Seminar in Scientific Writing 193.052, SS 2025, 2.0h (3 ECTS)

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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 TISS (first phase of course)

Topics are presented today, assigned tomorrow on TUWEL

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: compare and evaluate 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 report in PDF format
- Report has to be complete and minimum 8 pages!
- NEW: We will use TurnItIn to automatically check for plagiarism

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 camera-ready 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%
- Report: 45% (NEW: 15% for report, 30% for camera-ready report)

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

Important Dates

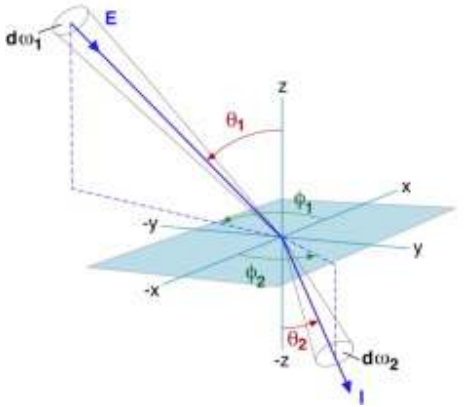
- 31.03. 23:59 Submit literature list (on TUWEL)
- 03.04.: Lecture Prof. Wimmer
- 10.04: Lecture Prof. Gröller
- Recorded: Lecture Prof. Kaufmann
- 19.05. 23:59 Submit report
- 02.06. 23:59 Submit review
- 24.06. 23:59 Submit slides
- 25.06. 9:00-13:00 and 15:00-18:00 (if required) Seminar talks
- 25.06. 23:59 Submit final report

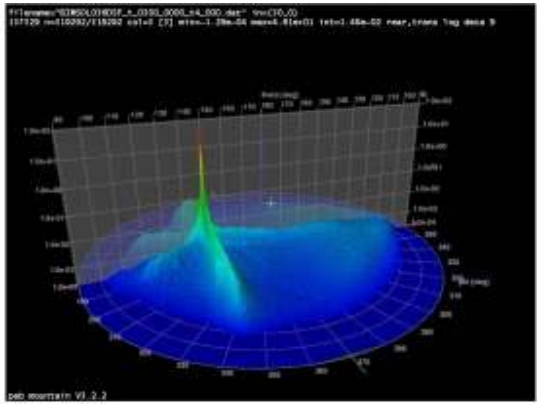
Topic Presentation

- Now 15 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 Representation of Measured Materials

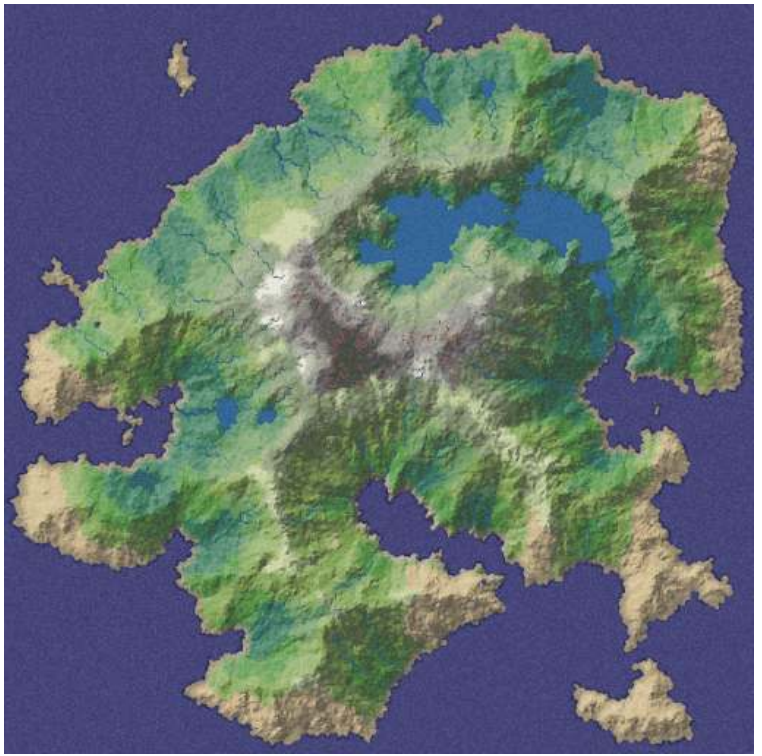
Conduct a survey of recent advances in the representation and application of measured materials





