An Artificial Maieutic Approach for Eliciting Experts' Knowledge in Multi-agent Simulations

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ABSTRACT
Models of human behaviours used in multi-agent simulations are limited by the ability of introspection of the social actors: some of their knowledge (reflexes, habits, non-formalized expertise) cannot be extracted through interviews. In this paper, we propose an artificial maieutic approach to extract such pieces of knowledge, by helping the actors to better understand, and sometimes formulate, their own behaviours. We present here the first results using two complementary works in social simulations, one in the domain of air traffic control and one in the domain of common-pool resources sharing.

1 INTRODUCTION
In order to make social simulation, it is necessary to model human behaviour. Usually, the model is built through an iterative process with the help of interviews between a modelling expert (the one who builds the model) and some social actors. This method is limited by the ability of actors to describe and explain their actions. But a part of the knowledge to be elicited from actors is not accessible through interviews or more general inquiries (sociological or anthropological). Reflexes, habits, reactions to unexpected situations or behaviours refined by experience represent some informal knowledge hard to capture and to formalize. How can we have access to this kind of knowledge in order to improve the models?

In this paper, we got inspiration from *human-in-the-loop* experiments which directly integrate human actors in the running loop of a simulation with the help of a dedicated interface. At present, those experiments are used to validate new working methods using domain experts [2].

We are making the following assumption: immersed in a real-conditions situation, the actor can better understand and describe his behaviours. One agent is attached to the interface as an assistant which role is to ask the actor about his actions, and to record and use the answers in order to improve the model. We call this approach "artificial maieutic" in relation to the questioning method used by Socrates (Greek philosopher of the 5th century B.C.) to make his interlocutor discover by himself some non-conscious knowledge.

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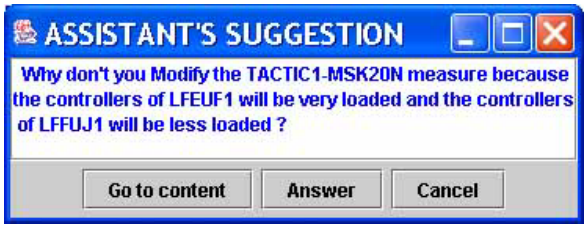
2 MODELLING AN AIR TRAFFIC CONTROLER
Current Air traffic Management (ATM) system is airspace-based. The airspace is divided in several sectors, the size of which depends on the number of aircraft in the region and the geometry of air routes. There are usually two air traffic controllers to handle the traffic in each air sector. One of their tasks is to avoid congestion and the overload of the controllers (due to the big number of aircrafts to be controlled). In order to do so, negotiations between controllers of neighbouring sectors occurs and flight routes are re-planned.

Air traffic managers have decided to improve the procedure used to avoid congestion. For obvious reasons of security this new procedure must be validated with an air traffic simulation tool which is driven both by artificial and human controllers. For this goal, we are implementing an agent/human hybrid simulator in which the human actors (controllers) and their assistant agents, are working together like team-mates

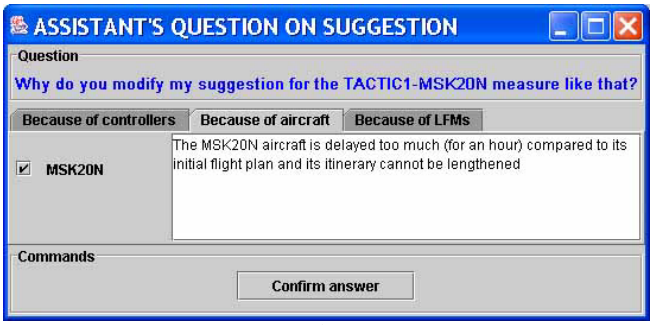
We added to the user interface dedicated to each participant expert an interface agent playing the role of assistant. This last one can play alone the role of the corresponding expert or only assist him. An expert and his assistant constitute, with respect to the other players, one and only one expert/assistant player. The expert plays the role, which was assigned to him within the simulation. The assistant observes, then proposes some behaviours which can be amended by the expert, these modifications being taken into account by the assistant as well as the results of his observations. This agent/expert relation leads to a dialogue in which the assistant questions "why don't you do that for this reason?" and the expert answers by modifying the behaviour suggested "I modify your proposal because of these entities and for this reason". The answer helps to improve the existing human behaviour model. This improvement can be made either by hand

by the designer after having studied the log of the simulation game or automatically by agents.

