ユーザインタフェース

～Information Visualization～

五十嵐 健夫

Schedule

- 6/6　Design and Evaluation
- 6/13　Information Visualization
- 6/20 Sketching Interfaces for Graphics, 課題出題
- 6/27 End User Programming /
- Multimodal Interaction
- 7/4　Programming Environments
- 7/11 Human-Robot Interaction,　課題〆切 (24:00)
- 7/18 課題講評

今回の内容

情報視覚化（Information Visualization）
情報検索

- Information Visualizer (Xerox PARC)
- Focus + Context, FishEye
- Zooming UI
- HCIL (Shneiderman)
- Tool Glass and Magic Lenses

情報視覚化（Information Visualization）
情報検索

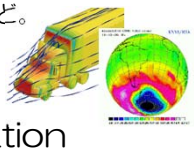
“The use of computer-supported, interactive, visual representations of abstract data to amplify cognition”

Readings in Information Visualization
~Using Vision to Think~

きれいな絵を見せること自体が目的ではない。
インタラクションを通じて、対象を理解することが目標

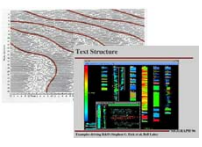
Scientific Visualization

もともと空間的な意味を持つ情報の可視化
流体シミュレーションの結果など。



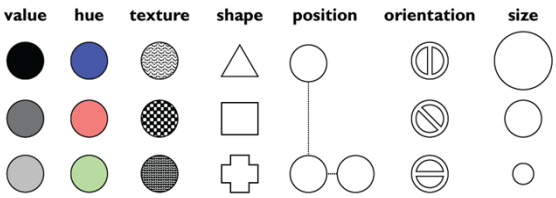
Information Visualization

抽象的な情報の可視化
どう空間へマップするかは自由

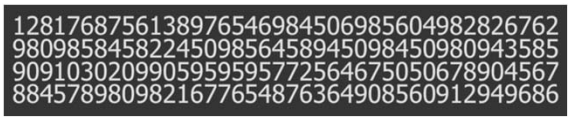


Basics

視覚属性による表現



Preemptive Perception



How many 3's ?

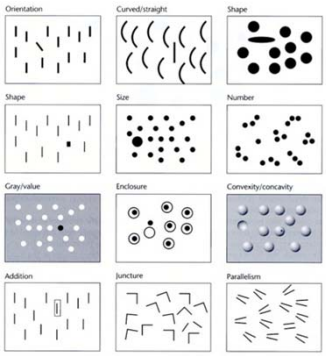
[Stasko, Agrawala]

Preemptive Perception

How many 3's ?

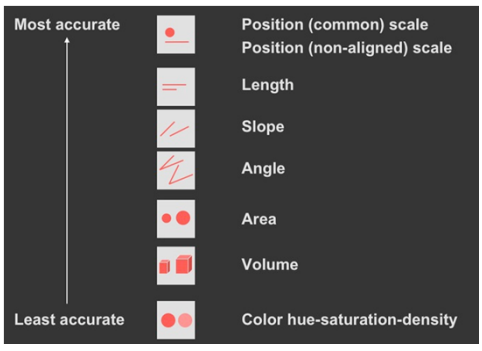
[Stasko, Agrawala]

Preemptive Features



[Information Visualization, Ware 04]

Relative Magnitude Estimation

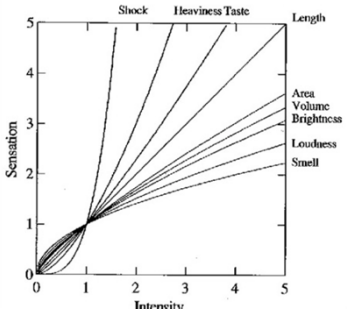


[Agrawala]

