

# Resumen de Tesis Doctoral



UNIVERSITAT POLITÈCNICA DE CATALUNYA  
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Escola de Doctorat

DNI/NIE/Pasaporte

Nombre y apellidos

Título de la tesis

Unidad estructural

Programa

Códigos UNESCO

(Mínimo 1 y máximo 4, podéis verlos en <http://doctorat.upc.edu/gestion-academica/carpeta-impresos/tesis-matricula-y-deposito/codigos-unesco>)

## Resumen de la tesis de 4000 caracteres máximo (si se superan los 4000 se cortará automáticamente)

The development of urban models based on mathematical and physics concepts has been one of the most intense scientific areas of research for the last two decades in urban studies.

Cellular automata (CA), a mathematical approach to the evolution of systems, is one of these concepts that have gained the attention of geographers and many other urban studies scholars since the 1970s. CA have two main features that are quite interesting for urban modelling. First, CA formulation and early development are very close to the development of computation sciences themselves. Second, CA benefits from an inherent spatiality that suits the modelling of a wide range of spatial phenomena. They allow the simulation of complex patterns of, for example, land use, starting from a very simple and perceivable conceptual framework that includes five simple concepts: (1) the cell and the cell space (representing form); (2) a finite set of cell states (representing, for example, land uses); (3) a neighbourhood of cells (representing spatial interaction); (4) a finite set of transition rules (representing behaviours, the urban function); and (5) the evolution of a system over time (representing the dynamic nature of complex systems).

CA models are commonly used to simulate land use change at a regional or metropolitan level considering land use dynamics at a local level. They consider increasingly smaller cells, making use of the high resolution of today's remote sense images to capture many interactions that occur at a very large scale. Regular cells are used at the local scale (traditionally image pixels) and at a regional scale, as aggregations of smaller cells. Neighbourhoods are user defined in the majority of the cases, fixing beforehand one of the most important abilities of CA models in capturing spatial interaction and its extent. Transition rules are usually applied to the entire region, making no real difference in the types of interactions that occur at different scales. CA models usually consider external drivers such as accessibility or land suitability as external attributes of cells, disregarding interdependencies between those drivers.

This dissertation presents the research on these previous features by developing a multiscale CA model to simulate land use change both at the regional and at the local scales, taking accessibility not as an exogenous cell attribute but as a part of the modelling package, improving the models' capacity to capture the interdependences between all drivers. The research addressed the issues of scale, cell form, neighbourhood definition, and calibration. A multiscale CA modelling framework aims to simulate land use dynamics at two different spatial and time scales: a macroscale CA that tries to model the aggregated land use change at a regional level; and a microscale CA that tries to model land use allocation at local scale. Irregular cells are used at both scales. Neighbourhood extension is defined at both scales as a model parameter, thus defined by the calibration procedure. The macroscale model generates aggregate values of land use demand as an input for the microscale model, which tries to allocate land use to best fit simulation to reality. Model calibration is made using an optimization procedure based on the particle swarm optimization heuristic.

The dissertation presents and discusses the main features of the models and of the calibration process. A set of modular modelling tools were developed to simulate complex urban phenomena that constitute the foundation of urban growth/urban change. The models have been applied to case studies in Portugal and Spain, with different scales and spatial structures, to illustrate the main findings.

Lugar  Fecha

Firma