2 Procedural Content Generation

- 3D Scenes, maps, assets
- 2D Maps
- UE5: Drop an asset, procedurally integrate it to surrounding



- Methods to efficiently modify points, triangles, voxels, NERF
- E.g., Pointshop, Nerfshop, …

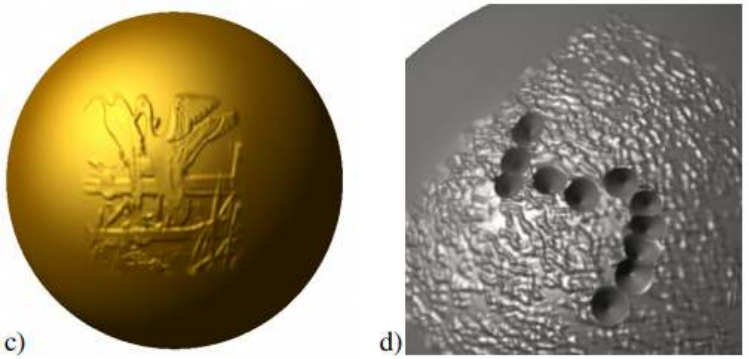
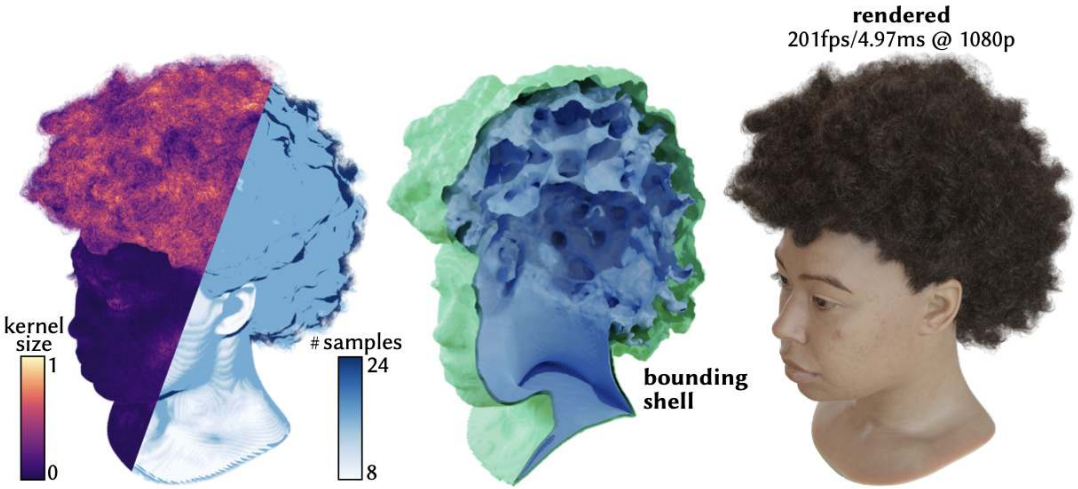


Figure 9: Editing operations: a) Texturing with alpha blending. b) Texture filtering. c) Normal displacement. d) Carving on a rough surface.

4 Real-Time (LOD) Rendering: Hair, Vegetation, Fibers



Wang, et al. “Adaptive Shells for Efficient Neural Radiance Field Rendering"
ACM Transactions on Graphics (TOG), Volume 42, Issue 6

Fig. 12. *Compared to rendering full hair geometry with single BCSDF f^{single}, using thick hair to reduce the hair size need our aggregated BCSDF f^{our} combined with shadow masking term $S(\phi, \theta_d)$.*

Tao Huang, Yang Zhou, Daqi Lin, Junqiu Zhu, Ling-Qi Yan, Kui Wu
"Real-time Level-of-Detail Strand-based Hair Rendering" *Arxiv*

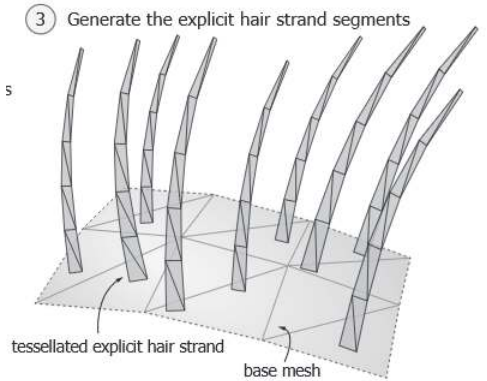
Lukas Lipp

5 Fur and Hair Rendering

Xia et al. 2023, A Practical Wave Optics Reflection Model for Hair and Fur

Yuksel et al. 2024, Real-time Hair Rendering with Hair Meshes

Andersen et al. 2016, Hybrid fur rendering: combining volumetric fur with explicit hair strands



