Modern Computer Vision Methods

Introduction Meeting

for WS 2024/25 [IN2107]

Dr. Benjamin Busam, Changxuan Li, Christian Kapeller, Diego Biagini, Felix Tristram, Mert Karaoglu, Mert Kiray, Sen Wang

MCVM Team

Felix
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Changxuan
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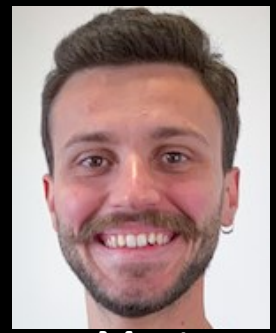
Mert
Kiray



Mert
Karaoglu

MCVM

Course Structure

Course Dates

15.10.2024	**Introduction Session**
	Individual Tutor Meetings
26.11.2024	**Presentation Training**
	Individual Tutor Meetings
10.12.2024	**Invited Research Talk**
	Individual Tutor Meetings
07.01.2025	Presentation Slot I
14.01.2025	Presentation Slot II
21.01.2025	Presentation Slot III

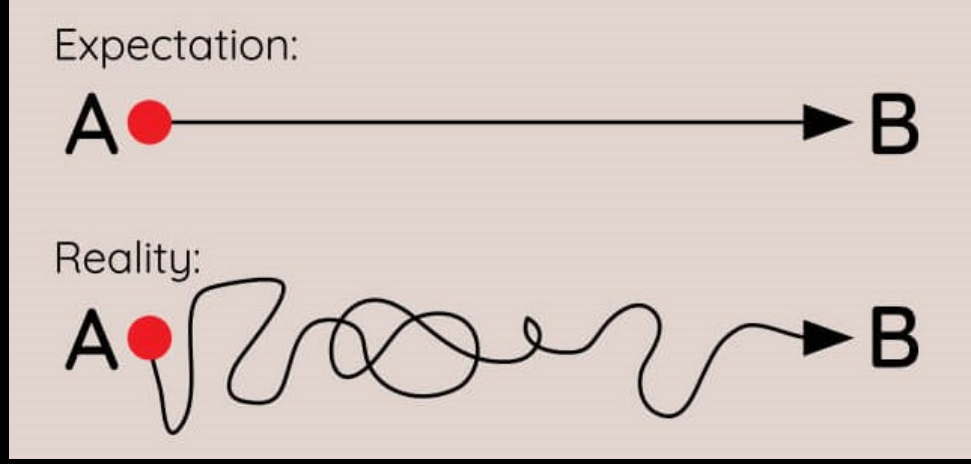
Paper Overview

Authors	Title	Source	Year	Supervisor
Attal, Verbin, Mildenhall, Hedman, Barron, O'Toole, Srinivasan	Flash Cache: Reducing Bias in Radiance Cache Based Inverse Rendering	ECCV	2024	Felix
Xing, Xia, Zhang, Chen, Wang, Wong, Shan	Dynamicrafter: Animating open-domain images with video diffusion priors	ECCV	2024	Diego
Karaev, Rocco, Graham, Neverova, Vedaldi, Rupprecht	Cotracker: It is better to track together	ECCV	2024	Mert Kar.
Fu, Liu, Kulkarni, Kautz, Efros, Wang	COLMAP-Free 3D Gaussian Splatting	CVPR	2024	Mert Kiray
Charatan, Li, Tagliasacchi, Sitzmann	PixelSplat: 3d gaussian splats from image pairs for scalable generalizable 3d reconstruction	CVPR	2024	Changxuan
Xiang, Li, Cheng, Lai, Zhang, Liao, Zeng, Liu	GaussianRoom: Improving 3D Gaussian Splatting with SDF Guidance and Monocular Cues for Indoor Scene Reconstruction	arXiv	2024	Sen
Peng, Tang, Zhou, Wang, Liu, Li, Chellappa	BAGS: Blur Agnostic Gaussian Splatting through Multi-Scale Kernel Modeling	ECCV	2024	Christian

In Person / Virtual – Hybrid

- Generally onsite
- In exceptional cases: virtual via zoom
- Tuesdays at 4pm in MI 03.13.010

What we expect from you



- Interest in Computer Vision
- Independent and pro-active participation
- Actively asking for help [supervisor meetings]
- Coding knowledge
- Illustrating methods with examples / demos

