

Spatial Hierarchies: Enlightenment to Space Syntax Theory

Houpengcheng Li

MSc-Graduate School of Human-Environment Studies, Kyushu University

doylelee.ucl@outlook.com

Abstract. This paper focus on how spatial hierarchies become a bridge between the concepts 'space' and 'space syntax', and how it helps space syntax theory to find out the relationships between social interactions and space, and finally in the situation of modernized era today, analyze the importance of space syntax theory.

Keywords: spatial, hierarchy, space, planning, quantification, social interaction.

1. Introduction

The idea of spatial hierarchies inspire people to give birth to space syntax theory, and then help to analyze the relationship between social activities and space configurations. It even does not have many limitations, any technical issues can be solved by technical measures, and the only issue is more and more complicated formulae, more related factored and more complex calculations. The main analysis of this paper is the importance of space syntax theory.

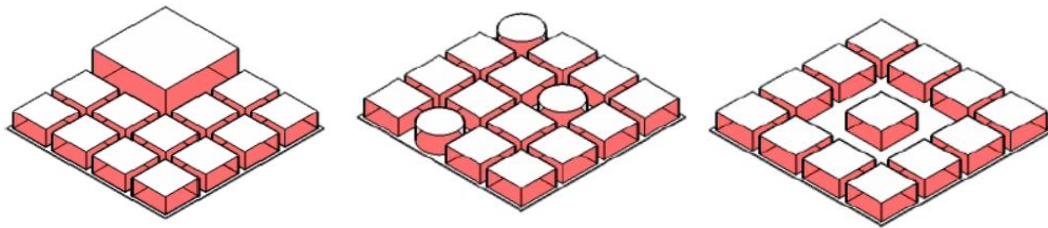
2. Overview of the essay

Spaces help the human beings of all ages, since the age of proving shelter, people created more and more activities with culture, and then spaces become much more important, in other words, people cannot live without spaces. During the change of times, the existence of relationship between spaces and human never changes. Someone believes that human shape spaces so that various activities could be carried on and needs could be satisfied. I agree with this view, however, unknowingly, will it be possible that the space also has impact on people's behavior? After years' research and study, Bill Hillier and Julienne Hanson found it to be true. The achievement named space syntax greatly helped urban planners to study the relationships of social interactions and their designs. In their study, a significant concept is spatial hierarchy, which connected to one crucial theory they introduced: the relationship between spaces. This essay would like to focus on how spatial hierarchies become a bridge between the concepts 'space' and 'space syntax', and how it helps space syntax theory to find out the relationships between social interactions and space, and finally in the situation of modernized era today, analyze the importance of space syntax theory.

3. Introduction of spatial form

Marcus Vitruvius Pollio wrote *De architecture* (published as *Ten Books on Architecture*) as early as between 30 and 15 BC. In this book, he asserted that a structure must exhibit the three qualities of *firmitatis*, *utilitatis* and *venustatis* (stability, utility and beauty), that is the famous Vitruvian Triad (Vitrubio Polión et al., 2001). 'Utility' mostly displayed the people's requirements to contemporary spaces and reflects the meaning of being created of space from another side. Generally, especially in architecture, the space refers to the vertical space divided by two floors. Yoshinobu Ashihara firstly introduced three elements that form spaces: ceiling, wall and floor in *Exterior Design in Architecture* (Yoshinobu Ashihara, 1981). In 1914-1915 Le Corbusier creatively raised the idea of Dom-Ino House which is manufactured in series that combines the order he discovered in classical architecture. Although it was just like the accumulation of floors, it greatly boosted the evolution of architectural space to vertical dimensions, and then 'spatial hierarchies' would emerge.

Hierarchies is another type of spatial form, they vary as the whole space changes. In architecture, spatial hierarchies mean the primary and secondary relations due to the difference among spaces in a spatial configuration. In other words, when people enter a space, the brain will deal with the information received by different sense organs, after this process, people will perceive the distinctiveness between smaller spaces and then divide them into primary or secondary sections. In these senses, visual sense is the most direct and fast one, so designer always uses this trick in their designing process. E.g. use light colors to make the space looks extensive. The picture below is a typical example. It forms a gradation in a contrast of spatial volume: In several spaces, the space with special volume would differ it from others, in order to make it prominent and give it special importance and meaning. Similarly, the second one forms a hierarchy due to the difference of spatial shapes. The differences in shapes have nothing to do with regularity or geometrics. Usually, the designing of these shapes aims to match the corresponding spatial functions. The last one put one space to a bold place and attracts people's attention. This kind of hierarchy not only put the eye-catching space to an important place, but also unifies the surrounding space and displays the primary and secondary relations in both the interior and exterior space.