6 Evaluating a 3D Reconstruction Algorithm 1

- Capture 4+ diverse photo datasets (e.g. inside out, outside in, plants, reflective)
- Download code for “**2D Gaussian Splatting for Geometrically Accurate Radiance Fields**” and at least one competing paper
- Run the benchmarks and compare, following the structure of the original paper
- Report
  - Background
  - Summary of algorithm
  - Data / graphs etc (similar to paper)
  - Conclusion
- Deliver Dataset

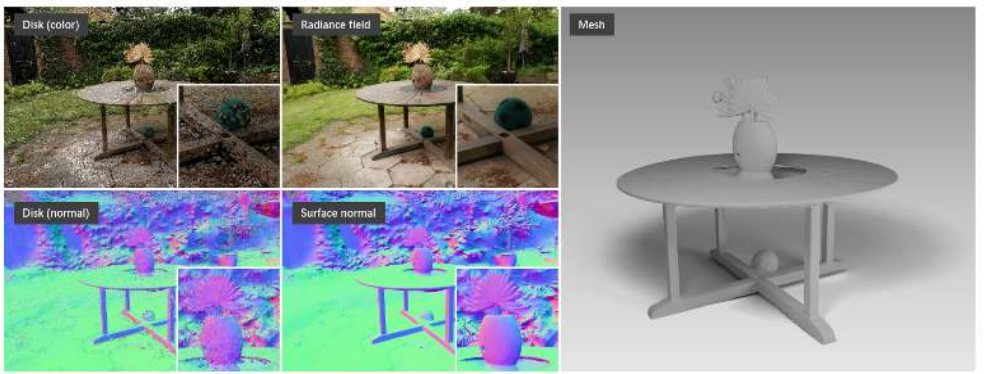
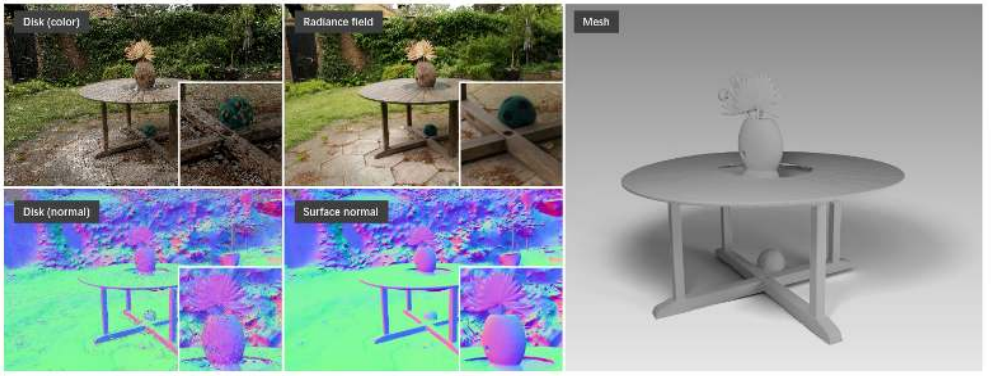


Figure 1: Our method, *2DGS*, (a) optimizes a set of 2D oriented disks to represent and reconstruct a complex real-world scene from multi-view RGB images. These optimized 2D disks are tightly aligned to the surfaces. (b) With 2D Gaussian splatting, we allow real-time rendering of high quality novel view images with view consistent normals and depth maps. (c) Finally, our method provides detailed and noise-free triangle mesh reconstruction from the optimized 2D disks.

From: 2D Gaussian Splatting for Geometrically Accurate Radiance Fields

7 Evaluating a 3D Reconstruction Algorithm 2

- Capture 4+ diverse photo datasets (e.g. inside out, outside in, plants, reflective)
- Download code for “**SuGaR: Surface-Aligned Gaussian Splatting for Efficient 3D Mesh Reconstruction and High-Quality Mesh Rendering**” and at least one competing paper
- Run the benchmarks and compare, following the structure of the original paper
- Report
  - Background
  - Summary of algorithm
  - Data / graphs etc (similar to paper)
  - Conclusion
- Deliver Dataset



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From: 2D Gaussian Splatting for Geometrically Accurate Radiance Fields

- How do Lidar rays interact with materials?

