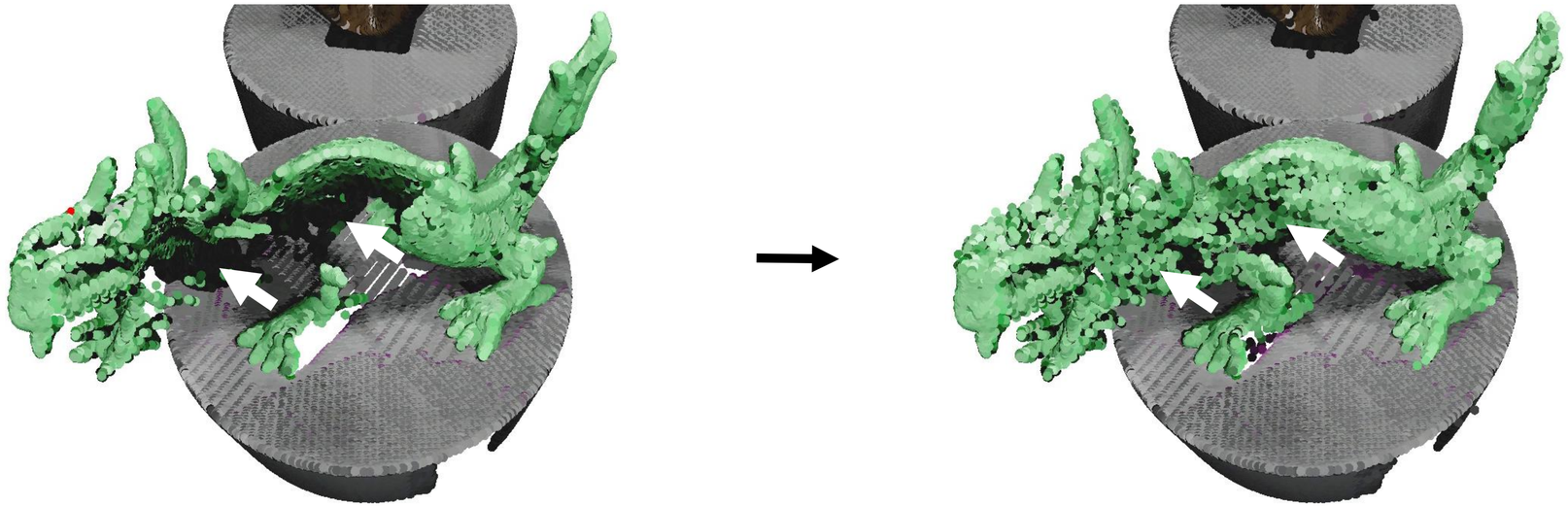
Universität Bremen

12th-16th May 2025 SE1 8XT

EUROGRAPHICS LONDON 2025

CG VR



TemPCC: Completing Temporal Occlusions in Large Dynamic Point Clouds Captured by Multiple RGB-D Cameras

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Motivation

Dynamic 3D scene reconstruction:

- Visual applications (e.g. telepresence)
- Depth based-occlusion tests

Challenge:

- Temporal occlusions, even with multiple RGB-D cameras.

CWIPC-SXR Dataset, 3 Cameras, MMSys'21 [1]

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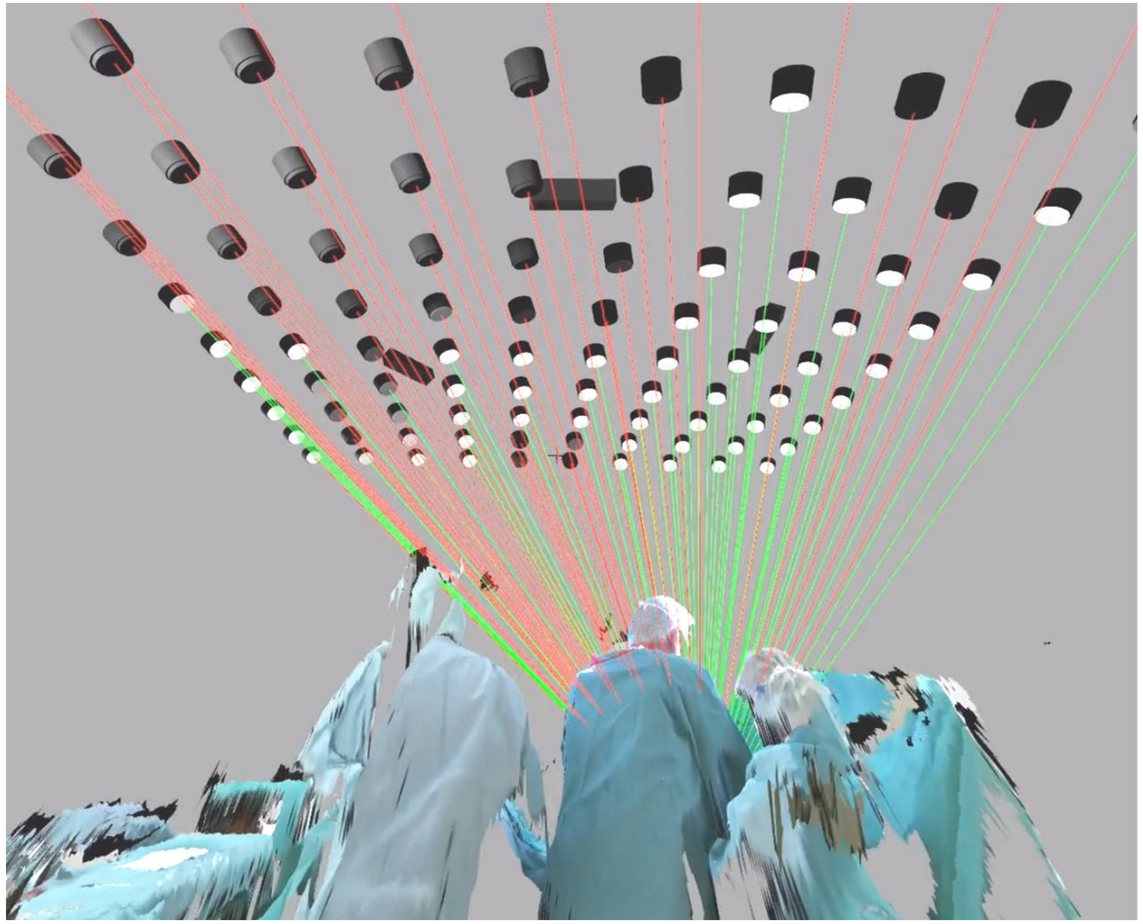
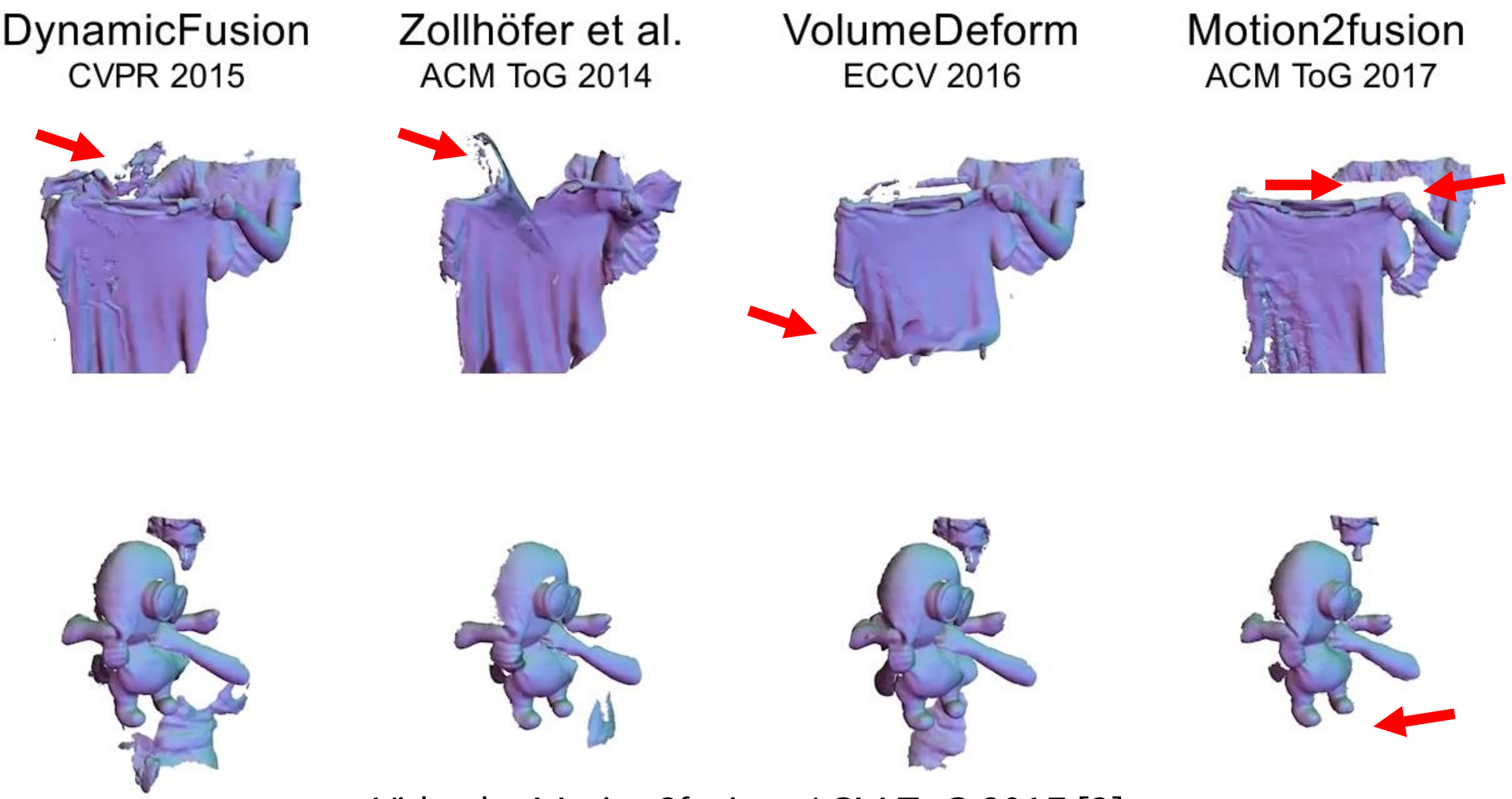


