**Study of Cellular Automata Models for Urban Growth**

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This project focuses on simulating multiple land use changes integrated with cellular automata..

Transition probabilities for the typical CA model depend on the state of a cell, the state of its surrounding cells, the physical characteristics of the cell (e.g., terrain, soil quality, vegetation, hydrology, and demographic characteristics), and the weights associated with the neighborhood context of the cell (e.g., proximity to other villages and the time since settlement). These weights and neighborhood conditions are determined from empirical analyses of LUCC based on social survey data, the GIS database that represents resource endowments of a site, and the spatial linkages between villages, land parcels, and other critical landscape features.

The CA model in general works by:

a) simulating the present by extrapolating from the past using the image time-series

b) validating the simulations via the remotely sensed time-series of past conditions and through the available collection of field observations

c) allowing the model to iterate to the year of choice in future

d) comparing model outputs to an autoregressive time-series approach for annual conditions

**Stucture and Transition Rules**

There are two layers, [Landuse] represents the land use changes, it has three states:5(forest), 6(non-forest), 7(urban); [Geo\_Popu] has four states representing geology suitability and population pressure. It was shown in the below form(Y is yes and N is no). Y for geology suitability is suitable to develop from forest to non-forest, to urban while Y for population pressure is there is need to transfer people from a place to another place.

|  |  |  |
| --- | --- | --- |
| State Variable | Geology Suitability | Population Pressure |
| 1 | Y | N |
| 2 | Y | Y |
| 3 | N | Y |
| 4 | N | N |

Transition Rules:

if cell(0,0,0)=5 and when there are at least three neighbors in the second layer has the state value 2 or 3, which means there are population to move in, then the cell(0,0,0)=6.

if cell(0,0,0)=6 and when there are at least three neighbors in the second layer has the state value 2 or 3, which means there are population to move in, then the cell(0,0,0)=7.

Hence, the land use can only change from 5(forest) to 6(non-forest), to 7(urban).

**Formal Specification**

The following is the formal specification for the Cell-DEVS Population model:

CD = < X, Y, I, S, θ, N, d, δint, δext, τ, λ, D >

X = Ø

Y = Ø

S = {1, 2, 3, 4, 5, 6, 7}

N = neighborhood ={ (-1,0,0), (0,-1,0), (0,0,0), (1,0,0), (-1,0,1), (0,-1,1), (0,0,1), (0,1,1), (1,0,1) }

d = 100 ms

τ: N🡪S:

[Landuse]

S = 6 if cell (0, 0, 0) = 5 and any three neighbors = 2 or 3

S = 7 if cell (0, 0, 0) = 6 and any three neighbors = 2 or 3

[Geo\_Popu]

S = 3 if cell (0, 0, 0) = 4 and any two neighbors =3

S=2 if cell (0, 0, 0) = 1 and any two neighbors =2 or 3

S=2 if cell (0, 0, 0 )= 3 and any two neighbors =2

**Analysis**

We could see from the results of CD++ Modeler, since population moves into the cell where geology suitability is fine and expands with time, almost the majority of land will be turned into urban with the population increase.

This model could be used to predict what will happen if the current urban development pattern continues integrating with GIS database.