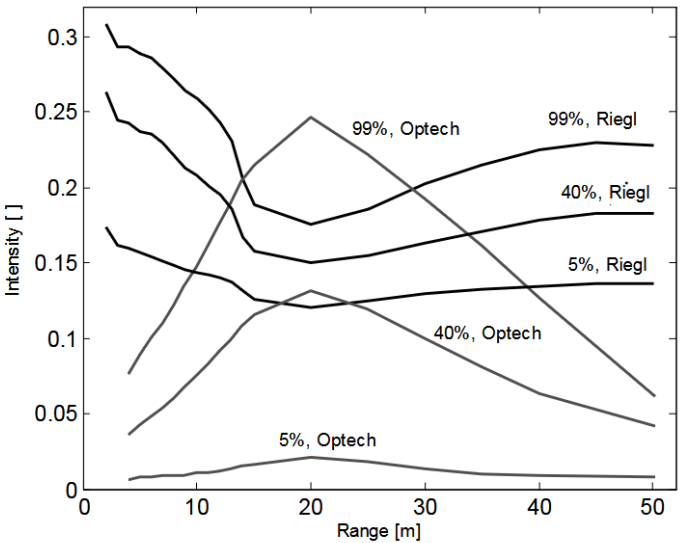
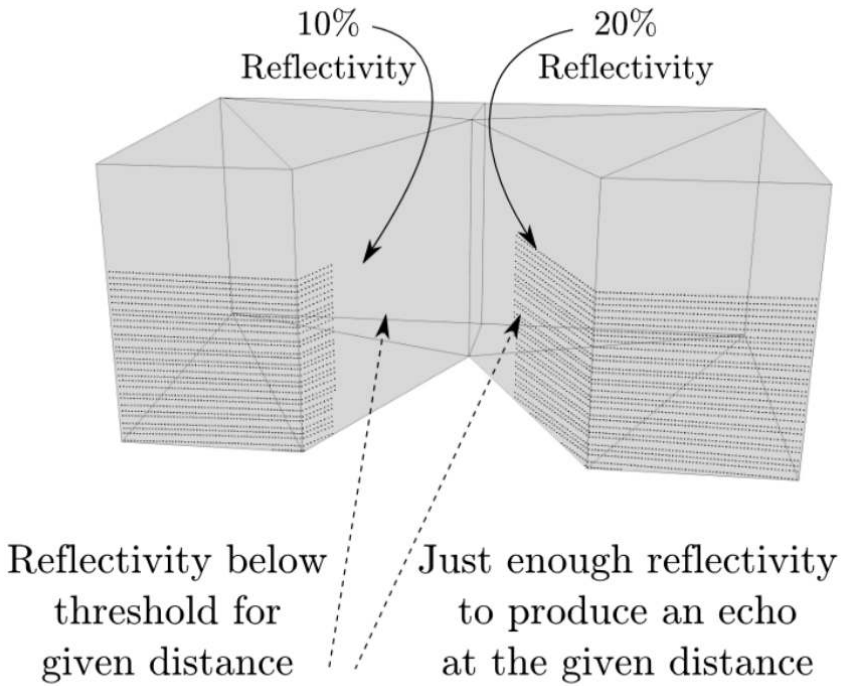
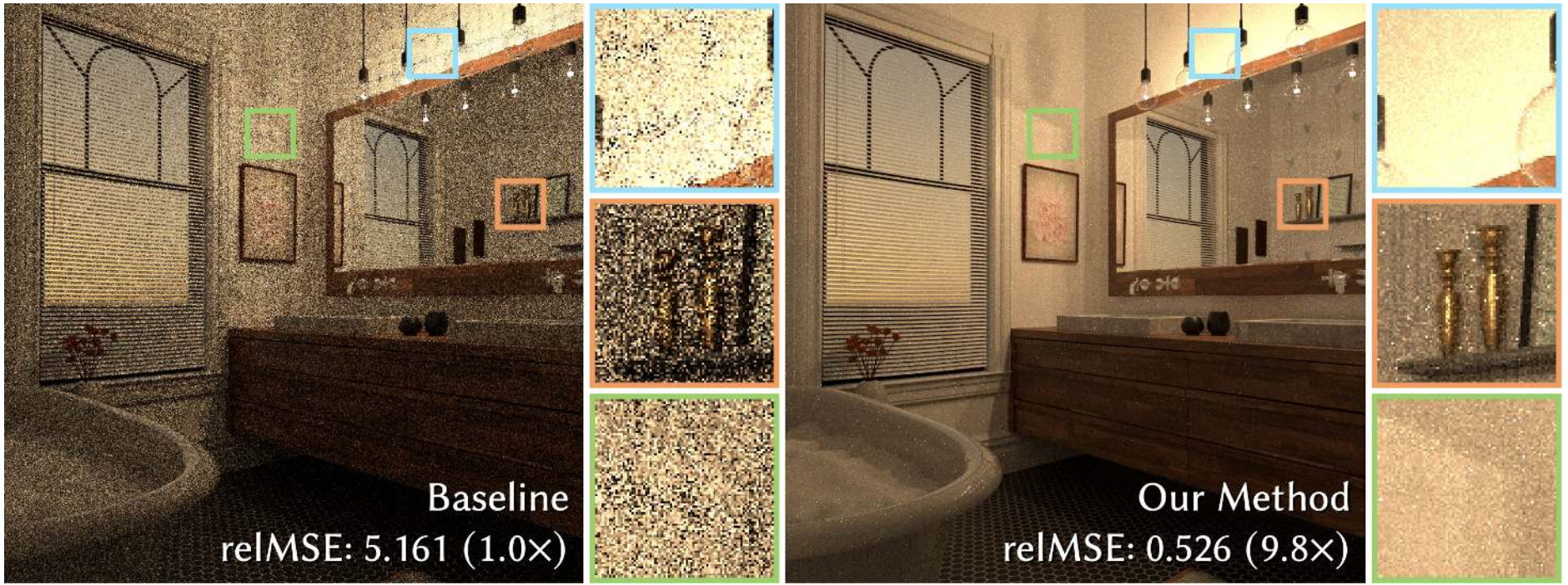


