INTRODUCTION TO MODELING AND SIMULATION OF SPATIAL SYSTEMS WITH DEVS AND CELL-DEVS

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ABSTRACT

Recent advances in computer technology have influenced simulation techniques to become an effective approach to understand physical systems. In recent years, grid-shaped cellular models have gained popularity in this sense. In particular, Cellular Automata (CA) have been widely used with these purposes. Despite their usefulness to describe complex behavior, CA can require large amounts of compute time, mainly due to its synchronous nature. The use of a discrete time base also constrains the precision of the model. Besides this, CA do not describe adequately most of existing physical systems whose nature is asynchronous. The Cell-DEVS formalism was defined in order to attack these problems. The goal of Cell-DEVS is to build discrete-event cell spaces, improving their definition by making the timing specification more expressive.

We will introduce the main characteristics of the Cell-DEVS formalism, and will show how to model complex cell spaces in. We will present different examples of application, and discuss open research issues in this area. We will then show some examples of the current use of DEVS, including applications in different fields. We will introduce an integrated environment that deals with these issues, orchestrating a cellular-based simulator (CD++), a GIS (GRASS) and data visualization (Google Earth), to simulate behavior and analyze results supporting the decision making for varied environmental scenarios. The limitations above are solved by adding raw simulation results into the georeferenced maps, associating many sources of information (even if they do not come from the simulation model), providing a more powerful analysis experience. The simulation model is fed by the GIS with updated data, while the model design process enables integrating additional information layers. The methodology uses a cellular modeling approach in which each cell is defined as a discrete event agent, and defines a procedure to couple cells evolving the state of the influenced neighbors.

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