Two Novel Techniques for Interactive Navigation of Graph Layouts

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1 Introduction

Navigation of the view space is an essential task during visual exploration of graphs. A fairly standard approach not only in graph visualization is to let users grab a view and drag it as necessary. Though being a very natural and intuitive interaction, it implies higher physical costs in terms of mouse milage [Harrower and Benjamin 2005]. To alleviate these costs, we propose two alternative navigation methods: *pan-wheel navigation with radar view* for the view space and *edge-based travelling* as a dedicated data space navigation method.

2 Pan-Wheel Navigation with Radar View

In contrast to common pan or scroll operations, for which users know the specific position to where they want to go, the *pan-wheel* interaction allows users to travel the view space freely when no particular graph region needs to be reached. This opens up the possibility of spotting "interesting" areas for further inspection via zooming into more specific regions. Pan-wheel navigation is activated by simply clicking and holding the left mouse button on the pan-wheel and dragging the mouse to specify direction and speed of the navigation.

A weak spot of this approach is that users are unaware of what they might discover during the course of the navigation. To address this concern, pan-wheel navigation is augmented by a novel look ahead guide of what is coming next in the current travel direction. Look ahead guidance has recently been suggested for mobile devices [Gustafson et al. 2008], but has not yet been proposed for graph visualization.

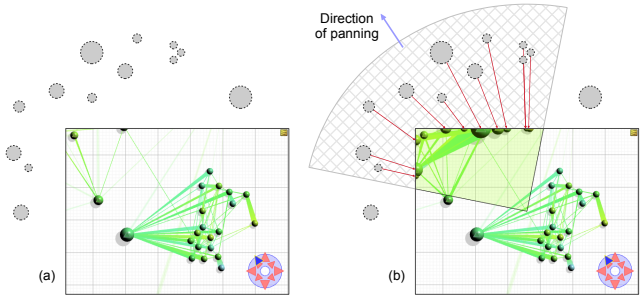

Figure 1: *Pan-wheel navigation – (a) without radar view and (b) with radar view.*

What we call the *radar view* shows a semi-transparent circular sector that emanates from the center of the view to infinity and that is aligned with the selected navigation direction of the pan-wheel. The sectors's central angle can be parameterized by users or can be dynamically changed depending on traveling speed. Our implementation currently uses a fixed angle of 90°. During pan-wheel navigation, all nodes that fall into the circular sector, but are currently not within the viewport, are projected to the borders of the viewport so that they become visible. The different sizes and colors of the projected nodes provide a look ahead mechanism of what will be found in the current navigation direction. Users can use this as a guide to adjust their travel direction with the pan-wheel. The radar view then adjusts itself accordingly. Figure 1 illustrates pan-wheel interaction with and without the radar view.

3 Edge-Based Traveling

Data space navigation is required to explore different data subsets. Most systems map the task of data space navigation to one of view space navigation. But graphs offer a well-defined structure that should be utilized for data space navigation. We propose a navigation method for node-link-representations called *edge-based traveling*. It allows users to explore a graph's structure by performing a series of simple mouse clicks. To activate edge-based traveling, the user has to *lock* on a node u. After that it is possible to click any edge adjacent to u. From then on there are two options to follow: *travel* or *preview*. The user can left click an edge (u, v) to *travel* to the node v. This causes the view to be centered on v, and v becomes the new locked node so that edge-based travelling can proceed further to nodes that are connected to v. Since not all nodes that can be reached via edge-based traveling are necessarily visible in the graph view, users sometimes do not know where they will be traveling when clicking an edge. In such cases, the *preview* mode helps. Users can right click an edge (u, v) to center it in the view so that both u and v become visible. In the preview, users can decide to actually perform edge-based traveling via a left click or to abort the preview and return to the original view by right clicking a second time.

To support the user's mental map, both preview and traveling are augmented with smooth viewport animations following the method described in [van Wijk and Nuij 2004]. During animation the viewport is parametrically interpolated between origin and destination. It is simultaneously slightly enlarged to facilitate the overview. The length of the animation is determined by the distance between origin and destination. The animation can be interrupted by the user at any point. This gives users the option to pause if they spot something interesting during the animation.

This edge-driven navigation is a novel interaction mode that to our knowledge has not been incorporated in previous systems. It is a useful tool to explore large graph layouts while keeping interaction costs low.

Both methods pan-wheel navigation with radar view and edge-based travelling are implemented in the graph visualization system CGV [Tominski et al. 2009], which provides coordinated linked views for interactive graph exploration.

References

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