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Tao LIN

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1 Related Work

1.1 Large Graph Layout

Many graph layout algorithms have been created over the past decades. GRIP[3, 4] is a hierarchical force-directed method for drawing large graphs. OpenOrd[5] has both serial and parallel implementation of large graph layout. Tikhonova et al.[6] presented a scalable parallel graph layout algorithm with good performance, scalability and the visual quality.

Comparing is essential for deciding the most suitable algorithms for the specific scenario. Gibson et al.[2] discussed a range of two-dimensional graph layout techniques for information visualization. Hachul et al.[1] compared several large graph drawing algorithms by the differences in drawing qualities and running times.

1.2 Level-of-Detail and Adaptive Techniques for Large Graph

Even it is available to layout large graphs in real time, it is difficult to obtain useful information from the visualization, since the size of display devices and users' cognition abilities are limited. Hence, the simplification should be considered.

Level-of-detail techniques are able to simplify the large graphs by applying graph clustering and summarization. ASK-GraphView[7] is a graph visualization system that allows clustering and interactive navigation of large graphs with interactive rates by the scalable architecture and sophisticated clustering algorithms. HiMap[8] is another system that visualizes by clustered graph via hierarchical grouping and summarization, but employed a novel adaptive data loading technique considering the visual density of the graph view.

Also, the visual design should be improved considering the levels of detail. Balzer et al.[9] presents level-of-detail techniques for visualizing large and complex clustered graph layouts with implicit surfaces. We propose a technique that allows straight-line graph drawings to be rendered interactively with adjustable level of detail. Zinsmaier et al.[10] proposes a combination of edge cumulation with density-based node aggregation for large graphs without precomputed hierarchies.

1.3 Parallel Computation in Information Visualization

Liu et al.[11] put up a combination of multivariate data tiles and parallel query processing for real-time interacive querying large data sets.

Shen et al.[12] introduced a two-tier visual analytics system, which incorporates a Hadoop-based parallel data processing platform to handle queries of massive web session data.

1.4 Web-based Information Visualization

Bender et al.[13] presented a framework which allows the easy and efficient implementation of general Web-based visualization systems which can either follow the fat server, the fat client, or a hybrid approach.

Johnson et al.[14] contrasted the performances of several web-native information visualization methods (SVG, HTML5's Canvas, native HTML) at different data scales.

Eick et al.[15] developed a thin client visualization framework that provides a rich user experience that is completely browser based.

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