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Simulating urban pattern dynamics by using an alternative approach of modelisation

Main feature of the research project: development of a tool for simulating urban dynamics.

→**Two principal goals:**

- understanding the link between agent's behavior and the morphogenesis of urban patterns,
- using this knowledge to simulate and visualize the impacts of a planning project.

→Test of different scenarios according to different planner's purposes.

→We use new concepts of formalization in order to understand the complexity of urban spaces evolution.

Key words: simulation of agent's behavior and their interactions, GIS, relational database, fuzzy logic

Three parts

1• Goals of the model, basic conceptions, working assumptions, concepts of formalization

2• Firsts steps of realization, based on a poll: *Besac Game*

3• Conceptual perspectives of modelling dynamics

First part: the architecture of the model

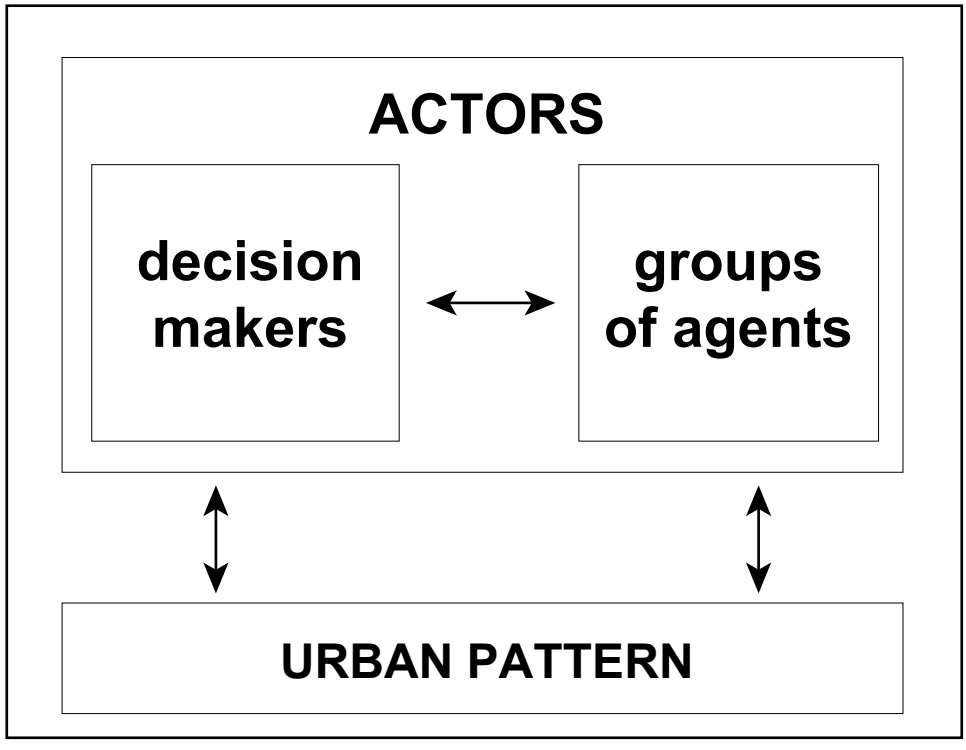
Urban pattern formation

A result of complex interactions processes between:

– spatio-economic conditions generated by planners' decisions (e.g. land-use plan)

– different groups of agents (residential population, entrepreneurs…) with different objectives (potential emergence of a social demand)

– spatial organization is affected by settlement dynamics and thus may be considered as an actor operating on future dynamics



Concretely

• cartographic representation of space by use of a GIS. Considered spatial units correspond to the scale of a land-use plan

→ Spatial units = residential zones, commercial zones…

• Spatial units are characterized by set of spatial and socio-economic attributes

• Pattern dynamics is governed :

– firstly, by spatial interactions and essentially by localization strategies of agents,

– secondly by the reactions of agents on the gradual transformation of space (retroaction of space on agents' behavior).

• Spatial and social interactions may operate on different time scales and spatial ranges

→ *Self-organization process may change dynamic rules in course of running simulation*

Model takes into account three levels:

1 macroscopic scale

• General regional, national or international economic or spatial conditions (external constraints)

2 mesoscopic scale

• Corresponds to a global point of view on the city

• Influence of the site: topographic constraints (overcosts for construction) or advantages

• Emergence of settlement patterns. Morphologic parameters.

• Frame for planning policy (land-use plan)

3 microscopic scale

• Corresponds to the spatial interaction of the different zones

• Social impact of planning projects, modelling mean behavior of agents (e.g. localization strategy of retail firms)

How to obtain information about space and agents' behavior?

Observations = polls and studies
- *of space*
- *of social agents acting on this space*

↓

Deduction of behavior rules

- *for space* (spatial interaction rules)
- *for social groups (*individual informations are used to obtain a mean behavior for each type of agents described by fuzzy values of perception and importance)

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Analysis of the result of the behavior

In which way the behavior of agents and space can modify the spatial structures of the city?

(the emergence of urban pattern will be controled by some morphological parameters such as fractal mesures)

How to generate dynamic rules ?

- **Taking into account space:** the attribute vector

Represents the relevant properties of the territory. E.g. : accessibility, vacancy rate, price of land…

- **Taking into account agents' behavior:**
  - *the perception vector* = fuzzy evaluation of the components of the attribute vector by different types of agents
  - *the vector of importance* = fuzzy evaluation of the importance concerning the components of tne perception vector with respect to different types of agents
  - *the attractiveness of each zone* = fuzzy synthetic measure combining informations of the two vectors importance and perception
  - *the predisposition to move of agents* (mobility rate)

- **Generating subsequent settlement dynamics**
  - dynamics based on agents' behavior. Deduction of land occupation rate for each zone and emergence of social demand
  - retroaction on urbanization process through the link between attribute and perception vector