Seminar in Scientific Writing 193.052, SS 2023, 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 TISS (first phase of the 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

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 full pages!

Scientific Review

- You will get a draft of another student to review
- Typical conference review form (Eurographics)
- This helps author to improve their 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

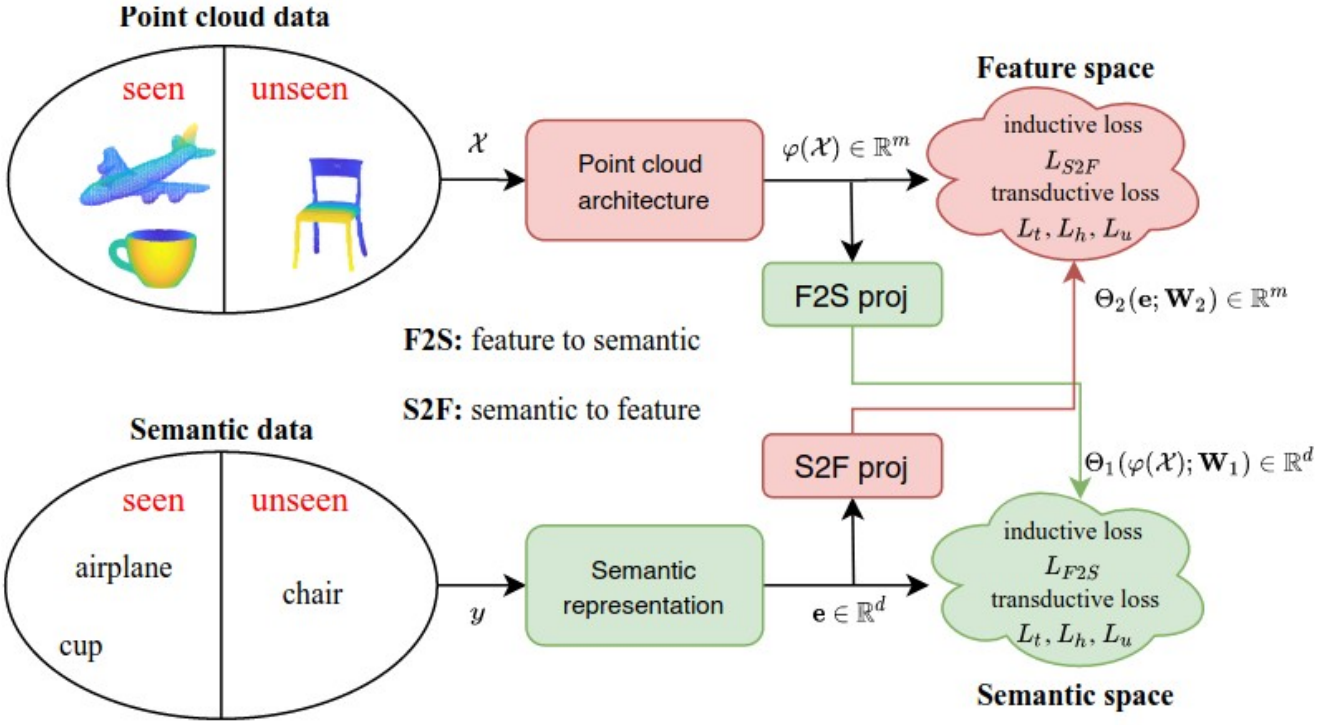
- 24.03. Latest date you learn whether you passed phase 1
- 30.03. 23:59 Submit literature list (on TUWEL)
- 23.03. 13:00 - 15:00: Lecture Prof. Gröller
- 21.04. 12:00 - 14:00: Lecture Prof. Wimmer
- 27.04. 13:00: Q&A Prof. Kaufmann (Lecture is online on TUWEL)
- 22.05. 23:59 Submit report draft
- 05.06. 23:59 Submit review
- 21.06. 23:59 Submit slides
- 22.06. 13:00 - 18:00 Seminar talks
- 22.06. 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”

1 Zero-Shot Learning: Discover unseen Object Classes

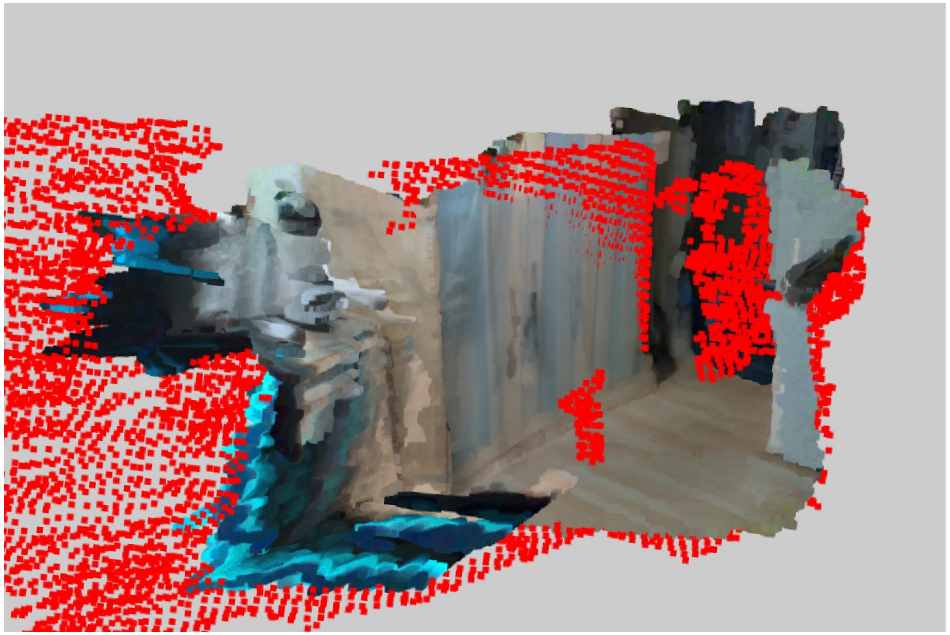
Learn new object classes in scanned point clouds on-the-fly:

