

Application of numerical methods to the modeling of suburbs' growth

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Abstract

Many factors (e.g. level of street noise, air pollution, prices of flats or a wish to have a private garden) influence inhabitants choice of a place to live. So, it would appear that the complexity of urban growth cannot be efficiently described by formal models. However, this paper presents a model based on an artificial neural network and a cellular automaton, which proved efficient in this situation. The area of study, the Poznań agglomeration, was divided into squares 500 x 500 m of size. Each square was equipped with data presenting the intensity of factors influencing peoples willingness to live in this area. The factor modeled was not, as used to be in previous models, the built-up area but population density. After the socio-economic changes following 1989 in Poznań as well as in other Polish cities, the number of buildings in their central areas has been rising, but the population density has been decreasing. For this reason the model based only on the built-up area would give incorrect results.

The simulation of the growth of suburbs in the Poznań agglomeration takes into account legal barriers to the development of new residential areas (e.g. protection of forests, fields), prices of plots of land, accessibility to roads and to public transport, distance from sources of noise, and the physical barriers like rivers and lakes. In the first approach all these factors were interrelated by artificial neural networks with an outcome in the form of a matrix of the probability of change in population density. The simulation was made by cellular automata which took into account not only the nearest Moore neighborhoods, but also extended neighborhoods. In the second approach, the artificial neural networks of the model were conjoined into rules for updating cells in the cellular automaton. These models brought good results applicable in socio-economic geography and physical planning.

Keywords

Artificial neural network, Cellular automaton, Suburbanization.

References:

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