Seminar in Scientific Writing
193.052, SS 2022, 2.0h (3 ECTS)

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Institute of Visual Computing and Human-Centered Technology
(E193-02)

TU Wien

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

Less in-depth/specialized than subsequent Master seminar!

If well done → can continue to bachelor or 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 in the seminar room

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

- 14.03. Group phase starts (you learn whether you passed phase 1)
- 04.04. 23:59 Submit literature list (on TUWEL)
- 24.03. 11:00-11:15 Q&A Lecture Prof. Wimmer
- 06.04. 15:00-15:15 Q&A Lecture Prof. Kaufmann
- 27.04. 11:00-13:00 Lecture Prof. Gröller
- 23.05. 23:59 Submit report draft
- 06.06. 23:59 Submit review
- 28.06. 23:59 Submit slides
- 29.06. 13:00-18:00 Seminar talks
- 29.06. 23:59 Submit final report

Topic Presentation

- Now 19 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”

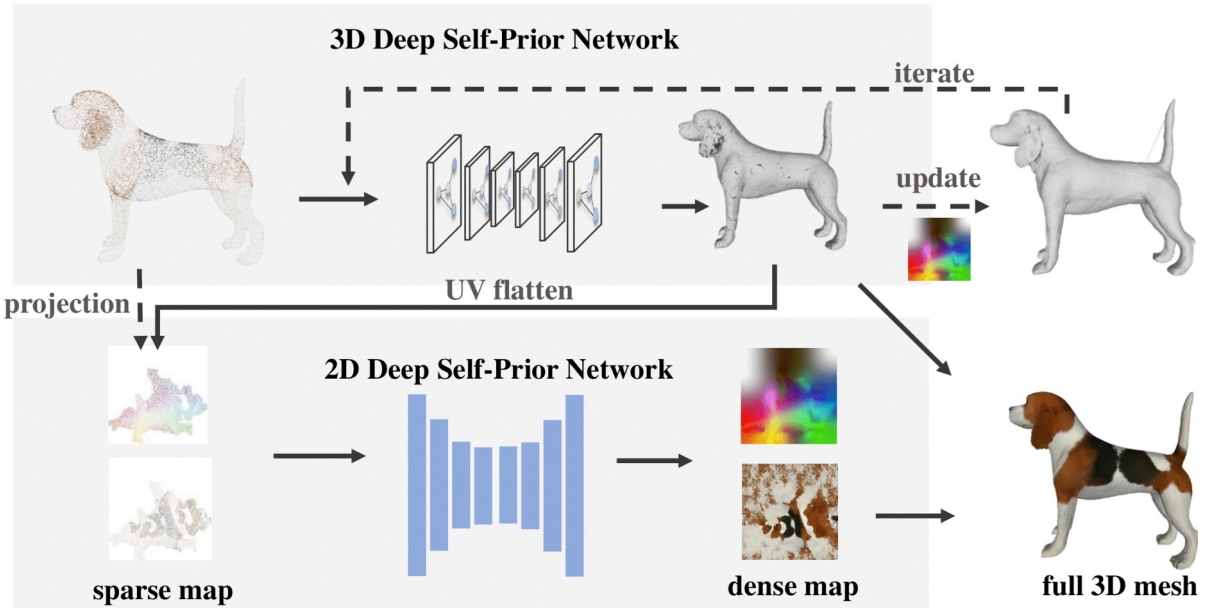
Topic Assignment

- 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”

1 Colored ReconstructionTopic Assignment

Input

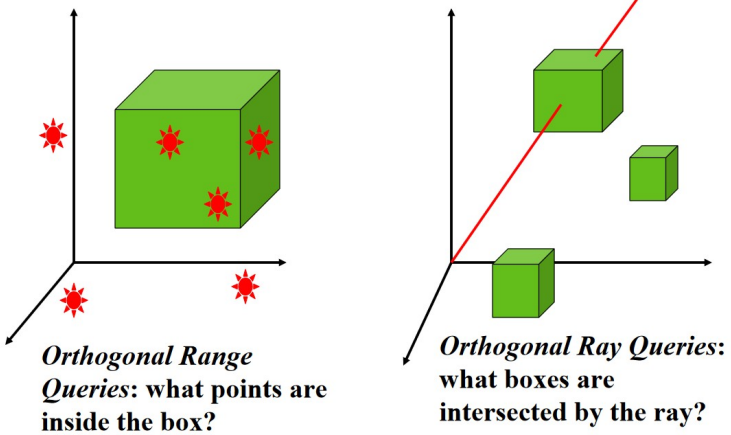
Ours (with texture)



Wei, Xingkui, et al. "Deep Hybrid Self-Prior for Full 3D Mesh Generation." *Proceedings of the IEEE/CVF International Conference on Computer Vision*. 2021.