Steven's Power Law

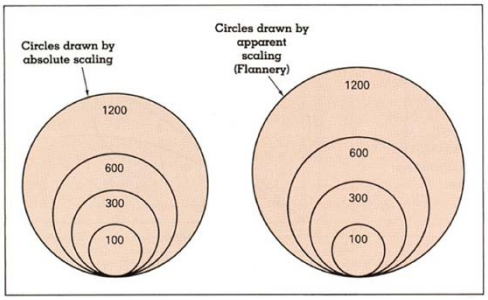
$S = I^p$

P<1 underestimate
P>1 overestimate



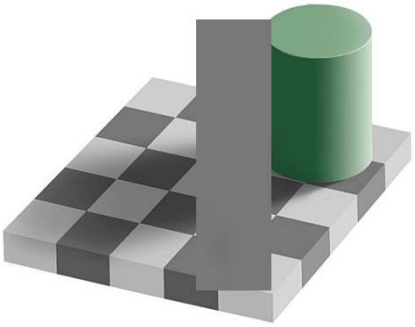
[Information Visualization, Ware 04]

Apparent Magnitude Scaling

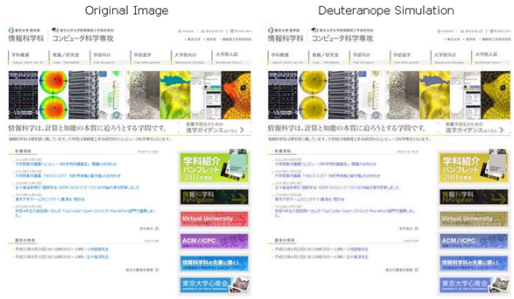


[Cartography: Thematic Map design, Dent 96]

色の知覚



色覚異常



http://www.vischeck.com/

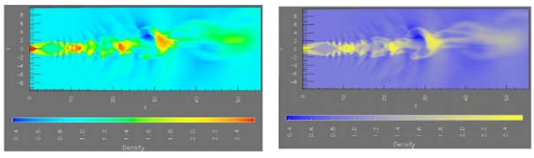
Just Noticeable Difference

JND (Weber's Law)

$$dS = k\, dI / I$$

Ratio is more important than magnitude.

カラーマッピング

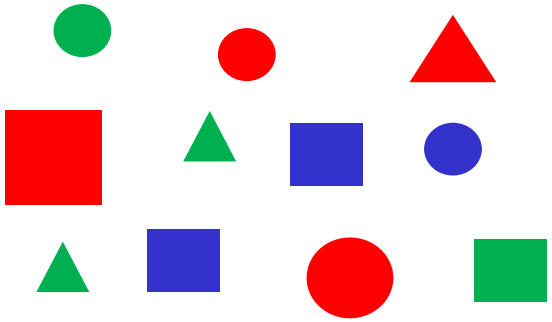


レインボーカラーマップ
低周波成分がわかりやすい

色調による1次元表現
高周波成分がわかりやすい

http://www.research.ibm.com/people/l/lloydt/color/color.HTM

Count Number of Each Color



How Many Red?

How Many Triangles?

Difference?

http://sunburst.usd.edu/~schieber/coglab/ChangeBlindness.html

Difference?

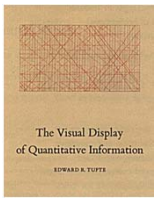
http://sunburst.usd.edu/~schieber/coglab/ChangeBlindness.html

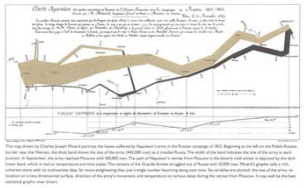
Difference?

http://sunburst.usd.edu/~schieber/coglab/ChangeBlindness.html

The Visual Display of Quantitative Information

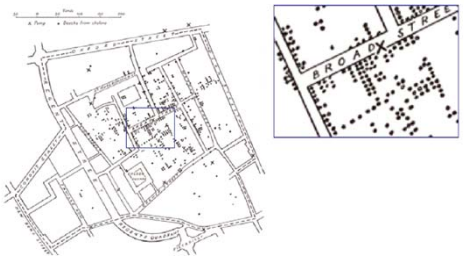
Edward Tufte





情報を効果的に伝えるための技法集

コレラの感染



[Tufte 83]

Research Projects

Information Visualizer (Xerox PARC)

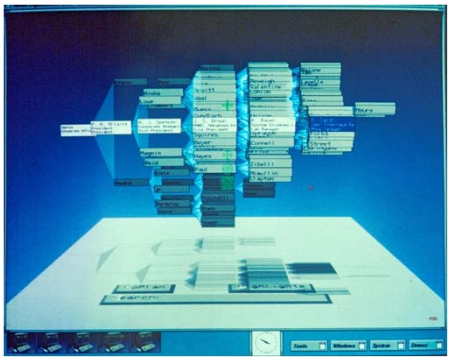
- Cone Tree
- Perspective Wall
- Document Lenz
- Hyperbolic Tree

