1. Self-rescue of the Dead City - The Construction of Information Entropy Self-Organizing Model Based on the Healing of Urban Aphasia Space (*Open Access*)

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Self-rescue of the Dead City——the Construction of Information Entropy Self-Organizing Model Based on the Healing of Urban Aphasia Space

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Abstract. The Daxing fire that occurred at the end of 2017 exposed the current situation that the survivors of the urban fringe had no fixed place and the living environment was overcrowded. The essence of this was that the spatial information could not be effectively transmitted, which eventually led to the lag of local information flow and potential hidden dangers. From the perspective of urban information flow transmission, four kinds of sports patterns already existed in the city are selected, and the rules of thermal change are extracted, and a new spatial information network with self-organization ability is reconstructed at the fire occurrence site. This kind of network is based on TOD theory. It combines five kinds of functional information carried by four main groups to explore the spatial unit of local static and regional dynamics, and makes scene prediction for the systematic evolution of information particles in urban fringe.

1. Introduction

The huge network trend has forced the social structure to undergo rapid changes. Buildings as a tool to adapt to the characteristics of the information age, to construct and restore complex worlds, to maintain a simple form or closed system is obviously out of date, it needs to input and output from other fields, and exchange and penetration of persistent substances, energy and information with the outside world.

2. Basic Urban Phenomenological Theory

2.1. Network System Theory

The number of urban spaces of different scales should be inversely distributed according to the law from small scale to large scale. The number of long-distance connections between small-scale modules and large-scale modules is also inverse power-law distribution. Salingaros also introduced the concept of entropy in physical thermodynamics, providing a quantitative measure of the connectivity of urban networks. Excessive entropy values affect the connectivity of urban networks, making the city lack of integrity; if the entropy is too small, there will be artificial cities with large scales as described by Alexander.

Network (global) Centralization measure: We measure network centralization by calculating the sum in differences in centrality between the most central node in the network and all other nodes; and

then divide this quantity by the theoretically largest such sum of differences in a star network of the same size.

$$C_x = \frac{\sum_{i=1}^{N} C_x(p_*) - C_x(p_i)}{\max \sum_{i=1}^{N} C_x(p_*) - C_x(p_i)} \tag{1}$$

2.2. Dissipation Theory

An open system far from equilibrium can exchange material, energy and information with the external environment. When the external conditions reach a certain threshold, it may change from a previously chaotic state to a spatially and temporally ordered state. Prigogine referred to this new stable and orderly structure formed in a nonlinear region far from equilibrium as a dissipative structure. Order in the dissipative structure is a dynamically changing order.

$$dS=\frac{dQ}{T} \tag{2}$$

2.3. CAS Resilient City Theory

The proposal of the third-generation system theory CAS has made up for the defects not mentioned in the previous two generations. CAS emphasizes the process of system transformation, evolution and development after the active cognition and self-regulation of the external world. It emphasizes that the key to system evolution and evolution lies in the interaction between individual adaptive ability and environment. Furthermore, it emphasizes the key role of random factors in evolution.

3. System Dynamics and Information Mirroring of Physical Space

For an open system far from equilibrium, the change of total entropy is composed of two parts: one is the entropy increase caused by the irreversible process of the system itself, that is, the entropy is generated, this item is always positive; the other part is the exchange of substances between the system and the outside world. And energy-induced entropy flow, this one can be positive or negative or zero, then the change of entropy of the whole system can be written as the sum of two:

$$dS=d_iS+d_eS \tag{3}$$

According to the second law of thermodynamics, there is constant $d(i)S\geq 0$. In an isolated system, there is no entropy flow, then $d(e)S=0$, the total system entropy is $dS=d(i)S\geq 0$, the system can change from order to disorder. Conversely, when a system's entropy flow $d(e)S\neq 0$, the system does not necessarily increase orderly, there are three cases: the first is the thermodynamic equilibrium state. At this time, although $d(e)S\neq 0$, $d(i)S>0$, the acceleration system tends to be disordered; the second is a linear non-equilibrium state. At this time $d(e)S\approx 0$, even if the system has some ordered structures at the beginning, its internal entropy increase will cause the system to eventually become disordered; the third is that the system is far from the equilibrium state. At this time $d(e)S<<0$, and when $|d(e)S| > d(i)S$, the total entropy dS of the system can be less than zero, ie $dS=d(i)S+d(e)S < 0$, at which time the total entropy of the system decreases over time. At this time, the outside of the system has the input of negative entropy flow, the system develops toward the direction of de-entropy, and the system tends to be ordered.

