Information Visualization

Multiple Views

Dr. David Koop
## Multiple Views

<table>
<thead>
<tr>
<th>Encoding</th>
<th>Data</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>All</td>
<td>Subset</td>
</tr>
<tr>
<td>Same</td>
<td>Redundant</td>
<td>Overview/Detail</td>
</tr>
<tr>
<td>Different</td>
<td>Multiform</td>
<td>Multiform, Overview/Detail</td>
</tr>
</tbody>
</table>

[Munzner (ill. Maguire), 2014]
Multiform

[Improvise, Weaver, 2004]
Small Multiples

• Same encoding, but different data in each view (e.g. SPLOM)
Overview-Detail View

[Wikipedia]
Multiple Views

Partition into Side-by-Side Views

Superimpose Layers

[Munzner (ill. Maguire), 2014]
I page. In Figure 2 there are 6 panels, 1 column, 6 rows, and 1 page. Later, we will show a Trellis display with more than one page. We refer to the rectangular array as the trellis because it is reminiscent of a garden trelliswork. Each panel of a trellis display shows a subset of the values of panel variables; these values are formed by conditioning on the values of conditioning variables. In Figure 1 the panel variables are variety and yield, and the conditioning variables are site and year. On each panel, values of yield and variety are displayed for one combination of year and variety.
Composite Visualization Techniques

(a) Juxtaposed views.  (b) Integrated views.  (c) Superimposed views.

(d) Overloaded views.  (e) Nested views.

[REFERENCES]

W. Javed and N. Elmqvist, 2012

ONCLUSION
Integration

[VisLink, Collins and Carpendale, 2007]
Nesting

Figure 10: protein-protein interaction dataset in ZAME.

Figure 11: [NodeTrix, N. Henry et al., 2007]
Visualization on Devices other than Personal Computers

VisTiles
[Langner, Horak, and Dachselt, VIS 2017]

David Meets Goliath
[Horak, Badam, Elmqvist, and Dachselt, CHI 2018]

Now: Large Wall-sized Displays

- More data
- More views
- More users

[R. Langner et al.]
Visualizations are more than just views

Visualizations have a rich body of characteristics and certain relationships to other visualizations

Idea: Considering these aspects alongside device properties and user preferences

[Horak et al., 2019]
Heuristics for MV Layout

1. **Visual Similarity** promotes comparison
   
   *If two views are **visually very similar**, they should be both **juxtaposed and aligned.***

2. **Data Similarity** indicates alternative representations
   
   *If two views have a **high degree of data similarity** and a corresponding visual similarity, they should be **placed close to each other.***

3. **Input Connectivity** fosters the data exploration
   
   *If an interface component serves as **data input for others**, it should be **placed close to the affected components.***

[Horak et al., 2019]
Heuristics for MV Layout

**4 Data Density** influences the space requirement

A view should be *allocated space proportional to the number of data points* it encodes.

**5 Device Suitability** differs for all visualizations

*If devices are diverse, view assignments should be guided by device suitability.*

[Horak et al., 2019]
Heuristics for MV Layout

6. User preferences always exist

If user preferences are applicable, they outweigh all other heuristics.

Users can have static preference about specific distribution details

In the context of analysis tasks, temporary user interest can occur

[Horak et al., 2019]
Adding Augmented Reality

[Langner et al., 2021]
Using Tablets and Augmented Reality

Using AR for adapting different *Overview+Detail* and *Focus+Context* techniques. (a) A typical map overview; (b) Marginal histograms around the mobile device; (c) 3D visualization of a Matrix Cube; (d) Navigation support by an off-screen coordinate origin; (e) Zoomed in bar chart with fisheye-style continuation; (f) Mobile device as a detailed lens into a larger map;
Using Tablets and Augmented Reality

ALTERNATIVE VISUALIZATION VIEWS

(a) SPLOM shows alternative scatterplots configurations; (b) Distributed views of a dashboard; (c) Tilted AR views; (d) Off-loaded legend and menus; (e) Continuous 3D track above a map; (f) 3D wall visualization aligned to a map.

SEPARATED VIS UI COMPONENTS

SUPERIMPOSED 3D VISUALIZATIONS

Using AR for Alternative Visualization Views, Separated Visualization User Interface Components, and Superimposed 3D Visualizations. 


MARVIS in 30 seconds! Watch the video on YouTube. (https://youtu.be/DHvnkpmjUhw)

R. Langner et al.
Using Tablets and Augmented Reality

Using AR for Relations Between Visualizations, Combination of Visualizations, and Multi-User Support. (a) Linking and brushing supported by curved AR connections; (b) Ribbons between devices indicate the relative proportions; (c) Icon meta-visualizations reveal view relations; (d) AR bar chart summarizes calculated differences between views; (e) Merging two views in AR; (f) Personal and shared areas for collaborative activities;
Schedule

• Critique Today
• Teaching Evaluations Today
• Progress Reports next Tuesday
• Presentations after Thanksgiving
• Papers due at the end of the semester
Layouts in Multiple Views
Classifying MV Layouts

- Display space
- Views of different types
- Small multiples

[Chen et al.]
When a user annotates a rectangle in the interface, the corresponding rectangle color in the small multiples will be fixed in a post-processing stage (see Section 4.3). The part indicates the view number within the small multiples. In the drop list, the user can choose one out of the 14 view types. For instance, we group the boxes (denoted $g_i$, $4 \leq i \leq 5$) together, forming a group of four-view. The boxes are in the same margins, and the box centers are in horizontal or vertical, and the widths/heights of the boxes are nearly the same. For instance, as in Figure 3, we can derive that the boxes can be connected in a straight line without crossing. The boxes are in the same row or column, and unannotated ones are shown in the white background.

The frequency of view count is presented in the left graph. The largest frequency of view count is 4 views. The second one is 5 views. The frequency of 3 or 10+ views is the lowest. The frequency of 2 views is in the middle. The frequency of views varies a lot. The right graph presents the frequency of each view type. Area (green) is the most frequently used category, followed by Bar (brown), Circle (yellow), and Map (red).
View Aspect Ratio Distribution

![Diagram showing view aspect ratio distribution for different view types.](image)

[Chen et al.]
Recommendations for MV Layout
Modeling layout design for multiple-view visualization via Bayesian inference

Today's Paper

Lingdan Shao · Zhe Chu · Xi Chen · Yanna Lin · Wei Zeng ©

Abstract

Layout design for multiple-view visualization (MV) concerns primarily how to arrange views in layouts that are geometrically and topologically plausible. Guidelines for MV layout design suggest considering a set of design considerations. However, with the ubiquitous growth of MVs, the number of possible configurations exceeds the scope of current practice-based guidelines. In this work, we use Bayesian inference to generate realistic MV layouts. The set of all MVs collected from various visualization publications is used to train a probabilistic generative model, which infers the posterior distribution of MVs via Bayesian inference. The results reveal many insightful MV layout design patterns, such as views in coordination type of comparison exhibit more balanced area ratio, while those for exploration are more scattered. This work makes a prominent contribution by updating the posterior probability of layout metrics given design factors by penetrating MVs from recent visualization publications. The analyses can serve as geometric metrics, and layout topology as a topological metric. We update the posterior probability of layout metrics given design factors by penetrating MVs from recent visualization publications. The analyses can serve as a starting point for a thorough understanding of MV layout design patterns. On the basis, we discuss how practitioners can use Bayesian inference approach for future research on finer-annotated visualization datasets and more comprehensive design factors and properties.