Design Ornamentation & Fabrication by Multi Agent System

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1. Introduction

From a historical perspective, we were extremely intrigued by the organizational complexity and integrity of traditional ornamentation styles in architecture & furniture design. One of the remarkable styles of interest is Rococo or "Late Baroque", which evolved in France & Italy for architectural structures and furniture décor. This research project is conceived from the notion of how design computation could be a valid medium to generate ornamentation in design, comparable to the one found in traditional architectural & furniture décor style. The research work predominantly studies the extent of ornamentation in Rococo Style at the scale of both Architectural Design and Product Design. Rococo was chosen to understand complexity & structural construction of ornamentation & motif formation. The rich grandeur and florid beauty of the motifs and the sculptural tectonics in Rococo is highly appreciated and thus, intent of the project was to develop a self-organized computational framework, which is calibrated to have the potential to form complex designed artifacts & art forms having unique ornate quality. Adding to that, the project strictly adheres to the objective to create a computational methodology or script which can provide series of such designed artifacts, based on designers input parameters and initial conditions.

2. Computational Framework

The coding for the computational framework was done in java based applet Processing. We were interested to learn and develop from the self-organized interactions/ simulation of multi agent system, where the embedded artificial intelligence of each agent reacts with each other based on predefined logistics. These reactions and feedback procedure imparted a visual pattern of self-organized complex system, having aesthetic qualities similar to traditional ornamentation style. Research work encompassed pheromone trail formation in Ant colonies (as exhibited in Ant Colony optimization methods), by which ants lay down pheromones directing each other to resources while exploring their environment. This trail obtained after laying pheromones gets stronger & stronger in further simulations, essentially based on the ants who achieve stronger solution sets in the previous simulation. At the designer's level, this web of complex pheromone trail in 2 or 3 dimensions is of aesthetic and ornamental quality, which could be used as a potential artifact of high dimension sculptural tectonics.

3. 3D formation & Digital Fabrication

Once the system is established and the coded simulation produced desired results, the 2 dimensional frameworks was converted to 3Dimensional setup with the addition of z- vector and z

coordinates on each of the agents in all of their respective classes. This time their 3 dimensional simulations of reactions and interaction resulted into similar coherent and controlled design ornamentation in 3-dimension space. Eventually, another program code was written to form iso-surfacing between the 3D point cloud obtained from the 3D ornamentation pattern from the simulation results. The iso surfaced mesh was exported as an .obj file and imported in Geomagic platform where it was fine-tuned with further mesh optimization and accuracy.
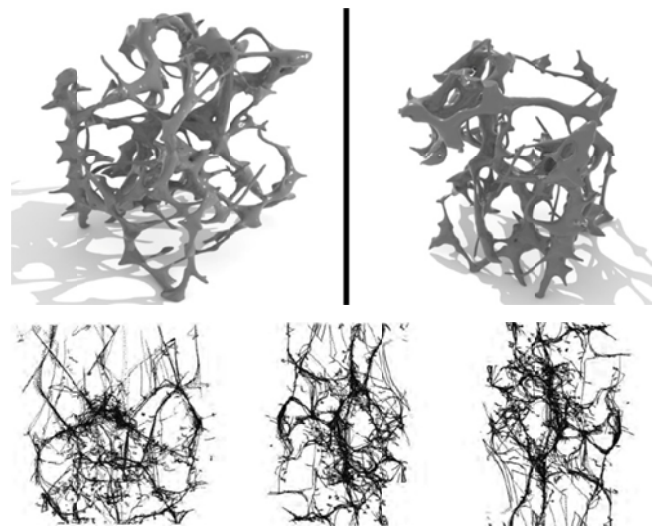

Figure 1. *Images depicting the 3d pattern organization.*

4. Conclusions

The advanced computational coding and digital fabrication tools allowed us to produce ornate artifacts of desired scale, precision and proportion. The procedure followed clearly unravels a novel paradigm of design endeavor wherein very complex and intricate design patterns can be computationally studied, analyzed and reinvented. The research project not only facilitates a genre of ornate digital crafts, but at the same time documents the complex computational framework adapted to synthesize such kind of design work. The digital crafts so produced can be successfully applied at all the scale of furniture décor, building fenestration components or ornamental units, sculpture design and so on.

References

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