Part 6

Focus+Context:

Distortion Techniques,

Overview and Detail, etc.

Fundamental Problem

[Stasko, InfoVis Course 2010]

Scale

Many Data Sets are too Large to Visualize on one Screen

- May Simply be too Many Cases
- May be too Many Variables
- May only be able to Highlight Particular Cases or Particular Variables, but Viewer's Focus may Change from Time to Time

Potential solutions lie in

Representation

Interaction

Both

From Problems to Goals

Problems

Scale : Large Data Sets

Small Window as Single Access-Point

Difficult to Interpret Single Information Items when Viewing it Outside of its Context

Goals

Allow the User to Examine a Local Area in Detail without loss of overall Context

Facilitate Navigation

Focus and Context

Usually

Either Detail or Full Picture

Lose Context When Zooming

⇒ Zoom In and Out a Lot

F+C

Integrate Detail and Big Picture

Make Better Use of Available Screen Space

Focus+Context Techniques

Spatial / Distortion-Oriented Methods

Fisheye Views, Perspective Wall, Stretchable Rubber Sheets, Hyperbolic Space, etc.

Dimensional Methods

Magic Lenses, Tool Glasses, etc.

User-Driven

Cue Methods

Color Saturation, Transparency, Brightness, ...

Data-Driven

Focus+Context Techniques

Spatial / Distortion-Oriented Methods

Fisheye Views, Perspective Wall, Stretchable Rubber Sheets, Hyperbolic Space, etc.

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Color Saturation, Transparency, Brightness, ...

Distortion Techniques

Basic Idea

Distortion of an Image to Allow a Visualization of Larger Amounts of Data

Polyfocal Display	[Kadmon & Shlomi 1978]
Bifocal Display	[Spence & Apperley 1982]
Fisheye View	[Furnas, 1981/1986]
Perspective Wall	[Mackinlay et al. 1991]
Graphical Fisheye View	[Sarkar & Brown, 1992]

Methods

[Leung & Apperly, 1994]

Abstract the Data

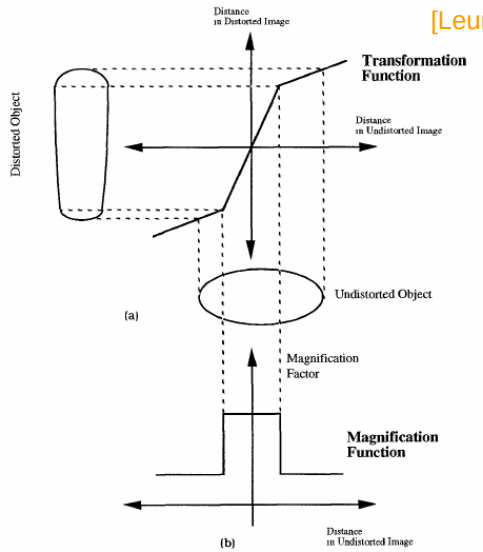
To Ensure Information Visibility

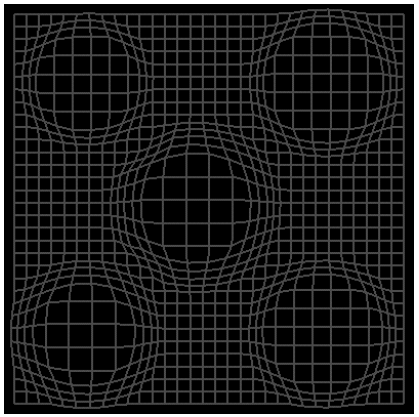
Apply a *Transformation Function* to the Abstract Data

Apply a *Magnification Function* to the Transformed Data

Methods (cont.)

[Leung & Apperly, 1994]



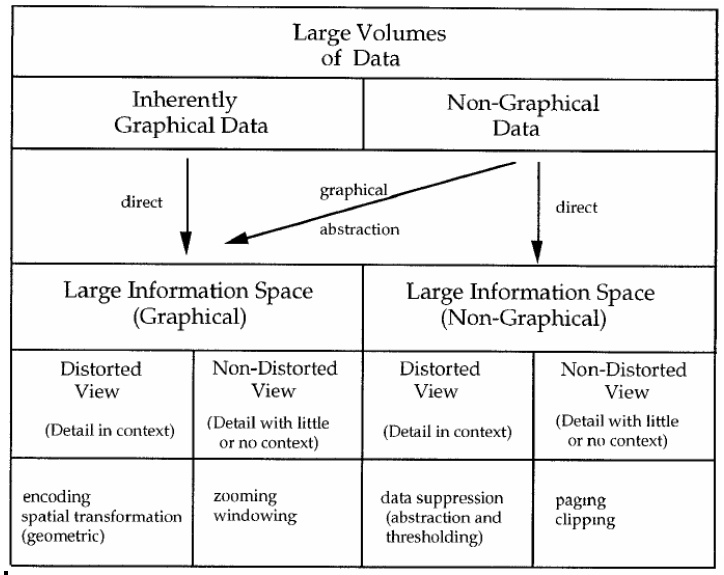


T. Alan Keahey
www.visintuit.com

Fig. 3. (a) The transformation of an elliptic object by applying the transformation function of a Bifocal Display in one dimension; (b) the corresponding magnification function of the Bifocal Display.

Taxonomy

[Leung & Apperly, 1994]



Overview -- History

1982 Bifocal Display (Spence & Apperley)

1986 Fisheye Views (Furnas)

1991 Perspective Wall
(MacKinlay, Robertson, Card)

1992 Fisheye Views for Graphs
(Sarkar & Brown)

1993 Stretching rubber sheet:
(Sarkar, Snibbe, Reiss)

Document Lens +
3D Interactive Animation
(Robertson, MacKinlay)

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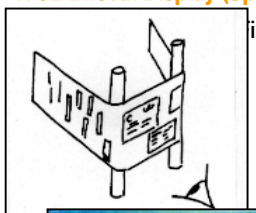

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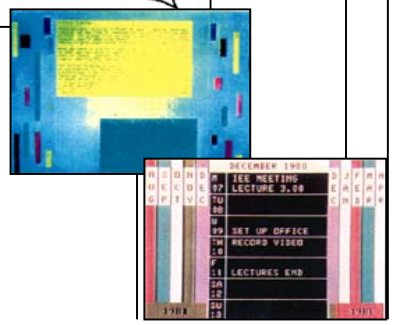

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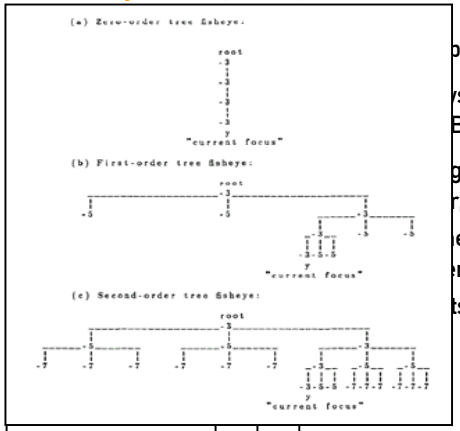

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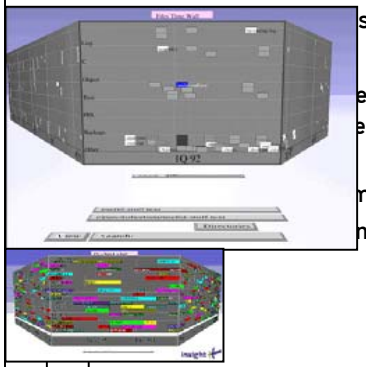

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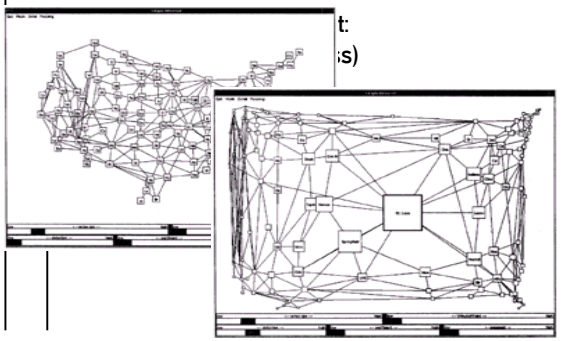

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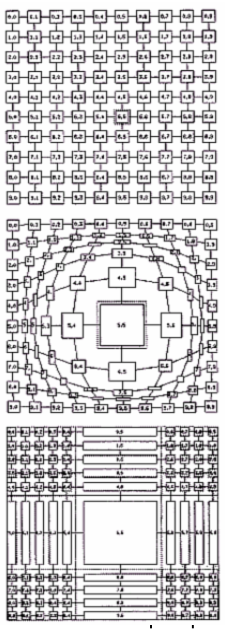
Overview -

1982 Bifocal Display (

1986



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erspective Wall
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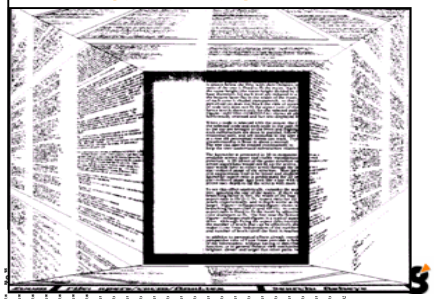

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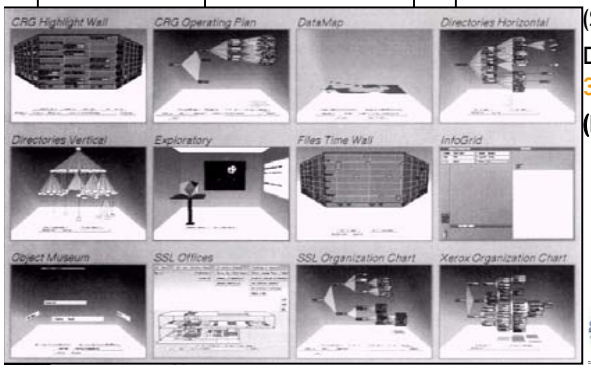
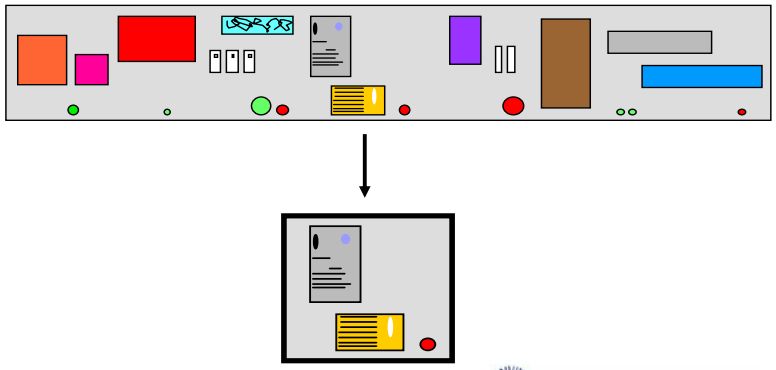


Bifocal Display

[Spence & Apperley 1982]

Combination of
a Detailed View and two Distorted Sideview

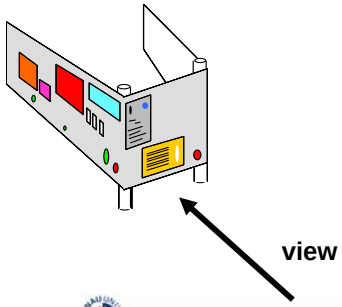
1-dim. Form



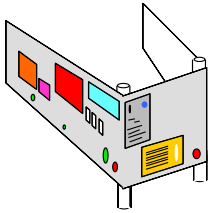
Bifocal Display: Presentation: Focus & Context

The Bifocal Display solution (1980):

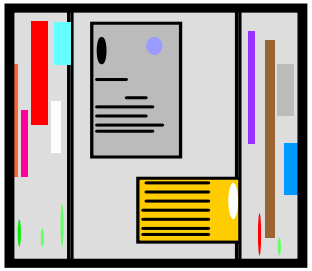
Form a scrollable but visible display



Bifocal Display (cont'd)



Viewed from the front, one or two items are in focus, but all items are present in a 'bird's eye' view



The Bifocal Display (cont'd)

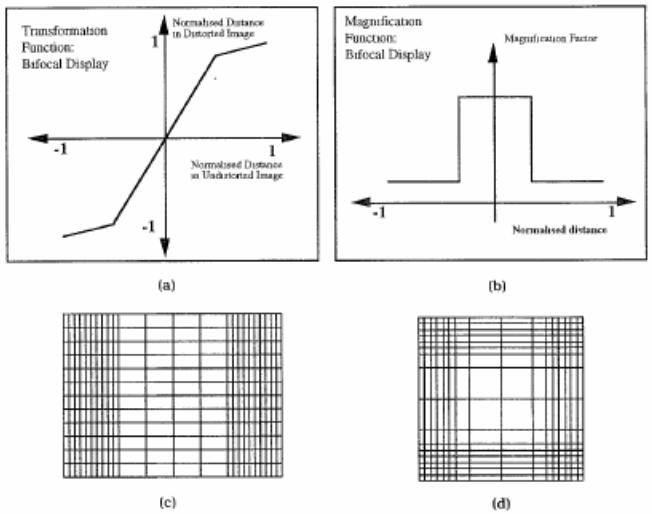
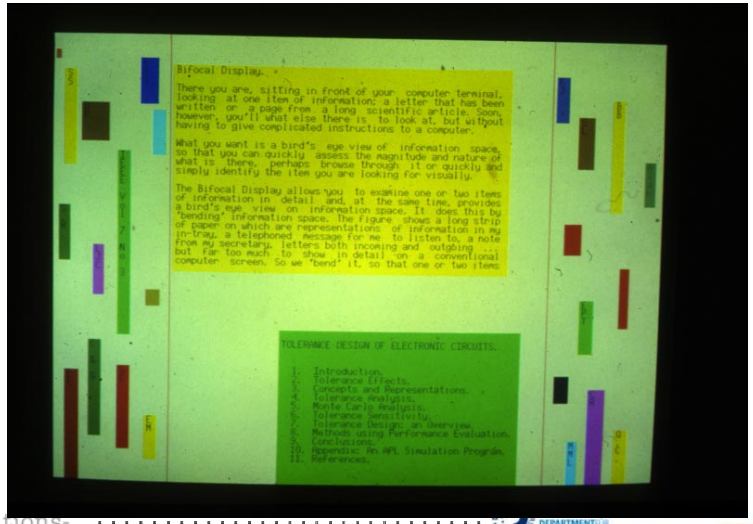


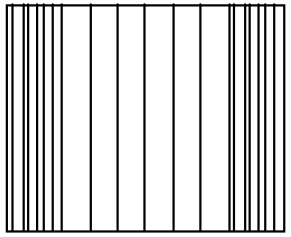
Fig. 6. The Bifocal Display: (a) a typical transformation function; (b) the corresponding magnification function; (c) the application of the display in one dimension; (d) the application of the display in two dimensions.

Early Implementation of Bifocal Display

1980



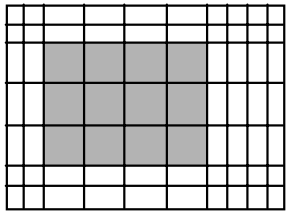
Combined X- and Y-Distortion



Two Examples ...