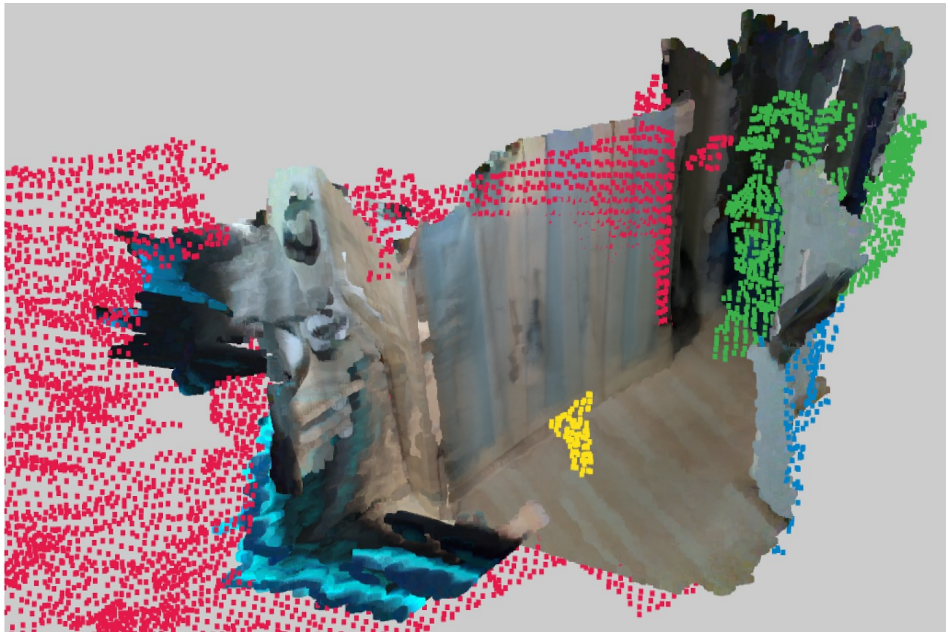


Cheraghian, Ali, et al. "Zero-shot learning on 3d point cloud objects and beyond." International Journal of Computer Vision 130.10 (2022): 2364-2384.

2 Detect Object Changes in Point Clouds in Real-Time

Detect changed regions, segment and classify the objects

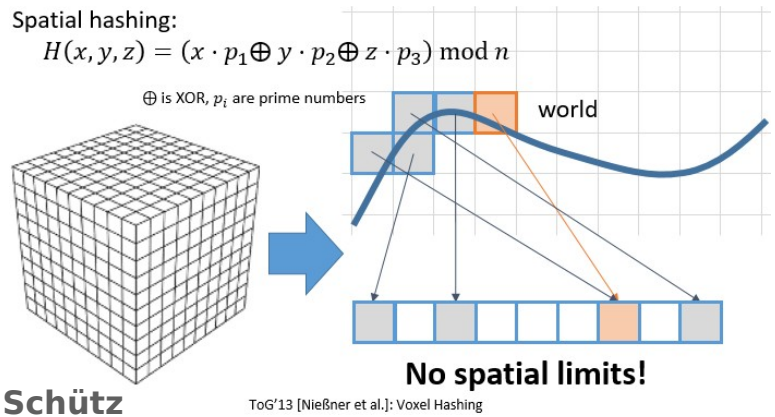


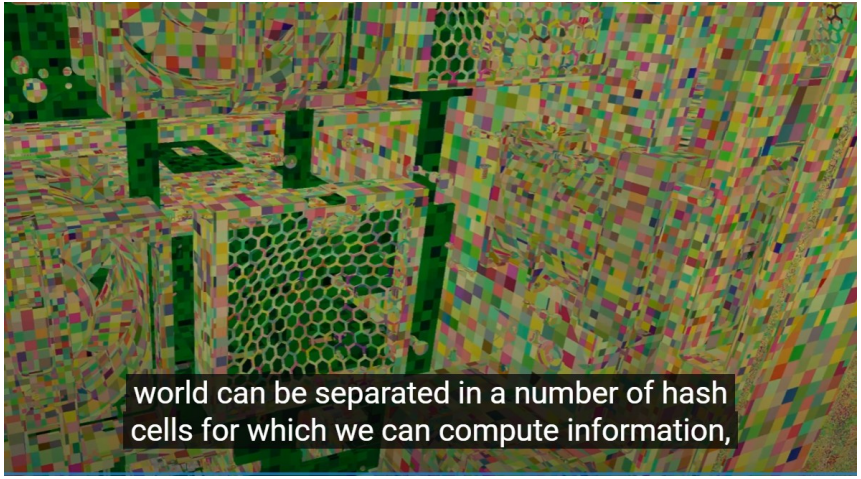


Marten Precht: “Image-based semantic change detection in 3D-point clouds using automatically sourced training data”, student project, TU Darmstadt

