Seminar in Computer Graphics 186.175, WS 2021/22, 2.0h (3 ECTS)

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Important!

Register to course in TISS and TUWEL: to get news & updates

These slides will on TUWEL and institute website after this meeting

Official registration: by submitting the literature list

Topics are presented and chosen today, assigned tomorrow

Seminar Goals

Practice selecting, reading and understanding

- Search and select papers relevant to your topic
- Summarize them as a state-of-the-art report
- Prepare a talk about your topic in the seminar

This permits in-depth familiarization with the topic

More in-depth/spezialized than Bachelor seminar!

If well done → can continue to master thesis ...

Tasks

- Submit a literature list (chosen with supervisor)
- Attendance of 3 lectures
- Meetings with supervisor: paper selection, discussion of papers, preparing talk slides
- Alternative: evaluate and compare algorithms
- Write a report
- Review a report from a colleague
- Final talk in seminar

Literature List

- Analyze recent papers (select with supervisor)
- Study secondary literature to understand topic
- How to find relevant papers:
- SIGGRAPH Proceedings
- Google Scholar: find the right key words
- Survey papers, often-referenced papers
- Submits a list of 10+ papers to TUWEL → official registration

State-of-the-Art Report (STAR)

- 8 pages per student, must be in english
- Format in the style of a scientific paper
- Use LaTeX template on course website, can use Overleaf
- LaTeX tools and guides also on the website
- Submit the draft in PDF format
- Draft has to be complete and minimum 8 pages!

Scientific Review

- You will get a draft of another student to review
- Typical conference review form (Eurographics)
- This helps author to improve the manuscript
- Guides on review writing on course website
- You will receive 2 reviews (student, supervisor)
- Improve final report according to reviews

Seminar Talk

- Prepare slides in advance, using template
- Each student talks for 15 minutes, in english
- 5 minutes discussion after each talk
- Focus is on overview/comparison of methods
- Present so that other students will understand it
- Active discussion is mandatory and is graded
- Slides presentation from your device on Zoom

Grading

- Lecture attendance 5%
- Review: 15%
- Seminar slides+talk: 30%, discussion 5%
- Final report: 45%

- Late submission: 15% off task per day, so no points after 1 week (this also concerns the draft!)

Important Dates

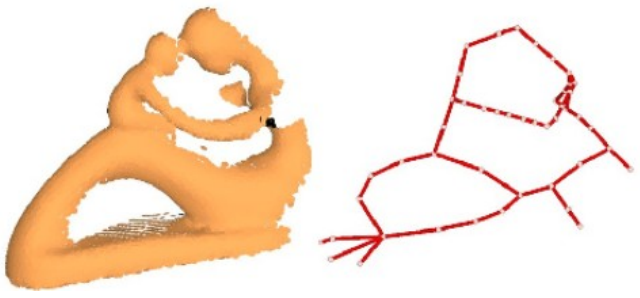
- 25.10. 23:59 Submit literature list (on TUWEL)
- 11.11. 13:00-15:00 Lecture Prof. Wimmer
- 17.11. 13:00-15:00 Lecture Prof. Kaufmann
- 24.11. 13:00-15:00 Lecture Prof. Gröller
- 13.12. 23:59 Submit report draft
- 10.01. 23:59 Submit review
- 24.01. 23:59 Submit slides
- 25.01. 13:00-18:00 Seminar talks
- 25.01. 23:59 Submit final report

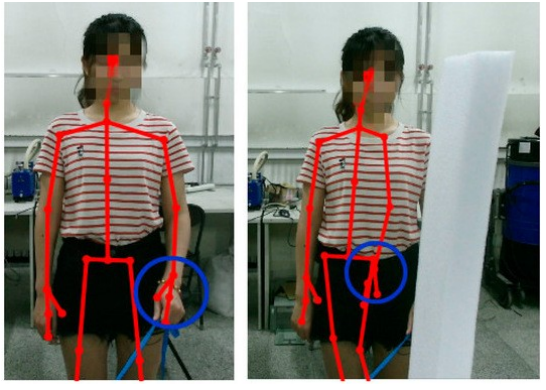
Topic Presentation

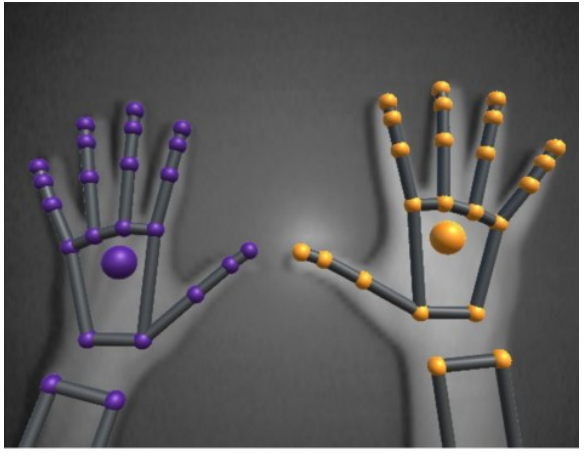
- Now 20 topics will be presented
- After the presentation, please mark down at least 3 in order of preference (1, 2, 3, …) and post your preferences in forum “Discussions” until the end of the day
- I will try to make a fair assignment of topics in case of conflicts and post them in forum “Announcements”

