Fingerprints – Means for Visual Analytics*
(Poster Abstract)

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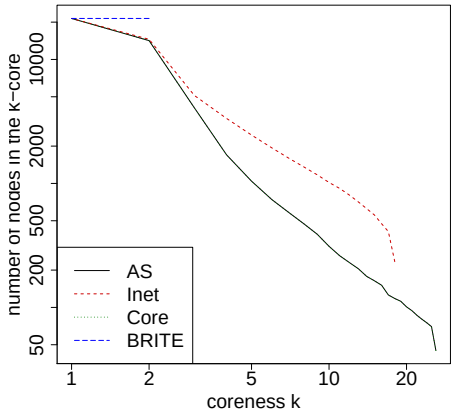
In computer science and physics, a growing research focus is the understanding of structural characteristics of large and complex networks such as the Internet [7, 4], networks of protein interactions [8], social networks [5] and many others [1]. Conventional network analysis and exploration comprises a multitude of analytic properties and features that have been identified as key elements in the comprehension of these networks. Prominent examples are rich club connectivity, k-core and clustering structure, and the distribution of degrees, centrality and status measures such as betweenness, closeness, or pagerank. Traditionally, these features are represented by tables or diagrams; an example is given in Figure 1. Although these characteristics reflect structural

coreness	AS	Core	Inet	BRITE
1	21419	21419	21419	21419
2	14188	14188	14542	21419
3	4066	4066	5120	
4	1700	1700	3343	
5	1043	1043	2456	
6	740	740	1934	
7	580	580	1591	
8	471	471	1355	
9	389	389	1173	
10	311	311	1018	
⋮	⋮	⋮	⋮	

(a) tabular representation



(b) diagram

Fig. 1. Representation of several distributions of different data sets in one table and diagram, respectively.

properties of the network, such a representation detaches analytic observations from the structural context of the network, however, different structures can yield the same peculiarities in analytic properties. In addition, the complexity of tables and diagrams generally increases with the size of the network.

An intuitive approach to remedy these downsides is to combine a proper visualization of the network that exhibits analytic properties. Recently, several researchers extended well-known layout paradigms in order to incorporate and emphasize analytic results. While displaying this information, the focus was still set on the esthetics of the obtain layout such as proper distribution of nodes, angular resolution, low crossing number. For example, Brandes et.al. complement conventional analysis techniques with tailored means of graphical interaction in their software tool visone [3]. Their approach renders data handling transparent, intuitive, and more readily accessible. As their implementation can deal with networks of moderate size, it has severe drawbacks when handling very large graphs.

With our concepts of *Fingerprints*, we focus on the fusion of visualization and analysis. More precisely, our goal is to develop sophisticated drawing techniques that incorporate the strength of abstract analyses, reveal the relation between graph structure and analytic results, and are

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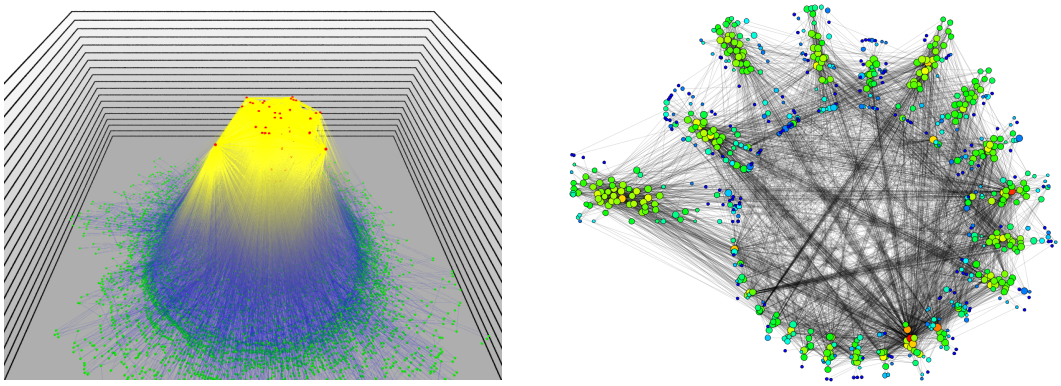
designed for human perception. In contrast to previous work, we concentrate on large networks and the visibility of their analytic properties. This naturally involves a tradeoff between level of detail and visible amount of information. So far, we developed a 2.5D layout paradigm suitable for displaying hierarchical structures [2] and a drawing paradigm that focuses decompositional properties [6]. Both techniques draw all elements of the network, while the global shape is partially predefined by analytic properties which are to be emphasized. Furthermore, both have been successfully adapted to real-world networks, facilitating and guiding application-specific analyses. An example is given in Figure 2. The explorative nature of our visualizations enabled us to per-



(a) 2.5D layout of the abstracted physical Internet, emphasizing its k-core structure

(b) network of email contacts with an angular decomposition representing departments

Fig. 2. Examples of Fingerprint visualizations of real-world networks.

form in-depth studies triggered by new insights. For example, we were able to reveal discrepancies between graph generators or models and the corresponding real-world instances more easily. Our results yield that our approaches are highly feasible and informative in fields of applications as diverse as Internet studies, social sciences, and many others. Thus, we conclude that the principle of Fingerprints, i. e., analysis-oriented visualizations, offer great future potential.

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