From Formal to Behavioral Architecture

Few Notes on the Abstraction of Function

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Abstract: With the advent of information theories, contemporary architecture is approached in terms of the energetic formations of memorization, association and connection. The former architectural diagram becomes a concretization, an instance, one possibility, of an operational code. Memorization refers to the ability of architecture to embed information within the deepest composition of matter. Architectural performance has always been revealed by the integration, or association, of multiple parameters. Connections are vectors which fuse the knowledge of heterogeneous symbiotic human environments. In the “C-chair”, a project by our laboratory Open Source Architecture, abstract objects such as points, lines, and surfaces act as memorizers of information. As the codified system reacts to external forces, an association of two distinct graph structures is developed and connections are formed as the architectural object emerges.

Keywords: Computational algorithm, information theory, computing design, energetic architecture, behavioral system

Energetic operators

With the advent of information theories and its ever-increasing role in design processes, architecture is now more than ever putting life at the center of its preoccupation. Commonly interfacing heterogeneous parameters, architectural forms have given place to energetic formations that are seen and designed to continuously process, assess and produce informative energies. By approaching architecture in terms of energetic formations, it is here suggested that the conventional terms form, structure and function are now encapsulated within notions of memorization, association and connection. Considering architecture in terms of information flows implies a shift from the common abstraction of forms to the abstraction of functions, meaning the coupling of information streaming, screening and re-sampling.

The three notions of memorization, association and connection result from the “informatization” (Negri and Hardt, 2000) of architecture. These three terms represent the parameters according to which one can assess today architectural performance and its produced formations.

Memorization refers to the ability of architecture to embed information within the deepest composition of matter. While memorization has shaped our “technological heredity” (Kiesler, 1939), the nano-degree of precision inherent in information technologies has significantly intensified our ability to
inform, to give shape, to matter. For memorization, everything is information, therefore alive and potential energy.

Beyond the notion of memorization, architectural performance has always been revealed by the integration, or association of multiple parameters. The computational paradigm has now triggered a reassessment of former ideal models and the emergence of iterated models which best exemplify the mutating aspects of reality. Evolutionary processes, agent-based systems and fluid dynamic engines, among others, now represent critical design procedures. Both simulated and stimulated by complex systems, these procedures have re-placed life at the core of an architectural anxiety to integrate and even to disappear within nature. Here, the notion of re-placing life refers to the idea that life is no longer simulated but is literally procreated. First perceived as a modus operandi that intensifies the form, information associability is about to reach a very different goal: “the possibility of life without objects” (Superstudio, 1972), meaning a shift from forms to pure kinetic energy.

The third notion, connection, has transposed architecture from its traditional disciplinary core toward a boundless platform of “fused knowledge” (Ahrens et.al, 2006). Architecture has always been a vector of interaction between heterogeneous human environments. Yet, with the tremendous development of information networks, architecture has turned into an open source where its produced formations are no longer autonomous but instead are dependent on multi-dimensional sources of knowledge. The architectural formation has a degree of performance that depends now on its symbiotic relationship with life. As an open source, the contemporary architectural formation acts as a source that transfers energy across N-dimensional grids of information.

Memorization, association, connection are three energetic operators that manage contemporary architectural formations. Architecture no longer prescribes forms but formations, so to say behaviors that emerge out of potential, kinetic and transfer energies of information.

From the abstraction of forms to the abstraction of function

From Peter Eisenman’s liberating forms to Greg Lynn’s curvilinear shapes, architectural research has been commonly associated with the abstraction of form. Yet, in recent years, with the “informatization” of the real, architecture is offered the possibility of perceiving our reality in terms of behavioral patterns rather than formal models. It is here proposed to consider the abstraction of function, instead of the abstraction of form, as a liberating force that offers behavioral and responsive architectural mechanisms rather than shallow images of reality.

Already in 1965, with the proliferation and specialization of building systems, Reyner Banham described this shift from form to function as a “baroque ensemble of domestic gadgetry [that] epitomizes the intestinal complexity of gracious living” (Banham, 1965). This analogy of mechanical and electrical services to systems regulating the living organism is striking because it suggests that the accumulation of energetic functions; as diverse as climatic, wireless and grid-based, implies the disappearance of the form, image and representation of architecture as we know it.