1 Generic Skeleton Extraction From Point Clouds

- Extract skeletons from point clouds for generic objects
- Recover occluded parts from time-varying series
- Recover fine-grained parts



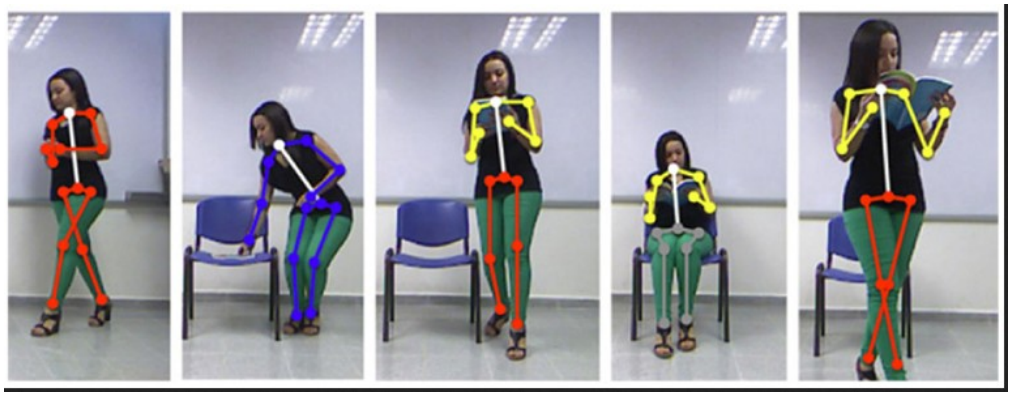




Qin, Hongxing, et al. "PointSkelCNN: Deep Learning-Based 3D Human Skeleton Extraction from Point Clouds." Computer Graphics Forum. Vol. 39. No. 7. 2020.

2 Action Learning with Context Objects

- Learn Actions from Human Skeletons
- Use Labeled Objects as Context



Yan, Sijie, Yuanjun Xiong, and Dahua Lin. "Spatial temporal graph convolutional networks for skeleton-based action recognition." Thirty-second AAAI conference on artificial intelligence. 2018.

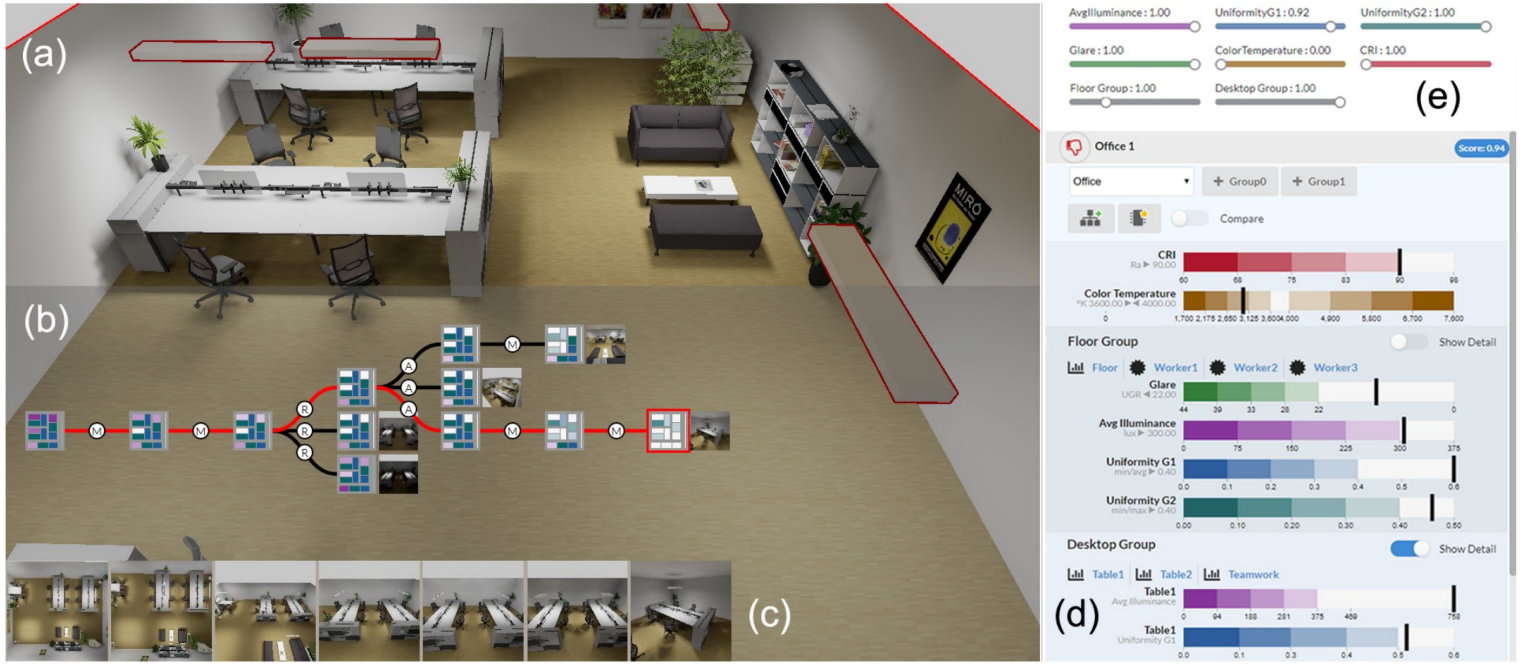
3 Modeling and Simulation of Plants

- Generate 3D geometry for single plants
- Explore dynamic growth, physical models, etc.