Autonomous Surgical Lighting, ACM Health 2025 [2]

Related Work



Video by Motion2fusion, ACM ToG 2017 [3]

Related Work

Raw	Function4D CVPR 2021	Motion2fusion ACM ToG 2017	UnstructuredFusion IEEE PAMI 2020
			Dose not Support Multi-person Scenarios

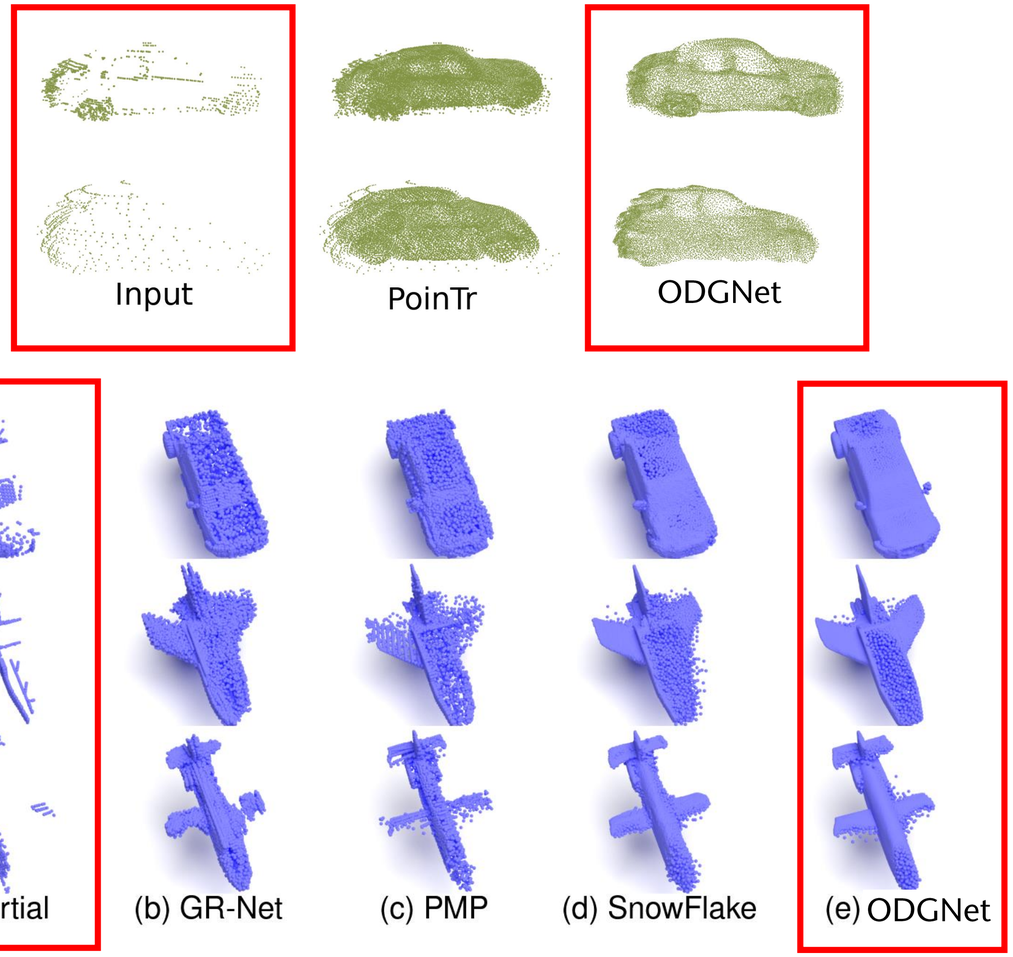
Comparison by Function4D, CVPR 2021 [4]

Related Work

Point Cloud Completion

- Focuses mainly on single static objects
- Completion by learning geometry
- Approx. 1k – 20k points