Goals

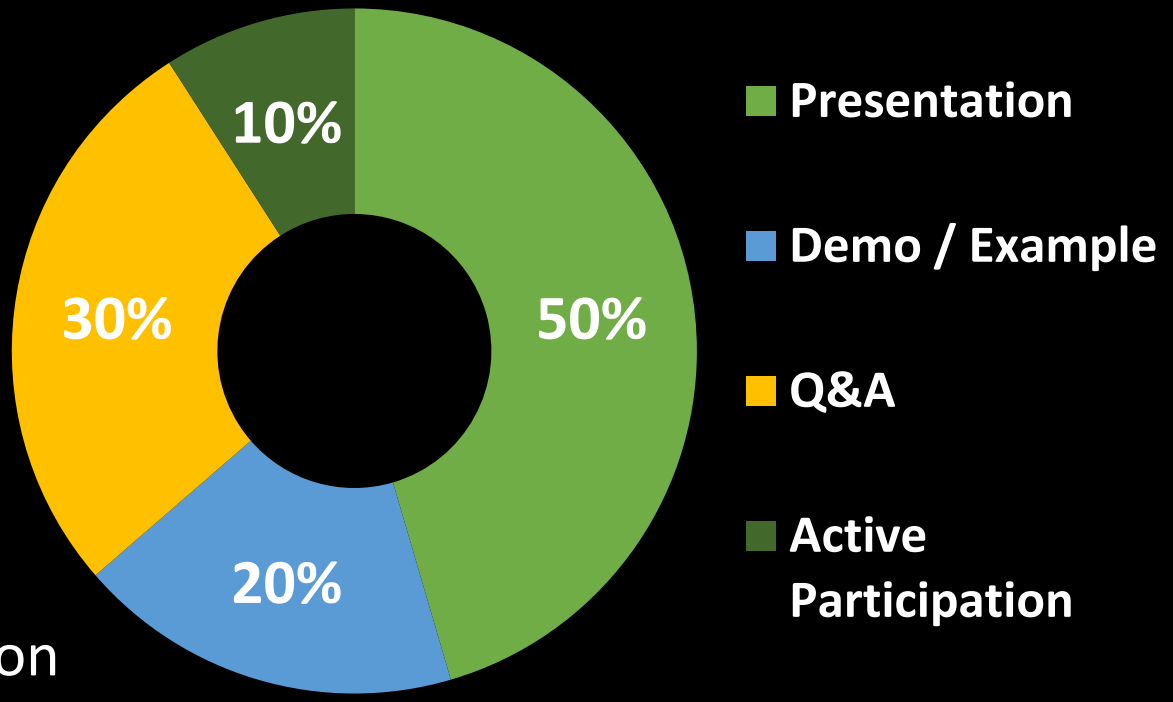
- Scientifically Learning about…
  - State-of-the-art Computer Vision
  - Current research challenges and applications
  - Communicate / discuss on most recent advantages with expert scientists
  - Hands-on experience with available code bases

- Skill training of…
  - Reading / understanding of a scientific work
  - Get overview of scientific field through literature research
  - Research talk in front of an audience, related Q&A

Presentation

- Presentation: 20 ± 2 minutes talk + 10-15 minutes Q&A
- Content should cover
  - Introduction / Relevance of Problem
  - Context / Related Work
  - Main Contribution(s)
  - Experimental Results
    - Hands-on experience with code
  - Discussion
  - Future Work
- Presentation should be self-contained, send slides 2 weeks before
- Attend all talks + active participation in other discussions

