Image based algorithm to support interactive data exploration

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How to support data exploration?

The key to supporting this task is not only to visualize data, but also to allow users to interact with them.

I explored new computing techniques called pixel-based algorithms so as to support efficient interactive visualizations for the exploration of large datasets.
Brushing and linking

*From Dady*

View simplification

*Edge Bundling techniques*

View animation

*MoleView*

*ColorTunneling*
Brushing and linking
FromDady
Christophe Hurter, Benjamin Tissoires, Stéphane Conversy.

**FromDaDy:** spreading data across views to support iterative exploration of aircraft trajectories.

*InfoVis 2009*
Outgoing investigation: What if system...
How the flows get reallocated when an harbor is closed,

Roeland Scheepens, Christophe Hurter, Huub van de Wetering, Jarke van Wijk
Visualization, Selection, and Analysis of Traffic Flows
In IEEE Transactions on Visualization and Computer Graphics xx(y),
(Proceedings of IEEE InfoVis 2015).

http://recherche.enac.fr/~hurter/AnimatedParticles/AnimatedParticles.html
Context

• Moving objects with functional relationship.

• Users

• Traffic Flows
Visualization

• Direction of flows

Colors? Glyphs?

Colors?

Glyphs?
Visualization

• Direction of flows

Colors? Animated Particles! Glyphs?
Selection

- Visually select
- Polygonal area
- Directional filter
- Intuitive widget

Air traffic over Paris
Selection

- Visually select
- Polygonal area
- Additional attributes
Flow Comparaison
View simplification
Edge Bundling techniques
County-to-county migration flow files (http://www.census.gov/population/www/cen2000/ctytoctyflow/). These data come from the Census 2000 long-form question on residence 5 years ago and contain the number of people who moved between counties.
Bundled
Shading

Christophe Hurter, Alexandru Telea, and Ozan Ersoy. pdf video slides
Graph Bundling by Kernel Density Estimation.
KDEEB pipeline

- edge resampling
- splatting
- gradient estimation
- edge advection
- Laplacian smoothing
- rendering

input graph → sampled edges → density map → gradient map → bundled graph → smooth bundles → final image

$n$ iterations
Hurter, C.; Ersoy, O.; Fabrikant, S.; Klein, T.; Telea, A.,
Bundled Visualization of Dynamic Graph and Trail Data.
doi= 10.1109/TVCG.2013.246
Demo mouse bundling
View animation
MoleView
ColorTunneling
Christophe Hurter, Ozan Ersoy and Alexandru Telea. 2011.
MoleView: An Attribute and Structure-Based Semantic Lens for Large Element-Based Plots.
InfoVis 2011
John Brosz, Miguel Nacenta, Ricky Pusch, Sheelagh Carpendale, and Christophe Hurter

Transmogrification: Casual Manipulation of Visualizations.
(UIST '13) In Proceedings of the 26th annual ACM symposium on User interface software and technology. ACM
C. Hurter, A. R. Taylor, S. Carpendale and A. Telea

Color Tunneling: Interactive Exploration and Selection in Volumetric Datasets

PacificVis 2014
Color Tunneling
Pixel based visualization technique

C. Hurter, A. R. Taylor, S. Carpendale and A. Telea
Color Tunneling : Interactive Exploration and Selection in Volumetric Datasets
PacificVis 2014
Research question

How to deal with large data set visualization and data occlusion?
The goal is to enhance our understanding of visual information by providing methods that enable **flexible exploration** and **manipulation** of data.
We provide a set of **real-time** multi-dimensional data deformation techniques that aim to help users to easily **select**, **analyze**, and **eliminate** spatial-and-data **patterns**.
User case 1: image exploration

C. Hurter, A. R. Taylor, S. Carpendale and A. Telea

Image manipulation

Dead pixel isolation
Use case 2: CT scan exploration

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Medical imaging

Exposing the top part of the brain structure in a 3D scan
Use case 3: image segmentation

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Image segmentation

Skin tumor segmentation
The user can double click to delete an object
Brushing and linking
*From Dady*

View simplification
*Edge Bundling techniques*

View animation
*MoleView*
*ColorTunneling*
Contributions
GPGPU technique

Transform feedback:
GPU implementation able to handle over 10M displayed data points at a frame rate of 20 images per second on a modern graphic card.
Take away message

• Design for interaction
• Design of the visualization
• Design of the pixel-based algorithm

It take times to leverage the user capability and expression power
Information

• Mailing list IHM:
  https://wwwsecu.irit.fr/listes/subscribe/sigchi-toulouse

• Meetup Khronos group:
  http://www.meetup.com/fr-FR/Khronos-Toulouse-Chapter/

• Page perso:
  http://www.recherche.enac.fr/~hurter/

Christophe Hurter
Image-Based Visualization: Interactive Multidimensional Data Exploration.
Chapter Leader: Christophe Hurter

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http://www.meetup.com/fr-FR/Khronos-Toulouse-Chapter/
Khronos is an Industry Consortium of over 100 companies creating royalty-free, open standard APIs to enable software to access hardware acceleration for graphics, parallel compute and vision.
What’s Khronos Chapter and how it works?

• **Khronos Chapter is:**
  – A local Khronos APIs related developer community;
  – A platform to communicate and share;
  – An opportunity to meet Khronos member companies and get the latest updates;
  – A chance to social with other developers.

• **How it works?**
  – The Chapter events will be held under the name of Khronos and get support from us;
  – A volunteering Chapter leader will drive the local chapter;
  – You may have meetup, demo, talk, competition, workshop and even cross-cities events.