Francois Dallegret’s drawings for Banham are a tribute to this conglomeration of mechanical, electrical and structural systems, with their associated requisites and interactions (Banham, 1965). This vision of the house as an exhilarating skeleton marks the advent of a design paradigm of performance for architecture of life, energy and (de)regulated behaviors. Similar to a living organism, Banham’s architectural object emerges out of energetic streams, organic veins forming a unitary system of interwoven and interacting sub-systems which combine effectively toward the whole.
From diagrammatic systems to codified operations

Today, with Dallegret’s mechanical systems turning into operational sets, the former diagram becomes a concretization, an instance, one possibility, of an operational code. With the ever-increasing integration of computational capability, it is now largely accepted that the architectural object is generated out of operational processes that are often inspired by other disciplinary fields such as biology and genetics. Like the DNA of living organisms, architectural reality as codified implies that it has become energetic. Its codes are dynamic and reactive to the ever-changing modalities of the external environment and internal capabilities of the architectural model. Architecture, as nature, induces vital mechanisms of manifold information streams, simultaneously memorizing, associating and connecting parameters that regulate the living and evolving designed organisms. This analogy of architectural codification to living organisms is not a coincidence. In comparing genetic encoding with software encoding, we find striking similarities between the theory of evolutionary development (Carrol, 2005) in biology and software techniques such as object-oriented design.

Our laboratory, Open Source Architecture (www.o-s-a.com) has produced the “C-chair” that exemplifies the development of such a system. C-chair is a proposal for a line of furniture commissioned by a major European design foundation. For this project, the model begins with inanimate objects such as points, lines, and surfaces. These objects, by themselves, are empty containers which act as memorizers of information. Once they are placed within the context of a spatial and temporal axis, they are imparted with information, such as location, direction, and connections. As these basic building blocks are established and well defined, a secondary level of information is imparted in the form of a connected graph.

Graphs are data structures which connect nodes and edges in particular ways to encode particular systemic behaviors (Diester, 2005). For instance, a graph regulated by the rule (gene) that any node can connect to any node results in a rhizome structure. A rhizome can fill a bounded surface or volume to a desired density pattern as controlled by genetic switches. For C-chair, a gradient switch responds to areas where the human body comes into contact with the chair surface. Another type of graph, a binary tree, is regulated by a rule stating that any node can connect to a number of child nodes (fig. 1). The tree’s character is hierarchical, and therefore lends itself to structural properties. Genetic switches also regulate its size, position, and density.

By associating these two informational structures, the emergent behavior of C-chair is developed. As such, systems become increasingly elaborated, information can be imparted into many different
The stochastic ontological drift of speed, direction and density. A clustering technique regulates the hierarchical structure of the tree. One by one, points are moved from one cluster to another until the system stabilizes to form a minimal overall Euclidean distance. The more complex organism, the tree, inherits the established knowledge of the less complex organism, the rhizome, and this knowledge is encapsulated as an object-oriented machine. Some methods are reused and others are augmented or overridden. (Fig. 3)

Properties which are common to both computer science and the biological science of evolutionary development include modularity, containment, hierarchy, combination, aggregation, encapsulation, inheritance, and polymorphism (fig. 4). A phylogenetic tree can be used to map the specificity and diversity of switches as they evolve to regulate increasing complexity through inherited knowledge and the combination of modules.

Further research is being conducted in our laboratory to develop behavioral models as applied to the architectural framework. Fuzzy Logic is a rule-based system which can model uncertain or ambiguous information. Finite State Automata are intelligent agents which can emulate cooperative natural systems. Evolutionary development inspires the encoding of biological mechanisms (fig. 5). This generalized model is capable of responding

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<td>Surface Point Cloud</td>
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<td>Cluster Division Factor</td>
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Figure 2
Information system reacting to structural requirements

Figure 3
Protocol of C-chair showing the use of object-oriented design, clustering, and binarization techniques
to structural, environmental, and even social forces. Architecture as an energetic system that informs mechanical behaviors implies a shift from the traditional abstraction of forms to a generative protocol that aims at abstracting the function, rendering reality in terms of memorizing, associating and connecting information.

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