Chaotic FCM as a Mean for Generating Idea in Complex Environment

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Abstract:- Coming events and future situations have been one of the most wanting visions for Architects and Urban Planners; in order to fit their products and to reach the best spatial answers for human desire. Morphologic studies used to be one the most common ways that totally based on pattern recognition; in order to reach the mentioned goals. Based on the examples discussed in this paper, the system's behaviors were studied out of linear time vector. It gave us the ability of understanding the hidden patterns of related systems. This led us to the creation of generating fluid plan for each system, and made us not to base the whole strategy of control upon linear expansion of one or two scenarios. So, by knowing the hidden pattern out of linear time vector the whole complex system continues its creative life and would be able to fit the proposed plan in relation with any new coming situation. So the whole living system is no more frozen for a certain prediction, to be truth. It goes on and on through its way of life, by pushing the future tellers to the concept of chaos.

Key-words:- Chaos theory, fractal, architecture, urban planning, chaotic FCM, complex environment, hidden pattern

1. Introduction

Scientists turned to a kind of future tellers; when the Laplac certainty born in the world of modern science. They used to study the initial condition and tried to formulate systems and predict the future behavior after a certain period of time. They were the only future tellers in human history that had the claim of certain prediction for coming events.

In those decades, the information was believed as an exact answer to a question and the prediction had the desire of narrowing down the various answers to one; but in the era of IT the information is turning to belief of robust question; and the prediction has no more any desire for certain answers and looks for the divergence of scenarios.

Understanding the complex environment's behavior has been a major problem in spatial design and planning. As the complexity itself, the spatial design and planning needs to base on scenario divergence in order to be capable enough to fit into the unpredictability and creativity of complex environment.

In the following papers we will take a short glance at the role of Hidden Patterns and Time Free Analysis through the Chaotic FCM (FCCM) in order to

catch the perception of idea generating in spatial design and planning.

2. A Taxonomy for Pattern Recognition Perspective As Current Methodology for Observation and Prediction

Coming events and future situations have been one of the most wanting visions for Architects and Urban Planner; in order to fit their products and to reach the best spatial answers for human desire. Morphologic studies used to be one the most common ways that totally based on pattern recognition; in order to reach the mentioned goals.

It seems that four following general perspectives regard the methodology of pattern recognition for this purpose, by the experts to catch their goals:

- Recognition of Previously Experienced Patterns
- Recognition of Ideal and Abstract Patterns
- Recognition of Basic Patterns Participating in Complex
- Recognition of Self Initiate Subjective-Intuitive Patterns

2.1 Recognition of Previously Experienced Patterns

It is based on the study of the history of events. It tries to follow the previous records and finding the patterns that the observed spatial systems used to obey. The observation process is figured out through the linear time vector and simply based on the linear causality principles. This perspective has had a suitable usage in the short term planning and was so successful in simple causal problem solving such as:

- Form Based Tectonic Studies
- Structure Static Analysis
- Spatial Typology Studies … etc.

2.2 Recognition of Ideal and Abstract Patterns

This perspective is based on Euclidean Geometry. By using those geometrical patterns the expert tries to extend its numeric and topologic rules to the domain of observed events and phenomena. It leads to the logical pattern of order as some universal criterion. In this way any anomaly in the Euclidean spatial pattern would be ignored as a disorder hostile event.

This would end to a rigid evaluation of spatial patterns; that could be quiet promising the most general methodology for classification the spatial structure that could define the multi structures, mega structures and infra structures in spatial analysis.

This perspective is still a common methodology that is used in many recent spatial studies such as:

- Krier's studies on Urban Morphology which studies the urban units in city[12]
- Sterling's studies on Spatial Architectural Forms which is concerned on the architectural forms and elements [12]
- Geuds' methodology of Regional Planning[11]

2.3 Recognition of Basic Patterns Participating in Complex

Denoting modern science approaches to natural phenomena this perspective tries to reduce the observed spatial system/phenomenon to separated subsystems/sub elements to take an advantage of studying them precisely.

Likely urban experts tried to reduce the complicate patterns to simpler patterns that could be studied to elaborate for better than other, by subtracting each defined pattern from the whole divided patterns; after studying the single pattern the result would be put together to understand the whole.

