

REPRODUCTION OF BURGES'S CONCENTRIC CIRCLE LAND-USE MODEL BY MULTI AGENT SYSTEM

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Abstract: *A city is captured as a static object accumulated with countless buildings, but actually, it has been changed its form drastically by each human's daily selection and activity for a long time. Especially modern capitalism cities are more influenced by each human than former ones because of free economics and less domination of administrators. Chicago in 1920's can be taken as a starting point of such city. Burges who was one of originators of "human ecology" found that the land use pattern of Chicago looked like concentric circles. It was consisted from centre of the city with central business district, transition district which is very poor environment with slums, labour residential district, and rich suburban residential district. In this paper, Burges's concentric circle model is reproduced as a computational model. Most conventional urban models employ mathematical models and are very limited to model the various human's properties and behaviours. In this study, multi agent system, which is one of the new AI technologies, is employed in order to break down the limitation.*

1 INTRODUCTION

A city is captured as a static object accumulated with countless buildings, but actually, it has been changed its form drastically by each human's daily selection and activity for a long time. Especially modern capitalism cities are more influenced by each human than former ones because of free economics and less domination of administrators. Chicago in 1920's can be taken as a stating point of such city. Burges who was one of originators of "human ecology" found that the land use pattern of Chicago looked like concentric circles (Burges, 1925). It was consisted from centre of the city with central business district, transition district, which is a very poor environment with slums, labour residential district, and rich suburban residential district. The pattern was thought to be formed by the dynamic change of humans' life stages. First, immigrants came to live in transition area where very low price houses were stocked. But according to the increasing of their wealth and families, they wanted to move to the place with better environmental conditions. As a result, the concentric pattern was formed. Though concentric circle model is defied by natural language and some static diagrams, some important questions such as the detailed precondition of concentric pattern or possibility of other patterns are left out.

In this paper, Burges's concentric circle model is reproduced as a computational model. The reason why the computational model is employed is not only to answer the above questions. Since Chicago in the 1920s was said to be the original type of very complex modern cities, although the structure was relatively simple, it is an appropriate subject for a new modelling technique. Success of such simple city model will open the door to more complex realistic model.

Most conventional urban models employ mathematical models and are limited to consider just some human properties and behaviours. In this study, multi agent system, which is one of the new AI technologies, is employed in order to break down the limitation (Takizawa et al., 2000). Multi agent system is a software system consisted of many autonomous agents. Recently, this is employed to simulate complex human society as "Artificial Society".

The purpose of agent-based simulation is to examine the emergence property of complex systems. In other words, this simulation intends to reveal what and how local interaction of each agent forms the visible macro order. Applying this idea to our study, we examine how daily human behaviours influence a macro order of the concentric circle land use.

2 MODEL

The proposed urban model is consisted of resident agents, houses, offices, and factories as these employ places, shop agents, estate agents, and travelling means such as cars and trains.

A resident agent has some general properties such as age, sex, family, job, income, an address, etc. It also has individuality such as favour to the housing environment and aptitude for jobs. It goes to work everyday, buys foods from a shop agent, eats them, gets married, changes its address, and finally ends its life. It does all actions within the area where it can move during a day. The area depends on its moving mean. For example, if one has its own car, one can go to very far distances. On the contrary, if one has no other moving means than own foot, one can reach only a very narrow area around its house. There were only a few people who had their own car in that time, and large majority had nothing but to walk everywhere.

All house are supposed to be rental ones and the resident agent must pay its rent. A house has some properties such as floor space, building year, location, and aesthetic grade. All houses are ranked by their properties. A house with better environmental conditions is priced higher than other ones.

All offices and factories are supposed to be located in the central business district. The wage of an office worker is supposed to be higher than that of a factory worker.

Shop agents sell daily foods to resident agents. They can locate at every place of the urban area, but they all are in competition on commerce and losers must disappear from the city.

Estate agents manage houses and supply them to resident agents. Following a market mechanism, they rent a house to the agent who can pay the rent in the highest price.

Simulation is carried out as follows: A very small city with CBD is prepared as initial setting. Some new resident agents are input to the centre of the city every simulation cycle. They do actions such as selection of shopping and their house according to their own rules and sense of values. The city grows or declines by repeating the above operations.

3 SIMULATON

Using this model, various simulations with different parameter sets are carried out. For example, there are simulations with different moving costs, different preferences to the housing environment, different marriage ratios, etc. Some of the results are as follows. If costs of moving means are not so different, concentric pattern tends not to be formed. If many agents prefer to live near their office or factory, rich suburban residential area does not grow and the concentric pattern is not clear.

4 CONCLUSION

In this study, we reproduced the Burges's concentric circle land use model as a computational model by multi agent system. Conditions of concentric circle pattern were revealed and it is concluded that the validity of the multi agent simulation is confirmed.

References

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