3 Spatial Hashing

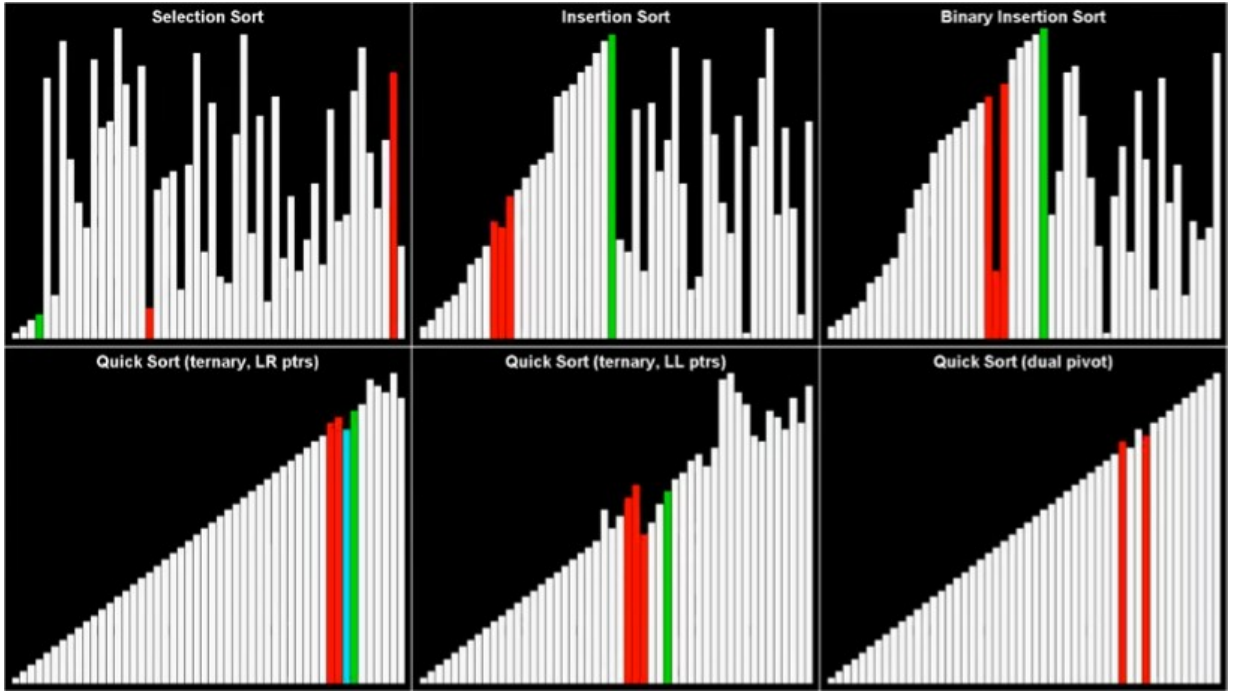
- Space Partitioning with hash maps
  - Huge (“infinite”?) “sparse grid” instead of quadtree, octree, ...
- Hash map entries for occupied space (cells)
- O(n) lookup of geometry around given world coordinate
- Investigate algorithms, use cases, etc.





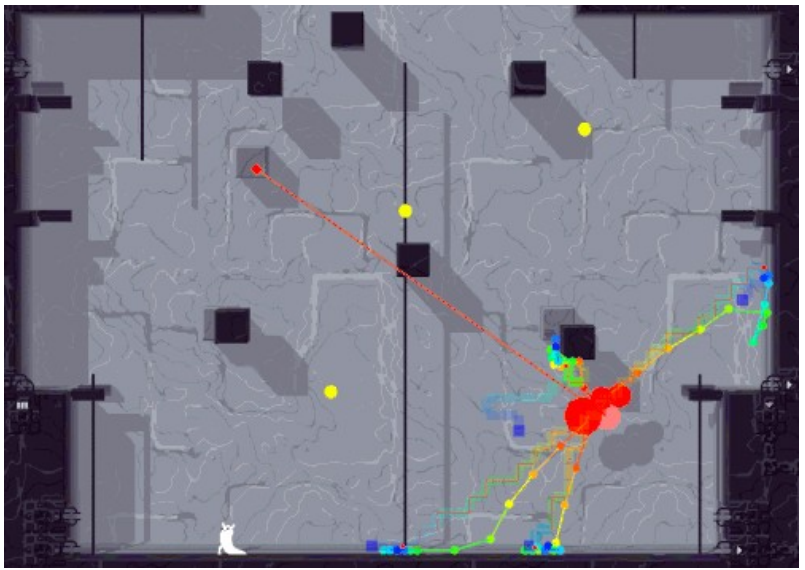
4 Sorting on the GPU

- Overview over various sort algorithms
- Advantages, Limitations, Performance, ...



5 Animation for Video Games

- Classic approach: Keyframe Animations, Motion Capture
- Dynamic/Context sensitive: Procedurally generated, Deep Learned

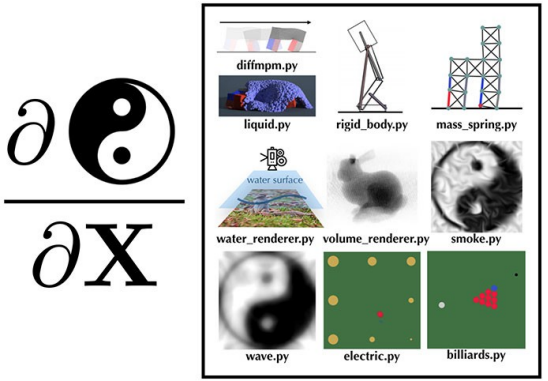


GDC Talk on Procedural Animations in "*Rain World*"
https://www.youtube.com/watch?v=sVntwsrjNe4