Hädrich, Torsten, et al. "Interactive modeling and authoring of climbing plants." *Computer Graphics Forum*. Vol. 36. No. 2. 2017.

4 Interactive Lighting Design

- Explore interactive and artistic approaches to lighting design
- Sketch-based, interactive exploration, indirect manipulation…



Walch, Andreas, et al. "Lightguider: Guiding interactive lighting design using suggestions, provenance, and quality visualization." *IEEE transactions on visualization and computer graphics* 26.1 (2019): 569-578.

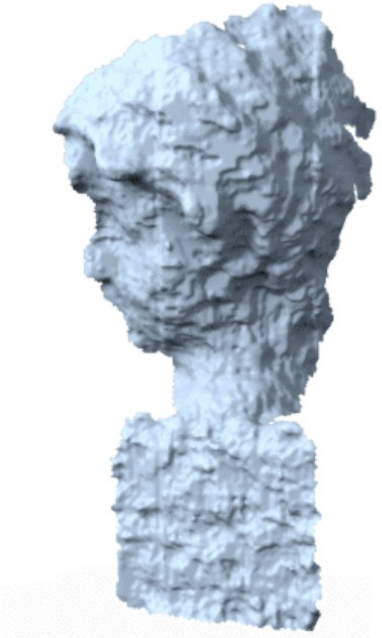
5 Camera Pose Estimation

Figure 1. (a) A section of the 3D point cloud from Shop Facade dataset [10]. (b) An RGB query image to be localized in 3D point cloud (c) Visualization of the area of the 3D point cloud, identified by our technique as the location of the query image.

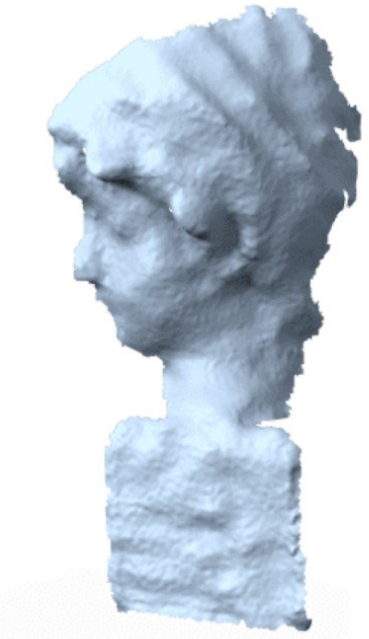
Nadeem, Uzair, et al. "Direct Image to Point Cloud Descriptors Matching for 6-DOF Camera Localization in Dense 3D Point Clouds." *International Conference on Neural Information Processing*. Springer, Cham, 2019.

6 Denoising Point Clouds

- Investigate denoising techniques for point clouds



Noisy input reconstructed with Poisson

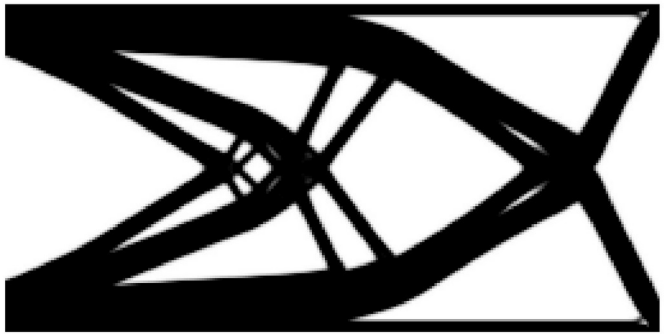


Denoised result reconstructed with Poisson

Ground truth surface

Rakotosaona, Marie-Julie & La Barbera, Vittorio & Guerrero, Paul & Mitra, Niloy & Ovsjanikov, Maks. (2019). PointCleanNet : Learning to Denoise and Remove Outliers from Dense Point Clouds: PointCleanNet. Computer Graphics Forum. 39. 10.1111/cgf.13753.

