Image based algorithm
to support interactive data exploration

September 2016
Research@ENAC

OPTIM
Optimization and Control of Dynamical Systems

DEVI
Data Economy Visualization

II
« Informatique Interactive » Interactive Computing

TELECOM
Signal Processing Antenna Networks

UAS

ATM

AGHOPA

Sustainable Development

Safety and Security

Support Team

Volière Drone Midi Pyrénées VDMP
Midi Pyrénées Flight Arena

www.enac.fr
DEVI
Data Economy and Visualization

• Scientific and technological commitment to emerging subjects in Air transport systems,

• Data collection, organization, cleaning, qualification, storage and sharing,

• Establishing the economical models allowing the analysis of the behavior of stakeholders,

• Evaluation and test of this models by the means of tools provided by the econometrics and the statistics,

• Statistical and economical data analysis,

• Interactive Visualization of data for knowledge extraction and for decision making.
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
*FromDady*

View simplification
*Edge Bundling techniques*

View animation
*MoleView*
*ColorTunneling*
Brushing and linking

FromDady
from Data to Display

EXE: [http://recherche.enac.fr/~hurter/FromDaDy/FromDaDy.rar](http://recherche.enac.fr/~hurter/FromDaDy/FromDaDy.rar)

Hurter, C., Tissoires, B., Conversy, S.

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

*In IEEE Transactions on Visualization and Computer Graphics xx(y), (Proceedings of IEEE 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?  Animated Particles!  Glyphs?
View simplification
Edge Bundling techniques
County-to-county migration flow files ([http://www.census.gov/population/www/cen2000/ctytoctyflow/](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
Us migration
Kernel Density Based Edge Bundling
22 million vertexes

Shading

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

Visual Studio C# code instance (GPU version)
Visual Studio C# code instance (CPU version),
Visual Aggregation of trajectories (edge bundling)

V. Peysakhovich, C. Hurter, A. Telea [pdf]
Attribute-Driven Edge Bundling for General Graphs with Applications in Trail Analysis
Hurter, C.; Ersoy, O.; Fabrikant, S.; Klein, T.; Telea, A.,
Bundled Visualization of Dynamic Graph and Trail Data.
(TVCG) Visualization and Computer Graphics, IEEE Transactions on,
vol.PP, no.99, pp.1,1
doi= 10.1109/TVCG.2013.246
View animation
MoleView
ColorTunneling
Christophe Hurter, Ozan Ersoy and Alexandru Telea. 2011. pdf video exe
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?
Method

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.
Contributions

**Animation** as an efficient exploration tool
Image manipulation

Dead pixel isolation
Medical imaging

Exposing the top part of the brain structure in a 3D scan
Use case 2: CT scan exploration
Use case 3: image segmentation
Image segmentation

Skin tumor segmentation
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
Christophe Hurter

Image-Based Visualization: Interactive Multidimensional Data Exploration.