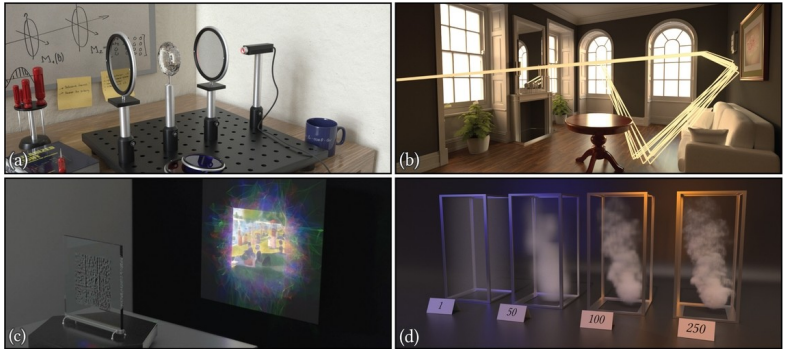
DeepPhase: Periodic Autoencoders for Learning Motion Phase Manifolds
https://github.com/sebastianstarke/AI4Animation

6 Differential Approaches

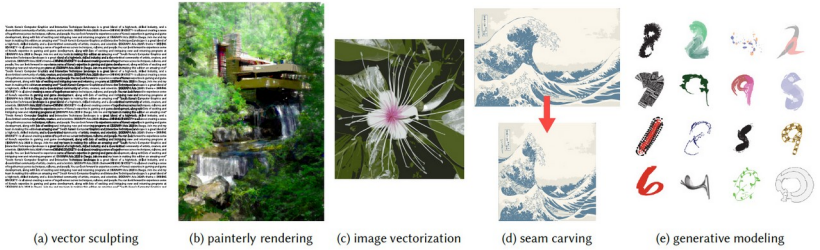
- Differentiation can be a useful tool to allow complex optimizations and better integration into neural networks



Yuanming Hu, Luke Anderson, Tzu-Mao Li, Qi Sun, Nathan Carr, Jonathan Ragan-Kelley, Fredo Durand - DiffTaichi: Differentiable Programming for Physical Simulation ICLR 2020

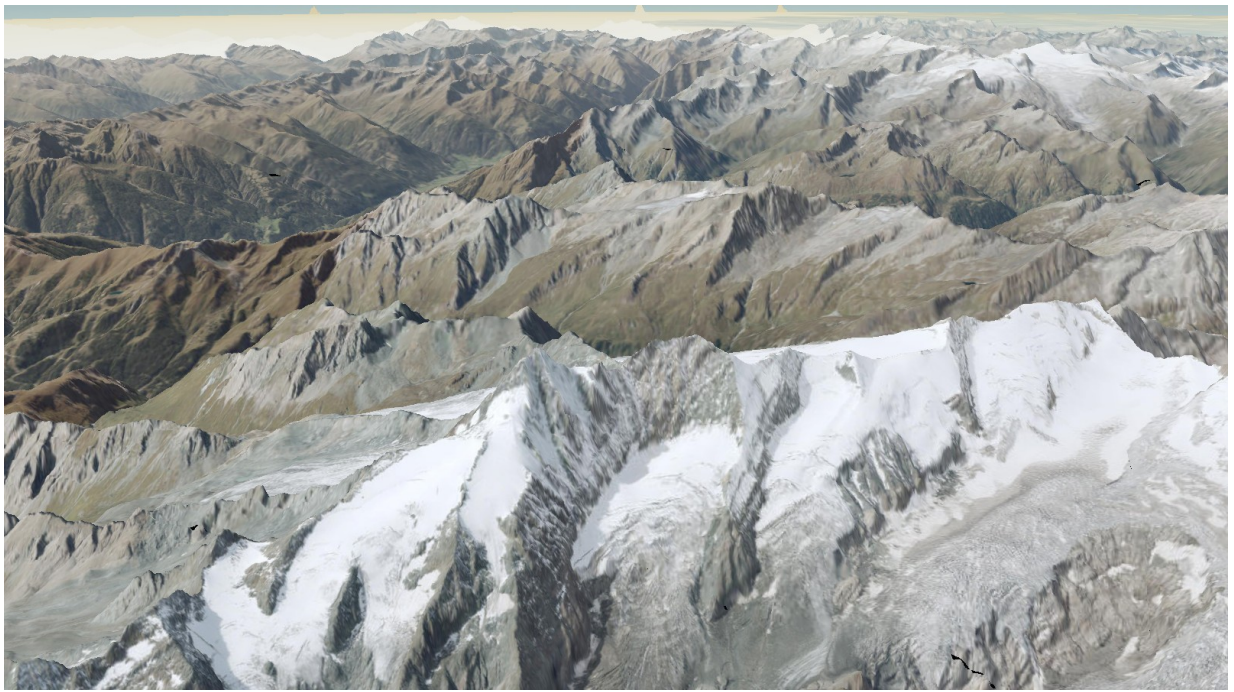


Merlin Nimier-David, Delio Vicini, Tizian Zeltner, and Wenzel Jakob. 2019. Mitsuba 2: A Retargetable Forward and Inverse Renderer. In Transactions on Graphics (Proceedings of SIGGRAPH Asia) 38(6).



