Interfacial Design

Situating contemporary autopoietic techniques within the context of the autonomy project and biotechnological revolution

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Abstract. *This paper reconsiders the agenda of Architecture's Autonomy Project against the American biotechnological revolution in the 1970s. The authors explore distinctions between autopoietic and emergent ontologies for the purpose of framing current biocomputational design techniques within interfacial design ontology. Emergent search is questioned as a next-generation method for addressing cities as living bodies of information and designing them as such.*
Keywords. *Autopoiesis; integrative design; autonomy project; multi-agent systems; emergent search.*

Introduction

Necessity for Interface

Architecture and urban design, in the context of conditioning increasingly complex social, material, and economic populations, has been presented with the task of integrating with and simultaneously affecting multiple dynamic processes within this milieu. As such, architecture has had to look beyond itself toward other disciplines that have and continue to utilize information and visualization technologies in relation to complex populations. A prominent instance of this methodological occurrence is found in architecture's appropriation of multi-scale, multi-agent models borrowed from the discipline of computational biology. The significance within these systems is the blurry boundary induced by design between the biological and the computational as a matter of integrating one into the other (and back again) through mediated communication networks.

Borrowing from another's definition of interface, biocomputational disciplines rely on "a boundary or point of contact between two [or more] complex systems which itself governs the exchange between those systems." (Bratton, 2008) Its implied protocol: first, precisely determining what aspects of any individual system are to be acknowledged, and second, mediating the degree of effect that systems exert upon one another by modulating that flow of information, constitutes something akin to a law of "correct use" (Tafuri, 1969) of and between systems. For architecture and urban design to consciously assume such a protocol allows for a realization of Deleuze and Guattari's (1980) machinic assemblage, "a set of cutting edges that insert themselves into the assemblage undergoing deterritorialization, and draw[ing] variations and mutations of it." Correct use

of the city then becomes a dynamic and biopolitical expression made possible through interface as a first order territorializing mechanism. This paper focuses on the convergence between autonomous formal simulations in architectural discourse and the constantly evolving integrative techniques of biological computation through multi-agent systems. This in turn, forms a new kind of architectural project that instrumentalizes biocomputational interface toward the purpose of distributed biopolitical autonomy of and within cities.

Manageability of Parts

Scientists (computer scientists and biologists alike) involved in the endeavor of biocomputational models realize their own inability to reproduce in totality any bottom up developmental process – there are simply too many conditions to account for and "beyond a certain level of complexity, qualitative thinking fails us." (Noble, 2002) In response to this problem, some biocomputational scientists have reverted to autopoietic techniques such as agent-based and evolutionary models. The coordinated interactions of agents with one another at multiple scales can result in global emergent phenomena like flocking formations (Von Mammen & Jacob, 2008), a genetic switch (Jacob & Burleigh, 2004) or a secondary immune response. (Jacob et al., 2006)

While these systems are typically capable of producing complexity and emergence, what is of concern is their structural ability to produce novel economies of information. The act of interface itself allows us "to overcome the ecological and economic limits to growth associated with the end of industrial production, through a speculative reinvention of the future." (Cooper, 2008) As such, biocomputational techniques can serve as interfacial diagrams toward the production of novel architectural and urban form. In relation to this charge, living systems become more than a concept, but rather something codified and spliced back into the polis so that it might have the capacity to remain productive, effective, legible and open. The correlation between biology and cities as vital organisms becomes a condition reified by the closing of systems into one another as a means of producing a constantly opening polis.

Synthesizing Ontology: Beyond Autonomy and Integration

Architecture has a long history with the production of autonomy. Architects who have developed an expertise at designing complex systems in accordance with those principles must address a major contemporary deficiency: their [complex systems] insertion into and integration with existing or immanent complex systems despite employing an ontology that frames systems as being closed and effectively detached; autopoiesis. Much of this has to do with a confusion between Architecture as a fetish object versus Architecture as the realization of technological ubiquity. While designs appear to be making significant strides in producing complexity, they more often than not fail to generate a substantial context for their presence, thus amplifying a detachment rather than taking advantage of an inherent potential to connect. Interfacial design reorients these ontologically internalized techniques, acknowledging the pure interiority of our present condition by reifying the autopoietic bodies that form the present polis. A distinction between autopoietic and emergent systems is employed to differentiate between stable-state and dynamic modes of framing in Architecture and biocomputational design. Emergent search is into architectural and urban interface design, complex systems may assume their rightful place as vital engines of social innovation by means of an ontological framework that has the capacity to absorb and re-engage the multitude of dynamic bodies they produce and interconnect.

