UDC: 007:338.8
DOI: 10.2298/IJGI1303279G

INFORMATION SYSTEM OF FORECASTING INFRASTRUCTURE DEVELOPMENT IN TOURISM

Bogdan Gats, Petro Bryzhak**, Yaroslav Vyklyuk*[1]*
* Bukovinian University, Chernivtsy, Ukraine
** National Academy of Public Administration under the President of Ukraine, Kyiv, Ukraine

Received 13 August 2013; reviewed 12 September 2013; accepted 01 October 2013

Abstract: Manuscript is devoted to the development of information system for tourist objects infrastructure growth and its practical implementation in form of information system using methods of fuzzy logic, theory of fractals and diffusion. Developed technology allows compute attractiveness of Carpathian region, structure, dynamics of the main tourist settlements Vorochta and Slavske, prospective territories for tourist business, growing strategies for region.

Key words: information system, information technology, knowledge base, the distribution of territory belonging to the urbanized, GIS.

Introduction

Modelling and prediction of the spatial form of infrastructure for various organizations, enterprises, institutions, including tourism industry, is an important administration task not only for big cities, but also for variety of large and small settlements and territories. The need to address this problem is follows.

First, an understanding of harmony, appropriateness and effectiveness of their development makes it possible to develop evidence-based recommendations for the further development of infrastructure. Existing methods and disparate models allow simulating the development of infrastructure form, but in the absence of this integrated approach, namely the incorporation of features and systems of selection, processing and analysis, they do not provide information technology of forecasting infrastructure for geographically distributed sites.

Secondly, stochastic spontaneous development is indicative for tourist settlements, i.e. infrastructure development is happening without any general plan. This often leads to natural disasters, landslides, sub-optimal use of

[1] Correspondence to: vyklyuk@ukr.net

resources and territories, the load on the environment and consequently - a significant reduction in tourist flows.

Thirdly, an important role in the development of the tourism industry plays features of the territory, which is one of the most important factors in the development of infrastructure. Having attributive places and their use as tourist attractions necessitates the development of supporting infrastructure and investing in new facilities. Therefore, for investing with maximum efficiency and avoiding crisis situations should be work out scientifically based recommendations on the choice of the most suitable areas for tourism development and the feasibility of building on their respective infrastructure.

Today, solving the problem of prediction the spatial form of infrastructure facilities in tourism industry is based on data from geographic information systems (GIS) and building appropriate mathematical models. Therefore, prediction the spatial form of infrastructure facilities demand manually sampled data or developing a software GIS add-on, which has implemented the selection and processing. However, in this way almost impossible to timely, efficiently and complexly solve a task. Currently, there is no special software to predict the spatial form of tourism infrastructure settlements. Obviously, the solution of this problem is possible only using advanced mathematical tools, advanced simulation methods for socio-economic processes, particularly in tourism industry, GIS and the introduction of new information technologies (IT).

Structure of information system of forecasting infrastructure development in tourism

A review of scientific research allows identify the main components, modules and mathematical methods for developing information system (IS). Obligatory components of IS are GIS, knowledge base, automated software module with several mathematical models of predicting tourism infrastructure growth, module for building spatial distributions belonging to the urbanized area (Vyklyuk, 2011).

The first step to build information system is developing informational technology for infrastructure growth prediction (ITIGP) that integrates methods of predicting the spatial characteristics of the tourist infrastructure objects, expanding their analytical capabilities through adaptation of mathematical packages with automated submission of geospatial data and processing by appropriate mathematical models. Unlike existing models has high efficiency and completeness in retrieving data from GIS and provides a comprehensive

approach to decision-making. Information technology consists of the following steps:

- Identify problems and forecasting facility.
- Extracting data from GIS based on the algorithm of selection and conversion geospatial data.
- Data processing.
- Training hybrid neural network, forming the rule base and fuzzy inference systems.
- Calculation the distribution of territory belonging to the urbanized, calculation by models for prediction changing the spatial form of infrastructure facilities in tourism industry and graphical display of simulation results.

The practical implementation of ITIGP is IS "Traverse" (Vyklyuk, 2012). Dataflow diagram for IS "Traverse" show on Figure 1.