In all, the spatial hierarchies are a type of spatial form which exist in divided, graded space. When subjective operation has been done on hierarchies, the order and primary-secondary relation can be clearly identified; the changes in volume, shape or place could all have influence on the form of representation of spatial hierarchies.

4. Statement of how spatial configurations generate the social interactions

4.1 Theoretical basis about spatial hierarchies

In *Space is the Machine: A Configurational Theory of Architecture*, Bill Hillier mentioned, space will not have influence on the social interaction, and the thing is the configuration relations between spaces (Hillier, 2007). In other words, the spatial hierarchies. He insists human and spaces are doing two-way interactions all the time: the space forms the behaviors of the individuals using it with its physical characteristics; the human's spatial behaviors change and transform the space (Siramkaya & Aydin, 2017). Interestingly, almost in the same time, famous American psychologist James Jerome Gibson introduced his Affordance Theory, which states that the world is perceived not only in terms of object shapes and spatial relationships, but also in object possibilities for action, namely the perception will also drive action. He believed that perception of the environment inevitably leads to some course of action, e.g. buttons for pushing, knobs for turning, and handles for pulling or levers for sliding. Although most of Gibson's theory concerns about how the physical environment can encourage individual's cognitive activity, to some extent, its core concept amazingly matches Hillier's space syntax (David, 2014).

In contrast, Hillier cares more about the interaction between characteristics of spaces and people's social behaviors: The location of these spaces, their way of coming together with other spaces, the physical characteristics of the space and its connection with outer space can develop movement patterns on humans that will support or prevent their interactions (Hillier, 2007). In other words, space syntax is an attempt to constitute a configurational theory in architecture by generating a theoretical understanding of how people make and use spatial configurations (Dursun, 2007), also, an attempt to identify how spatial configurations express a social or cultural meaning and how

spatial configurations generate the social interactions in built environments (Siramkaya & Aydin, 2017). So as his conclusion, since the spatial hierarchies can be planned, then people's social interaction could also be modified as a result. However, the mechanism in it is hard to explain in words, so I use several graphs in order to illustrate it.