大規模な情報への効率的アクセス

Focus+Context, アニメーション

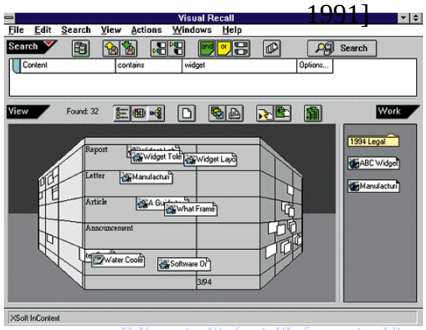
Cone Tree

[Robertson 1991]



Perspective Wall

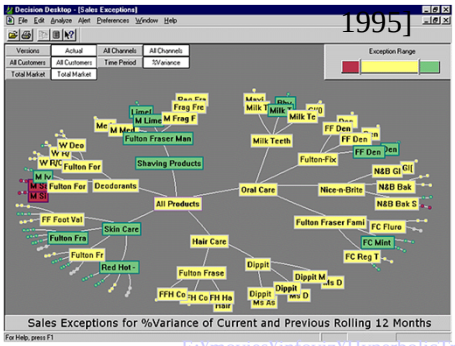
[Mackinlay 1991]



E:¥movies¥infoviz¥InformationVisualizer.mpg

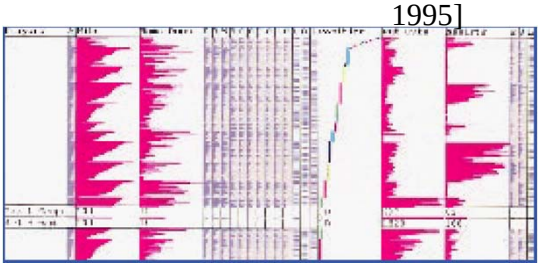
Hyperbolic Tree

[Rao 1995]



E:¥movies¥infoviz¥HyperbolicTree.mpg

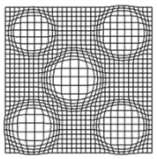
Table Lens [Rao 1995]



E:¥movies¥infoviz¥TableLens.mpg

Non linear Magnification Focus + Context views

- Original Fisheye view
- Fisheye lens



Focus を大きく表示

Context を失わないように小さく表示

Fisheye view [Furnas 81]

Focusの近くにあるもの
階層構造で上位にあるもの
を優先的に表示する。

Fisheye view [Furnas 81]

```
  1 The FISHEYE view: a new look at structured files
  2       I. ABSTRACT
  3       II. INTRODUCTION
...23     III. GENERAL FORMULATION
...51     IV. A FISHEYE DEFINED FOR TREE STRUCTURES
...52        A. The Underlying Fisheye Construction and its Properties
...76        B. Examples of Fisheye for Tree Structured Files
 77             1. Indent Structured Files: Structured Programs, Outlines, etc.
 78                a. Examples: Programs, Outlines, etc.
 79                b. Usually ordered + fisheye is compatible
 80                c. Specific example 1: paper outline
>>81                   Figure 3: outline, regular and fish views
 82                   i. some adjacent info missing
 83                   ii. traded for global information
 84                d. Comment: standard window view = degenerate fisheye
 85                e. Specific example 2: C program code
...89                f. Other indent structures: biol. taxon., org. hierarch...
 90             2. Count-Until: A Simple Generalization of Indent Structure
...100          3. Examples of the Tree Fisheye: Other Hierarchical Structures
...106       V. FISHEYE VIEWS FOR OTHER TYPES OF STRUCTURES
...117       VI. A FEW COMMENTS ON ALGORITHMS
...140       VII. OTHER ISSUES
...162       VIII. CONCLUDING REMARKS AND SUMMARY
```

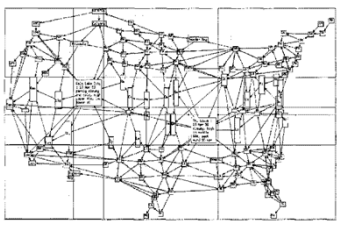
Fisheye view [Furnas 81]

