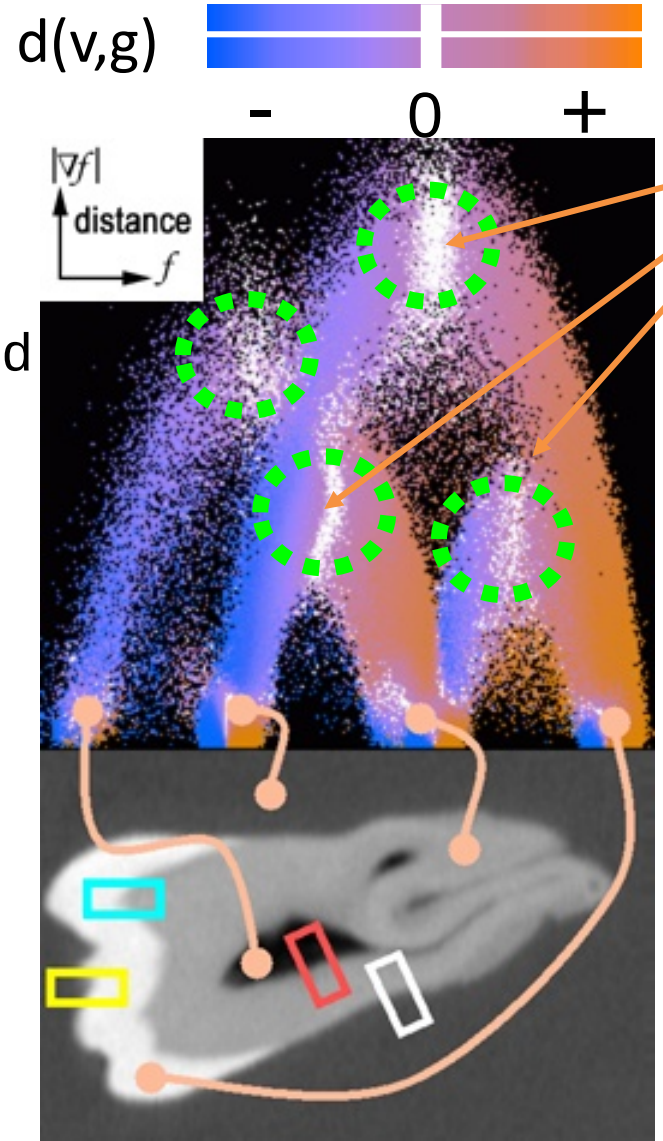
# Final Project Topic Overview

# Categories of Topics

- Scientific data visualization
  - 3D scalar field visualization
  - Vector field visualization
  - Tensor field visualization
- Information data visualization
  - Graph visualization
  - Tree visualization
  - High-dimensional data visualization
  - Heterogeneous data visualization
- Visual analytics

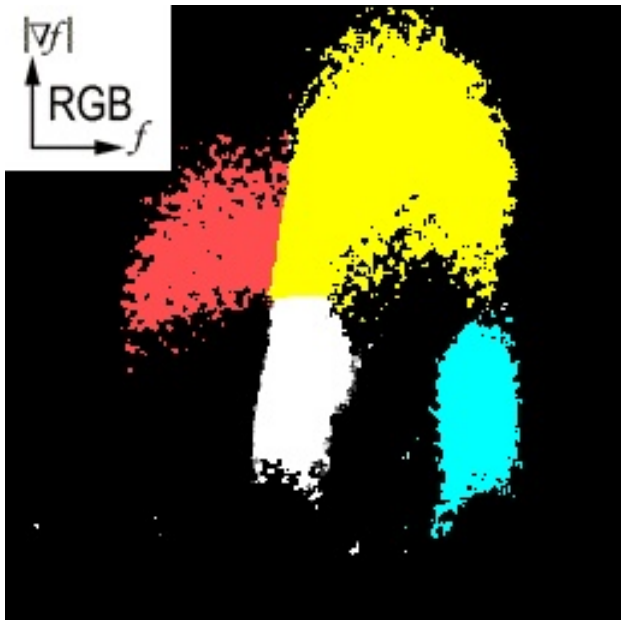
# EXAMPLES PROJECTS FOR SCIENTIFIC DATA VISUALIZATION

# Semi-automated transfer function design




White regions in color mapped 2D distance function plot are boundary centers

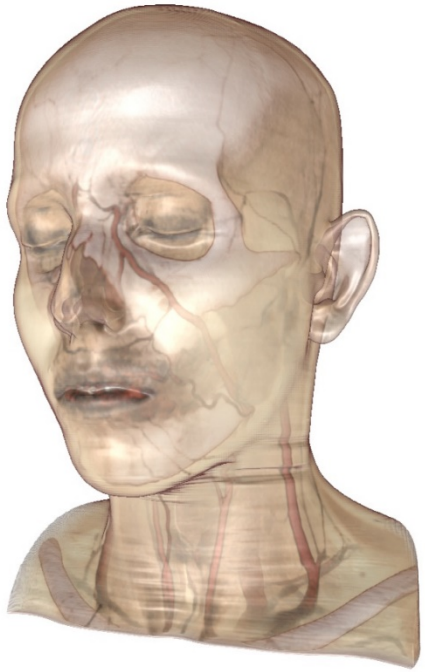
- Pulp
- Background
- Dentine
- Enamel

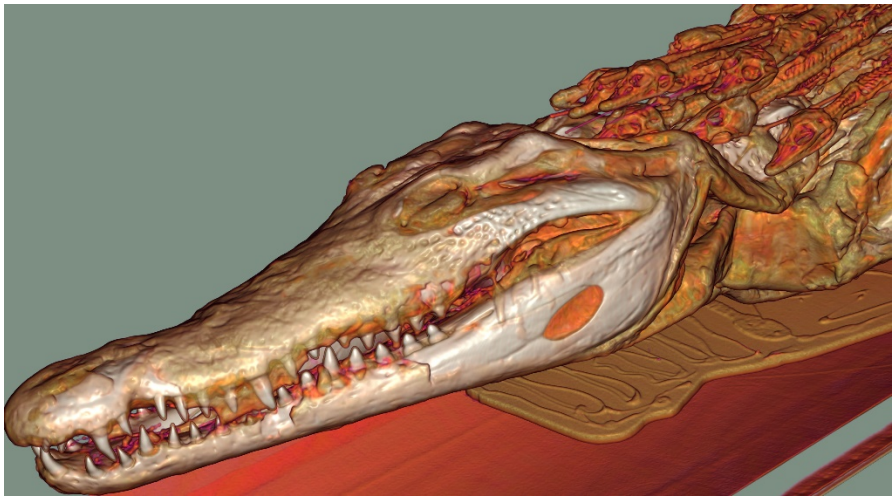



Color transfer function

# Real-time volume rendering

- Basic raycasting with GPU support
- Enhanced volume rendering + iso-surface rendering