Two Special Cases: Range Queries and Ray Queries

SIGGRAPH2005



Orthogonal Range Queries: what points are inside the box?

Orthogonal Ray Queries: what boxes are intersected by the ray?

Quantum Rendering vs. Classical Rendering (3)

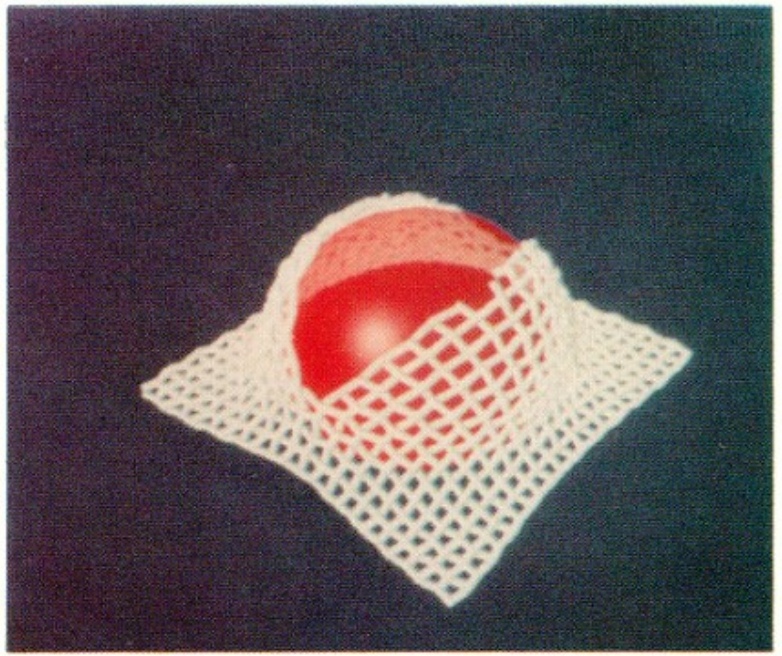
SIGGRAPH2005

NP = Number of rays	Query Time	Space Resources
Classical Ray Casting Brute Force *General Objects*	O(NP N)	O(N)
Classical Ray Casting Linear Space Tree *Coord. Boxes*	$O(NP (N^{1-1/d} + k))$	O(N)
Classical Ray Casting Non-Linear Space Tree *Coord. Boxes*	$O(NP(Log^d N + k))$	$O(N Log^{d-1} N)$
Quantum Ray Casting *General Objects*	$O(NP ((Nk)^{1/2} + k^{1/2}))$	O(N)

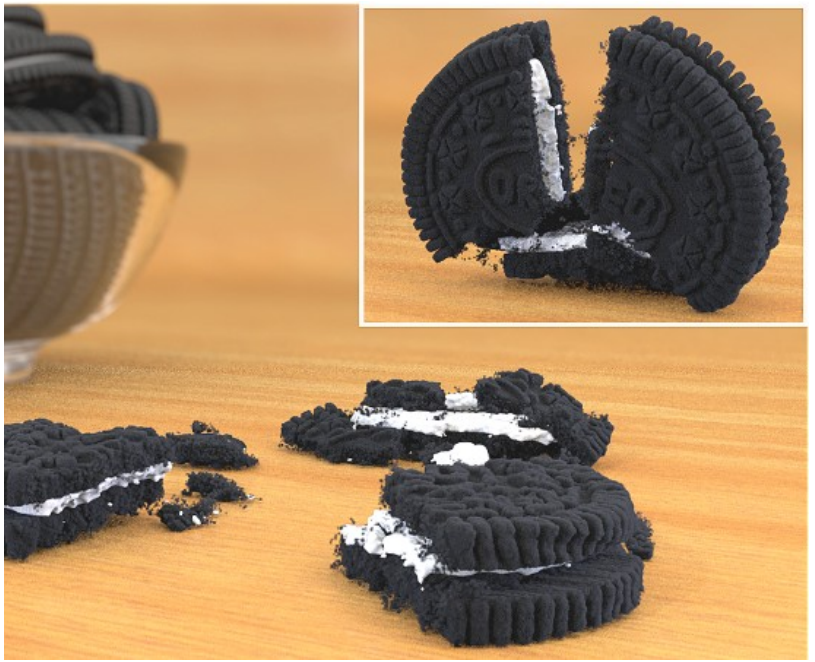
Leung, Nelson, et al. "Speedup for quantum optimal control from automatic differentiation based on graphics processing units." *Physical Review A* 95.4 (2017): 042318.

