

Information Visualization

W03: Introduction to Data Visualization

Graduation School of System Informatics

Department of Computational Science

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Purpose

- The importance of data visualization technique as a key component for the knowledge discovery from complicated and sophisticated Big Data is rising concurrent with recent advances in technology.
- The course discusses the elemental techniques of data visualization widely used in scientific, medical and industry fields in addition to computer graphics techniques.
- The purpose of the course is to understand the elemental algorithms of computer graphics and data visualization, and its implementations with GPU acceleration techniques.

目的

- 近年の爆発的な情報技術の進歩に伴い大規模・複雑化するデータから、そこに隠された特徴や変化を見逃さず、新たな知見を得るために情報可視化技術は、欠かすことのできない基盤技術として重要性が増している。
- 本講義では、コンピュータグラフィックスの要素技術に関する説明に加え、多くの分野で活用されている可視化の基本アルゴリズムについて解説する。
- 本講義では、コンピュータグラフィックスおよび可視化基本アルゴリズムとGPU(シェーダ)を使ったプログラミングの習得を目標とする。

Keyword

- Computer Graphics
- GPU
- Shader
- Data Visualization
- Isosurface Extraction
- Volume Rendering

Schedule

- General information
 - Q1
 - Tue (13:20 - 14:50) Classroom lecture
 - Wed (13:20 - 14:50) Programming exercise

Schedule

- W01 4/10 Guidance
- W02 4/11 Exercise (Setup)
- W03 4/17 Introduction to Data Visualization
- W04 4/18 Exercise (JavaScript Programming)
- W05 4/24 Computer Graphics
- W06 4/25 Exercise (Shader Programming)
- W07 5/01 Visualization Pipeline
- W08 5/02 Exercise (Data Model and Transfer Function)
- W09 5/08 Volume Visualization
- W10 5/09 Exercise (Isosurfaces and Volume Rendering)
- W11 5/22 Flow Visualization
- W12 5/23 Exercise (Streamlines and Line Integral Convolution)
- W13 5/29 Workshops 1
- W14 5/30 Workshops 2
- W15 6/05 Presentations

Grading and Requisites

- Grading is based on results of each exercise and one final report.
- Although JavaScript and Three.js will be used in the exercises, the experiences of JavaScript programming won't necessarily be required.
- Textbooks will be appropriately instructed for each class.

Website

- <https://sites.google.com/site/kobeinfovis2018>

The screenshot shows the homepage of the "Information Visualization 2018" website. The page has a white background with a dark sidebar on the left.

Left Sidebar (Dark Background):

- Title:** 情報可視化論
2018年
- Links:** ホーム, W03: Intro to Data Vis

Main Content Area (White Background):

- Title:** Information Visualization 2018
- Description:** The importance of data visualization technique as a key component for the knowledge discovery from complicated and sophisticated Big Data is rising concurrent with recent advances in technology. The course discusses the elemental techniques of data visualization widely used in scientific, medical and industry fields in addition to computer graphics techniques.
- Keywords:** Computer Graphics, Data Visualization, Volume Rendering, Flow Visualization
- General Information:**
 - Tuesday, 13:20 - 14:50, Classroom lecture
 - Wednesday, 13:20 - 14:50, Programming exercise
- Instructor:** Naohisa Sakamoto, Akira Kageyama
- Schedule:**
 - W01: Guidance
 - W02: Exercise (Setup)
 - W03: Introduction to Data Visualization

Polling

- Take the poll

The screenshot shows a poll interface. On the left, there is a sidebar with a dark background containing the text "情報可視化論" and "2018年" in white, followed by "ホーム" and a link to "W03: Intro to Data Vis". The main area has a light gray background. At the top, the text "W03: Introduction to Data Visualization" is displayed in blue. Below it, a blue header bar contains the text "W03: Intro to Data Vis". Underneath the header, the text "*必須" is shown in red. A form field labeled "Student ID Number *" is present, with the placeholder "回答を入力" and an input field below it. In the top right corner of the main area, there is a small search icon.

Visualization?

