Architectural and Media Studies

Report on Computational and D2RP strategy for the design project

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As we know, the space logic and context of urban and architecture space are deeply influenced by the complexity of society organisation, economic structure, cultural orientation and even the political strategy. With the developing in modern times, until now, it is obvious that the complexity continuously increases in some place to a level, which is almost beyond the ability that a human or architect can well manipulate. If we still design architecture or urban space in a traditional method, or with traditional tool, we will face the problem that something in the result becomes out of control and our consideration. Some tools and methods need to be implemented to deal with such a complexity, and we are funtrrnate that the computational and robotic technology have already well developed and being ready to help us.

A typical example of this complexity is the urban village in china. The Urban Village is a quite special social and urban phenomenon of China, because of certain specific social, politic and economic condition. It's a village which is surrounded and isolated from the city, and characterised by the extremely density and hybridity. There are different kinds of people living inside with different social class. Various of functions are required because of the requirements from the different group of people. Several types of economic activities generate special network. Due to the high density, the physical condition in the urban village is worse than the average requirement of human living, bad daylight condition, almost no radiation, especially in winter. We can see that, each of these characteristic is already complex and filled with informations. When we try to overlap all these characteristic together in a single layer and try to understanding this urban village as a whole, it becomes an impossible task for us. The goal of my graduation project is well understanding the urban village and based on that a bottom-up intervention are going to be growing in the village in order to improve the physical condition and urban and architectural space in corresponding to the current social relationship and economic structure in the urban village.

In order the achieve this goal, there should be a flexible and well-adapted design and producing method to be fitted into such a complex field. The freedom of expending and manipulating the parametric of computational design can be useful in the work of facing plenty of information and complex condition. And the customisation of robotic production is well connecting with the various unique result of computational design.

First of all, the computational design or parametric design is a data-driven method. Thus, we need to find a way to transform those informations in the research design space to a numerical-based data as an input for the computational scrip. Obviously, some characteristic of the space are originally kinds of quantity properties, such as distance, radiation value and so on. But the others, like the privacy, order, accessibility, these kinda of quality properties need to be represented by numerical level in a proper way. When I read about the space syntax theory of Bill Hiller, I was inspiring by him. Based on the notion of topology, he subtract the urban or architecture space from its geometry shape

into a interrelationship within condition like symmetry or asymmetry, distributed or non-distributed, in order to obtain the justified graph showing the topological steps how far a single is away from another one within the system. depending on this topological distance, Bill proposed several quantised properties of the architecture or urban space, like the depth of a space to the outer environment, the relative asymmetry value, the measure of interaction, the measure of control or the integration value, which reflects whether a space tends to integrate the system or to be segregated from the system. The higher integration value means the shallower average distance to all other nodes. However in a real design project, this kind of abstract theory without considering the space dimension and distance is not proper enough. So, based on his computing structure, I increase the physical dimension into the computing process. As a result, finally, I obtain the several numerical-based data of the research design space: the daylight factor, the radiation value, the privacy, the accessibility of inner village, the accessibility of outer city, the space-space distance and so on.

After having the input parameters, we should know which exactly logic or functions we should use to obtain our final result. Generally, there are three types of computational method involve: 1.Recursive Search in a data field 2.Particle, Force Based systems 3.Complex systems: Agent based models. These three methods have their own advantages and proper implemented conditions. The recursion method is a step by step process which is based on a well enough data field with a clear destination and operation role, it fits better in the condition which already has an abundant context. The Particle, Force Based systems is an dynamic system which try to find a stable state after we have set each forces, attraction or repulsion, between each items in the system. This type of method is more suitable when the items in the system is limited and the relationship between each terms is clear. The agent based method is about the groups of agents which represents different objects influence by the value of cohesion, separation and alignment, and the result will be determined after running a simulation of a swarm behaviour of different agents approaching the site. The agent based method fits more in the situation that, there are a plenty of items in the complexity, and we could set the relationship between the group to group, and between the items in each group. All of these three method is not independent from each other, they can be combined with each other, or embedded into the others depending on our project logic and goal. I my situation, I decide to use the Particle, Force Based systems to find the internetwork between different functions and use the Recursive Search Method in a data field to generate a first rough form finding process for the intervention in urban village.

If we regard the computational method is implemented in a macro-scale of design program, then the research of robotic production is focus on the micro-scale. For this graduation program, my focus point about the robotic production is about the hybridity of the material and the producing method. We know that different materials have different properties, and also the different treatment on the same material will generate different properties too. And also the different ways of producing, like milling, 3D printing, cutting, will lead to different form result, and each of them fits different material. For example, the combination of EPS and concrete, the Combination of EPS, wood or 3D printing material, both of them will have different logic of producing and different result properties.

Finally, I have two direction to research, one is from the macro-scale, a computational method, one is from the micro-scale, a robotic producing method. they both orient to same point from different direction, and eventually influence and shape my project together.