4.2 Illustration for quantification and calculation of spaces

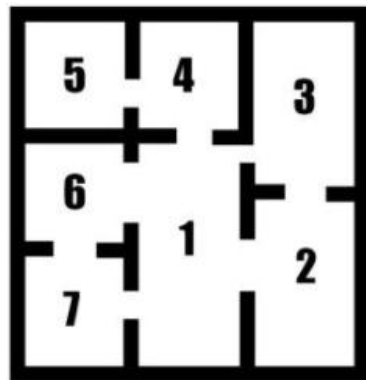


Figure 1
Common space layout

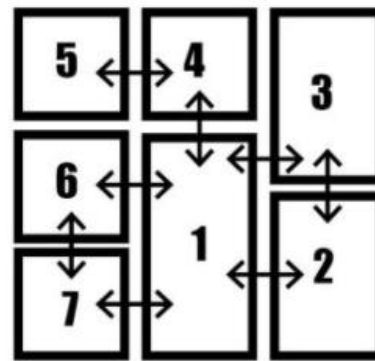


Figure 2
Connectivity of each room

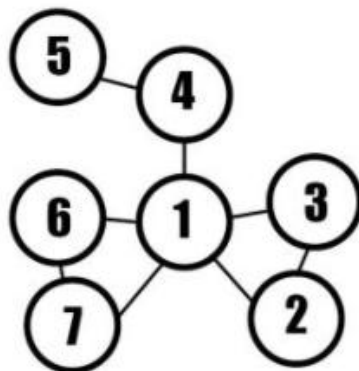


Figure 3
Abstract connectivity of each room

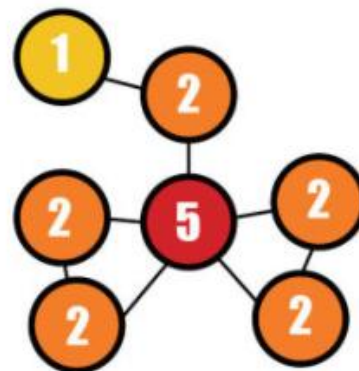


Figure 4
Connectivity digit of each room

The Figure 1 shows a common layout of a space. It has been divided into 7 rooms; each of them has different size and accessibilities with each other. The Figure 2 uses several arrows to show the connectivity of each room in this space. Then the Figure 3 is the abstraction of Figure 2. The final stage calculate the 'connectivity digit' (the accessibility, counted by the number of arrows in each room) of each room. This process can be seen as an easy way to do space syntax. Under this condition, the 'connectivity digit' could be really useful: people could easily decide the functions of each room. For example, room no.1 has the best accessibility, so it would be better to use it as living room or public space. In this case, social interaction has been supported by the planning of spaces. Inversely, if people would like prevent social interaction, then room no. 5 will be the best choice.

Turning back to spatial hierarchies, actually the Figure 1 just shows the hierarchy relations in this space as the space is divided into different rooms. After people's intervention (add the connectivity relations), it displays a typical order (room no.1 has the best accessibility, while the room no. 5 has the least).

Someone would say such layout of space is easy to find the most accessible room, even by their eyes. However, the most significant meaning of space syntax (especially in nowadays) is quantification and calculation of spaces.

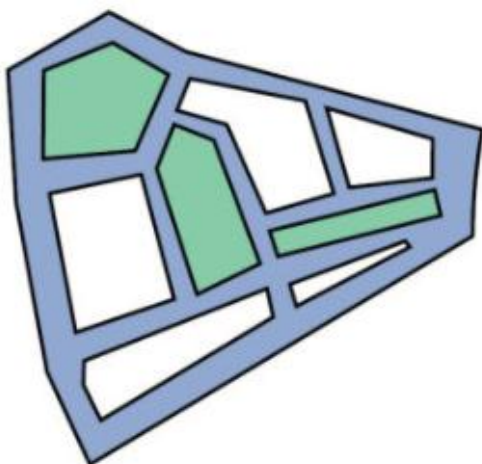


Figure 5

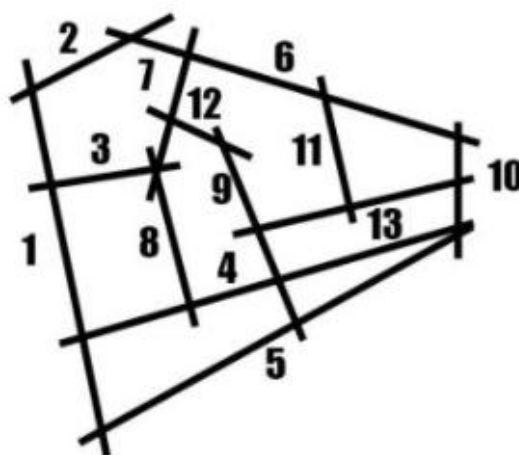


Figure 6

Can you identify which is the most accessible road in this area? There are 13 roads in this area.