7 Shape and Topology Optimization



via Wikimedia
User:Meenakshsundaram

A System for High-Resolution Topology Optimization, Wu et al., TVCG 2016

Narrow-Band Topology Optimization on a Sparsely Populated Grid, Liu et al., ACM Transactions on Graphics (SIGGRAPH Asia 2018)

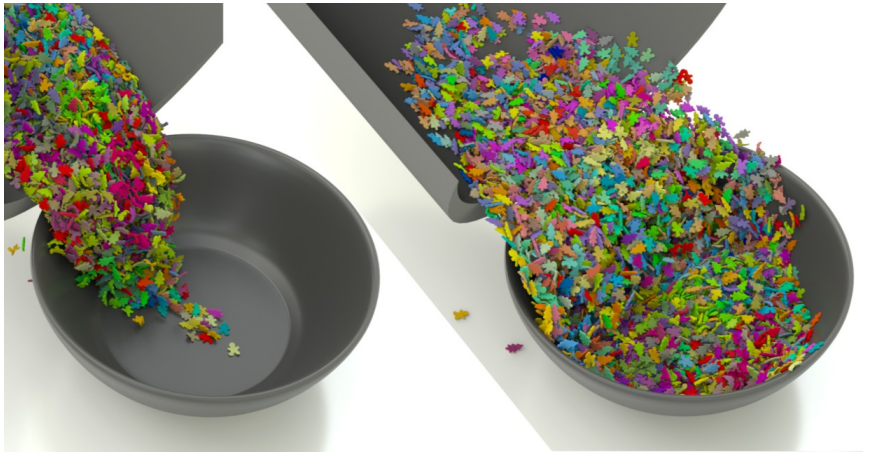
Potential **MSc thesis** project:

Shape / Topology Optimization of Light Sources

(w/ global illumination / ray tracing)

8 GPU-accelerated Simulation

developer.nvidia.com/flex



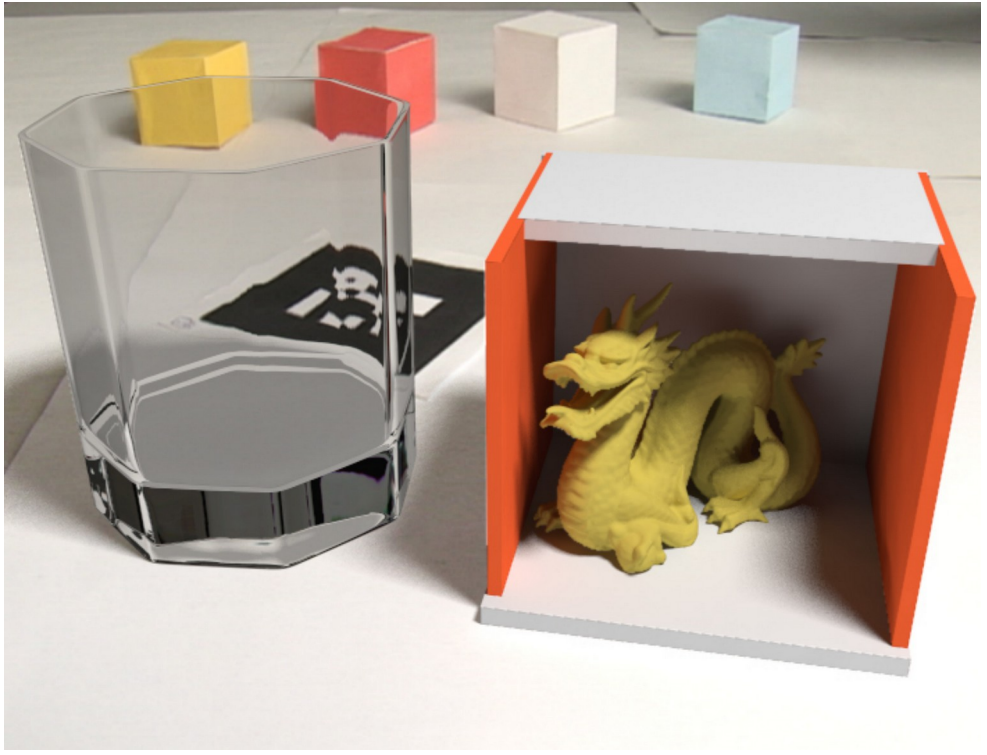
A Massively Parallel And Scalable Multi-GPU Material Point Method
Wang, et. al (SIGGRAPH 2020)

Implicit FEM and fluid coupling on GPU for interactive multiphysics simulation, Allard et al., SIGGRAPH 2011

9 Applications of Machine Learning for Rendering

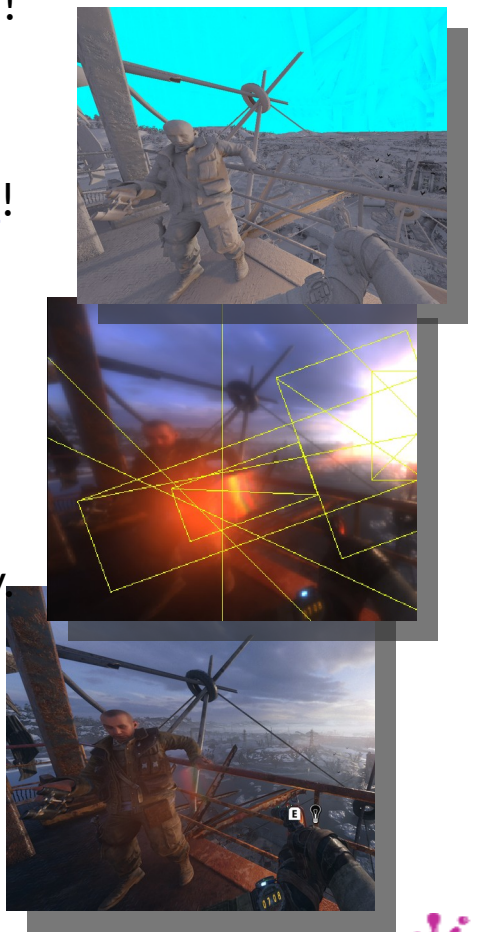
- Provide an overview of techniques that leverage machine learning for rendering.

