SIMULATION MODEL OF AGENT-BASED CROWD BEHAVIOR AND FUZZY LOGIC

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Resumen

Crowds modeling and simulation is an active area of research development used to analyze and represent different phenomena, mainly human actions. Simulations are used to entertainment (video games, movies) but there is a special utility to understand human behaviors to take decisions related with impact, diffusion, crisis management and mobility. One of the problems in the realism of simulations of crowds is the individual personality of the agent in the simulation and how the agent affects the total population. This proposal shows the use of fuzzy logical to provide “personality” in a crowd simulation over GPUs using a special framework to achieve realism and good performance.

Crowd and Agent Simulations

Crowd and the large amount of agent simulations (or multi-agent simulations) [1][2] is a process of simulating large number of elements (Agent), as persons, creatures or characters, each interaction in one environment (or context). In fact, the agent realize movements and actions in accordance with goals and these actions generate responses of other agent and the context. One of the problems is to define a specific behavior for each one of the agent (personality) due to the huge number of variables and levels of conducts. One of the possible solutions for this problem is the use of fuzzy logic [3][4] to define uncertain personality in accordance with the general context. As is well known, fuzzy logic is based on the observation that agents make decisions based on imprecise and non-numerical information. Fuzzy models or sets are mathematical means of representing and imprecise information (hence the term fuzzy. In the case of the crowd human simulations, the incertitude is interesting and fuzzy logic allows the construction of human's actions in contexts with imprecise possibilities.

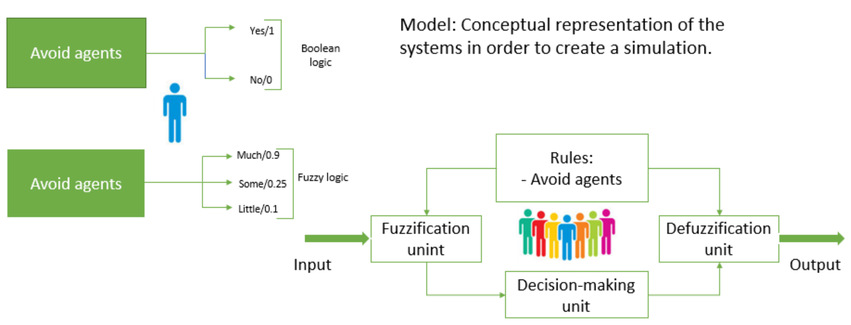

Fig. 1. Implementation of fuzzy logic inside the rules of an agent.

Methodology

Figure 2. Methodology used for the creation of crowd simulations with fuzzy logic

Experiments of analysis

With the objective of identifying how the implementation of fuzzy logic inside a simulation can result in the creation of simulations more representatives of the real world, we create three different cases of study in which we could observe how the use of fuzzy logic would affects the behavior of the entities inside the simulation in specific situations.

- First case of study : The agents of the simulation interact only withing themselves.
- Second case of study: The agents of the simulation interact with obstacles.
- Third case of study: The agents of the simulation interact with external forces.

Result

After realizing the experimented of integrating fuzzy logic inside the each of the cases of study that were established, the differences that could be found in the simulation altered by the utilization of fuzzy logic were the following:
A loss of computer performance.
Alteration of the routes taken by the agents.
centralization of places where agents concentrate around obstacles

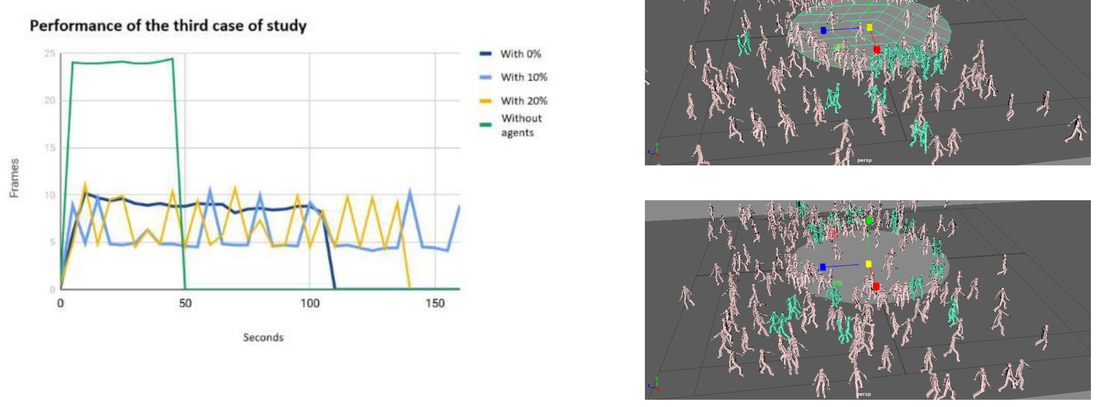

Fig. 3. Results of the analysis of the third case of study.

Conclusions

After the implementation of fuzzy logic in each of our cases of study we immediately started to see changes in the behavior of all the simulations, we saw alterations in the patrons of movement, lost on computer performance and a centralization of zones where the agents would group. Showing that the use of fuzzy logic inside a simulation would in fact change the observed result of the simulations without the need of changing the methodology use to create them.

Equipment Specifications

- Processor: Intel® Core™ i5-8265U CPU @ 1.60GHz
- RAM: 8.00 GB
- Operating system: Windows 10 64 bits.
- Graphic card: NVIDIA GeForce MX230

References

[1] Crowd and Multi-Agent Simulations, http://gamma.cs.unc.edu/research/crowds/

[2] M. Wooldridge, «Agent-based software engineering», IEE Proceedings - Software Engineering, vol. 144, n.o1, pp. 26-37, feb. 1997, doi: 10.1049/ip-sen:19971026.

[3] "What is Fuzzy Logic? "Mechanical Engineering Discussion Forum". https://mechanicalsite.com/157/what-is-fuzzy-logic

[4] L. A. Zadeh y R. A. Aliev, Fuzzy Logic Theory and Applications: Part I and Part II. New Jersey: WSPC, 2018.

[5] D. Burgos, «SIMULATION AND DISPLAY OF DYNAMIC CROWD BEHAVIOR USING GRAPHIC ACCELERATORS», p. 106, 2015

Links

First case of study:
-0%:https://youtu.be/c-nFTZcGUOc -10%:https://youtu.be/KgeDa1dmzNs
-20%:https://youtu.be/P4wR203CKR8.