https://dl.acm.org/doi/abs/10.1145/1198555.1198722

3 Fracture Simulation



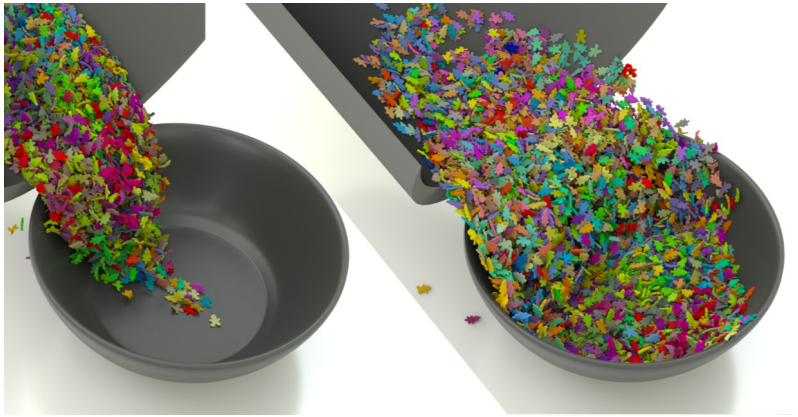
Terzopoulos and Fleischer, Modeling inelastic deformation: viscolelasticity, plasticity, fracture. Proceedings of the 15th Annual Conference on Computer Graphics and Interactive Techniques (1988)



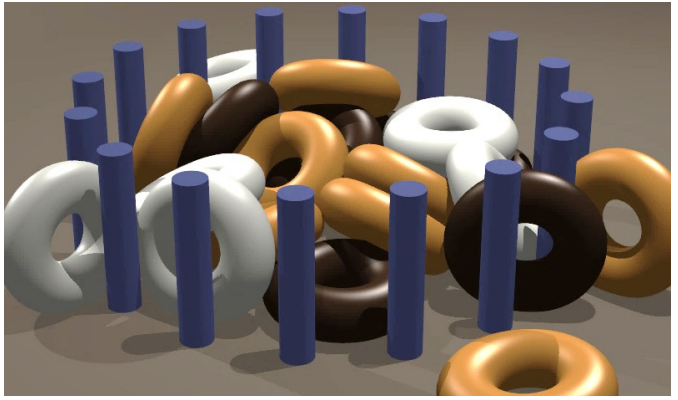
Wolper et al., CD-MPM: Continuum Damage Material Point Methods for Dynamic Fracture Animation. ACM Trans. Graph. 38, 4 (2019)

4 GPU-Accelerated Real-Time Physics

developer.nvidia.com/flex



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

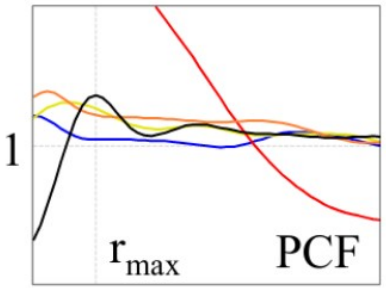


Implicit FEM and fluid coupling on GPU for interactive multiphysics simulation, Allard et al., SIGGRAPH 2011

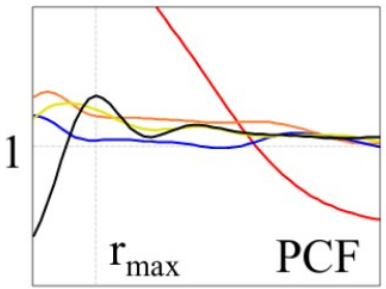
5 Recent Advances in Real-Time Global Illumination

- Provide an overview of current real-time global-illumination techniques (including voxel cone tracing, dynamic diffuse global illumination, etc.)