英語 ▾



日本語 ▾



visualization

可視化

Kajika



他 3 件の翻訳



visualization



All

Images

News

Videos

Books

More

Settings

Tools

View saved

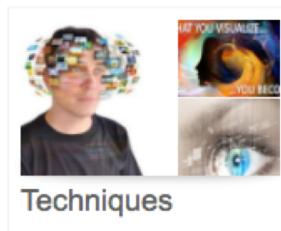
SafeSearch ▾



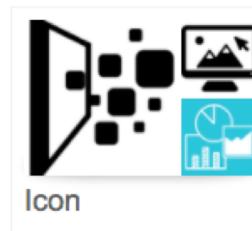
Data



Creative



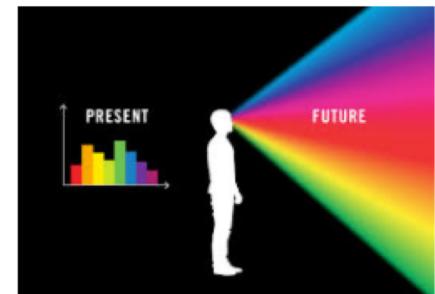
Techniques



Icon



Sports





data visualization



All

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Videos

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More

Settings

Tools

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SafeSearch ▾



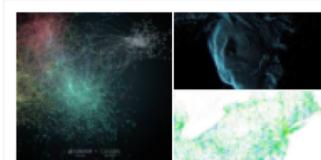
Infographics



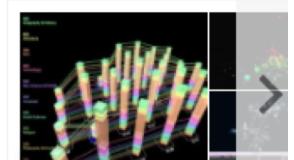
Simple



Dashboard



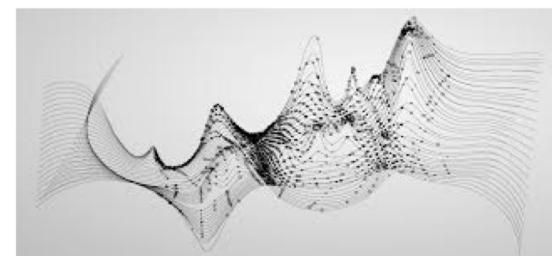
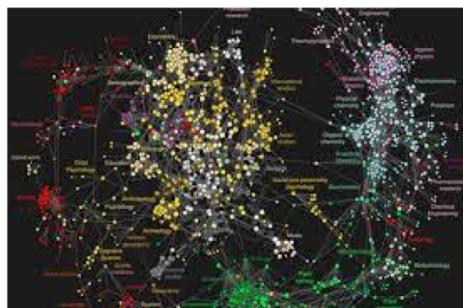
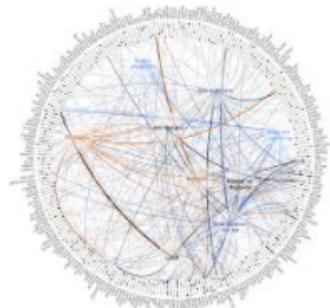
Art



3D



DATA VISUALIZATION



Visualization

- The term visualization may refer to:
 - Mental image
 - Creative visualization (sports visualization)
 - Flow visualization
 - Geovisualization
 - Illustration
 - Information graphics (visual representations of information, data, or knowledge)
 - Interactive visualization
 - Music visualization (a feature found in some media player software applications)
 - Scientific visualization
 - Security visualization
 - Software visualization
 - Visualization (computer graphics)
 - Visulation (graphic visualization + computer simulation)
 - Guided imagery