Figure 3: Mean intensities for the Riegl and the Optech laser scanner for three targets (99%, 40%, and 5% reflectivity) at different distances.



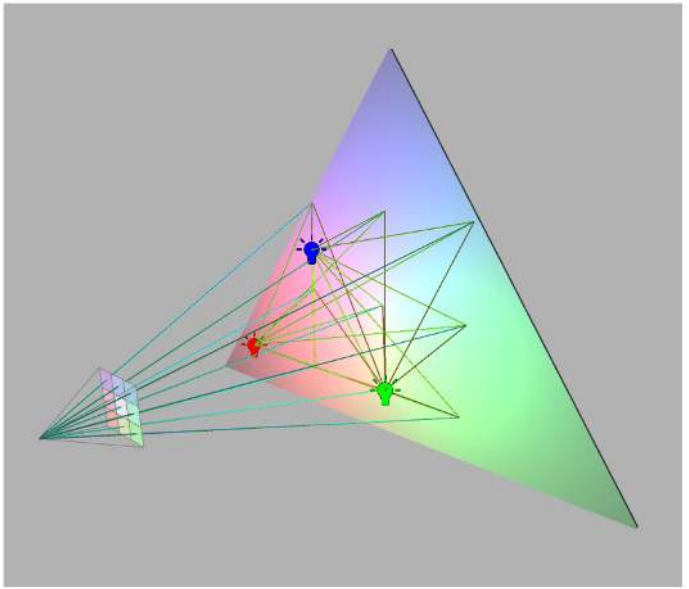
9 The Bleeding Edge in Path Guiding

- Path guiding is a highly active area in realistic rendering.
- Provide an overview over the **very latest** path-guiding techniques.