➢ Currently not suited for entire, dynamic or unknown scenes



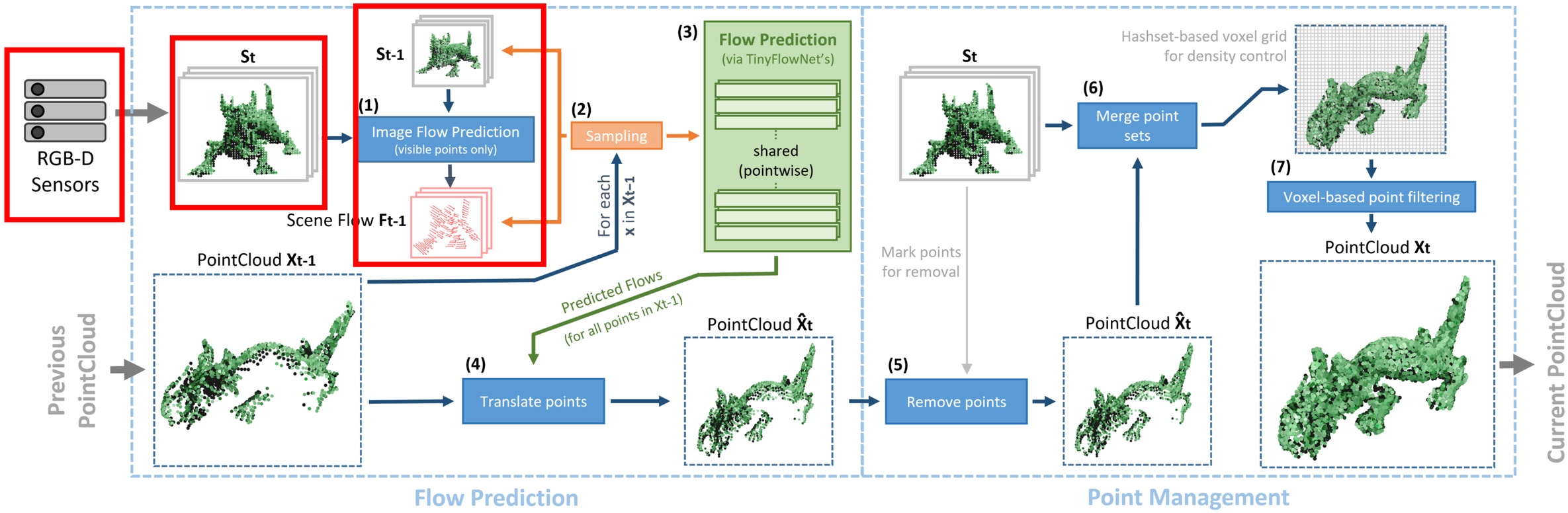
ODGNet, AAAI 2024 [5]

TemPCC: Method

Temporal point cloud completion by **preservation** and **motion prediction** of **occluded points**

- No canonical model reconstructed
- Point-wise processing
  - Scales to arbitrary point sizes
  - Linear complexity ***O(n)***, *with n = #points*

