
Digital Literacy in Architecture: How Space is Organized by Computation

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Abstract

The integration of architecture and digital technologies happens on an instrumental level, where digital is associated with making the design process more efficient. Architects commonly report on interaction with computers describing the service software has provided. Computational procedures remain obscured by design outputs. In this project, we propose to critically study the relationship of architecture and technology from a perspective of interaction with digital tools. We propose the use of text-mining on a corpus of architectural discourse in social media. With concepts extracted from this initial step, we will conduct a series of experiments on *collaborative qualification* using a mobile application. We will show how the challenge of organizing a discourse on computational process in architectural design could involve computation in productive new ways. Finally, we will discuss how these insights could enrich the future development of computer-based tools for design.

Author Keywords

Digital literacy; text-mining; meaning-making; computer-aided design; collaborative qualification;

ACM Classification Keywords

H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous;

Introduction

Current discourse in both theory and practice of architecture engages predominantly with the products of algorithms and software routines. More often than not, what architects report on their interaction with computers is a superficial account of the service software has provided. We hear about the way their tools iterate through solutions until the designer is satisfied with the result. Computational procedures remain obscured by design outputs, which architects seem to control only partially.

The Digital in Architectural Practice

Digital tools (such as computer-aided design, CAD and building information modeling, BIM) are used to quantify and optimize parameters of spatial designs. There is a significant difference between the way architects who work with computer-based tools articulate design concepts and the way these are translated into computational routines. Peter Eisenman, one of the pioneers of computer-aided design in architecture, points to a persistent inattention to the underlying operation of algorithms that determine a computer's *aid* in the design process.

What we need is a more developed language to discuss the role of computation in the production of architectural experiences. How can we establish a terminology to apply to the effects of computation on architectural experience? How might we use computational tools as a feedback into the design of alternative tools for architects? An open-ended framework which is based on a generic terminology describing structured experiences of space can help close this gap.

The Digital in Architectural Theory

Contemporary architectural theory and practice are, like much of contemporary culture and scientific metaphors, inspired by computational concepts (algorithms, databases, software). Luciana Parisi introduced *contagious architecture* [14] to describe a digital space composed of uncertainty and the *incomputability* intrinsic to computation (chance, randomness and complexity). Keller Easterling defined the role of algorithms as defining in both zoning rules and regulations, 3D modelling software and the aesthetic of architectural designs [6]. *Spatial products*, claimed Easterling, are the outcomes of *algorithmic performances* on space - "a non-digital spatial software that is both shaping and generating the activity of making houses" [5]. Carpo [4] turns to the paradigm of *identity*, symptomatic of industrial production and speculates about new modes of production enabled by mass customization and participation. Expressing concerns similar to Peter Eisenman's, Carpo argues that designers need to engage in the production of tools and refrain from becoming mere "clients of design agencies of a higher order" (software tools).

A lot of the interesting discussion about architecture today happens in social media as it does in the academic discourse. Could digital tools serve the analysis of architectural qualities? How can digital networked technology help discuss qualities and experience of space? Seeking to answer these questions, we will collect and mine a large amount of textual data coming from online discourse through social networks, micro-blogging etc. We will look for keywords and concepts that architects use to describe their interaction with digital tools. We will then explore *collaborative qualification* of architectural experiences

- In a lecture at the opening of *Archaeology of the Digital* exhibition curated by Greg Lynn (CCA, Montreal, May 2013), **Peter Eisenman** discussed the use of digital tools in architectural practice and pointed out the different levels of computer literacy architects can have. **Using a computer as a critical instrument** as opposed to simply a tool requires more sophisticated understanding of what computers actually do. A video recording of the lecture is available at: <https://www.youtube.com/watch?v=hKCrepgOix4>

□ **Digital Literacy** is mainly tackled from the perspective of usability and capacity of users to complete tasks on a computer. When discussing digital literacy, we imply more than a proficiency in using computing devices and networks: we refer to the understanding of underlying digital processes and the nature of digital information. For example, in *The Computational Turn*, David Berry (2011) argued that the **digital** is the new unifying idea in academia. This can be applied to **architecture and design** in two contexts: one is the use of computer-based tools (CAD, BIM) to generate design solutions; the other is a grammatical interest in systems such as Pattern Language or Space Syntax. Our interest here is to focus on the role of computation in architectural design and explore ways in which architects can be literate in the digital. See: Bühlman, V., Hovestadt, L., Moosavi, V: Introduction – Coding as Literacy, *Coding as Literacy*, Birkhäuser, 2015

using a mobile software application for real-time, location-specific reporting.

