Computational Study of Conforming Behavior Phenomena in Random Networks

Stepan Kochemazov, Alexander Semenov, and Oleg Zaikin

Institute for System Dynamics and Control Theory, SB RAS, Irkutsk, Russia,
veinamond@gmail.com, biclop.rambler@yandex.ru, zaikin.icc@gmail.com

For an arbitrary collective, comprising of a set of agents, the conforming behavior corresponds to that, when the agent makes decisions regarding its actions largely based on the opinions or actions of agents around it. Conformity as a social phenomenon can often be observed in real world. One of the first formal models of conforming behavior was proposed by M. Granovetter in [2]. In that paper it was assumed that collective were represented by complete graphs, thus each agent observed actions of all the other agents. The dynamics in [2] was defined via the number of active agents in the collective at particular time moments. In [2] there was considered the problem of finding stationary points — situations when the number of active agents at the next time moment coincides with that at the current time moment.

In [4] we described automaton models of conforming behavior. To represent collectives in [4] we used Synchronous Boolean Networks (SBN) [3]. From our point of view, the models from [4] make it possible to naturally interpret activation dynamics in networks defined by graphs of arbitrary structure. It was also shown that the proposed models possess relatively efficient algorithmic component. In computational experiments the state-of-the-art SAT solving algorithms [1] made it possible to analyze networks of random structure with up to 500 vertices.

In this report we present new computational results for models from [4]. In particular, we propose new techniques for constructing propositional encodings of automaton mappings, that make it possible to study activation dynamics (of models from [4]) for networks of thousands of vertices. In our computational experiments we considered networks generated according to Erdős-Rényi, Watts-Strogatz and Barabási-Albert models.

References

1. Biere, A., Heule, M., van Maaren, H., Walsh, T. (eds.): Handbook of Satisfiability, Frontiers in Artificial Intelligence and Applications, vol. 185. IOS Press (2009)
2. Granovetter, M.: Threshold models of collective behavior. American Journal of Sociology 83(6), 1420–1443 (1978)
3. Kauffman, S.A.: Metabolic stability and epigenesis in randomly connected nets. Journal of Theoretical Biology pp. 437–467 (1969)
4. Kochemazov, S., Semenov, A.: Using synchronous boolean networks to model several phenomena of collective behavior. PLOS ONE 9(12), 1–28 (2014)