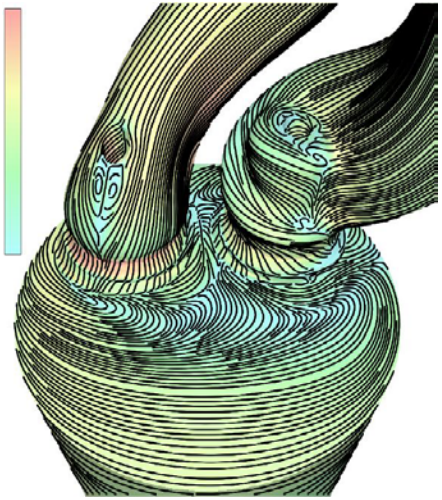


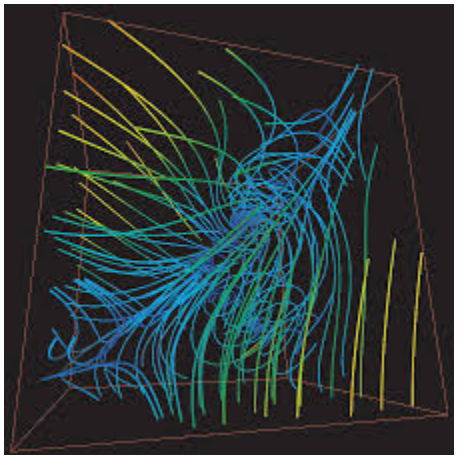


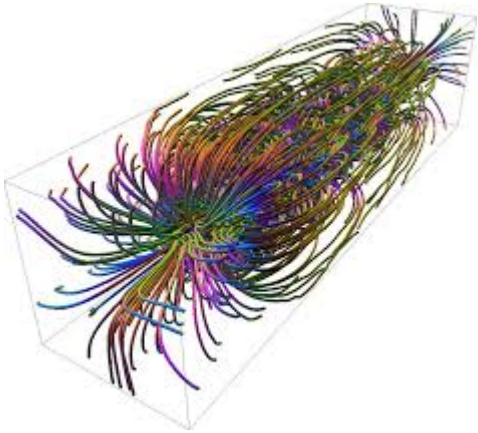
Open source for your reference: Exposure render

# Surface/3D Streamline placement

Streamline placement in 2D domain with enhancement



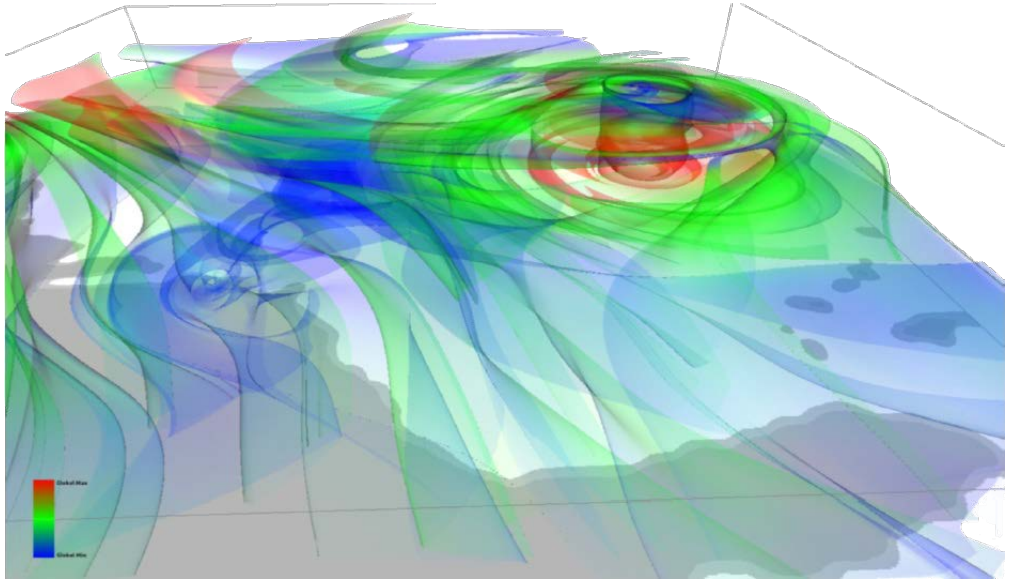


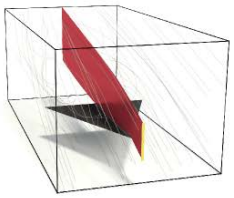


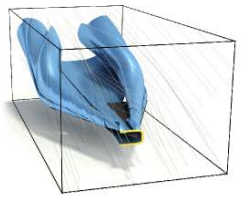
Streamline placement on surfaces and in 3D space

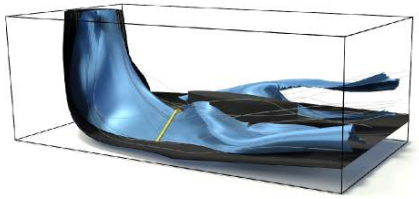
# High-dimensional vector field visualization

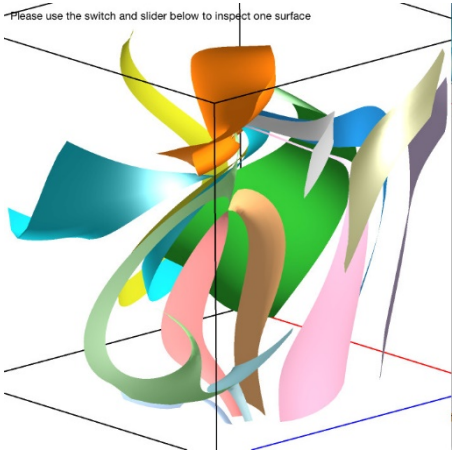
- Automatic or user-driven stream surface placement





