Propagation dynamics on networks featuring complex topologies

Laurent Hébert-Dufresne,[1] Pierre-André Noël,[1] Vincent Marceau,[1] Antoine Allard,[1] and Louis J. Dubé[1]

[1] *Département de Physique, de Génie Physique, et d'Optique,*
Université Laval, Québec (Québec), Canada G1V 0A6

(Dated: May 6, 2010)

Analytical description of propagatory phenomena on random networks has literally flourished in recent years, yet more complex systems have mainly been studied through numerical means. In the present work, a mean-field description is used to coherently couple the dynamics of the network elements (nodes, vertices, individuals...) on the one hand and their recurrent topological patterns (subgraphs, groups...) on the other hand. In a SIS model of epidemic spread on social networks with community structure, this approach yields a system of ODEs for the time evolution of the system, as well as analytical solutions for the epidemic threshold and equilibria. The results obtained are in excellent agreement with numerical simulations and converge towards the random network approximation in the appropriate limit. With the help of this novel approach, we will highlight the importance of social topology for epidemic description and present a new platform for the modelisation of real-life intervention scenarios.