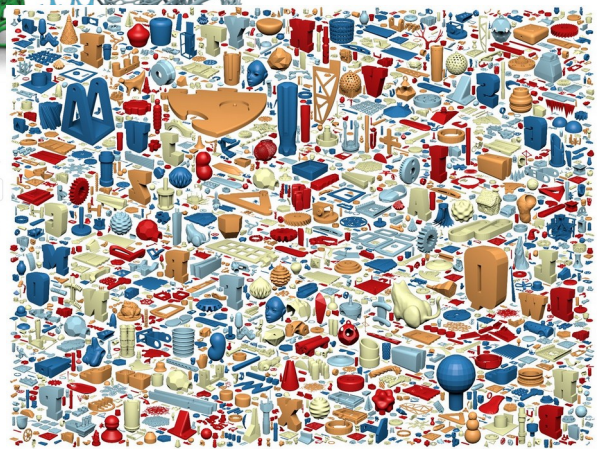
Tzu-Mao Li, Michal Lukáč, Michaël Gharbi, Jonathan Ragan-Kelley - Differentiable Vector Graphics Rasterization for Editing and Learning. ACM Transactions on Graphics 39(6) (Proceedings of ACM SIGGRAPH Asia 2020)

- 2.5D Terrain rendering
- Level of Detail (LoD)
- Planetary scale



8 Datasets for Deep Learning

- Focus on 3D Reconstruction
- Sizes, Properties, Benchmarks



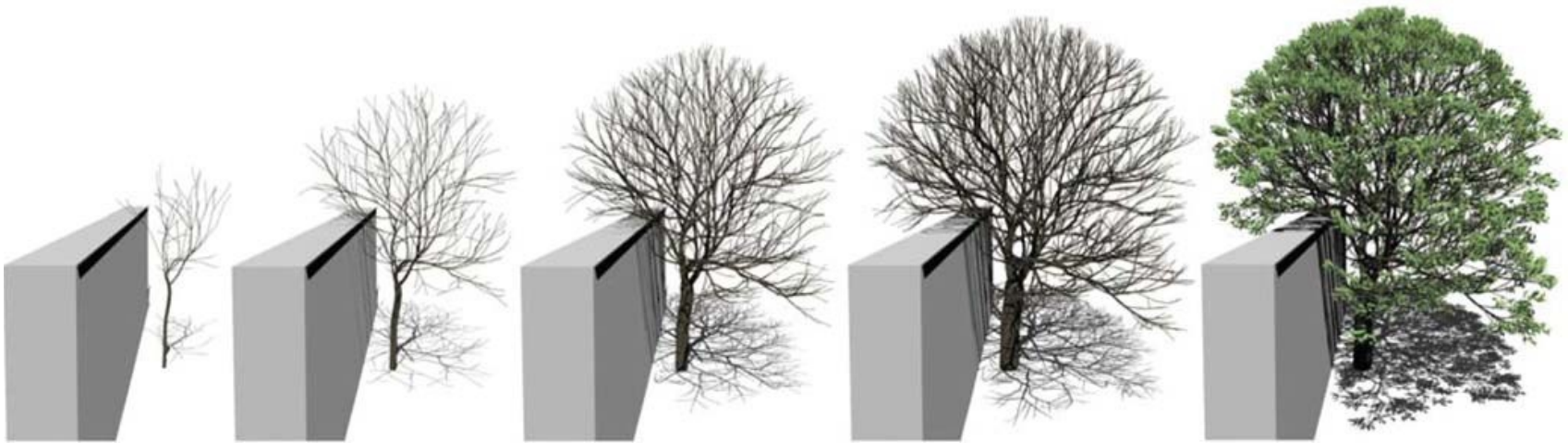
3D Reconstruction on DTU

Leaderboard Dataset

https://paperswithcode.com/sota/3d-reconstruction-on-dtu

9 Growth Models of Plants

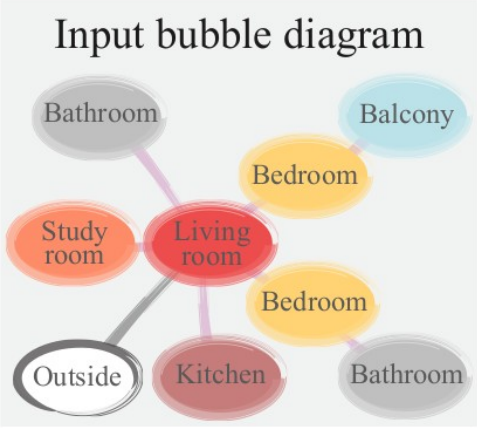
- Biologically-driven, physically-based
- All over its lifespan
- Procedural modeling vs. simulation

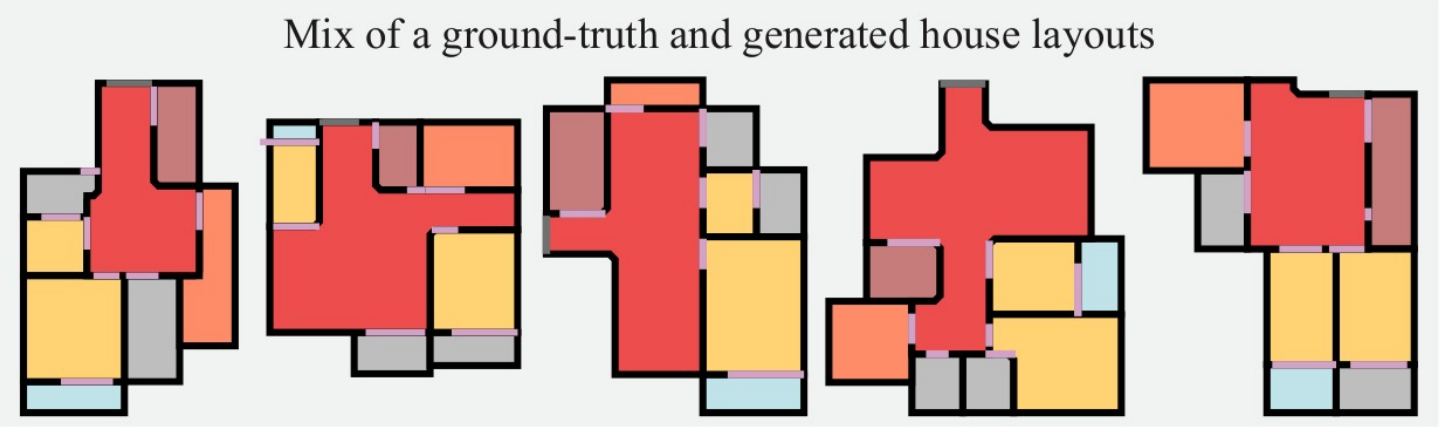


By Yi et al. from *Tree Growth modeling Constrained by Growth Equations* in Computer Graphics Forum 37 (2018)

