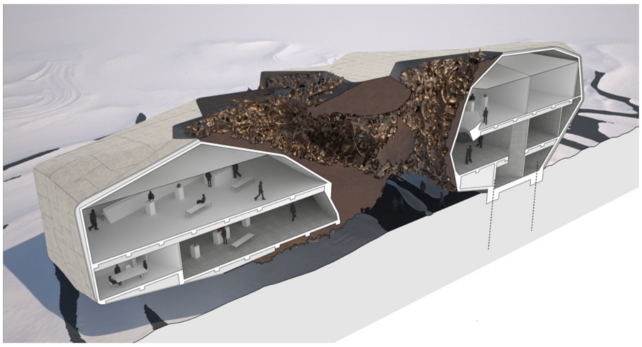

Fig. 7

Figs. 6-7: Babiy Yar Memorial, Kiev, Ukraine, 2010. Project Team: Roland Snooks (Design Director), Casey Rehm, Fleet Hower, Bryant Netter. © Studio Roland Snooks.

experimentations. The growing recourse to the physical/material prototype today clearly addresses the shortcomings of an absorption in heavy formalism, and comes as an indication of the necessity for dialogue between the world of computation and the more familiar and intuitive phenomenological sphere. Indeed, the structural logic and behaviour of new materials and forms are too complex to be anticipated and predicted within either the computational or physical medium alone. In this sense, the inseparability of computational and physical media in design research can be seen to be a logical consequence of the complexity of recent formal and structural explorations. These explorations are now manifesting an increasing interest in integrating forms of computational and material production.

Calculation leaves an incomplete space that cannot be saturated with information alone and waits to be filled with meaning and interpretation. A possible reconciliation between computational and phenomenological traditions could attempt to remedy the gap by reintroducing dimensions of subjectivity, intentionality and intuition into the medium of computation. The field of computational design research can only benefit from a call for an augmented phenomenological contribution to counteract its heavy formalism.[17]

Among the new generation of architects designing and researching within the realm of complex systems and exploring the potentials of generative design strategies, the work of Roland Snooks Studio and Kokkugia can be situated within the context of such a reconciliation. Roland Snooks directs a sustained critique on the subject of contemporary generative algorithms, the shortcomings of which are related to their inherently formalist logic: 'The inability to embed architectural decisions within a generative model remains a primary limitation of contemporary algorithmic processes, and substantially defers architectural intention to the evaluation of these generative models.'[18] Highlighting the gap between the formalist logic on which these algorithms operate and the architectural logic that is expected of them, Snooks notes that:

> It is the architect's role to adjust their parameters iteratively in an attempt to navigate their outcomes to a successful architectural result. An even more concerning trajectory within computational design is the prevalent ambition to remove the designer from this feedback loop, automating evaluation based on quantitative criteria, such as structure, in an attempt to optimise the engineering performance of buildings.[19]

Thus the work of Roland Snooks centres on the difficult task of embedding architectural design intention within generative algorithms in order to reinstate intention and subjectivity, and to affirm that the 'qualitative nuances, references, complexity, richness, and experience of architecture are beyond the capacity of numerically describable criteria'.[20] Insisting on the primacy of qualitative concerns over pragmatic ones, Snooks defines his design approach as one that 'works through the feedback of non-linear computational processes and subjective design decisions in creating an architecture […] defined by the strange characteristics that emerge from these processes'.[21] [figs. 1-2] Indeed, the very procedure used for this reconciliation has been named 'strange feedback', a key strategy used in Snooks' design research, and defined as 'a non-linear and inconsistent strategy of negotiation between generative and direct design procedures'.[22] 'Strange feedback' combines the bottom-up, emergent processes driven by computation with the top-down intentions and intuitive decision-making of the architect: 'This strategy is premised on feedback between algorithmic procedures and direct digital surface modelling, an attempt to maximise and hybridise the potential of each mode of design […] This interaction is both a shortcut for intuition and a mechanism for direct, subjective and non-systemic decisions.'[23]

A similar process of feedback between intuition and computation is advocated by Tom Wiscombe. Expressing his concerns about the impact of a heavy formalism on contemporary computational design, Wiscombe observes:

> [Advanced computation] has reached a kind of fervor, where technique is promoted over outcomes and effect […] you lose too much information when everything in an architectural problem has to be processed through an algorithm. Inputs are forced to become quantitative or otherwise abstract in order to be able to be computed, so it is not surprising that outputs are also anemic.[24]

A hybrid process, similar to 'strange feedback' is defined by Wiscombe as 'messy computation':

> There are such hardened camps now: you are either a bottom-up researcher or a top-down designer; you either experiment with means, or you design towards ends. A crossover term I like is "messy computation" – it is open-ended enough to allow you to be a designer but also capitalizes on the advantages of recursion and agency. Nothing is taboo that way. You pick and choose the right tool for the job, and more importantly, create custom workflows which jump around between techniques. It's a patchwork […] which I find very convenient, and happily, free of ideology.[25]

The apparent parallelisms between the approaches of Wiscombe and Snooks led to collaboration between Roland Snooks Studio and Tom Wiscombe Design in the design of a thematic pavilion for the Yeosu 2012 Expo, exploiting the shared sensibilities of the two architects. [figs. 3-5] Indeed, the practices of Roland Snooks and Tom Wiscombe distinguish themselves from many practices in contemporary algorithmic architecture in their articulation of subjective intention and reliance on intuition rather than placing confidence solely in the outcomes of computational procedures. In point of fact, the work of Roland Snooks Studio is said to have evolved in this direction from earlier work after an assertion that bottom-up techniques do not prove self-sustainable and that they need to be supplied with top-down procedures to achieve what Snooks calls 'a negotiated whole',[26] in which the two seemingly incompatible phenomenological and computational modes of design find themselves 'partly embedded within the generative algorithm as behaviors and partly in evaluation embedded within our intuition', and distributed within the work as self-organised and self-assigned intentions.[27] [figs. 6-7]