Mechanisms of Autonomy: Subverting Historical Limitations

Effacing History in Architecture

It is important to at least partially retrace the conceptual and historical correlation between the agendas of the Autonomy Project and biotechnology in order to frame a more specific problem that relates one to the other. K. Michael Hays (2001) identifies the 1970s as having been the "moment of architecture's re-foundation" precisely because the architectural image as commodity had at once lost its meaning in the context of technological reproduction while simultaneously losing its historical ability to exert resistant force through an understanding of those images. Jameson (1984) correctly points out (reiterated by Hays) that this limit condition of the real as it relates to architecture demands a shift away from representational modes toward alternative methods of power production and resistance.

Peter Eisenman in his analysis of the Fascist architect, Giuseppe Terragni, identified and reproduced Architecture's technological (the designer's) capacity to efface history. In his essay, *Terragni and the Idea of a Critical Text*, Eisenman (2003) explains this proposition as it relates to nature. "When the language of architecture is understood as natural, the question of the possible is removed, and cultural shifts in architecture are limited. Formal displacements, articulations, and experimentation can be posited as critical in this regard, in that they do not assume that the condition of an architectural language is objectively given but rather that it constitutes a series of unarticulated expressions." The statement is significant in two ways. First, it frames nature as an undesirable object of limitation or objective limits. Second, it is a limit that can ultimately be overcome through the production of an alternative self-referential and internally contingent system. The ultimate historical force, nature, becomes something that crumbles in the face of formal structures and strategies. While Eisenman aims his argument at the mechanisms of critical practice in architecture, he reveals an attitude about technology's ability to redefine the historical relationship between architecture and nature. Where architecture was once something concerned with respecting and working with nature and other normative conditions of history, Eisenman identified a new capacity for architecture: to produce a multitude of speculative futures independent of natural limitations.

It is in the work of the Futurists (and subsequent work of the avant-gardes) who were primarily concerned with producing and internalizing, by means of aesthetics and image production, a politics of technology. Boccioni's "Elasticity" (1912) does as much, reimaging man's body as a fragmented whole synthesized into the body of the horse he rides through the force of speed and power contained in the hybrid. The technological object expresses its inherent power to both disintegrate and reintegrate bodies into one another forming new relationships, organizations, structural formations and behaviors that the liberal subject is powerless to resist. Tafuri (1969) addresses this condition when he writes, "The laws of production thus came to form part of a new universe of conventions explicitly posited as 'natural.' Herein lies the reason why the avant-gardes did not raise the question of appealing to the public. Indeed, the question could not even be raised: since they were interpreting something necessary and universal, the avant-gardes could easily accept being temporarily unpopular, knowing full well that their break with the past was the fundamental condition for their worth as models for action." And so Tafuri's claim that architecture's ideology is consumed within the "nature" of the polis is to say (in advance) that architecture's quest for autonomy is a process of reinventing nature by means of autocannibalistic forms of consumption. However, architecture's reliance on ahistorical techniques of the early 20th century avant-garde would only enable it to go so far. It would take a crisis of global economic and environmental proportion to unlock the more robust and productive biotechnological potential of

autonomous techniques.