Method: TemPCC



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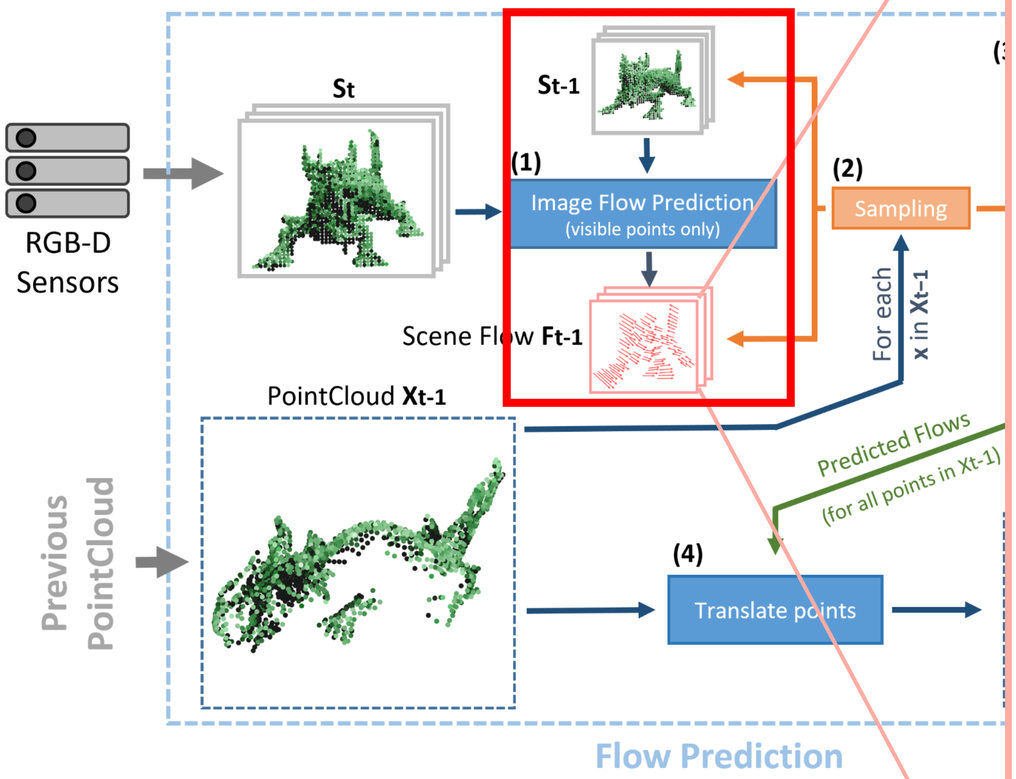
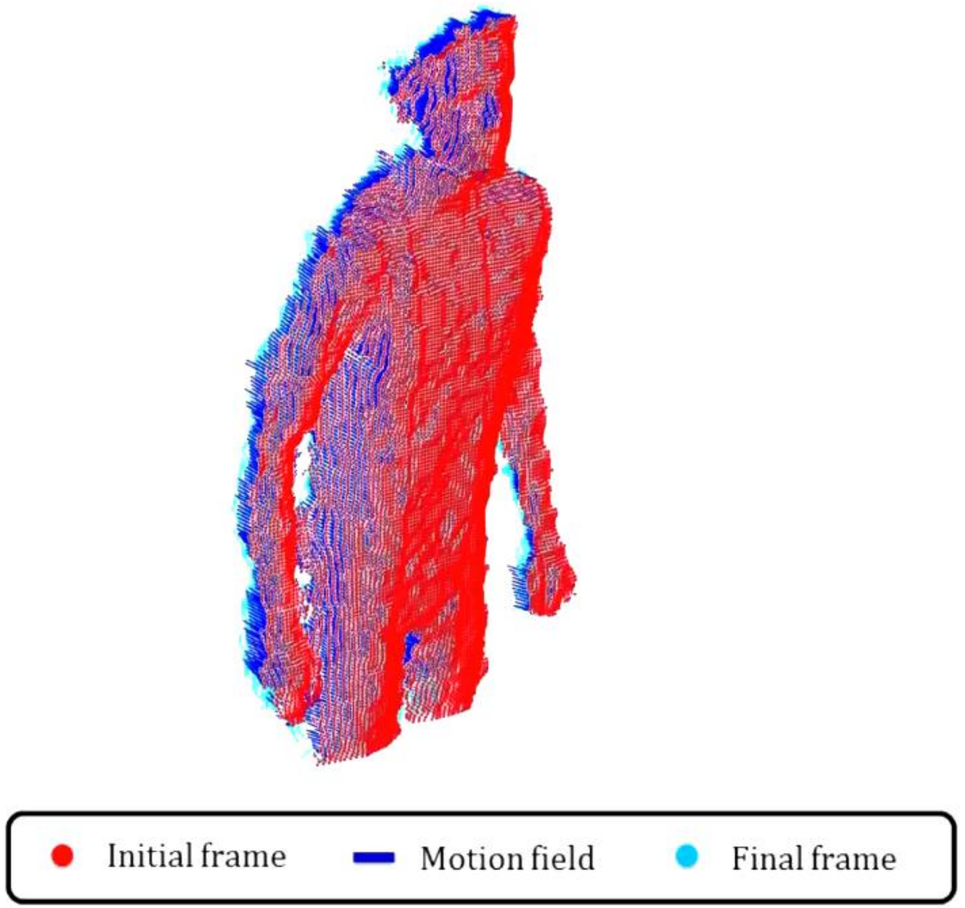
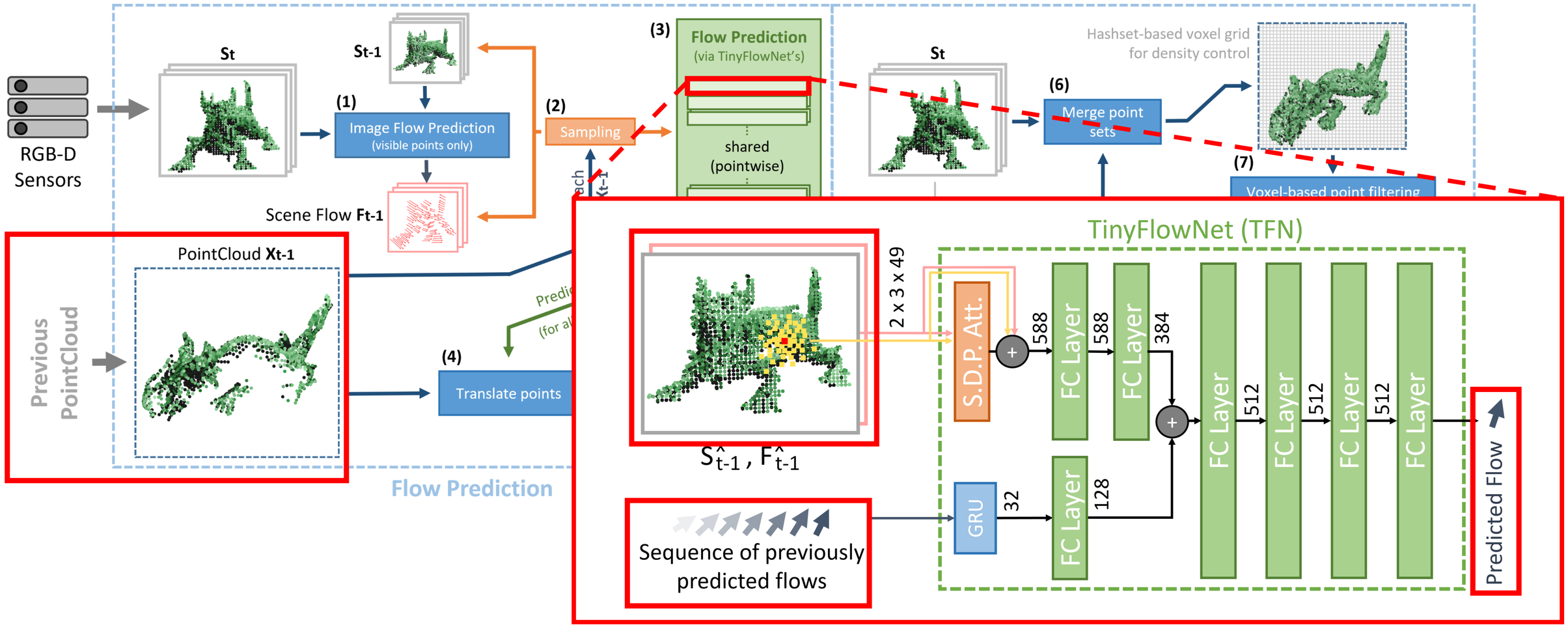




PDFlow, ICRA 2015 [6]