4. Model Construction Theory and Program Practice

4.1. Initial Motion Model

4.1.1. Variable Analysis

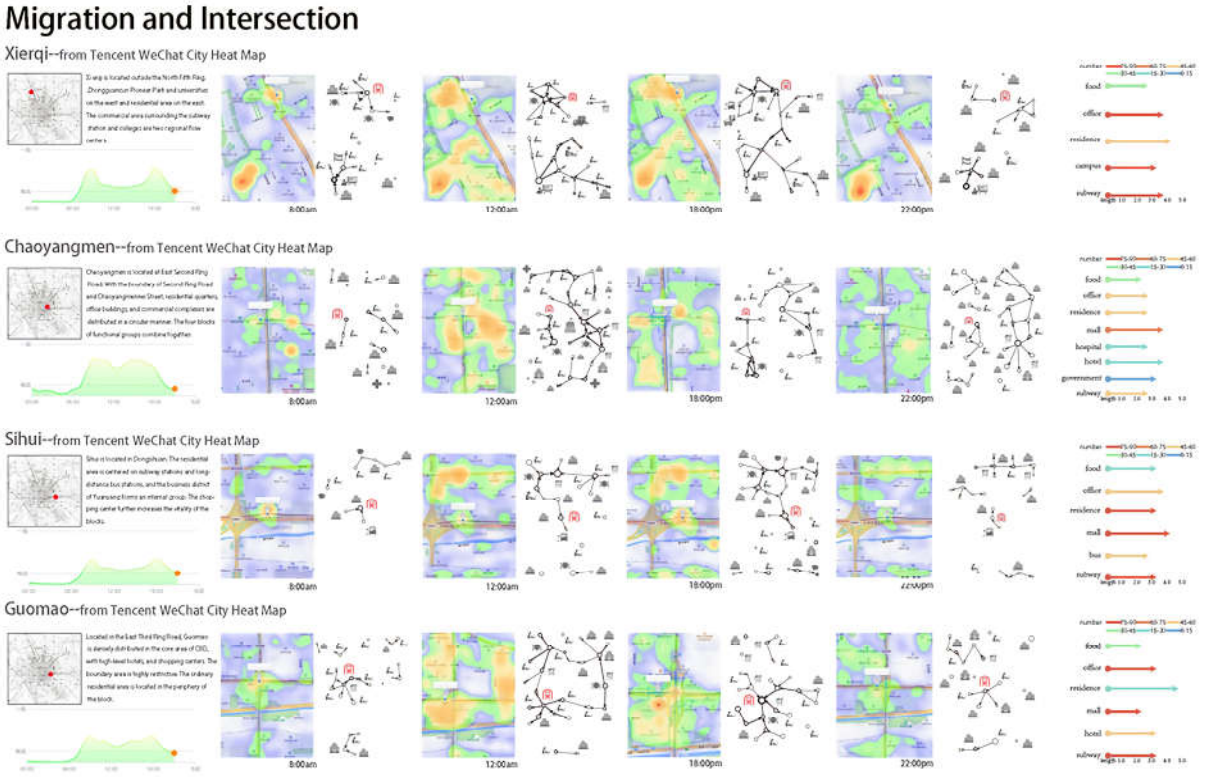

Figure 1. Timeliness Analysis of Four Regional Thermal Maps

Using central location theory as a logical framework, multi-layer networks are self-organizing based on local rules and information exchange. Each place attracts certain urban activities that are modeled by a multi-level agent movement that collectively forms group behavior in an urban environment. Select four existing regional motion patterns from the heat map, and perform particle system simulation of processing. Among them, managers, workers, participants and rovers are the main body of information, and five kinds of behaviors, such as business, entertainment, residence, commuting and work, are used to construct a network. The directionality index measures the balance of information flow in both directions.

$$T_{X,Y}^{S} = T_{Y,X} - T_{X,Y} \tag{4}$$

4.1.2. Prototype Category. Analysis of typical regional activities in existing cities provides four basic rules of evolution. Flocking force vector expression is

defined as liner combination of cohesion, separation and alignment force.