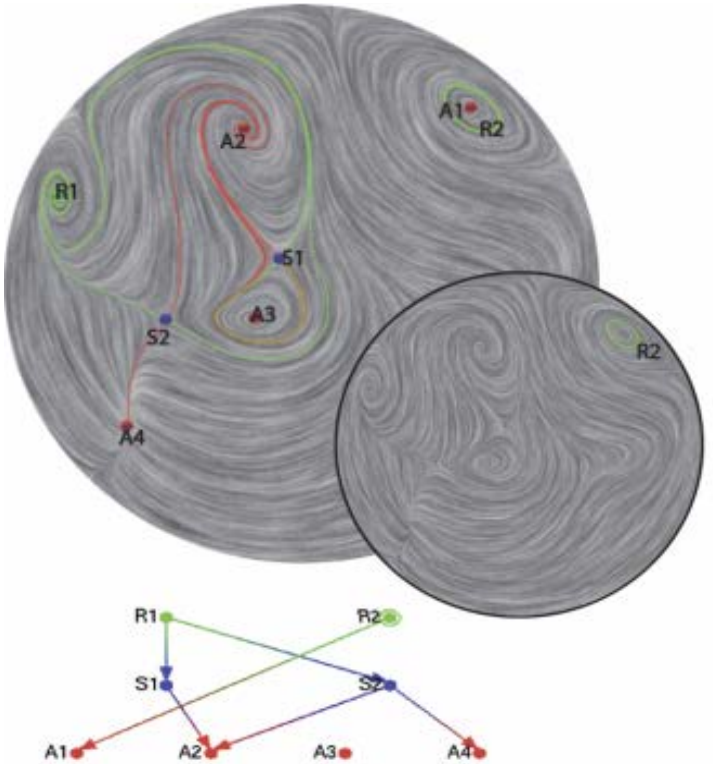




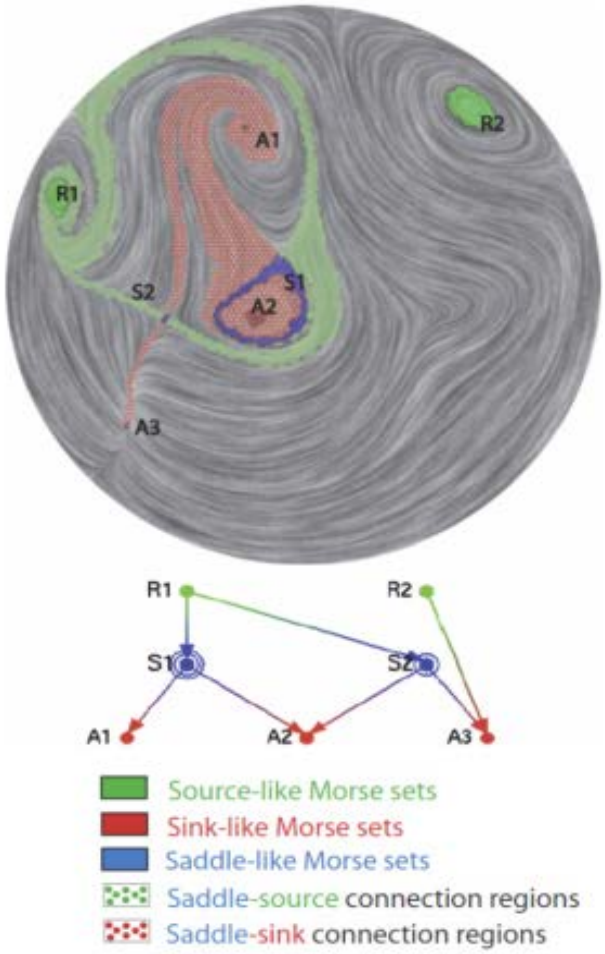


# Vector field topology

- ECG versus MCG

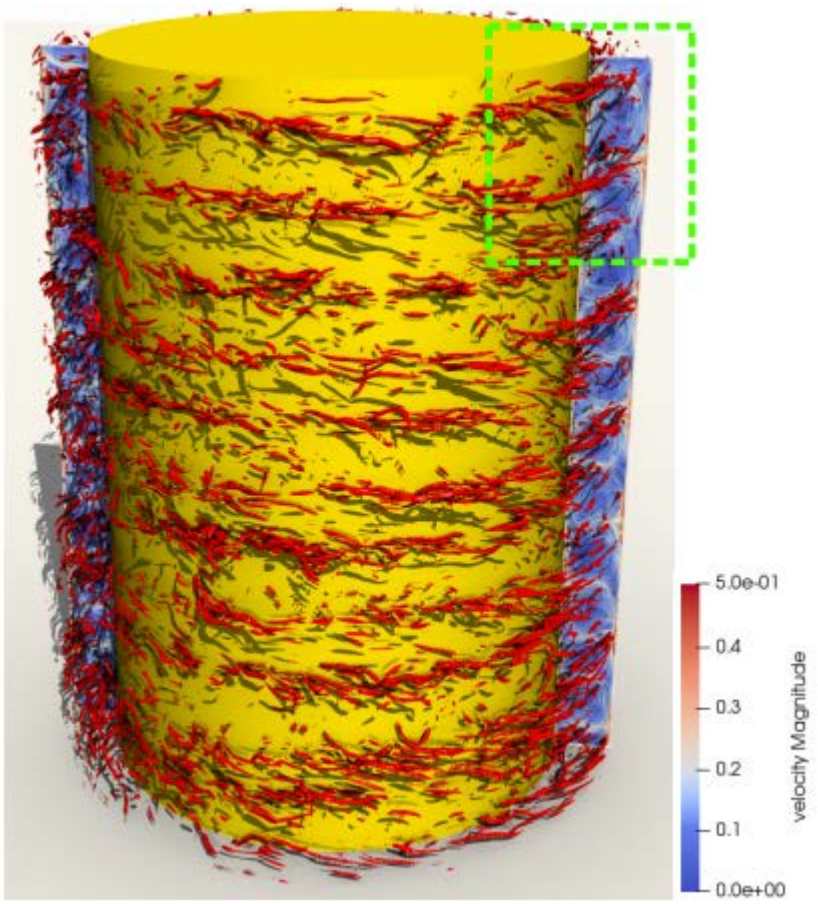


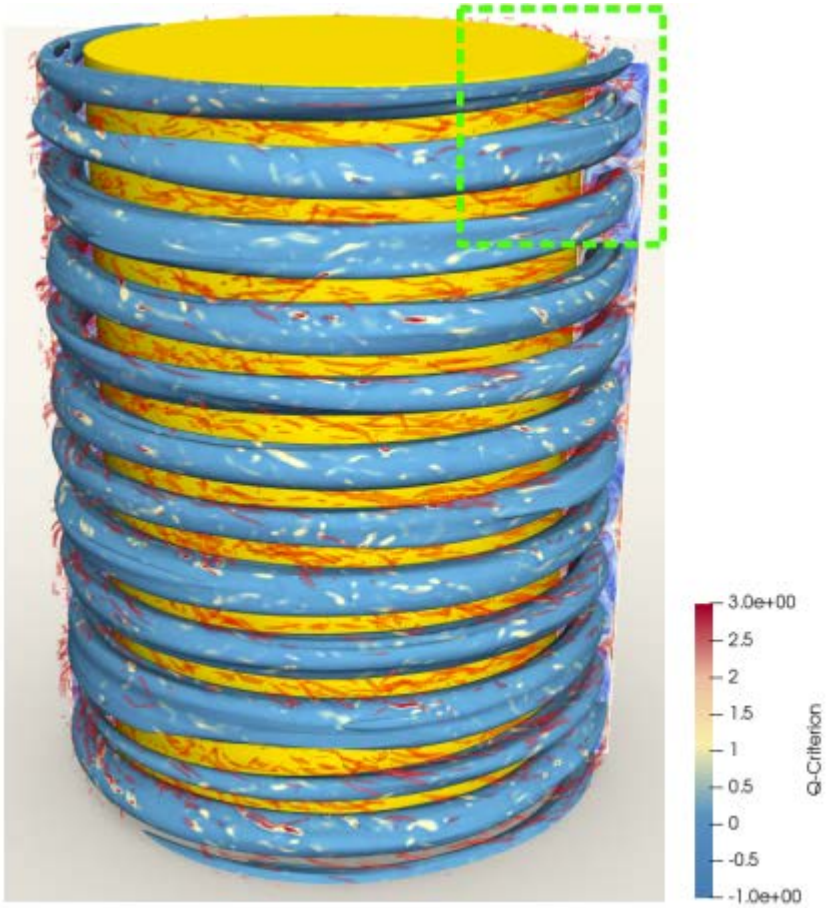

ECG




MCG

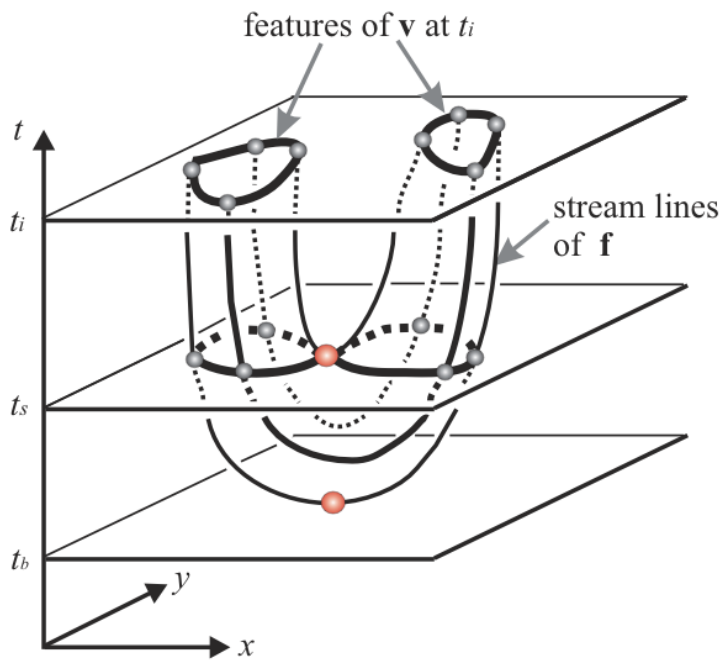
# 3D vortex extraction

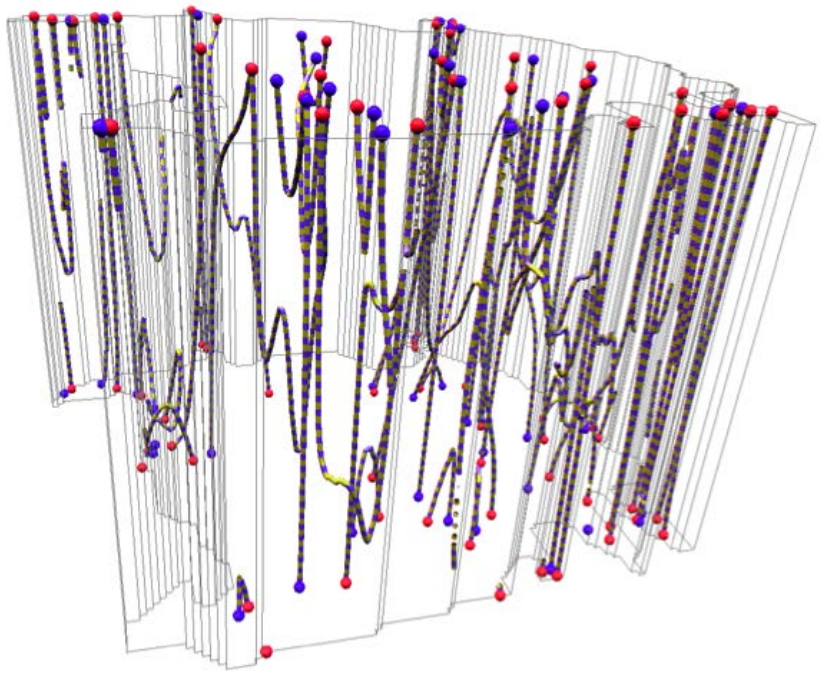