10 Procedural Floor Plans

- Automated generation of Floor Plans
- Procedural vs. AI approaches
- Various levels of control

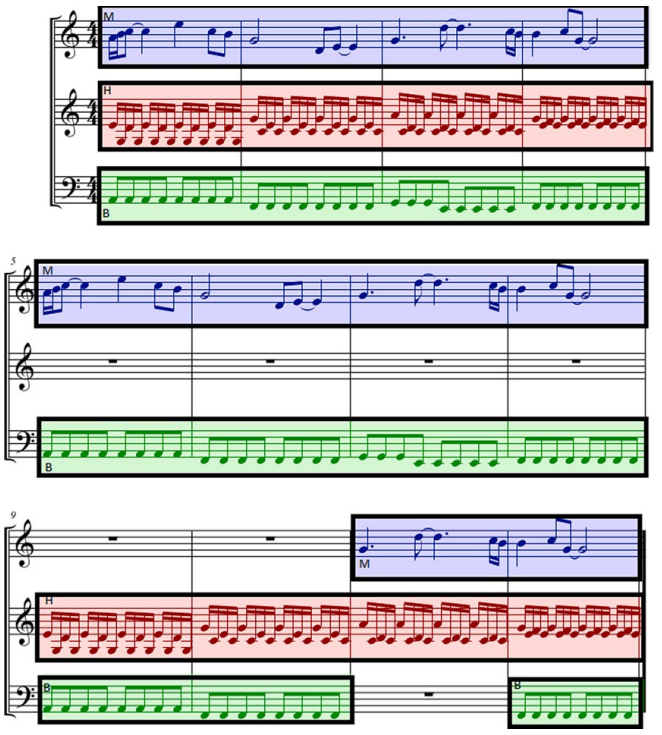




By Nauata et al. from *House-GAN++" Generative Adversarial Layout Refinement Network towards Intelligent Computational Agent for Professional Architects* at CVPR 2021

11 Generative Music Systems

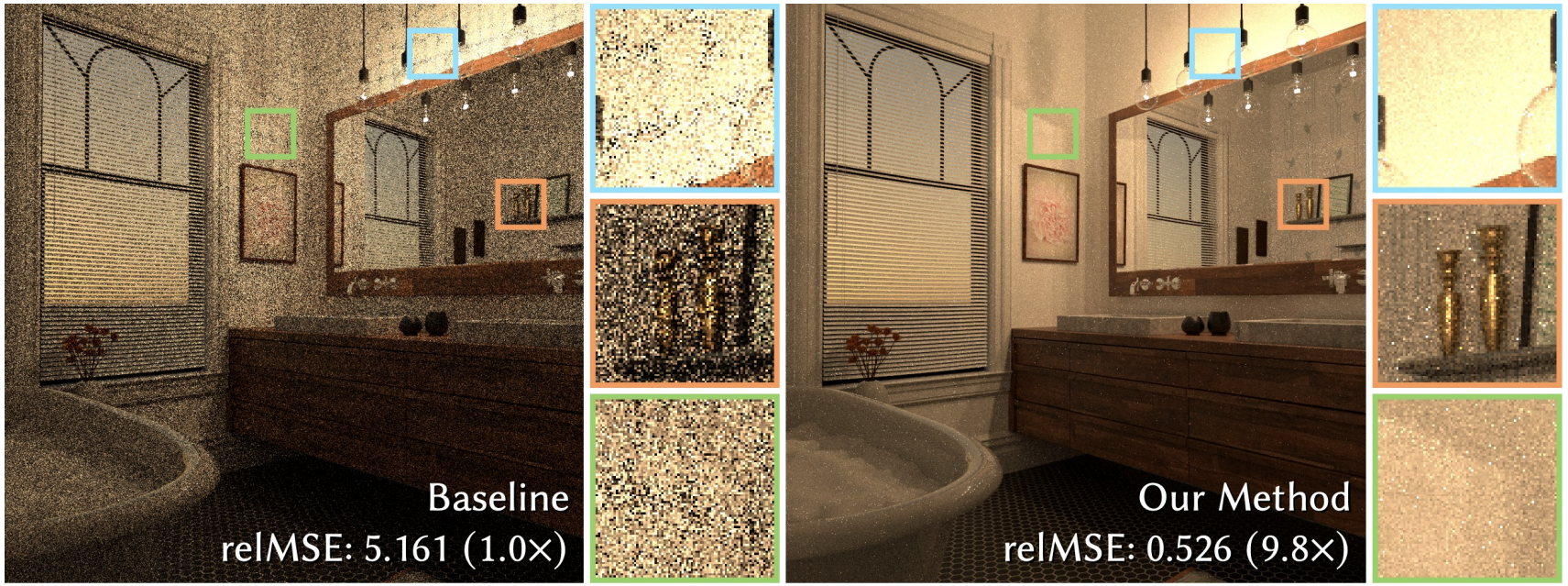
- Various methodologies
- Interactive and adaptive
- Tools for Games, Videos etc.