Diverting from the approach of Parisi [14] or Easterling [6] who take a computational concept and apply it to their observations of the immediate, we will begin with the immediate and build up a framework that is able to address computational concepts. The reason for this is, first of all, to assess a discourse that is much closer to the practice of designing in relation to the felt immediacy of an experience. Second, it is a way to escape obscurity about what makes specific academic communities different from each other.

Methods

The project will progress through three phases. In the first phase, we will focus on forming a corpus of texts from social media streams. Selecting the streams of interest will be done through filtering accounts, hashtags, groups and pages that mention parametric and computer-aided design, digital and computation in architecture. The second phase will use this corpus as a starting point for an iterative process, to be repeated multiple times over the course of the project. This process will include mining textual data, extracting key concepts that characterize the convergence of the digital with architecture, and bundling it into a mobile application. The mobile application will be used for experiments in *collaborative qualification* of space. These experiments will be conducted in collaboration with two research partners. We will explore the way groups use of this collaborative tool, the app, as a form of meaning making through interaction [9]. In the third phase, we are planning to address the questions about digital literacy and the articulation of computational concepts by translating them into the realm of design.

Assembling Tools: Gathering and Mining Data; Designing Reporting Systems;

GATHERING AND MINING EXISTING DISCOURSE

The use of text-mining in this project is way to shift the focus from explicit to peripheral zones of attention and cognition. We are not looking for what people would report explicitly about their lived experience of space but for their non-direct, immanent cognition and emotion. Assembling the necessary tools will rely on existing, open source tools such as Python tweepy, facebook, textmining and sompy modules and SciPy library in combination with Twitter and Facebook Graph APIs.

DESIGNING A MOBILE APPLICATION TO REPORT ON SPATIAL EXPERIENCE

Relevant concepts extracted from the social media discourse will be used in the design of communication channels which enable reporting and *collaborative qualification*. The communication channels will include a website and a mobile application. They will foster intuitive assessment of spatial experiences in the context of computation-affected and computation-determined designs. They will enable people to make suggestions on how to qualify or classify spatial designs and experiences in a real-time, location-specific way. By inciting a discourse in a community through concepts derived from our initial research, we will examine how these concepts relate to people's experience of space. We will make suggestions on how can they be used in architectural design.

Collaborative Experiments

PROJECT 1: PUBLIC SPACE IN SOCIAL MEDIA

Following each development iteration, an experiment will be organized in collaboration with a research

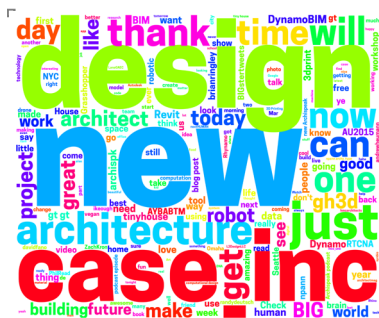


Figure 1: Word-cloud showing most frequent terms used by 10 prominent twitter accounts that belong to contemporary architects. Accounts were selected based on a search for "architect" and "digital" and/or "computation" and/or "data-driven" in the account description and amongst first 12-15 tweets. The dominating phrase "design new architecture" obscures some more interesting words like "robot" and "3dprint" or words from CAD jargon: "BIM", "Revit" or "Grasshopper". More information:

<http://bit.ly/2kXrHZK>

partner. We are planning to work with the chair for Communal Planning at TU Vienna on several *space tagging* sessions in May and June 2017. The chair team and their students will be invited to use the mobile application, and evaluate terminology extracted by text-mining. In this experiment, we will investigate how physical interaction and collaboration might inform cognitive and social processes in space. The experiment, conducted in public space, and with a particular focus on the effects of computation, will create the basis for future collaborative experimentation.

PROJECT 2: PUBLIC SPACE IN SOCIAL MEDIA, HUMANOID ROBOT PERSPECTIVE

In the second experiment, we will perform long-term observation of interaction with the mobile application with new and precedent users, mostly TU students and architects. For this experiment, we are planning to enlist collaboration with the research team of the *Humanoid Robots in Architecture and Urban Spaces* project, also based at TU Vienna. We are interested in how the sensors distributed in a humanoid robot body (cameras, gyroscopes, microphones, etc.) can be used to report on computational phenomena in its surrounding.

Implications of the work for the CHI community

Using Computation to Mind for Meaning

Text mining, as a data-driven research tool that allows categories to emerge from the data, shares the same goal with certain qualitative methods, such as grounded theory and content analysis. Yu et al. [16] maintain that text mining encourages open-mindedness and discourages preconceptions. However, there are

indications of shortcomings of big-data analysis to account for interactions on the network, context and meaning of the content [8,11,15].

The use of algorithms and data mining techniques in marketing and social analysis has been critically addressed in culture studies. Mark Andrejevic regards Facebook and Twitter as the worlds biggest focus group (a term from marketing research) [1].

