

Jonathan C. Roberts^{†α}, Rick T. Walker^{†β}, Lukas Roberts^{§γ}, Robert S. Laramee^{‡δ} and Panagiotis D. Ritsos^{†ε}

(†) Bangor University, UK - (§) The Data Exchange - (‡) Swansea University, UK

[α] j.c.roberts@bangor.ac.uk [β] rick.t.walker@gmail.com [γ] l.roberts@thedataexchange.com [δ] r.s.laramee@swansea.ac.uk [ε] p.ritsos@bangor.ac.uk

Introduction

We present a method of using copy, cut and paste interaction principles to explore datasets through multiple coordinated views.

Our goal is to help oceanographers (in particular) visualize and navigate their data over several runs. We have been using parallel coordinate plots to display every data value.

Through our copy, cut, past interactions we aim to enable users to drill-down into specific data points and explore datasets in a more expressive way.

Users can put different visualizations on a Zoomable User Interface (ZUI) canvas, select various visual components such as axis or polylines and use copy, cut and paste to adapt the artifacts.

The Challenge

We collaborate with ocean scientists, whose research requires many runs with different parameterizations, generating many Terabytes of data.

We employ a Parallel Coordinate Plot (PCP), where every data point becomes one polyline. While PCPs allows easy manipulation and filtering of the information, it is slow to render, and extreme overplotting makes it difficult to understand. We have used binning techniques and intensity rendering styles, to enhance the PCPs clarity. Yet the user has to drill down and explore specific parameterizations.

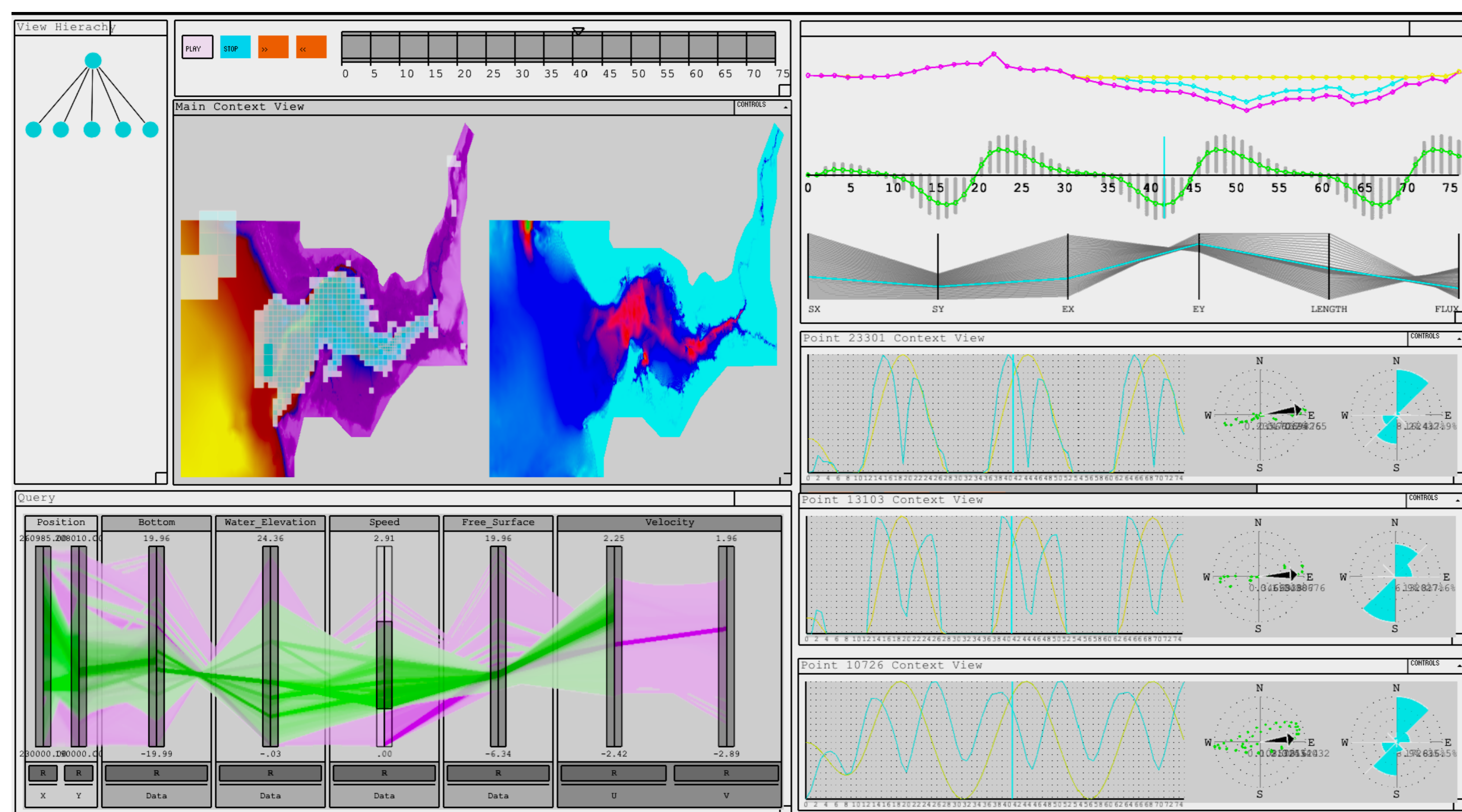


Figure 1: Screenshot from Vinca our Visual analytic oceanographic interface, showing multiple coordinated views (1).

