193.052 Seminar Wissenschaftliches Arbeiten
186.046 Seminar aus Visualisierung

WS 2020

Organizer: Hsiang-Yun Wu

Teaching staff: Hsiang-Yun Wu, Eduard Gröller, Aleksandr Amirkhanov, Christoph Heinzl, David Kouřil, Peter Mindek, Nicolas Grossmann, Manuela Waldner, Tobias Klein, Laura R. Luidolt

Institute of Visual Computing&Human-Centered Technology

TU Wien, Austria

Important

- Always check up-to-date information on institute webpage
  https://www.cg.tuwien.ac.at/courses/2020W/WissArbeiten/SE

- Always check up-to-date information on TUWEL page
  https://tuwel.tuwien.ac.at/course/view.php?id=31186

- If you want to participate in other seminars (e.g. Seminar aus Visualisierung),
  please contact: wu@cg.tuwien.ac.at

Seminar

- Get an idea how scientific work is carried out (in Visualization / CG)
  - Practice to review literature and get familiar with a particular scientific topic
    - Selecting, reading and understanding
    - Summarizing and explaining (orally and written)
    - Comparing and discussing
  - Practice to give a talk
  - Active discussion participation

Seminar - Procedure

1. **Select a topic**

Topic

- Topics are available at https://www.cg.tuwien.ac.at/courses/2020W/WissArbeiten/SE
- TUWEL: https://tuwel.tuwien.ac.at/course/view.php?id=31186

Important!!

Register on TU WEL

Initial Meeting: 22th October

Topic selection start:
23th October 2020, 08:00

Topic selection due to:
27th October 2020, 23:59

First come first serve

Seminar - Procedure

1. Select a topic
2. **Submit a literature list**

Submit a Literature List

- Meeting with Supervisor
- List of papers related to the topic

- Literature List Deadline: **05.11.2020**

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. **Attend 3 lectures**

Attend 3 Lectures

- **Video lecture**

  Wie schreibt man eine wissenschaftliche Arbeit

  Professor Wimmer

- **Video lecture**

  Forschung und wie sie funktioniert

  Professor Gröller

- **Video lecture**

  Wie halte ich einen Vortrag

  Professor Purgathofer

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. Attend 3 lectures
4. **Write a report**

Write a Report

- State-of-the-Art Report
- Final Report: 6-8 pages (min. 6 pages)
- In English
- Format as for a scientific paper
  - LaTeX (Template on the wepage)
- Regular Meetings with Supervisor

Deadline Report: **6.12.2020**

Deadline Final Version Report: **15.01.2021**

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. Attend 3 lectures
4. Write a report
5. **Give a presentation**

Give a Presentation

- Use institute's PowerPoint template for presentations (template is on the webpage)
- In English
- 15 + 3 minutes
- Active discussion participation

Presentation Day: **17.12.2020**

In case of too many students, an additional presentation day will be announced and/or the length of the presentation will be adjusted. This will be communicated in advance.

Seminar - Procedure

1. Select a topic
2. Submit a literature list
3. Attend 3 lectures
4. Write a report
5. Give a presentation

Grading

- Two parts
  - 1st (central) part: 17% of the grade
  - 2nd part: 83% of the grade
    - It is necessary to attend the 3 lectures to get a positive grade!
    - Grading criteria:

      50% written report

      40% presentation

      5% attendance during the presentations

      5% active discussion after the presentations

Report Grading

- Grading criteria:
  - Structure, figures,...
  - Language
  - Content
  - References
- Points will be deducted for:
  - Delayed submission
  - Page number below 6
- Plagiarism check!

Plagiarism

“plagiarism involves the use of another person's work without full and clear referencing and acknowledgement”

http://tim.thorpeallen.net/Courses/Reference/Citations.pdf

Presentation Grading

- Grading Criteria
  - Content Expertise
  - Didactic / Preparation
  - Presentation Technique
  - Overtime

Important Dates

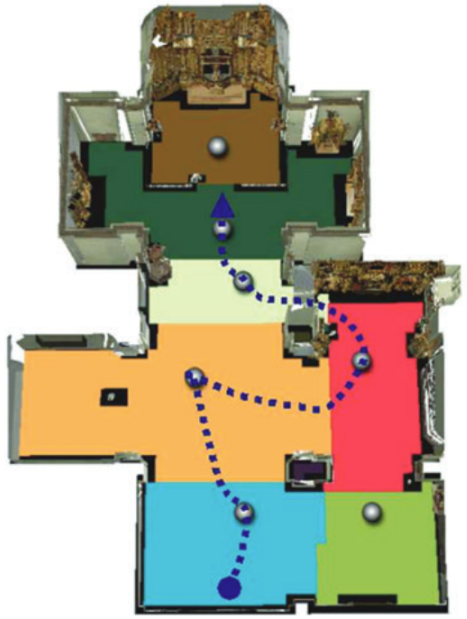
- **23.10.2020:** Select your topic
- **05.11.2020:** Submit your literature list
- Attend 3 lectures (in ICGA seminar room):
  - **Video lecture:**
    Wie schreibt man eine wissenschaftliche Arbeit
  - **Video lecture:**
    Wie halte ich einen Vortrag
  - **Video lecture:**
  - Forschung und wie sie funktioniert
- **06.12.2020:** Submit the report
- **17.12.2020:** Talks
- **15.01.2021**: Submit final report

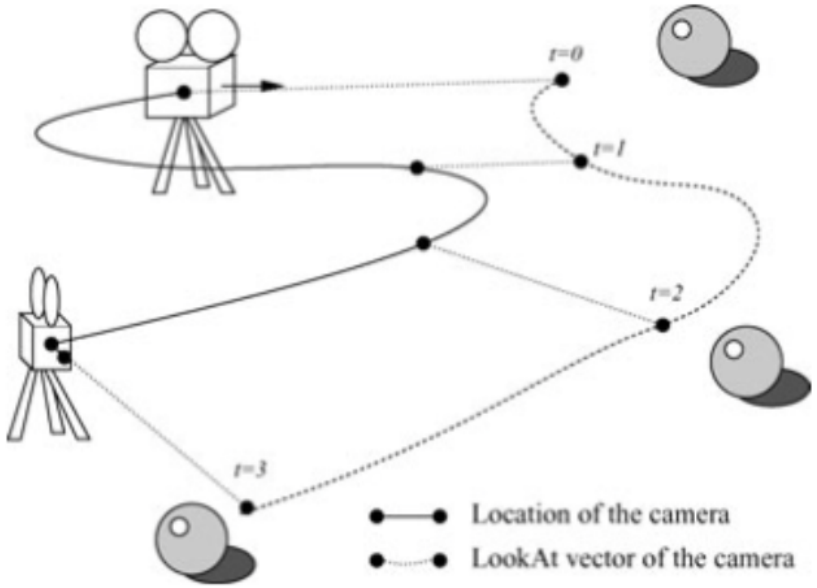
All submissions are done on TUWEL https://tuwel.tuwien.ac.at/course/view.php?id=31186

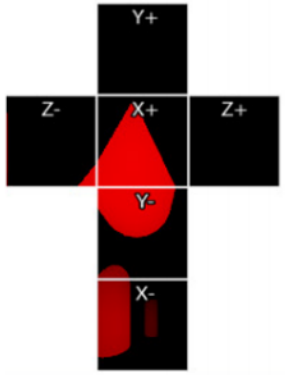
Topics 2020/2021

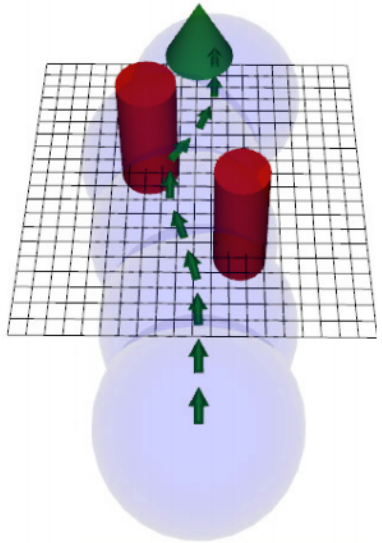
1. Smart Camera Control

- Research and summarize methods used for (semi-)automated camera control in interactive applications
- Methods which can be applied in scientific visualization and leverage specific data characteristics in a “smart” way are to be preferred