London Underground Map

Diary

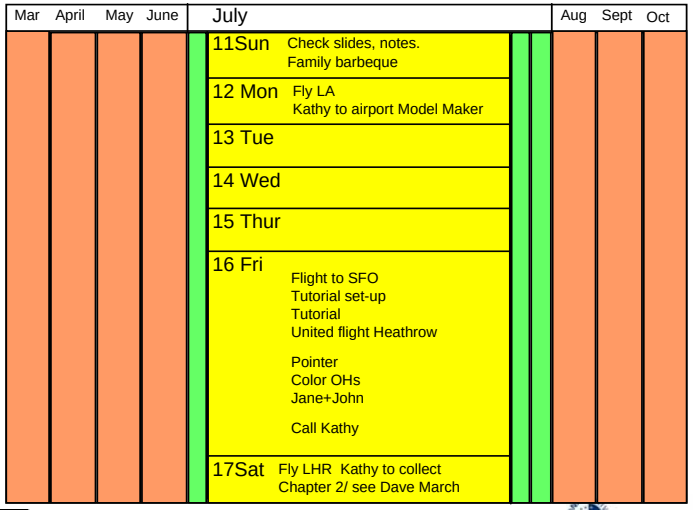


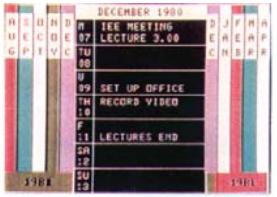
Ex1: London Underground Map

Combined X- and Y-Distortion

Ex2: A Diary

Combined X- and Y-Distortion





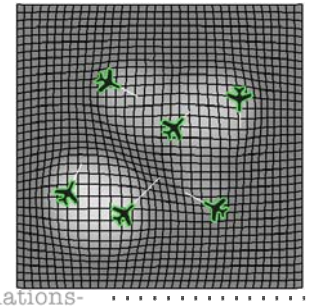
Polyfocal Display

[Kadmon & Shlomi 1978]

Projection of Statistical Data on Cartographic Maps

Non-interactive Method

Mathematical Foundation for many later Distortion-Oriented Presentations (Fisheye)



Polyfocal Display

[Kadmon & Shlomi 1978]

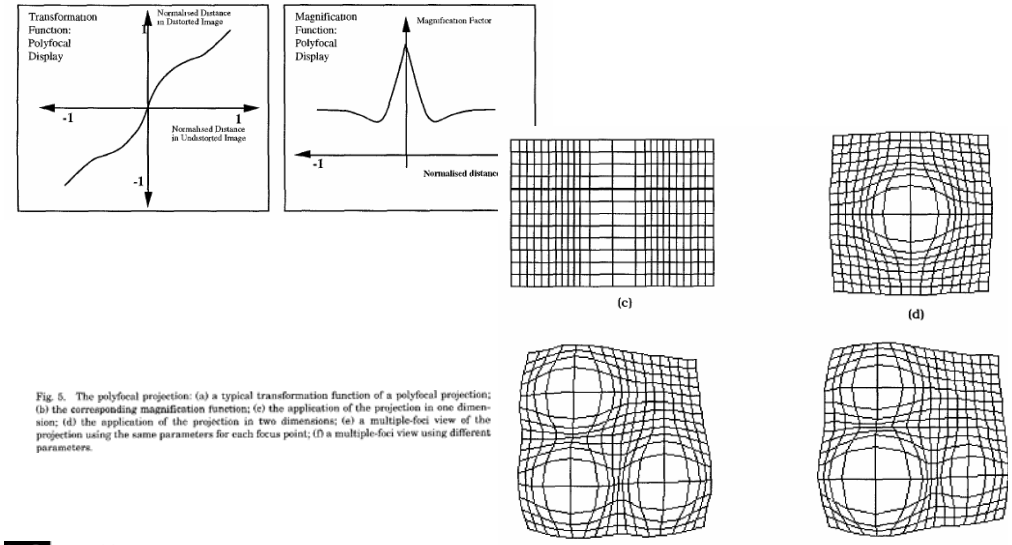


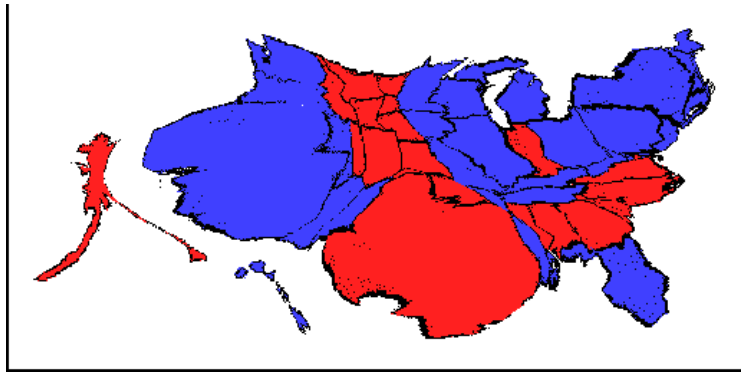
Fig. 5. The polyfocal projection: (a) a typical transformation function of a polyfocal projection; (b) the corresponding magnification function; (c) the application of the projection in one dimension; (d) the application of the projection in two dimensions; (e) a multiple-foci view of the projection using the same parameters for each focus point; (f) a multiple-foci view using different parameters.

Polyfocal Display

[Keahey 1999]

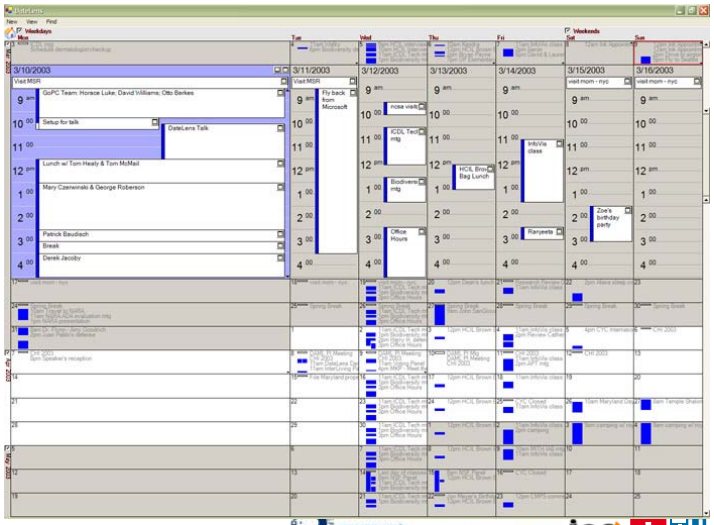
Continuous Cartograms

Area-normalized thematic views



DateLens by Ben Bederson

Demo (3:02 min)



Fisheye View

[Furnas, 1981/1986]

Originally Proposed for Hierarchical Information Structures

Each Information Element

A Priori Importance (API)

(old name: Level of Detail)

Distance between
Information Element and Point of Focus

Thresholding

Represent Relevant Information in Detail

Suppress Irrelevant Information

Fisheye View

[Furnas, 1981/1986]

Mathematical Degree of Interest (DOI) Function

DOI(a|.=b) = API (a) - D(a, b)

DOI(a|.=b)...	DOI in **a**, given that the current point of focus is **b**
API(a) ...	is a static global value called A Priori importance; pre-assigned to each point in the structure
D (a, b) ...	is the distance between point **a** and the point of focus **b**

"how interested" is the user in seeing **a** when **b** is focused

Fisheye View

[Furnas, 1981/1986]

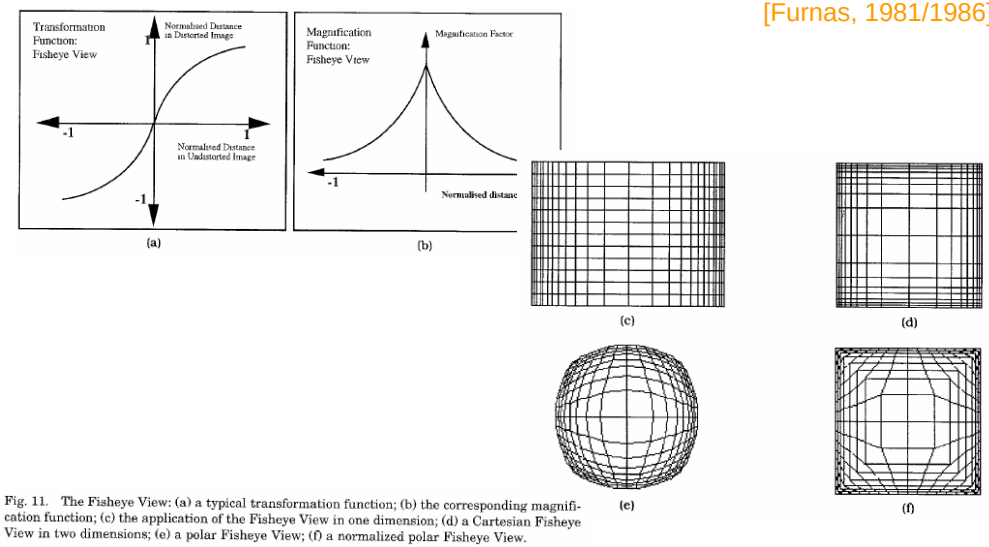


Fig. 11. The Fisheye View: (a) a typical transformation function; (b) the corresponding magnification function; (c) the application of the Fisheye View in one dimension; (d) a Cartesian Fisheye View in two dimensions; (e) a polar Fisheye View; (f) a normalized polar Fisheye View.

Fisheye View

[Furnas, 1981/1986]

Text-Based Application

Calendar

Large Selection of Program Code

→ Menus

→ Text

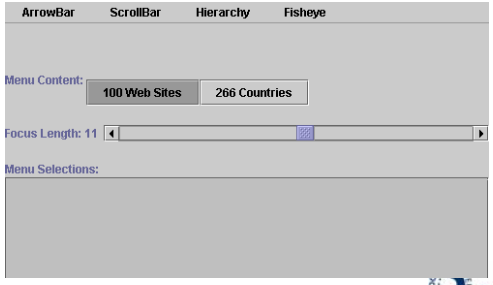
Fisheye Menus

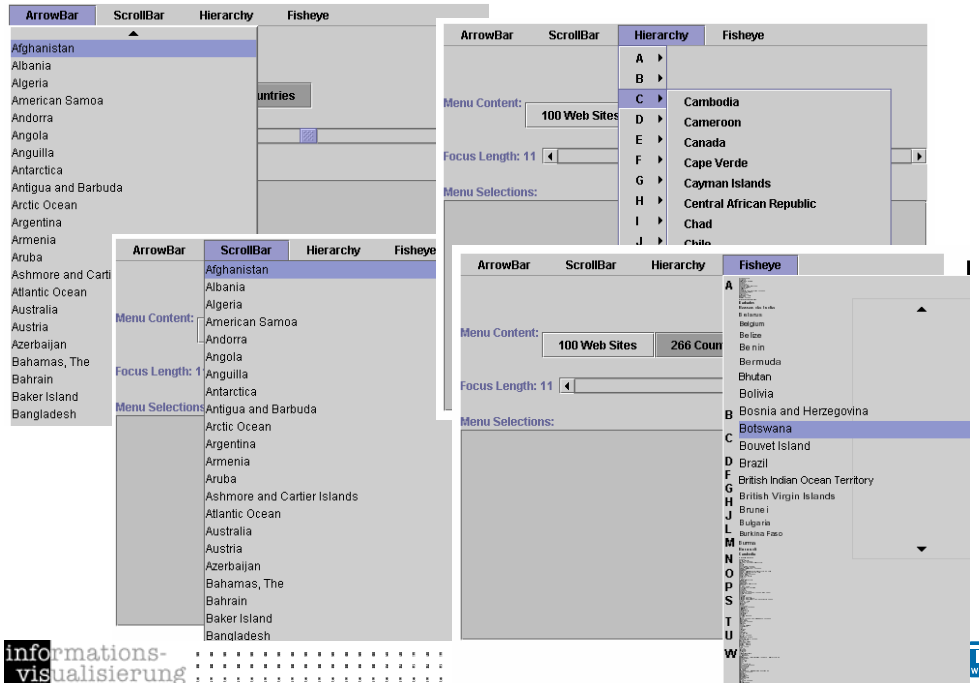
University of Maryland
Human-Computer Interaction Lab

E-commerce on the Web

Selection of an Item from a Long Linear List

`http://www.cs.umd.edu/hcil/fisheyemenu/`





Fisheye Menus

University of Maryland
Human-Computer Interaction Lab

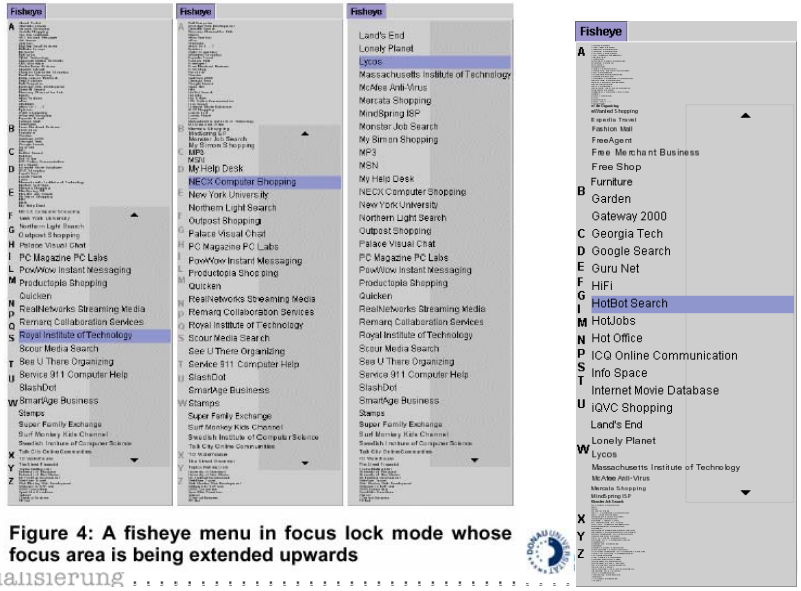


Figure 4: A fisheye menu in focus lock mode whose focus area is being extended upwards

"Flache Darstellung"

2.062	Aus dem Bestehen oder Nichtbestehen eines Sachverhaltes kann nicht auf das Bestehen oder Nichtbestehen eines anderen geschlossen werden.
2.063	Die gesamte Wirklichkeit ist die Welt.
2.1	Wir machen uns Bilder der Tatsachen.
2.11	Das Bild stellt die Sachlage im logischen Raume, das Bestehen und Nichtbestehen von Sachverhalten, vor.
2.12	Das Bild ist ein Modell der Wirklichkeit.
2.13	Den Gegenst¨ anden entsprechen im Bilde die Elemente des Bildes.
2.131	Die Elemente des Bildes vertreten im Bild die Gegenst¨ ande.
2.14	Das Bild besteht darin, daß sich seine Elemente in bestimmter Art und Weise zu einander verhalten.
2.141	***Das Bild ist eine Tatsache.***
2.15	Daß sich die Elemente des Bildes in bestimmter Art und Weise zu einander verhalten, stellt vor, daß sich die Sachen so zu einander verhalten. Dieser Zusammenhang der Elemente des Bildes heiße seine Struktur und ihre Möglichkeit seine Form der Abbildung.
2.151	Die Form der Abbildung ist die Möglichkeit, daß sich die Dinge so zu einander verhalten, wie die Elemente des Bildes.
2.1511	Das Bild ist *so* mit der Wirklichkeit verknüpft; es reicht bis zu ihr.
2.1512	Es ist wie ein Maßstab an die Wirklichkeit angelegt.
2.15121	Nur die äußersten Punkte der Teilstriche *berühren* den zu messenden Gegenstand.
2.1513	Nach dieser Auffassung geh¨ ort also zum Bilde auch noch die abbildende Beziehung, die es zum Bild macht.
2.1514	Die abbildende Beziehung besteht aus den Zuordnungen der Elemente des Bildes und der Sachen.
2.1515	Diese Zuordnungen sind gleichsam die F¨ uhler der Bildelemente, mit denen das Bild die Wirklichkeit berührt.
2.16	Die Tatsache muß, um Bild zu sein, etwas mit dem Abgebildeten gemeinsam haben.
2.161	In Bild und Abgebildetem muß etwas identisch sein, damit das eine überhaupt ein Bild des anderen sein kann.
2.17	Was das Bild mit der Wirklichkeit gemein haben muß, um sie auf seine Art und Weise – richtig oder falsch – abbilden zu können, ist seine Form der Abbildung.