By Plut and Pasquier from *Generative Music in Video Games: State of the Art, Challenges, and Prospects* in Entertainment Computing 33 (2020)

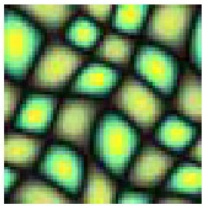
12 The Bleeding Edge in Path Guiding

- Path guiding is a highly active area in realistic rendering.
- Your mission, should you choose to accept it, is to provide an overview over the **very latest** path-guiding techniques.



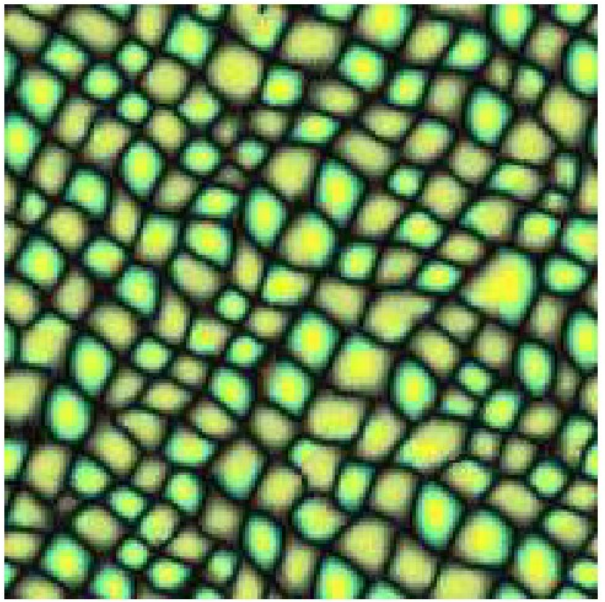
13 Traditional Texture Synthesis

- Traditional as opposed to „deep learning based“



input

Texture synthesis

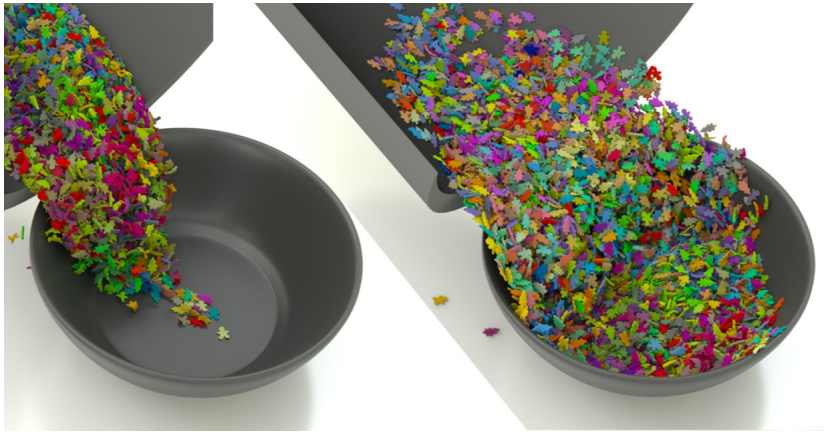


output

Li-Yi Wei, Sylvain Lefebvre, Vivek Kwatra, Greg Turk. State of the Art in Example-based Texture Synthesis. Eurographics 2009, State of the Art Report

14 GPU-accelerated real-time physics

developer.nvidia.com/flex

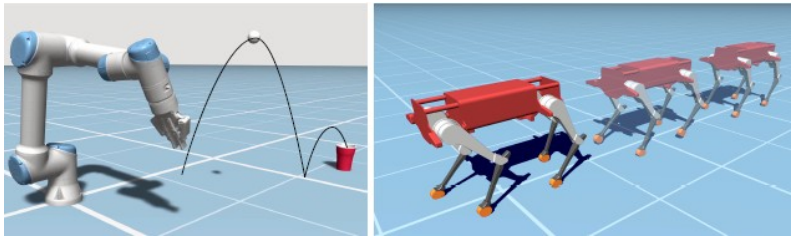


A Massively Parallel And Scalable Multi-GPU Material Point Method
Wang, et. al (SIGGRAPH 2020)

Time Integrating Articulated Body Dynamics Using Position-Based Collocation Methods, Pan and Manocha, WAFR 2018

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

15 Nonlinear optimization in computer graphics

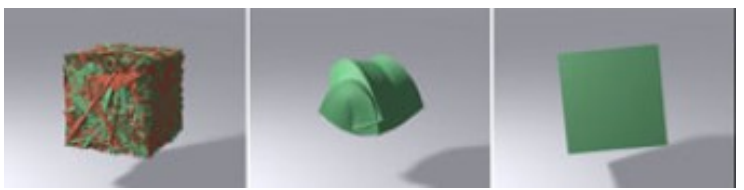


ADD: Analytically Differentiable Dynamics for Multi-Body Systems with Frictional Contact, Geilinger et al., SIGGRAPH Asia 2020

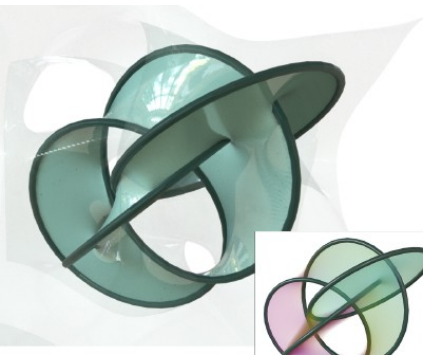
Computational Design of Planar Multistable Compliant Structures, Zhang et al., SIGGRAPH Asia 2021

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

Real2Sim: Visco-elastic parameter estimation from dynamic motion, Hahn et al., SIGGRAPH Asia 2019



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



Computing Minimal Surfaces with Differential Forms, Wang and Chern, SIGGRAPH 2021