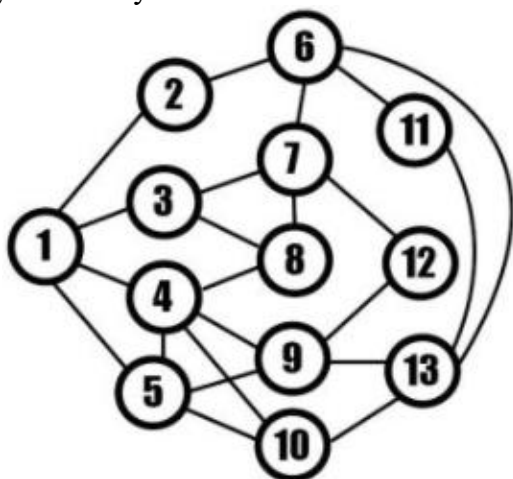


Figure 7

Abstract connectivity of each road

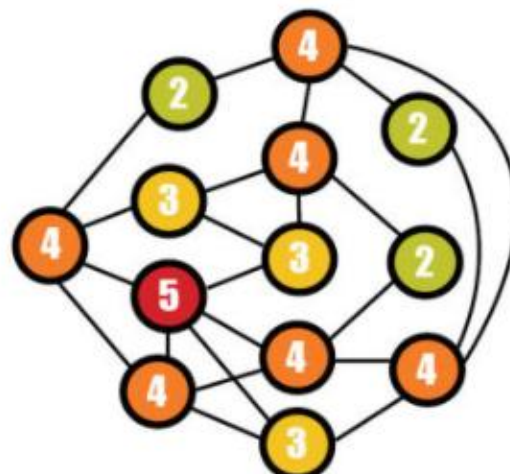


Figure 8

Connectivity digit of each road

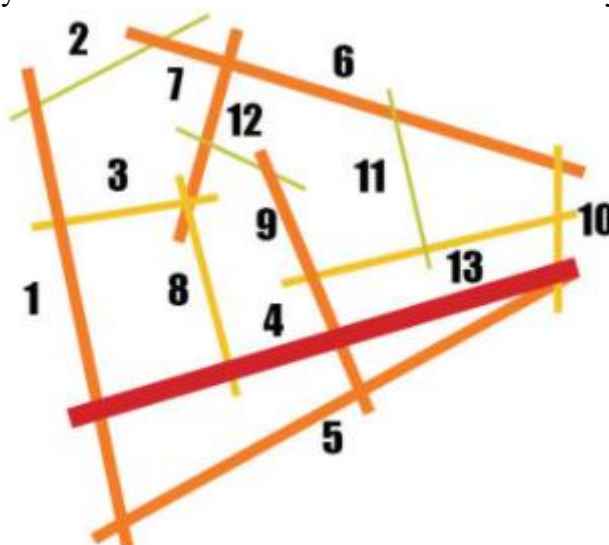


Figure 9 Road No.4 is the most accessible road

These pictures show a much more complicated process of doing a space syntax analysis in an area. This time, I think it is nearly impossible for people to just use their eyes to identify which is the most accessible road in this area according to Figure 5. Figure 6 even justify the last sentence: there are up to 13 roads in this area. After abstraction and visualization back to the picture, the

'connectivity digit' of each road can still be calculated through analyzing the connection relations of roads. Then we find out that the most accessible roads for people is road no.4. In this case, we can assume that road no. 4 is the main street in this area with big amount of vehicles and people every day. So, if we want to open a new restaurant in this area, road no.4 should be our best choice. Nevertheless, someone else may ask this type of analysis does not include any objective elements like government's policy, no extra spaces or other factors that would obstruct us to open restaurant on road no.4. Under this condition, actually more precise analysis could be done:

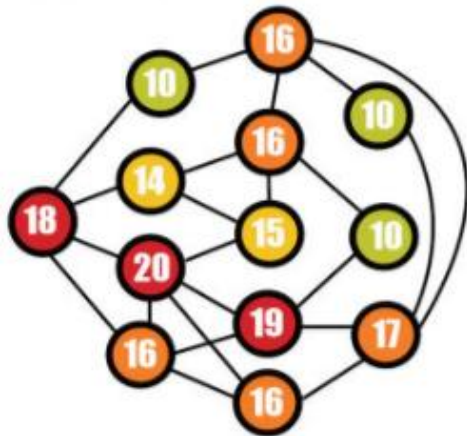


Figure 10

Precisely calculated connectivity of each

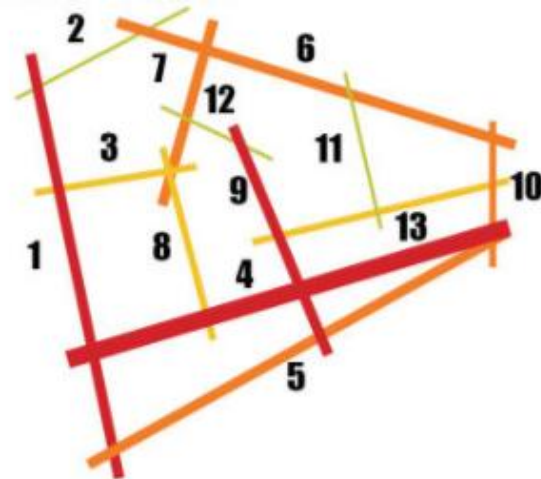


Figure 11

More objective and realistic accessibility of all the roads

Figure 10 shows the abstraction of this area after precise calculation and Figure 11 visualize the picture again. Here the precise analysis assumes people have enough physical strength to walk through two blocks. In other words, at the stage of counting connectivity digits, we add all the numbers the road connected to. For example, road no. 2 links road no. 1 and road no.6, when we count the precise digit, we need to add the original digit of road 1 and 6, then plus the original digit of road 2, that is: $4+4+2=10$. If we take a carefully look at Figure 9 and Figure 11, it is not hard to find several differences: the accessibility of road no.1 and road no.9 increases to tier 1, the accessibility of road no.10 increases from tier 3 to tier 2. So then the accessibility of all the roads become much more objective and realistic compared to the last one. So, overall, if certain objective conditions do not allow us to open a restaurant on road no.4, then road no.1 or road no. 9 will also be a good potential choice. This also shows that in most of the time, space syntax does not have many limitations, any technical issues can be solved by technical measures, and the only difference is more and more complicated formulae, more related factored or more complex calculations.

Just because of the idea of spatial hierarchies, people like Bill Hillier would be inspired to give birth to space syntax theory, and then analyze the relationship between social activities and space configurations. As I mentioned above, people can calculate and do easy space syntax on the paper, however, if we would like to analyze a much complicated building, or even a city, people's brain is obviously not enough; so, in this case, people came out with different computer software in order to calculate more complex situations, one well-known programme is Syntax 2D, which the spatial configuration is analytically evaluated by space syntax analysis and quantitative data can be obtained (Siramkaya & Aydin, 2017).

5. Conclusion

After my research and study, I think spatial hierarchy plays an important role in developing process of advanced space syntax theory, in other words, a connecting link between 'space ' and

‘spatial syntax’, helping us analyze the relationship between social activities and space configurations. In today's information age, big data calculation is urgently needed for designers and architects to obtain regions' characteristics and then wiser decisions can be made to determine whether social interaction should be supported or not.

References

- [1] [1] Vitrubio Polión, M., Rowland, I., Howe, T. and Dewar, M. (2001). Vitruvius. Cambridge: Cambridge University Press.
- [2] [2] Ashihara, Y. (1981). Exterior design in architecture. New York: Van Nostrand Reinhold.
- [3] [3] Hillier, B. (2007). Space is the machine: a configurational theory of architecture, http://eprints.ucl.ac.uk/3848/1/SpaceIsTheMachine_Part1.pdf
- [4] [4] Siramkaya, S.B. & Aydin, D. (2017). The effect of spatial configuration on social interaction: a syntactic evaluation of a faculty building. Global Journal of Arts Education. 7(3), 83-92.
- [5] [5] David L, "Affordance Theory (Gibson)," in Learning Theories, July 24, 2014, <https://www.learning-theories.com/affordance-theory-gibson.html>.
- [6] [6] Dursun, P. (2007, June). Space syntax in architectural design. In 6th International Space Syntax Symposium (pp. 01-56).
- [7] [7] KWAN M-P,DING G X, Geo-Narrative: Extending Geographic Information Systems for Narrative Analysis in Qualitative and Mixed-Method Research [J].The Professional Geographer,2008,60(4);443-465
- [8] [8] CONGRESS. Endless Frontier Act[EB/OL]. 2020-015-22[2022-06-01]. <https://www.congress.gov/bill/116th-congress/house-bill/6978/text>
- [9] [9] KATZ B, WAGNER J. The rise of innovation districts: a new geography of innovation in America[R]. Brookings Institution, 2014-05-14.
- [10] [10] ELHORST J P. Specification and estimation of spatial panel data models[J]. International Regional Science Review, 2003,26(3):244-268.
- [11] [11] FAN F, WEN X, FENG Z, et al. Optimizing urban ecological space based on the scenario of ecological security patterns: the case of central Wuhan, China[J]. Applied Geography, 2022, 138: 102619.