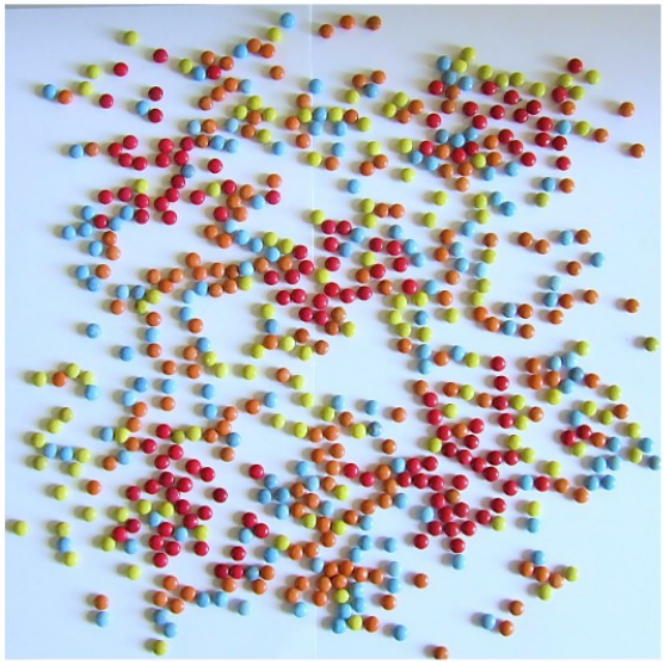
6 Point Distribution Synthesis



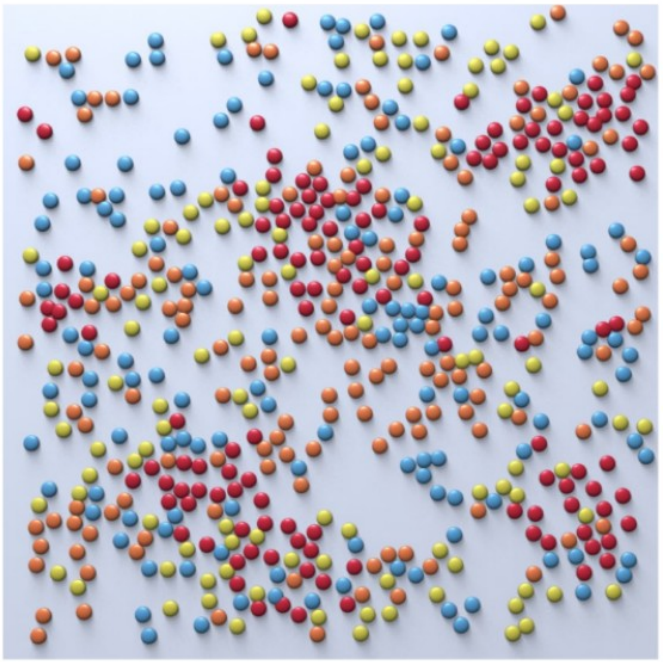
Original



Synthesized



Original (Photo)



Synthesized (Rendering)

Öztireli, A. Cengiz, and Markus Gross. "Analysis and synthesis of point distributions based on pair correlation." *ACM Transactions on Graphics (TOG)* 31.6 (2012).

7 Medial Axis Computation

- The medial axis contains points that are closest to 2 or more points on the boundary
- Can be used for shape simplification

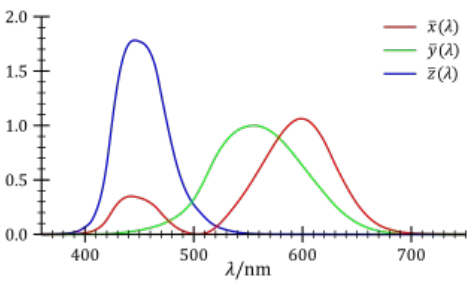
Surface Reconstructed from Boundary Points | Original Medial Axis | Simplified Medial Axis | Strongly Simplified Medial Axis | Surface Reconstructed from Strongly Simplified Axis

Roger C. Tam, Wolfgang Heidrich:
Shape Simplification Based on the Medial Axis Transform. IEEE Visualization 2003: 481-488