$$\begin{aligned} \vec{F}_{fi} &= \vec{F}_{ci} + \vec{F}_{si} + \vec{F}_{ai} \\ &= \left(w_{ci} - \frac{w_{si}}{D_i} \right) \vec{e}_{\vec{D}_i} + w_{ai} \vec{e}_{\vec{V}_i} \end{aligned} \tag{5}$$

(1) Island type

The island-type system has one main impact point and three secondary impact points. The main impact point function needs are the most complex, and the implementation efficiency of the secondary influence point function is hindered to some extent. The steady-state trend is the fastest and the selection possibility is the least. Between secondary influence points, the link is weakest, and it is difficult to make contact between the main impact point and the secondary influence point. The whole system forms the office core, and there are fewer commutes around the city, and less commercial entertainment.

(2) Branch type

The branch system has one main influence point and three secondary influence points. The main influence point reaches the steady state trend faster, the near secondary influence point grows faster, and the tree connection is established, and the connection mode is more selected. The location close to the main impact point forms the office core, surrounded by commercial commuting and living, and adds entertainment. The end of the branch is far from the main influence point and does not form an obvious core, which is unstable.

(3) Boundary type

The four influences of the boundary type system are equal and are in a free state distribution, and none of the four influence points form a stable core. Commuting business and office have a high degree of mixing, and there are few entertainment and residential functions. The influences are cross-linked within a certain range, and there are many possibilities and instability. Connections in the boundary are broken by heterogeneous functions, such as the distribution of entertainment functions at boundary breakpoints, while homogenous functions tend to form continuous connections.

(4) Closed loop type

The closed-loop system has two main influences, two symmetric effects, and is symmetrically distributed. The main influence points grow faster, and the steady-state structure is formed before the secondary influence points. Finally, the whole system establishes a balanced relationship inside the ring. The structure is relatively stable. The main influence points form the functional core, the high degree of mixing, the collection of commercial office and entertainment, and the connection between commuting and living. The whole system is the most open.

4.2. Information Classification Processing

4.2.1. Heat Dissipation Diagram and Distribution of Function. The heat dissipation in the area between the Fifth Ring and the Sixth Ring in the south of Beijing has a significant edge effect, forming a fuzzy boundary of the multi-core model. The nuclear function is mainly based on science and technology development zones and residential areas, surrounded by university experimental zones, aviation distribution zones, cultural industrial parks and urban green spaces. The whole moves from the center of the core to the edge.

4.2.2. TOD Life Circle Mode. (1) The 10Km living circle mainly covers the vicinity of Metro Line 4 and Line 8, crossing the Fifth Ring Road and the Sixth Ring Road and the expressway along the line. The functional set includes the science and education area, the residential area, and the airport experimental area.

(2) The 5Km living circle is mainly close to the border of the Sixth Ring Road, including industrial production bases close to the main road, science and technology industrial parks, and emerging residential growth points outside the Sixth Ring Road.

(3) The 2Km living circle is located near the ring road and the intercity expressway. It is mainly a mixed office type, combined with the logistics park and cultural business.

4.2.3. Second Level Simulation Substitution. The second information level study range is 5km in diameter, which is the life circle where driving is 10min. The research process superimposes the five

functional information motion points in the four basic forms, and the horizontal superposition results in four basic forms in the existing site change process, and the vertical superposition results in five information points and the final trade-off point. The overlap of weights is carried out for the next 2km range of studies.