Our approach

Our idea is to place the PCP on a Zoomable User interface (ZUI) and provide copy, edit and split operations to manipulate the PCP. This offers oceanographers new interaction techniques – to help them interact with their data in a more expressive way.

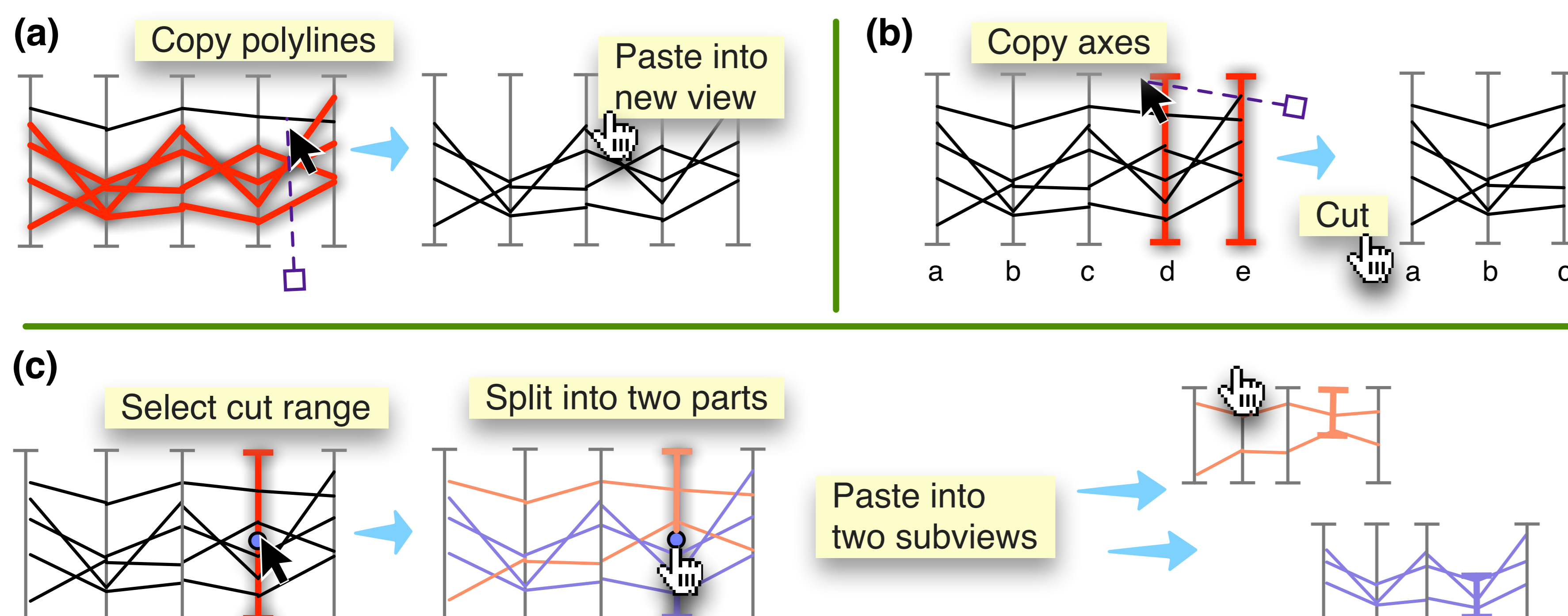


Figure 2: To demonstrate copy and paste, the user has chosen a line selection tool (selecting every element that touches this line); demonstrating the following operations: (a) a subset operation (b) polyline cut, and (c) split then paste to subviews.

Design methodology

Our design methodology is one of *replication* and *editing*. Copying the original visualization and then adapting it. This fits in with the three part model of replace, replicate, overlay (2), and is used in visual comparison (3).

In our design users can start with a visualization and then take copies of the whole, or of parts. Fig 2 shows a schematic of some operations. Specific axis can be selected and pasted to generate a view of only that data (the other parts are removed from the new display), or users can select a split point to derive two versions (one with values above that split point and vice versa.)

Implementation

Our implementation employs PCP subviews on a zoomable canvas, providing free form positioning. Copy and paste can then be applied hierarchically, making the use of a zoomable canvas for exploring the instances. The subviews act as a demonstration of the users' interaction history. We display the context of the editing operations through different colors, and relationships by lines.

Our prototype (see Fig 3), shows depictions of the cars dataset. Users can *cut* (to remove polylines or axis) and *copy* (to select the whole PCP or sub parts of the display), in order to make subviews of those selections. Subviews can also be generated by selecting a point along an axis, and slicing the visualization in two.

We also use cross-view *brush* and *highlight*. Users can *reposition* and *resize* the views on the ZUI, *zoom* into specific visualizations, while *automatic layout* algorithms can be applied to position the subviews in the ZUI.

