BDI agents for social dynamics in epidemiology. Application to Schistosomiasis[1].

Supervisor: Jean Marie Dembele (jean-marie.dembele@ugb.edu.sn)

Keywords: Artificial Intelligence, Cognitive Agents, BDI (Believes, Desires, Intentions), Epidemiology, Modelling and Simulation, Schistosomiasis.

Problematic: Epidemiological phenomena often involve a large number of entities - host, vector, pathogen, environment, etc. - that can interact and give rise to complex dynamics ranging over several spatiotemporal scales. These dynamics can have serious health consequences, especially in Africa, like the spread over large geographical areas and the contamination of a large number of persons. Epidemiological phenomena, because of their evolution that results from the elements interactions, can be described as complex systems [1]. To efficiently study them, it is necessary to go through a process of modelling and simulation [2] in order to produce prediction tools and define prevention and control policies. Traditional mathematical epidemiology has always been an essential framework for epidemiological problems. It puts emphasis on equations-based models to represent disease dynamics. However, such models use homogeneousness over space and individual. This is problematic when we observe the geographical, social and interactional aspects of populations in the spread of diseases. Indeed, these models do not take into account the complexity of human interactions which serve as a mechanism for the transmission [3]. Through different epidemiological concerns such as roles of geo-spatial, social and interactional aspects in the spread of disease, new epidemiological challenges of modelling and simulation are to examine in order to better understand and fight against the spread of infectious disease [4], [5] [6]. This is the purpose of this subject; review/define/use computational tools [7][8] in epidemiology, especially agents [9] with cognitive capabilities based on the BDI architecture (Believes, Desires, Intentions) [10].

Expected results:

- a specific BDI architecture in the context of disease spread;
- its implementation with an object-based language in comparison to existing platforms (i.e. JASON [11]);
- the integration of the architecture in a dedicated platform (i.e. GAMA[12]) and the simulation at scale, with real data from Senegal or West-Africa.

---

[1] Schistosomiasis, also known as Bilharzia, is a parasitic disease that is found in tropical and subtropical areas and is caused by a tapeworm called schistosome or bilharzia.

References:

[1] Bar-Yam, Y., 1997. Dynamics of Complex Systems. Perseus Books Group.

[2] Coquillard, P., Hill, D., 1997. Modélisation et simulation d'écosystèmes. Masson.

[3] C. L. Barrett, S. Eubank, et M. V. Marathe, « An Interaction-Based Approach to Computational Epidemiology. », in AAAI, 2008, p. 1590–1593.

[4] M. Marathe et N. Ramakrishnan, « Recent Advances in Computational Epidemiology », IEEE Intell. Syst., vol. 28, no 4, p. 96‑101, 2013.

[5] P. Patlolla, V. Gunupudi, A. R. Mikler, et R. T. Jacob, « Agent-Based Simulation Tools in Computational Epidemiology », in Innovative Internet Community Systems, T. Böhme, V. M. L. Rosillo, H. Unger, et H. Unger, Éd. Springer Berlin Heidelberg, 2004, p. 212‑223.

[6] P. F. Gorder, « Computational Epidemiology », Comput. Sci. Eng., vol. 12, no 1, p. 4‑6, janv. 2010.

[7] P. A. Cisse, J. M. Dembele, M. Lo, et C. Cambier, « Assessing the Spatial Impact on an Agent-Based Modeling of Epidemic Control: Case of Schistosomiasis », Complex Sci., p. 58‑69, janv. 2013.

[8] P. A. Cisse, J. M. Dembele, C. Cambier, et M. Lo, « Multi-agent simulation of water contact's patterns in relation to schistosomiasis: A BDI architecture using kernel functions », in 2014 Second World Conference on Complex Systems (WCCS), 2014, p. 536‑541.

[9] J. Ferber, « Les systèmes multi-agents: un aperçu général », Tech. Sci. Inform., vol. 16, no 8, 1997.

[10] P. Caillou, B. Gaudou, A. Grignard, C. Q. Truong, and P. Taillandier. A simple-to-use BDI architecture for agent-based modeling and simulation. In 11th Conference of the European Social Simulation Association (ESSA), 2015.

[11] R. H. Bordini, J. F. Hübner, et M. Wooldridge, Programming Multi-Agent Systems in AgentSpeak Using Jason (Wiley Series in Agent Technology). John Wiley & Sons, 2007.

[12] A. Drogoul, E. Amouroux, P. Caillou, B. Gaudou, A. Grignard, N. Marilleau, P. Taillandier, M. Vavaseur, D.-A. Vo, et J.-D. Zucker, « GAMA: A Spatially Explicit, Multi-level, Agent-Based Modeling and Simulation Platform », in Advances on Practical Applications of Agents and Multi-Agent Systems, 2013, vol. 7879, p. 271‑274.