Fisheye View: Definitions

Data

Text Paragraphs

DST (u, x)

Sum of the Levels until the Joined Main Parapgraph

API (x)

Negative Number of Digit

$$DOI(x|u) = API(x) - DST(u, x) = -(\#Digit + DST(u, x))$$

Function of Representation: Threshold >= -6

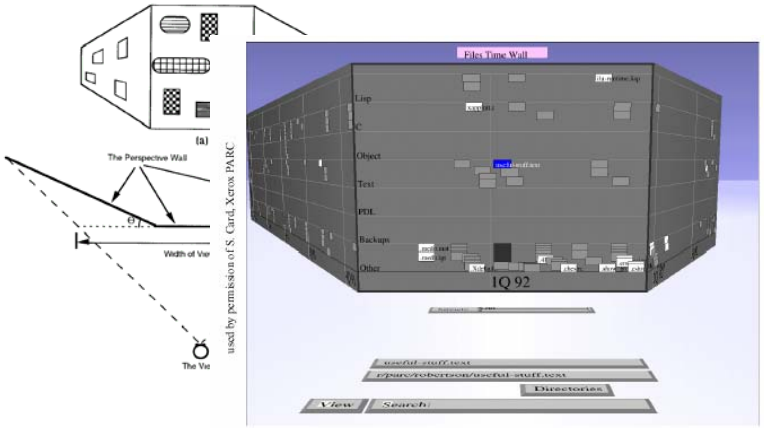
Fisheye View

1	Die Welt ist alles, was der Fall ist.
2	Was der Fall ist, die Tatsache, ist das Bestehen von Sachverhalten.
2.1	Wir machen uns Bilder der Tatsachen.
2.11	Das Bild stellt die Sachlage im logischen Raume, das Bestehen und Nichtbestehen von Sachverhalten, vor.
2.12	Das Bild ist ein Modell der Wirklichkeit.
2.13	Den Gegenst¨ anden entsprechen im Bilde die Elemente des Bildes.
2.14	Das Bild besteht darin, daß sich seine Elemente in bestimmter Art und Weise zu einander verhalten.
2.141	***Das Bild ist eine Tatsache.***
2.15	Daß sich die Elemente des Bildes in bestimmter Art und Weise zu einander verhalten, stellt vor, daß sich die Sachen so zu einander verhalten. Dieser Zusammenhang der Elemente des Bildes heiße seine Struktur und ihre Möglichkeit seine Form der Abbildung.
2.16	Die Tatsache muß, um Bild zu sein, etwas mit dem Abgebildeten gemeinsam haben.
2.17	Was das Bild mit der Wirklichkeit gemein haben muß, um sie auf seine Art und Weise – richtig oder falsch – abbilden zu können, ist seine Form der Abbildung.
2.18	Was jedes Bild, welcher Form immer, mit der Wirklichkeit gemein haben muß, um sie überhaupt – richtig oder falsch– abbilden zu können, ist die logische Form, das ist, die Form der Wirklichkeit.
2.19	Das logische Bild kann die Welt abbilden.
2.2	Das Bild hat mit dem Abgebildeten die logische Form der Abbildung.
3	Das logische Bild der Tatsachen ist der Gedanke.
4	Der Gedanke ist der sinnvolle Satz.
5	Der Satz ist eine Wahrheitsfunktion die Elementarsätze. (Der Elementarsatz ist die Wahrheitsfunktion seiner selbst.)
6	Die allgemeine Form der Wahrheitsfunktion ist: ...
7	Worüber man nicht sprechen kann, darüber muss man schweigen.

Perspective Wall

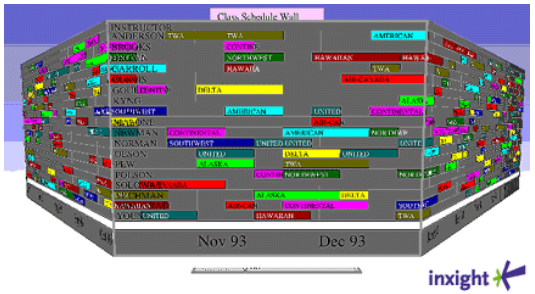
[Mackinlay et al. 1991]

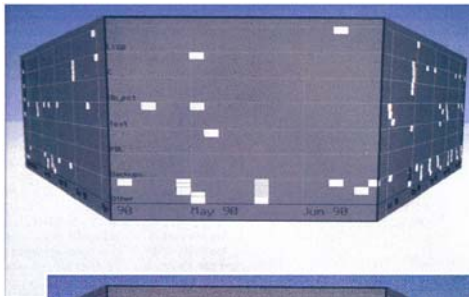
Video: Spence (54 sec)

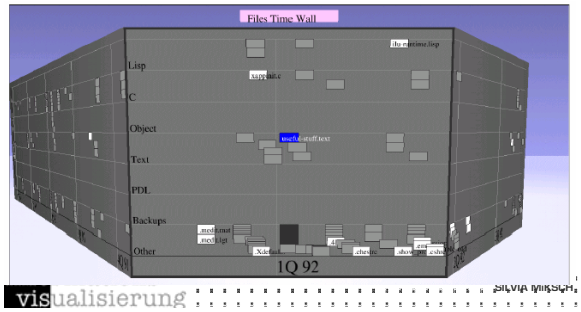


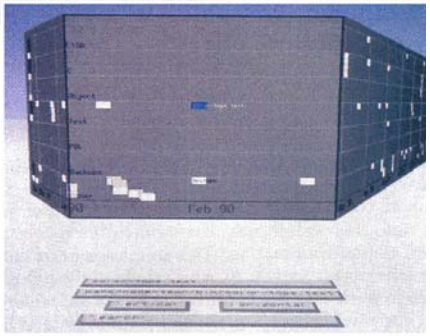
documents arranged on a perspective wall

Perspective Wall



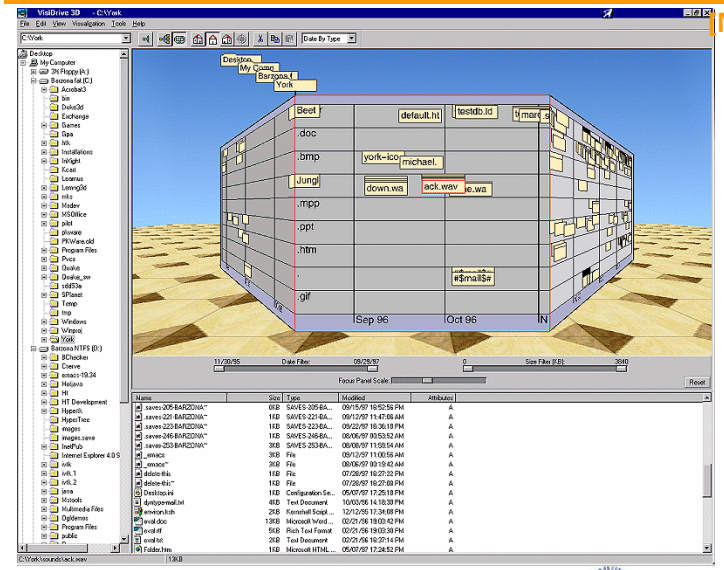






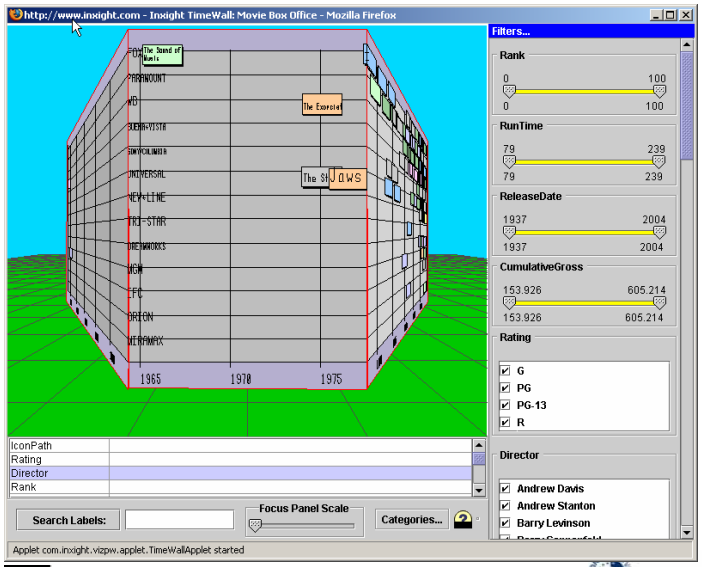
Perspective Wall

[Mackinlay et al. 1991]



Inxight's Time Wall

[www.inxight.com]



Perspective Wall

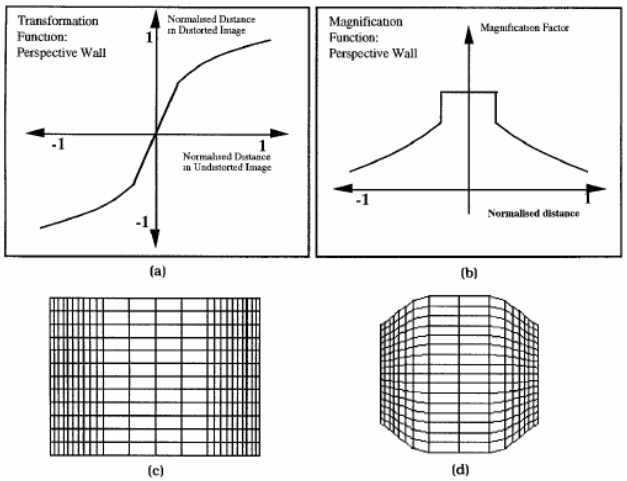


Fig. 10. The Perspective Wall: (a) a typical transformation function; (b) the corresponding magnification function; (c) the application of the wall in one dimension; (d) the application of the wall in two dimensions. Here the number of dimensions relates to the dimensions in which the perspective transformation is applied on the projection, not to the dimensionality of the model on which the projection is based.

Perspective Wall

Out-of-Focus Region Demagnifies at an Increasing Rate

Discontinuity where Side Panels meets the Middle Panel

Adds a Full 3-dim. View to the flat bifocal Display

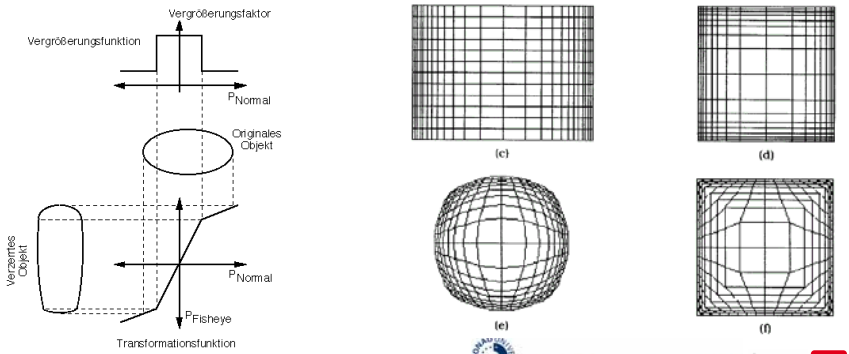
Graphical Fisheye View

[Sarkar and Brown, 1992]

Based on *Furnas, 1986*

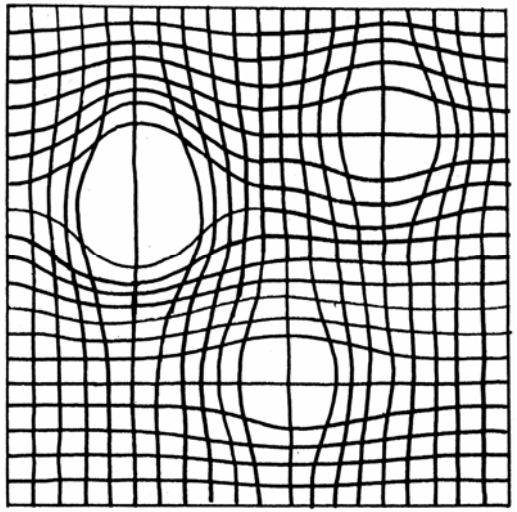
Different Distortions with Different Properties

Stretchable Rubber Sheet (*Sarkar et al, 1993*)



Stretchable Rubber Sheet

[Sarkar et al,1993]

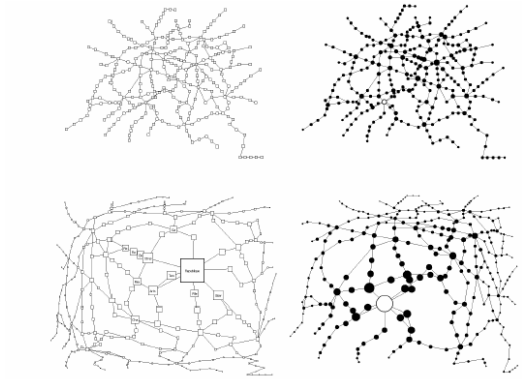


Graphical Fisheye View

Compare: Course networks & hierarchies

[Sarkar and Brown, 1992]

Fisheye View Extended for Topological Networks, Multi-layered Data, and Hierarchical Structures



Graphical Fisheye View

Compare: Course networks & hierarchies

[Sarkar and Brown, 1992]

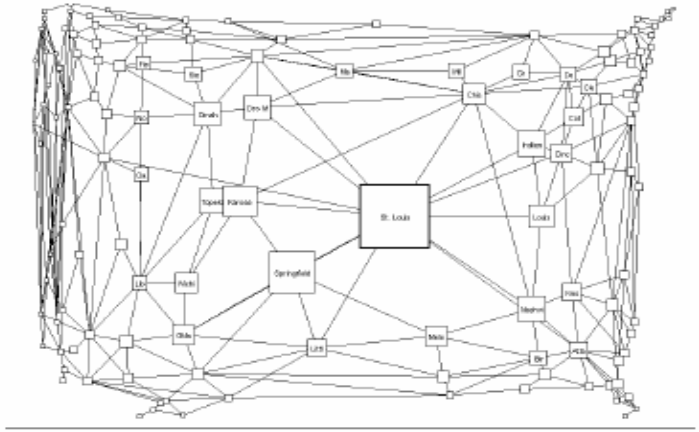
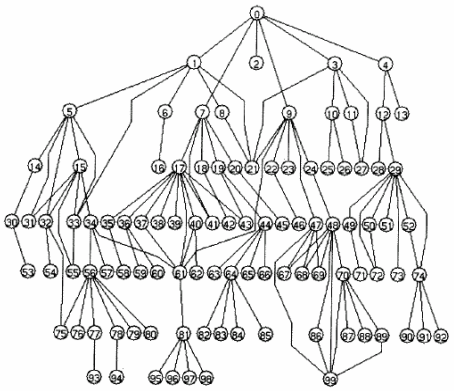


Figure 2: A fisheye view of the graph in Figure 1. The focus is on St. Louis. (The values of the fisheye parameters are $d = 5, c = 0, e = 0, VWcutoff = 0$; the meanings of these parameters are explained in Sections 4 and 6.)