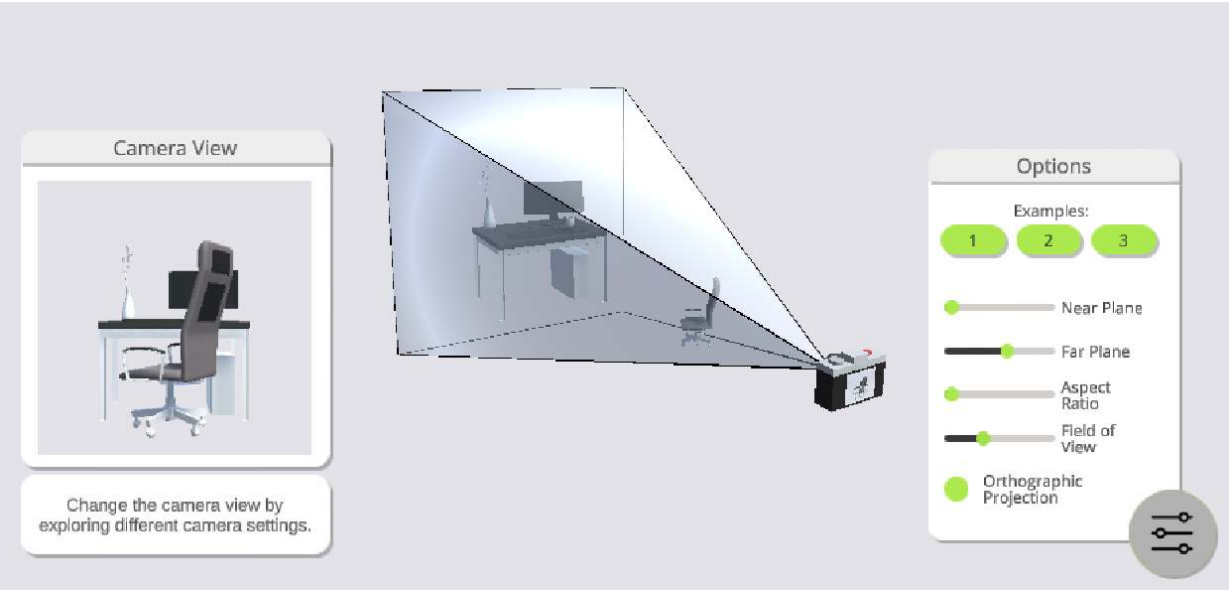


- Where can I find good stuff for CG lectures?
- How should we teach CG? In VR/AR?

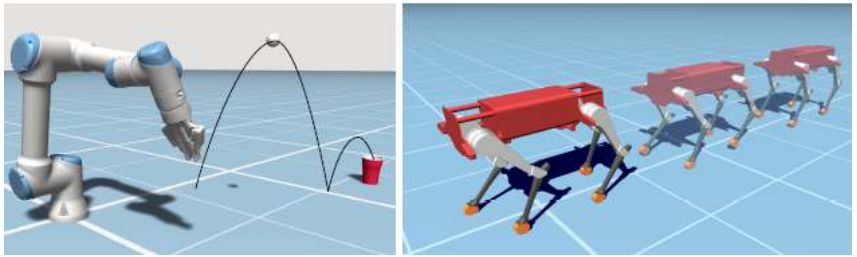
Virtual Ray Tracer



Field of View



11 Non-Linear Optimization in Computer Graphics

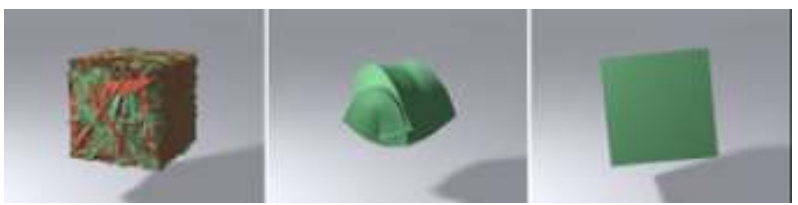


ADD: Analytically Differentiable Dynamics for Multi-Body Systems with Frictional Contact, Geilinger et al., SIGGRAPH Asia 2020

Computational Design of Planar Multistable Compliant Structures, Zhang et al., SIGGRAPH Asia 2021

View-Independent Adjoint Light Tracing for Lighting Design Optimization, Lipp et al., TOG 2024