- Provide an overview of global illumination rendering techniques for virtual and augmented reality.

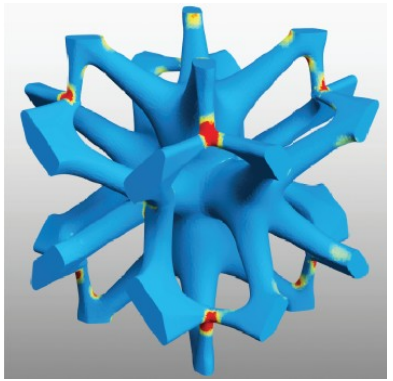


11 In-Depth Frame-Analysis of High-End Game Graphics

- Pick a game with high-end 3D graphics and analyze how a frame is rendered!
- *Warning:* This seminar topic will involve hands-on work, because ***you*** are supposed to do the frame analysis!
  - Use a frame debugging tool like NVIDIA Nsight Graphics or RenderDoc!
  - You **may** choose a game that has been analyzed before by others to make better progress (see, e.g., Adrian Courrèges' Graphics Studies Compilation, or similar sources)
- In your seminar paper, describe the results of your frame analysis, **and** describe rendering techniques used by the game in-depth!
  - It is not always easy to figure out which technique a game uses exactly. Therefore, research the state of the art of a specific effect (e.g., ambient occlusion, or shadows) and make an educated guess which variant the analyzed game might have used!
  - Perform this in-depth effect analysis for multiple (at least 2) effects!
- This topic is offered twice. Different games and effects must be analyzed.

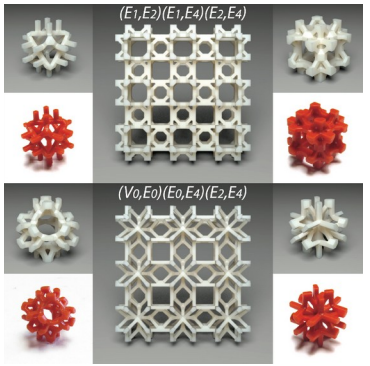


Generating mesoscale structures with target elastic properties



Panetta *et al.*, 2017

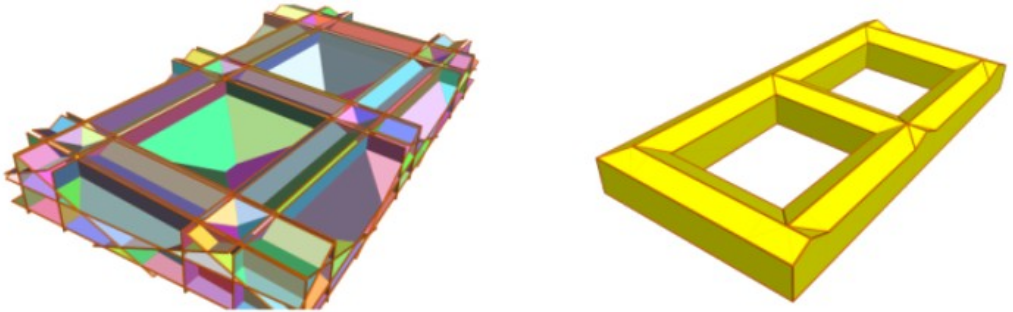
Martínez *et al.*, 2016



Panetta *et al.*, 2015

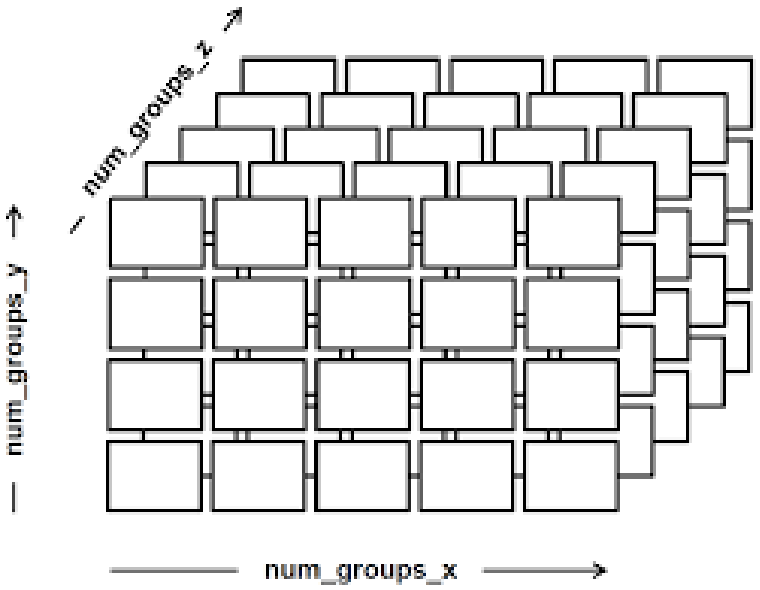
13 Labeling Problem in Polygonal Reconstruction