2.4 Recognition of Self Initiate Subjective-Intuitive Patterns

This perspective is totally based on experts' intuitions which are figured out by her/his previous experiments and the specific knowledge. Although this would be successful in many cases but has some limitations that could never be expanded and extended to all cases; for instance:

- It limits to the domain of expert's previous experiments
- It couldn’t be useful for non professional users
- It has lost the hidden aspects of studied event.
- If the experts have any bios this will be transferred to the whole process.

3. Limitations of the Above Taxonomy with Respect to Generating Ideas in/for Complex Environments.

A system is a set of objects, which possesses expressed system properties, i.e. such properties that neither belong to any part of the system, nor can be derived from the properties of its parts. Any element of the system is an object with unambiguously determined known properties, are similar to those of the system.

Although the complex systems would consist of a large number of elements but it would not sufficient unless the elements have the dynamic interactions. They do change with time (not only the linear time vector) but these changes or interactions do not have to be physical and could be thought as the informational transference or transformation.

Those interactions are nonlinear and it also guarantees that small cause can have large results (Butterfly Effect). It is important to remember that complex systems are usually open systems and interact with their environment, and also it is difficult to define the boarder of the complex system; only if it could be done physically it is impossible to be defined as an informational point of view.

So the Hidden Pattern of a complex system which controls the whole processes in the system would be free of time [likely the Strange Attractors in Chaos theory] and could hardly be understood with those mentioned perspectives.

4. The Proposed Scheme for Generating Novel Ideas based on Chaotic FCM

4.1 Role of Chaos in Figuring Out Complex Systems

The concept of the determinism has only covered the systems with a certain behavior; Chaos theory extended that to the random behavior too, since 1960, i.e. the chaos theory describes the chaotic system as a deterministic system with the random behavior. Before 1960's the picture of the world were separated in two separated parts by the concept of order and chaos; that was the main vision of defining deterministic and non-deterministic systems through the rational, reductionism's point of view. But during 1960's the chaos changed the whole concept by presenting a new definition of chaotic systems, and a new image of chaos[1].

The main aspect of deterministic systems has been the certain prediction which should be followed by knowing the system's functions, giving initial condition and receiving the final outcomes after a considered time (through the linear time vector). But the chaos revolution broke down the whole concept and described that there would be a deterministic system with no ability of ours to predict it, and though with clear rules and functions, but with no certain outcome through their interplays. Chaos shows, there is no certain classification for input and output of complex system, so instead of having objective classification, that would be necessary to have an interpretation process. Chaos also shows that the similarity of form or structure has no record of causing the same reasons, but it describes the existence of the same process. Let's say, it is process-oriented and no more result-based.

What we would like to be concerned is to give a new definition of "process" related to chaos, in which there is no image of linear time vector and no more linear connection between past and future. That is why we believe in "cognitive map" (CM) as a suitable instrument for analyzing and understanding any chaotic system in relation with the following items:

- CM) could be free of time-linearity.
- CM) could be free of linear causality.
- CM) could be free of fixed-structure & quantity.

[1] [1] The state of a system is an ordered totality of values of the internal and external parameters, which determine the course of processes in the system. The behavior of a system is the temporary sequence of reactions of the system toward external effect. The state of system can be represented as a point in the phase space of its parameters, and its behavior as trajectory (law of motion) in the phase space. The phase portrait of system is the totally of its trajectories. The introduction of phase space allows using ready geometrical analogies. To each state of the system corresponds a definite point in the phase, which is called phase point. The time variation of the state of the state of the system is represented as motion along some curve called phase trajectory.

An attractor is a manifold of phase trajectories toward which all neighboring trajectories are attracted. There are four types of attractors:

- Point attractors, which specify systems with equilibrium point;
- Limit cycle attractors who specify systems with periodic behavior;
- Torus attractors which specify systems with quasi-periodic behavior;
- Strange attractors which specify systems with chaotic behavior;

The strange attractor, by contrast to others, has no classic geometrical or regular form or structure. In fact they are irregular, self-reflective and non-linear whit an infinitive semio-topologic capacity, which is called fractal.

- CM) could be the association of objectivity & subjectivity.
- CM) is based on interpretation instead of classification.

4.2 Chaotic FCM 1 as a Means for Generating Ideas

Chaos shows, there is no certainty about the systems behavior, neither in qualities nor in quantities, whether trying to have an associated image or not. This is the heart of the complexity of environment. The dichotomy of quality & quantity through the uncertainty and duality is the main effect of chaotic systems, which gives no sharp limits for measurable modules. Therefore the association of qualities and quantities is to be carried out through the non-binary validation, such as Fuzzy in precise means, and uncertainty through the dynamic systems which could be followed by Chaotic Systems.