Method: TemPCC



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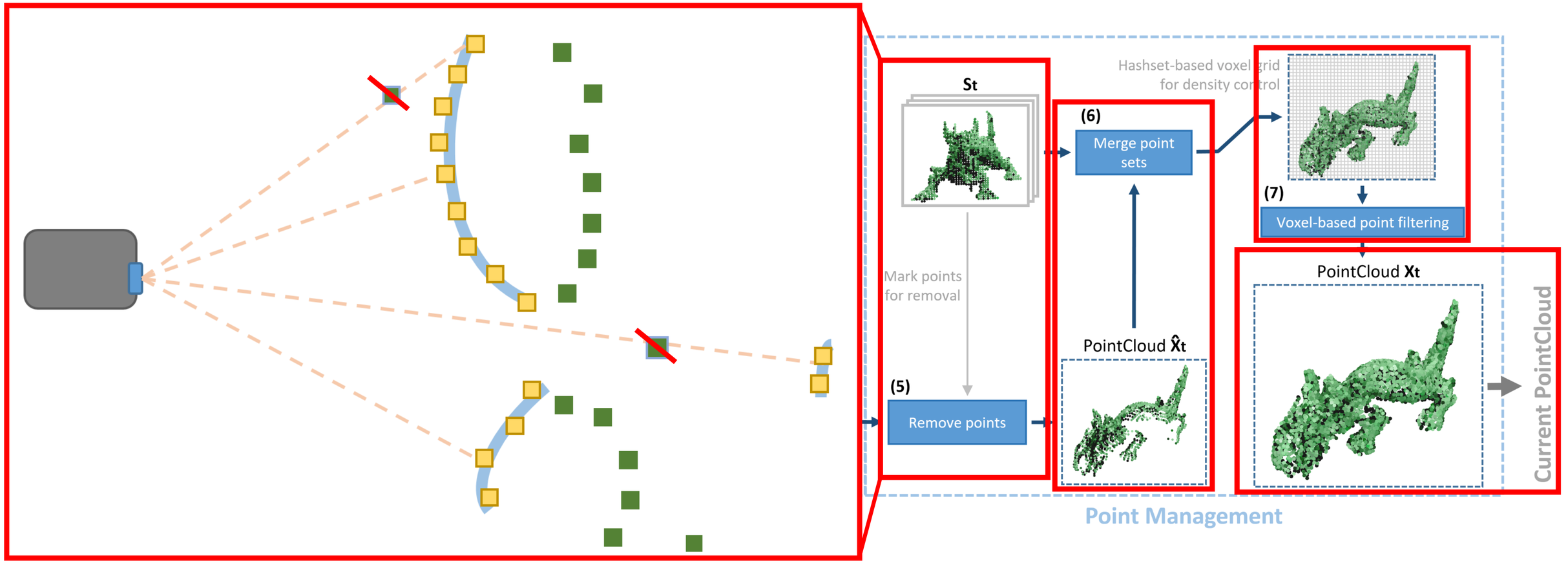
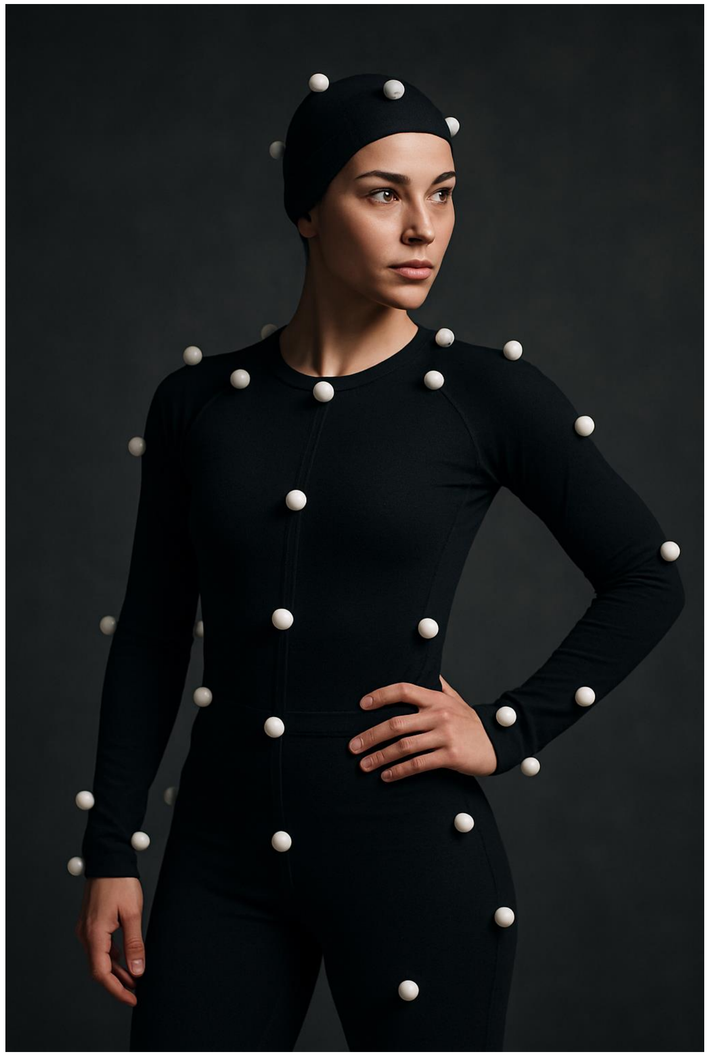
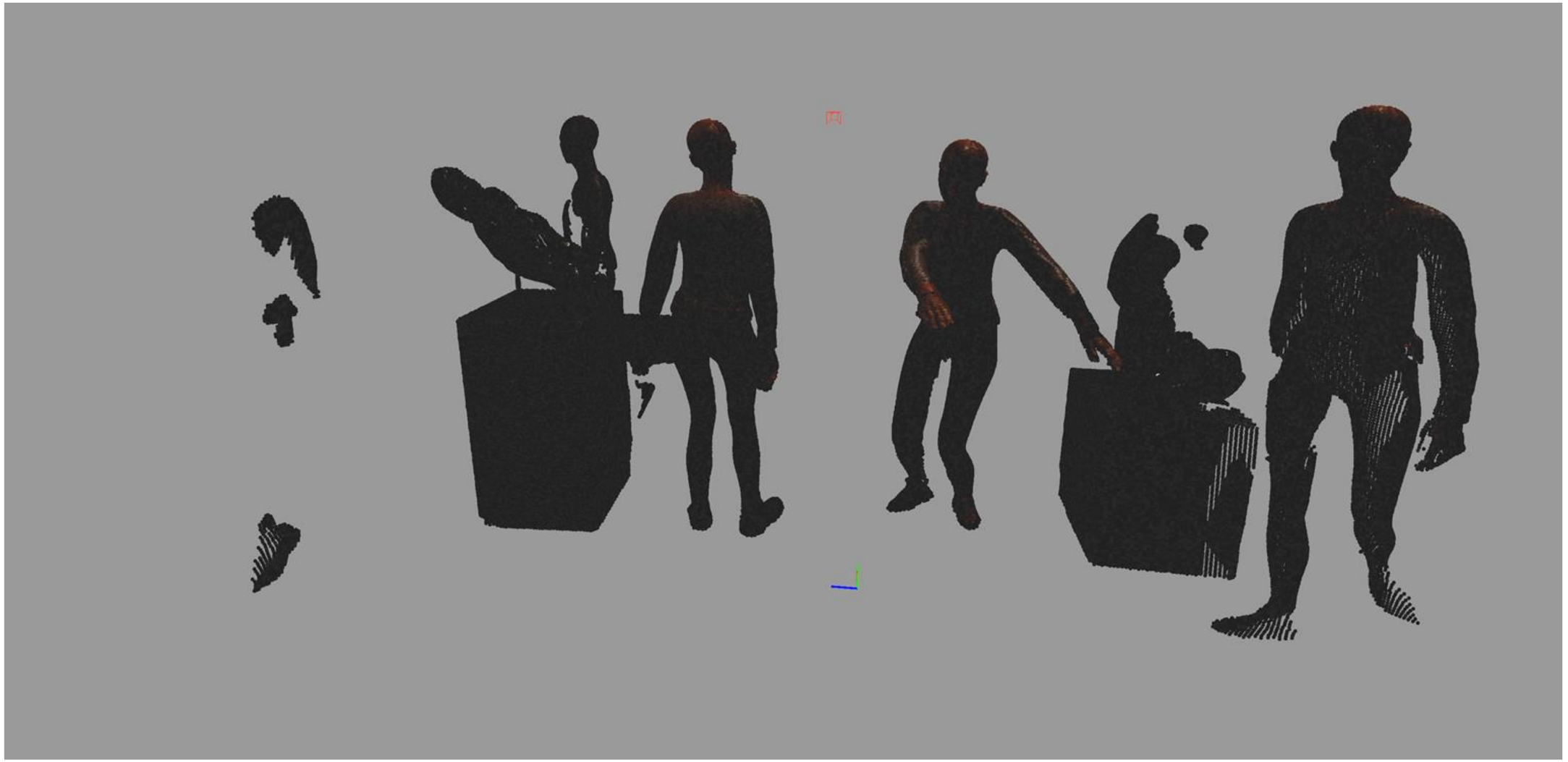