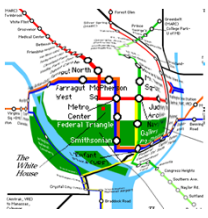
"Degree Of Interest" (*DOI*) function

1. focal point: '.'
2. distance from focus: D(.,*x*) [*D*(.,.)=0]
3. level of detail, importance, resolution: *LOD*(*x*)

$$DOI\ (x \mid .) = f\ (\ g\ (LOD(x)) - h\ (D(.,x))\ )$$

Fisheye Graph [Sarkar 93]





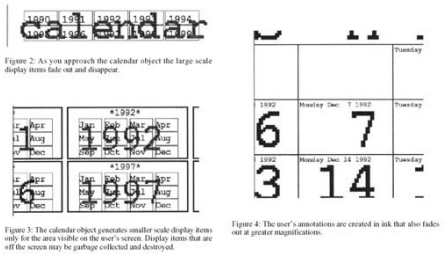
E:¥movies¥infoviz¥FisheyeGraph.mpg

Zooming User Interfaces

- Pad
- Pad++
- Jazz

連続的ズーミングを中心とした
情報空間のブラウズ・ナビゲーション手法

Pad [Perlin 93]



連続ズーミングで階層構造を表現

ズームすると下の階層が徐々に現れる。

E:¥movies¥infoviz¥Pad.mpg
padwish

Jazz [Bederson 00]

Java 版　　SceneGraph構造

http://www.cs.umd.edu/hcil/jazz/

hinote

Prezi

ズーミングプレゼンの製品

prezi

HCIL Maryland Univ

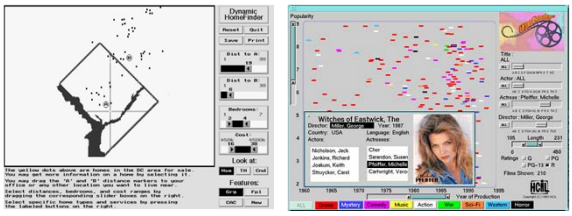
- Film Finder
- TreeMap

“Dynamic Query”

連続的に条件を変化させ結果が追従する

Home Finder, Film Finder

[Williamson 92, Ahlberg 94]

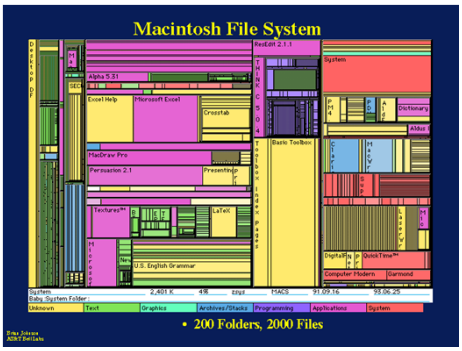


条件をスライダで調整すると連続的に結果が変化する

E:¥movies¥infoviz¥DynamicQuery.avi

Tree Map

[Johnson 91]



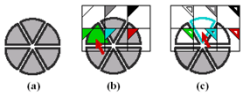
その他

- Magic Lens
- Comic Chat
- RouteMaps

Tool Glass and Magic Lenses

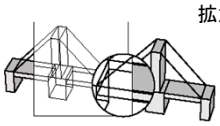
[Bier 1993]

Tool Glass = 半透明のツールパレット。両手操作。



Magic Lenses = 囲まれた範囲の表示が変化する

拡大、透視、など



E:¥movies¥infoviz¥MagicLens.avi

Comic Chat

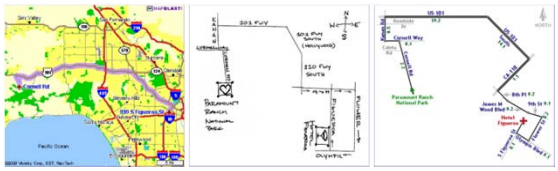
[Kurlander 1996]

チャットの内容を自動的に漫画にして表示する。

E:¥movies¥infoviz¥ComicChat400kbps.flv

Rendering Effective Route Maps

[Agrawala 2001]

