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Simulacrum, Not Simulation: A Theoretical Approach to Simulation in Education

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Abstract

As the practice of architecture grows increasingly more infatuated with verisimilitude, the technical skills required to enable a morphogenetic design process become increasingly specific and extensive. While this model is not as problematic within the realm of practice, in a pedagogical environment the time and expertise requisite for conducting and evaluating comprehensive simulation is an impediment to developing fundamental design skills and mastery of a morphogenetic process. This paper promotes an approach of simulacra; a procedural acknowledgement of an imperfect simulation that serves to advance design aptitude and critical thinking, rather than the pretention of perfection or accuracy.

Keywords: Simulation; Morphogenetic design; Computational design; Simulacrum; Performance

Introduction

"The simulacrum is never that which conceals the truth—it is the truth which conceals that there is none. The simulacrum is true." – Jean Baudrillard (1981)

The linkage of simulation engines and scripting software facilitates a rapid production of emergent formal conditions, spatial effects, and performative components. This performative morphogenesis is dependant upon the ability of a simulation engine to produce productive results and the capacity of a designer to manipulate the engine and understand its output. As morphogenic processes become more complex and more intrinsic to architectural production, the ability to evaluate the efficacy of a performative analysis becomes a more vital part of the process and requires a more specialized knowledge base.

Just as it is rare for an architect to be qualified to evaluate the performance of a complex structural or mechanical system, it is equally rare for an architect to be qualified to evaluate the performance of complex morphogenetic systems which are frequently grounded in structural and environmental principles. For computational designers to develop expertise in all of the disciplines encountered in a variety of climates and conditions is an inefficient and unproductive premise- the alternative, for a computational designer to develop expertise in one condition, climate or set of systems is limiting and equally unproductive. Additionally, the scripts that are generated by these dynamic, disparate systems are sufficiently complex to resist meaningful external evaluation, thus the result is the production of a system that is completely linked to the author's understanding of a foreign discipline, the artificial construction of a specialist in a generalist discipline.

This contradiction calls into question the appropriateness of simulation as a component of a morphogenetic design methodology. Simulation is an inherent abstraction and reduction, as Jean Baudrillard writes "To simulate is to feign to have what one doesn't have." (Baudrillard, 1981) As simulation engines continue to develop, the independence of one phenomenon relative to another will become increasingly more suspect. Evaluating solar gain without considering air flow, temperature and humidity may produce viable strategies but the results will seem limited in comparison to the promise simulation provides. This inflation of parameters and input will lead to increasingly complex and expensive computations, and will require an increasingly specialized knowledge bases to assess them- all of which, according to Baudrillard, will never achieve true accuracy.

Simulacrum liberates designers from this spiral of time and resources by engaging in a low fidelity process, de-emphasizing detailed reproduction and exhaustive precision for generative reduction and efficient summary. A morphogenesis based from an abstracted representation is more facile, light and malleable than a morphogenesis infatuated with an elusive perfection. Designers create intuitive illustrations of phenomena, moving quickly towards guiding the performative morphogeneses. Architectural effects lead the morphogenesis, not the construction of a dynamic system. By avoiding the expense and inaccuracy of simulation, simulacrum empowers designers by maintain focus on formal and spatial conditions by only creating implications of performance. Removing the necessity for simulated perfection, simulacrum refocuses the morphogenic process away from the construct of an elaborately flawed synthesis of dynamics and towards an iterative process of prototyping. The resulting object-based iteration produces a dialogue with specialists and objects for evaluation in real world conditions. This paper proposes that a process of simulacrum can develop facile, flexible and efficient morphogenic prototypes, as demonstrated by investigations into Aeolian dune migration, hurricane resistance, tidal energy and structural stability.

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Simulation

Digital simulation tools have recently become a critical component of morphogenetic design processes. In 2003, the possibility of incorporating simulation analysis data into a computational design workflow was theoretical (Kolarevic, 2003), but is currently prevalent with high-profile corporate firms such as Gensler, Aedas, and Skidmore Owings, and Merrill having robust design computation groups and morphogenetic workflows derived from simulation engines (Zeljic, 2010) (Aedas, 2013) (Skidmore, Owings & Merrill, 2013).

While the incorporation of simulation software into morphogenetic processes has proved viable in professional practice, the incorporation of simulation into education has been problematic. (Fischer, T., & Herr, C. M., 2001). To run simulation engines effectively, students need specific direction within the programs themselves (Ibarra, D. & Reinhart, C. F., 2009), which is time consuming and a distraction relative to the goal of developing a morphogenetic design process. Once a morphogenetic process incorporates a multitude of performative simulations, the formal relationship to these simulations becomes exponentially more opaque.

The complexities intrinsic relative to the formalization of synthesized simulations requires more investigative and substantial means of evaluation than a typical design review. If a student develops a performative system, the evaluation of the system cannot be limited to formal, spatial, and contextual evaluation but must be evaluated in terms of performance as well. In practice, designs would be evaluated by third parties to discern the performance of the morphogenetic product. While this is not impossible in an academic environment, a third party simulation of a design response to multiple simulations is beyond the scope of many studios and seminars.