Training: Challenge

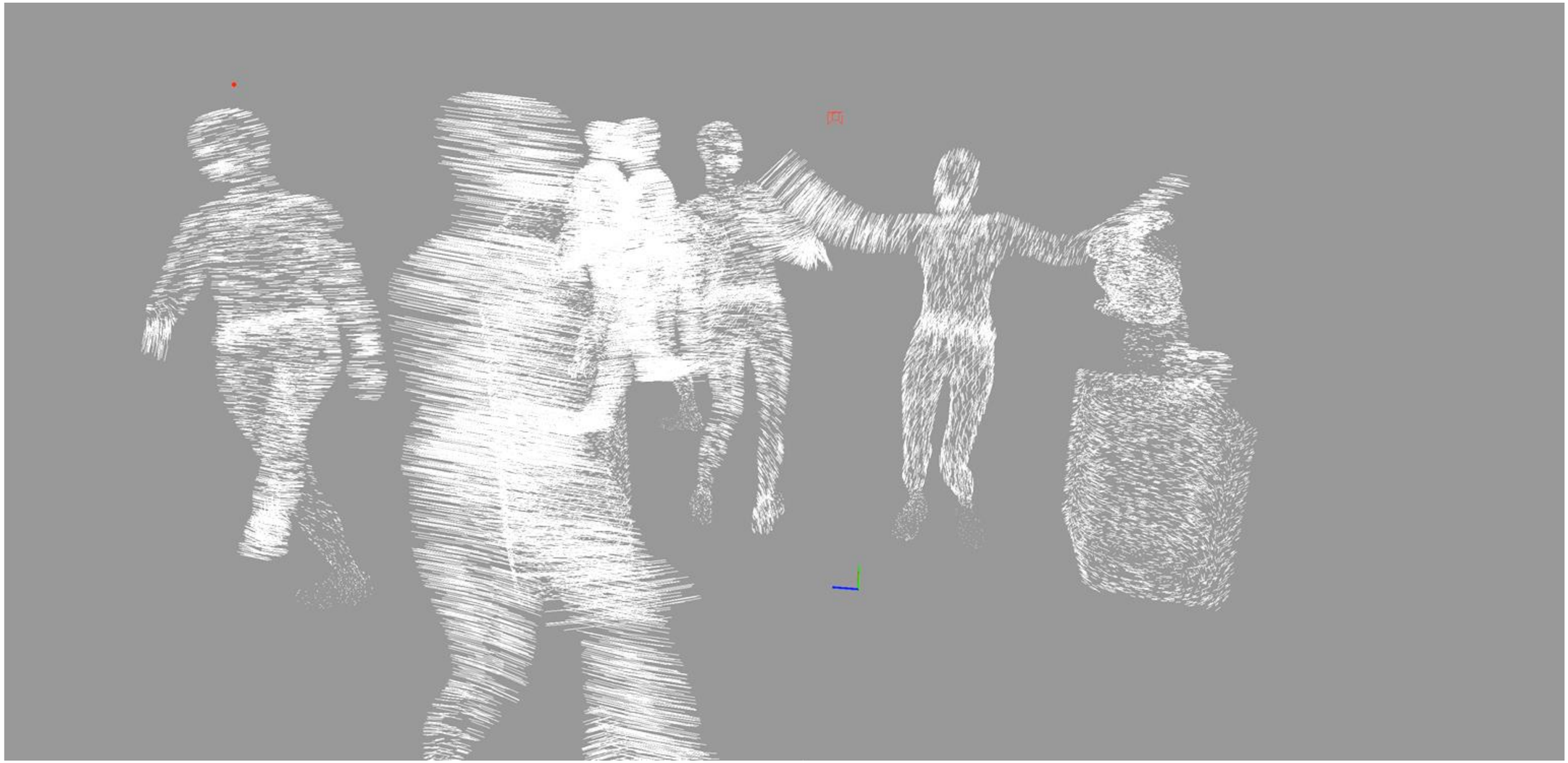
- Training the TinyFlowNet (TFN) requires ground truth motion information of occluded points
  - ➢ Hard to obtain in huge amounts for real world data.