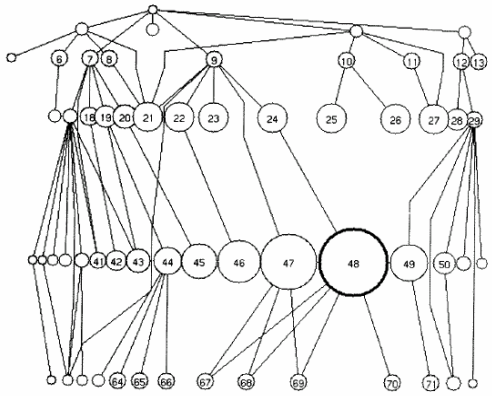
Fisheye View of Graph Data

Compare: Course networks & hierarchies

[Sarkar and Brown, 1992]



original graph



fisheye view of the graph

Fisheye View of Cone Tree

Compare: Course networks & hierarchies

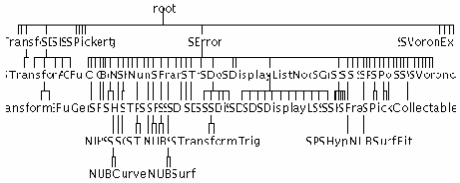


Figure 5: A Standard 2D Tree.

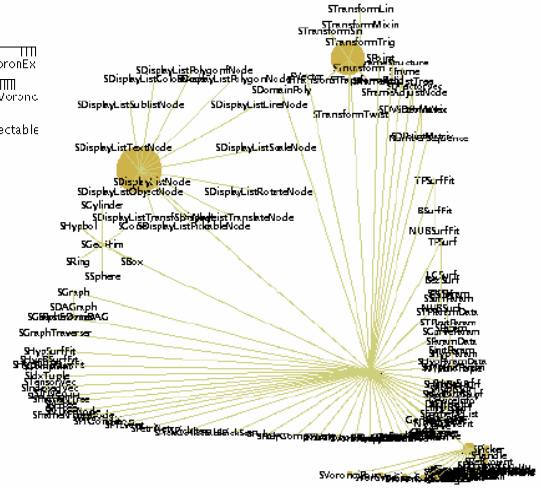
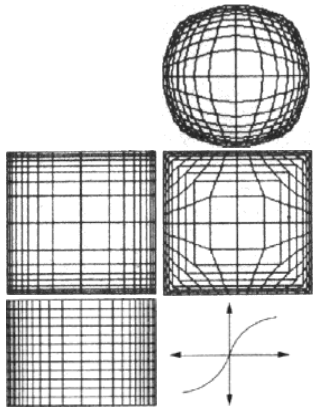


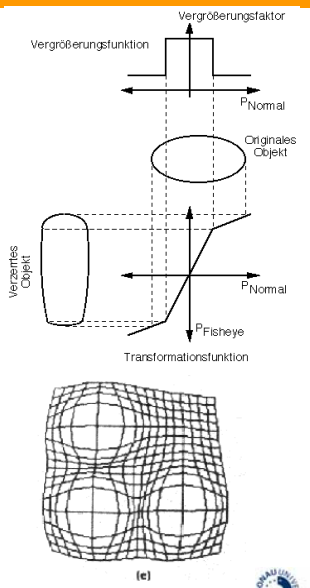
Figure 10: A Fish-eye View of a 2D Cone Tree.

Fisheye views

[Sarkar and Brown, 1992]

Models:





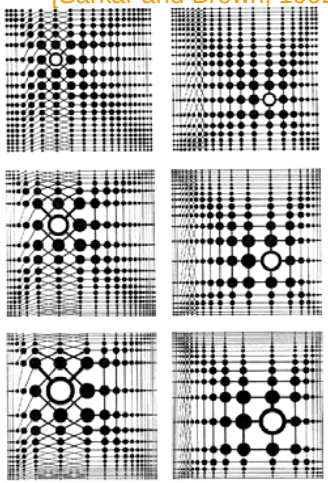
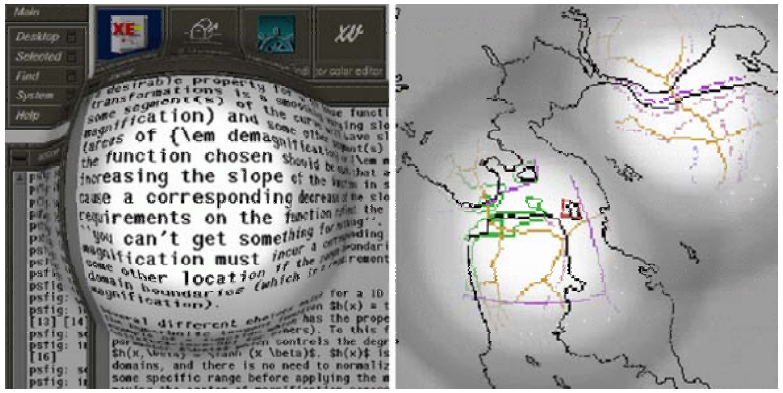


Figure 8: Fisheye views of the nearly-symmetric graph from Figure 7 using a cartesian mapping. The left column uses a focus in the northwest, and the right column uses a focus in the southeast. The distortion increases from top to bottom: In the top row $d = 1.46$, in the middle row $d = 2.92$, and in the bottom row $d = 4.38$. Note that the thickness of each edge varies with the sizes of the vertices it joins.

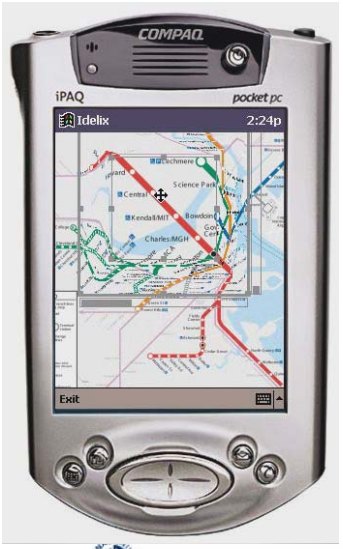
Seamless Multi-Level Views

[Keahey, 1998]



Rubber Sheet Map Distortion

Demo: 1 min

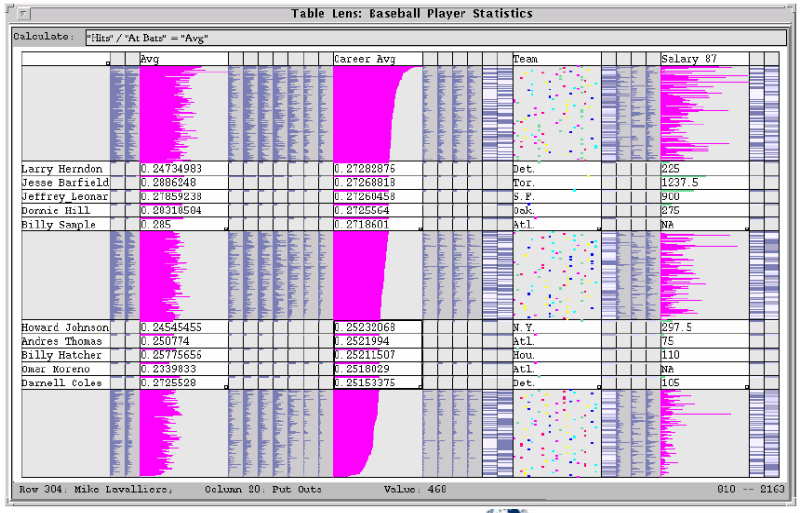


TableLens

inxight

[Rao & Card 1994-1997]

Demo (Video: 6:35 min)



Focus+Context Techniques

Spatial / Distortion-Oriented Methods

Fisheye Views, Perspective Wall, Stretchable Rubber Sheets, Hyperbolic Space, etc.

Dimensional Methods

Magic Lenses, Tool Glasses, etc.

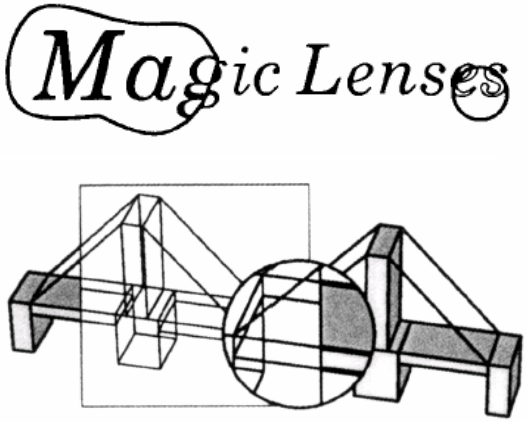
Cue Methods

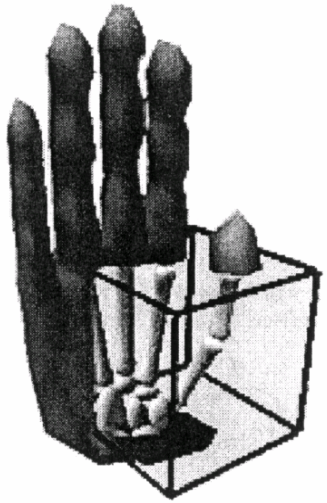
Color Saturation, Transparency, Brightness, ...

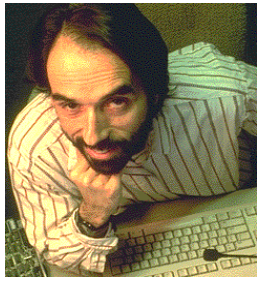
Magic Lenses

[Stone, et al. 1994]

Local Changes of Views







[Lieberman, 1994 and 1997]

Powers of Ten Thousand Navigating in Large Information Space

The Macroscope

Henry Lieberman

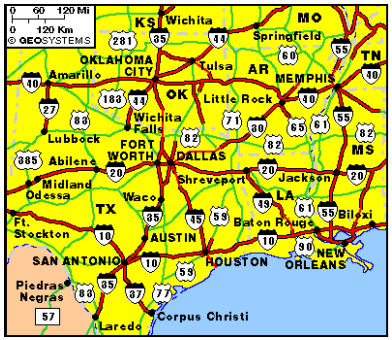
Media Laboratory
Massachusetts Institute of Technology

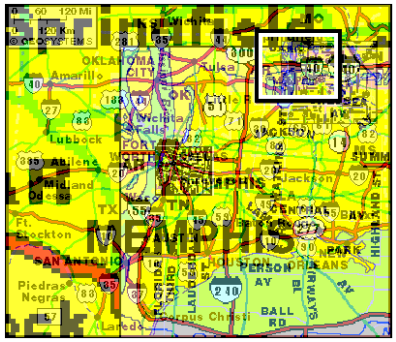
The Macroscope — Focus + Context

[Lieberman, 1994 and 1997]

Displays Several Zoom Levels at Same Time

Different Location Projected Over Each Other





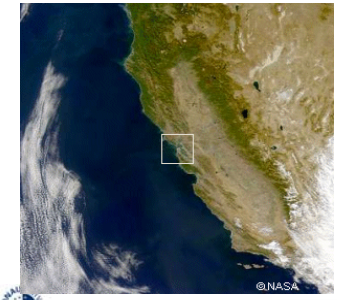
"Powers of Ten"

[Lieberman, 1994 and 1997]

Power of Ten – from Quarks to Quasars

Order of Pictures Scaled by 10 orders of magnitude

BUT: static, NOT dynamic



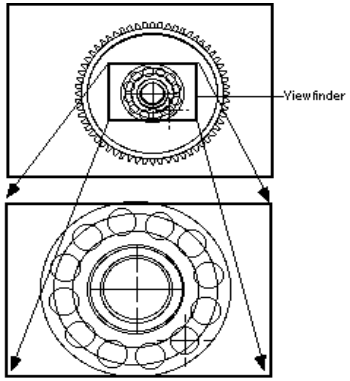
The Macroscope: Zoom and Move

[Lieberman, 1994 and 1997]

Zoom

Select a Part of the Image (Viewfinder)

Viewfinder of the Whole Image



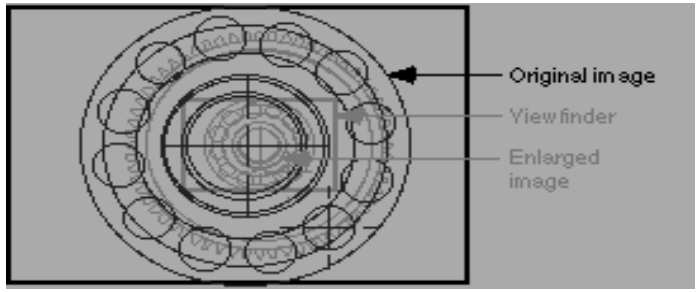
Problem: Context Lost!

