Urban Growth Submodel Example

The urban growth submodel in RSim consists of spontaneous growth of new urban areas, patch growth (growth of preexisting urban patches), and road-influenced urbanization constraints that are applied at each iteration of the model to create new urban land cover. This approach builds upon the concepts set forth by a regional planning model called SLEUTH [[i], [ii], [iii], [iv]]. Spontaneous urban growth in RSim allows for randomized urbanization, and the patch growth in RSim is influenced by the proximity of existing urban centers. Road-influenced urban growth considers the proximity of major roads to newly urbanized areas. Upon each iteration of the urban growth model, a set number of non-urban pixels in a land-cover map are tested for suitability for urbanization according to the spontaneous and patch growth constraints. For each pixel that is converted to urban land use, an additional test is performed to determine whether a major road is within a predefined distance from the newly urbanized pixel. The proposed road changes were primarily derived from the Georgia Department of Transportation's (DOT's) Governor's Road Improvement Program (GRIP) [[v]], which began in 1989 and plans to widen two-lane roads to four-lane roads and to attract economic development by improving the state's highway network.

In order to identify a candidate road for growth, a search procedure is performed in RSim to seek out potential pixels for urbanization. The search process continues either until it must be aborted because a suitable direction is lacking or until the distance traveled exceeds a predefined travel limit coefficient. To simulate the higher costs of traveling along smaller two-lane roads than along larger four-lane roads, each single-pixel advancement on a two-lane road contributes more toward the travel limit than a single-pixel advancement on a four-lane road; this accounting in effect allows longer searches along four-lane roads.

Upon the successful completion of a search, the immediate neighbors of the final road pixel visited are tested for potential urbanization. If a candidate pixel for urbanization is found, it is changed to an urban type and its immediate neighbors are also tested to find two more urban candidates. If successful, this process creates a new urban center that may result in spreading growth as determined by the patch growth constraint.

[[i]] The SLEUTH model is described on the following website: http://www.ncgia.ucsb.edu/projects/gig/index.html

[[ii]] Candau JC. Temporal Calibration Sensitivity of the SLEUTH Urban Growth Model. University of California, Santa Barbara, CA. M.A. Thesis, 2002.

[[iii]] Clarke KC, Gaydos LJ. Loose-coupling a cellular automation model and GIS: long-term urban growth prediction for San Francisco and Washington/Baltimore. *Geographical Information Science* 1998:12(7):699-714.

[[iv]] Clarke KC, Gaydos L, Hoppen S. A self-modifying cellular automata model of historical urbanization in the San Francisco Bay area. *Environment and Planning B.* 1996:24:247-261.

[[v]] Georgia Department of Transportation. Governor's Road Improvement Program (GRIP): http://www.dot.state.ga.us/DOT/plan-prog/planning/programs/grip.