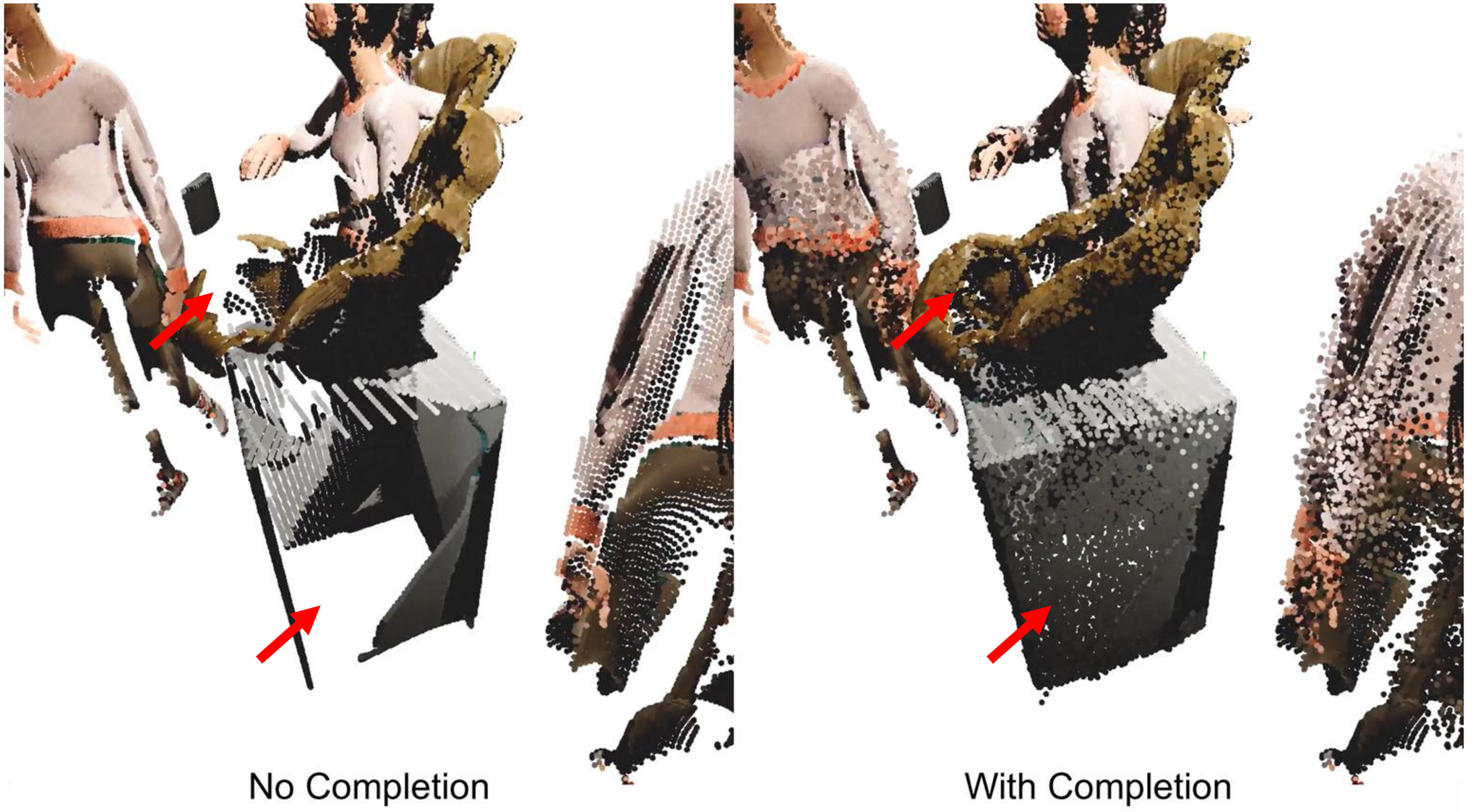
Training: RGB-D Data



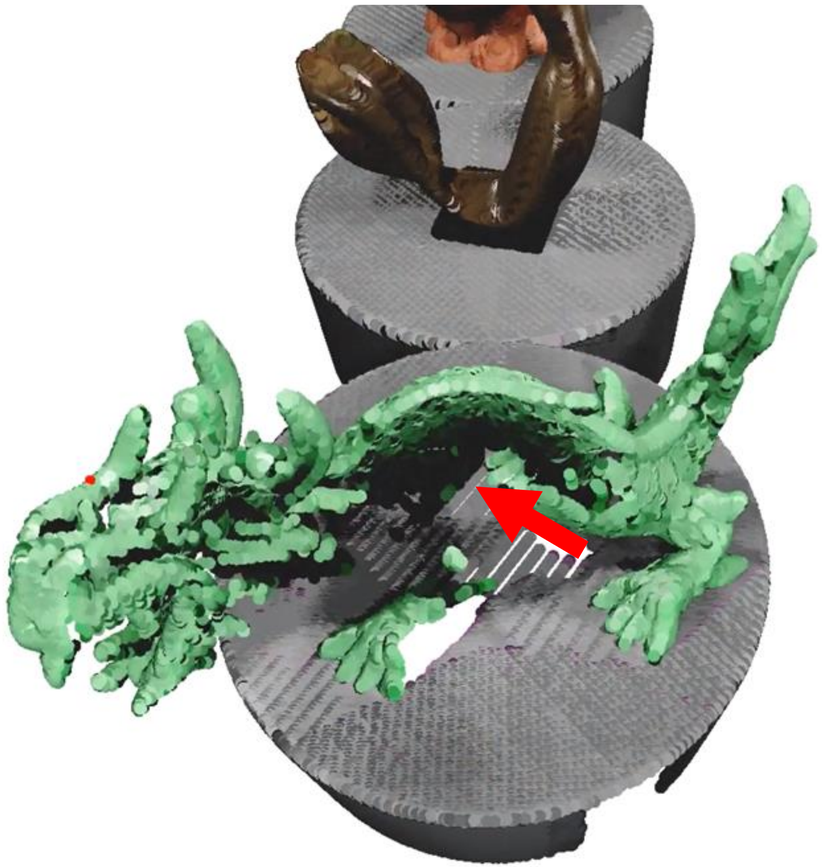
Training: Ground Truth Motion



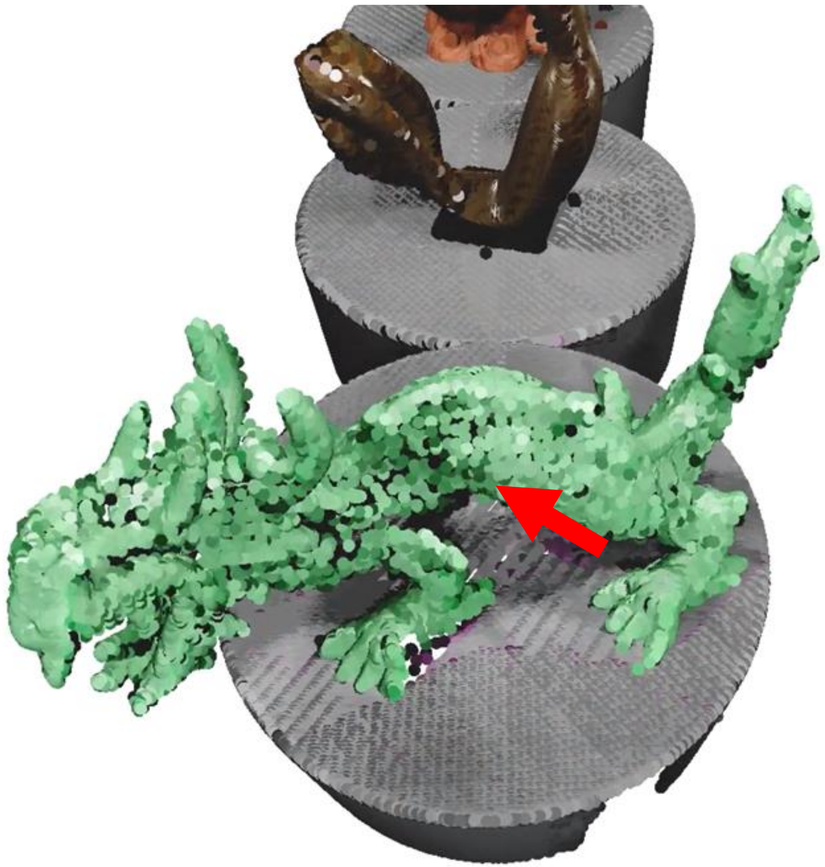
Results on Training Scene



Results on Unseen Scenes



No Completion