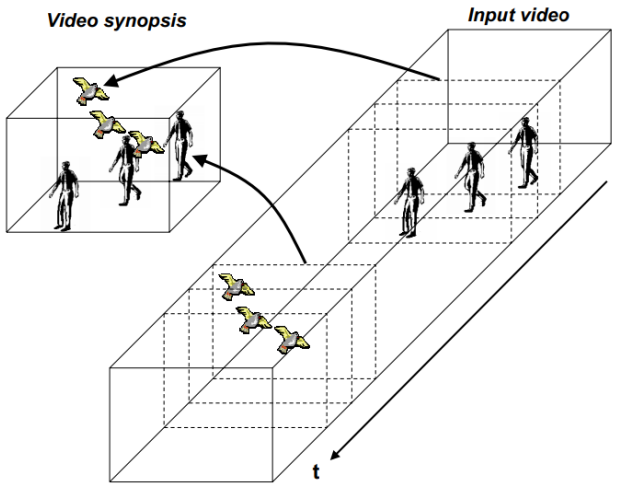


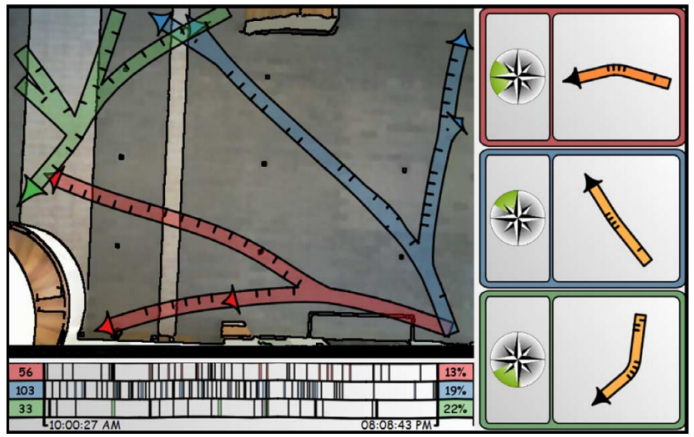


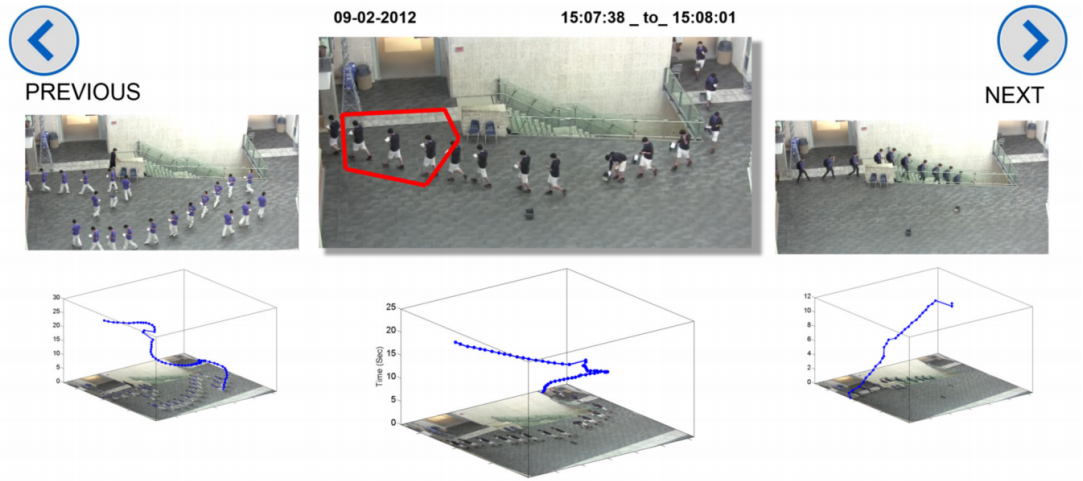


2. Summarizing and Exploring Extremely Long Videos

- Investigate methods for gaining information from extremely long video footage, e.g., from surveillance cameras
- Focus on methods that either summarize the interesting actions captured or enable less cumbersome exploration (playback) of these media

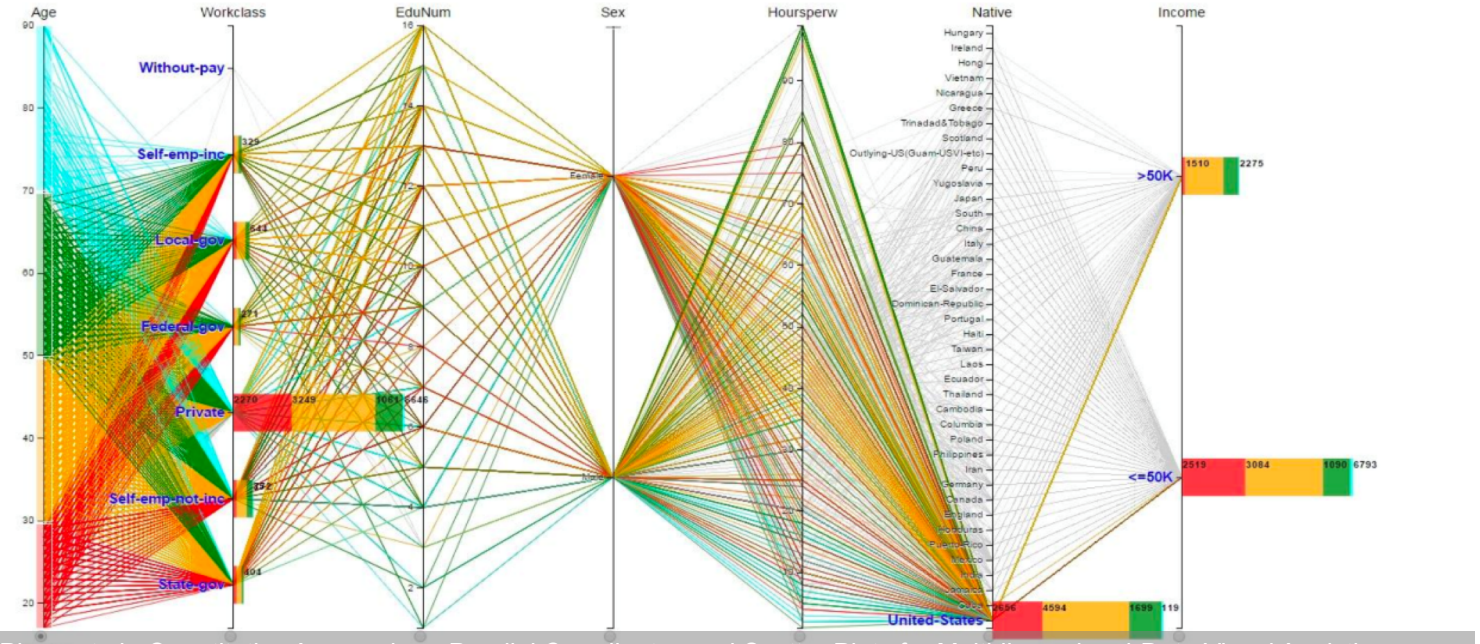






3. Comparative Visualization of High Dimensional Data

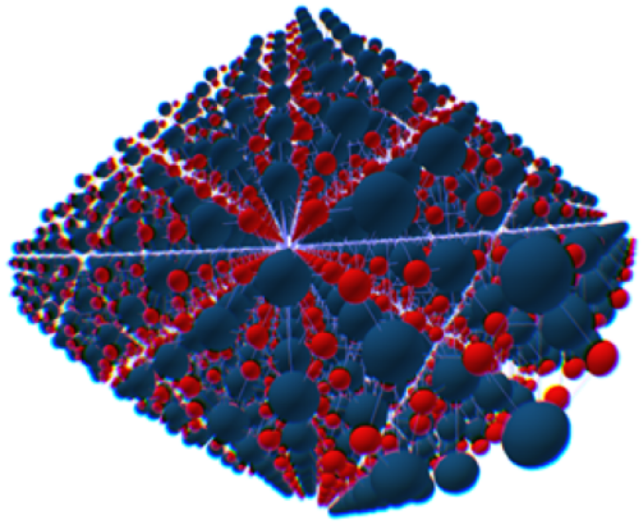
Scientists as well as practitioners often need to compare multiple datasets, for example results of feature characteristic derived from segmented images or nD data from simulation. Current strategies typically focus on **dimensionality reduction techniques** (e.g., PCA, MDS, t-SNE), computing **similarity metrics** (e.g., Euler distance in nD) or **comparing individual characteristics** with each other using conventional visualization techniques (e.g., scatter plots, parallel coordinate plots). Your task is to provide an overview over the state-of-art in **methods for comparing multiple high dimensional datasets**.



Source: Pham et al., Quantitative Approach on Parallel Coordinates and Scatter Plots for Multidimensional-Data Visual Analytics

4. Visualization Techniques for AR/VR Applications in Material Science

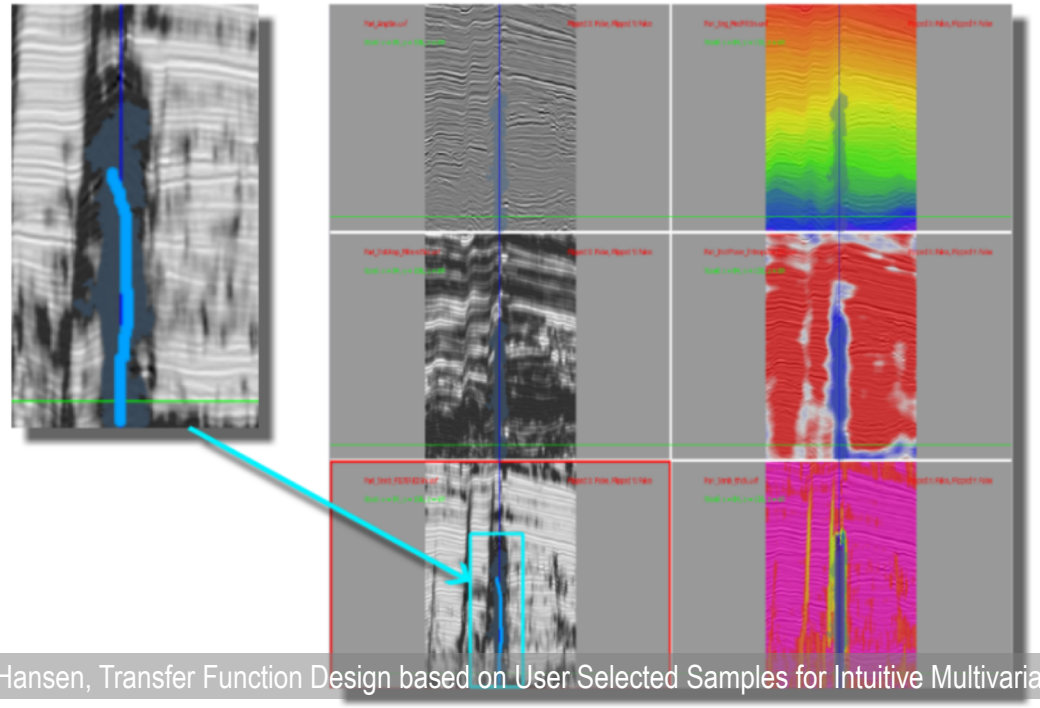
Virtual and augmented reality has come to stay and is used in many application domains. AR and VR feature the potential to boost data analysis through more intuitive insights and more intuitive interactions; the transfer of the spatiality is intuitive and probably more effective than when rendering the same scene on a 2D monitor. Virtual and augmented reality have the potential to help in a variety of tasks such as quality control / parts inspection, the characterization of the micro-structure of materials, or the visualization of atomic structures. Your task is to provide an overview on the state of the art regarding **methods in virtual and augmented reality:** where these be used to support material science tasks, what are their benefit, what are their limitations.



