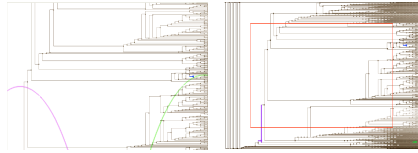


An Evaluation of Pan & Zoom and Rubber Sheet Navigation with and without an Overview



Pan & Zoom

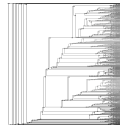
Rubber Sheet Navigation

Dmitry Nekrasovski, Adam Bodnar, Joanna McGrenere, François Guimbretière, and Tamara Munzner



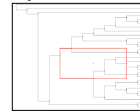
Motivation

- Problem: Help make sense of large datasets
- Solution: Interactive Visualization!
- Challenge: Efficient navigation techniques

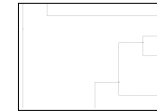


Conventional Pan & Zoom (PZN)

- Navigation via panning (translation) and zooming (uniform scale changes)
- Easy to lose context and become lost



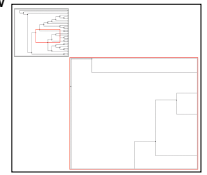
Selecting region to zoom



Zooming result

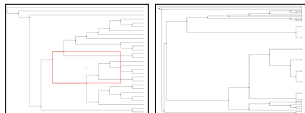
Overviews

- Separate global view of the dataset
- Maintain contextual awareness
- Force attention split between views



Rubber Sheet Navigation (RSN)

- Focus + Context technique
- Stretching and squishing rubber sheet metaphor
- Maintain contextual awareness in single view



Selecting region to zoom

Zooming result

Previous Findings Mixed

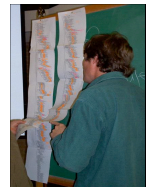
- Mixed results for navigation and overviews
- Speed: F+C faster than PZN [Schaffer et al., 1996; Gutwin and Skopik, 2003]
- Accuracy: PZN more accurate than F+C [Hornbaek and Frokjaer, 2001; Gutwin and Fedak, 2004]
- Preference: Overviews generally preferred [Beard and Walker, 1990; Plaisant et al., 2002]

Goals

- Evaluate RSN navigation technique
- Clarify utility of overviews for navigation
 - Why add overview to F+C?
 - Need evidence to support or refute common InfoVis assumption regarding usefulness of overviews

Motivating Domain

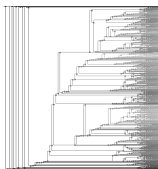
- Evolutionary biologists model relationships between species as large tree datasets
- Large datasets and clear tasks
- Requires understanding of topological structure at different places and scales
 - Efficient navigation techniques



[Munzner et al., 2003]

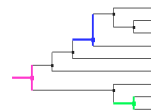
Dataset

- 5,918 node binary tree
- Leaves are species, internal nodes are ancestors
- Labels removed
 - Surprisingly seldom used
 - More interested in topological structure



Task

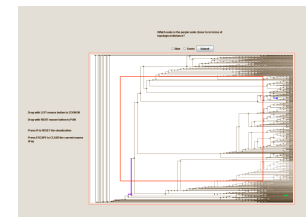
- Generalized version requiring no specialized knowledge of evolutionary trees
- Compare topological distance between marked nodes
- Requires multiple navigation actions to complete
- Several instances isomorphic in difficulty



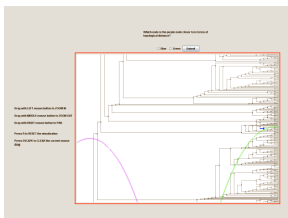
Experiment Interfaces

- Common visual representation and interaction model
 - Lacking in majority of previous evaluations
- Common set of navigation actions
- Guarantee visibility of areas of interest

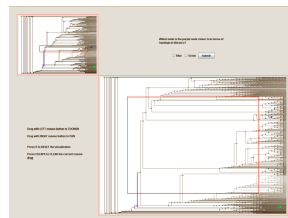
RSN



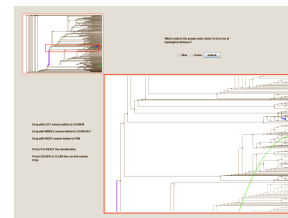
PZN



RSN + Overview



PZN + Overview



Guaranteed Visibility

- PZN
 - Implemented in PZN similarly to Halo [Baudisch et al., 2003]
- RSN
 - Implicit as areas of interest compressed along bounds of display
- Sub-pixel marked regions always drawn using PRISAD framework [Slack et al., 2005]



Hypotheses

- H1 - RSN performs better than PZN independent of overview presence
- H2 - For RSN, presence of overview does not result in better performance
- H3 - For PZN, presence of overview results in better performance

Design

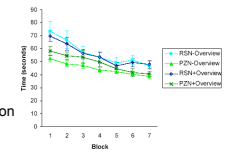
- 2 (navigation, between) x 2 (presence of overview, between) x 7 (blocks, within)
- Each block contained 5 randomized trials
- 40 subjects, each randomly assigned to each interface

Procedure and Measures

- Training protocols used to train subjects in effective strategies to solve task
- Subjects completed 35 trials (7 blocks x 5 trials), each isomorphic in difficulty
- Completion time, navigation actions, resets, errors, and subjective NASA-TLX workload

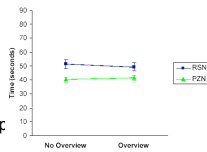
Results - Navigation

- PZN outperformed RSN ($p < 0.001$)
- Learning effect shows performance plateau
- Subjects using PZN performed fewer navigation actions and fewer resets
- Subjects using PZN reported less mental demand ($p < 0.05$)



Results – Presence of Overview

- No effect on any performance measure
- Subjects using overviews reported less physical demand and more enjoyment ($p < 0.05$)



Summary of Results

- H1 - RSN performs better than PZN independent of overview presence
 - No - PZN outperformed RSN
- H2 - For RSN, presence of overview does not result in better performance
 - Yes - No effect of overview on performance
- H3 - For PZN, presence of overview results in better performance
 - No - No effect of overview on performance

Discussion – Navigation

- Performance differences cannot be ascribed to unfamiliarity with the techniques
- Design guidelines for PZN extensively studied, but not so for F+C or RSN

Discussion – Overviews

- Overviews for PZN and RSN:
 - No performance benefits
 - Preference for overview
- Overview may act as *cognitive cushion*
 - Provide subjective but not performance benefits
- Guaranteed visibility may provide same benefits as overviews

Future Work

- Investigate methods of providing contextual information with guaranteed visibility
- Explore patterns of overview use through eye tracking technology
 - Interact vs. glance vs. ignore

Conclusions

- Presented first evaluation comparing PZN and RSN techniques with and without an overview
- Performance:
 - PZN faster and more accurate than RSN
- Preference:
 - Overviews preferred, but no performance benefits

Acknowledgements

- David Hillis and research group from University of Texas at Austin for discussions and dataset
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Backup Slides

Level of Context