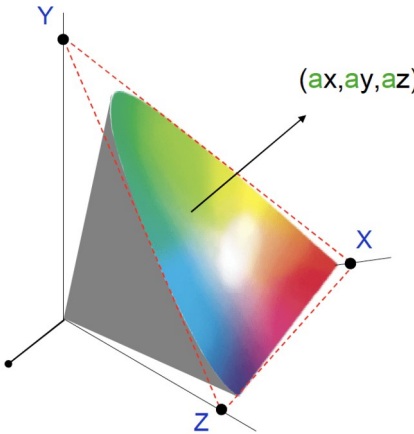
Nina Amenta et. al. 2001. The power crust. In Proceedings of the sixth ACM symposium on Solid modeling and applications (SMA '01). Association for Computing Machinery, New York, NY, USA, 249–266. DOI:https://doi.org/10.1145/376957.376986

8 Color Perception and Color Spaces

- Colors are electromagnetic waves (photons) at different wavelengths
- Most knowledge about how humans perceive color is based on tests with humans (standard observer, Fairman et al)
- Monitors… but also spectral rendering makes use of these observations



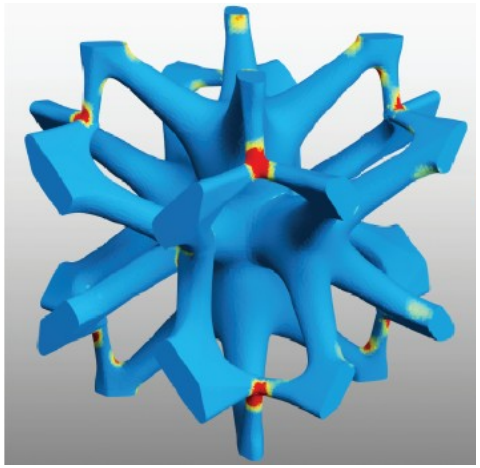
CIE XYZ standard observer color matching functions, Wikipedia



CIE XYZ Color space, Wikipedia

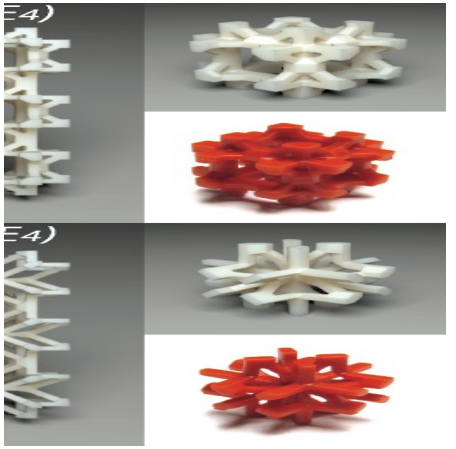
Fairman et al. "How the CIE 1931 color-matching functions were derived from Wright-Guild data". Color Research & Application

