Visualizing the Effects of Logically Combined Filters

Thomas Geymayer, Alexander Lex, Marc Streit, Dieter Schmalstieg

Graz University of Technology, Austria
Motivation: Large Data Sets

Trend: ever growing data, e.g.,
  Biology
  Astronomy

Not possible to show each data item
  Performance problems
  Not enough pixels, overplotting
  Overloaded visualizations, clutter
Solution Approaches

Increasing data-to-ink ration
Increasing resolution

Abstraction Methods:
- Aggregation
- Random Sampling
- Segmentation

Really important, but not always the best solution!
Sometimes: good old **FILTERING** preferable
Why use Filtering?

It is easy!
It scales!
For algorithms and visualization alike
A lot of data that is irrelevant!
Noise
Uncertain data (beyond a threshold)
It can easily be integrated into existing software!
It helps you focus on the interesting data!
State of the Art in Filtering

Often considered a preprocessing step

Mostly used as a **black box**

A number of filters are applied sequentially, the result is visualized

Problems:

Impossible to judge the effects of individual filters
Logical combinations (other than AND) often not supported
VISUALIZING FILTERS
Inspiration

[Charles Minard, 1869]
Main **Requirements** for Filter Visualization

**R1**  Show Sequence

**R2**  Show Consequences
    Show how many elements a filter removes.

**R3**  Show and Create Compositions
    Sequence of filters is equal to logical AND
    Logical operations such as OR and XOR cannot be visualized as easily
Filter Pipeline for **AND** Combinations

Fold change HCC_06 and HCC_07

-2944

p-Value Reduction of HCC_0

-833

p-Value Reduction of Ctrl_0

-338

Alexander Lex
OR Combinations

Alternative 1: Filter Fan
OR Combinations

Alternative 2: Parallel Filters
Interaction
Recap Main Requirements

R1  Show Sequence

R2  Show Consequences

R3  Show and Create Compositions
Secondary Requirements

R4  Modify Filters
    Change parameters, remove and move filters

R5  Hide Filters
    To compensate for disproportional filters

R6  Show Filter Efficiency
    Show effect of every filter on the data set as if it were the only one
R4: Modify Filters

Edit filter parameters by double clicking filter

Move using drag & drop

Remove using context menu
R5: Hide Filters
R6: Show Filter Efficiency
Future Work, Recent Developments

Non-binary filters (uncertainty)
Integrate Not, XOR
Nested Filters
Integrate brushing on subsets
Thank you for your attention!

Questions?

http://caleydo.org
Scalability - FAN
Scalability - Parallel Filters
Implementation

Part of Caleydo
Information Visualization Framework
OpenGL, Java, RCP

http://caleydo.org