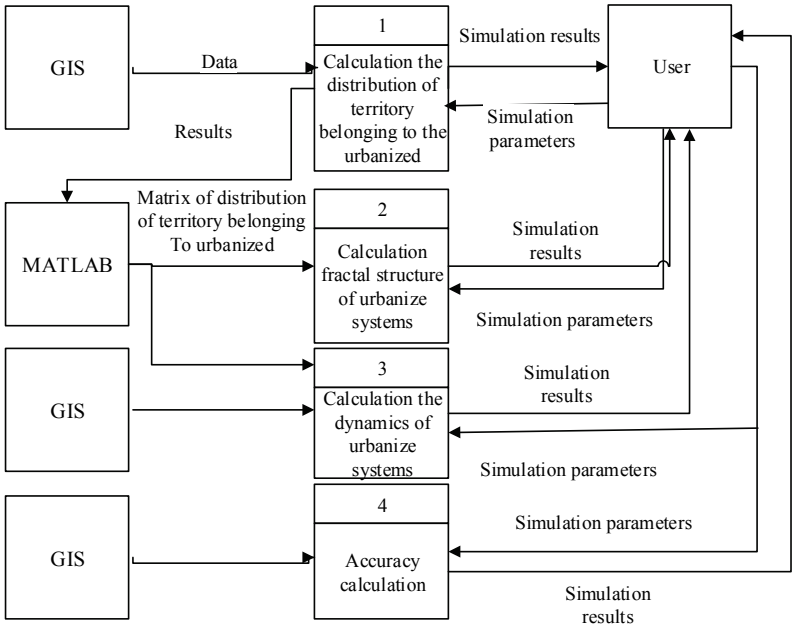


Figure 1. Dataflow diagram for Information System "Traverse"

For calculation spatial form of infrastructure implemented in IS "Traverse" block diagrams were constructed, namely: forecasting the spatial form of tourist settlements, forecasting the development of infrastructure and calculation accuracy. Block for prediction the spatial form of tourist settlements designed to

perform the following functions: model selection, based on which prediction of spatial form for tourist settlements will be, determination of appeal centers that act as attractors, building fractal structures in urban systems, graphical display of results. Figure 2 shows the data flow diagram of this block.

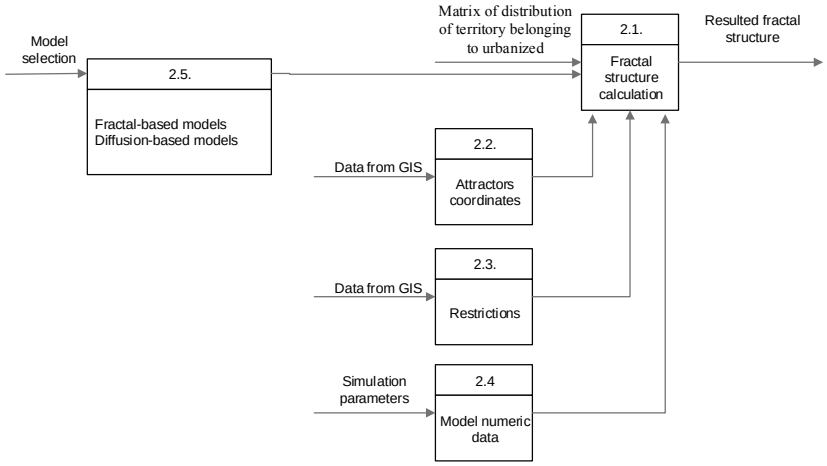


Figure 2. Dataflow diagram of prediction the spatial form of tourist settlements for IS "Traverse"

Block for forecasting the development of infrastructure designed to perform the following functions: convert selected in GIS cities in the matrix structure, simulation the dynamics of city infrastructure, graphical display of results. In Figure 3 developed a data flow diagram for this block.

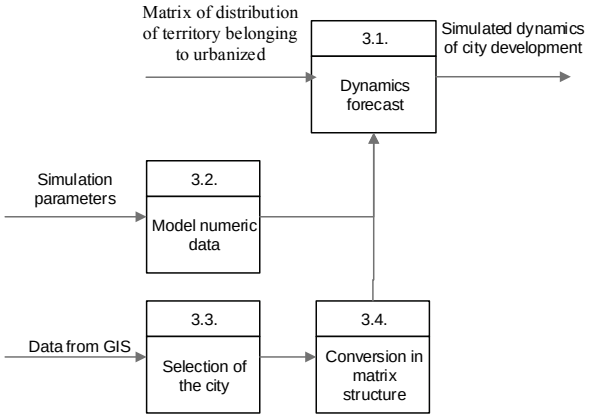


Figure 3. Dataflow diagram of forecasting the development of infrastructure for IS "Traverse"

Block for calculation accuracy includes m-files which calculating parametric identifier of simulated fractal structures. The block developed to calculate the fractal dimension, perimeter and area of a fractal, determine the accuracy of the calculations (Figure 4).

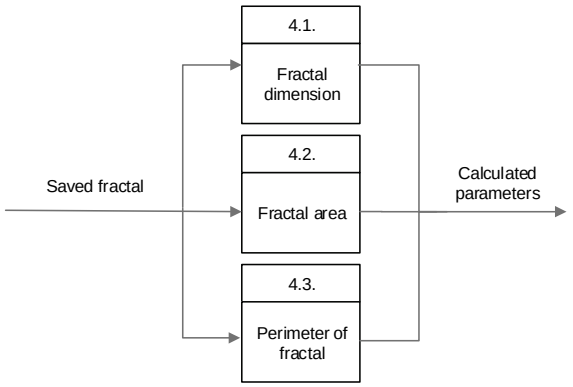


Figure 4. Dataflow diagram of calculation accuracy for IS "Traverse"

Thus, created blocks model of information system to calculate the spatial forms and data flow diagrams helped to integrate ITPRI objects of tourism industry in developed IS “Traverse”.

