Effect of Assortativity Coefficient on Network Communication Efficiency and Robustness

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Degree correlation coefficient between two linked nodes is also called by assortativity which is a preference for node to attach to others which has a similar degree or not. For example, in social networks, highly connected nodes tend to be connected with other high degree nodes(called by assortative), but technological and biological networks typically show that high degree nodes tend to attach to low degree nodes(called by disassortative),. In recent works, it was been found that rewiring links from random to assertive can improve robustness for scale-free networks which has a pow-law degree distribution, but there are also many networks could not keep the degree distribution like scale-free networks, for these networks, the relation of assortativity with network communication efficiency and robustness is not clear yet. On the other hand, as we know, for most networks in real world, changing a large number of links is not easily because that either removal or addition of links will increase spending. So just add some shortcuts is often be used when improving network communication efficiency and robustness, since the node pair that at two ends of shortcut will decide how this shortcut effect on network, it is very important to konw that can degree correlation of two nodes which are decided to create shortcuts effect on network's. communication efficiency and robustness Moreover, for geographical communication networks, shortcuts like speedway is more probable appear in the path which is used Frequently, so, it is also very important to find that do the degree difference effects on network when add shortcuts in the communication path which is used Frequently.

For this reasons, I begin this research by three typically degree distributions($P(k)\sim k^{-2.5}$, $P(k)\sim \exp(-0.4)$ and poisson distribution when $\lambda = 6$), then I connect nodes with a Probability

dependent on their degree difference. Thus, I can keep the degree distributions and make a variety of networks that have different Assortativity. By comparing these networks, I can find the relationship between Assortativiy and network's communication efficiency and robustness not only in scale-free network but also other Typical network models. As a result, I find that for all kind of typical degree distributions I used, when nodes in network connecting each other from uncorrelated to assortative, communication efficiency have a slight decrease but robustness can be strong improved.

After that, in order to find the relationship between degree difference at both ends of shortcut and network's communication efficiency and robustness. I use a method by adding a small numbers of shortcut in typical networks. there are two method for pick node pairs to create shortcuts, one is pick them randomly, another is pick with a Priority by degree. After node pairs are found, joining them with a link Probability dependent on their current degree difference when add shortcuts. All the results show that shortcuts can improve network communication efficiency. For robustness, I find that add shortcuts to Similar degree node pairs are much better than add shortcut by random at improve robustness.

At the end, I use a representative geographical network model called by LS(link Survival) that are generated by Population Distribution. I use a simulation by making the packet generate Probability according to the population distribution of Keihan, Kanto, and Nagoya areas. Then, I joined node pairs with a link Probability dependent on their current degree difference in the path which is used Frequently by packets. By the simulation result, I find that the method of adding shortcuts at Similar degree node pairs can keep the same level at link length and communication efficiency with method of adding shortcuts by random, but it can do much better at improve robust.