# Time-varying vector field analysis

- Stable feature flow for feature tracking

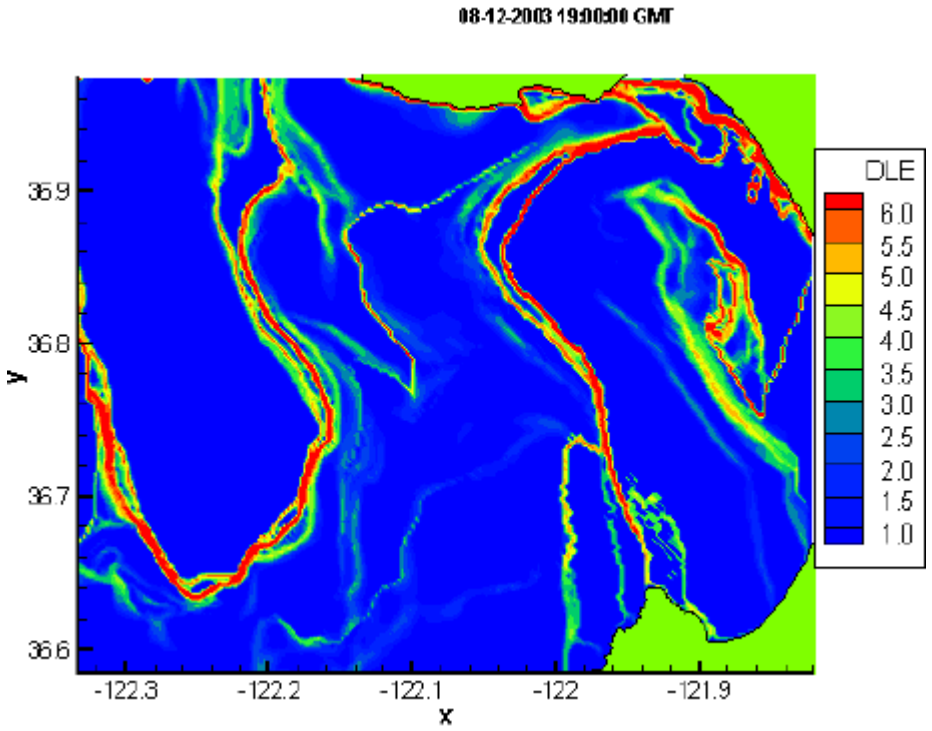


T. Weinkauf, H. Theisel, A. Van Gelder, and A. Pang. Stable Feature Flow Fields. IEEE Transactions on Visualization and Computer Graphics 17(6), June 2011