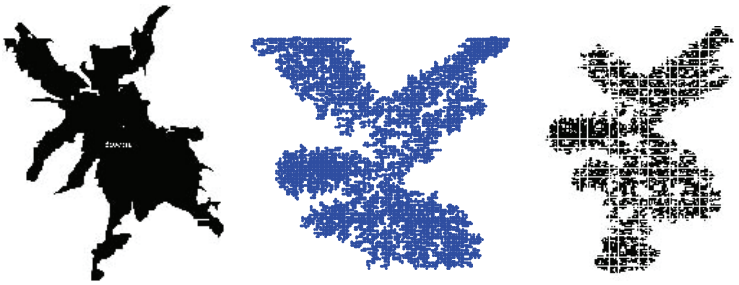
Implementation and simulation results

Information system "Traverse" is able to analyze the different strategies of the region by predicting changes in spatial form of infrastructure facilities in tourism industry, identifying promising sites for the development of infrastructure.

Developed IS "Traverse" showed a high level of accuracy of the results in comparison with the real look of settlements. Fractal growth testing based on Cellular Urban Model (Teknomo, 2004) for tourist township settlements Vorochta (Figure 5), Yaremche Slavske was conducted. The calculation was carried out in the approximation of nearness; the dimension of the matrix is 200 x 200. Attractors are coordinates of the city center, roads, railway station. One type of development was simulated - green tourism.

Testing of forecasting infrastructure development carried out by the example of the village Slavske. The prediction based on the algorithm CUM, but as a matrix of aggregated particles acting form of the village, which transferred to the matrix structure. Select city imported as an image into the IS "Traverse", released its contour shape and filled single cells. The calculation was carried out in the

approximation of nearness, the dimension of the matrix is 200 x 200, number of iterations is 8 million. Time spent on calculation on computers with processors Pentium Dual-Core T4200 CPU 2 GHz, was approximately 10 minutes (Vyklyuk, 2012).



a) view in Google Maps b) simulated structure based on CUM c) adding layer to CUM

Figure 5. Vorochta

Figure 6 shows the forecasting results of urban spatial development for Slavske. Actual city limits marks by red contour. Projected growth is observed in the direction of the existing road where the distribution of membership within 0.7-0.9 and the main objects of attraction are located.

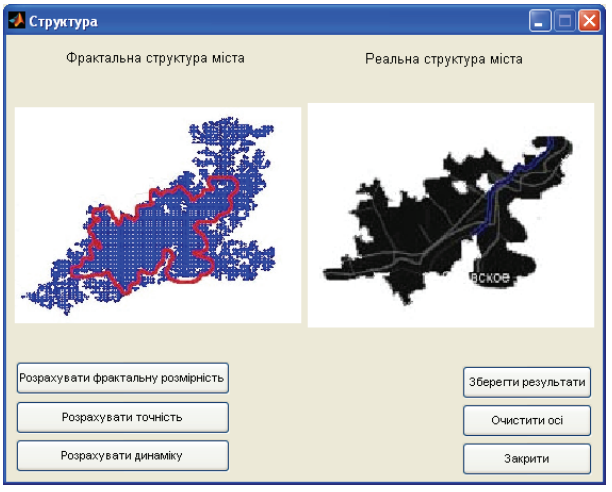


Figure 6. Forecasted for settlement Slavske

Proximity of road and railway stations constitutes another area of high origin and distribution branch in the form of a plateau in growth fractal. Calculation of

fractal dimension showed that the projected structure has a dimension $D = 1{,}94$ and a real city – $D = 1{,}8$.

Conclusions

Implemented within ITPRI IS "Traverse" allowed to get spatial forms of the main tourist settlements in the Carpathian region in a matrix, which is the main parameter for range of models designed to determine the harmony of urban development. In turn, developed IS can be used for different settlements in size and functions to help the administrative structures determine the feasibility and effectiveness of their development, to create evidence-based recommendations for the development of infrastructure. In addition, the possibility of imposing theoretically possible infrastructure near existing on the GIS map enables to predict the possible scenarios of the area. Spatial distributions territory belonging to the urbanized that obtained in IS "Traverse" made it possible to solve the problem of identifying the most attractive places for tourism infrastructure development. This in turn makes it possible for entrepreneurs to make decisions about investing in new facilities, and the accompanying development of existing infrastructure.

References

Vyklyuk, Y., & Gats, B. (2011). Overview of the current state of information functioning in tourism industry. *Announcer of National University «Lvov politehnica» the «Informative systems and networks»*, 715, 59-68.

Vyklyuk, Y., & Gats, B. (2012). Ontology of creation information system for infrastructure forecasting in tourism. *East European Journal of Advanced Technologies*, 1/2 (55), 19-23.

Teknomo K. (2004). Cellular Urban Descriptors of Lowland Urban Model. *International Symposium of Lowland Technology*, 297-302.

Vyklyuk, Y, & Gats, B. (2012). Using cellular urban model for predicting urban form of tourist settlement. *Selection and processing of information*, 35 (111), 122-127.