Evaluation Criteria



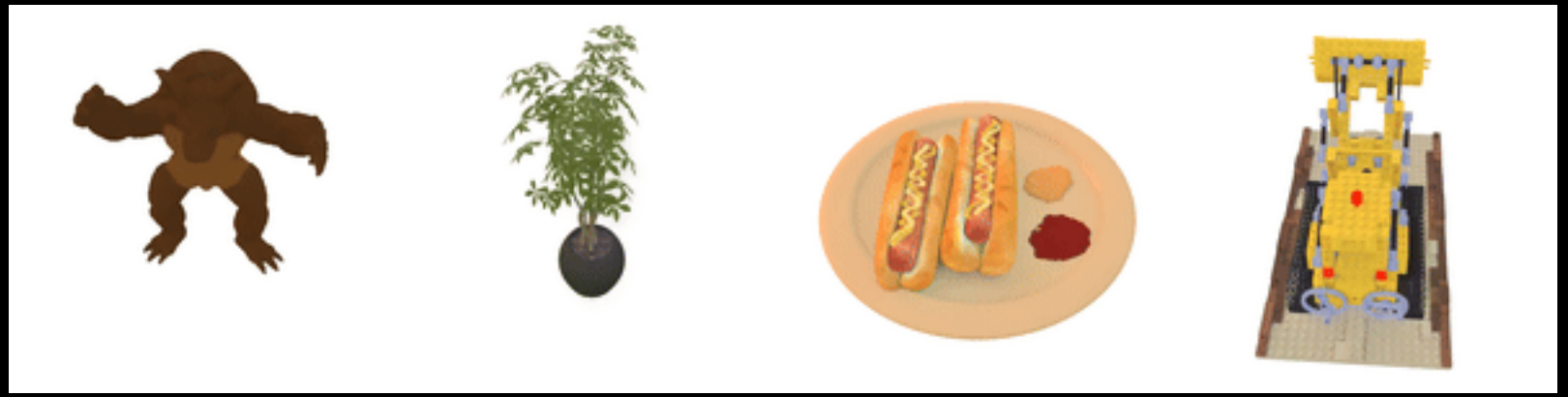
- Quality of Presentation
  - Scientific Content of the Talk + Preparation
  - Quality of the Slides
  - Putting the Topic in Context (Related Work)
- Examples / Hands-on Code
- Scientific Discussion (Q&A)
- Independent Interaction / Active Participation in the Course

Seed Paper Intros

MCVM WiSe 24/25

Flash Cache: Reducing Bias in Radiance Cache Based Inverse Rendering [Felix]

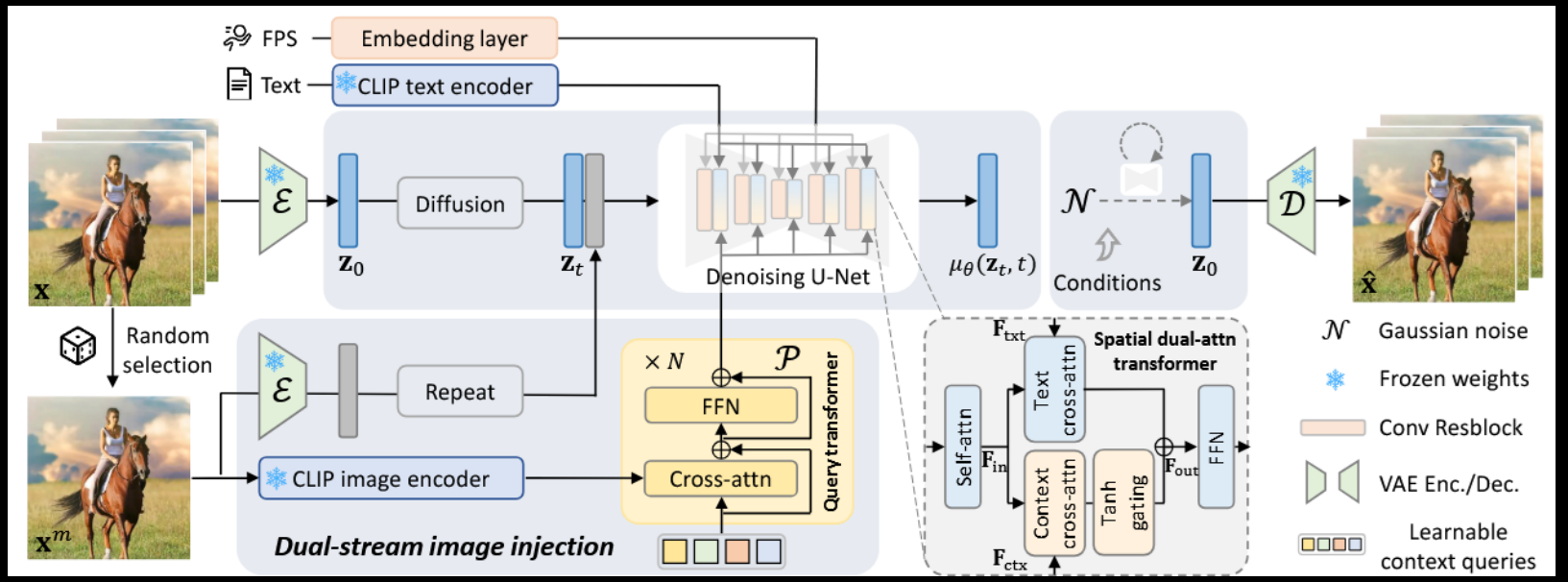
- Reconstruct a scenes geometry, materials and lighting from observed images
- hard to model incoming light in current methods
- Flash Cache uses fast caching and smart secondary rays interactions to speed up this learning