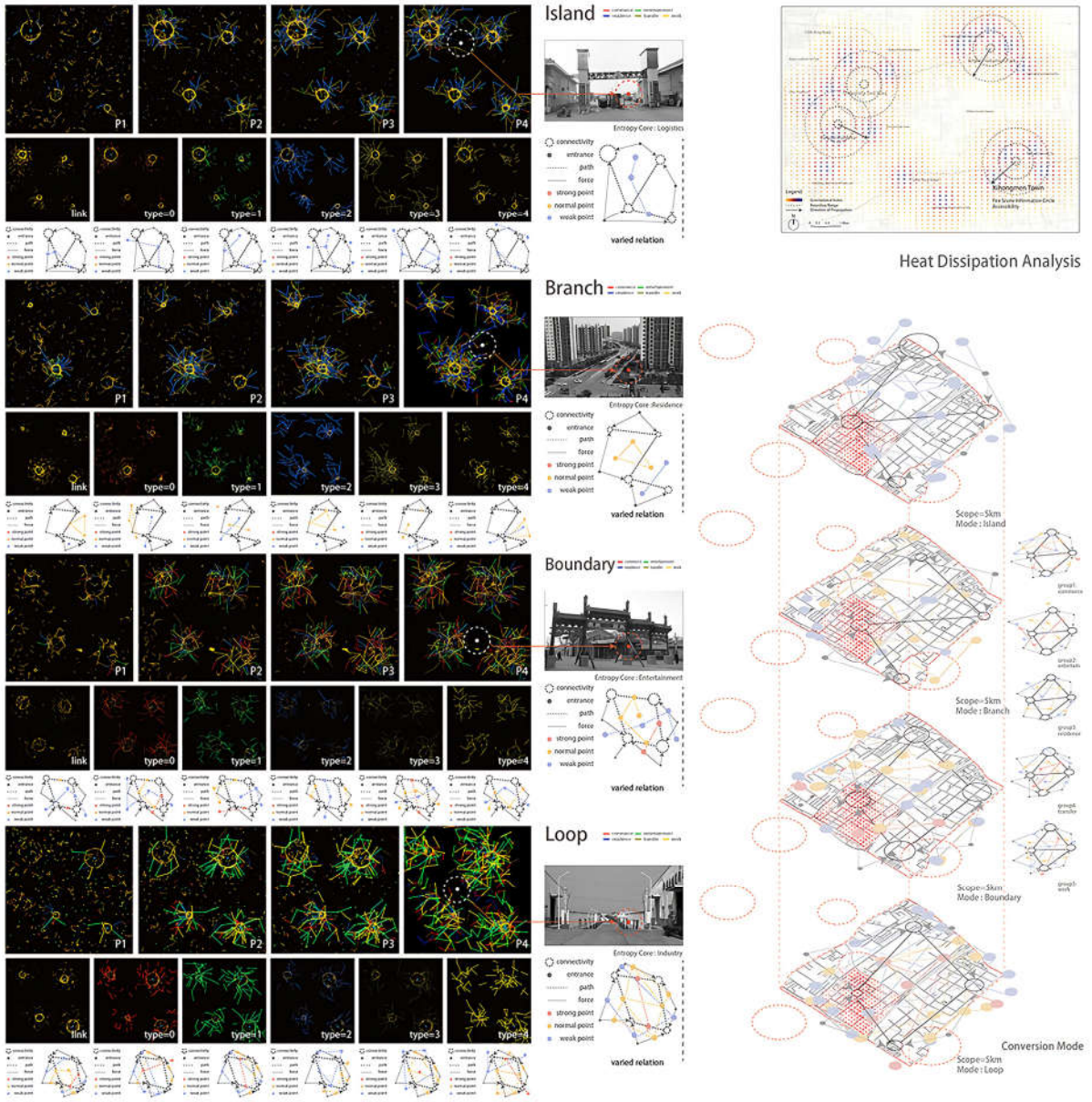

Figure 2. Ovelap and Analysis of Basic Law Weights in 5Km Range

4.2.4. Target Site Information Clustering. The third information level is the boundary around the fire occurrence site, and the research area is 2km in diameter, which is the living circle where the driving is 5min. The research process optimizes the overlapping of information rights obtained by the 5km research scope, and develops the regular simulation of complex transformations, which comprehensively reflects the balance effects of the four basic types: island type, branch type, boundary type and closed loop type thermal motion. The law exhibited by this two-dimensional simulation directly guides the next static simulation and dynamic exploration of the internal core motion in the

three-dimensional space of the fire scene, and finally leads to the embedding of static units and the sprawling development of dynamic units in the original site.