Generating mesoscale structures with target elastic properties



Panetta *et al.*, 2017

Martínez *et al.*, 2016



Panetta *et al.*, 2015

10 Deep Learning Fluid Simulation

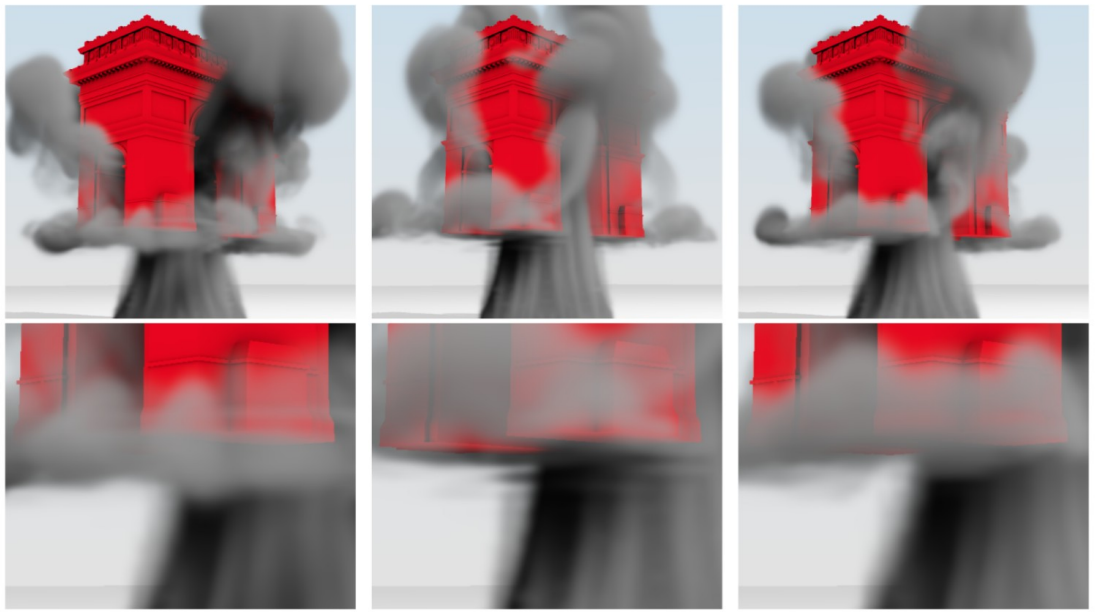
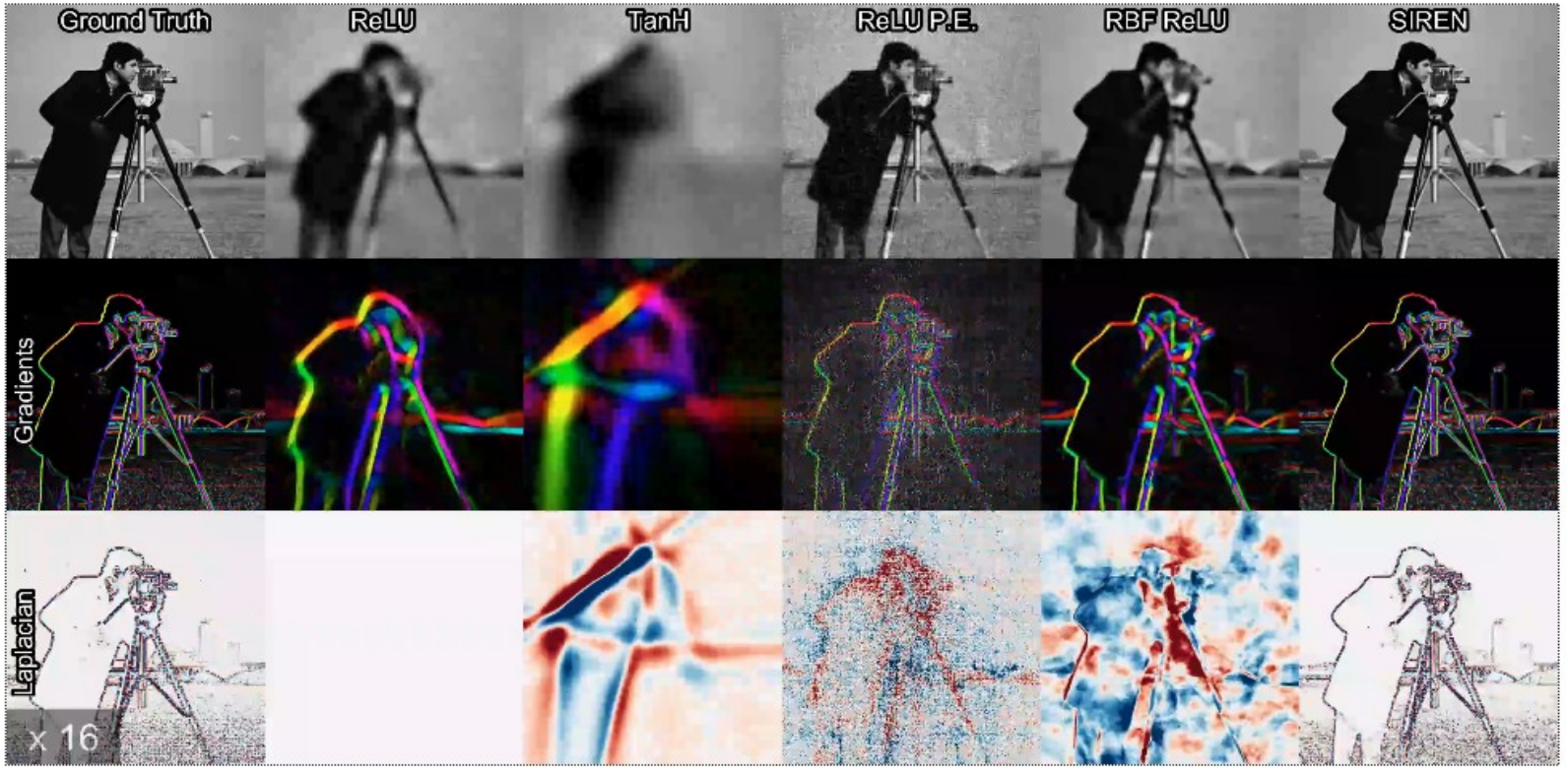


Figure 7. Plume simulation with "Arch" geometry. *Left*: PCG. *Middle* small-model *Right*: this work.

