

Attribute Analysis on Dynamic Networks

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1 Abstract

This study explores the use of similarity measures in the analysis of dynamic networks. Dynamic networks arise in many modern applications such as email, social networks and telecommunications among others. Their defining feature is their evolution through time. Thus characterising this change requires the use of similarity measures that can be compared at different time intervals. For this study I use the Enron Email Network data from John Hopkins which is in the form of (timestamps, to, from) tuples to compare a large range of existing measures and propose some novel measures. The contributions of this study are the following. First, I consider a large range of existing network measures to determine the signal in the graph time series. Second, I use these measures to benchmark the novel measures which are of two categories: one based on the notion of the complex trace and the second on matrix decomposition. Third, I propose 3 novel visualisation techniques for multiple attribute analysis on graphs: the Frequency-Wavenumber Plot, the Radon Plot and the Log Panel. I show that these novel measures when calculated from the normalised Graph Laplacian are very stable and capture the network dynamics well. Also they are able to highlight additional areas of interest that are not obvious from the existing measures. These attributes can be used as global measures to characterise network change, visualised as attribute maps to consider local changes and finally to highlight interesting nodes. Also I propose a global NRMS measure to aggregate all these network attributes into one metric.

Keywords: Dynamic Network Analysis, Attribute Analysis, Attribute Visualisation