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CALIBRATION OF A FUZZY CELLULAR AUTOMATA MODEL OF URBAN GROWTH BY USING OPTIMIZATION ALGORITHM

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Abstract

Cellular Automata (CA) has been extensively utilized to replicate the intricate dynamism of complex systems such as urban growth. The aim of this research is to simulate urban land-use development based on three main criteria maps namely, land value, accessibility, and attractiveness as the indicators of sustainable development. The study area encompasses Qazvin urban area in Iran. To perform the simulation, a fuzzy CA model has been implemented. This framework has been proposed for the modeling of the ambiguous nature of urban development phenomena through the utilization of fuzzy logic. Subsequently, innovative algorithms (artificial bee colony and genetic algorithm) have been devised to calibrate the values of fuzzy membership functions and the weight of fuzzy rules, thereby enhancing the performance of the model. The proposed model was calibrated during the period 2005-2010. Subsequently, the optimized model was employed to forecast the advancements in 2015 by utilizing the artificial bee colony algorithm, yielding a Kappa index accuracy of 90.97% and accuracy of 50.13% based on the Figure of Merit index. However, according to the outcomes of the genetic algorithm, the accuracy reached 88.72% based on the Kappa index and 39.05% based on the Figure of Merit index.

Key words: artificial bee colony algorithm, fuzzy logic, genetic algorithm, Qazvin, urban development

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