Attal, B., Verbin, D., Mildenhall, B., Hedman, P., Barron, J. T., O'Toole, M., & Srinivasan, P. P. (2024). Flash Cache: Reducing Bias in Radiance Cache Based Inverse Rendering. arXiv preprint arXiv:2409.05867.

DynamiCrafter [Diego]

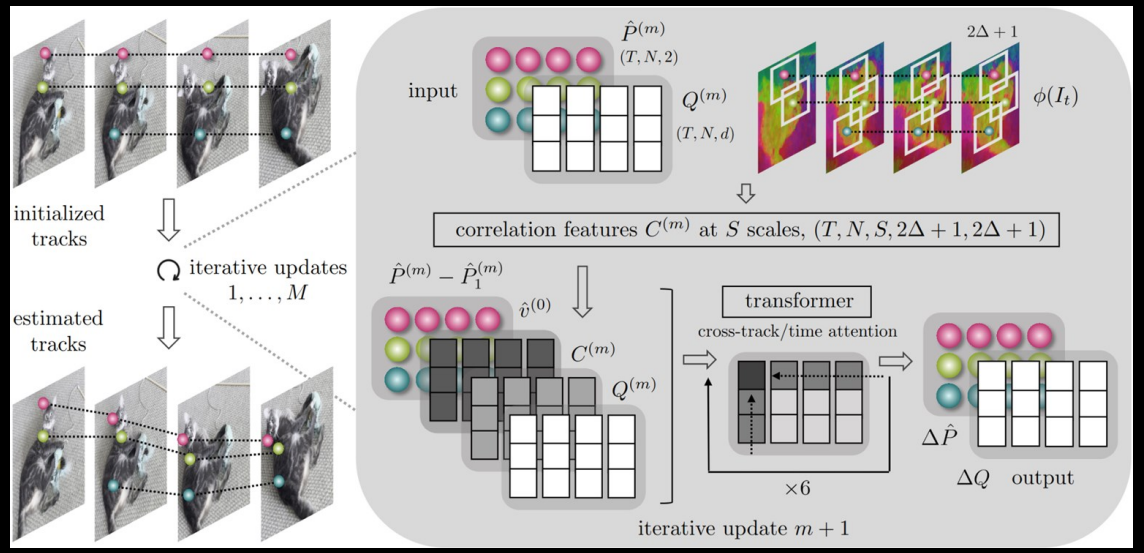
- Diffusion-based video model for Image2Video
- Injects image conditioning through dual-stream mechanism, first projecting image in text-aligned embedding space
- Multi stage training strategy(based on T2I as well)



Xing, J., Xia, M., Zhang, Y., Chen, H., Wang, X., Wong, T. T., & Shan, Y. (2023). Dynamicrafter: Animating open-domain images with video diffusion priors. ECCV 2024

CoTracker [Mert]