Visualization

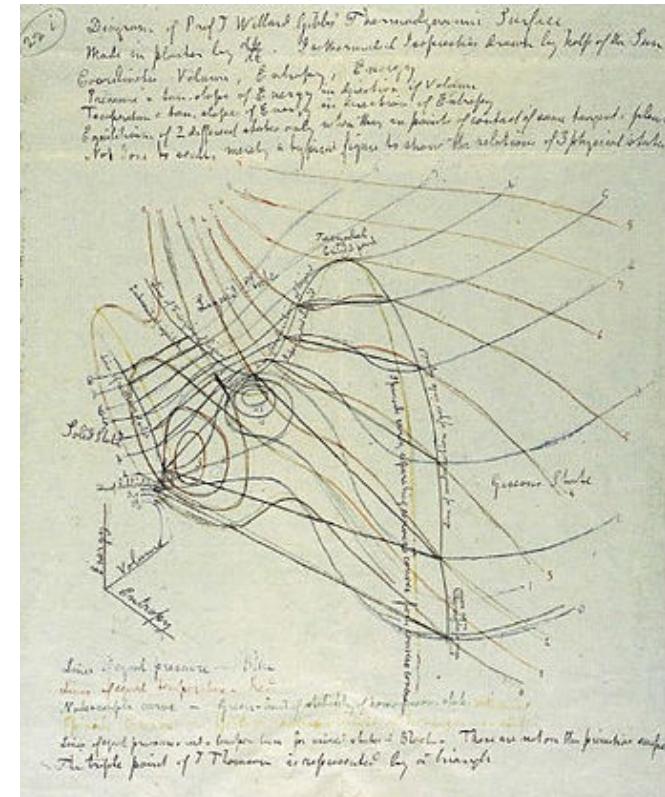
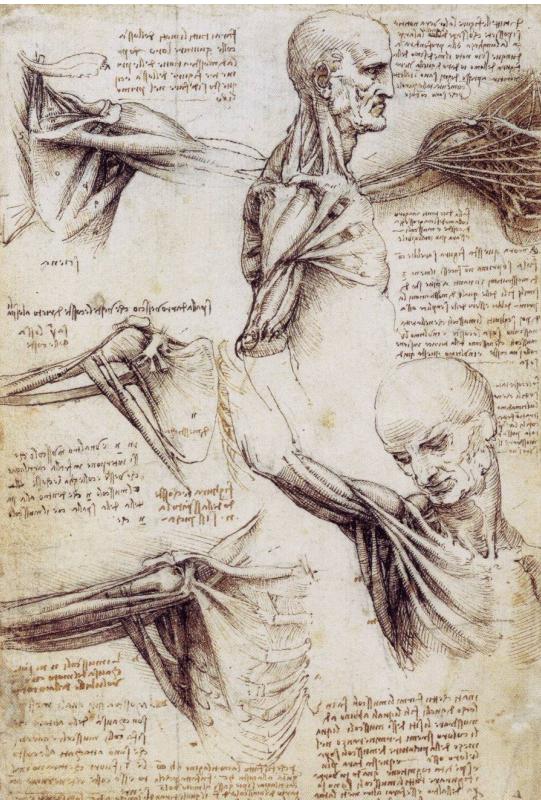
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 - Music visualization (a feature found in some media player software applications)
 - **Scientific visualization**
 - Security visualization
 - Software visualization
 - **Visualization** (computer graphics)
 - **Visulation** (graphic visualization + computer simulation)
 - Guided imagery

Scientific Visualization

- Earliest examples of 3D scientific visualization



Drawings of Leonardo da Vinci (1508-1510)



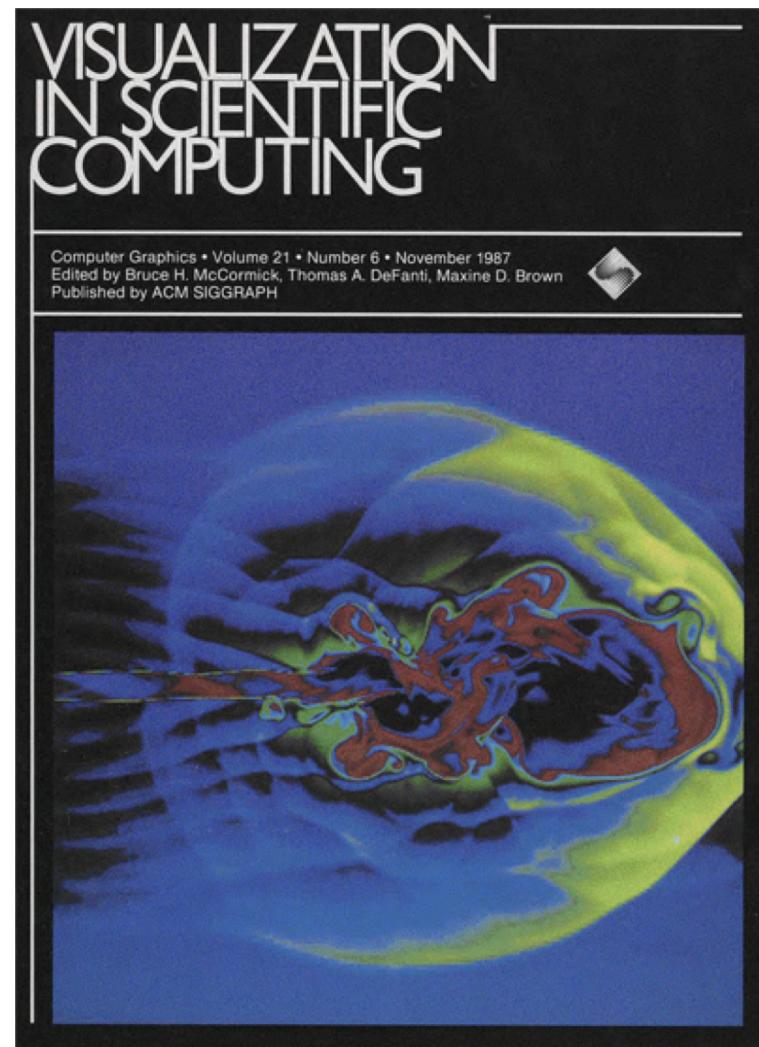
Maxwell's thermodynamic surface (1874)

