Small-world behavior in time-varying graphs[1]

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Abstract

The analysis of social and technological networks has attracted a lot of attention as social networking applications and mobile sensing devices have given us a wealth of real data. Classic studies looked at analysing static or aggregated networks, i.e., networks that do not change over time or built as the results of aggregation of information over a certain period of time. Given the soaring collections of measurements related to very large, real network traces, researchers are quickly starting to realise that connections are inherently varying over time and exhibit more dimensionality than static analysis can capture.

In particular, the small-world phenomenon, i.e., the fact that real networks have high clustering coefficient, while the typical distance between their nodes is small as in random graphs, has been investigated in *static graphs*, neglecting the temporal dimension [2, 3, 6]. The time evolution of a real system, when considered, is usually studied by evaluating the standard static measures (distances and clustering coefficient) on snapshots of the network taken at different times [5, 4]. However, this approach does not capture entirely the dynamic correlations of a time-varying network.

In this poster we will present firstly, new temporal distance metrics to quantify and compare the speed (delay) of information diffusion processes taking into account the evolution of a network from a global view and secondly, a measure of how fast a dynamic network evolves. Intuition would lead us to believe that slowly evolving networks would be slower for information diffusion, however on the contrary using both a modified brownian motion model and empirical traces we find that time-varying networks can be strongly clustered in time and, at the same time, exhibit short temporal paths between their nodes. This phenomena has important dynamical consequences for biological, social and man-made systems and we hope that our work will stimulate further studies of temporal small-world behavior in real time-varying systems.

References

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