Both the challenge of developing proficiency with a simulation engine and the challenge of effectively evaluating the performance of a design not only produce time and resource constraints upon a studio or curriculum, but emphasize technical skills over critical thinking and design process. The trajectory of increasing specificity serves to undermine the generalist nature of architecture practice and pedagogy.

Simulacrum

In “Teaching Generative Design”, Thomas Fischer and Christiane Herr describe generative design as problematic in that it requires study of in depth exercises and techniques, technologies, and methodologies (Fischer, T., & Herr, C. M. 2001). To prevent the requisite mastery of technical skills from impeding other pedagogical agenda, Fischer and Herr suggest “asking students to develop non-computerized generative systems in early stages of learning, requiring no technical skills by merely a basic understanding of generative design.” While this strategy is becoming more prevalent in many architectural programs, the transition from fully analogue to fully digital remains significant. This paper proposes a simulacrious approach as an intermediate step, a digital design process driven by simplistic digital or even analogue simulation engines.

When applied to an morphogenetic design process, a simulacrious approach is essentially an architectural integration of Bayes Theorem. Bayes Theorem is a statistical method that quantifies conditional probabilities, weighting potential outcomes based off of accessible information. A classic example is of a coin flip involving three coins, where one coin is weighted to always land heads up. Before a coin is flipped, the probability of any coin being the weighted one is one in three. If one coin is flipped three times and lands heads all three times, the Bayesian method calculates the probability of that coin being the weighted one four in five. (Paulos, 2011)

The simulacrious privileging of a specific set of information or ignorance of other data sets allows for a prioritization of input and an optimization of output in terms of efficiency and flexibility rather than accuracy. This prioritization maintains input from the designers themselves, rather than producing an optimized genome, simulacrum produces an informed but un-optimized result that invites modification for spatial and experiential effect.

By taking a simulacrious approach, the process of simulation is allowed to be subjectively weighted. This emphasis of specific datasets is facilitated by acknowledgement that any simulation would be inherently inaccurate and by minimizing the components and accuracy of a simulation design decisions will be allowed to be more efficient and facile. The simulacrious approach embraces selection of what to simulate as part of the design process, empowering the designer with the responsibility of producing a design that responds to a variety of interests, simulated or not.

Method

Utilizing Grasshopper, a visual scripting plugin for Rhino3D, summary representations of natural phenomena are generated through approximation and analogy. Flow lines, dynamic fields, animations, simple particle dynamics are all used as sketches, quick descriptions of complex systems to begin the design process. The morphogenetic products are by no means to be understood as complete, but iterations towards an intelligent solution. The prototypes are vehicles for further development, conversation pieces in an ongoing dialogue. The product avoids misguided illusions of perfection, and invites input from stakeholders and specialists to augment performance. The following descriptions are simulacrious abstractions of complex physical and environmental forces, reduced to simple sketches to engender a simplistic morphogenetic design process.

Thermodynamics

To incorporate thermodynamic performance into a morphogenetic design process, a simulacrious model is constructed in Grasshopper. Using Utos' FlowLines component for Grasshopper, vector fields of information are generated relative to positive and negative point charges (Utos, 2013). These points are utilized to denote the extremes temperatures of a desired thermodynamic condition relative to the project's context. The FlowLines component interpolates the vector lines between the points to describe temperature gradient (Figure 1). In comparison to a complex simulation of temperature gradients, this approximation is significantly more facile while remaining productive.

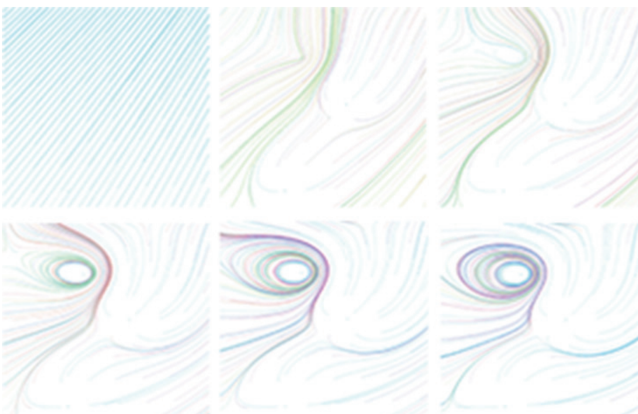

Figure 1: Thermodynamic FlowLines by Ben Ortega

Figure 2: Topology Optimization by Ben Ortega

Hurricane Resistance

A morphogenetic system designed to resist hurricane force must accommodate wind and water resistance. In the case of this project, wind is addressed through channeling and water is resisted through aperture (Figure 3). Both strategies are simplistic; the method of channeling is intuitive and facile while the method of drainage is pervasive and uniform. Neither are intended to provide accurate simulation of actual hurricane forces or their necessary formal responses, but to provide quick generation of form spawned by simulacra.