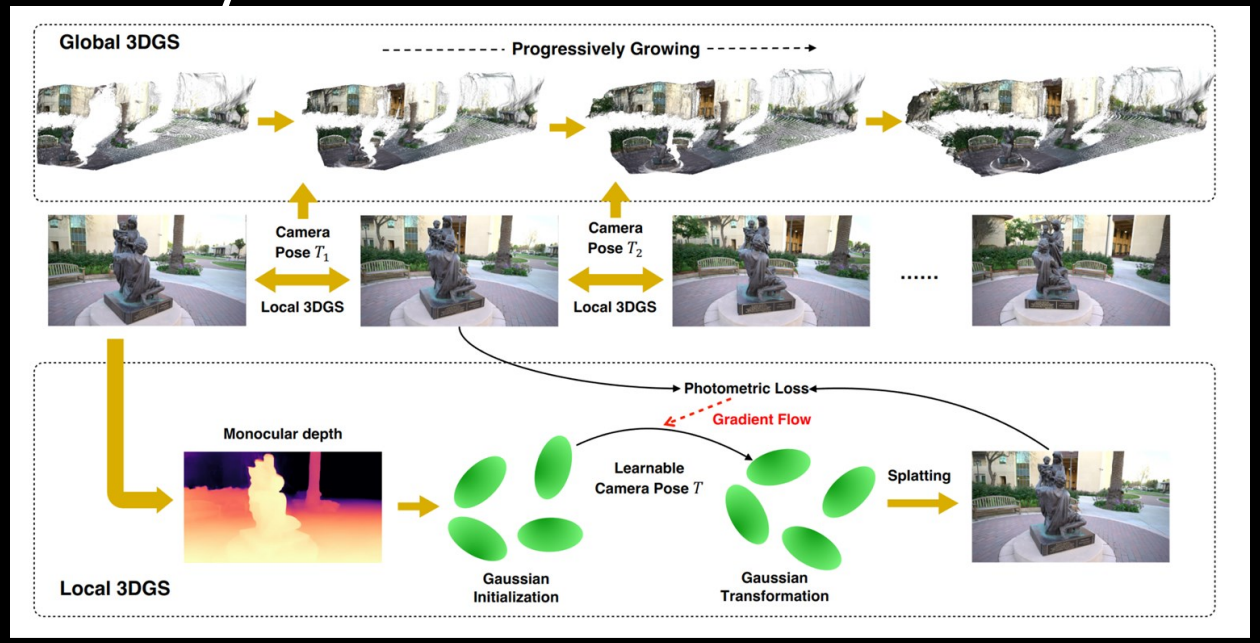
- Long-term point tracking method from RGB videos
- Processes tracklets in temporal windows
- Utilizes cross-track and -time attention for spatial and temporal causality



Karaev, Nikita, Ignacio Rocco, Benjamin Graham, Natalia Neverova, Andrea Vedaldi, and Christian Rupprecht. "Cotracker: It is better to track together." ECCV (2024).

COLMAP-Free 3D Gaussian Splatting [Mert]

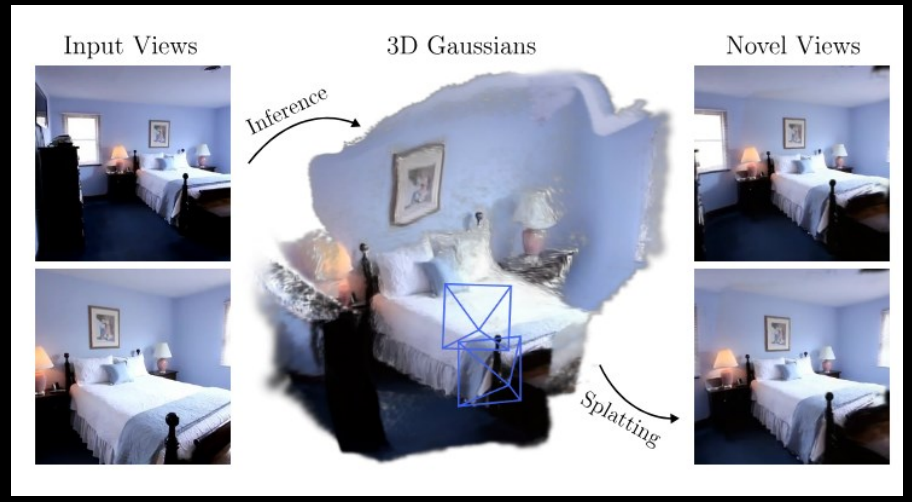
- Progressively grow the 3D Gaussians without the need to pre-compute the camera poses
- Pose estimation by 3D Gaussian transformation in frames t-1 and t