Scientific Visualization

- Google ...

ViSC Report

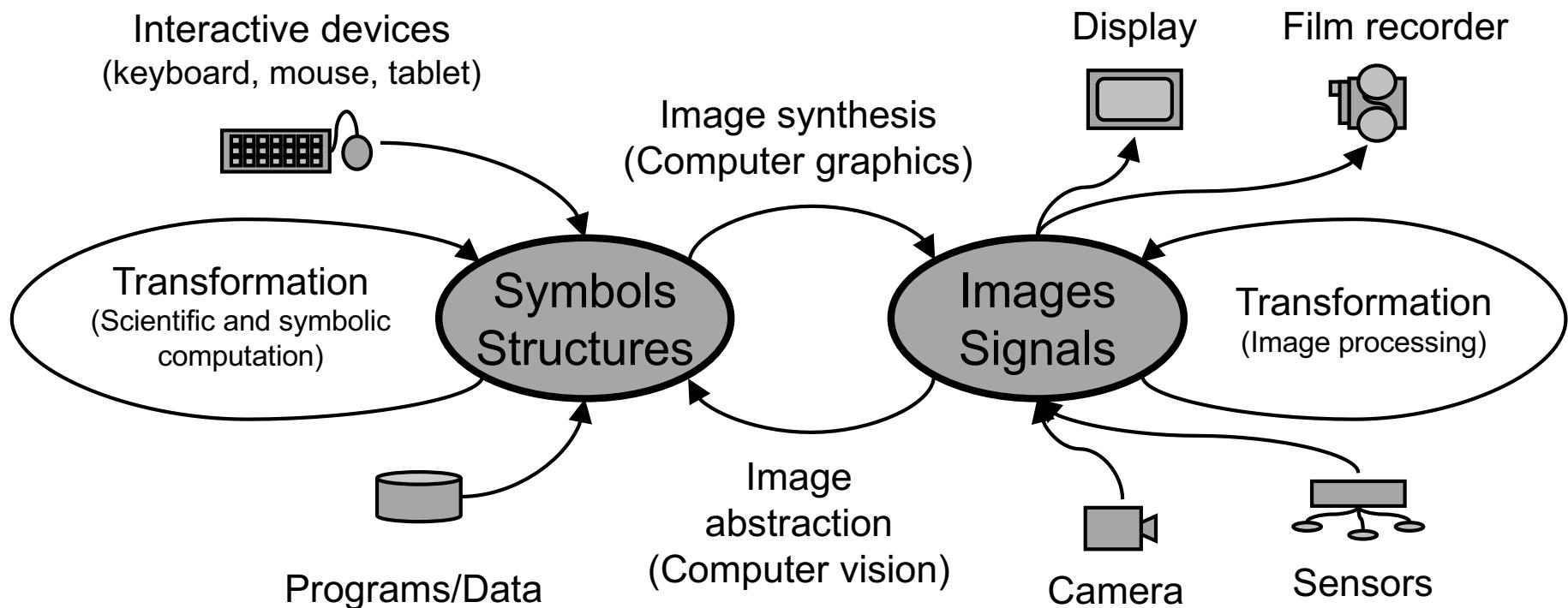
- Published by ACM SIGGRAPH in 1987
 - Applying graphics and image processing techniques to computational science
 - Definition, domain and recommendations of visualization
 - Starting point of scientific visualization



[B. McCormick, et al., 1987]