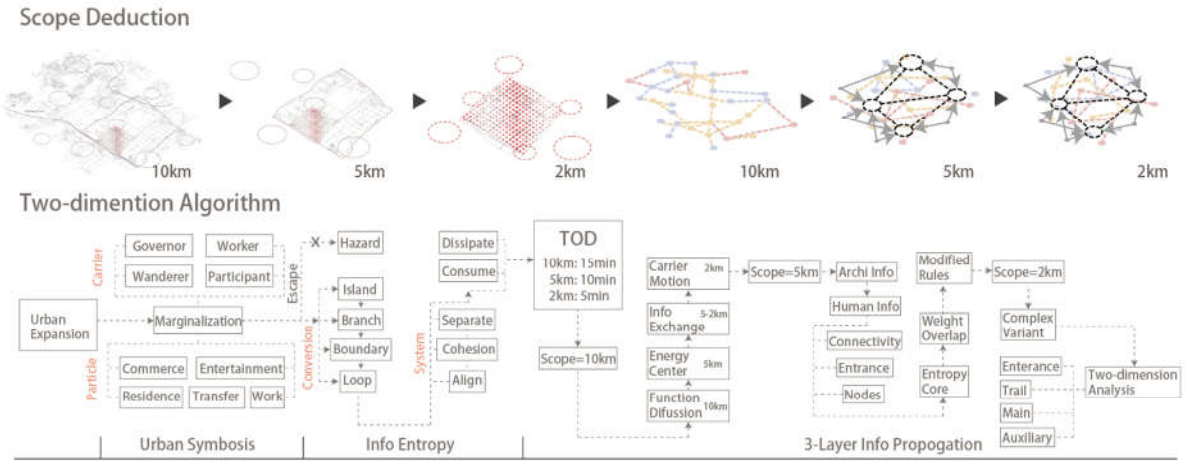

Figure 3. Information Hierarchy Analysis Logic

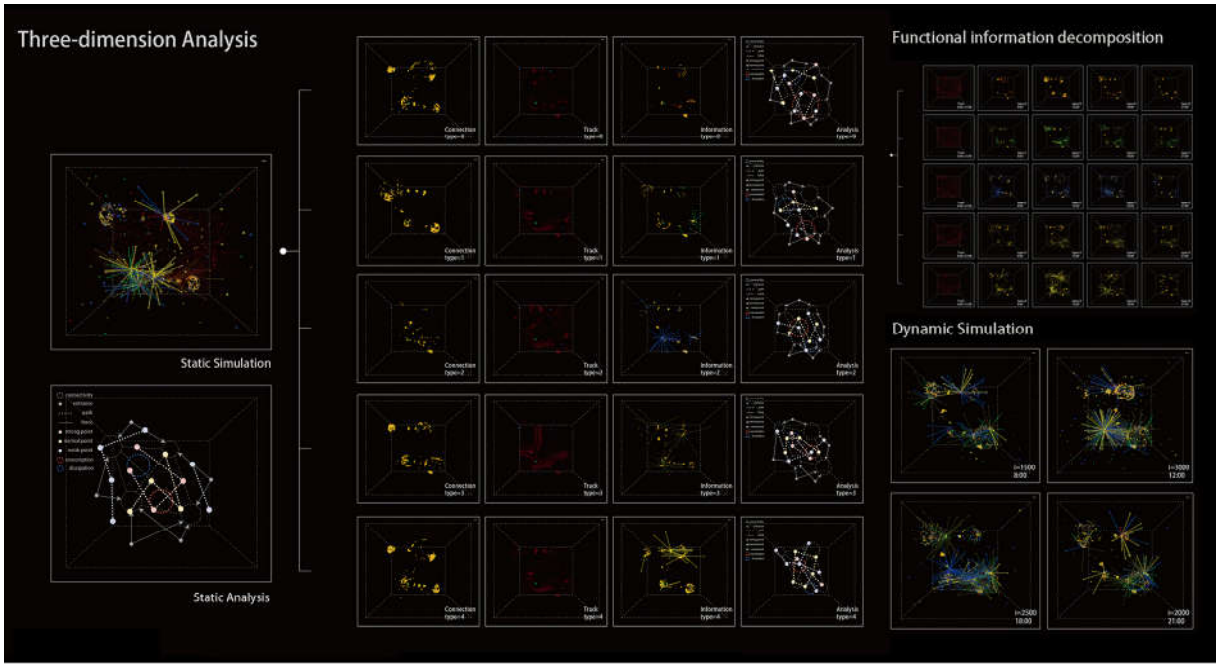

Figure 4. 3D Static and Dynamic Derivative Analysis

4.3. Spatial Model Evolution

4.3.1. Three-dimensional Space Type. The processing simulation is extended from a two-dimensional plane to a three-dimensional space. First, the static analysis is performed to deconstruct the information.

Then enter the dynamic analysis stage, set the time of 8:00, 12:00, 18:00, 21:00, change the number of particles, the direction of motion and the magnitude of gravitational repulsive force, and finally form four development periods.