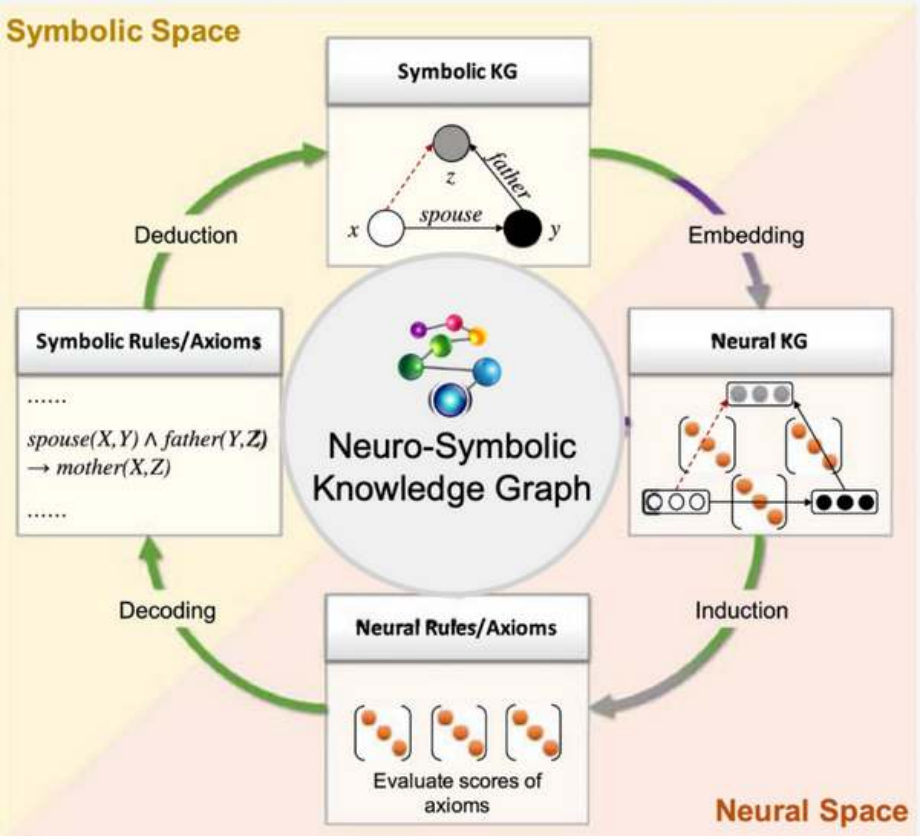
$$\min \quad f(\mathbf{x})$$
$$\text{s. t.} \quad \mathbf{g}(\mathbf{x}) = 0$$



Optimization Integrator for Large Time Steps, Gast et al., TVCG 2015

12 Symbolic Representations: Neural 3D Program Synth.

- Survey parametric scene graphs, shape assemblies and programs and full programming concept that are utilized for inverse scene modeling with the purpose of later possibility of editing
- Look for semantics and attention aspects and also various neural approaches using them



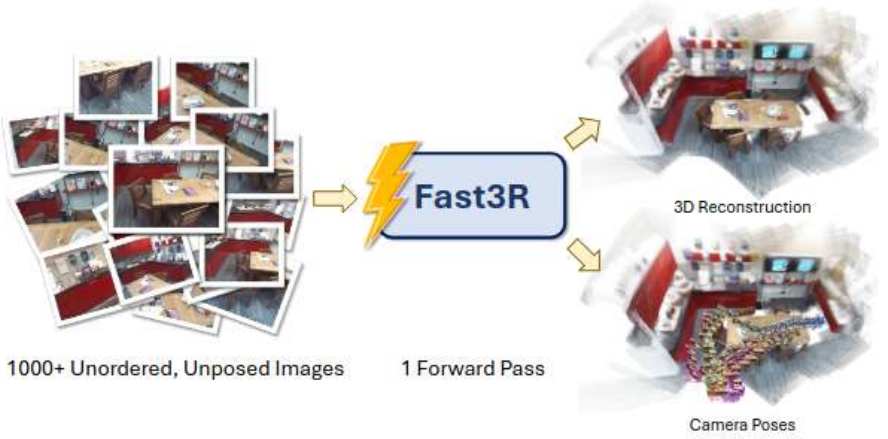
https://allegrograph.com/what-is-neuro-symbolic-ai/

13 Large-Scale Neural 3D Reconstruction in the Wild

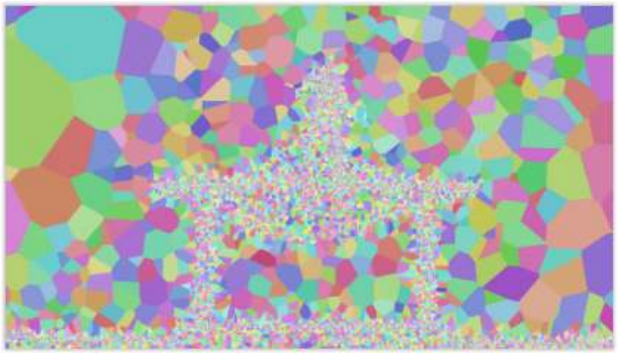
- Overview of techniques:

  complete 3D reconstruction, using very recent neural methods

- Starting from camera alignment (e.g. Fast3r) up to the scene (e.g. 2DGS, Radiant Foam)