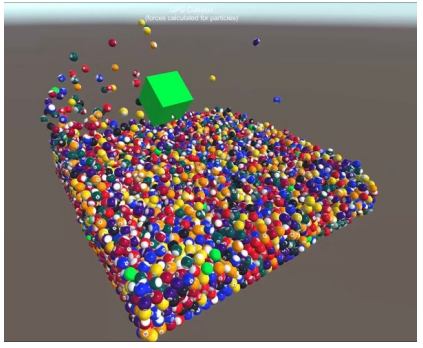
- As an intermediate stage in piece-wise planar reconstruction, one extracts a cellular complex – intersection of all planes with each other
- Given such complex, how to label cells or facets to extract a polygonal mesh?

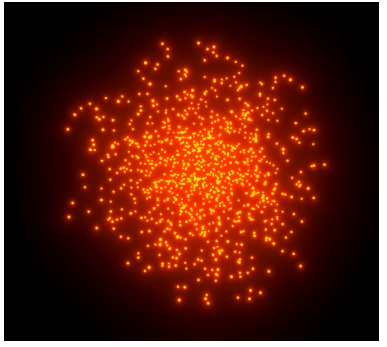


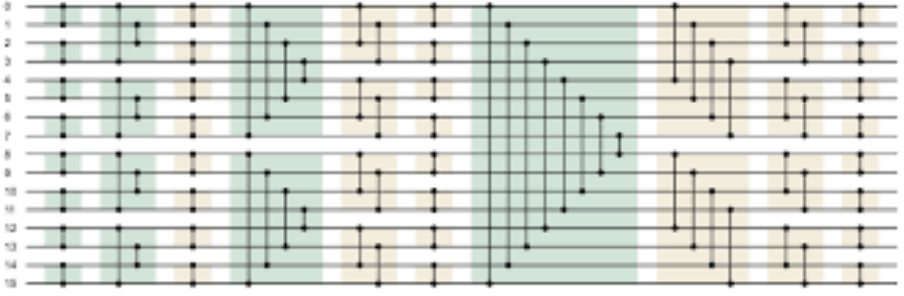
Nan, L., Wonka, P., 2017. “Polyfit: Polygonal surface reconstruction from point clouds”

- Investigate a mix of several different uses for compute shaders
- Sorting, Rendering, Processing, etc.