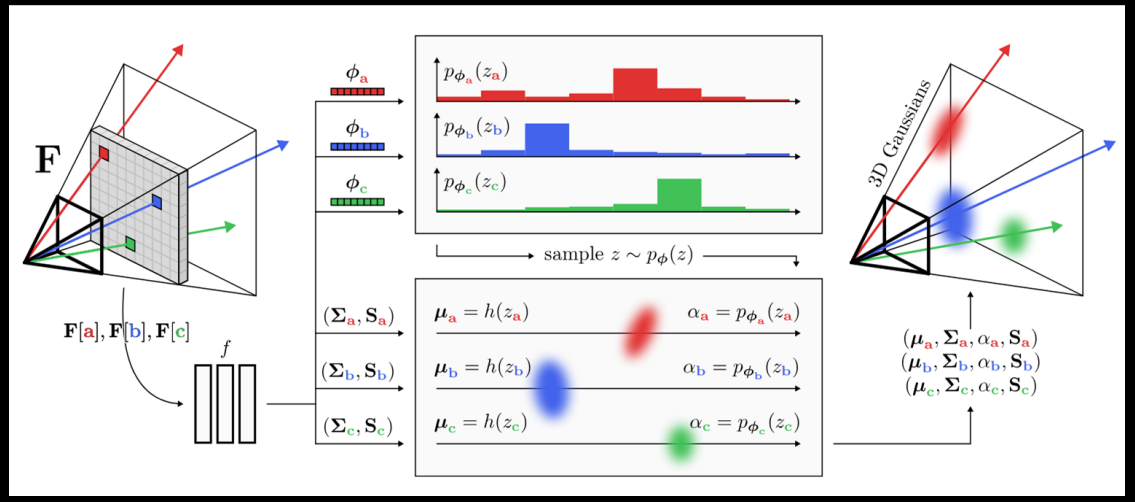


Fu, Yang, Sifei Liu, Amey Kulkarni, Jan Kautz, Alexei A. Efros, and Xiaolong Wang. 'COLMAP-Free 3D Gaussian Splatting'. In Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 20796–805, 2024.

PixelSplat [Changxuan]

- Feedforward scene reconstruction w/ pair of images by 3DGS
- Scale factor inferred by multiview epipolar transformer
- Dense Gaussian distribution and differentiable sampling to avoid local minima

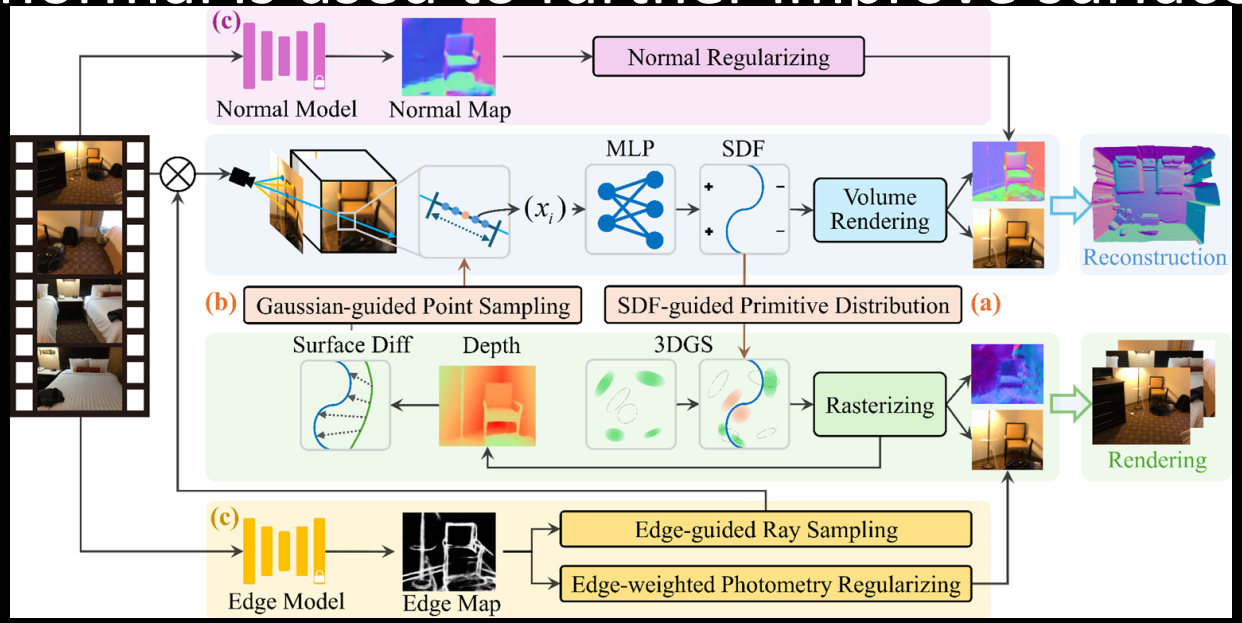




Charatan, David, Sizhe Lester Li, Andrea Tagliasacchi, and Vincent Sitzmann. "pixelsplat: 3d gaussian splats from image pairs for scalable generalizable 3d reconstruction." In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pp. 19457-19467. 2024.