(1) Germination type

The entertainment function is attached to the commercial

function, and the point distribution is presented. The living and commuting functions have the gravitational force pointing to the center of the area, and the working unit is highly mobile.

(2) Growth type

The work-production function dominates, has a radiation effect, becomes a gravitational center, and the residential and commuting functions are gradually consumed, and the commercial and entertainment units grow out as subsystems.

(3) Maturation type

The residential and productive functions tend to be balanced, the commuting unit acts as a support network, and the commercial and entertainment functions are at a balanced point, combined with a scatter entertainment unit.

(4) Collapse type

Commuting and production-type functions shrink, the residential function is relatively stable, and a relatively complete commercial-entertainment subsidiary unit is formed around it as a regional gravitational field.

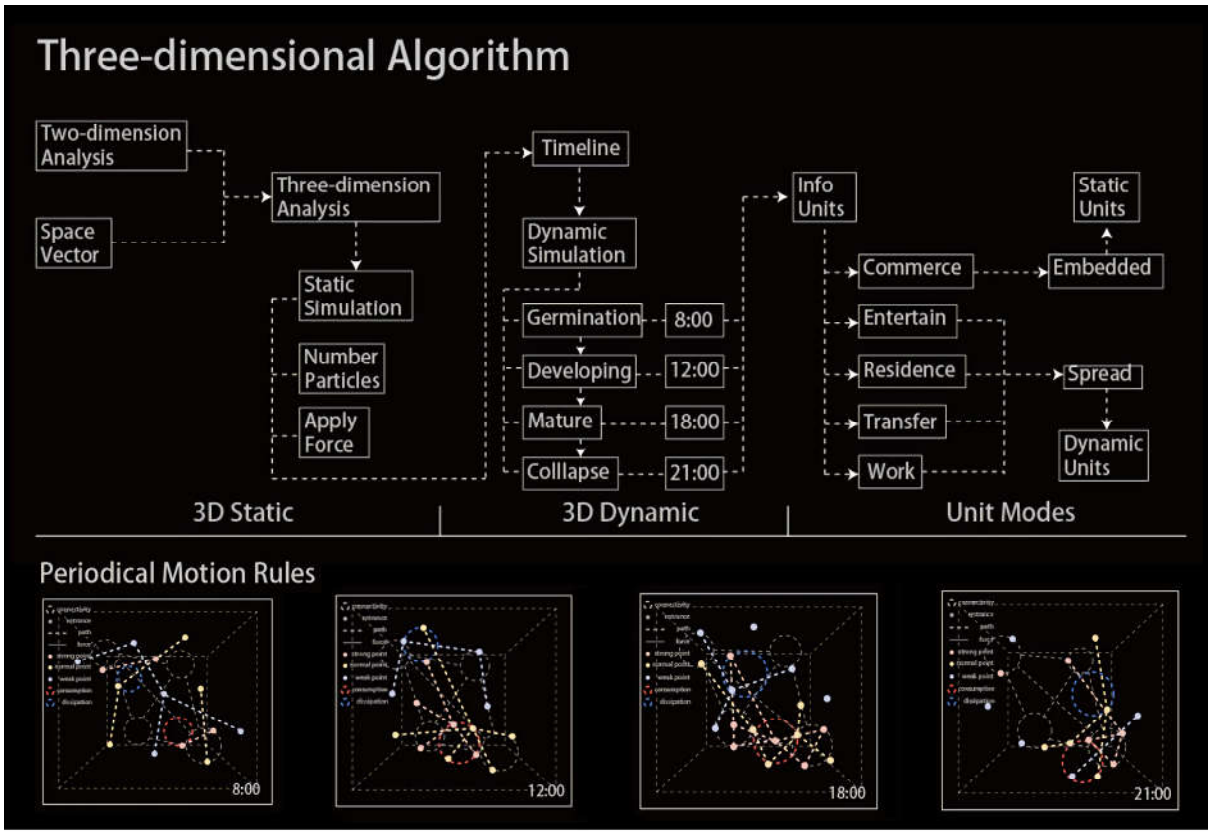

Figure 5. Growth Stage Logic and Denifition

4.3.2. Data Classification and Spatial Forming. Dataize the function points in the processing, and coordinate with the grasshopper to perform spatial shaping operations.