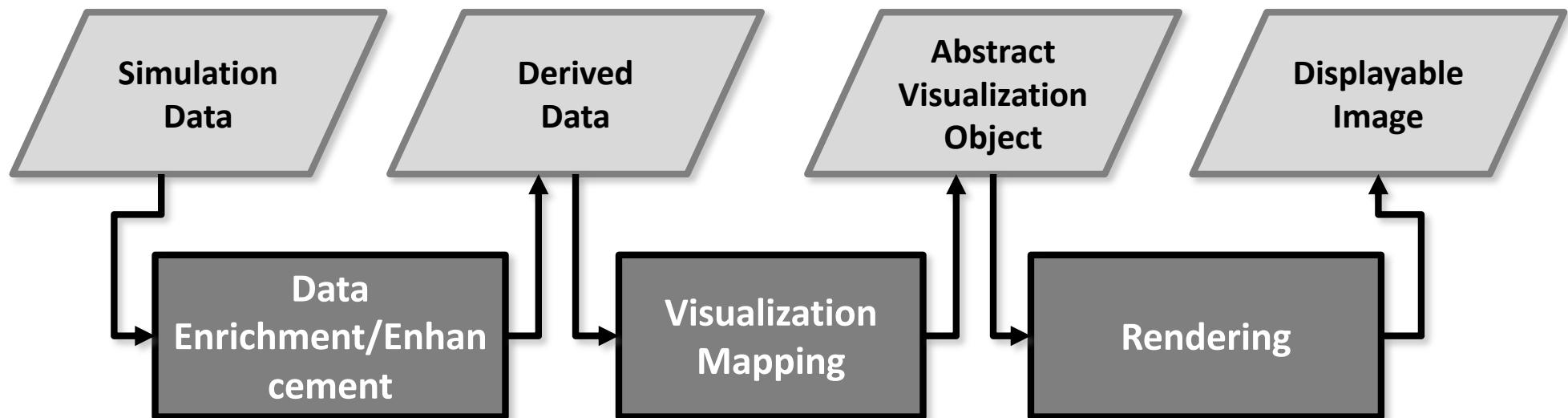
Definition of Visualization

- “*Visualization is a method of computing*”
 - *It transforms the symbolic into the geometric, enabling researchers to observe their simulations and computations. Visualization offers a method for seeing the unseen. It enriches the process of scientific discovery and fosters profound and unexpected insights.*

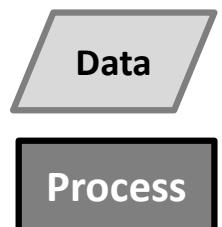


Visualization Idioms

- Visualization process model



Habber-McNabb dataflow model [Habber et al., 1990]



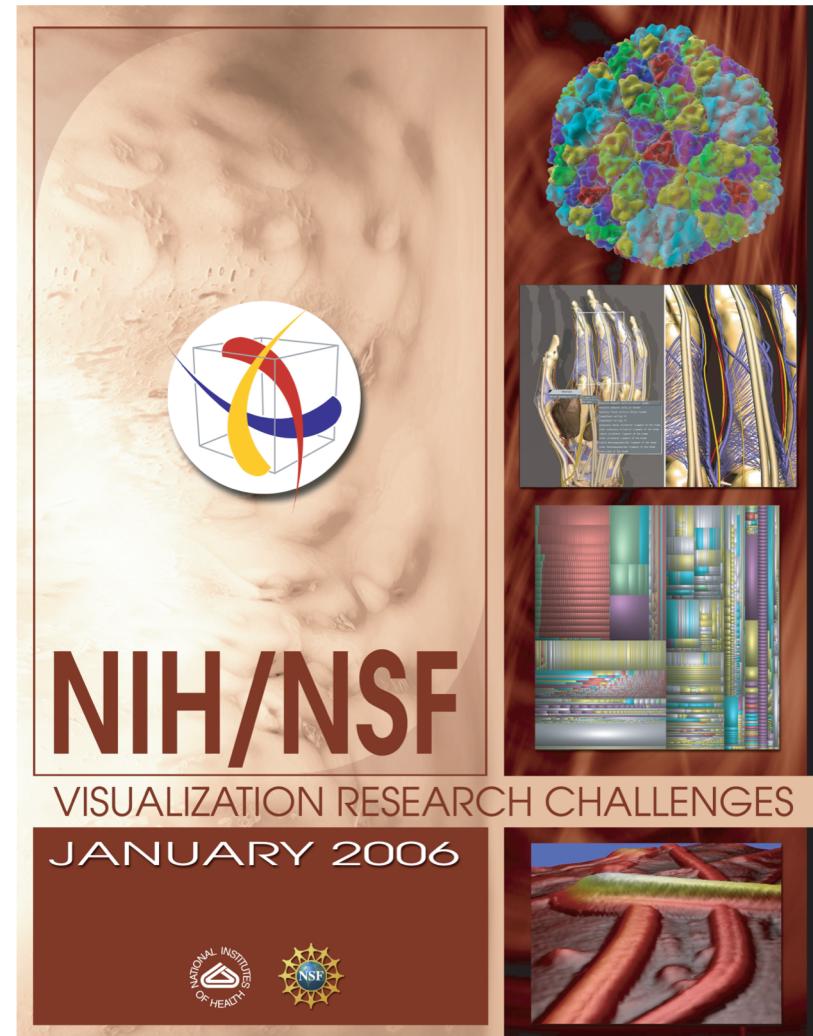
Framework of Visualization Apps.

