Dynamic Multilevel Modeling in the design of Decision-Support Systems for Rescue Simulation: combining agent-based and mathematical approaches

Proposition de recherche doctorale

Mots clés :

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- Co-encadrant(s) :
- Unité de recherche : Unité de modélisation mathématique et informatique de systèmes complexes
- École doctorale : École Doctorale Informatique, Télécommunications, Électronique de Paris
- Domaine scientifique principal: Divers

Résumé du projet de recherche (Langue 1)

General framework of the research project Nowadays, panic situations (fire, bomb attack, tsunami, earthquake, etc) in urban areas threaten more and more human lives. Evacuation plan in panic situation is becoming an important application of simulation in many projects [1][3]. Real environments for such simulation often include road networks. The movement of pedestrians in road networks is a complex system to study. Evacuation simulation can be used to predict the performance of evacuations and thus become an importance method for evacuation analysis. The major methodologies of crowd simulation in dynamic environment are either based on micro and macro models. Each of the two types of model represent choices in the trade-off between level of details and efficiency. The domain of pedestrian flow simulation in road networks is no exception and theories rely either on equation based model (LWR) or agent based models. There is a growing interest for hybrid modeling that combines both models together. The mathematical models in evacuation of crowd population [6][7] did not take into account agents or individuals and their behavior, it has become necessary to develop models that take into account individual behaviors and their impact at the result of model. Recent work [4][6][8] show the interest to confront and compare mathematical and computer models of the same system in evacuation of crowd population. This research work is a continuation of these multidisciplinary research designed to take advantage of the synergy between mathematical models and those based agents. Optimizing evacuation plan in Nhatrang city is the issue that we desire to solve. Nhatrang of Vietnam is a famous beach for tourism but it is near earthquake sources from Philippine that may cause tsunami disasters. The problem studied in this paper is building the model of the evacuation in road networks with the assumptions of J junctions, B different safe places that pedestrians ought to reach, one direction to escape from endangered places. The thesis project involves three components: A modeling approach with computer models of individual-centered agent-based as they are developed in the unit by Alexis Drogoul and Jean-Daniel Zucker. A mathematical modeling approach in line with previous work in unity by [6][7]. The problem of combining both micro and macro models of pedestrians to speedup identification of optimal evacuation plan. The goal is therefor to use efficient macro modeling in part of the road networks that do not require fine grained model and less efficient but more detailed micro modeling elsewhere. The key issue raised by such an approach is to demonstrate the consistency of the resulting hybrid model. Research in computer modeling approach with agent base model in the field of modeling of complex system, the study of the impact of individual behavior on the collective future of populations is more often done using computer models called "individual-centered" or "multi-agents" [1][2]. In these models, studied for several years in the unit, individuals are explicitly represented with their attributes, their rules of action and interaction, and changes in their status (receiving information, changing velocity, choosing right way, following other person,...). The simulations, which involve placing these individuals in an artificial environment itself simulated for studying finely emerging forms that arise from their virtual interactions and especially to understand the conditions of their emergence through the games complex interaction [2]. The thesis of Mrs. Nguyen Thi Ngoc Anh is in the context of theoretical about crowd movement of the work presented above. Several aspects concerning the thesis, a part of mathematical modeling will be supervised by Prof. Nguyen Huu Du (Vice President of Mathematical Society of Vietnam) and a computer modeling including Jean-Daniel Zucker will direct. One expected the thesis, important for the field of crowd movement, will work to define a single system for the conditions under which a mathematical model on the one hand and the individual model. Ms. Nguyen Thi Ngoc Anh will take care to place this research in a methodological framework generalizable to other theoretical models in crowd simulation. References Thanh Quang Chu, Alexis Drogoul, Alain Boucher and Jean Daniel Zucker, "Interactive Learning of Independent Experts’ Criteria for Rescue Simulations", Journal of Universal Computer Science, pages 2701-2725, 2009. Drogoul A., Les Systèmes Multi-agents, in L'intelligence (Traité des Sciences Cognitives), Lautrey J et Richard J-F., Ed., Hermès, France, 2005. Gil Quijano J., Drogoul A., et Piron M. 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