

Interactive Exploration and Analysis of Network Centralities

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1. Introduction

The use of network centralities in the field of network analysis plays an important role when the relative importance of nodes within the network topology should be rated. Such a single network can be easily rendered by the use of standard graph drawing algorithms. However, not only the exploration of one centrality might be important: the comparison of two or more of them is often crucial for a deeper understanding. When visualizing the comparison of several network centralities, we are facing new problems of how to visualize them in a meaningful way. In the life sciences, centrality measures help scientists to understand the underlying biological processes and have been successfully applied to different biological networks. Similar observations were made in the area of social network analysis.

The aim of our tool is to overcome those problems and to come up with a new solution of how to visualize networks and its centralities. It introduces a new way of drawing networks including their centrality values with the help of a circular view. Researchers can then focus on the exploration of the centrality values including the network structure without dealing with visual clutter or occlusions of nodes. Simultaneously, filtering based on statistical data concerning the datasets and centrality values support this.

2. The Approach and Features

Existing approaches for the visual analysis of network centralities as described by Dwyer et al. [DHK*06] deal with visualization problems such as occlusions and visual clutter when rendering the networks, but they do not reveal the actual network structure and have a lack of good interaction and filtering features.

Our tool *ViNCent* solves those problems by using a radial graph drawing approach, where each single node of the network is positioned as a small graphical element on a circle. Its connections to the other nodes (i.e., the edges) are laid out within the inside of this circle. Figure 1 shows an example of such a radial layout in its center. This arrangement of nodes clearly shows how nodes are interconnected and how many connections a node has. Moreover, features like edge bundling [Hol06] and degree marking support the user in finding important relationships between nodes as well as

high- or low-connected nodes [Kös11]. Additionally, this circular display visualizes the nodes' centrality values. Thus, it provides an overview of the entire network and supports the user to get the main actors at a first glance. Our tool offers two possible layouts of a node's centrality representation (called *centrality bar* in this poster abstract): traditional *stacked bars* as well as *maximum value stacking*. Whereas for traditional stacking, the single bars corresponding to centrality values are immediately stacked onto each other, maximum value stacking starts all bars from the level of the maximum value of the current centrality, thus providing a better comparability of relative values of centralities. The latter techniques is not visible in the example screenshot.

The single histogram views (see Figure 1, top right) provide a statistical overview of the centrality values showing the distribution of a single network centrality over all nodes. Based on the distribution, the tool allows the user to filter out data by the use of range sliders below the histograms, by filtering out single bars of the histogram, and by single-node filtering. Linking and brushing techniques are also used to actively spread filters across the histogram views.

Single centrality bars are not only displayed in the circle view; a selected bar is redundantly visualized in a small view (Figure 1, bottom right) with detailed information about the corresponding node's centrality values, i.e., name, relative percentage, and absolute value. Thus, hovering a node leads to highlighting of its neighborhood, the connecting edges and detailed information about the node itself.

References

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- [Kös11] KÖSTINGER H.: *ViNCent – Visualization of Network Centralities*. Master's thesis, Linnaeus University, School of Computer Science, Physics and Mathematics, Växjö, Sweden, 2011. 1

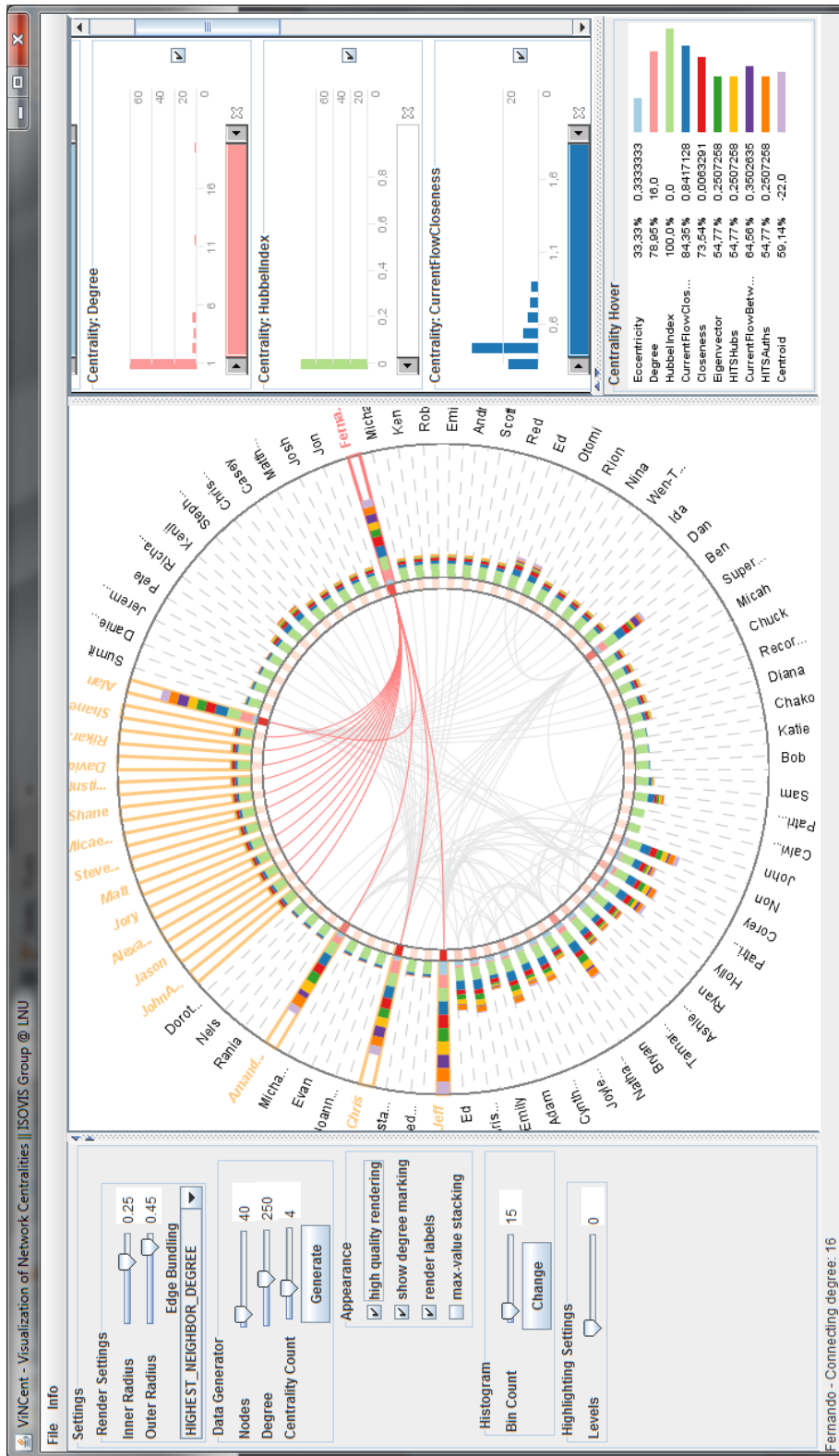


Figure 1: Overview of the ViNCent tool. The center view shows a social network (taken from test data of the Prefuse toolkit [<http://prefuse.org/>]) using a radial graph layout with embedded stacked bars to visualize centrality values of nodes. To the right, the corresponding histograms of the network centralities are shown (top) as well as more detailed information about the hovered node (bottom). Histograms can be used to filter the view. To the left, the settings panel allows the user to change the appearance of the tool.