# Time-varying vector field analysis

- FTLE analysis
  - Lagrangian coherent structure (LCS)

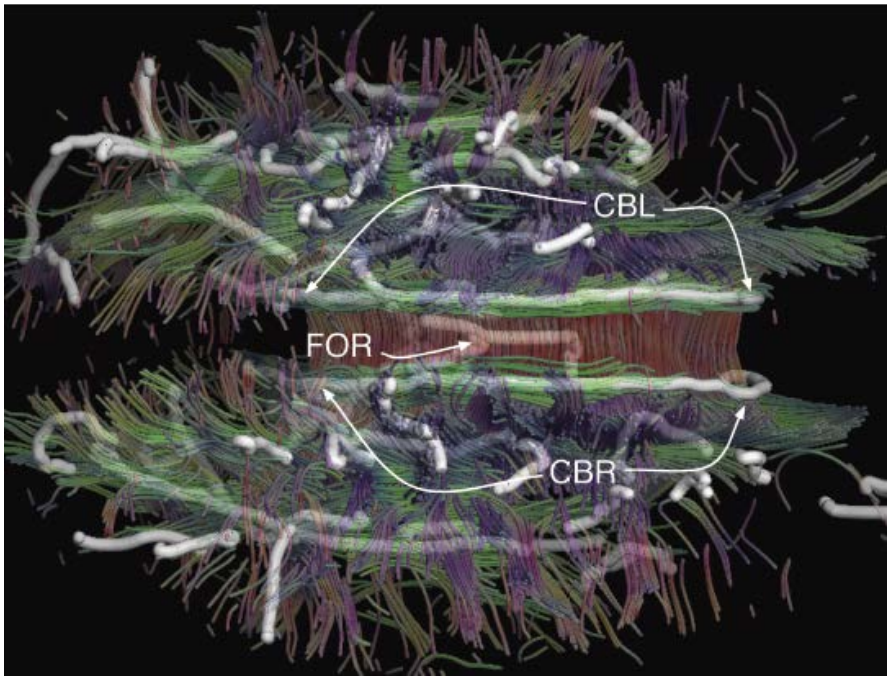



Ridges in Lyapunov exponent
Transient view

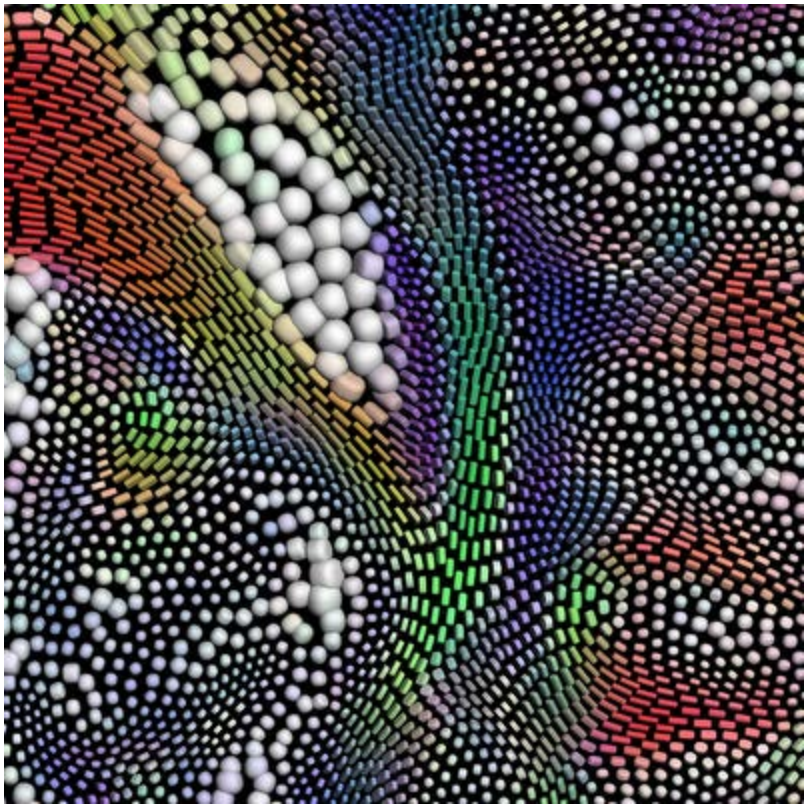
Confluences

LCS = interface

# Diffusion tensor imaging

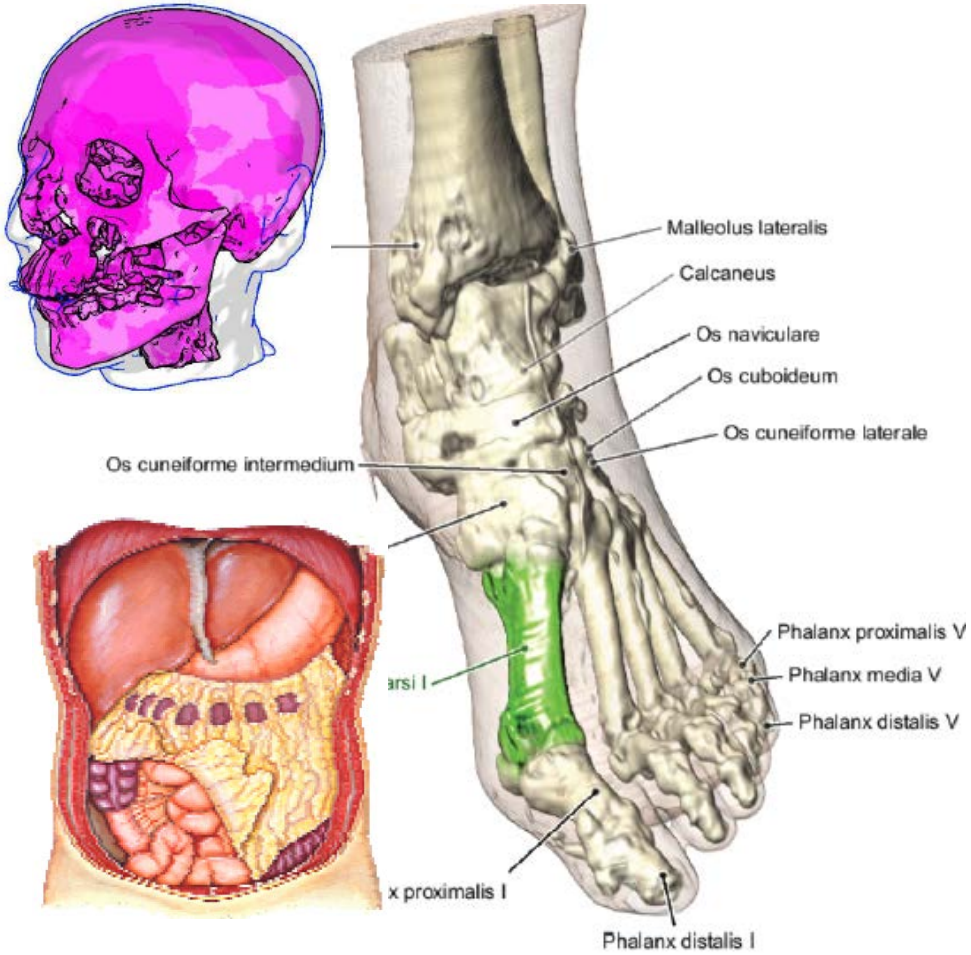



X. Tricoche, G. Kindlmann, and C.-F. Westin, Invariant crease line s for topological and structural analysis of tensor fields, IEEE Visualization 2008

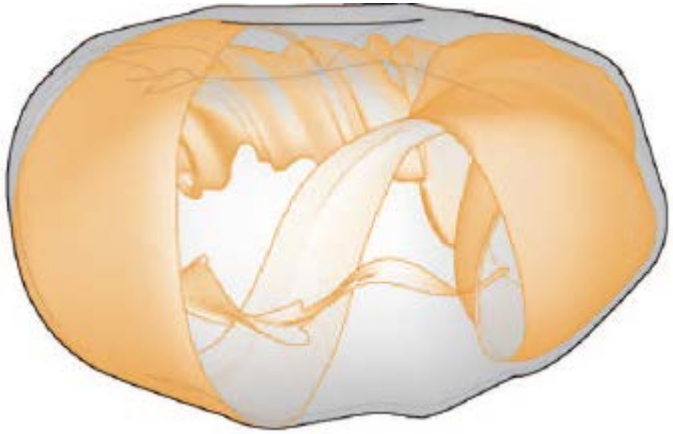


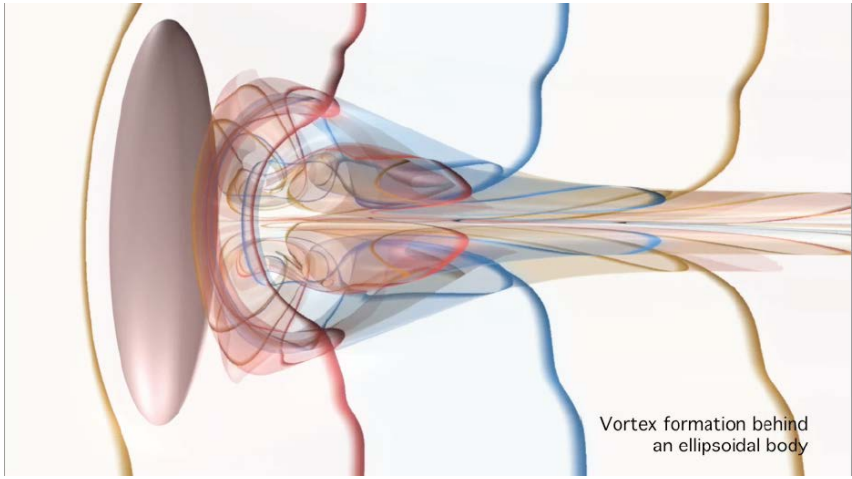
Gordon Kindlmann and Carl-Fredrik Westin. Diffusion tensor visualization with glyph packing, IEEE Visualization 2006.

