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A morphological cellular automata-agent based model prototype for simulating future isobenefit urbanism growth

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Paper Abstract

The 20-minute neighbourhood concept of each citizen reaching essential functions within a short walk/cycle is receiving increasing attention in the UK, and the urban forms that enable this are practically limitless. To visually simulate what these can look like in real-life, this study extends the existing cellular automata (CA)-based Python codes of 'Isobenefit Urbanism Morphogenesis' (D'Acci,2013;2019) into a CA-agent based model on NetLogo using real-life spatial (40*40m grids) and population data from five wards of the New Forest district council area. Land use is classified into nature (water/green), residential (low/medium/high-density) and centrality which contains key functions such as work, commerce, healthcare, education and entertainment. The objective is to build new housing (turning nature into residential) while ensuring the existing and new population's access to nature and centralities. The simulation runs until it reaches the population of 35,000 (around 35% increase from 2021) and exports the results into raster maps. The metric 'percent of residential areas within 1km of nature and centrality' is around 47% in 2021 and can reach around 72% depending on the policy scenarios (e.g., with/without nature corridor) and parameter settings (e.g., probability and population threshold for new centrality formation). We discuss developing such model as a planning support science for local authority planners, with potential for the addition of human behavioural aspects (e.g., retail business location linked with centrality formation, resident travel linked with active mobility), and the capturing of pro-health and pro-environmental outcomes as metrics within the model.