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Q-voter model with independence on multiplex networks

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Q-voter model with independence is studied on multiplex networks with two layers (duplex networks) analytically using pair-approximation method and numerically by Monte Carlo simulations. The layers have a form of random regular, Erdős–Rényi and scale-free networks with identical degree distributions. In a usual q-voter model, each time step agent interacts with a group of q randomly chosen neighbours; if q-neighbourhood is homogeneous then the agent follows its opinion with probability $1-p$ and acts independently with probability p. In the q-voter model on multiplex networks two kinds of dynamics are considered, LOCAL&AND and GLOBAL&AND [1]. In the case of LOCAL&AND dynamics agent changes opinion if the above-mentioned update rule applied separately to q-neighbourhoods on each layer suggests change; in the case of GLOBAL&AND dynamics the agent changes opinion if the above-mentioned rule applied to a neighborhood composed of all q-neighborhoods from all layers suggests change. Depending on the kind of dynamics and the parameter q continuous or discontinuous phase transition to a ferromagnetic state is observed as p is decreased. Qualitatively, this transition resembles that reported for the q-voter model with independence on a duplex network with fully connected layers [2]. Quantitatively, significant differences in comparison with the latter case are observed in Monte Carlo simulations, depending mainly on the relationship between q and the mean number of neighbours within each layer. These Monte Carlo results exhibit good quantitative agreement with the analytic predictions from the pair-approximation method.

[1] C.D. Brummitt, Kyu-Min Lee, K.-I. Goh, Phys. Rev. E 85, 045102 (2012).
[2] A. Chmiel, K. Sznajd-Weron, Phys. Rev. E 92, 052812 (2015).