García-Hernández and Kranzlmüller: NOMAD VR: multiplatform virtual reality viewer for chemistry simulations

5. Guidance Methods for Transfer Function Specification

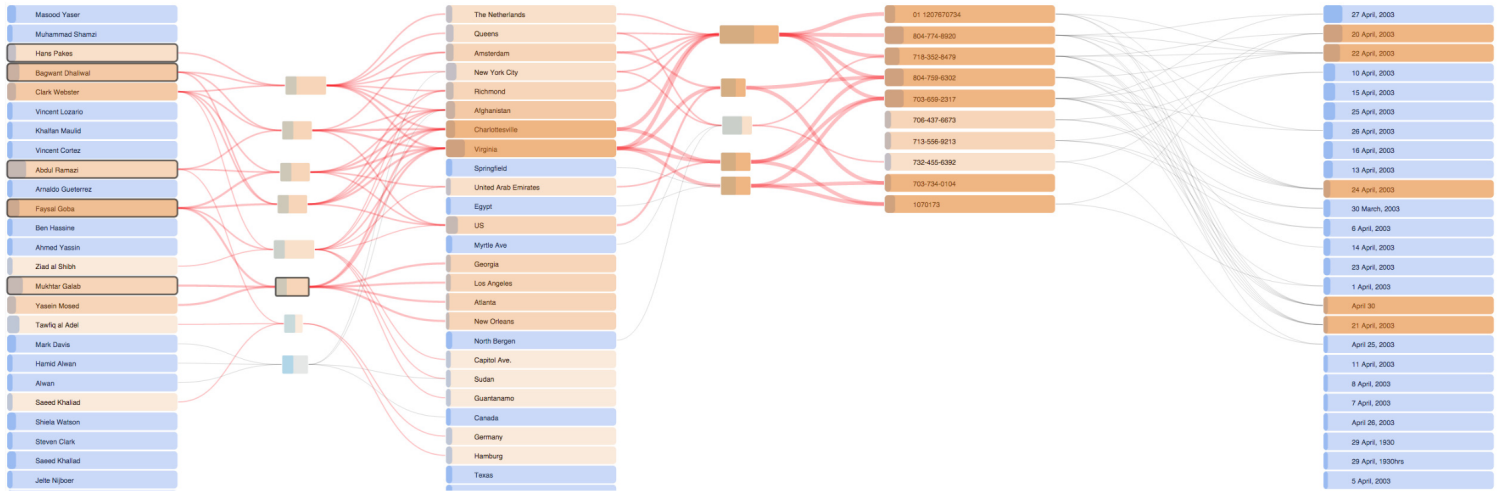
When directly visualizing (potentially multi-variate) volume datasets, a transfer function is required. Current tools for this purpose are often unintuitive; its often not clear how changes in the transfer function will affect the resulting visualization; using volume visualization tools therefore first requires a certain experience by the user, as well as often a trial and error approach to color the volume in the desired fashion. Recently, methods have emerged that simplify this process, or provide guidance to the user. Your task is to provide a survey on the state of the art of **methods guiding users in setting up transfer functions** for volume visualization.



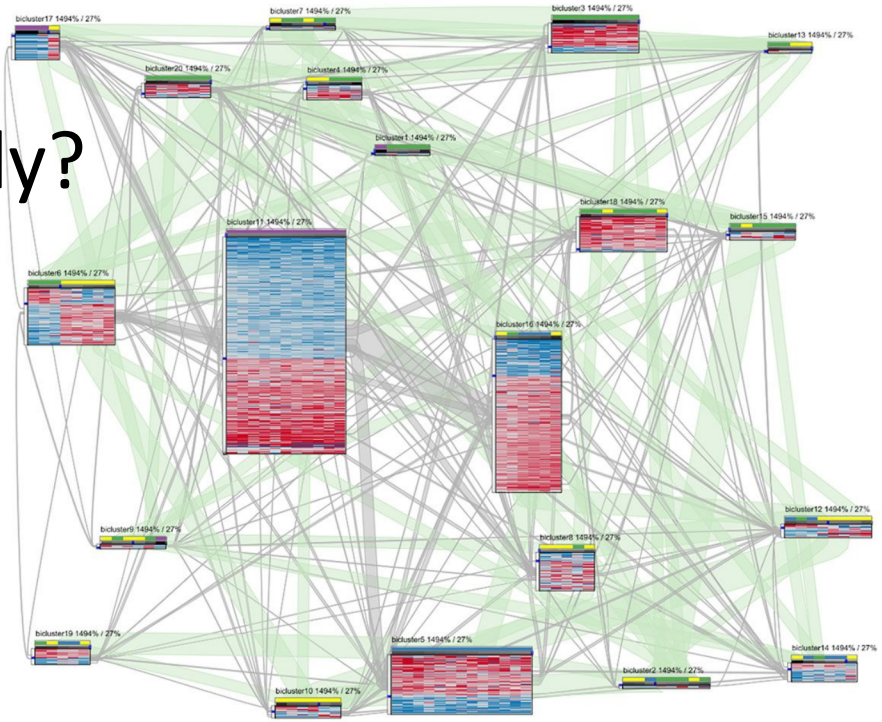
Source: Zhou and Hansen, Transfer Function Design based on User Selected Samples for Intuitive Multivariate Volume Exploration

6. Visualization of Bipartite / k-Partite Graphs

- Graph with vertices divided into two independent sets, such as
  - People and affiliations, genes and conditions, actors and movies
- Which visualization techniques exist?
- How to explore a k-partite graph interactively?



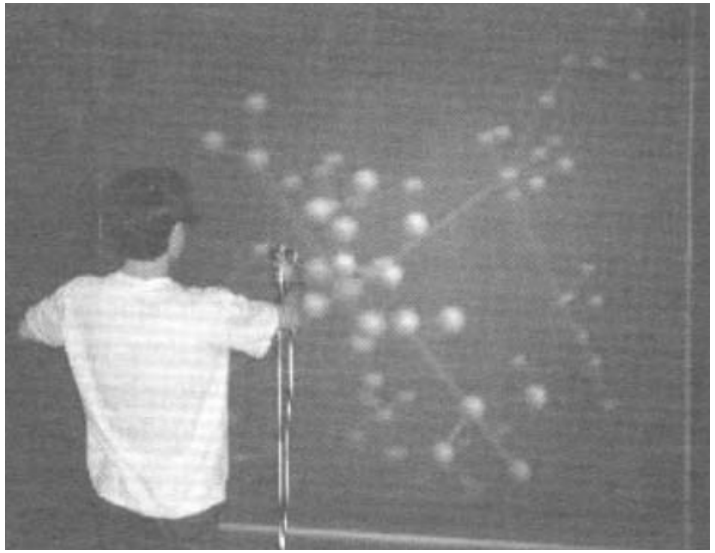
[Sun et al., BiSet, TVCG 2016]



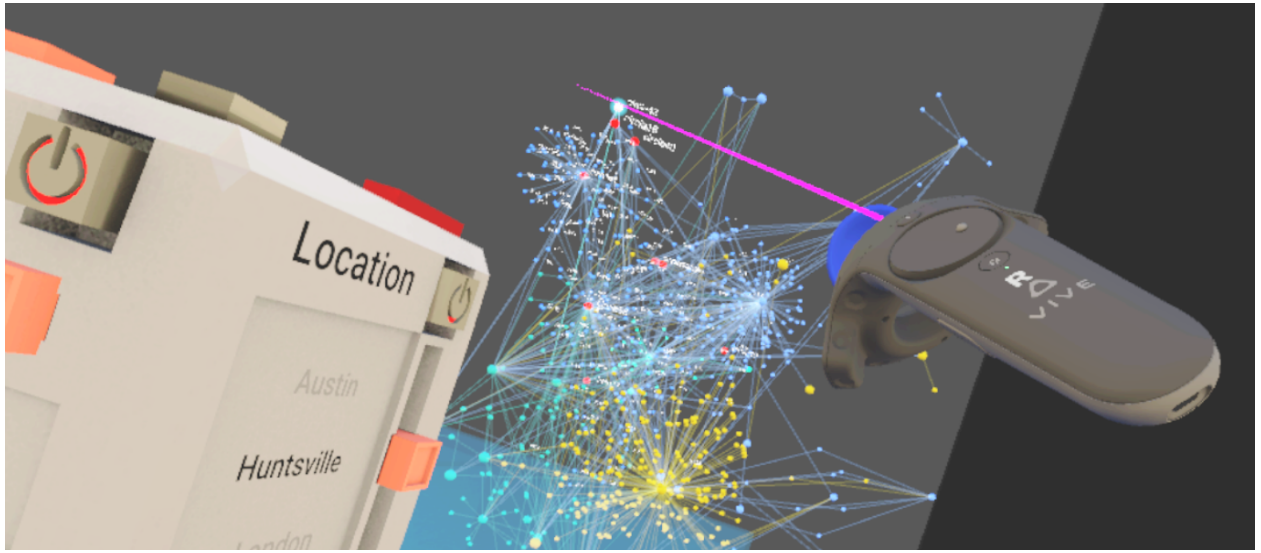
[Streit et al., Furby,
BMC Bioinformatics 2014]

7. Visualization of Networks in Virtual Reality

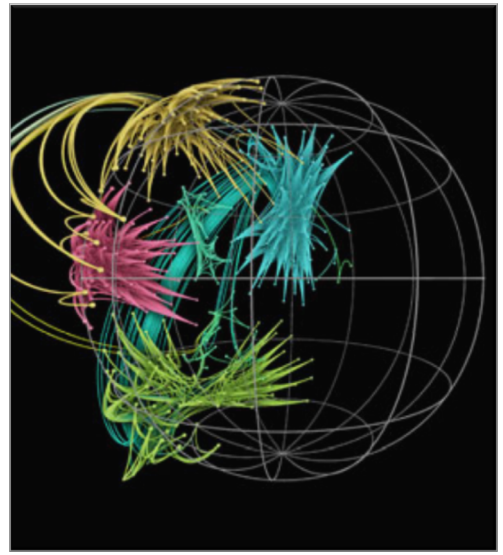
- Immersive analysis of 3D graphs in virtual reality from the 90ies to now:
  - Rendering & graph layout
  - Embodied interaction & effective locomotion



[Osawa et al., 2000]



[Drogemuller et al., 2017]

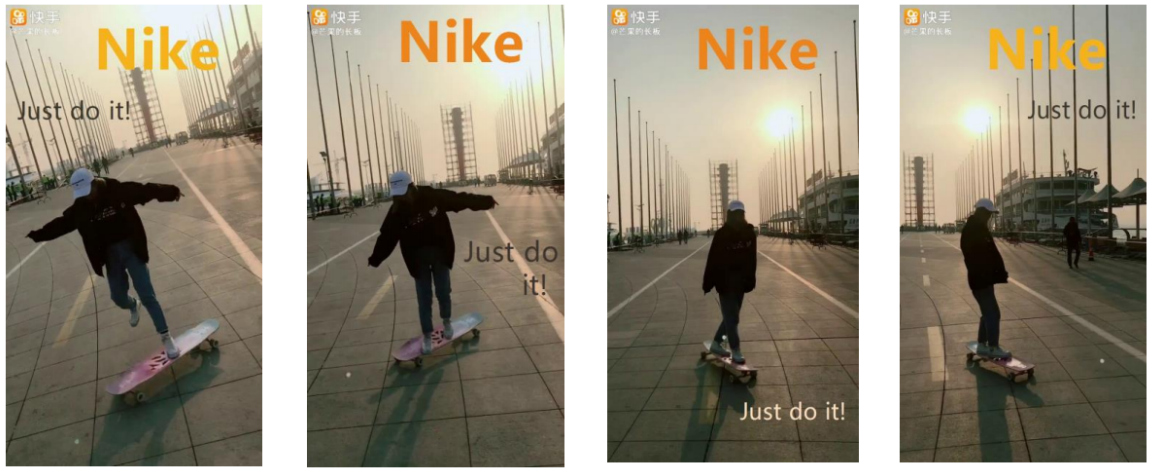


[Kwon et al., 2016]