# Illustrative visualization




Illustrative visualization of scalar fields






Illustrative visualization of vector fields

# Applications?

**Climate/weather data visualization**

**Visualize universe/galaxies**

**Visualize ocean currents**

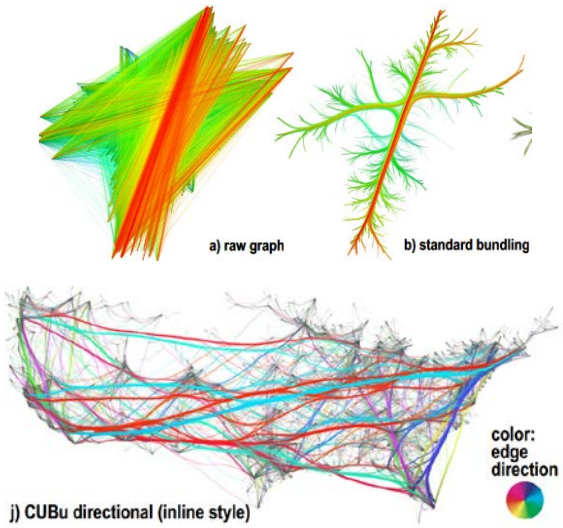
**Visualize blood flows**

# EXAMPLES OF INFORMATION DATA VISUALIZATION

# Graph visualization

- Recent graph visualization

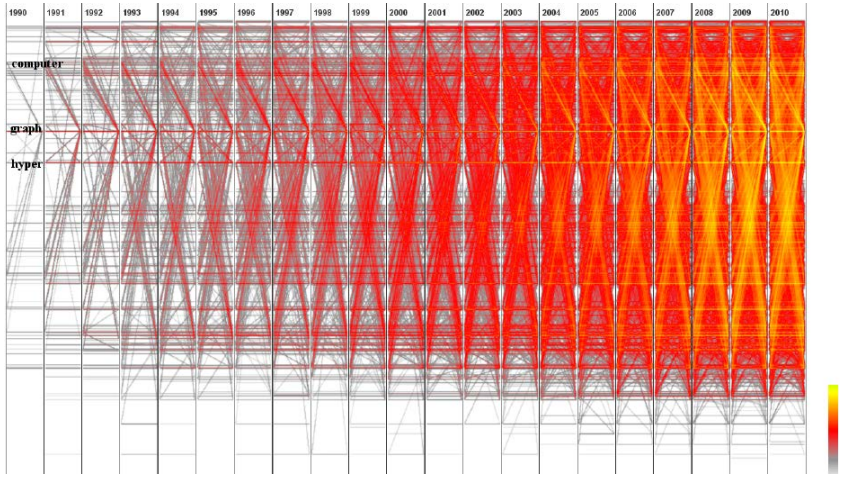

**Improved graph layout:** Yunhai Wang, Yanyan Wang, Yingqi Sun, Lifeng Zhu, Kecheng Lu, Chi-Wing Fu, Michael Sedlmair, Oliver Deussen, Baoquan Chen, Revisiting stress majorization as a unified framework for interactive constrained graph visualization , IEEE Visualization 2017