https://fast3r-3d.github.io/



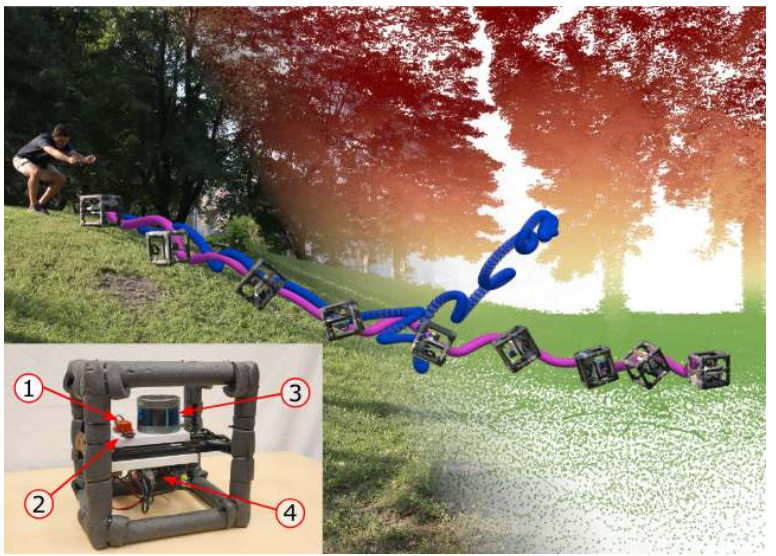
https://radfoam.github.io/

14 Extreme Motion Registration

- LIDAR scans from wildly varying motions need to be registered

Overview of experimental smart helmet

Saturation- Aware Angular Velocity Estimation: Extending the Robustness of SLAM to Aggressive Motions*, Deschenes et al., ICRA 2024

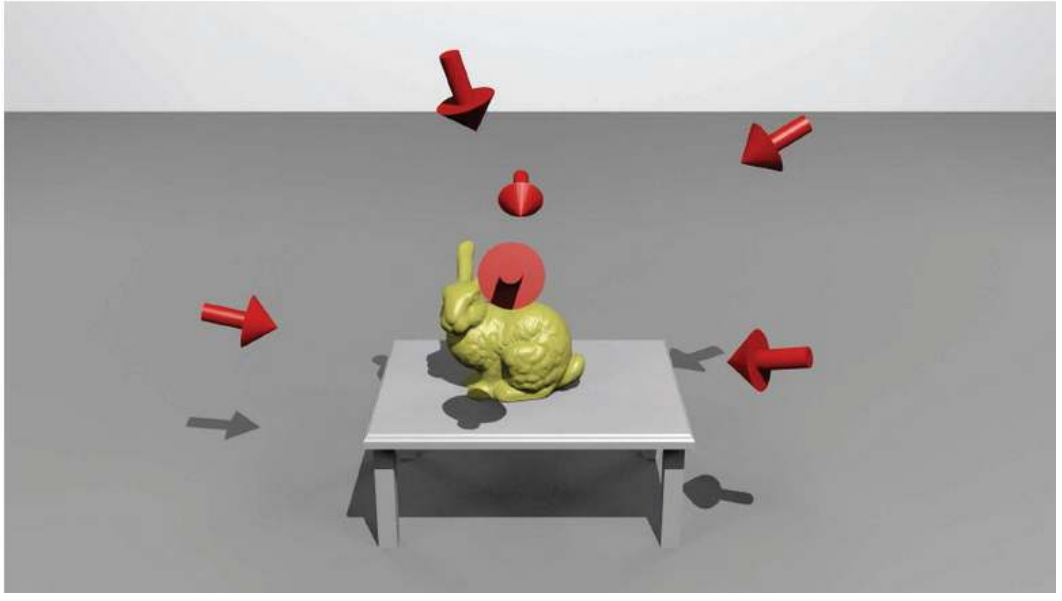


Map building using helmet-mounted LiDAR for micro-mobility. Yoshida et al. ALR 2023

15 Evaluation of Next-Best-View Algorithms

Determines the ideal next camera position for scanning

→ Compare algorithms for effectiveness and objects vs. scenes



Volumetric Next-best-view Planning for 3D Object Reconstruction with Positioning Error, Vasquez-Gomez et al., IJARS 2014

Questions?

- Get in contact with your supervisor ASAP
- Discuss literature list with your supervisor
- Submit the list to TUWEL by 31.3.