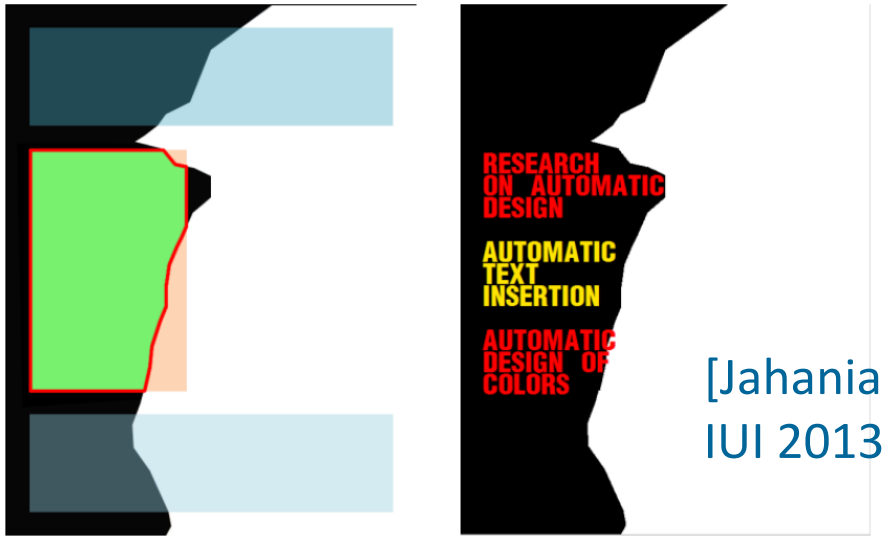
8. Automatic Layout Generation

- Layout algorithms for computational composition of many media (text, images, etc.) into a single:
  - Magazine cover
  - Advertisement or banner
  - Poster …

[Yin et al., MM 2013]

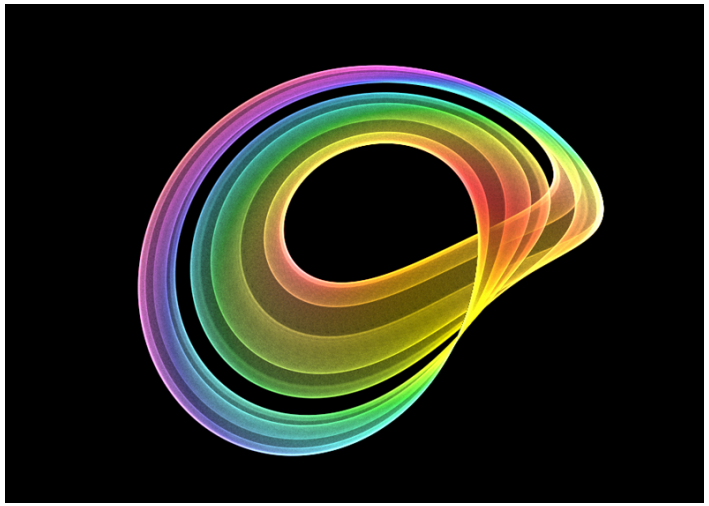


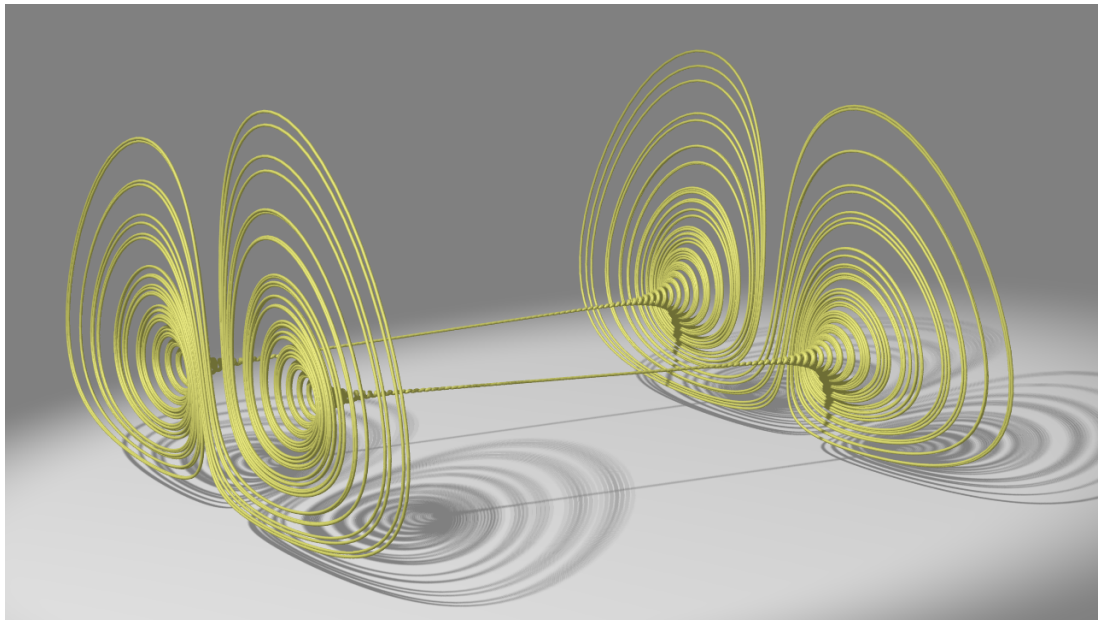
[Liang et al., BigMM 2018]

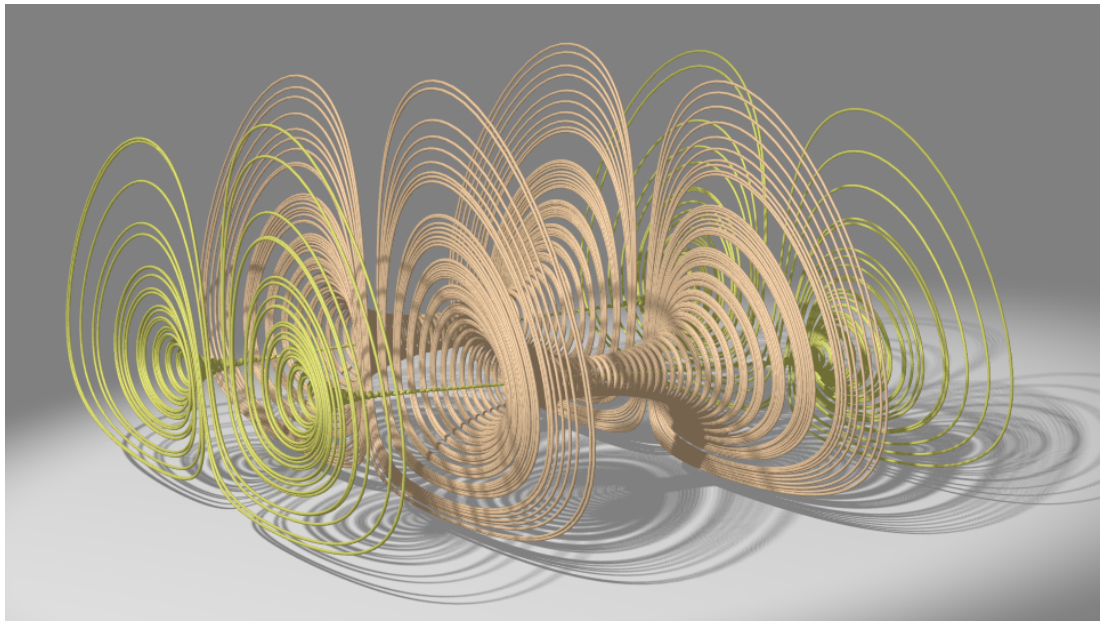


[Jahanian et al., IUI 2013]

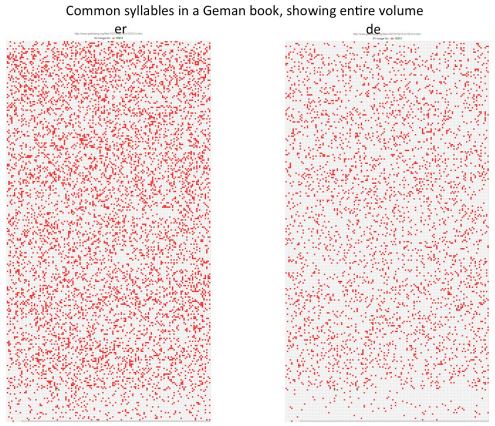
9. Visualization of Dynamical Systems

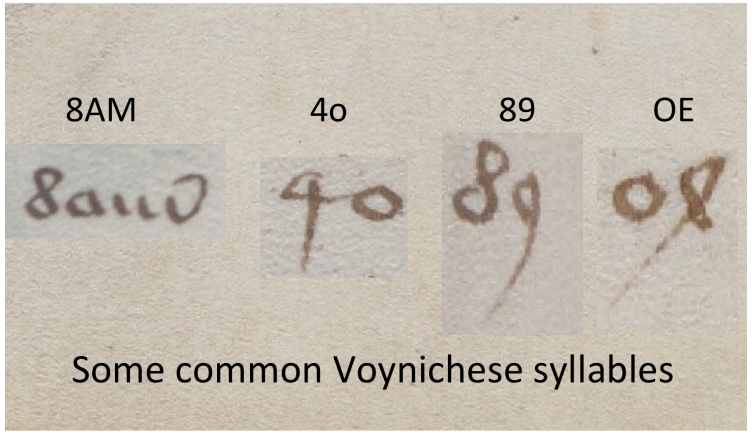






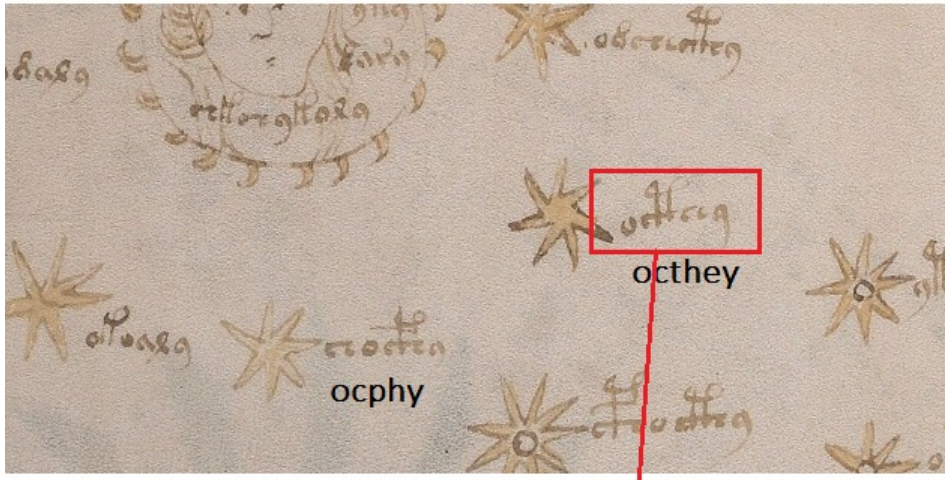
10. Visualization of Text in Voynich Manuscript



