Interaction Design in Multidimensional Visualization

Techniques for multidimensional data visualization, exploration and visual analytics

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CERTIFICATE OF AUTHORSHIP/ORIGINALITY

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I certify that the work in this thesis has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

I also certify that the thesis has been written by me. Any help that I have received in my research work and the preparation of the thesis itself has been acknowledged. In addition, I certify that all information sources and literature used are indicated in the thesis.

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Abstract

Interaction is an overloaded term in information visualization. Basically, every software tool is interactive but mostly through the manipulation of a widget. Broadly speaking, a visualization is just a software application. What makes the interactive component of a visualization really distinctive is how well it supports an arbitrary selection of data directly in the interface in order to facilitate subsequent analytic tasks. This is challenging due to over-plotting and visual clutter in the multidimensional space and such phenomenon is commonly known as the *curse of dimensionality*.

Data selection is a frontier of a visualization and too many multidimensional visualizations claiming to be interactive mostly address the change of view without explicitly specifying the core technique of how to materialize such operations. Perhaps, the interactive component is achieved through the traditional widget.

To overcome the complexity of truly interacting with multidimensional data for effective visual analytics, we first propose an interactive framework for better understanding of the problem domains. Dynamic data selection is materialized by a novel and sophisticated technique called the *Hierarchical Virtual Node* which opens an application to interact with data directly in parallel coordinates that would otherwise have been impossible or difficult to achieve by existing methods. It works well even under the circumstance of the curse of dimensionality and offers several advantages over others. For example, the use case only requires a mouse click to select a set of data item(s). To achieve an efficient visual analytics, a set of analytic tasks are also developed in each layer of the proposed framework.