

## **Achieving the Harmonic Forming of Interior Design & Furniture Elements through Algorithmic Theories**

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### **Abstract:**

An algorithm is a computational procedure for addressing a problem in a finite number of steps. It involves deduction, induction, abstraction, generalization, and structured logic. It is the systematic extraction of logical principles and the development of a generic solution plan. Algorithmic strategies utilize the search for repetitive patterns, universal principles, interchangeable modules, and inductive links. The intellectual power of an algorithm lies in its ability to infer new knowledge and to extend certain limits of the human intellect.

Despite the proliferation of computers in architecture today, the use of algorithms in architectural design is generally limited. Instead, the dominant mode of utilizing computers in architecture today can be identified as that of computerization, i.e. that where entities or processes that are already conceptualized in the designer's mind are entered, presented, or stored on a computer system. In contrast, algorithms, as process of creating design solutions by the use of mathematical or logical methods, are generally limited. While the research and development of software itself involves extensive algorithmic techniques, mouse-based manipulations of 3D computer models on a computer screen are not necessarily algorithmic processes.

As mentioned before, AD allows the generation of forms and shapes through algorithms. In particular, a category of algorithms aimed at producing unpredictable results quickly triggered designers' interest, allowing them to explore new uncharted formal territories in architecture. Shape grammars, mathematical models, topological properties, genetic systems, mappings, and morphisms are a few examples of algorithmic processes explored for their unpredictability.

By combining this flexibility of AD with analysis and simulation softwares, design alternatives can then be analyzed and compared with relative simplicity to select a solution that offers optimal performance. This allows the designer to prioritize performance early in the design process, or even let it lead the process, and presents a massive shift from traditional design methodologies, where performance evaluations are typically done at the end of the process, making it rarely a priority. These optimization procedures are not only restricted to technical aspects of the design performance such as structure, thermal behavior, acoustics, and

aerodynamics; they can also include other aspects such as material usage, spatial distribution, among others.

Finally, AD also enables the automation of repetitive, time-consuming tasks that had to be manually executed before, such as repetitive modelling or fabrication processes. This relieves architects from tedious and error prone work, allowing them to save a lot of time and effort during the design process.

### **Keywords:**

Algorithms - Algorithmic architecture - Algorithmic design AD - Generative design - Digital fabrication.

### **Introduction:**

Mathematics has always played an important role in the process of creating form in art, architecture and interior design over time. The construction was initially based on traditional mathematics and Euclidean geometry for several centuries. As a result of the inability to solve complex mathematical calculations to create new forms, this reliance on traditional (classical) mathematics continued until the beginning of the twentieth century. At the end of the twentieth century, traditional mathematics (classical) and Euclidean geometry were no longer a sufficient basis for architectural and interior design, or for the process of creating shapes, as a result of the requirement of increasing complexity in the plastic process. As a result, accreditation was directed to other branches of mathematics to solve this dilemma, which has become a priority that must be achieved in this world that requires renewal in the sources of inspiration and the forms emanating from them to suit the spirit of the age. In particular, the development of calculus in the 18th century provided mathematicians with tools to aid the development of advanced branches of mathematics. These tools have combined with the information technology revolution to provide CAD for architectural design. And then the advantages of CAD provided us with new engineering possibilities that make their way away from the well-known Euclidean geometry and help in the process of creating new configurations. And this reciprocal relationship between the development of mathematics and information technology has continued, until these new mathematical tools have made different other activities instead of creating different solutions to mathematical equations, which is the creation of innovative formations. This approach is now known as Generative Design. Many generative design models have introduced new tools known as Shape Grammars, Parametric Variations, and Algorithmic Generation. Recently, other tools have been presented to search for new shapes and formations in the world of Chaos and random equations, such as Fractals Geometry and Evolutionary Tools based on the process of genetic engineering such as Genetic Algorithms and Cellular Automata. These tools have changed the perceptual, theoretical and mathematical nature of architectural form. It transformed the Euclidean Platonic geometry into a new type of geometry that could never be predicted. And algorithmic theories have a great impact on modern engineering because of their definitions and classifications of different transformations, especially distortions or changes in shape. This not only provided inspiration for new conceptual architectural models, but when combined with computer technology, it can help create Deformed and Distorted Designs.