The Macroscope: Zoom and Move

[Lieberman, 1994 and 1997]

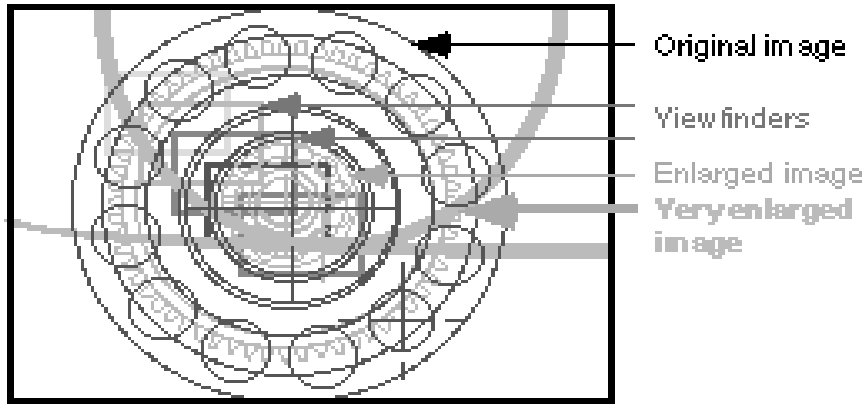
Solution

Transparent Image - Overlapping



The Macroscope: Zoom and Move

[Lieberman, 1994 and 1997]



The Macroscope: Zoom and Move

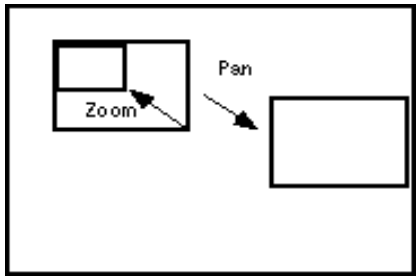
[Lieberman, 1994 and 1997]

The Macroscope: Interactive Control

[Lieberman, 1994 and 1997]

Change the Viewfinder's Position = Move

Change the Viewfinder's Size = Zoom



The Macroscope: Interactive Control

[Lieberman, 1994 and 1997]

Select the Viewfinders and
Adapt them without Overview Lost

Layers with Corresponding Viewfinder
--> Emphasize

Dynamic Generation of Transparency between the Layers

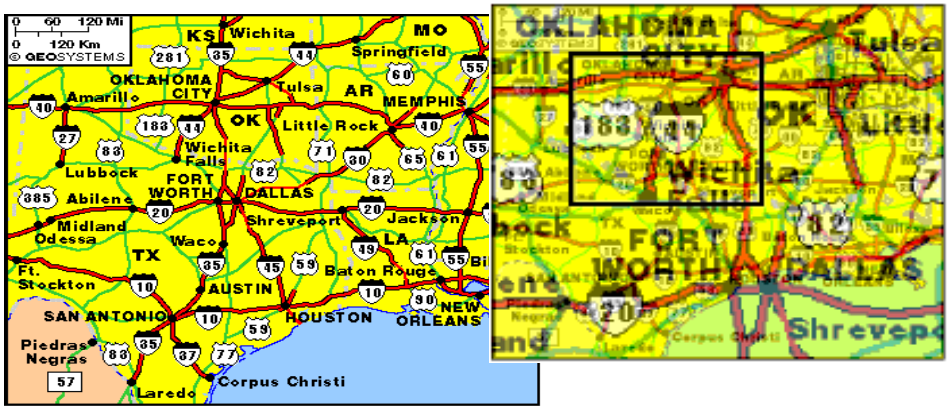
Movie

[Lieberman, 1994 and 1997]

The Macroscope
QuickTime, 0:51 Minuten

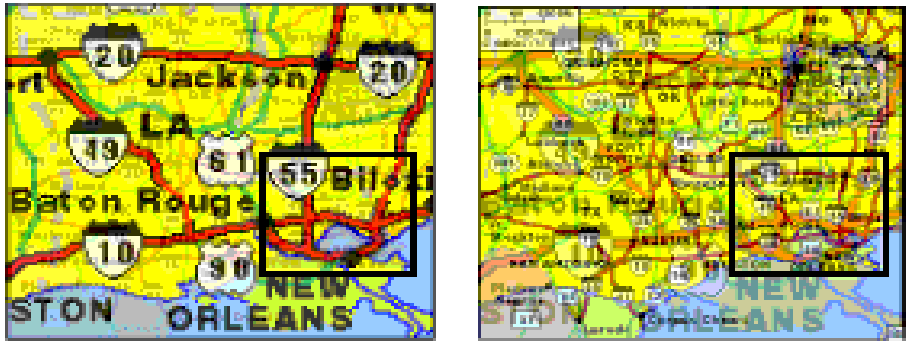
Examples

[Lieberman, 1994 and 1997]



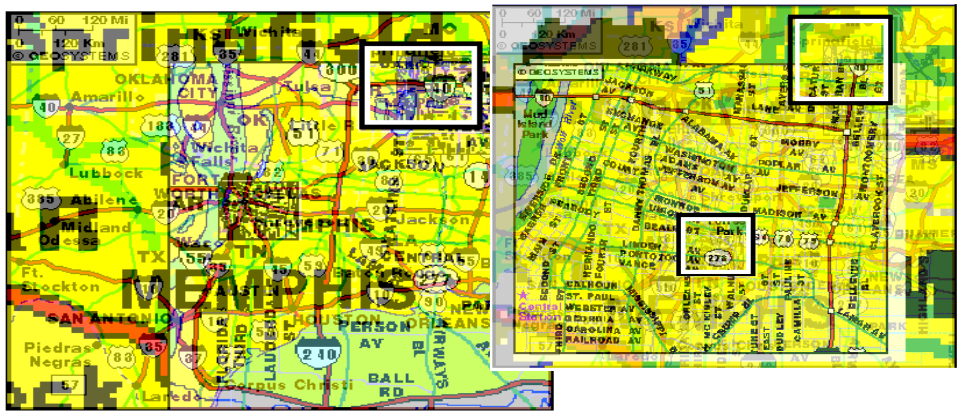
Examples

[Lieberman, 1994 and 1997]



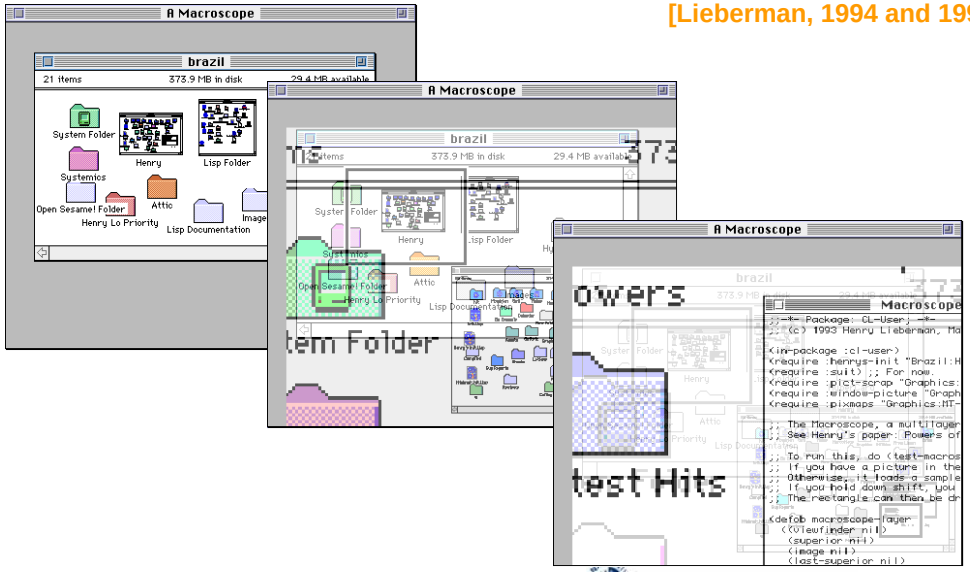
Examples

[Lieberman, 1994 and 1997]



Examples

[Lieberman, 1994 and 1997]



Sunburst

Hierarchy Visualizations

Compare: Course networks & hierarchies

[Stasko, et al. 2000]

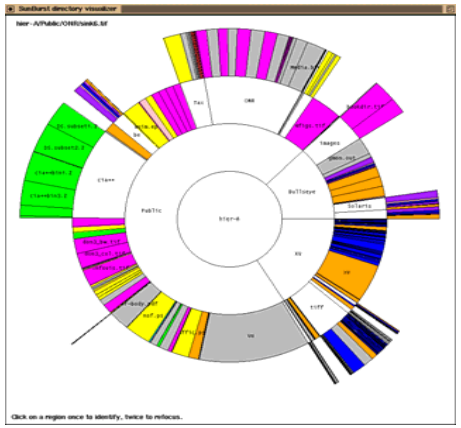
Circular Space Filling Technique

Angular Detail method

Detail Outside method

Detail Inside method

Demo (Video: 4 min)



Sunburst: Angular Detail Method 1

[Stasko, et al. 2000]

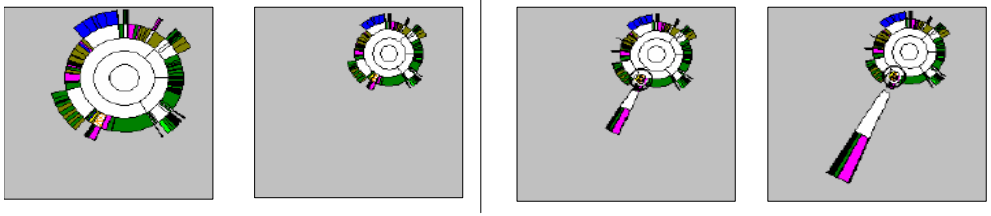
Step 1

Overview Shrinks

Moves to Opposite Corner

Step 2

- Selected Item Extends
- Bulls Eye Over Selected Item

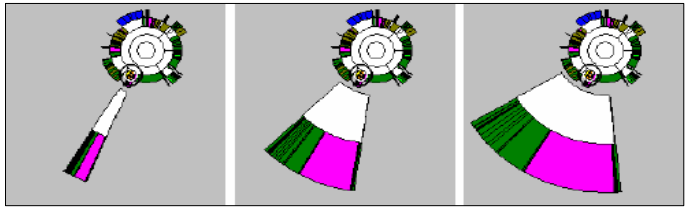


Sunburst: Angular Detail Method 2

[Stasko, et al. 2000]

Step 3

Item's Children Expand Radially



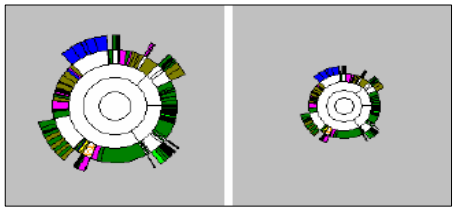
Sunburst : Detail Outside Method 1

[Stasko, et al. 2000]

Step 1

Overview Shrinks

Stays in Center



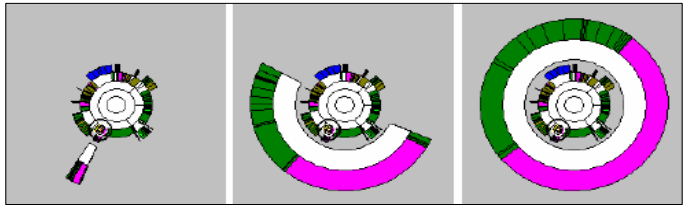
Sunburst: Detail Outside Method 2

[Stasko, et al. 2000]

Step 2

Selected Item Emerges

Item Expands → New Ring



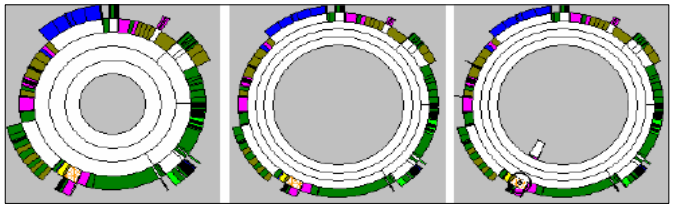
Sunburst: Detail Inside Method 1

[Stasko, et al. 2000]

Step 1

Overview → Pushed Outwards

Selected item → Extends in Center

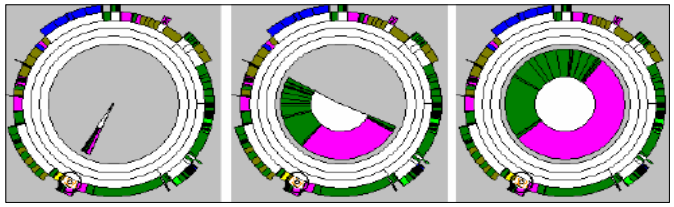


Sunburst: Detail Inside Method 2

[Stasko, et al. 2000]

Step 2

Item → New Circle in Center
→ Expands Radially



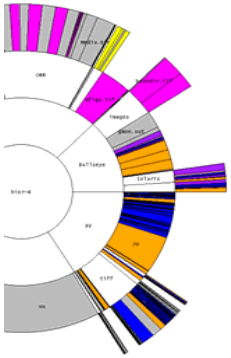
Sunburst: Goals & Limitations

[Stasko, et al. 2000]

Good Representation of Hierarchy

Better Use of Area Than Tree Maps

Small Peripheral Slices



Sunburst - Summary

[Stasko, et al. 2000]

Space-Efficient

More Detailed Examination

Balance Overview & Detail

Keep Context

Changes → Difficult for User

Large Hierarchies → Performance Problems

Focus+Context Techniques

Spatial / Distortion-Oriented Methods

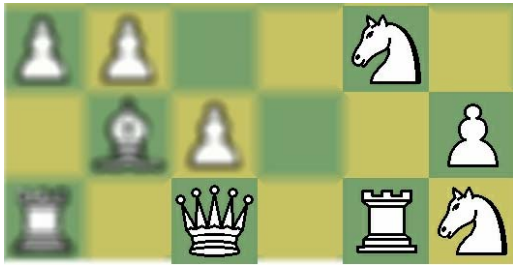
Fisheye Views, Perspective Wall, Stretchable Rubber Sheets, Hyperbolic Space, etc.

Dimensional Methods

Magic Lenses, Tool Glasses, etc.

Cue Methods

Color Saturation, Transparency, Brightness, ...



Robert Kosara*, Silvia Miksch*, Helwig Hauser**

Semantic Depth of Field

* Institute of Software Technology & Interactive Systems
Vienna University of Technology
Austria
http://www.asgaard.tuwien.ac.at/
{rkosara, silvia}@asgaard.tuwien.ac.at

** VRVis Research Center
Austria
http://www.VRVis.at/vis/
Hauser@VRVis.at

Overview

Focus+Context

Depth of Field (DOF) in Photography

Semantic Depth of Field (SDOF)

Applications

Implementation

Evaluation

Conclusions & Future Plans

Focus and Context: Threats?

Which chessmen threaten the white knight on e3?

Where is e3, anyway?

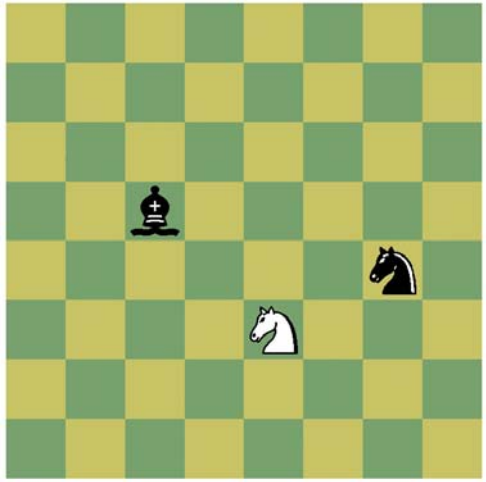
No Difference Between Focus and Context

Focus, but no Context ...

Reduction to Most Important Objects

Focus Easy to See

But no Context



Focus *and* Context: Threats?

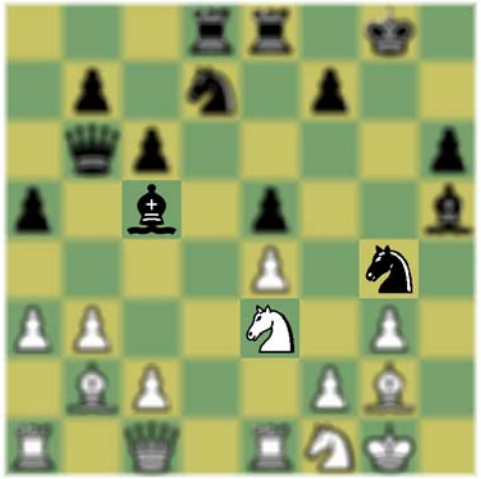
Show Important Objects as Usual

Blur Context

Focus Easy to See

Context Still Visible

Idea Behind SDOF!



