Shergin, V., Grinyov, S., Chala, L., Udovenko, S. (2025). Creating of the generative model of a scale-free network with homophilic structure. Eastern-European Journal of Enterprise Technologies, 2/4 (134),

Abstract

The aim of the research. The object of this study is the models of complex networks. The task addressed is to construct a generative model of a growing network, which has two key features characteristic of real-world networks: scale-free property and homophily. Homophily of a network is understood as the tendency of nodes to group into communities. To combine the requirements for homophily and scale-free property, a two-level rule of preferential attachment has been devised. First, the color of a new node is chosen with a probability proportional to the volume of the corresponding community, and then, according to the usual rule of preferential attachment, neighboring nodes are chosen within the community. It has been shown that the computational complexity of generating a network model with n nodes is O(n). It has been proven that under such conditions, the distribution of degrees of nodes across the entire network is the same as in the classical non-homophilic Barabási-Albert network and does not depend on the number and structure of communities. Under the conditions of homophily, it is quite natural to generalize the requirement for scale-free property to the distribution of community sizes. It has been found that this distribution is determined by the intensity of the formation of new communities. The dependence of the expected time interval between the formations of successive communities on their index has been established. The measure of homophily of the generated networks – modularity – has been estimated; its dependence on the scaling of the community volumes was found. The model built allows step-by-step generation of growing scale-free networks that have a built-in mechanism for the formation of communities, which is of practical significance. Conclusion. The proposed model could also be used in the opposite direction: given the structural parameters of the network, it is possible to restore the hidden rules by which this network evolves

Keywords:

scale-free property, homophily, modularity, generative network models, node communities