

# Seminar aus Computergraphik 186.175, WS 2022/23, 2.0h (3 ECTS) Stefan Ohrhallinger

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

<u>TU Wien</u>

http://www.cg.tuwien.ac.at/staff/StefanOhrhallinger.html





### **Register** to course in TISS & TUWEL

These slides will on the website after this meeting

Official registration: by submitting the literature list

Topics are presented and assigned here today





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 ...







- 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
- Final talk in seminar
- All tasks and uploads are in TUWEL
- All documents and talks are in English





- 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  $\rightarrow$  official registration



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





- 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





- Prepare slides in advance, using template
- Each student talks for 15 minutes
- 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
- Submitted slides are presented on seminar PC







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

• Late submission: 15% off per day, max. 1 week (this also concerns the draft!)





- 24.10. 23:59 Submit literature list
- 03.11. 13:00 15:00 Lecture Prof. Wimmer
- 10.11. 13:00 15:00 Lecture Prof. Gröller
- 17.11. 13:00 15:00 Lecture Prof. Kaufmann
- 19.12. 23:59 Submit report draft
- 09.01. 23:59 Submit review
- 25.01. 23:59 Submit slides
- 26.01. 13:00 17:00 Seminar talks
- 27.01. 23:59 Submit final report





- Now 18 topics will be presented
- After the presentation, please mark down at least 3 in order of preference (1, 2, 3, ...)
- I will try to make a fair assignment of topics



# 1 Artistic Non-Physically Based 3D Rendering

- Most rendering research revolves around physically based rendering, to create photorealistic results.
- Yet, historically, most art isn't photorealistic. There has thus been a recent push in film towards experimenting with alternatives forms of 3D rendering.
- The student is free to pick what to focus on. Examples: contours, lights/shadows, shading, character elements, particles, in-betweens.









# 2 Containers on the GPU



- GPU implementations of Hash Maps, Linked Lists, etc.
- What are they used for? (Order independent transparency, ...)



"REAL-TIME CONCURRENT LINKED LIST CONSTRUCTION ON THE GPU", Jay McKee

**Markus Schütz** 



# 3 Sorting on the GPU

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



https://www.youtube.com/watch?v=BeoCbJPuvSE



# 4 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.





# 5 Handling Discontinuities in Differential Rendering

- Methods
- Edge sampling
- Reparameterization
- Warped area sampling



Warped area sampling. Bangaru et al. 2020

Lukas Lipp





#### **6 Thermal Radiation Simulation**

- Conduct a survey on methods for efficient simulation of thermal radiation





### 7 Simulation and Modeling of Plants

- Conduct a survey on methods for the simulation and modeling of plants or ecosystems based on biological models





**Christian Freude** 

#### **8 Neural Radiance Fields for Reconstruction**

- Learn scene representation from photos
- Extract geometry and materials for rendering



Martin-Brualla, Ricardo, et al. "Nerf in the wild: Neural radiance fields for unconstrained photo collections." Proceedings Conf. Computer Vision and Pattern Recognition. 2021.



#### **Philipp Erler**

# **9** Denoising Point Clouds



- Real-life scans are often corrupted with noise and outliers
- These artefacts make surface reconstruction difficult or impossible
- A solution is to find and eliminate noise before reconstruction
  - $\rightarrow$  Investigate denoising techniques for point clouds



Denoised result reconstructed with Poisson Noisy input 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

### **10 Clouds: Generation and Rendering**

- From skyboxes/billboards to real-time volumetric clouds via raymarching
- Volumetric Path Tracing for offline rendering
- Procedural Generation/Simulation





https://www.guerrilla-games.com/read/the-real-time-volumetric-cloudscapes-of-horizon-zero-dawn https://www.pbrt.org/scenes-v3
Annalena Ulschmid 21





### **11 Procedural Generation of Buildings**

- Procedural modeling, inverse modeling, example-based, etc.
- How are different architectural styles handled?



Nishida, Gen, et al. "Procedural Modeling of a Building from a Single Image." Computer Graphics Forum (CGF), 37 (2), 2018.