- Visual Information-Seeking Mantra
 - First overview, zoom and filter, then details-on-demand
 - First overview, zoom and filter, then details-on-demand



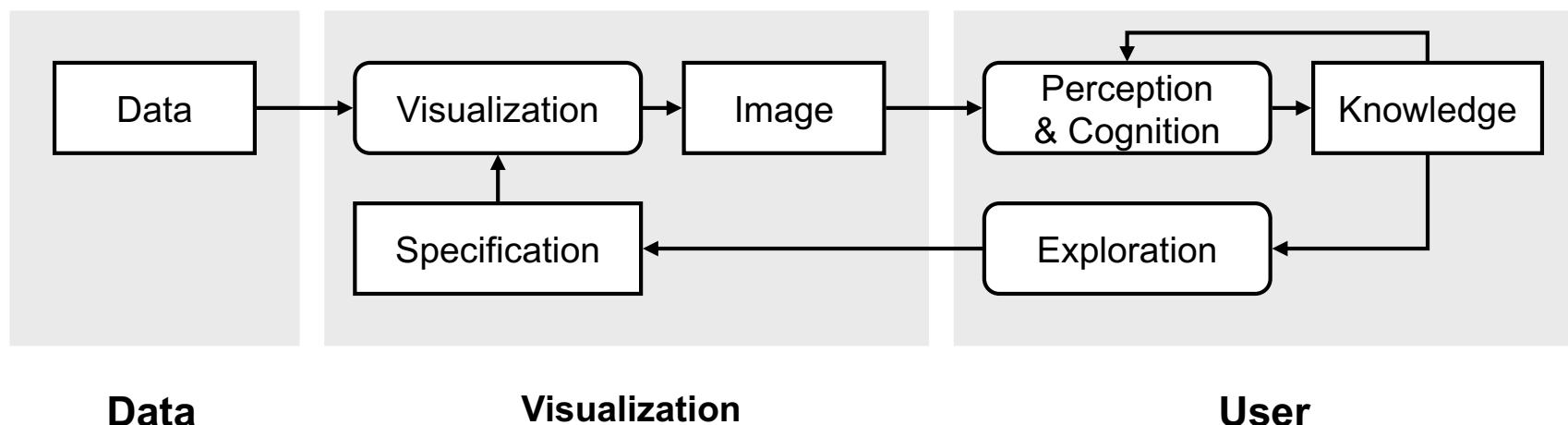
VRC Report

- Published by NIH/NSF in 2007
 - Follow up to ViSC Report published in 1987 (nearly 20 years ago)
 - Potential impact of visualization on areas of importance
 - Findings and recommendations for the future
 - Users of visualization research, and researchers and practitioners in visualization