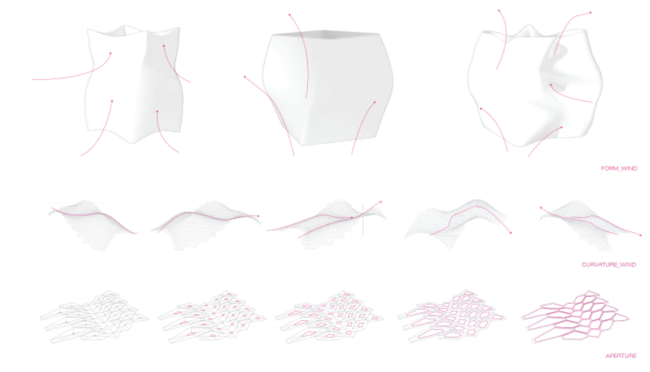

Figure 3: Responsive Shelter by Jaime Rivera

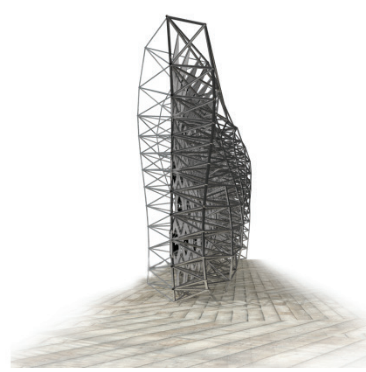

Figure 4: Responsive Shelter by Jaime Rivera

Aeolian Dune Migration

In the investigation of concretizing sand aggregation, a simulacra of Aeolian dune migration is a critical component. Resisting complex particle dynamic simulations, a simple analogue for dune migration patterns is utilized. Geologist Brad Werner described sand dune mass as a series of square cells (Werner, 1995). The simplification of millions of particles into simple cubes facilitates cellular automation which produces an approximation of dune morphology (Elder, 2009). Stills from Jim Elder's animation of dune morphology (Figure 3) are used in Grasshopper as a framework to analyze and optimize structural and formal responses.

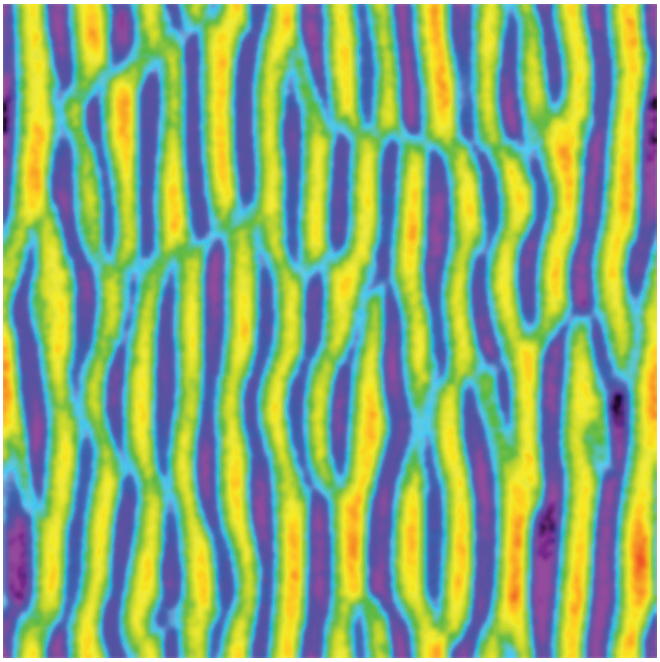

Figure 5: Cellular automaton representing dune migration (taken from Elder, 2013).

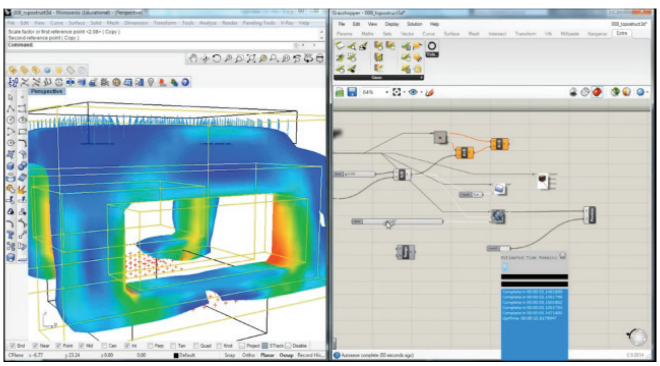

Figure 6: Diagenesis Initial Experiments by Kameron Baumgardner

Conclusion

This paper proposes simulacrious engines for morphological processes in pedagogical environments as an alternative to comprehensive simulation. Conceived as a Low-Fidelity process, simulacrious engines provide a facile platform for design by "proposing to break through the tendencies and illusive promise of verisimilitude." (Besler, 2012) By recognizing that simulation is a simple acknowledgement of what it is not, simulacra suggests a design of the simulated process to respond to the pressures of process.

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