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

11 Neural Representation of 3D Data

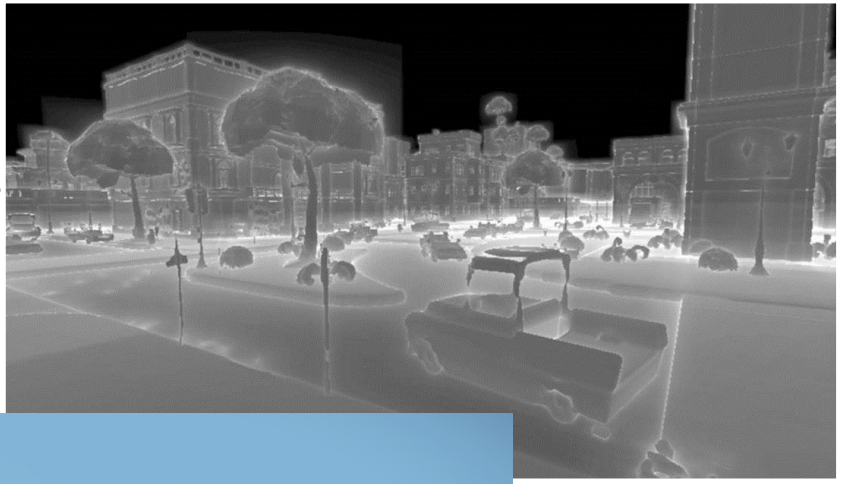


Vincent Sitzmann, Julien N. P. Martel, Alexander Bergman, David B. Lindell, Gordon Wetzstein.
Implicit Neural Representations with Periodic Activation Functions

Conduct a survey of recent advances in real-time non-photorealistic rendering

Lukas Lipp

Conduct a survey on
signed distance field rendering.



14 Neural Radiance Fields (NeRFS)

- NeRFs learn 3D scenes from images and can then synthesize new viewpoints!
- Input: 20 photos →
- Hot topic: Introduced in 2020 („NeRF Explosion“)
- You will need to:
  - Understand the basics of the original NeRF approach
  - Get an overview of the different variants and specializations
  - Pick one and explore (e.g., solutions for dynamic/unbounded scenes)

15 Neural Denoising

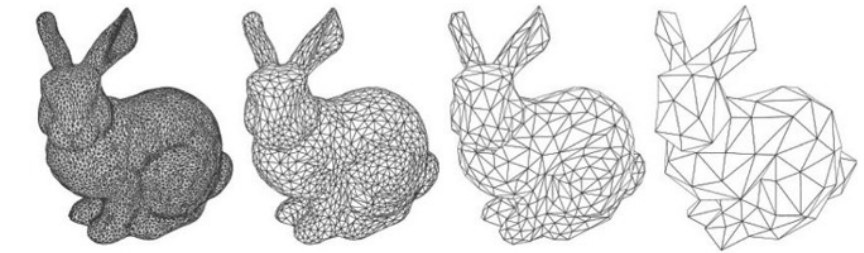
- Denoising/reconstruction is vital for producing high-quality renderings quickly: Advanced methods can produce noise-free images from very noisy input

Input (8 spp) | Per-pixel | Per-sample | Layered | Reference (65536 spp)

- Neural denoising can apply its learned knowledge of common or probable scene features to fill in the blanks
- But is it better than conventional denoising or reconstruction methods? You should find out and provide a detailed comparison of pros and cons!

