

SIMPARC PROJECT: COMPUTER SUPPORT FOR PARTICIPATORY MANAGEMENT OF PROTECTED AREAS

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An important and difficult challenge facing contemporary world is the apparent dilemma between the competing objectives of environmental conservation, economic development, and social inclusion. Brazil faces such challenges, in rural but also in urban environments, as it happens with the remains of the Atlantic Forest within the city of Rio de Janeiro.

Recent initiatives to address these challenges, notably by the Brazilian Ministry of Environment, are based on bottom-up participatory approaches, that allow for building solutions using the knowledge of local actors (stakeholders) and communities. Such bottom-up approaches echo the research conducted by members of the "ComMod" (for companion modeling) movement (BARRETEAU, 2003). Over the last ten years, they have developed a participatory method to support negotiation and decision-making in the field of collective management of natural renewable resources. This method consists in jointly using role-playing games involving stakeholders and computer-based agent-based simulations of the environment and associated resources.

Our project inherits from this tradition, but we propose to use a recent evolution of the ComMod methodology called participatory simulations (GUYOT & HONIDEN, 2006) that merges role-playing games and agent-based simulation. Our main hypothesis is that such an approach favors discussions between stakeholders and the emergence of policy proposals. From a computing perspective, it also has several advantages: distribution, use of assistant agents, automatic analysis of traces. The project, named "SimParc", gathers French and Brazilian researchers in the various fields involved (computer science, modeling, simulation, regional planning, environmental management and biodiversity conservation, social sciences). It is mainly funded by the ARCUS program ("Actions en Régions de Coopération Universitaire et Scientifique") of the French Ministry of Foreign Affairs, Région Ile-de-France, and Brazil.

The question of the integration of the social actors in the management of biodiversity is still largely under discussion in fundamental and applied research fields. It constitutes also

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a key element of the application of the Convention on Biological Diversity. It concerns Brazil but also France, in particular on the stakes of the development of national parks at the border.

Our objective is, starting from case studies, to elaborate a strategy for management of protected areas, which integrates local actors and defines spaces of dialogue about the public policies. Therefore, the following questions are some inspiration for research (IRVING, 2004): (a) Who are the social actors?; (b) What are their negotiation strategies?; (c) What are the conflicts and how can we contribute to their resolution?; (d) What are the political, economic, social and ecological stakes of the conservation of protected areas?; (e) What are the social dynamics?; (f) On what representations and practices are they based?; (g) How to design a model of management able to consider the existing conflicts and the solutions suggested?; (h) How to envision management of protected areas through middle and long term projections of scenarios?

These questions will imply to establish an assessment of the situation of social dynamics related to these protected areas, and to reflect on the interest of the models of management at use in Brazil and in other countries. For this study, we decided to study the use of advanced accompaniment methodologies combining role playing games and simulation (BRIOT & IRVING, 2005). These approaches, although recent, already proved their potential on a certain number of projects of management of renewable resources. Their application to the management of protected spaces will be a first attempt, with returns awaited on methodology.

Since the end of the 1990s, a group of researchers has been developing a participatory approach to support negotiation about collective practices in the context of natural resource management. Gathered within the ComMod movement (standing for "Companion Modelling" (BARRETEAU, 2003), they mostly belong to French agriculture- or development-centered research institutes, such as CIRAD, CEMAGREF, INRA and IRD. Their method, called the MAS/RPG approach (BARRETEAU, 2003b) consists in coupling agent-based computer simulations (MAS, Multi-Agent Systems) and role-playing games (RPG) with the concerned actors (stakeholders).

Agent-based simulations are built from models of individual behaviors, and thus are well-suited to simulate phenomena from a combination of diverging or conflicting points of view and representations. This aggregation and the possibility to present the impact of individual behaviors on the environment are exploited by these researchers to support negotiation (BOUSQUET *et al.*, 1999), e.g., about the rarefaction of water resources (ADAMATTI *et al.*, 2005).

Role-playing games are particularly well-suited to foster dialog between actors. Indeed, experiments conducted by members of the ComMod movement assessed the improvement brought by the joint use of role-playing games and agent-based simulations displaying the dynamics of the resource and its exploitation. The method was first used to allow farmers to collectively design irrigation strategies (BARRETEAU *et al.*, 2001). Besides, this approach can help actors gain a broader understanding of a problem, notably by conducting role-playing games where roles are exchanged.

A main drawback of the traditional joint-use of agent-based simulations and role-playing games is that organizers must be present during the role-playing game. They manually input the decisions and actions taken by participant to allow the computer to determine the new state of the environment and they present this result to the actors. This process is complex and prone to possible errors of transcription.

We developed an alternative to the MAS/RPG approach called "agent-based participatory simulations". It consists in further integrating computers into the role playing-game, and can be considered as a merge of the role-playing game and the agent-based simulation. Participants directly access the simulation like agents, using a graphical user interface. All communications between participants take place on the network, as for distributed games, and are recorded. This approach has many advantages over the traditional MAS/RPG approach (GUYOT & HONIDEN, 2006): (a) Simulations can involve stakeholders who are geographically distant; (b) Being computer mediated, interactions can be recorded and used to help participants and organizers better understand the dynamics of the game; (c) Participants can be replaced by artificial agents when they are away and cannot take part in the simulation (CACCIAGUERRA & ROFFILLI, 2005); (d) It is possible to introduce eliciting assistant agents with learning capabilities that make suggestions based on the mistakes of the participants.

Our first site of study agent-based participatory simulations for participatory management of protected areas is the urban National Park of Tijuca. It undergoes a real pressure, by urban growth and illegal occupation. This makes the question of the conflicts resolution one of the key issues for the management of the park (PEIXOTO *et al.*, 2005). The Tijuca National Park has been created as a National Park in 1961, and is a protected area devoted at integral preservation, according to the Brazilian legislation (BRAZIL, 2000). The management strategy is executed by the administration of the park (IBAMA, 2006), through the management plan and the management council. That latter has recently been installed and

includes representatives of the various actors located or acting at the periphery of the park, as well as non-governmental organizations (NGOs), on some equal basis.

The process is now concentrated in the building capacity and empowerment of the councillors. For the project, we are identifying the actions taken by the different actors and their effects, and known conflicts, in order to design a first model of participatory simulation and conduct preliminary experiments as a first bootstrapping step. More generally speaking, there are currently 55 National Parks in Brazil (IBAMA, 2006), aimed at a compromise between nature protection and social inclusion. They represent great challenges for construction of democratic governance (IRVING *et al.*, 2006).

In this paper, we introduced our SimParc research project on the use of agent-based participatory simulations to help the management of protected areas for biodiversity conservation and social inclusion. We discussed the context of the National Tijuca Park which is our current site of study. We hope that this description of our ongoing project could witness both on the important challenges of constructing democratic governance of protected areas, and on the potential of agent-based participatory simulations as an innovative companion approach.

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