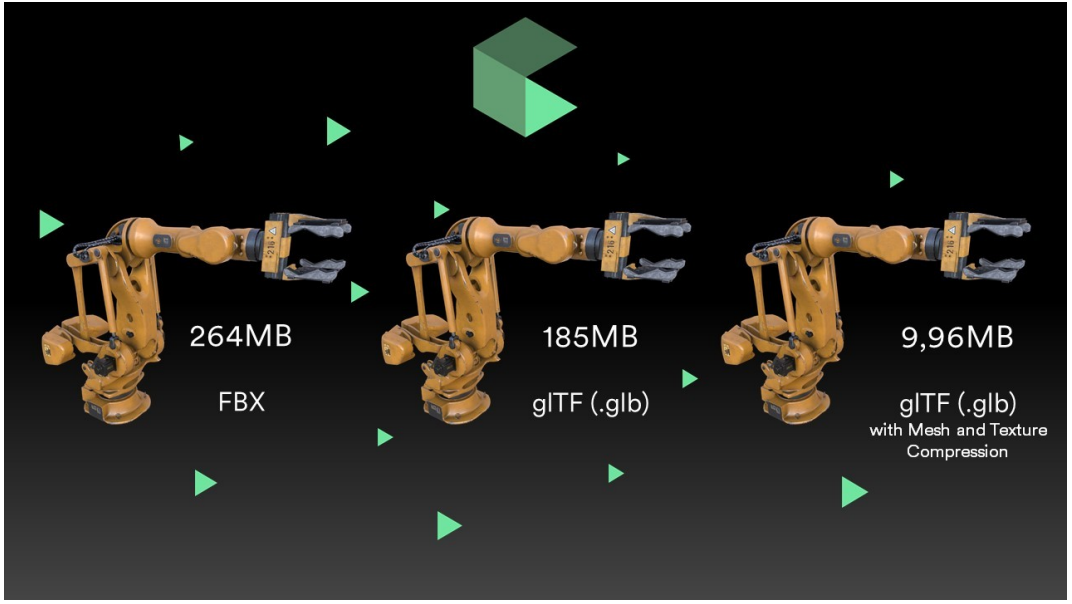




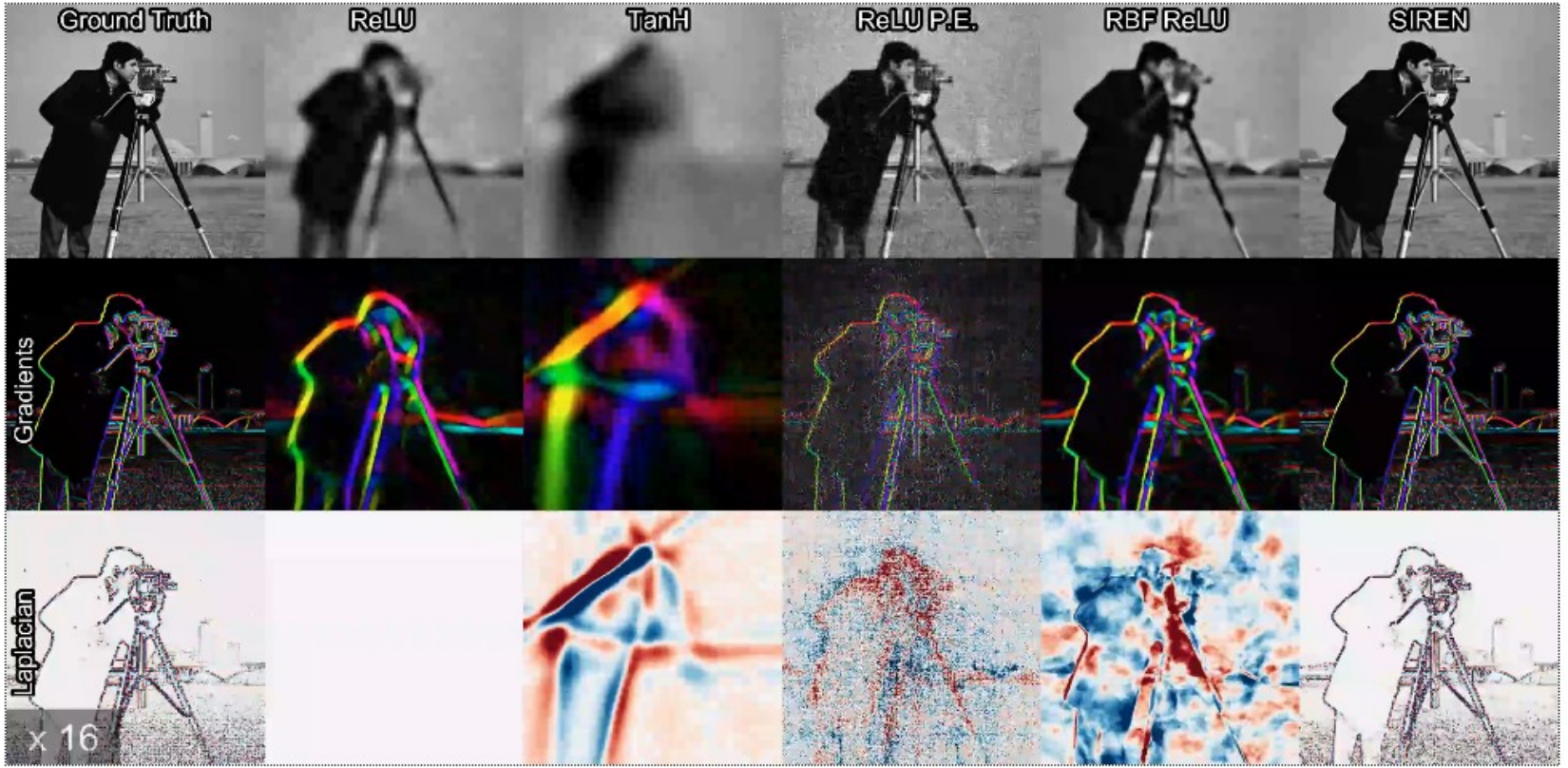


15 Compression

- Present modern compression techniques for geometry and textures
- Differences between compression for disk-storage and rendering?
- Perf of encoding and decoding; Compression ratio; …



16 Neural Representation of 3D Data



Vincent Sitzmann, Julien N. P. Martel, Alexander Bergman, David B. Lindell, Gordon Wetzstein.
Implicit Neural Representations with Periodic Activation Functions