16 Medial Axis Computation

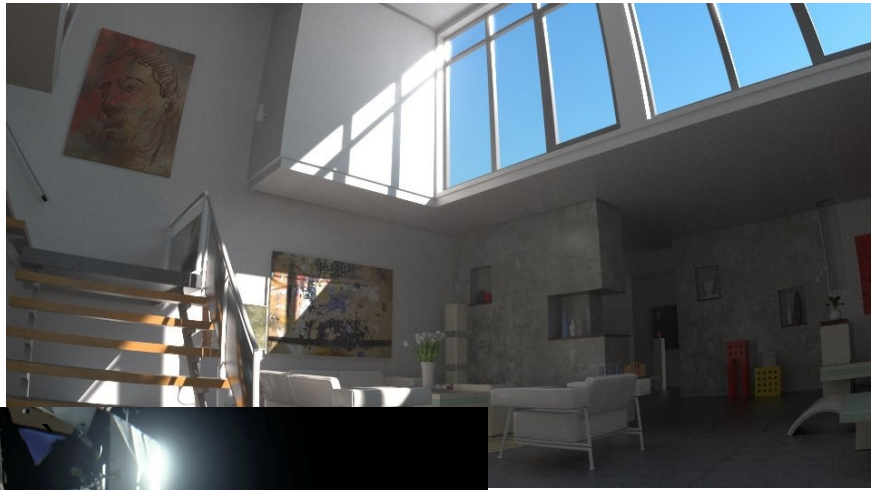
- The medial axis contains points that are closest to 2 or more points on the boundary
- Can be used for shape simplification

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

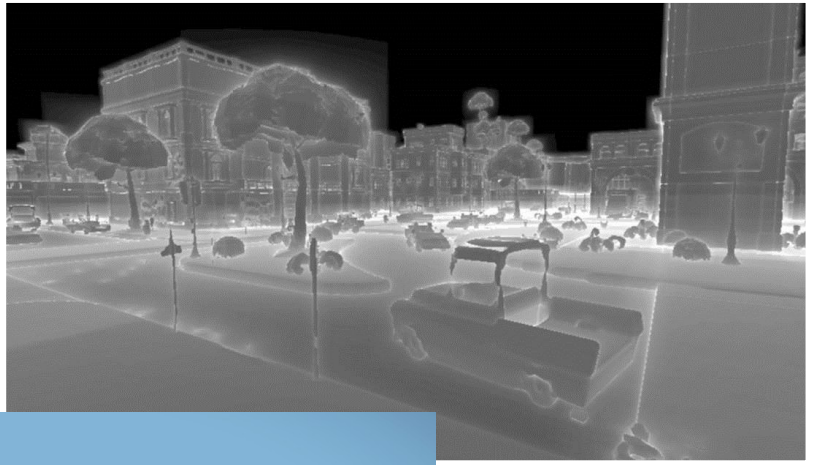
Nina Amenta et. al. 2001. The power crust. In Proceedings of the sixth ACM symposium on Solid modeling and applications (SMA '01). Association for Computing Machinery, New York, NY, USA, 249–266. DOI:https://doi.org/10.1145/376957.376986

Conduct a survey of recent advances in real-time global illumination

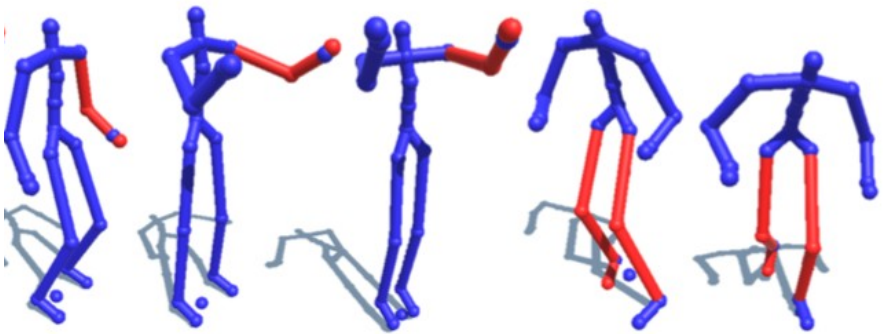


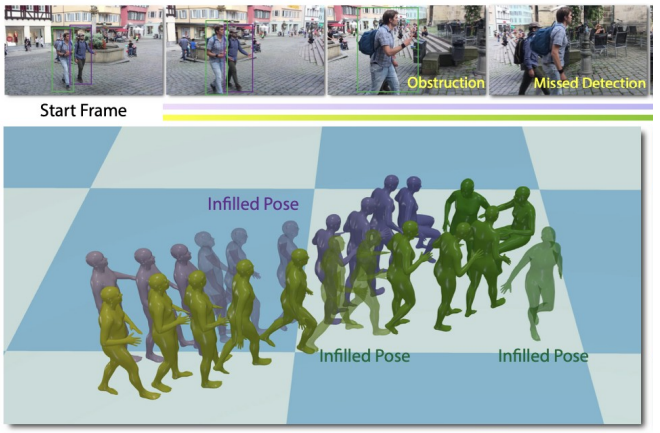
18 Signed Distance Field Rendering

- Conduct a survey on signed distance field rendering.



19 Human Motion Synthesis Based on Partial Specific.





Kaufmann, Manuel, et al. "Convolutional autoencoders for human motion infilling." *2020 International Conference on 3D Vision (3DV)*. IEEE, 2020.

Yuan, Ye, et al. "GLAMR: Global occlusion-aware human mesh recovery with dynamic cameras." *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*. 2022.

Questions?

- Get in contact with your supervisor ASAP
- Discuss literature list with your supervisor
- Submit the list to TUWEL by 30.03.