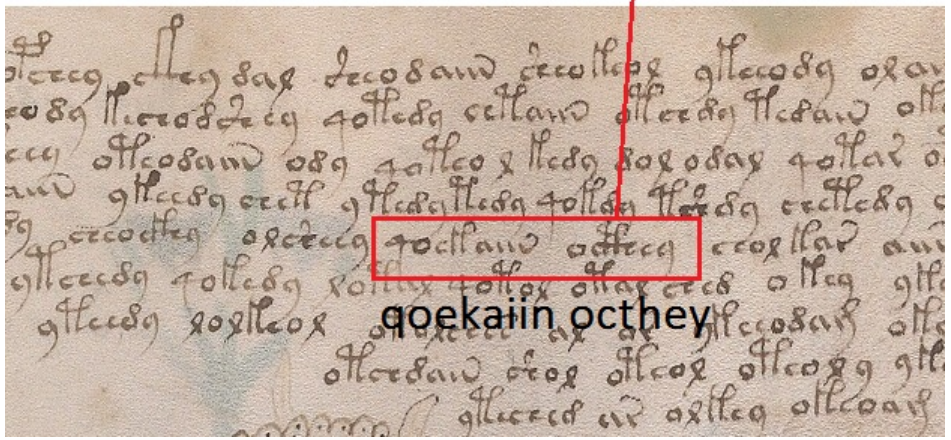


Some common Voynichese syllables

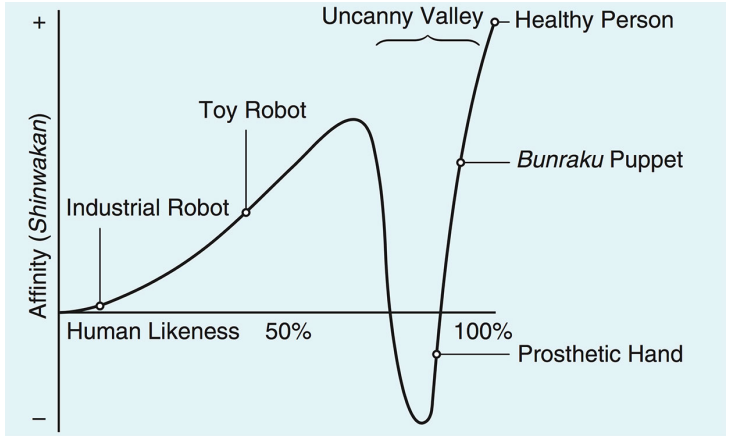
Folio 68



Folio 48

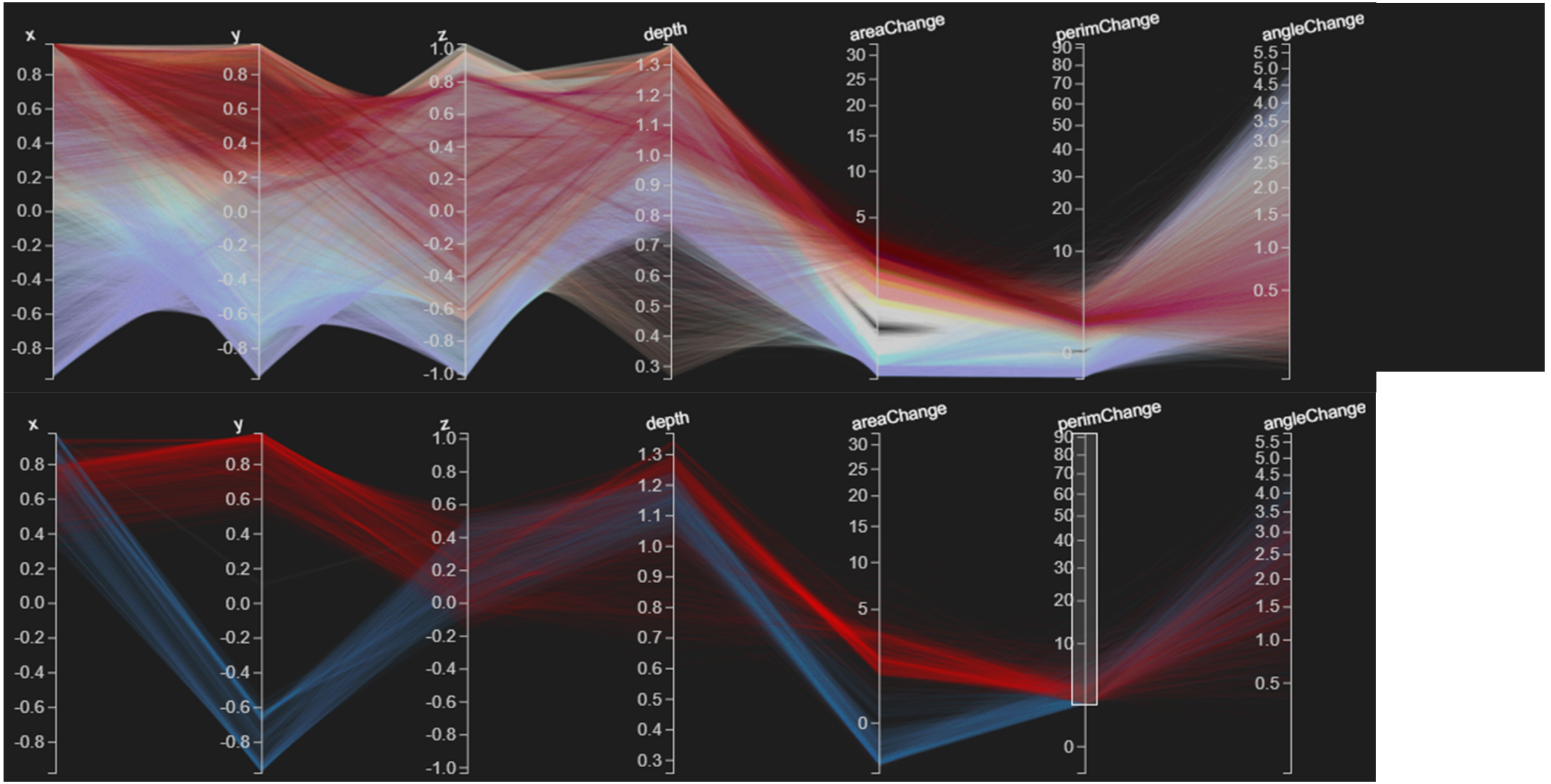


11. Visualization and Uncanny Valley

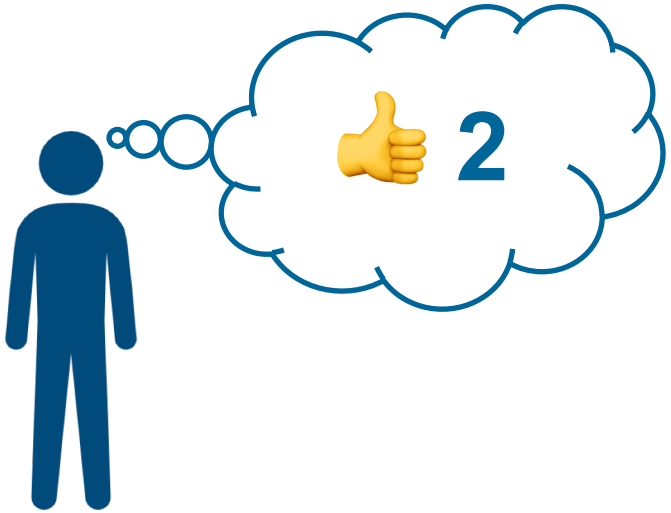


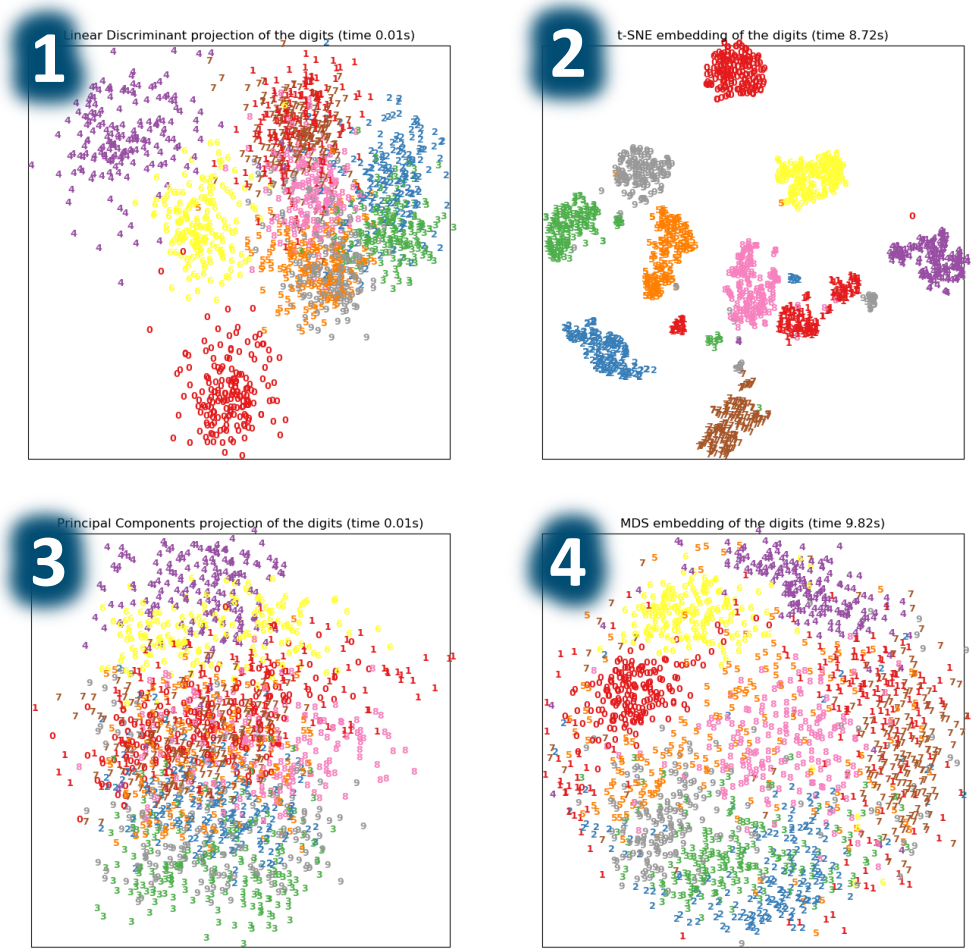
12. Hierarchical Aggregation for Information Visualization

