

Peer Review

Review of: "Modeling and Simulating Agent-Based City Migration Using Conway's Game of Life"

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In this manuscript, the authors use Conway's Game of Life (GoL) to simulate the change in urban settlements in a city.

While I appreciate that the authors chose a simple and easily understandable modelling framework, I consider that the manuscript suffers from crucial issues which heavily diminish the value of the findings of the study.

1. Lack of rigorous mathematical definition. The model is mainly defined in terms of its computational definition, which makes it difficult to understand and replicate the results. To begin, the initial condition is not clear. The number of occupied lattice sites seems to be a binomially-distributed random variable with parameters N (the total number of lattice sites) and p (the user-defined probability). However, this is not stated. Furthermore, the definition of the rings and the grid-within-a-grid is unclear, especially since this is defined via a "distance" from the sentence, which is not mathematically defined. The authors probably mean the Euclidean distance, which would make the definition more obscure, given that space is discretized by the grid, so some kind of additional restrictions should be applied to define which boundary sites are considered inside and outside each ring. Authors should define the random variables corresponding to their initial conditions and define the specific distance metric (Euclidean, taxicab, etc.) as well as any quantitative criteria for defining ring borders.
2. Observables are not well-defined. The authors focus on the impact of initial conditions on the final configuration. However, GoL is known to be chaotic and to exhibit self-organized criticality, making it difficult to predict long-term behavior. Furthermore, their definition of convergence

does not take into account that GoL very commonly exhibits cycles (for example, oscillators and gliders), which would not be counted as having converged.

3. Results are not statistically significant. The results are obtained as averages over only fifteen realizations, which are not enough to approximate the representative behavior. Furthermore, instead of using a robust statistical quantity such as the median, the authors chose to use the mean and artificially remove data points corresponding to long convergence times. Any statistical results should be made with a robust metric, if there are significant outliers, over hundreds of realizations, and providing some kind of metric about data dispersion around the mean or median.
4. The discussion of the spatial distribution of occupied sites is not substantiated by data. The authors make claims about the spatial distribution of occupied lattice sites (pockets of high density, gentrification patterns) but do not provide any quantitative spatial observables to support these claims (e.g., mean occupancy gradient, spatial autocorrelation function, clustering coefficients). The discussion is based on simulation snapshots and plots of occupation percentage versus time, which lack spatial resolution.

Declarations

Potential competing interests: No potential competing interests to declare.