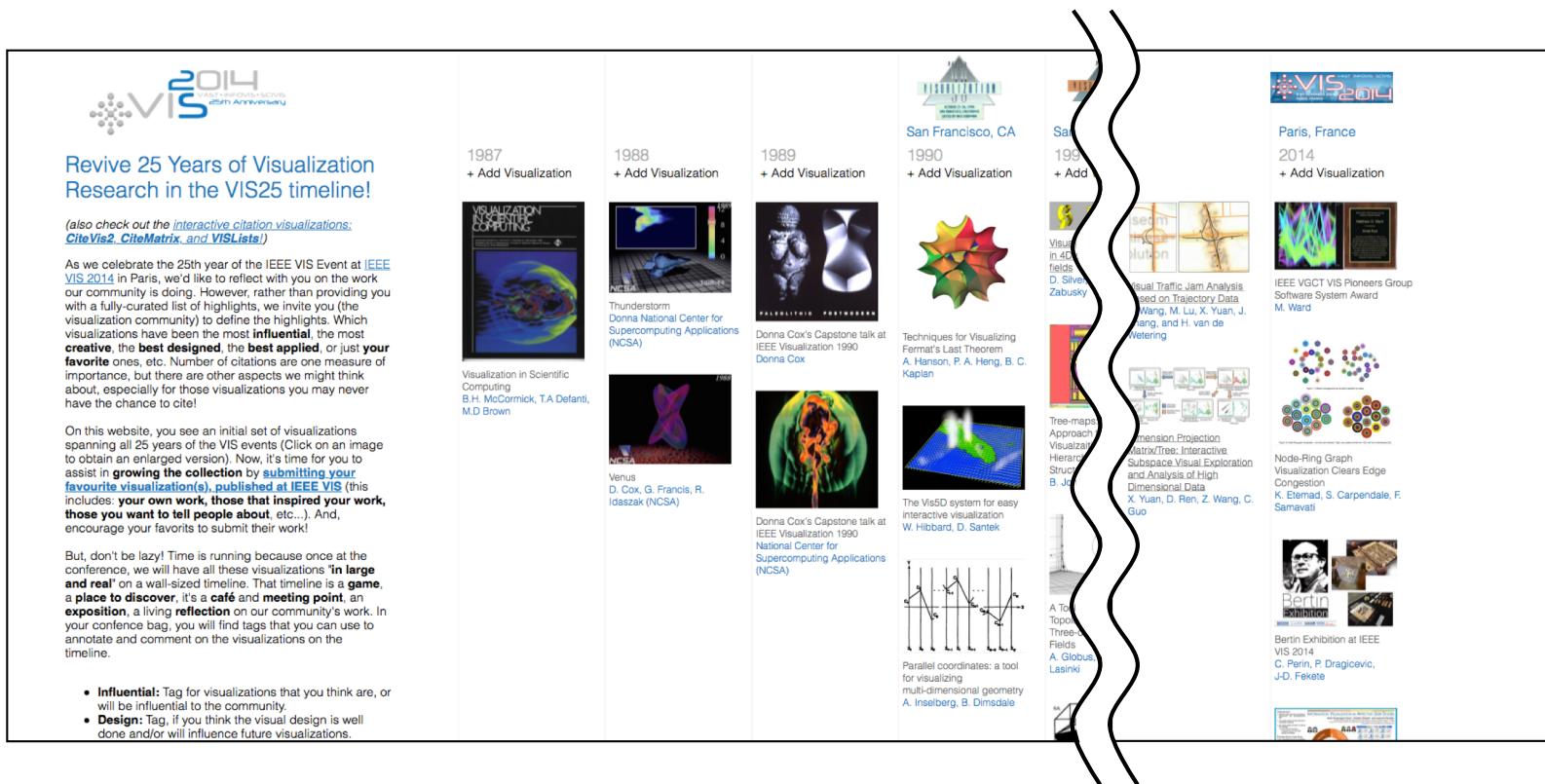
Visualization Discovery Process

- Visualization system
 - Human in the loop by extending human capabilities
- Discovery process
 - Raw data is transformed into knowledge



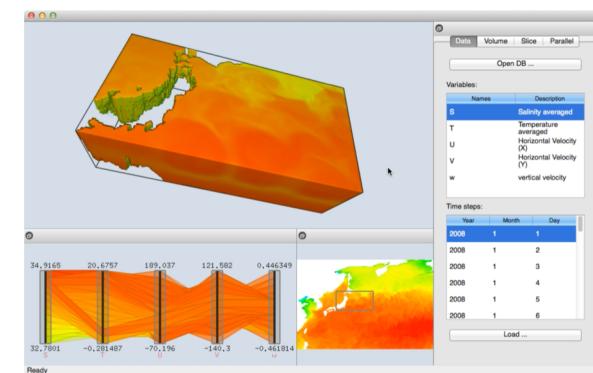
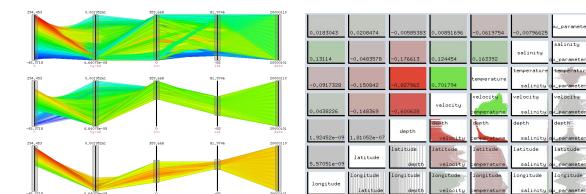
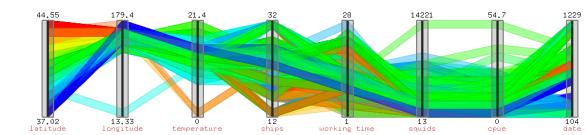
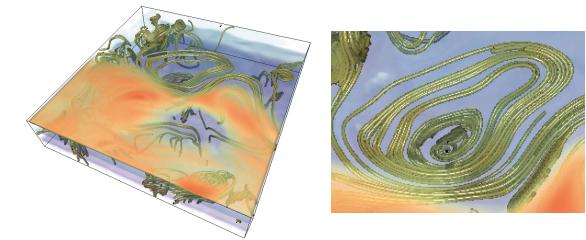
VIS25 Timeline