In this passage each FCM swirl enough up to its stabilized situation, after each new iteration, the FCM came to a new mode and defined new correlations(Fig1). So, if the FCM seems to describe existence of a complex system with a nonlinear and fluid-like behavior in different conditions, it would reveal different results. It guides us to a process-oriented field of our study. It is the first point that was so exciting. It is not a simple system to be an exact result-based process; because of that we try a way which could handle this. **The Chaos Theory was the answer**.

(FCM) or (FCCM)?

The (CM)'s validation of parameters' affections, which is dialogical, seems to have a quali-quantitive computing process. By contrast to classical logic (binary one), through the FCM, one would go round and round, or would argue with each link. May be he/she doesn't like an arrows direction or wants to take whole arrow out. But, even if one agrees with the FCM links, what would he/she do with things of following terms:

- Feedback and accuracy
- Accurate pictures of the world are full of feedback!
- How to work with feedbacks?

Any feedback could be a message from hidden patterns. To look for hidden patterns in the FCM edges, it is normal to turn FCM net on, let it swirl and let the dynamical system converge to equilibrium. Events blink on-and-off or fire to some degree. One concept or event swirls into the others.

What is a hidden pattern? It is where the swirl stops. It is the equilibrium.

That is what dynamical systems theorists call it attractor. This is the point that joins FCM and Chaos [as a new approach in the system theory]. The association of FCM & Chaos (FCCM) is definable in the following terms:

- A definition of complex hidden patterns as a strange attractor of chaotic system.
- A definition of FCM net as a chaotic net (or chaotic net work)
- A fractal definition of FCM for giving a semio-topological image of phenomena, which is a visual expression of chaotic effects. [4]

4.3 A Case Study

Example A

META'S GARDEN

This following sample shows the first step of using FCM for idea generating of strange attractor and fractal pattern of a complex system which needed to be simulated for handling a landscape design project; followed by a chaotic modeling.

[1] FUZZY COGNITIVE MAP (FCM)

Kasko gives a simple example of Fuzzy Cognitive Map (FCM) and describes its global concepts. Kasko says:

' *A fuzzy cognitive map or FCM draws a causal picture. It ties facts and things and processes to values and policies and objectives. And it lets you predict how complex events interact and play out.*

An FCM stands behind every op-ed article and every political speech. I had read an article by Henry Kissinger and turned it into Mideast FCM.each arrow in figure (following) defines a fuzzy rule. It defines a causal link or connection. A plus (+) means causal increase. A minus (-) means causal decrease... You can weight these rules or arrows with any number between 0 and 1(or between -1 and 1) or you can use word weights like " a little " or "somewhat" or "more or less". That's part of what makes an FCM'.

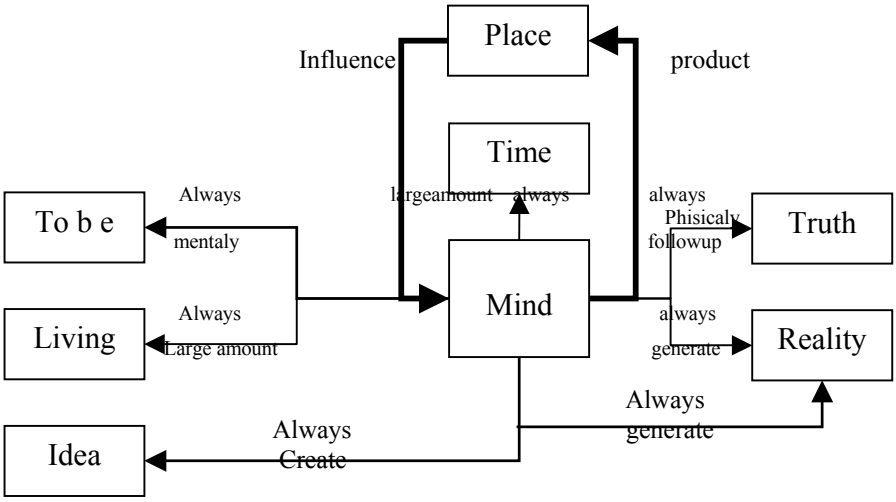

Fig.1

4.3.1 The process of computer simulation

- Extracting the information of each hidden layers using GIS systems
- Sorting the information in to appropriate databases.
- Finding the main growth function for each layer through studying their history of growth as a time series functions.
- Creating suitable software for modeling the growth process of elements based on the growth function already studied.
- Extracting the final structure of each layer using clustering methods that are based on the criteria of Landscape Architecture(Fig.2).