Life as Surplus and the Employment of Emergence

The 1970s marked a significant period in time in American and global biopolitics stemming from economic and environmental crisis induced by the realization of finite global-economic resources. Cooper situates American neoliberal belief and investment in biotechnology as the primary solution to these exact problems qualifying the agenda as producing life beyond the limits; a parallel of the Autonomy Project's desire to reconstitute nature, replacing it with the infinite resource of the human mind. Building on Foucault's biopolitics, she claims that the rise and development of the biotech industry is inseparable from neoliberal politics that enable a "relatively mutable set of biopolitical relations." (Cooper, 2008)

Declaring a "wholesale crisis in the realm of reproduction," (Cooper 2008) she situates The Club of Rome's world futures report of 1992 (Meadows et al., 1992) as having identified resource scarcity as a temporal problem where the point of no return had already been crossed, thus environmental catastrophe was imminent. As an alternative to exponential growth, the Meadows team advocated its replacement with some form of a steady-state economy.

Charged by an ideological resistance to state-forms of power and a belief in the dynamic power-making capacity of life itself, the neoliberal right turned to biotechnology in order to "restructure the U.S. economy along post-industrial lines… In particular, [the biotech revolution] explores the crossover between neoliberal theories of growth, crisis, and limits and the strategies of speculative growth deployed in the development of new life science technologies. Neoliberalism and the biotech industry share a common ambition to overcome the ecological and economic limits to growth associated with the end of industrial production, through a speculative reinvention of the future." (Cooper, 2008) Only when industrial production had reached a limit condition by its own making, did a threat-driven cause for biotechnology come into existence. At the very core of this condition lies the premise of emergence as a means of power production; the parallel agendas of the Autonomy Project and the biotech revolution coming into full focus with this realization. That the future of technological development and speculative capital futures are intimately intertwined specifically implicates architecture as being tasked with inventing and projecting the image of a biotechnologically enabled emergent economic future; excess being the commodity par excellence. The result of this politico-technological model being a displacement of autonomy into inherently mutable information networks that could on one hand be negatively understood as the annihilation of the liberal subject, or productively as the fragmentation of subjectivity into constituent "dividuals." (Deleuze, 1992)

Cyborg Biopolitics

The integration of biotechnology into society inherently radicalizes the relationship between life itself, biopolitics and autonomy. The technological ability to splice, recombine and blur conventional biological boundaries and the institutes that operate in accordance with them creates an excessive pressure on Cartesian notions of autonomy and liberal subjectivity. Paralleling the shift away from the individual subject and toward distributed field conditions tackled in the Autonomy project, Hayles (1999) identifies similar tensions in the development of cybernetic technologies. When integrating man into larger circuits of information, such as ballistic targeting systems, the liberal subject began to disappear as classical boundaries became increasingly blurry in relation to the flow of information through and between physical and virtual informatic bodies. As cybernetic technology rapidly evolved during the 20th century, she identifies three significant phases within its evolution that provide insight into the biopolitical complications. The latter two phases; reflexivity and virtuality, operate as functions of autopoiesis and emergence respectively. By using these terms to frame systemic ontology, we are able to better

problematize the Autonomy Project for the purpose of understanding its value in relation to interfacial design ontology. We do not mean to disregard other definitions of emergence, particularly that of Banzhaf (2004). We also acknowledge the fact that autopoiesis is itself an emergent phenomenon, but one that is idealized and isolated to describe the process of reproduction independent of environmental and evolutionary conditions. We simply find this distinction a useful one when both producing and managing complex systems with emergent conditions.

Within autopoiesis as ontology, the act of framing is privileged and forms the legible (closed) definition of the system as such - the conserved aspects of a system act to define and recreate itself. Within emergence as ontology, the indeterminate (open) conditions define the system and as such preclude an ability to form substantial definitions. This is to say that the distinction is meant to be a productive one - framing systems as closed (autopoietic) or open (emergent).

Autopoiesis is a concept introduced and developed by Maturana and Varela in 1972 identifying self-making machines; machines that can regenerate or reproduce themselves. The concept itself was introduced for the purposes of providing a manageable definition for living things that could disregard, filter, or overcome the problems associated with the impossibility of totally reproducing developmental or evolutionary processes. Much like the Autonomy Project, in the context of infinitely complex systems and indeterminate behaviors, autopoiesis allowed systems theory to turn inward in order to generate complexity rather than having to address the multitude of complexities external to it.