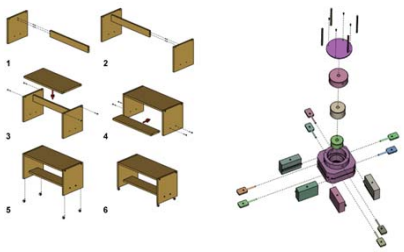


通常の地図表示　　手書きの地図　　工夫した地図

間違えそうなところは拡大して、単純なところは縮小して、わかりやすい地図を作成する。

Designing Effective Step-By-Step Assembly Instructions

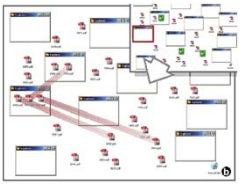
[Agrawala 2003]

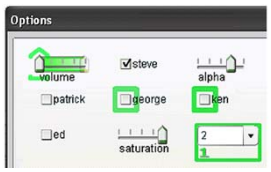


組み立て手順説明図を自動生成する。

Phosphor: Explaining Transitions in the user Interface Using Afterglow Effects

[Baudisch 2006]





- 残像効果でUndoを支援
- アニメーション効果との比較実験など

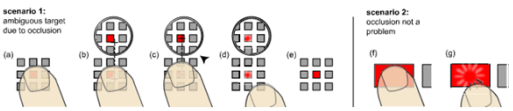
E:¥movies¥infoviz¥Phosphor.avi

Small Screen

- shift
- escape
- halo

shift

[Vogel and Baudisch 2007]



- 指の下にあるものを拡大表示

E:¥movies¥infoviz¥Phosphor.avi

Escape: A Target Selection Technique Using Visually-cued Gestures

- 指の動きで選択

escape

halo

[Baudisch 2003]

- 画面の外にあるものを円周で表示

E:¥movies¥infoviz¥Phosphor.avi

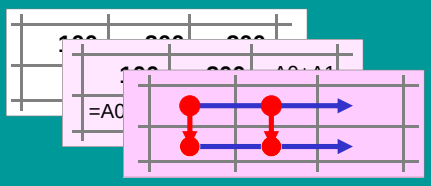
Our Projects

Visual Languages 98

Fluid Visualization of Spreadsheet Structures

Takeo Igarashi (Univ. of Tokyo)
Jock Mackinlay (Xerox PARC),
Bay-Wei Chang (Xerox PARC),
Polle Zellweger (Xerox PARC)

A spreadsheet has an underlying *dataflow graph* in addition to the surface numerical view.

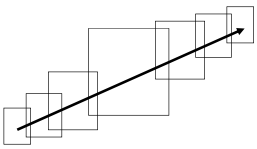


We visualize these structures using animation and interaction techniques.

..¥..¥..¥archive¥www¥~takeo¥video¥fluid.mpg

移動速度に応じた自動ズーミングによる効率的ナビゲーション

UIST 00



五十嵐　健夫 (東京大学)
Ken Hinckley (Microsoft Research)

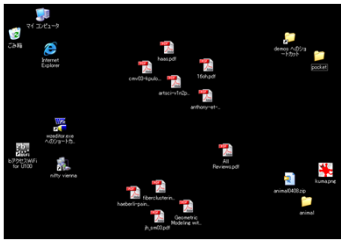
autozoom

Bubble Clusters

An Interface for Manipulating Spatial Aggregation of Graphical Objects

Nayuko Watanabe, Motoi Washida,
Takeo Igarashi
(The University of Tokyo)

Target Task



Object manipulation in spatial layouts

bubble　ink

CHI 2008

Ninja Cursors

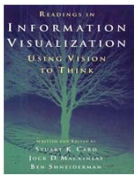
Masatomo Kobayashi
Takeo Igarashi

ninja_cursors.mov

参考文献

Readings in Information Visualization: Using Vision to Think

S.K. Card, J.D. MacKinlay, B.Shneiderman



情報視覚化の会社（InXight）

http://www.inxight.com/

情報視覚化のチュートリアル（増井俊之）

http://www.csl.sony.co.jp/person/masui/Visualization/

まとめ

情報視覚化・検索システムを紹介した。

キーコンセプト

- Focus + Context
- Animated transition
- Degree of Interest
- Zooming Interfaces
- Dynamic Query