17 Deep Learning Fluid Simulation

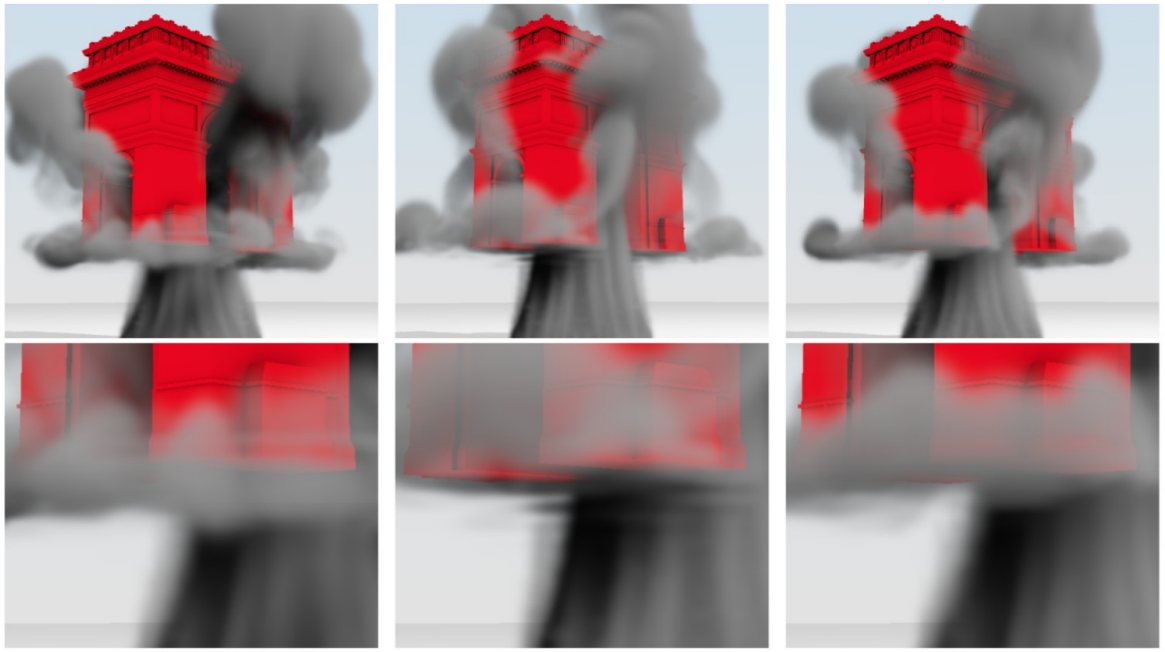
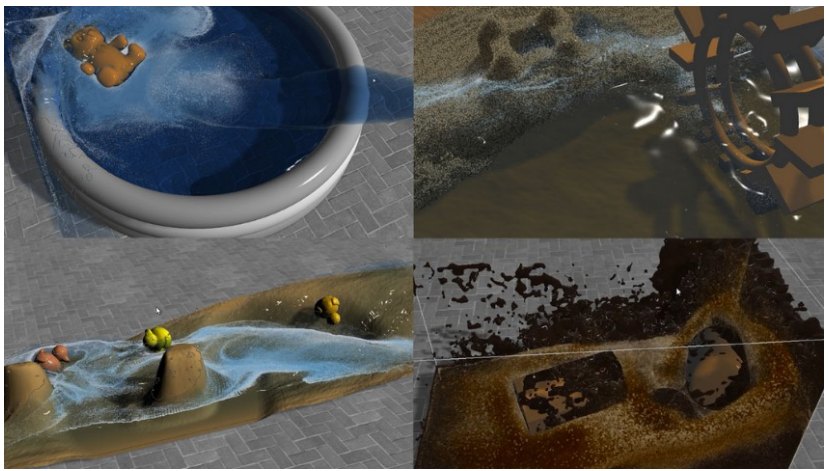
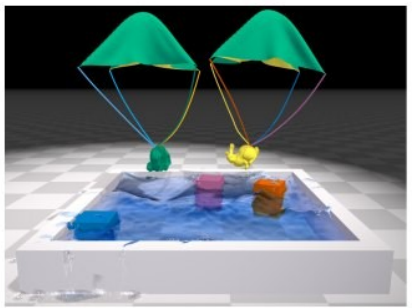


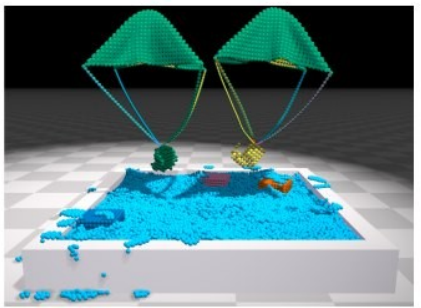
Figure 7. Plume simulation with "Arch" geometry. *Left*: PCG. *Middle* small-model *Right*: this work.

Jonathan Tompson, Kristofer Schlachter, Pablo Sprechmann, Ken Perlin.
Accelerating Eulerian Fluid Simulation With Convolutional Networks

- Conduct a survey of the state-of-the-art in Real-time Physics Simulation







- Conduct a survey of the state-of-the-art in Physically Based Rendering

20 Real-time Illumination from Polygonal Lights

- Calculating the illumination from area lights is a non-trivial problem in real-time rendering and requires thought-out solutions.

Eric Heitz, Jonathan Dupuy, Stephen Hill, and David Neubelt. 2016. Real-time polygonal light shading with linearly transformed cosines. ACM Trans. Graph. (Proc. SIGGRAPH).

Topic Assignment

- Please please mark down at least 3 topics in order of preference (1, 2, 3, …) and post your topic preferences in forum “Discussions” until the end of the day
- I will try to make a fair assignment of topics and post them in forum “Announcements”

Questions?

- Get in contact with your supervisor ASAP
- Discuss literature list with your supervisor
- Submit the list to TUWEL by 25.10.