Hayles, while exposing contradictions within the concept of autopoiesis, precisely identifies the unifying capacity of autonomous interface between otherwise disparate bodies. Citing *Autopoiesis and Cognition* (Maturana and Varela, 1980), autopoiesis is defined through a distinction between structure and organization. "*Organization* denotes those relations that must exist among the components of a system for it to be a member of a specific class. *Structure* denotes the components and relations that actually constitute a particular unity and make its organization real." (Hayles, 1999) Her problem with this logic as it relates to living systems is revealed in the following argument: "Either [two different species] have the same organization, which would make them members of the same class, in which case evolutionary lineages disappear because all living organisms have the same organization; or [two species] have different organizations, in which case organization - and hence autopoiesis - must not have been conserved somewhere along the line. Either organization is conserved and evolutionary change is effaced, or organization changes and autopoiesis is effaced… Conserving organization means conserving life, a fact that may be adequate for autopoiesis to qualify as a property of living systems, but does nothing to articulate autopoiesis with evolutionary change." (Hayles, 1999) The critique is significant on two levels. First, she exposes autopoiesis' ability to integrate life into a common substrate through a conservation of internalized contingent logic. Second, she inadvertently identifies the autopoietic capacity to avert classic models of developmental/evolutionary process in favor of reproducing new life through novel recombinancy and interconnection.

Going even further, Hayles identifies the circular logic of autopoiesis as an ahistorical method for knowledge production that could just as well be a definition for the Autonomy Project, "Leaving aside the problems with his explanation of structure and organization, that something is basically the integrity of a self-contained, self-perpetuating system that is operationally closed to its environment. In Maturana's metaphysics, the system closes on itself and leaves historical contingency on the outside. Even when he is concerned with the linear branching structures of evolution, he turns this linearity into a circle and tries to invest it with a sense of inevitability. Seen as a textual technology, *The Tree of Knowledge* is an engine of knowledge production that vaporizes contingency by continuously circulating it within the

space of its interlocking assumptions." (Hayles, 1999) The functional logic of autopoiesis under this definition is identified as displacement from an exterior by means of totalized internal integration, paralleling even the most commonly misguided critique of contemporary autopoietic architecture: its apparent detachment from the real rather than acknowledging its productive reality. An inflection point between interiority and exteriority is needed to usefully understand autopoietic territory.

Using Virilio's accident in relation to this concept serves to articulate a significant (political) difference between autopoietic and emergent ontologies. By our definition, autopoiesis integrates the accident into its spectrum of desired potentials by defining it and as such insures the complete enclosure of its systemic boundaries. In an agent-based system, this process would unfold in the following manner: produce formal agent definition - define agent interfaces (attributes, perception, actuators), configure, run, and relate emergent formations to the conditions that produced them. While autopoietic systems are capable of producing emergent formations, by definition those formations do not have an inherent capacity to exert transformative force back into source code itself.

These systems, like living things, can die. This is to say that autopoietic systems are stable in their circularity precisely because they do not have the ability to generate emergent conditions that can autonomously separate them from their parent system. This is the condition of the liberal subject, who's only option for autonomy is the ability to augment the structure of the autopoietic network they inhabit. This is certainly a recognizable thrust within a project such as Skinput (Harrison et al., 2010) that transforms the network capacity of one's on skin into an interactive touch-screen device, Tsao's "Curious Displays" [1] that deploys an interactive pixilated amoeba-like screen within domestic environments, or Real Time Copenhagen [2] that transforms the city into a swarming network of social interaction using real-time imaging of mobile devices. In each of these cases, interactive participation within the system (real-time or otherwise) ends up incorporating individual choice into processes of reorganization. Play and excess being always already internalized into the systems in order to produce differentiation and new forms of intelligence.

It is also to say that autopoietic systems are not purely ahistorical. Rather a subject's only real escape from a given sphere of interiority is to interface some part of it with another thus redefining the system through an appropriation and internalization of multiple histories. This is the mechanism of power relations that has the capacity to replace sovereign power and the state of exception as a model for evolutionary and developmental processes.