# 12 Mesh Improvements using Photos









Adam Celarek

#### **13 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





# 14 Shape and Topology Optimization





via Wikimedia User:Meenakshsundaram A System for High-Resolution



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)

#### **David Hahn**

# 15 Surrogate-based Optimization and Learning

(b)



- (Lighting) Design optimization
- Expensive (differentiable) simulations
- Fit an inexpensive model
- Speed up design process
- Allow interactive editing

(a)



Gorissen, 2022, Heterogeneous Evolution Of Surrogate Models.





# 16 Change Detection from 3D Point Clouds

- We want to know what has changed in an outdoor scene
- Lots of work on photos but little on 3D scanned point clouds
- Goal: Show changes in real-time/AR (master thesis possible)



Input image (query)

Ground-truth (superimposed)



Input image (database)

Ground-truth (mask)



Sakurada and Okatani: "Change Detection from a Street Image Pair using CNN Features and Superpixel Segmentation", 2015.



#### **Stefan Ohrhallinger**

# 17 Human Pose and Shape Estimation – Meta Survey





Google Scholar	human pose estimation survey
Articles	About 882.000 results (0,13 sec)
Any time	Deep learning based 2d human pose estimation: A survey
Since 2022	Q Dang, J Yin, B Wang, W Zheng - Tsinghua Science and, 2019 - ieeexplore.ieee.org
Since 2021	parsing based methods for human pose estimation, but most surveyed human pose estimation
Since 2018	methods, but their surveys The pose estimation methods for particular human part, such
Custom range	☆ Save 59 Cite Cited by 197 Related articles All 10 versions
Sort by relevance	The progress of human pose estimation: a survey and taxonomy of models applied in 2D human pose estimation
son by date	TL Munea, YZ Jembre, HT Weldegebriel, L Chen IEEE, 2020 - ieeexplore.ieee.org
and here	Like some remarkable surveys [14]-[18], this paper also provides a general concept of human
any type	pose estimation. It Provides an overview of recent models on 2D human pose estimation
keview articles	☆ Save 55 Cite Cited by 53 Related articles All 2 versions
include patents	Monocular human pose estimation: A survey of deep learning-based methods
<ul> <li>include citations</li> </ul>	Y Chen, Y Tian, M He - Computer Vision and Image Understanding, 2020 - Elsevier
	Although there are some existing reviews for HPE, however, there still lacks a survey to
Create alert	2D/3D human pose estimation methods from monocular images or video footage of humans ☆ Save 59 Cite Cited by 226 Related articles All 6 versions
	2d human pose estimation: New benchmark and state of the art analysis
	M Andriluka, L Pishchulin, P Gehler Proceedings of the, 2014 - openaccess.thecvf.com
	Given these rich annotations we perform a detailed analysis of leading human pose
	estimation approaches and gaining insights for the success and failures of these methods
	☆ Save 59 Cite Cited by 2115 Related articles All 18 versions ≫
	Human pose estimation from monocular images: A comprehensive survey
	W Gong, X Zhang, J Gonzàlez, A Sobral, T Bouwmans Sensors, 2016 - mdpi.com
	Several surveys on human pose estimation can be found in , model-based approaches or
	human motion analysis, etc. As far , a comprehensive survey of human pose estimation from
	☆ Save 55 Cite Cited by 117 Related articles All 22 versions ≫
	A survey of human pose estimation: the body parts parsing based methods

Zheng, C., Wu, W., Chen, C., Yang, T., Zhu, S., Shen, J., Kehtarnavaz, N., & Shah, M. (2020). Deep Learning-Based Human Pose Estimation: A Survey. *arXiv*. https://doi.org/10.48550/arXiv.2012.13392



#### **Manfred Klaffenböck**

# 18 Human Motion Synthesis based on Partial Specification

5 5 5 8 8 4 A.A.A.



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

![](_page_28_Picture_4.jpeg)

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.

![](_page_28_Picture_6.jpeg)

#### **Manfred Klaffenböck**

![](_page_29_Picture_1.jpeg)

- Please mark at least 3 topics in order of preference (1, 2, 3, ...), with your name, email and student number
- Hand in the sheet
- Then I will assign the topics on the spot

![](_page_29_Picture_5.jpeg)

![](_page_30_Picture_0.jpeg)

![](_page_30_Picture_1.jpeg)

- Get in contact with your supervisor ASAP
- Discuss literature list with your supervisor
- Submit the list on TUWEL by 24.10.

![](_page_30_Picture_5.jpeg)