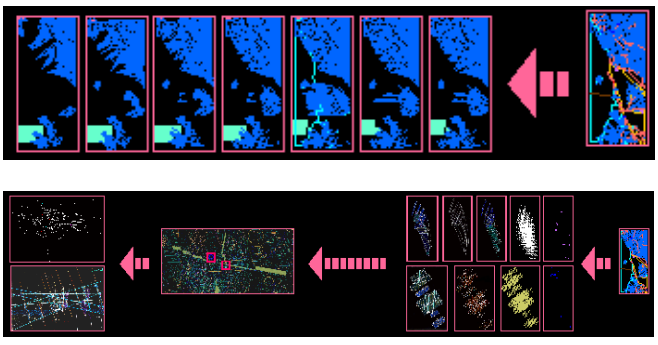

Fig.2

Conclusive observation of the Meta's Garden shows a remarkable matching of the computer modeling based on Chaotic FCM, with the actual world. These matching show the following facts (Fig.3):

- The computer simulation showed the existence of a spring phenomenon that matched and confirmed by post-studies of actual environment.
- The computer simulation had also showed the existence of natural green areas that further landmark studies confirmed this natural phenomenon.
- The remarkable fact was the result of simple non-machinery computing which is exactly match able with the further actual environmental studies on the location of caravans.

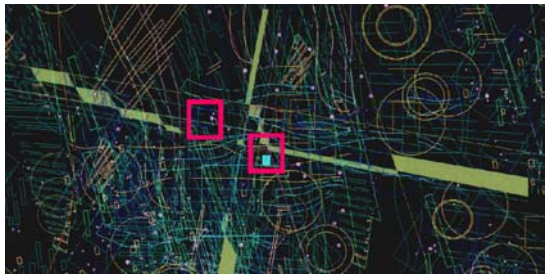

Fig.3

Example B

TEHRAN'S LOCAL CRITERIAS for HIGH RISES

In the following example the computer simulation itself is the visualization of the FCCM of Tehran which was designed for studying the behavior of high-rises free of linear time vector. It followed by superposing the multi informational layers of Tehran

urban area and based on the growth of hidden pattern of urban objects (Fig.4).

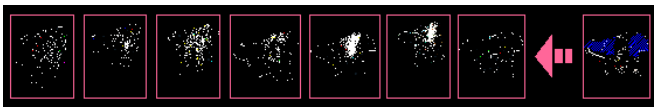

Fig.4

This visualization shows that such an improbable fact would come through the urban observed system. After 7 years further studies confirmed the whole prediction of this chaotic FCM. The interesting facts are:

- Decreasing the request of making high-rises in Elahieh and Jordan lands located in 3rd urban region of Tehran, which used to be the most attractive regions for high-rises.
- Increasing the request and the existence of high-rises in 2nd, 5th and 22nd urban regions of Tehran.
- Crossing the North Urban Border of Tehran (Called 1800 Boarder) by the high-rises, while it has been limited to the new hidden border which was visualized by computer simulation.
- The extension of construction high-rise projects to the south of Tehran, which in those days had no economical means for having high-rises.

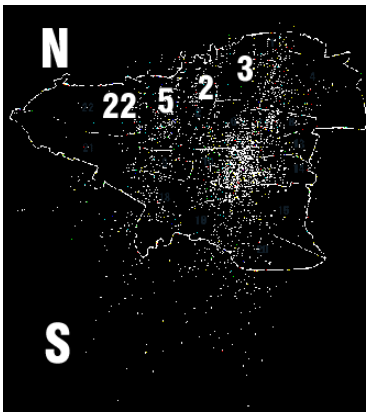

Fig.5

5. Concluding Remarks & Future Prospects

Based on the examples discussed above, the system's behaviors were studied out of linear time vector. It gave us the ability of understanding the hidden patterns of related systems. This led us to the creation of generating fluid plan for each system, and made us not to base the whole strategy of control upon linear expansion of one or two scenarios. So, by knowing the hidden pattern out of linear time vector the whole complex system continues its creative life and would be able to fit the proposed plan in relation with any new coming situation. Conclusion is that, the whole living system is no more frozen for a certain prediction, to be truth. It goes on and on through its way of life, by pushing the future tellers to the concept of chaos.

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