Emergence as an ontology is fundamentally different in relation to the accident. The accident is incorporated into the system through its exclusion. (Agamben, 2005) Emergent ontology defines a potential threat and then mobilizes an indeterminate prophylactic force as a standing reserve to combat it. Emergent ontology allows for initial parent-child relationships to be destroyed precisely because the parent code does not explicitly define the emergency. In the case of the state of emergency, contingency becomes annihilated by sovereign force as a mirroring of the indeterminate and catastrophic potential of accidents rather than the accident itself. They are indeterminate states that operate with a reliance on sovereign power in order to abandon a system in the context of but not necessarily in the event of an emergency (the accident).

We posit that despite their appearance as being mutually exclusive, that the two form an ideologically complementary pair in relation to the framing of code itself: autopoiesis making the state its paradigmatic cyborg (Hayles, 1999) with the desire for self-preservation and conservation in a closed environment; emergence employing exceptionalism as its paradigmatic model (Cooper, 2008) internalizing mechanisms that undermine stable forms of state power for the purpose of evolution in purposefully undefined environments. This ideological distinction

is significant in that one model (autopoiesis) frames stability, its reproduction and recombinancy as its performance goals while the other (emergence) frames instability and accidental evolution as its performance goals; the former making use of the law to prevent, internalize or co-opt the exception (thus transforming the law); the latter making use of the law to produce the exception (thus negating the law).

Interfacial Design and Emergent Search

Defining Interfacial Design

Interfacial design is a practice descending from the Autonomy Project, appropriating two distinguishable aspects from it for use. First, it provides autopoietic, self-referential techniques of interconnection that generate emergent forms and formations. Second, it provides us with an autonomous instrument, the diagram, that has the technological potential to form new connections between otherwise unconnected systems. As mentioned in the introduction, interface is "any boundary or point of contact between two [or more] complex systems which itself governs the exchange between those systems." (Bratton, 2008) This concept is launched under the general premise that instead of making more detached things, Architecture should invest its expertise of autopoietic techniques toward the organization and interconnection of the things that already exist as a matter of good content management. The primary challenge for interface in contemporary architectural discourse (as well as for biocomputational science) is the ability to access, modulate and reproduce existing complex systems that operate in complex environments.

Interfacial design is the design of interfaces as a first gesture of design, borrowing Derrida's (1987) proposition that the first act of art is the construction or fabrication of the frame; "a primary gesture that requires the body's prior separation from the earth, from nature, from its world." (Grosz, 2008) If interfaces frame; interfacial design constructs, organizes and produces frames. Given this basic understanding, interface presents itself as a concept that acknowledges an a priori detachment between systems in relation to one another. It also presents interface as an autonomous object in advance of its design; an act that exists prior to the law. As pure concept, interface is a filter of flows that do not yet exist. Interface is both a means of and method for ubiquitous integration.

This is not to say that two [or more] systems might not already be interconnected to one another, but rather that there are alternative ways to structure their relationship and as such produce new form. This is apparent as evidenced by the increasingly complex and diverse forms that continue to emerge from within the computational exploits of Architecture and biocomputation, driven in particular by the aforementioned Architectural obsession with the biological as well as the appropriation of computer science into the fold of biological science.

Multi-agent systems have a great deal of internal sophistication. One particular advantage in agent-based systems is their ability to "capture properties that are intrinsic to distributed systems." (Bandini et al., 2002) Given this understanding, the autonomous displacement of complex/high-resolution agent-based systems allows us to "see" existing systems in new ways, particularly when an agent-based system can produce scalar corollaries in terms of the complexity of given systems, for example when a given system cannot be represented by the functionality of a single component type, multi-agent systems have the capacity to handle the differences; managing part-to-part interactions within and between different phenotypes and systemic ontologies. They go on to identify multi-agent systems' ability to engage both open and closed systems. Such is the case demonstrated in *Genetic Swarm Grammar Programming: Ecological Breeding Like a Gardener* where Von Mammen and Jacob (2007) produce multi-agent swarms that operate as a phenotypical breeder enabling developmental process to take place interactively