In this sense, 'strange feedback' is also impure, and this interaction of human intuition with computational logic is expected to lead to the emergence of 'something strange or potentially unique'.[28] This calls to mind the observation made by Bachimont that the mediation of a computational support could help us conceive and elaborate new intellectual tools and concepts if this support is made to meet an interpretation. This is precisely what is being explored in the practices observed: work within the computational environment imposes a shift to a new conceptual regime that at first produces alienation, but which then leads to discoveries/recoveries in new forms when this shift is able to be accommodated within a new interpretive regime. This would account for an augmentation of phenomenology rather than its naturalisation if it is agreed that the task is not the translation of phenomenological practices into naturalistic ones, but their integration into the naturalistic environment through a simultaneous articulation of formalist and intuitionist modes of design. This is a creative task of reconciliation that contemporary computational design research can answer with creative outcomes.

Notes

1. Jean-Michel Salanskis, *Naturaliser*, 2000, <http://jmsalanskis.free.fr/IMG/html/Naturaliser.html> [accessed 13 May 2005]

2. Dan Zahavi, ‘Phenomenology and the Project of Naturalization’ in *Phenomenology and the Cognitive Sciences* 3 (Netherlands: Kluwer Academic Publishers, 2004), p. 331.
3. Ibid., p. 332.
4. Bruno Bachimont, *Herméneutique matérielle et Artéfacture : Des machines qui pensent aux machines qui donnent à penser; Critique du formalisme en intelligence artificielle*. PhD thesis in epistemology. Paris, École Polytechnique, 1996, <http://www.utc.fr/~bachimon/Livresettheses.html> [accessed 10 June 2003]
5. Bruno Bachimont, ‘L’intelligence artificielle comme écriture dynamique: De la raison graphique à la raison computationnelle’, in *Au nom du sens,* ed. by J. Petitot (Paris: Grasset, 1999), pp. 290-319.
6. Bachimont, *Herméneutique matérielle et Artéfacture,* 1996.
7. Bruno Bachimont, ‘*Théorie du support: du support numérique à la raison computationnelle. Prolégomènes et critique*’, 2006, <http://www.utc.fr/~bachimon/Approchephilosophique.html> [accessed 10 June 2008]
8. Bachimont, 1999.
9. Bachimont, 1996.
10. For a discussion of an educational experiment on this issue, see: Zeynep Mennan, ‘Non Standardization Through Non-Visualization: Scripting the Dom-Ino House’ in *The Architecture Co-Laboratory: GameSetandMatch II, On Computer Games, Advanced Geometries and Digital Technologies*, ed. by Kas Oosterhuis and Lukas Feireiss (Rotterdam: Episode Publishers, 2006), pp. 234-41.
11. Mario Carpo, ‘*Pattern Recognition*’, 2006, <http://architettura.supereva.com/extended/20060305/index_en.htm#notes> [accessed 03 March 2007]
12. Carpo, 2006.
13. Bachimont, 1999.
14. Bachimont, 2006.
15. For new directions in phenomenology, cognitive science and hermeneutics see *Naturalizing Phenomenology: Issues in Contemporary Phenomenology and Cognitive Science*, ed. by Jean Petitot, Francisco J. Varela, Bernard Pachoud and Jean-Michel Roy (Stanford: Stanford University Press, 1999); Jean-Michel Salanskis, *L’hermeneutique formelle* (Paris: Editions du CNRS, 1991); Bruno Bachimont, 1996.
16. Cited in Zahavi, p. 335.
17. This position is akin to the one held by Harthong and Reeb in their epistemological discussion of intuitionism as a lighter variant of formalism rather than its epistemological counterpart. Jacques Harthong and George Reeb, ‘Intuitionnisme 84’, in *La Mathématique non Standard; Histoire, Philosophie, Dossier scientifique,* ed. by H. Barreau and J. Harthong (Paris: Editions du CNRS, 1989).
18. Roland Snooks, ‘*Behavioral Formation: Multi-Agent Algorithmic Design Strategies*’ (unpublished doctoral dissertation, RMIT University, 2014), p. 9.
19. Ibid.
20. Ibid., p. 53.
21. Ibid., p. 18.
22. Ibid., p. 103.
23. Ibid.
24. Ralf F. Broekman and Olaf Winkler in conversation with Tom Wiscombe, ‘A Higher Order of Organisational Complexity’ in *build urban architecture and design*, March 2010, <http://www.build-magazin.com/index.php/interviewpartner2010/items/tom-wiscombe.html> [accessed 10 June 2014]
25. Ibid.
26. Snooks, p. 15.
27. Ibid., p. 210.
28. Ibid., p. 105.

Biography

Zeynep Mennan is an architect, theorist and design critic. She has researched, published and lectured at major institutions and leading conferences in Europe, the USA and Australia. In 2003, she co-curated the ‘Non Standard Architectures’ exhibition at the Centre Georges Pompidou, Paris. Her fields of interest include the epistemology and aesthetics of computational design. At METU, she currently teaches architectural design as well as graduate and doctoral courses in architectural theory, research, epistemology and computational design theory.