GaussianRoom [Sen]

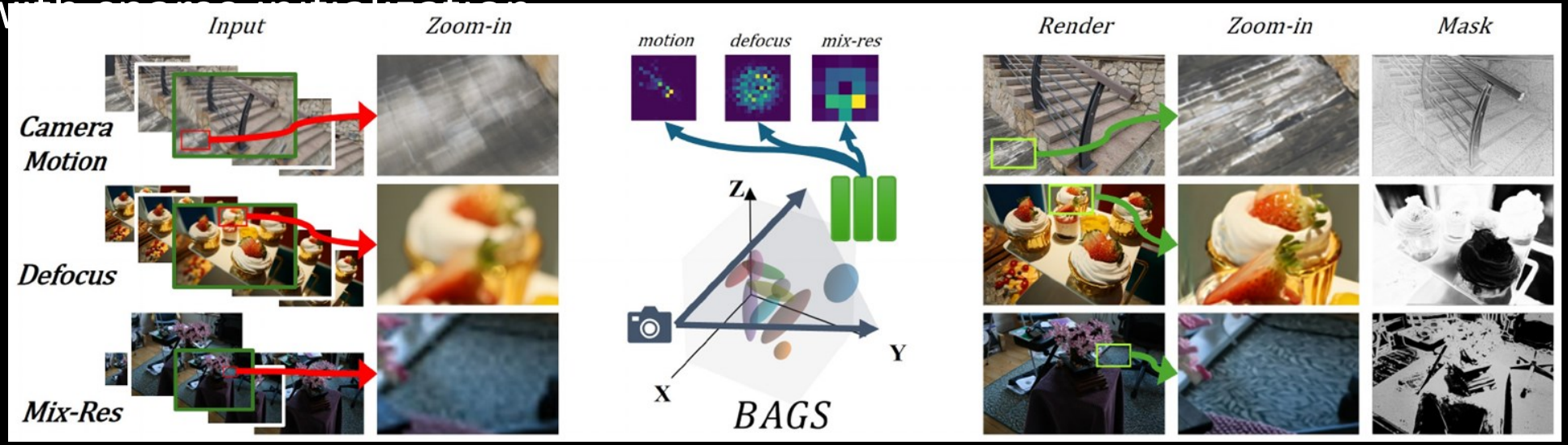
- Integrate neural SDF within 3DGS and form a positive cycle.
- Geometry from the SDF will constrain the Gaussian primitives.
- The rasterized depth from Gaussian provide constraint for SDF.
- Additional normal is used to further improve surface reconstruction.



Haodong Xiang, Xinghui Li, Kai Cheng, Xiansong Lai, Wanting Zhang, Zhichao Liao, Long Zeng, Xueping Liu. GaussianRoom: Improving 3D Gaussian Splatting with SDF Guidance and Monocular Cues for Indoor Scene Reconstruction. arXiv 2024

BAGS - Blur Agnostic Gaussian Splatting through Multi-Scale Kernel Modeling [Christian]

- 3D reconstruction from blurry images (motion, defocus, mix-res)
- Uses a proposal network that estimates per-pixel convolutional blur kernels
- Coarse-to-fine optimization scheme allows fast processing and deals w



Peng, C., Tang, Y., Zhou, Y., Wang, N., Liu, X., Li, D., & Chellappa,BAGS: Blur Agnostic Gaussian Splatting through Multi-Scale Kernel Modeling. ECCV 2024. http://arxiv.org/abs/2403.04926

Next Steps

Paper Selection

https://forms.gle/aV9bur1VyXXwxqWc9

Deadline: November 20, 2024

- We optimize for global happiness

Next Meeting(s): Individual Meetings with Tutors

- Presentation Training: Tuesday, November 26 at 4pm in MI 03.13.010

Questions

E-Mail us on

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Your MCVM Team:

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Web:

https://www.cs.cit.tum.de/camp/teaching/seminars/modern-computer-vision-methods-ws-2024-25/