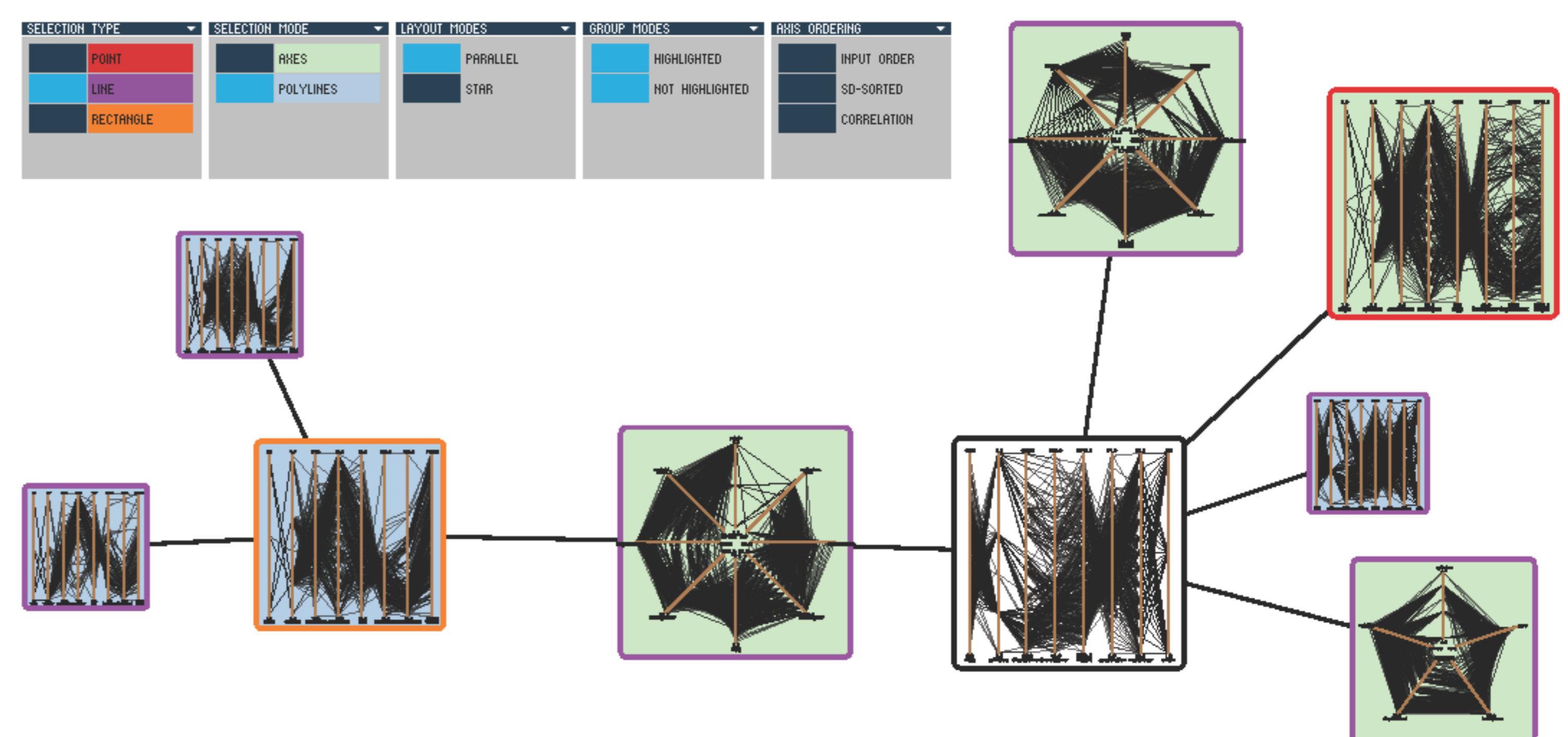


Figure 3: Screenshot of our cut/copy/paste window. Showing a ZUI interface, with menus to control how the paste operations occur. In this prototype stage, the data is using the car dataset, and we are currently integrating the ZUI into the oceanographic tool.

Conclusion

We are currently working on integrating our ZUI into our oceanographic tool. In our current implementation on our oceanographic multiple view system, we have found the ZUI to be extremely useful, enabling users to try out alternative parameterizations and explore the dataset through subviews.

However it does add many windows, requiring a large viewing space. Further research is required for the effective management of multiple views.

References

- (1) R.L.S.F. George, R.R. Robins, A.G. Davis, P.D. Ritsos, and J.C. Roberts, "Interactive visual analytics of Hydrodynamic Flux for the Coastal zone", *Environmental Earth Sciences*, pp.1-14, May 2014
- (2) J.C.Roberts, "State of the Art: Coordinated & Multiple Views in Exploratory Visualization", *In Proc CMV2007*. IEEE Press, pp.61-67, 2007.
- (3) M.Gleicher and D.Albers and R.Walker and I.Jusuifi and C.D.Hansen & J.C.Roberts, "Visual comparison for information visualization", *Information Visualization*, 2011, 10:4, pp.289-309, 2011.