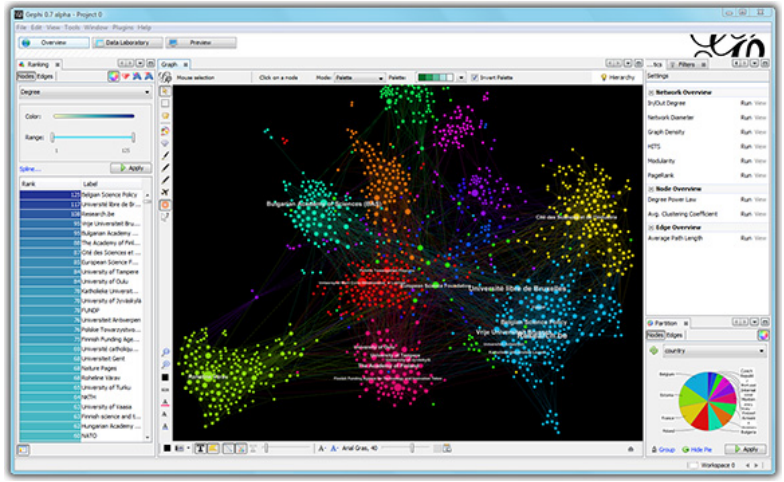

Matthew van der Zwan, Valeriu Codreanu, Alexandru Telea, CUBu: Universal Real-Time Bundling for Large Graphs, IEEE Visualization 2016

# Large dynamic graph visualization

- Large scale dynamic graph visualization




Michael Burch, Corinna Vehlow, Fabian Beck, Stephan Diehl, and Daniel Weiskopf. Parallel Edge Splatting for Scalable Dynamic Graph Visualization. IEEE Information Visualization 2011.



Open source: [https://gephi.org/](https://gephi.org/)
http://www.caida.org/tools/visualization/walrus/

# Higher dimensional data visualization

- Examples

Text data visualization

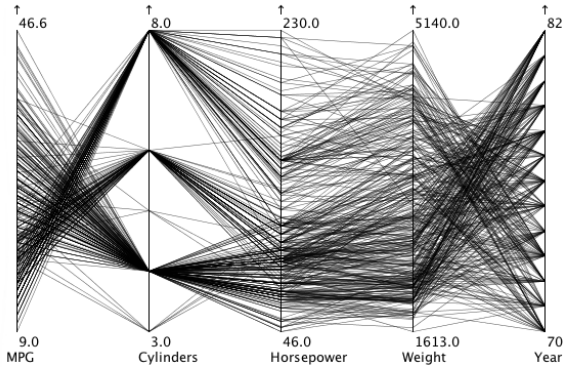
bio- data visualization

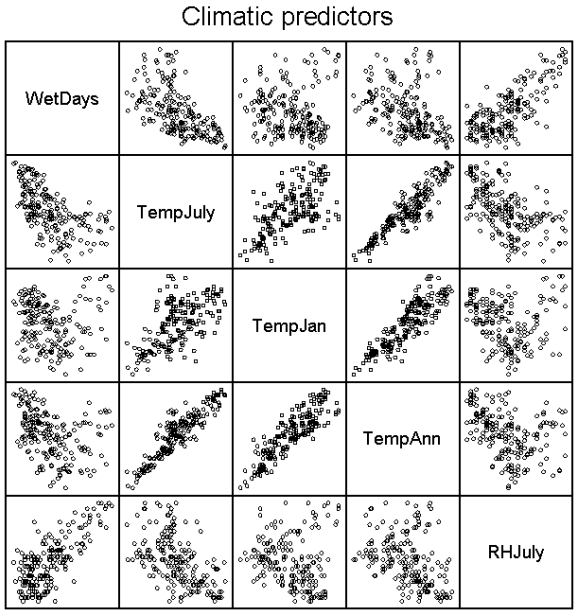
Health care data visualization

Urban data visualization

Ecosystem data visualization

**Others?**

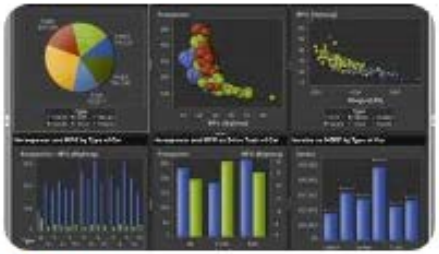


# Visual Analytics System

Tanuka's Blog

Visual Analytics – A Layman'...



LinkedIn

See Your Data for All It's Wor...

Solutions Review

The 19 Best Visual Analytics ...

HEAVY.AI

What is Visual Analytics? De...

www.bwosteopathy.co.uk

Visual Analytics

SR analytics

Data Visualization: An eye-op...

www.hannahrees.org.uk

Visual Analytics

SelectHub

Best Visual Analytics Tools 2...

Zoho

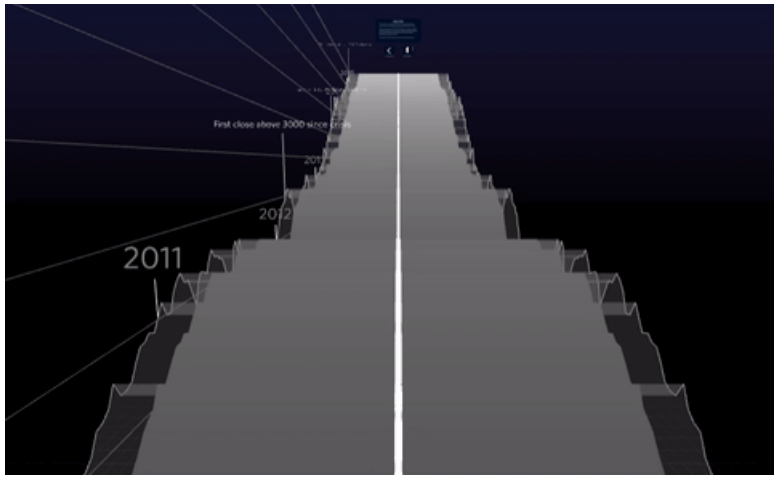
What is Data Visualization? ...