13. Parallel Coordinates



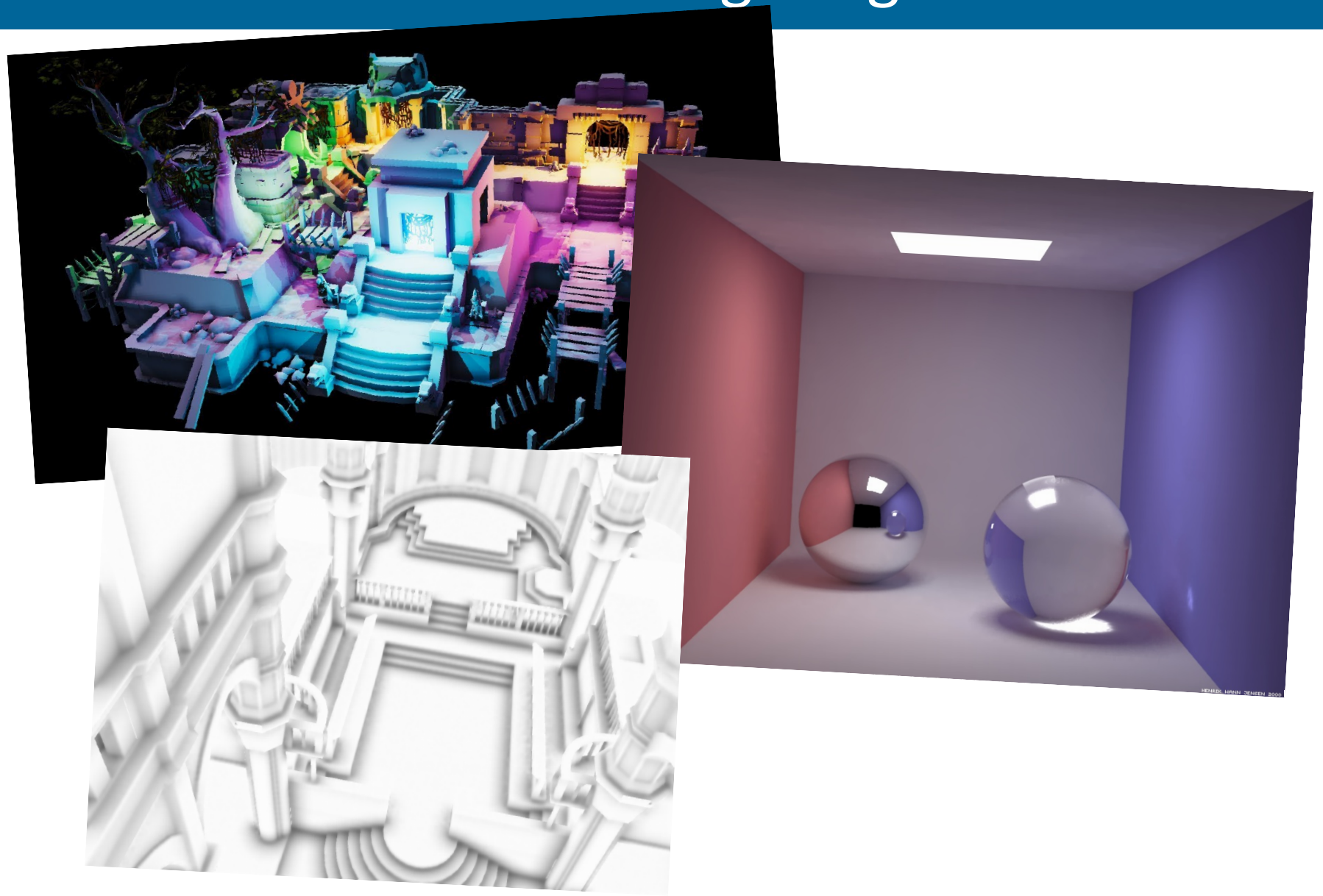
14. Visual Quality Measures





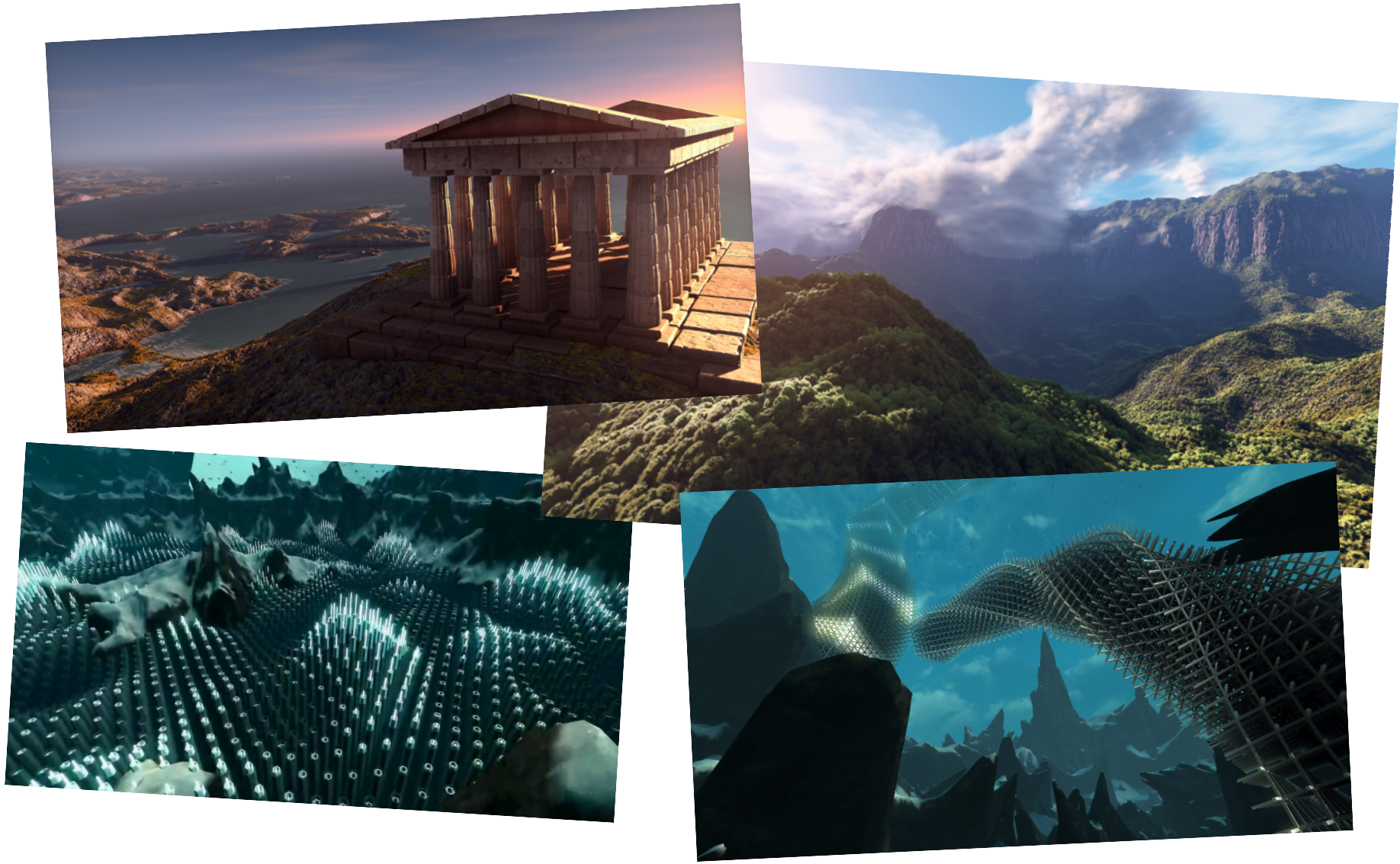
Can we model how humans see visualizations?

Real-time Lighting



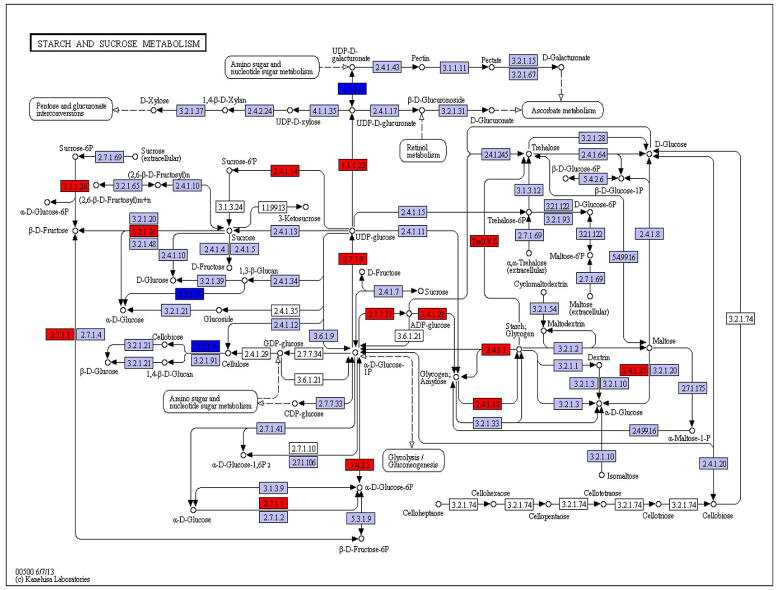
16. Modern Particle Systems

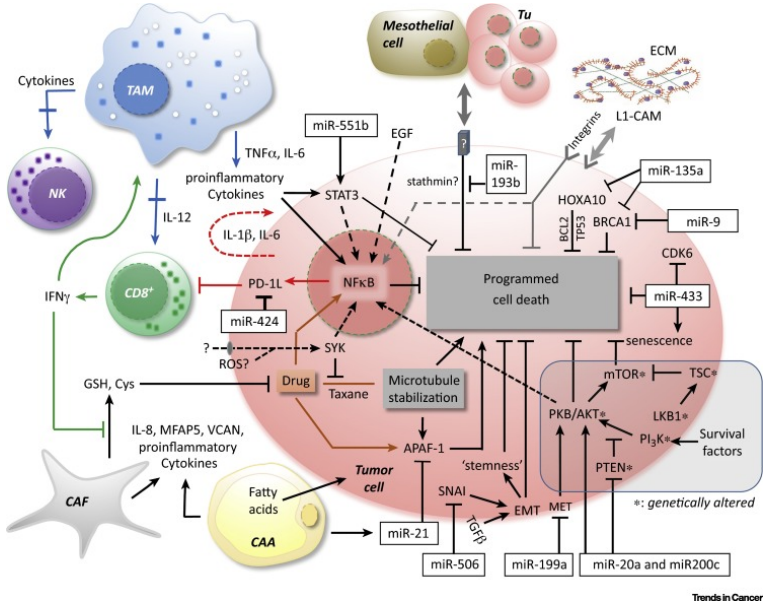
17. Special Effects in Computer Graphics