More detailed description of this work can be found in [2].



(a)



(b)

Figure 1. Examples taken from a session of interaction between an assistant and an ATC actor. (a) Suggestion of the assistant with justification. (b) Question of the assistant on the amendment and answer of the expert.

3 MODELLING A REACTIVE BEHAVIOR

In the previous section, we have described a practical example of the artificial maieutic approach in the complex domain of air traffic control. In order to explore this approach, we have started a series of modelling experiments with more simple human behaviour: some computer science students were asked to make a model of their own behaviour during a role playing game (the game of Friends). We present here the first step of these experiments where students of the French-speaking institute of computer science (IFI - Institut de la Francophonie pour l'Informatique) in Hanoi, Vietnam, have no artificial maieutic tools to complete the modelling task. This experiment has two purposes. First, it will allow us to understand better the difficulties that someone has to face when making a model of himself: we expect to learn more on how to design these tools. Second, this experiment will be used later as a reference for an evaluation of the artificial maieutic tools.

The students took part in a role playing game which is similar to another one played by farmers from northern Vietnam (the game of Buffalos) as part of political science research [1]. This research program is focused on people's behaviour when they face the growing scarcity of common-pool resources [3]. In this paper, we are only interested in modelling questions and we will not tackle the social side of the experiment.

One play gathers 5 players who share network bandwidth which starts abundant and ends scarce. Players can control their bandwidth needs making new friends or quitting old ones. Finally we want to model how players react to the resource scarcity. The self modelling experiment was divided into 5 steps that took place during a week. Students had to code for an agent that model their behaviour during the game. They could evaluate their in-progress model whit the help of a game simulation.

This experiment has shown how difficult it is for someone to understand and explain even simple actions made few hours ago. Some of those non-conscious behaviours could have been rediscovered through game log analysis, but not all of them, and even when possible, students did not necessarily understand the reason of a given action. Analysis is not enough for understanding.

In addition, students re-create a picture of themselves during the modelling process for two reasons: first, because they do not always remember the motivations nor even the conditions of their actions, second because they want to build a "nice" model rather than a true or useful one. As they discover some weaknesses or contradictions in their strategy during the game, a lot of students have indeed the tendency to "improve" their behaviour in the model. They want a consistent behaviour for their agent, although we were repeating all time long that in the game of Friends there are no good or bad behaviour. Tendency to idealization of behaviour is very problematic as it is judgement itself that is biased.

How could an assistant agent help an actor to stay faithful to his real behaviour? Explicit questioning, like in the air traffic control application, could be improved in taking advantage of the flexibility of a computer interface. With a simulation, it is easy to filter the perceptions of an actor, modifying actor's interface. In place of a direct question like "why did you make a new friend", which may be difficult to answer as we seen, an indirect question could be "what would you do in such situation?".

4 CONCLUSION

In this paper, two complementary works about artificial maieutic were presented. First, in the air traffic simulation, the model of a sophisticated behaviour is improved little by little by a maieutic dialogue. In the second experiment, spontaneous behaviours have to be modelled. Here, maieutic agents are required to help self-designers to remind their first reaction and to avoid the traps of the modelling process. In both cases, the model of an actor is confronted of to the real action of the actor through a simulation session. Therefore divergences between model and reality can be more easily detected and informal knowledge elicited.

5 REFERENCES

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