**Research problem:**

- 1- The scarcity of using algorithmic theories as a source of inspiration in contemporary design.
- 2- The lack of interior design elements in the modern era of plastic harmony between its singularity.

**Research goal:**

- 1- Extrapolation of the philosophy of inspiration through algorithmic theories.
- 2- The call to look beyond things, not only by looking at what we see, but with the system that created that thing.
- 3- Linking between algorithmic theories and shape generation mechanisms in an image that serves interior design and furniture.
- 4- Achieving harmony, coherence and unity among the vocabulary of the interior space through algorithmic theories

**Research Hypothesis:**

Testing the hypothesis of the relationship between algorithmic and harmonic plastic theories as a relationship that results in new plastic formations.

**Research Methodology:**

Descriptive analytical method.

**search tools:**

- 1- The questionnaire.
- 2- Note.
- 3- The test.

**Results:**

- 1- Algorithmic theories in design are illustrative guiding theories that depend on changing the methodology of the design process and changing its tools to reach unique design solutions bearing new intellectual features and characteristics.
- 2- Design with the help of theories and algorithms opens new horizons for design thought, which no longer depends on the subjectivity of the designer in the rules of formation, but depends on mathematical equations and scientific analysis that includes design based on analysis and performance evaluation and design according to design information.
- 3- Both architectural design and interior design have become fused in the crucible of algorithmic design, so it is not possible to separate the vision and influence of each on the other, which requires a holistic view of the design process based on the organic relationship and the relationship of influence and vulnerability between all elements.
- 4- Algorithmic theories allow designers to visualize and explore a wide range of different design possibilities. Since the generated design is parametric - that is, it exploits associative geometry to describe the relationships between things, and thus create associative relationships between them - changes made to the algorithms that generate the design or its variables are propagated so that the designer doesn't have to do updating all aspects of the design manually.
- 5- AD algorithmic design also allows for the completion of repetitive, time-consuming tasks that previously had to be performed manually, such as repetitive modeling or manufacturing processes.

- 6- The intellectual strength of the algorithm lies in its ability to infer new ways and expand the limits of the human mind.
- 7- The algorithmic theories of these new mathematical tools made other activities different instead of creating different solutions to mathematical equations, which is the creation of the new formations.

### **Recommendations:**

- 1- The researcher recommends the necessity of using algorithmic design, benefiting from its advantages, and applying it through various computer programs.
- 2- The necessity of continuous access to the latest design approaches or production and manufacturing technology to update the design thought in the academies specialized in design education.
- 3- The necessity of developing academic study programs in educational institutions, whether in terms of design courses - interior, architecture or others, in order to introduce students and train them on modern digital technologies and their various and varied applications in all fields of work.

### **Refernces:**

- 1- eabaas , luay habashi kamal , alatijah altuwbuluji kamanhaj 'iibdaeiin fi tasmim aleimarat aldaakhiliat , dukturah. kuliyat alfunun aljamilat jamieat al'iiskandariat 2014.
- 2- eabd allah , yumnaa khalid 'iibrahim muhamad: "al'atjah albaraimtaraa fi altasmim aldaakhilaa fi almintaqat altijariat alduwaliati" , risalat majistir , kuliyat alfunun altatbiqiati. jamieat hulwan , 2016.
- 3- alsafati, marwat wayil. "al'anmat altasmimiat lil'iida'at altabieiat fi altasmim aldaakhilii w aleimarat al'iislamiatu" majalat aleimarat walfunun waleulum al'iinsaniat almujalad 6, aleadad 28
- 1- El Iraqi , Ahmed Medhat, Form Generation in Architecture using Tools Based on Evolutionary & Mathematical Functions, M.Sc. Degree in Architecture , Ain Shams University, 2008.
- 2- Terzidis, Kostas, "Algorithmic Design: A Paradigm Shift in Architecture?", PhD, School of Design, Harvard University.
- 3- Feist, Sofia Teixeira de Vasconcelos, "A-BIM: Algorithmic-based Building Information Modelling", Master, tecnico lisboa.