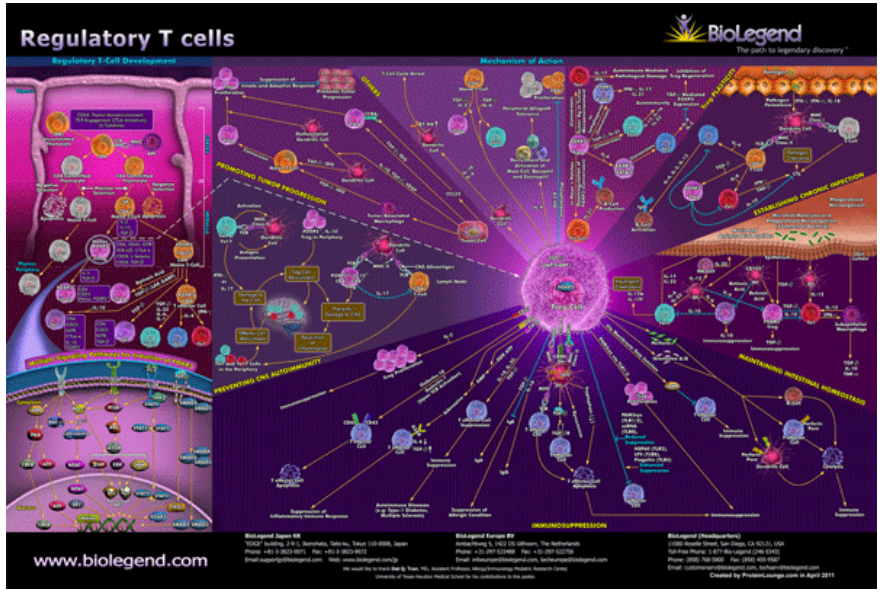


18. Network Visualization for Biological Pathways

- **Challenge:**
  - Layout simplification and arrangement
  - Scalability, complexity, and usability



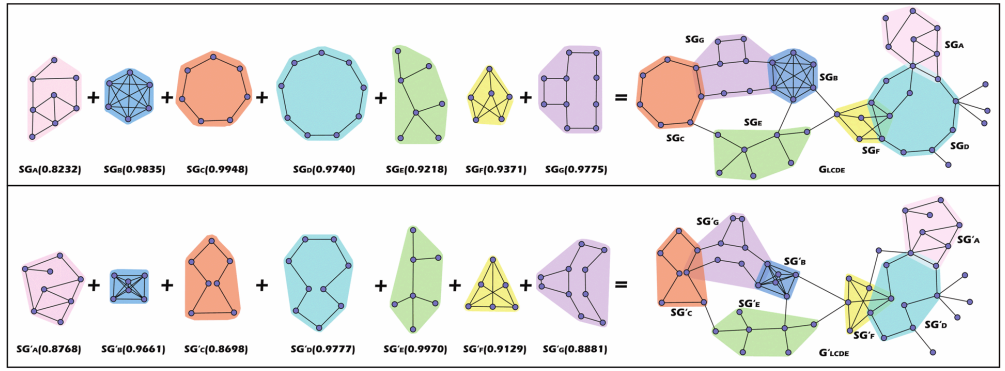


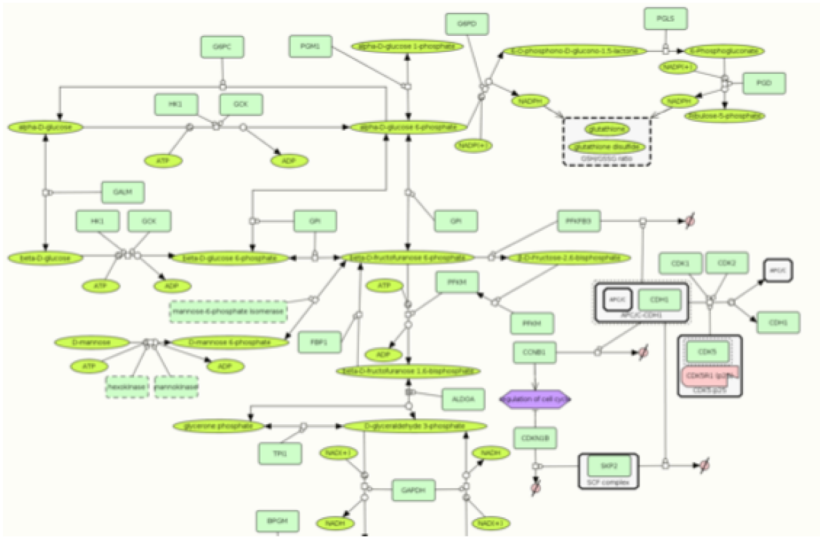


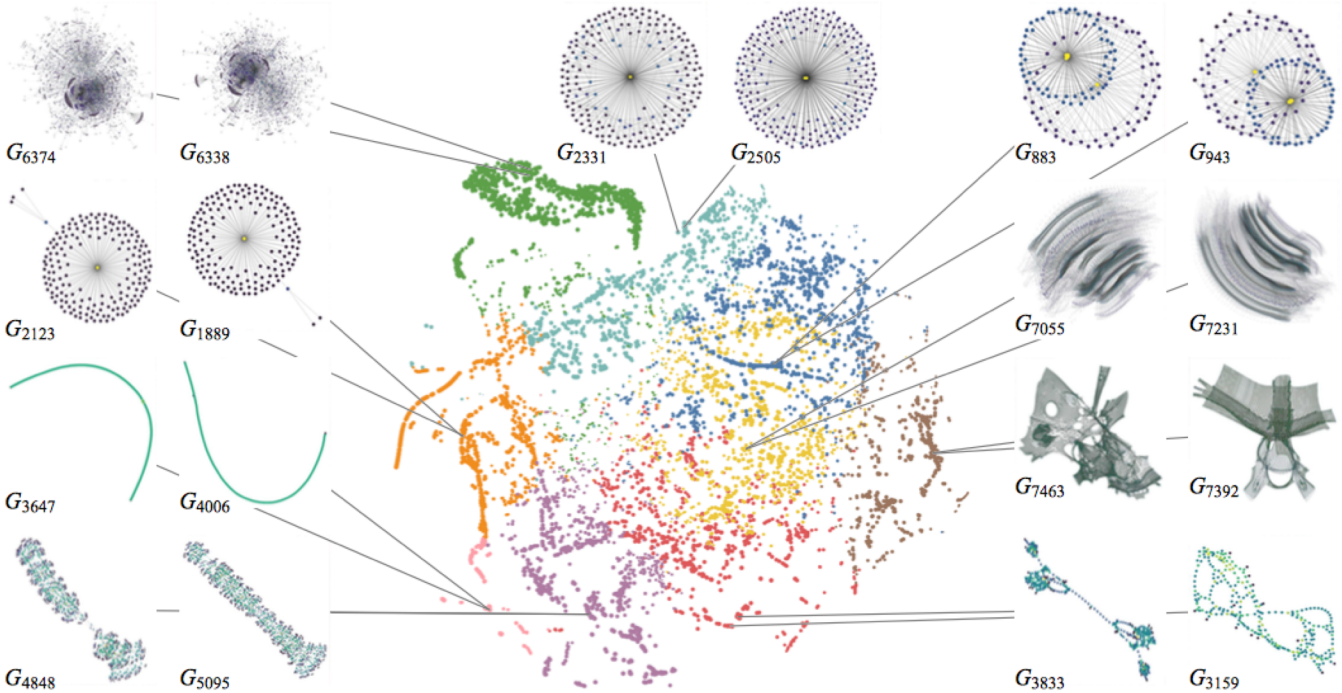
19. Machine Learning in Graph Visualization

Challenge:

Formulation for machine learning technique

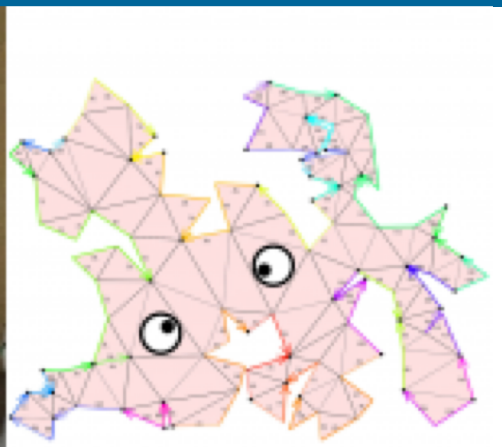


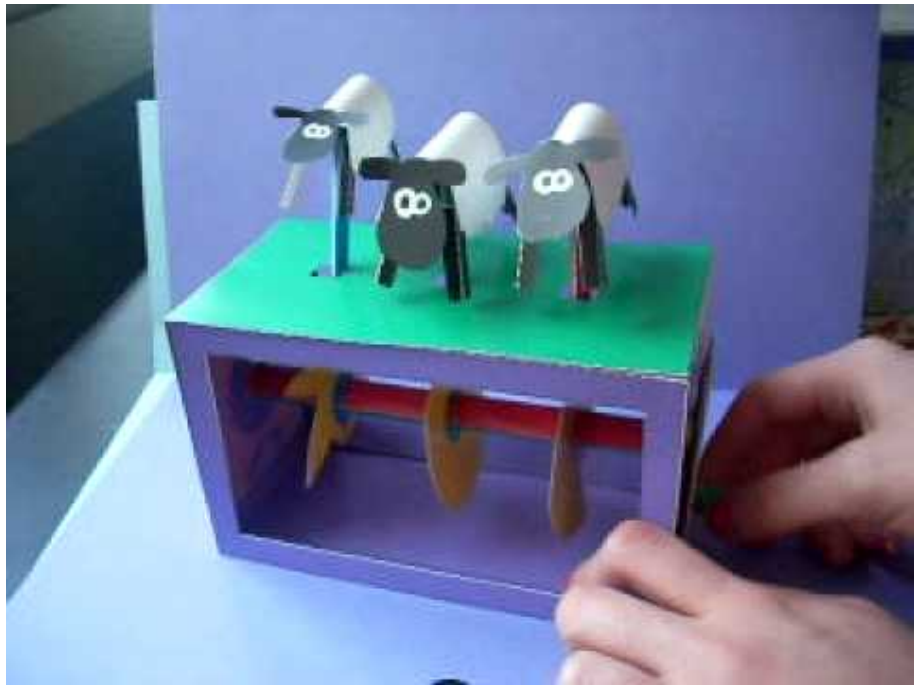




20. Data Physicalization

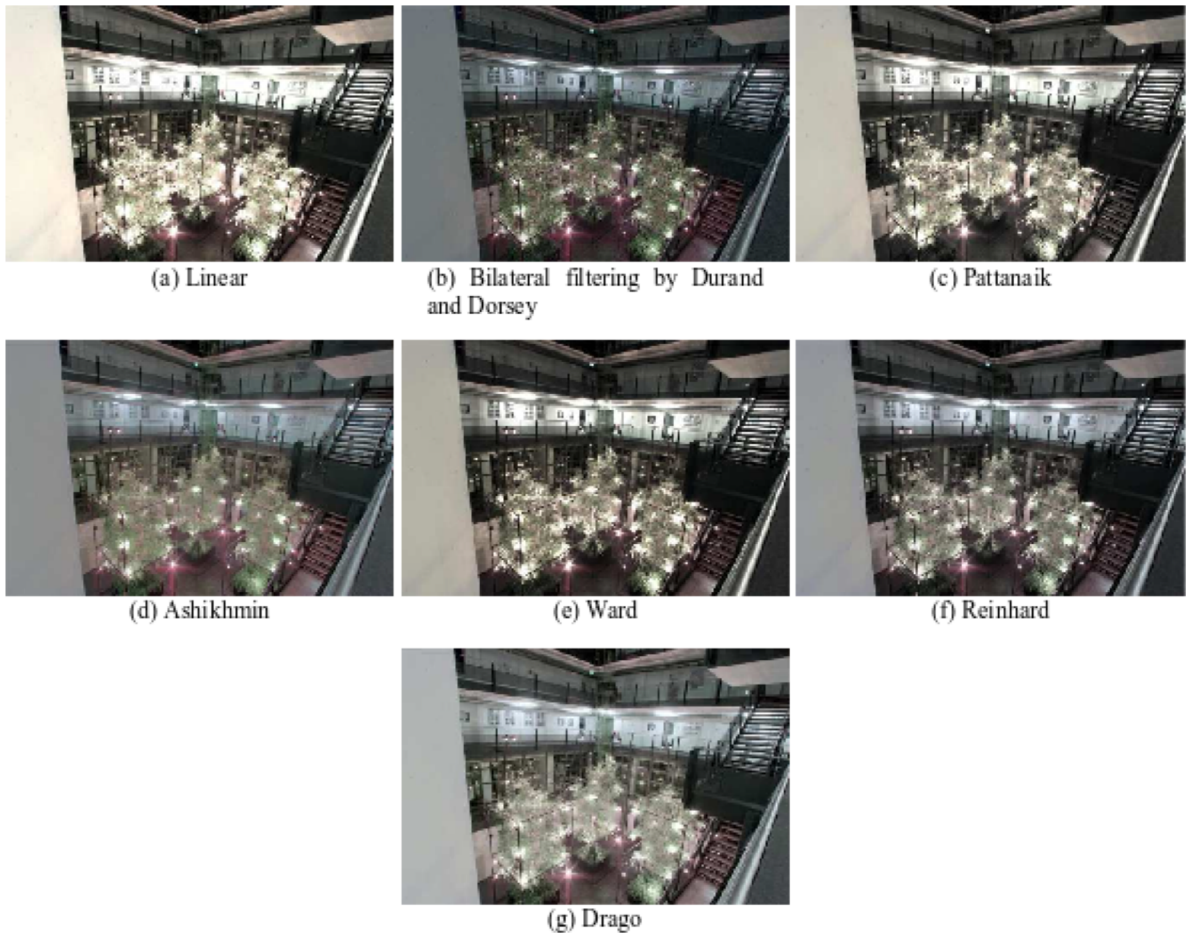
- **Challenge:**
  - Geometry
  - Combinatorial complexity
  - Optimization





21. HDR tone mapping techniques

- Compress HDR images/renderings to display on LDR screens
- Explain and compare different approaches and methods
  - Global vs. local
  - Perception based
  - Subjective quality



(a) Linear

(b) Bilateral filtering by Durand and Dorsey

(c) Pattanaik

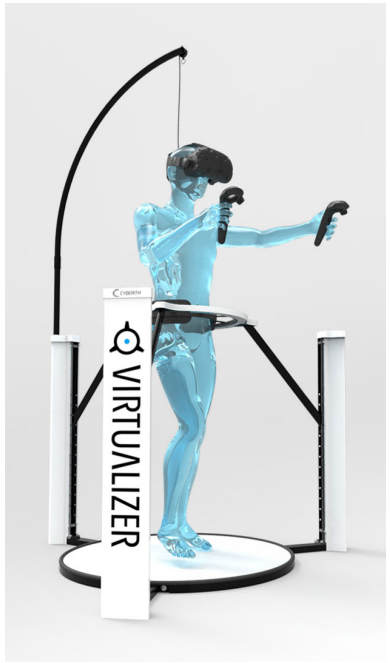
(d) Ashikhmin

(e) Ward

(f) Reinhard

(g) Drago

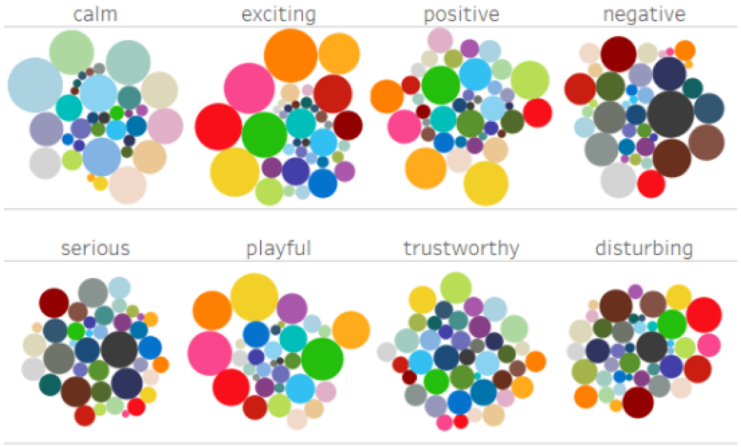
22. Interaction in Virtual Reality

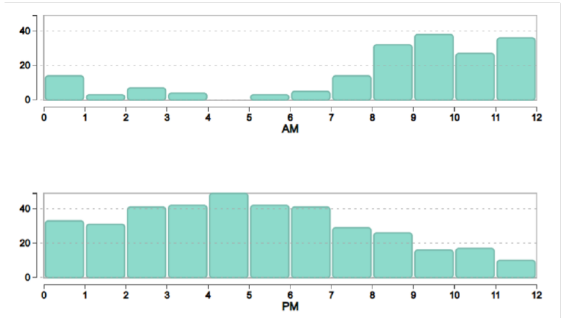


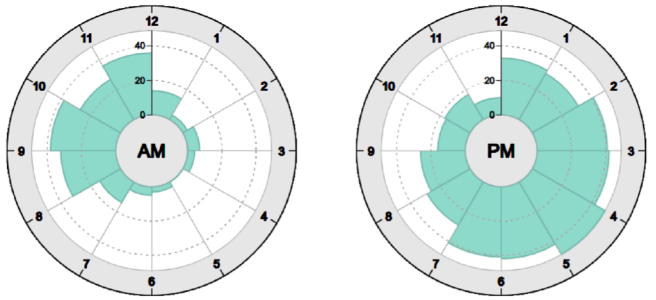
- Mouse and keyboard not suited for VR input
- Evaluate input devices and interaction methods such as
  - Different controllers
  - Eye-tracking interaction
  - Locomotion methods

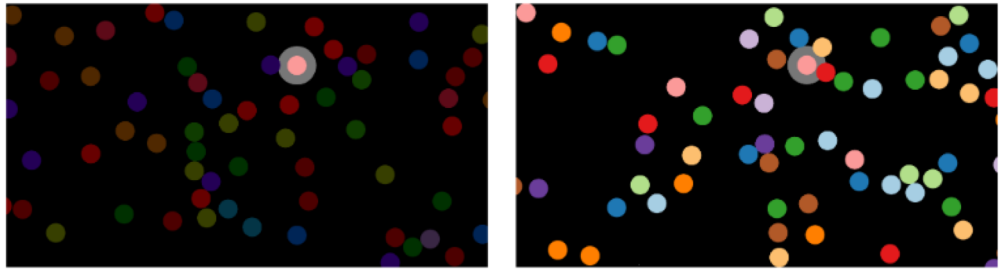
23. Perception in Visualization

- Better comprehension of visualized data by taking human perception into account
- Explore major influences of perception, e.g.,
  - Color schemes
  - Data representation
  - Attention cues
- … and how they can be used to improve various visualizations









Topics 2020/2021

1. Smart Camera Control
2. Summarizing and Exploring Extremely Long Videos
3. Comparative Visualization of High Dimensional Data
4. Visualization Techniques for AR/VR Applications in Material Science
5. Guidance Methods for Transfer Function Specification
6. Visualization of Bipartite / k-Partite Graphs
7. Visualization of Networks in Virtual Reality
8. Automatic Layout Generation
9. Visualization of Dynamical Systems
10. Visualization of Text in Voynich Manuscript
11. Visualization and Uncanny Valley
12. Hierarchical Aggregation for Information Visualization
13. Parallel Coordinates
14. Visual Quality Measures
15. Real-time Lighting
16. Modern Particle Systems
17. Special Effects in Computer Graphics
18. Network Visualization for Biological Pathways
19. Machine Learning in Graph Visualization
20. Data Physicalization
21. HDR tone mapping techniques
22. Interaction in Virtual Reality
23. Perception in Visualization

Questions?

Always check up-to-date information on institute webpage
https://www.cg.tuwien.ac.at/courses/2020W/WissArbeiten/SE

Always check up-to-date information on TUWEL page
https://tuwel.tuwien.ac.at/course/view.php?id=31186