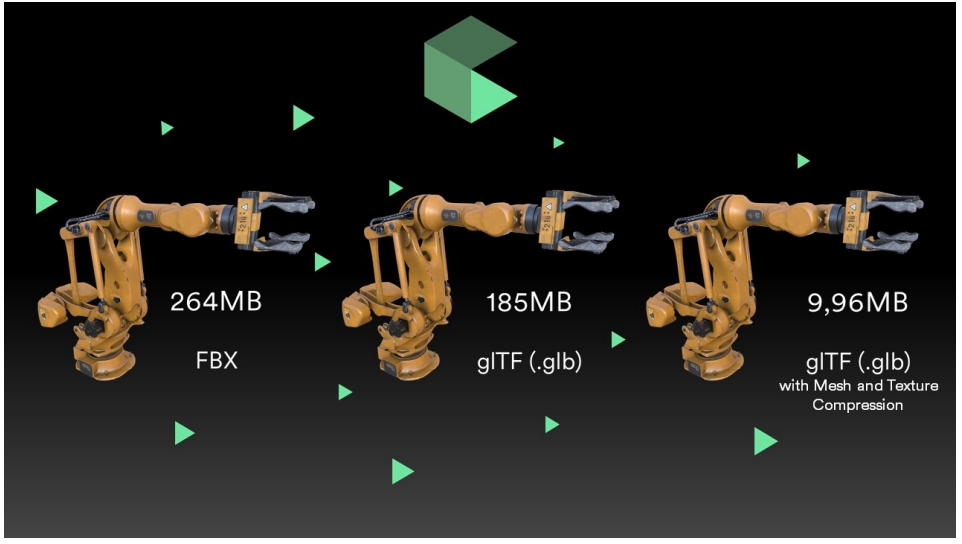
16 Level of Detail

- Investigate the latest trends for level of details
- Triangles, Voxels, Signed Distance Fields, etc.
- Vegetation, Terrain, Particles, Molecules, ...



17 Compression

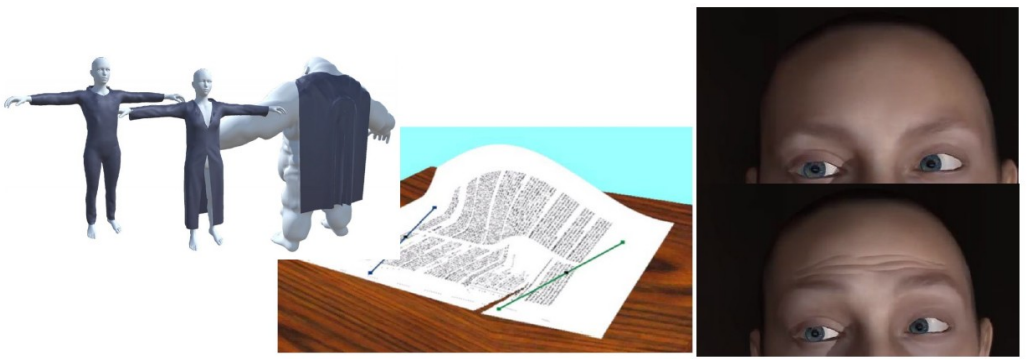
- Present modern compression techniques for geometry and textures
- Differences between compression for disk-storage and rendering?
- Perf of encoding and decoding; Compression ratio; ...



Interactive Simulation of Deformable or Tearable Materials

- Solving the animation of this type of materials is non-trivial, with the added constraint of interactive rates requiring a compromise between fidelity and computational cost.

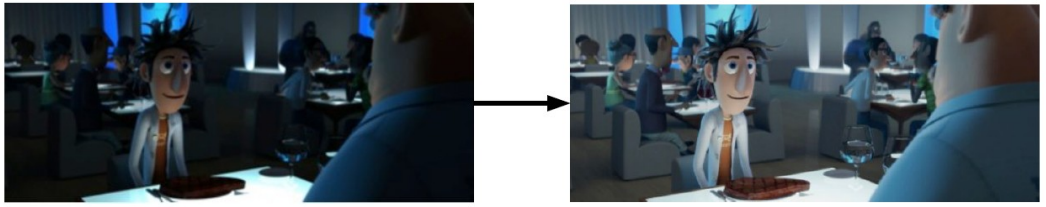
- Generally, approaches can be divided into physically based and data driven models. Models can also be generalists (for no specific purpose) or optimized to specific problems (examples: paper, clothing, skin)



Automated Color Correction

- Images from both photography and film often require color rebalancing. Modern tools, like photoshop, feature algorithms to automatically balance the color in a photo.

- The student is expected to explain what is color balance and write an overview of both automated traditional methods and deep learning based solutions. Finally, the student should compare them.



Questions?

- Get in contact with your supervisor ASAP
- Discuss literature list with your supervisor
- Submit the list to TUWEL by 04.04.