DOF in Photography

Depth of Field (DOF)

Provides Context

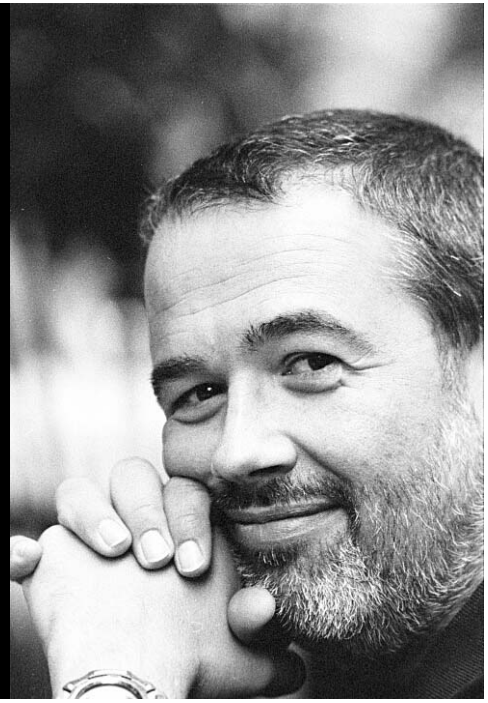
Guides Viewer to Main Object

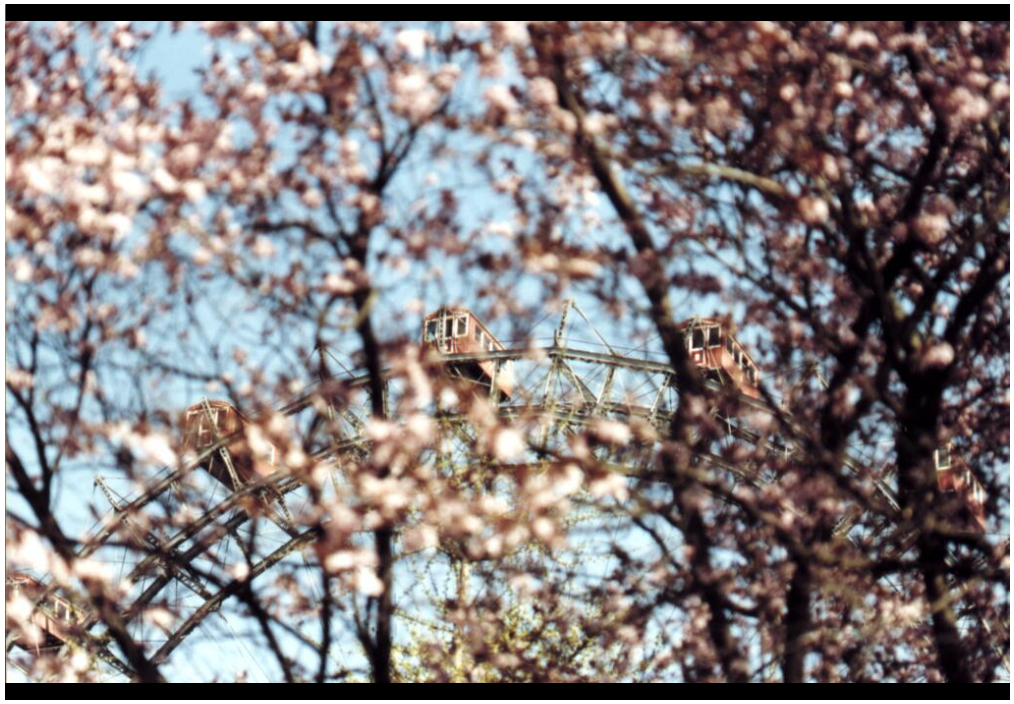
Easy to See (Preattentive)

Very Intuitive

People are Used to DOF

- Photography
- Movies





Semantic Depth of Field

SDOF is based on DOF

Blur depends on *relevance*,
rather than on *physical layout*

Well-known visual metaphor

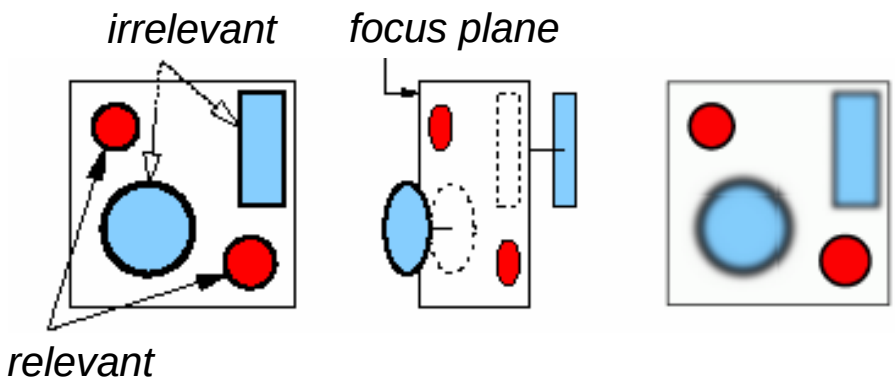
Works in 2D and 3D

Intuitive (eye)

Preattentive

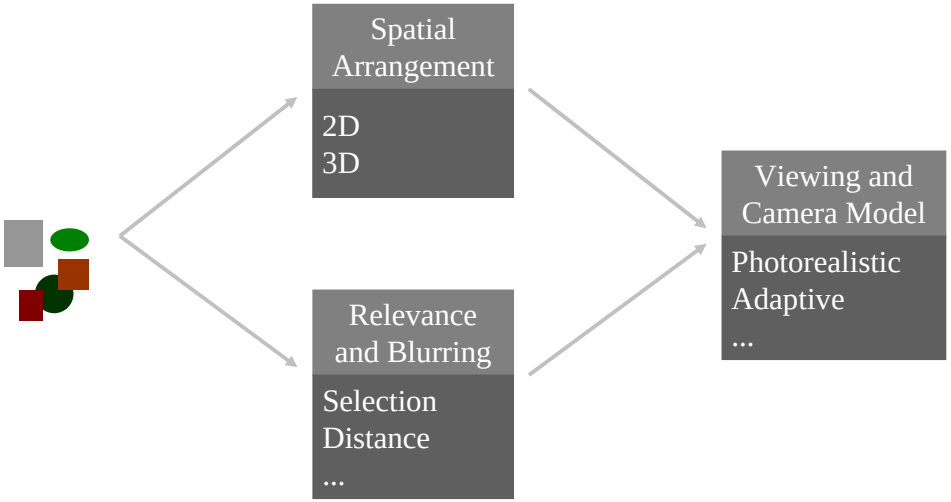
Idea: 2D SDOF Scene

[Kosara, et al. 2001]



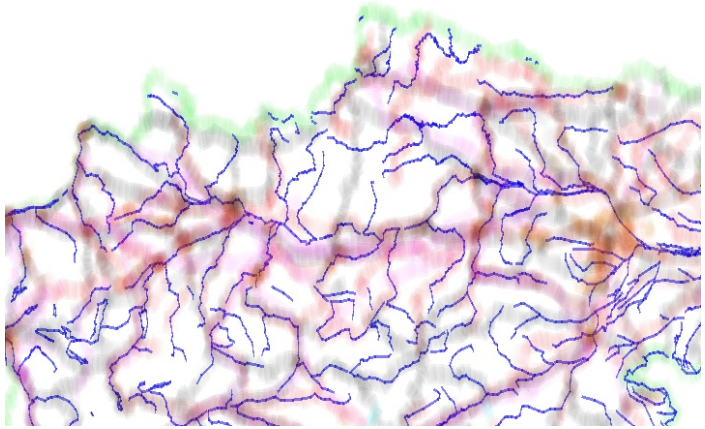
SDOF Principle

[Kosara, et al. 2001]



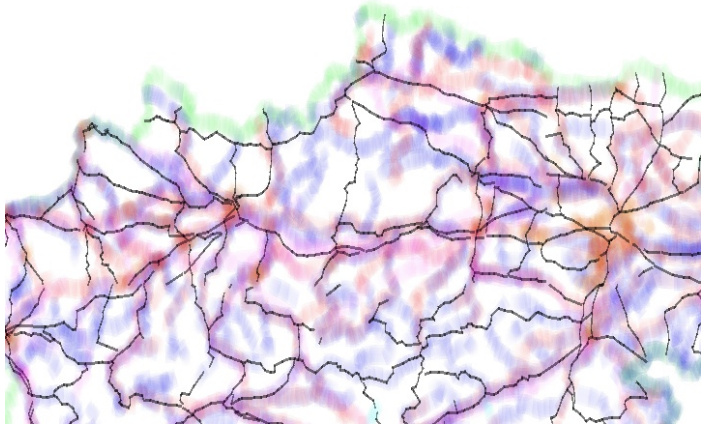
SDOF Application: MapViewer

[Kosara, et al. 2001]



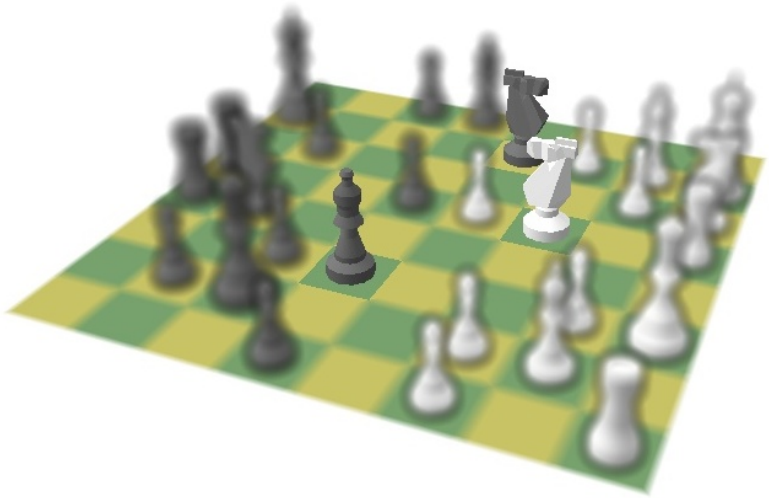
SDOF Application: MapViewer

[Kosara, et al. 2001]



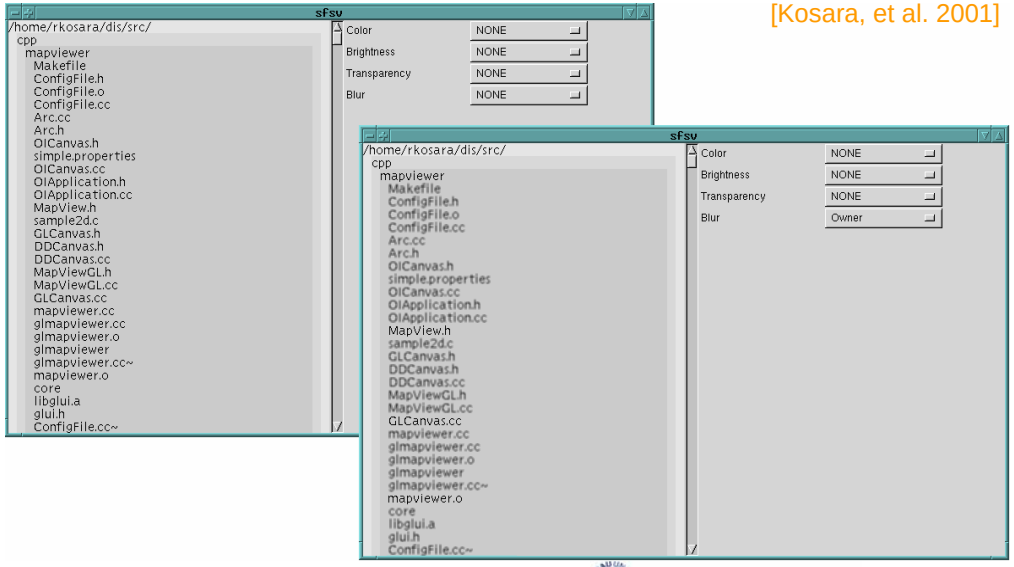
3D SDOF: Covering Pieces

[Kosara, et al. 2001]



sfvs: Files in Focus

[Kosara, et al. 2001]



SDOF: Works for Text, too!

[Kosara, et al. 2001]

Fisheye Views

Semantic Depth of Field

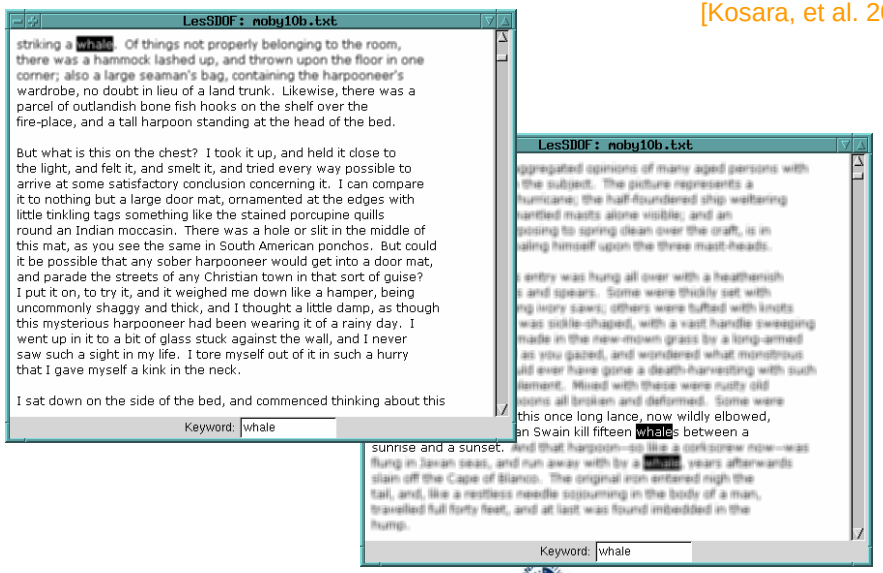
Stretchable Rubber Sheet

Hyperbolic Trees

Cone Trees

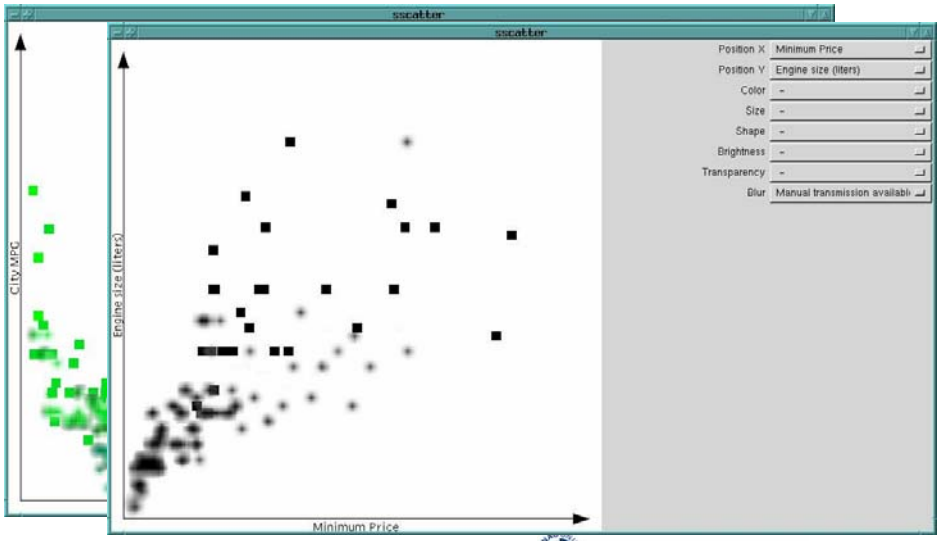
lesdof: Keyword in its Context

[Kosara, et al. 2001]



