

An Affordance-Based Multi-Agent Simulation to Constrain Emergence

B. Doussin¹, N. Verstaevel², B. Gaudou², E. Kaddoum³, F. Amblard²

¹ IRIT, Université de Toulouse, CNRS, Toulouse INP, UT3, Toulouse, France

² IRIT, Université de Toulouse, CNRS, Toulouse INP, UT3, UT1C, Toulouse, France

³ IRIT, Université de Toulouse, CNRS, Toulouse INP, UT3, UT2J, Toulouse, France

benoit.doussin@irit.fr

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Abstract

Today, metropolitan areas are marked by a phenomenon of urban growth and densification, leading to significant congestion and mobility problems. The urban development of new neighborhoods in the city, therefore, requires upstream planning of the various means of access, in particular in terms of public or shared transport modes. Tools for analyzing the structure of the urban fabric and the various transport networks, as well as their evolution[1], are now essential tools for urban planners to understand these problems. To go further and be able to test the evolution of the behavior of the inhabitants to different choices of developments, modeling, and simulation-based on agents is one of the most appropriate tools[2].

An agent-based model can represent a phenomenon at the individual level and generate emergent phenomena at the macroscopic level or mesoscopic levels. For example, the simulation of the individual mobility of users of a university campus (students, teachers, etc.) brings out patterns of attendance in teaching or catering buildings, regular at the weekly scale.

The main problem with these emerging phenomena is that they are difficult to anticipate, understand and control. This is, even more, the case at the mesoscopic level: how to ensure that certain constraints set by the modeler on areas of the environment are satisfied while preserving the autonomy of individual agents (microscopic level) in their choice of behavior?

We describe in this paper a novel approach allowing the modeller to specify its macroscopic or mesoscopic constraints directly in some entities of the environment that will influence the behavior of individuals. The idea is to allow the modeler to specify directly in the model the interactions that he wants to be able to observe at a macroscopic level. We define two agent roles, the Enabler, which offer certain action potentialities, and the Consumer who can achieve them. We base our model on the concept of Affordance and propose a first implementation on the Paul Sabatier Campus. The main purpose is to allow an urban developer, with certain business knowledge, to come and specify the interactions he wishes to observe, such as the attendance of buildings.

Additional material

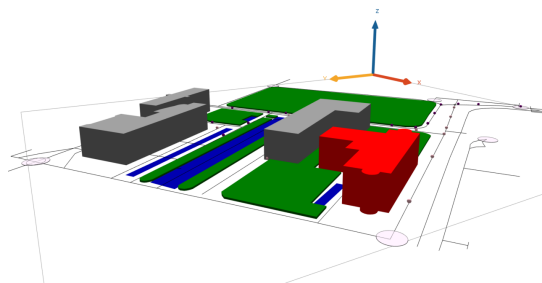


Figure 1: Capture d'écran de la simulation sur le campus

References

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- [2] A. T. Crooks, A. Patel, and S. Wise. Multi-agent systems for urban planning. In *Technologies for urban and spatial planning: virtual cities and territories*, pages 29–56. IGI Global, 2014.