In the context of architecture, the use of data analysis received significant attention at the CAAD chair, ETHZ, Switzerland. Hovestadt and Bühlmann have extensively explored the way technology and architecture converge in productive ways, most notably in *Sheaves* [10] and *Coding as Literacy* [3]. Some practical applications include the work on self-organizing maps (SOM) and topological data analysis (TDA). For example, Moosavi is looking for ways to apply data driven modelling of urban data streams to questions of air pollution [13] or real estate markets (Figure 2).

In this project, we address the shortcomings of data analysis identified by Gerbaudo [8] by an innovative approach we call *collaborative qualification*. This experimental activity should enable inferences and interpretation which are purely qualitative, but which are based on results of processing of large data-sets. We expect a specific kind of collaborative meaning-making to emerge from interactions facilitated by this tool – interactions between participants in our experiments and the surrounding space. Architecture here serves as matrix to observe how people interact with computational” and algorithmic systems.

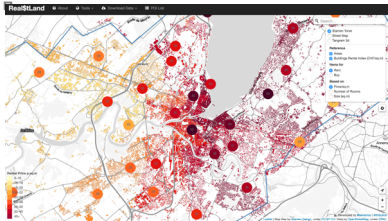


Figure 2: A map of Geneva real-estate prices. From Vahid Moosavi's research blog, <http://bit.ly/2jl113x>

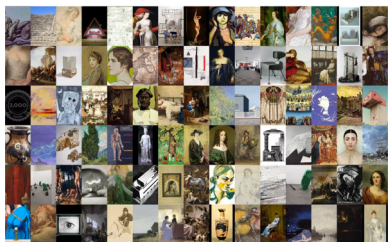
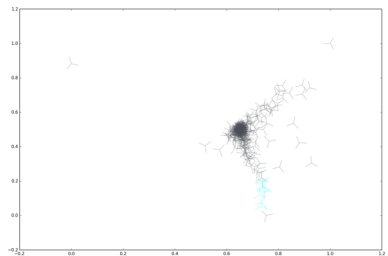


Figure 3: Manifold learning of posts to identify similar blog themes, research by Jorge Orozco, <http://bit.ly/2ilstk4>

Furthermore, we value the debate around the third HCI paradigm, which regards interaction as critical for meaning making [9]. McCullough observed this similarity in the fact that both architecture and interaction design “address how contexts shape action” [12]. Based on this emphasis, we propose to design and study interaction with a mobile application which will be used to tag, comment and describe – in one word qualify experience of space in the context of computer-aided design.

We hope to form a comprehensive body of research that can be applied both in the creation of computational tools for advancing architectural theory and in architectural design itself. With the collaborative qualification experiments we hope to go further than data analysis of discourse could, and address recent criticism of the incapacity of this approach to address issues of meaning [8]. The inquiry in the way computational concepts can be translated into the domain of architectural design and experience will hopefully serve as a generic ground for discourse on future developments in designers’ interaction with software tools.

Discussion and Future Work

The presented work proposed to consider how the challenge of organizing the discourse on computational process in architectural design could involve computation in largely unexplored ways. While computation happens on multiple levels of architectural design, construction and use, the application of digital tools is largely understood as manipulation of spatial parameters, virtual volumes and graphics. We argue that digital tools could also have an important potential

in the analysis of the meaning and qualities of digitally-produced architectures.

This project lays at the intersection of a number of disciplinary vectors, united around the interest in phenomena that organize space and the role of digital tools in this process. Disciplinary boundaries are not what we are trying to cross – they have been contested by a number of researchers already. It is about endowing the established fields with the perspective of digitization, increasingly seen as the unifying idea in academia [2]. The project will render explicit the activity in different *channels of information exchange* that affect architectural design processes – a crucial issue for 21st century politics and sociality.

Towards Digital Literacy

Digital literacy contributes to a clarity in translating computational concepts into the realm of design of architectural experiences. The process of *collaborative qualification* will work towards raising the level of *digital literacy* and fostering an analytical – hence, critical – approach to synthesis by digital tools. Attending to Eisenman's critique of using computer as a tool, digital literacy could result in syncretic design of space, departing from an understanding of space as heterogeneous [7].

A discourse adapted to the phenomena invoked by active performance of technology in spatial design could bring clarity to the process of designing and make more adequate and more innovative use of digital technologies. Digital literacy in architectural context reinforces a more substantial relationship between computational processes and design decisions than we have today.

Recommendations for further investigation

Following on the assumption that digital literacy is significant for the scope of outputs designers can deliver using computer-based tools, we propose to study how these tools can be improved or adapted to particular needs. We expect to have more concrete proposals once the main concepts emerge from text-mining activities. For now, we envision to collaborate with architects on defining design routines that are related to computational processes and implementing these in existing CAD tools.

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