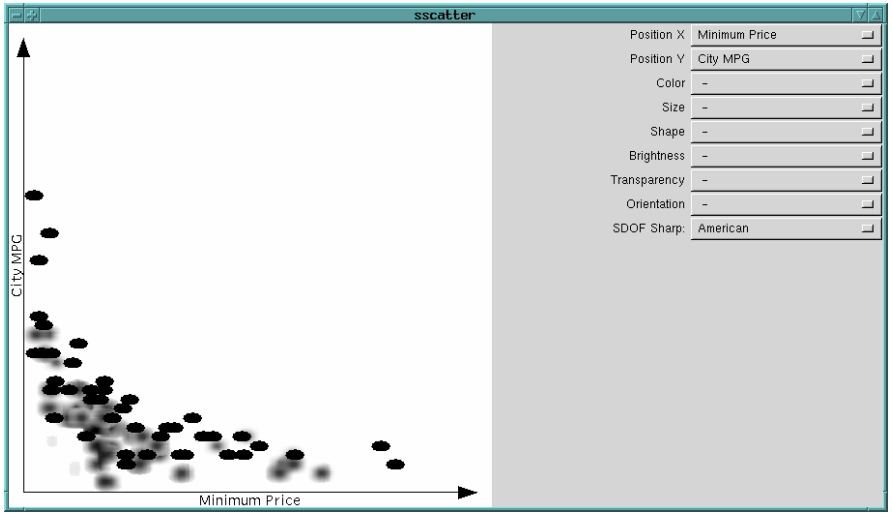
sscatter: sdof Scatter Plots

[Kosara, et al. 2001]



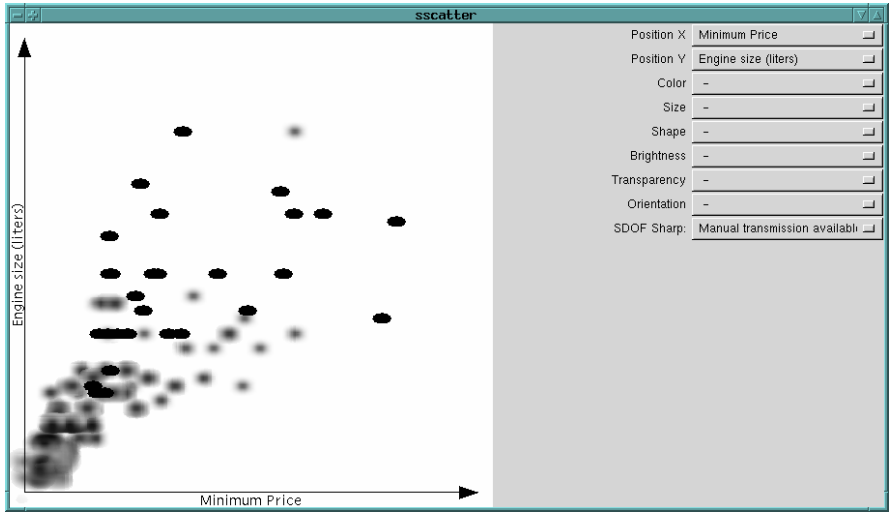
sscatter: sdof Scatter Plots

[Kosara, et al. 2001]



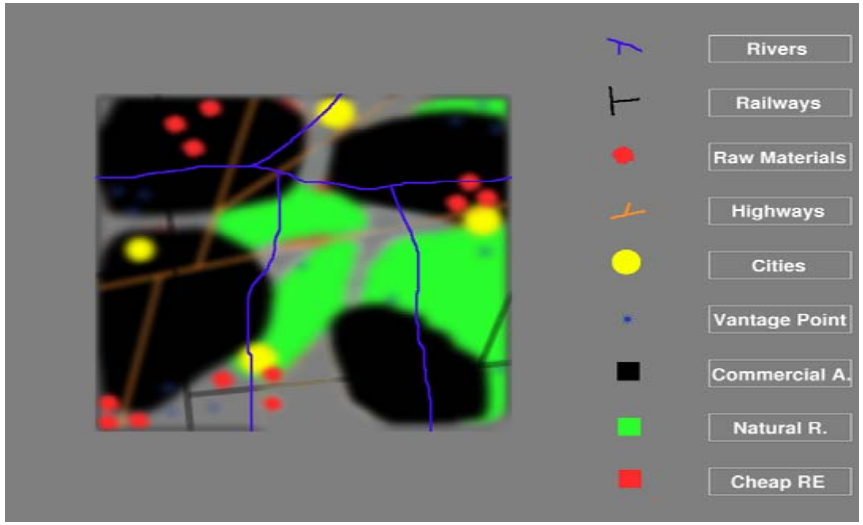
sscatter: sdof Scatter Plots

[Kosara, et al. 2001]



sMapViewer

[Kosara, et al. 2001]

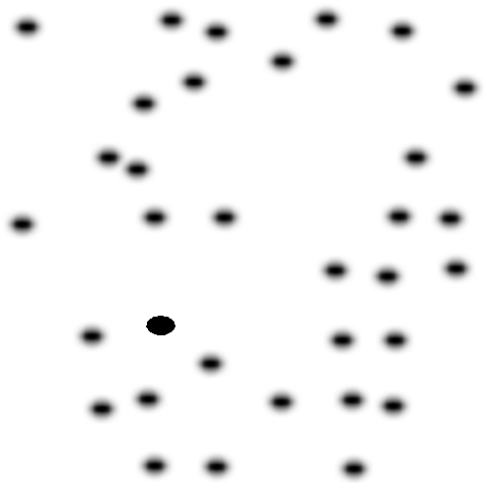


Preattentive Perception

[Kosara, et al. 2001]

Preattentive Perception

- after ~200ms
- Parallel, High Bandwidth
- Detection of Target, Locati



User Study

- 16 Participants
- 2 Hours Each
- Professional Usability Lab

Overview of Results (1/2)

[Kosara, et al. 2001]

Participants can Preattentively

- Detect Targets
- Locate Targets
- Estimate Number of Targets

High Precision

- Dependant on Blur Levels of Distractors
- Dependant on Number of Distractors

Overview of Results (2/2)

[Kosara, et al. 2001]

Distinction Between Blur Levels Difficult

Very Weak Perception of Blur Difference

Blur and Orientation not Slower than Orientation alone

Blur not Significantly Slower than Color!

Some did not like Blurred Text

Conclusions

[Kosara, et al. 2001]

SDOF is an Effective and Efficient F+C Technique

Does not Provide More Space, but Better Discrimination

Natural, Intuitive, *Preattentive*

Future

- Combination with other F+C methods
- Combination with other Cues to Encode More Information

More Information

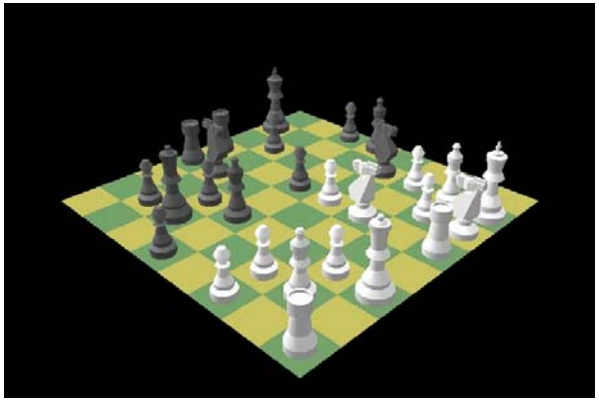
Acknowledgements

VRVis Research Center

Institute of Software Technology & Interactive Systems

Center for Usability Research and Engineering (CURE)

FWF (Austrian Science Fund)



http://www.VRVis.at/vis/research/sdof/

http://www.asgaard.tuwien.ac.at/sdof/

Pacific Vis 2011

[Gschwandtner, et al. 2011]

CareCRUISER

Exploring and Visualizing Data, Processes, and Effects Interactively

Theresia Gschwandtner

Wolfgang Aigner

Katharina Kaiser

Silvia Miksch

Andreas Seyfang

CareCRUISER

[Gschwandtner, et al. 2011]

Visually communicating:

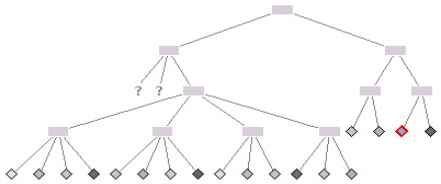
1. Patient's condition
2. Applied treatment plans
3. Effects of the treatment

} Multiple Views & Interactive Features

Views

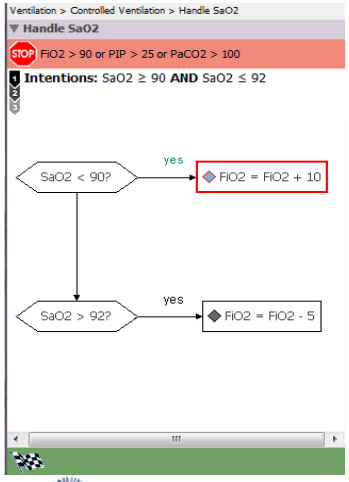
[Gschwandther, et al. 2011]

Hierarchical structure



Brushing & Linking between Views!

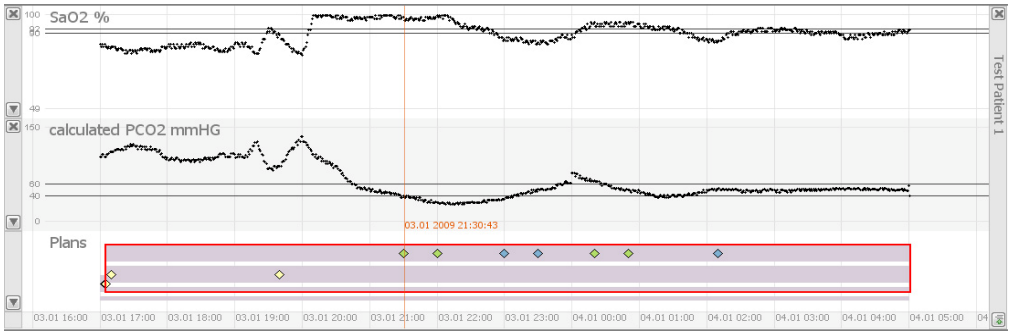
Logical sequence



Views

[Gschwandther, et al. 2011]

Temporal view on treatment plans and patient data



Views

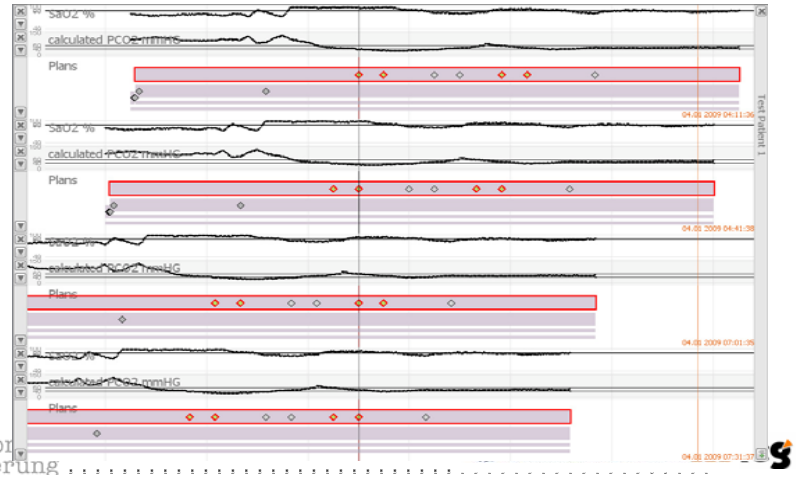
[Gschwandther, et al. 2011]

Temporal view on treatment plans and patient data

Stepwise Interactive Exploration of Effects

[Gschwandther, et al. 2011]

1) Aligning treatment plans or clinical actions

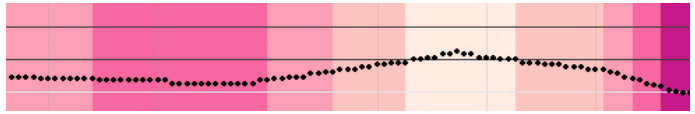


Stepwise Interactive Exploration of Effects

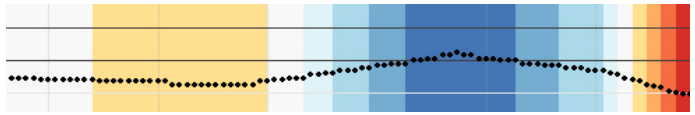
[Gschwandther, et al. 2011]

2) Color coding effects of actions/treatments

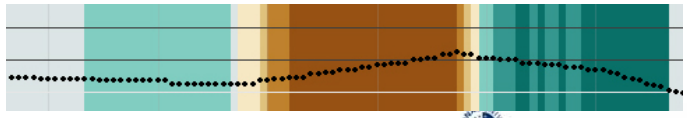
Distance from intended value



Progress from initial value

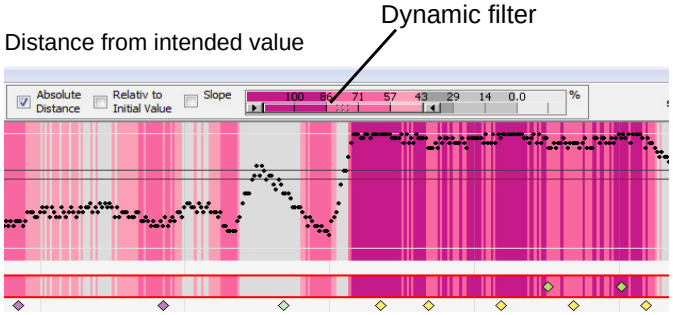


Slope



Stepwise Interactive Exploration of Effects

2) Color coding effects of actions/treatments

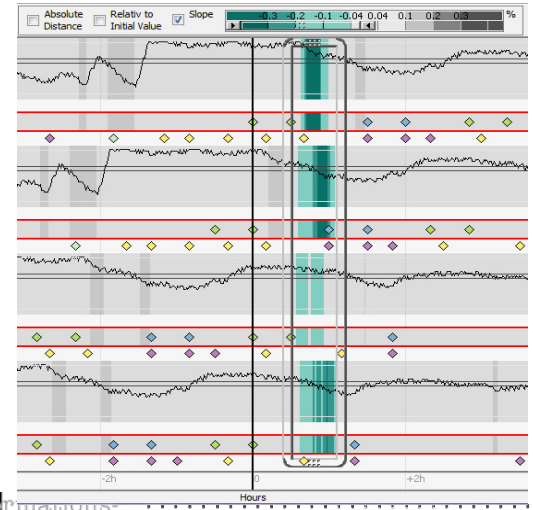


[Gschwandther, et al. 2011]