with the user/gardener. As phenotypes evolve, they exert differential pressures within the system given developmental behavior within the simulation. The code explicitly defines the gardener through a set of tools and actions within the system inviting the user to participate in the evolution of the system. Architectural design research practices such as Kokkugia and Synthetiques are also incorporating multi-agent techniques toward the production of form addressing referencing processes such as delamination in neural crest development using particle swarm optimization. More banal forms of agent-based modeling have come into the mainstream as well. Big box stores such as Walmart and Home Depot employ agent-based models that mine demographic conditions as a means for locating new stores or testing the viability of existing locations. The models include basic census data as well as real time purchasing patterns, relative distances to other self-similar stores and of course transportation accessibility. As such, one of the most sophisticated images of post-industrial socio-economic and biopolitical environmental conditions might come through the reading of Walmart retail locations [3].

Emergent Search

Rising from practices of natural disaster search and rescue techniques (Drabek et al., 1981), emergent search incorporates catastrophic events with large distributed system environments. While biocomputational research has been developing such as context-dependent emergent search in social aggregates (Torney et al., 2009), explicit and emergent cooperation schemes within search algorithms (Crainic and Toulouse, 2008) and multi-layered multi-agent situated systems (Bandini et al., 2002); the most compelling instances seem to come in the form of urban agent-based networks.

Such was the case in the Mumbai terrorist attacks where GPS, mobile telecomunication devices and Twitter feeds all came into play in a completely unpredictable, dynamic and urban scenario unfolded. [4] As the attacks were coordinated through (nearly) untraceable pre-paid mobile phones and broadcast through 24-hour news networks, a counter-swarm of Twitter feeds ended up producing a real-time adaptable image of safe egress throughout the city interconnecting those within the city to those safely outside. The form of the system resulting from TV camera men, police reports, reporter announcements, twitter feeds from people trapped or escaping from within the event. The sphere of interconnection coming into form as the event was happening and dissolving once the crisis had availed. The city became a full scale mobilization of multiple heterogeneous agents swarming and counter-swarming. An ad-hoc defense mechanism that functioned in a fluid and adaptable manner through a rapid opening up of informatic flows when there none to be had otherwise.

Another more mature form of emergent search comes in the form of the murder reporter networks of *Alarma!* [5] In this more established network form, photographers for the sensational magazine monitor police and ambulance reports announcing the locations of the freshest murdered corpses in Mexico City. Once notified, they race to the scene attempting to get there before their access is limited or denied. Once on the scene, they capture the most graphic images of dead flesh (usually drug-related torture-murders). Shooting up to 8 corpses on any given night, they deliver their product to the editors who put the paper out on a daily basis - the cover page always coming in the form of a full page image of the most gruesome image possible. The headline of course is sensationalized to amplify the effect. It is a magazine with huge circulation and is most definitely mainstream. But the agent-based biopolitics is something to note; internalizing rather than excluding the most explicit images of violence into the norm. The entire event transforming an otherwise abandoned landscape within the night of Mexico City into a slaughter house for the busiest restaurant in town. How this network ever came into formation must have only been a minor morbid curiosity that grew in strength as the curiosity transformed

into something much more pervasive - much more normal. That a polis has an appetite for its own flesh seems like the clearest metaphor for the behavior in agent-based systems - a literal example of the "monstrosity of the flesh" (Hardt and Negri, 2005) that the multitude is capable of producing.

Conclusions

We wonder if there might be an instance in nature that operates in accordance with what we've described as interfacial design. And so we turn to Elizabeth Grosz's writing on art and nature: "Art takes what it needs - the excess of colors, forms, materials - from the earth to produce its own excesses, sensations with a life of their own, sensation as 'nonorganic life.' Art, like nature itself, is always a strange coupling, the coming together of two orders, one chaotic, the other ordered, one folding and the other unfolding, one contraction and the other dilation, and it is because art is the inversion and transformation of nature's profusion that it too must participate in, and precipitate, further couplings." We like to think that this passage describes the act and the agenda of interfacial design. Rather than a militarized political agenda bent on world domination, whether fascist or neoliberal, that interfacial design might be a proper form for making lives of and within the polis.

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