Fall 2017

Unimaginable Form Semantic Exploration in Digital Turn 2.0

Yang Wang
Syracuse University

Follow this and additional works at: https://surface.syr.edu/architecture_theses

Part of the Architecture Commons

Recommended Citation

Wang, Yang, "Unimaginable Form Semantic Exploration in Digital Turn 2.0" (2017). Architecture Senior Theses. 463.
https://surface.syr.edu/architecture_theses/463

This Thesis Prep is brought to you for free and open access by the School of Architecture Dissertations and Theses at SURFACE. It has been accepted for inclusion in Architecture Senior Theses by an authorized administrator of SURFACE. For more information, please contact surface@syr.edu.
UNIMAGINABLE FORM
Semantic Exploration in Digital Turn 2.0

YANG WANG

Advisor
Amber Bartosh
“We live in a universe whose age we can’t quite compute, surrounded by stars whose distances we don’t altogether know, filled with matter we can’t identify, operating in conformance with physical laws whose properties we don’t truly understand.”

---Bill Bryson, “A Short History of Nearly Everything”
UNIMAGINABLE FORM

“...no architecture known to man or to human imagination, with vast aggregations of night-black masonry embodying monstrous perversions of geometrical laws.”

---H. P. Lovecraft, *The Call of Cthulhu*, 1928
Using Big Data-Driven algorithm based on the Self-Organized Mapping(SOM) and Convolutionary Neural Network (CNN) to do the Computational Generative Form Design with huge complexities of Form Reality.
Philosophy

(Why)
“Focusing on the vast withdrawn complexities of an architectural project would not only be a welcome antidote to the trope of inventing architectural concepts and diagramming them for easy comprehension, but would also liberate architects’ creativity.”

---Mark Foster Gage, *Killing Simplicity*, 2016

The initiatively avoidance on the complexities of form has imprisoned architects’ creativity.
Object-Oriented Ontology

“The only way to do justice to objects is to consider that their reality is free of all relation, deeper than a reciprocity.”

“After decades of computational calculation, exactitude, and the translation of information and diagrams into mostly banal, literal buildings, perhaps inference through illusion and innuendo offers fertile fields for developing newer, slipperier, and more uncertain forms of architectural practice.”

---Mark Foster Gage, *Killing Simplicity*, 2016
“In Object- oriented ontology, real objects are simply not fully knowable. This is not a mystical notion but rather one that emerges from the sheer infinitude of qualities and relations-as-objects that define an object. As such, it is an information-dense proposition.”

---Mark Foster Gage, Killing Simplicity, 2016

(Representing the density of form information)
Methodology

(how)
“...designers use ‘big data’ to notate reality as it appears at any chosen scale, without having to convert it into simplified and scalable mathematical notations or laws.”

---Mario Carpo, Breaking the Curve: Big Data and Design, 2017
“Similar processes do not necessarily beget similar shapes. Understanding these processes, on contrary, will help us shape better things.”


“We didn’t design the form, we designed the process that generated the form.”

---Michael Hansmeyer, TED lecture, 2015
...a far effective way to create forms is to use information that is already contained in forms...

---Michael Hansmeyer, TED lecture, 2015
Neural Network

“The role of the designer here is the role of an instructor of learning machines.”

---Jose Algeciras Rodríguez, Trained Architectonics, 2016
Algorithm Explanation

Vegetable-Fruit Juice = \( a \cdot \text{APPLE} + b \cdot \text{BANANA} + c \cdot \text{CARROT} + \ldots + n \cdot \text{ANY} \)
(\( a, b, c, \ldots, n \) is the numbers of spoon)

\[
\mathbf{f}(\mathbf{x}) = \omega_1(A) + \omega_2(B) + \omega_3(C) + \ldots + \omega_n(N) = \sum_{i=1}^{n} \omega_i(N)
\]

\( w \) - Weight of Iteration Size
\( x \) - Initial Learning Sample
\( N \) - Forms of Learning Object

1) Setting up the existing 3D models transmitted into point-cloud

2) Using SOM to process the dimensionality reduction which could simplify three dimensional sample set into two dimensional classification algorithm

3) Using CNN to solve the classification function

4) Control and adjust the times of algorithm iteration

5) Setting the next learning sample model ready

6) Repeat the step 2) to step 4) until finishing all models

7) Export the final point-cloud set into Grasshopper to do the data processing and rendering
First Prototype Description

- **3D Model (.skp)**
- **FME Desktop Workbench**
- **Point-Cloud Set (.xyz)**
- **Notepad++**
- **Point-Cloud Set (.txt)**
- **IntelliJ IDEA (java)**
- **Point-Cloud Set (.txt)**
- **Meshlab**
- **3D Model (.3ds)**
- **Rhinoceros 5**

### Data Format Transformation

1. Importing .txt file into Meshlab
2. Surface Reconstruction based on Ball Pivoting
3. Smooth Face Normals
4. Exporting .3ds format File
Core Script Algorithm

1. Untrained Random Point-Cloud Set: Volume 10,000
2. Writing Untrained Points into Array of 100 by 100
3. Reading the Point-Cloud of Learning Sample
4. Calculating the Euclidean Distance of Untrained Points and Learning Sample One by One
5. Filtering Array[i][j] based on the radius of influence
6. Return Results to main script
7. Moving Selected Untrained Points with the square foot of distance
8. Isolating the matched points of Learning Sample
9. Repeating setting iteration times from step 4 to step 8
10. Reading Output and Exporting .txt format File
Untrained Point-Cloud Set starts learning to First Sample
Due to the lucky mistake of two different space coordinates
The process of learning perfectly described by points moving
Lots of points are learning to the first learning sample
Roughly finishing the learning to first sample
Using the result of last machine learning process to learn with second learning sample
SECOND SAMPLES LEARNING ITERATION: 40000
Auto-generation geometry without supervision
"Where does the individuality of such a building begin and on what does it depend? Clearly it depends more on its form than on its material..."

---Aldo Rossi, The Architecture of The City, 1966

"the architectural artifact is conceived as a structure and that this structure is revealed and can be recognized in the artifact itself. As a constant, this principle, which we can call the typical element, or simple the type, is to be found in all architectural artifacts. It is also then a cultural element and as such can be investigated in different architectural artifacts..."

---Aldo Rossi, The Architecture of The City, 1966

"... I would define the concept of type as something that is permanent and complex, a logical principle that is prior to form and that constitutes it."

---Aldo Rossi, The Architecture of The City, 1966
Learning instinct of human being is seeking Common Information

Artificial Intelligence is learning Full-Scale Information

Architectural Typology
Purely Architecture Value

Architecture Technology

Form

Intuitive

Data

Artificial Intelligence

Architectural Typology

Metaphysical

Regular Pattern
Quotation

Code Citation