Fiverr · Out of stock

Upwork

# Virtual Reality for Visualization

https://infogram.com/blog/8-immersive-virtual-reality-data-visualizations/

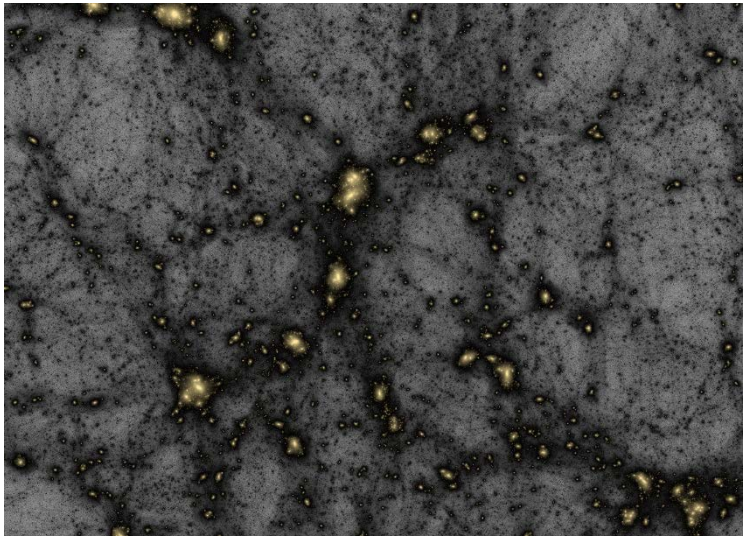



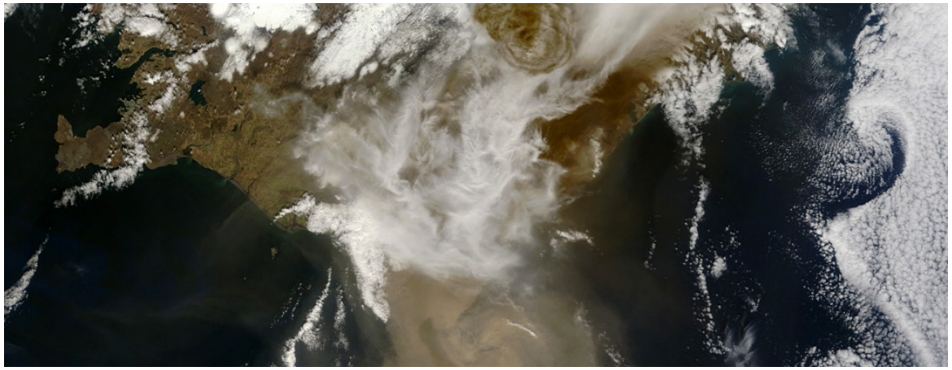

https://www.youtube.com/watch?v=wacNaAVGXdU

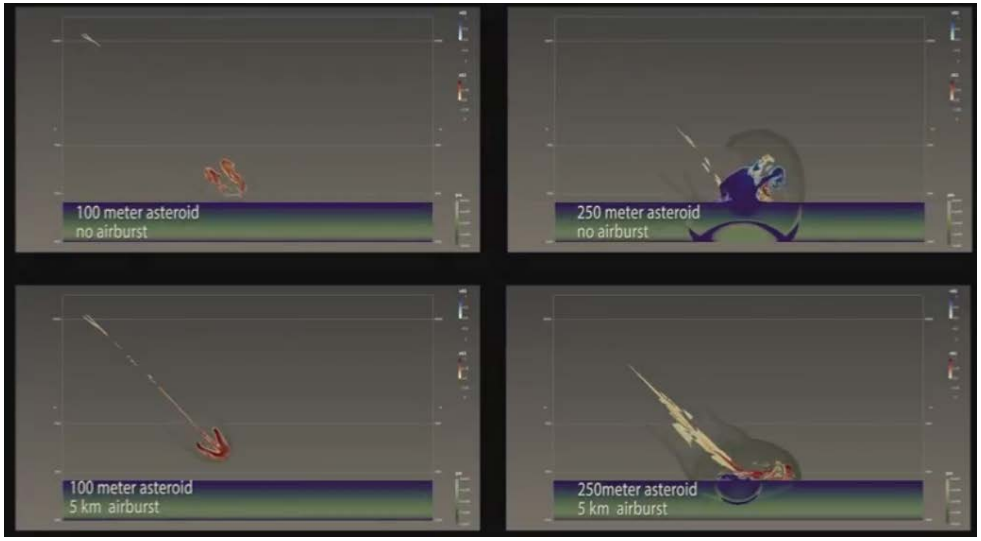
VRvisu: A Tool for Virtual Reality Based Visualization of Medical Data

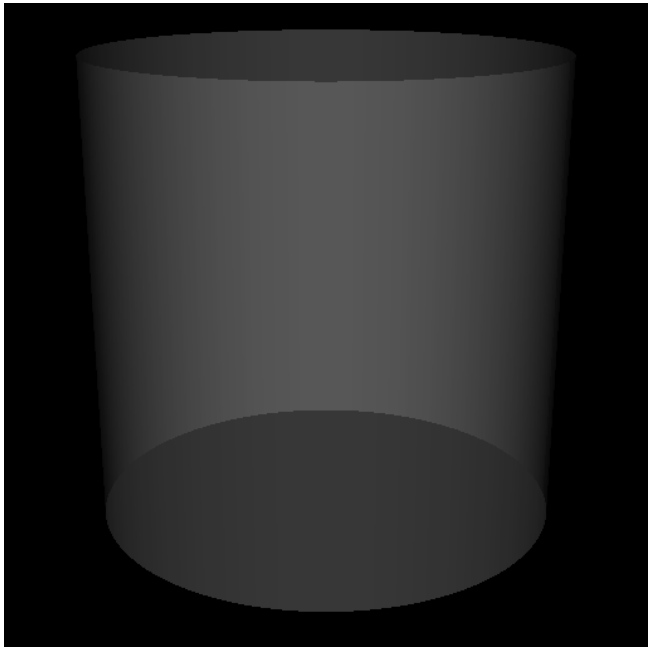
2017 IEEE/ACM International Conference on Connected Health: Applications, Systems and Engineering Technologies (CHASE)

# IEEE Visualization Contest







# Others?

Has to be related to your current research project(s).

Be creative! Be aggressive! Be ambitious!

# Requirements of the Final Project Proposal (Due 10/20):

The final project proposal should consist of the following

1. The title or topic that you are going to work on (it will be better if a brief description of the problem is given)
2. Name(s): please list the names of the team members (up to **3 students** each project)
3. Reference paper(s): if you are going to implement a paper or a technique used by different papers, please list this paper(s).
4. Timeline and milestones

   Please provide a weekly plan from now to the submission of your final project

   - Week1: what are you planning to work on? What will be the expected outcome?
   - Week2: ...

   ... (you get the idea)