- Revive 25 years of visualization research
 - <http://www.aviz.fr/~bbach/vis25timeline/>



Visualization Research

- Scientific Visualization
 - Visualization of 3D phenomena (meteorological, medical, biological, etc.)
 - Information Visualization
 - Visual representations of abstract data include numerical and non-numerical data.
 - Visual Analytics
 - Science of analytical reasoning facilitated by interactive visual interfaces



Computer Graphics and Visualization

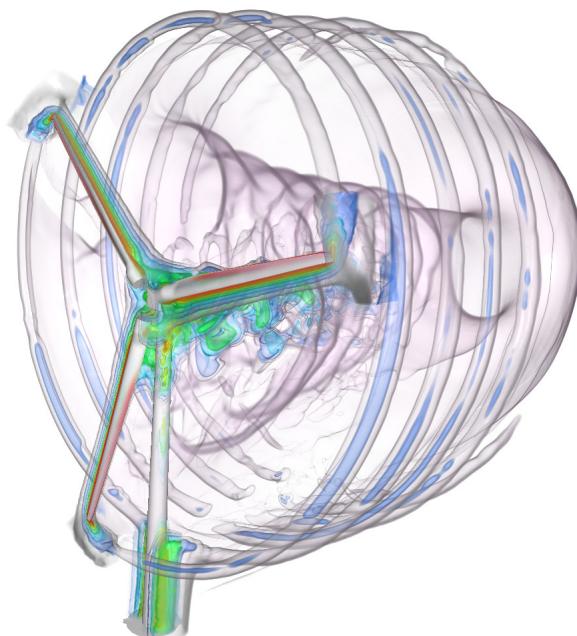
- Computer graphics
 - Use a 3D representation of geometric data that is stored in the computer for the purposes of performing calculations and rendering 2D images.
- Visualization
 - Computer graphics has been used to study scientific problems.
 - Used for analytical reasoning.

Goal

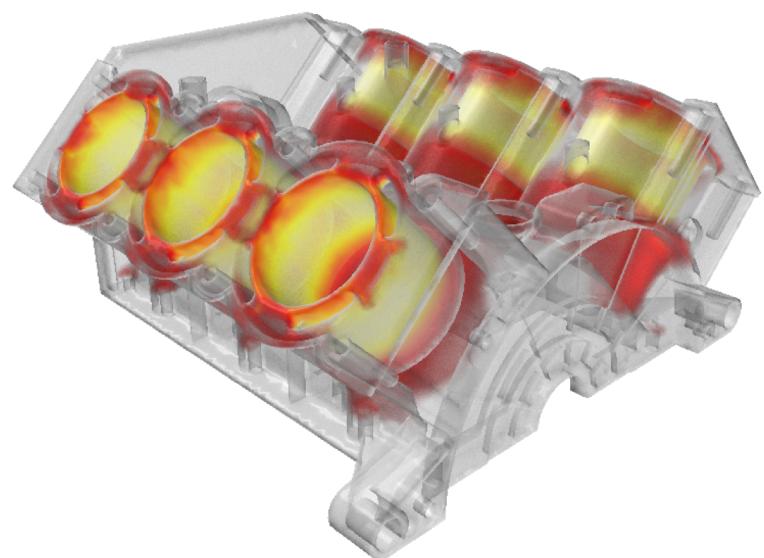
- Final goal of this course is to implement **Volume Rendering** method for the volume dataset with **JavaScript**.



[S.Bruckner, et al., EuroVis 2005]



[M.Shih, et al., LDAV2014]



[N.Sakamoto, et al., PacificVis (VisNotes) 2014]

Polling

- Take the poll
 - Student ID Number
 - Name
 - What programming languages do you have experience with?
 - What do you want from this coarse?