Stepwise Interactive Exploration of Effects

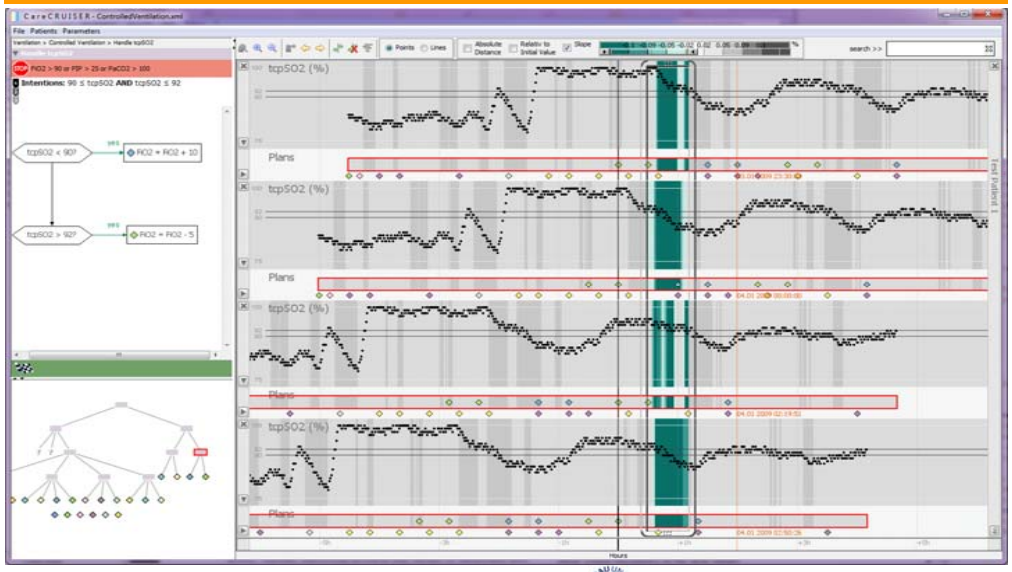
3) Focus and Context Lens: detecting patterns of effects

Slope



[Gschwandther, et al. 2011]

CareCruiser Project



Conclusion

[Gschwandther, et al. 2011]

Visualizing

- Patient's condition
- Applied treatment plans
- Effects of the treatment

Multiple views:

- Hierarchical structure of treatment plans
- Logical sequence of treatment plans
- Temporal view on treatment plans and patient data

Interactive features for a stepwise exploration of treatment effects:

- Aligning treatment plans or clinical actions
- Color coding effects of actions/treatments
- Filtering color-highlighted events
- Focus and Context Lens: detecting patterns of effects

Information Mural

[Stasko, et al. 2000]

Idea

2D

Miniature Representation of Large Information Data

Entire Information Space

Visual Attributes (Color, Intensity)
→ Information Density

Complete Display Window / Screen

Information Mural: Goals

[Stasko, et al. 2000]

Create Representation of Large Information Space

Mimic Original Visual Representation

Minimize Loss of Information

Information Mural: Idea

[Stasko, et al. 2000]

Use techniques of Computer Graphics (Shading and Antialiasing) to More Carefully Draw Overview Displays of Large Data Sets

Think of each Data Point as Ink and each Screen Pixel as a Bin

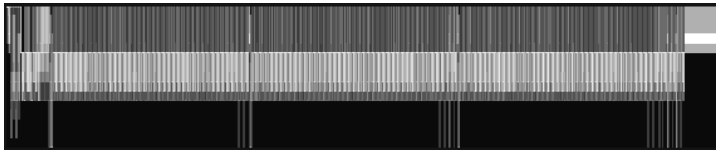
Data Points (Ink) don't fit Cleanly into one Bin, some Ink may Go into Neighboring Bins

Can Map Density to Gray or Color Scale

Mural Applications: Execution Mural 2

[Stasko, et al. 2000]

Using new Mural technique



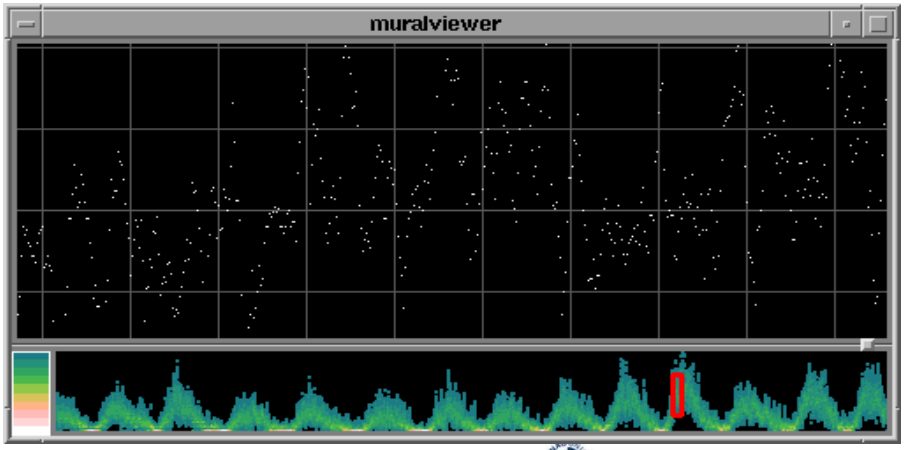
Using classic technique (overplotting)

Mural Applications: Time-oriented Visualizations

[Stasko, et al. 2000]

Mural → Context & Navigation

View → Focus



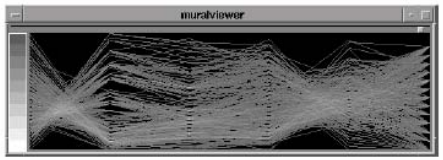
Mural Applications: Parallel Coordinates

[Stasko, et al. 2000]

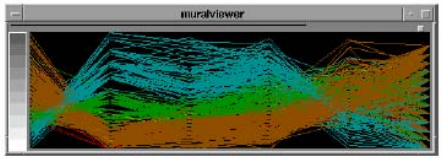
Parallel Coordinates

normal

muralized

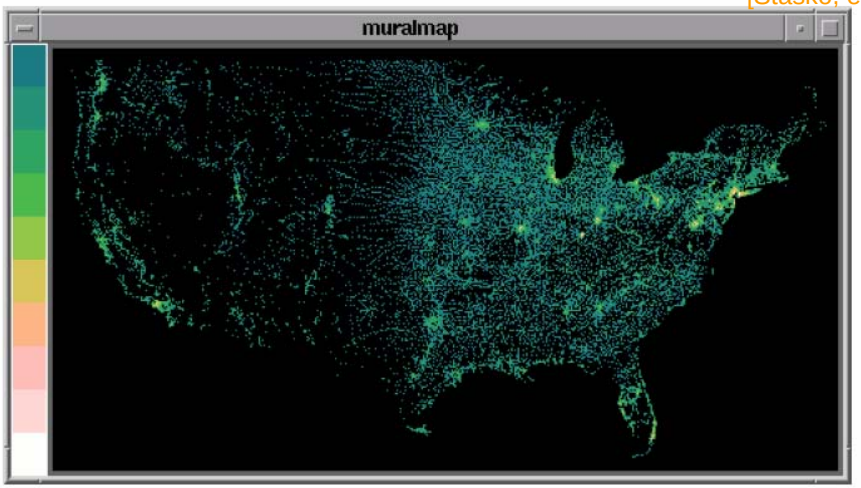


colorized



Mural Applications: Census Data

[Stasko, et al. 2000]

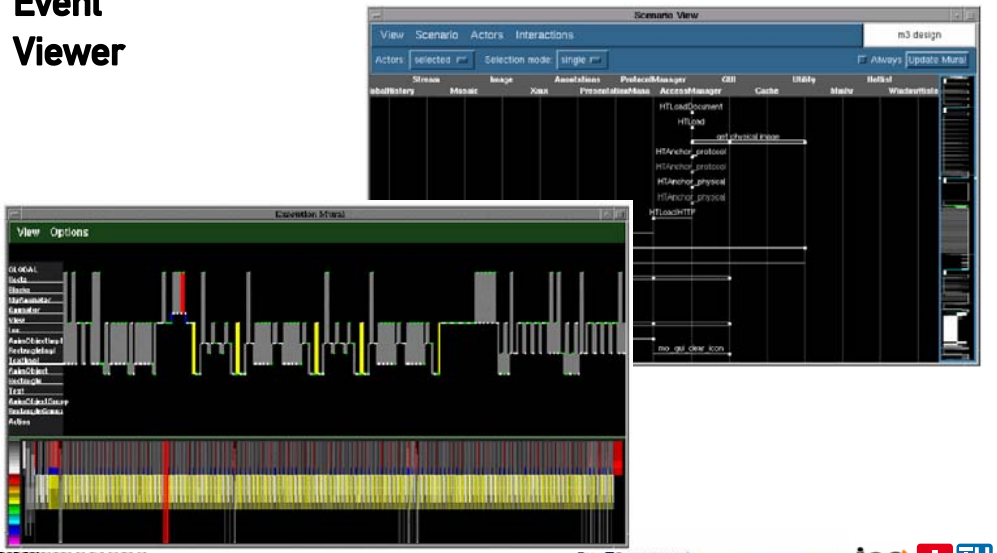


U.S. Census Data

Multiple Windows (Information Mural)

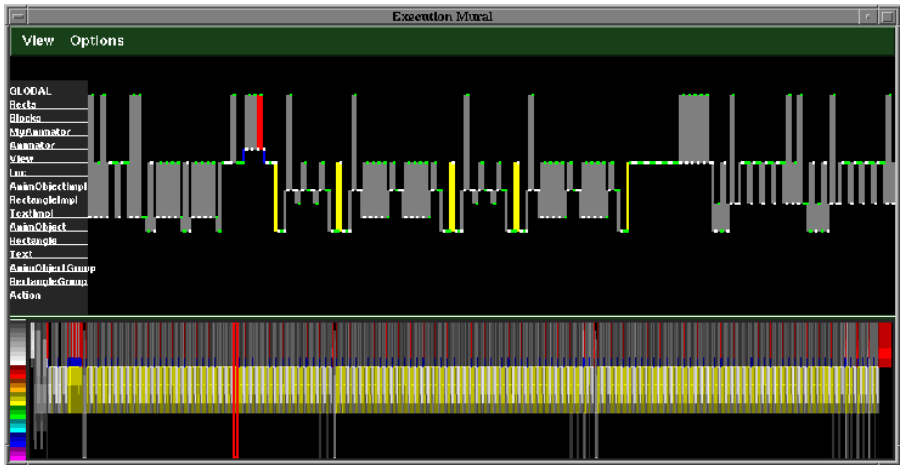
[Stasko, et al. 2000]

Event Viewer



Mural Applications: Execution Mural

[Stasko, et al. 2000]

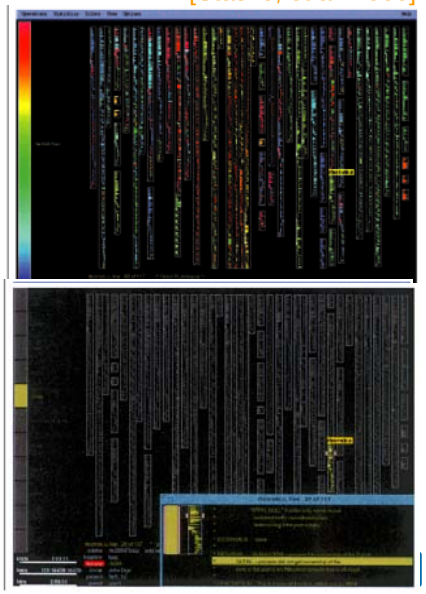


Multiple Windows (Information Mural)

[Stasko, et al. 2000]

Software-Viz

Editor



1 This Visual Insights code viewer screen displays 16,439 lines of source code across 55 files. The most recently modified lines are red, the oldest blue, and a color scale indicates intermediate status.

2 This Visual Insights code viewer screen shows lines of source code associated with a particular feature (i5699). The browser window adds an expanded view of the code that is part of feature i5699 in file rtscrndc.c. Line 27 of the file is highlighted in the browser window.

Mural Applications: Document Visualization

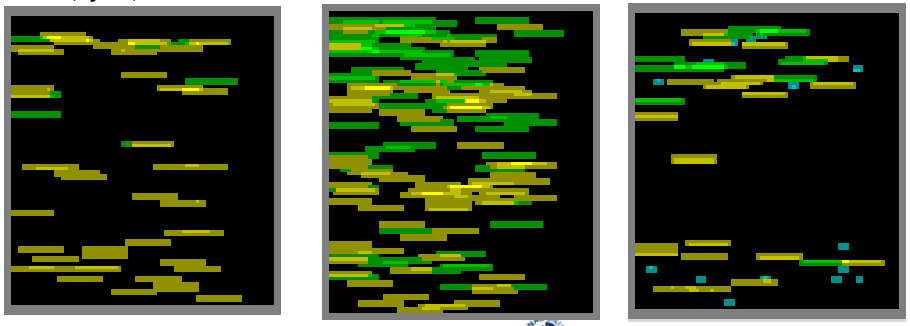
[Stasko, et al. 2000]

3 Documents → Keyword Distribution

"Visualization" (yellow)

"Object-oriented" (green)

"OO" (cyan)



Information Mural Suitable Applications

[Stasko, et al. 2000]

Time-Orientated Visualizations

Visualizations With Miniature Re-presentation (Problem With Details)

Text Files, Documents

Graphs, Charts → Scaling, Rounding

Image (Resize → Loss of Information)

Benefits & Limitations: Information Mural

[Stasko, et al. 2000]

New Approach
→ Representing Data Density

All Points in Source Image
→ May Be Slower

Very Large Data Set
→ Mural Becomes Fuzzy

F+C: Summary

Spatial / Distortion-Oriented Methods

Fisheye Views, Perspective Wall, Stretchable Rubber Sheets, Hyperbolic Space, etc.

Dimensional Methods

Magic Lenses, Tool Glasses, etc.

User-Driven

Cue Methods

Color Saturation, Transparency, Brightness, ...

Data-Driven

F+C: Potential Limitations

[Keahey 2003] extended

Limited Degree of Magnification?

- 10X Maximum?
- Open Research Question

Disorientation

- Complex Transformations Might Cause Viewer to Get Lost
- Need Effective Visual Cues to Avoid this
- Distortion can be Annoying
- Can be very Difficult to Implement

F+C, Disorientation :: Complexity

- Any Change in Focal Point Potentially Requires Recalculation of DoI for all Objects and Hence re-rendering of all Objects -> Expensive!

Strengths of F+C

[Keahey 2003] extended

Mirrors the Way the Visual Cortex is Designed

Good Navigation Tool for Interactively Exploring Data

- Probe Regions of Interest Before Committing to Navigating to Them (Easily Reversible)

Can be Combined with other Viewing Paradigms such as Pan&Zoom

Alternatives to F+C

[Keahey 2003]

Pan&Zoom

- Scales to High Factors
- Navigation can be a Problem

Overview + Detail

Multiple Views at Different Scales

- No Distortion between Scales
- No Continuity Either

Filtering

Selective aggregation

Micro-macro readings

Highlighting

…

Overview + Detail

K. Hornbaek et al., Navigation patterns and Usability of Zoomable User Interfaces with and without an Overview, ACM TOCHI, 9(4), December 2002