Specifically, the site within 2km constitutes a dynamic system, forming different adaptive functional groups and connections at four times of the day. The four sports people and the five functional information particles they carry form the contact network and nodes. See the video for the change:

https://www.youtube.com/watch?v=7YmGQaO2r2o

The whole design process emphasizes respect for people and the environment, the selection and selection of the prototype prototypes, the importance of causal continuity, the expectation of obtaining design results corresponding to the design starting point, and the study of structural systems and logic to ensure the design results' implement ability.

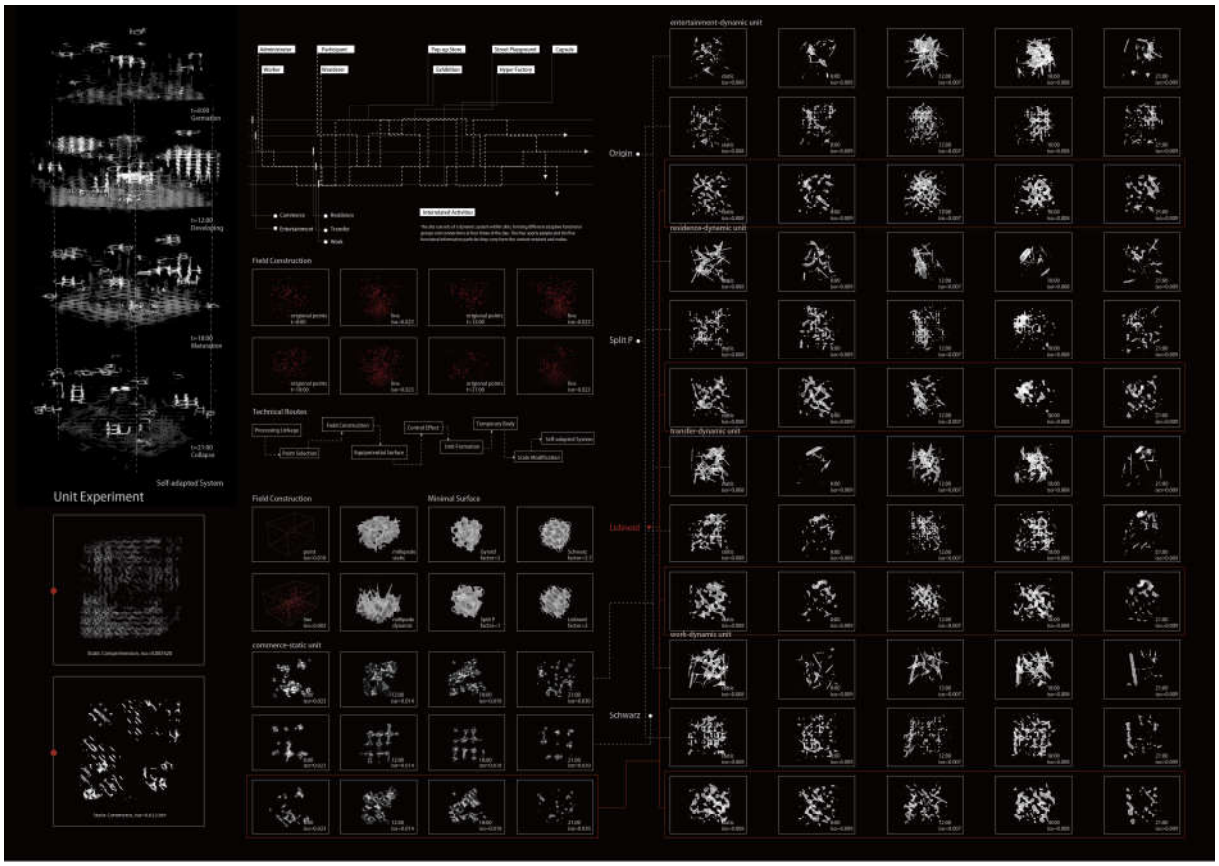

Figure 6. Unit Experiment and Self adapted System Construction

5. Conclusion

The bottom-up design approach to the process of generating a design is essentially the result of actions and decisions that many individuals intervene. A collective design project includes choices from architects, end users, and environmental factors. Agents who play collective intelligence perceive all of these influencing factors and enter them into the selection process. In the era of big data, understanding complex adaptive systems and paying more attention to the bottom-up order of origin is of great significance to urban research.

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