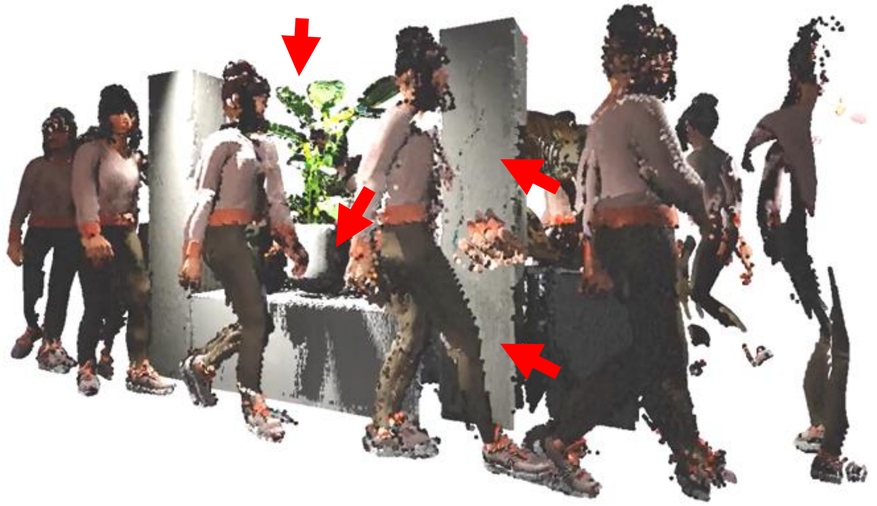


With Completion

Results on Unseen Scene

No Completion

With Completion

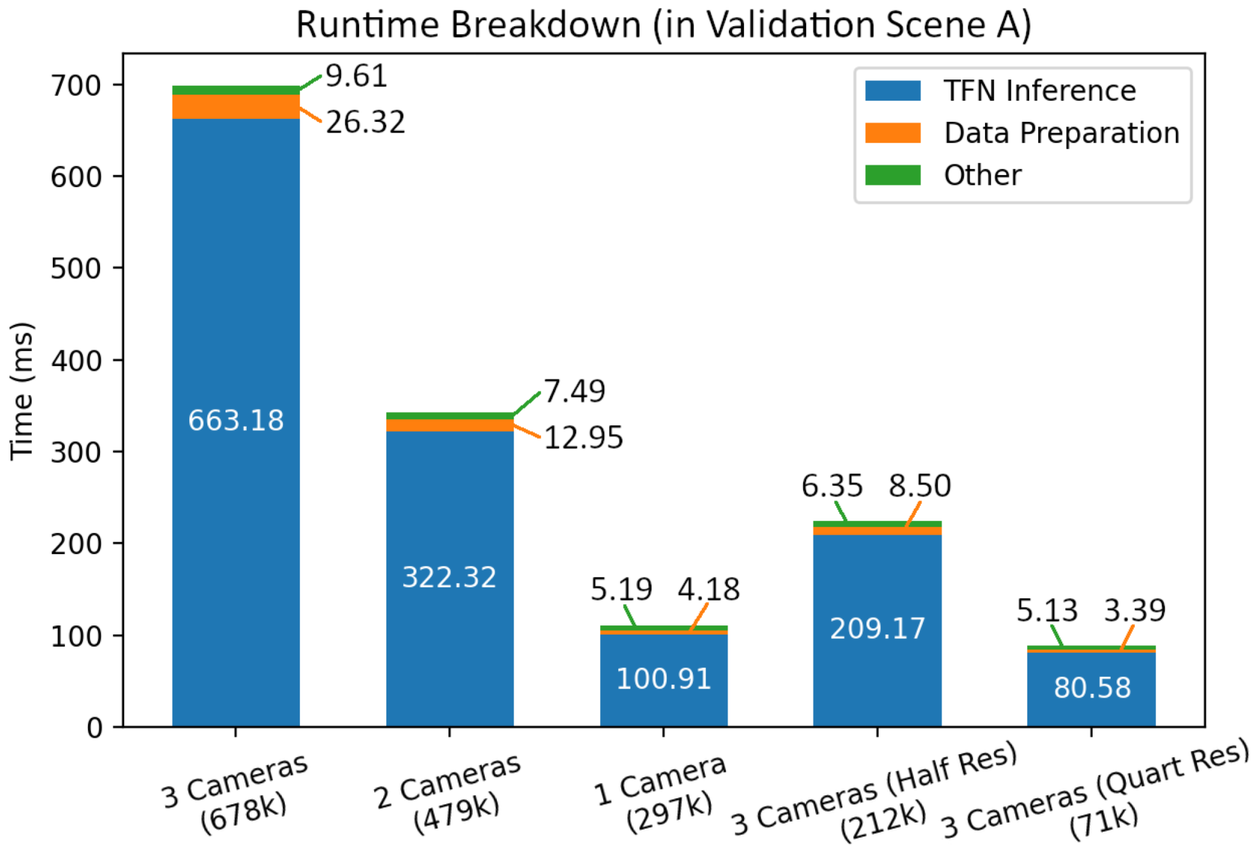


Results

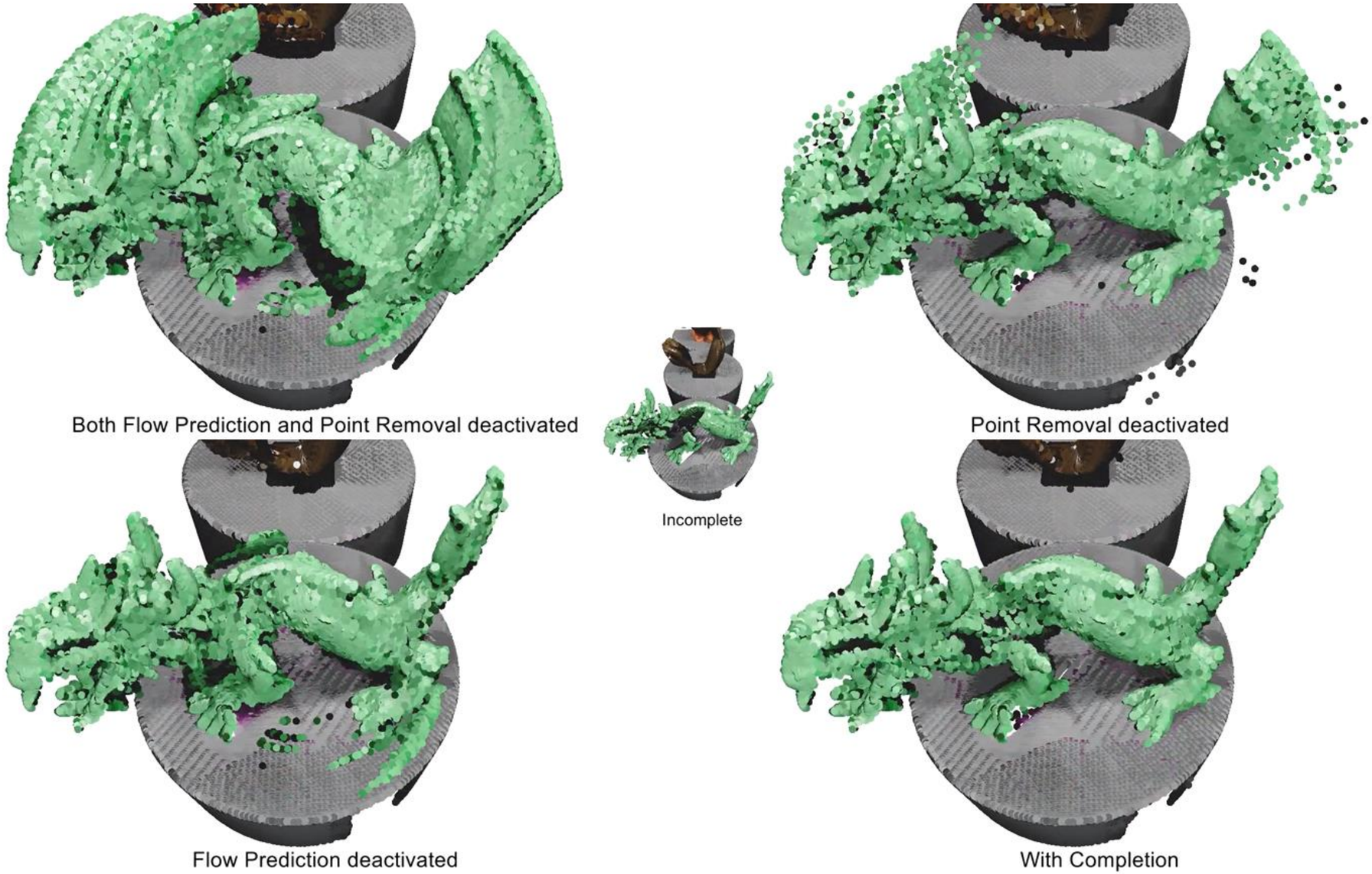
Real-time performance (30fps)

- 1 camera: up to 100.000 points
- 3 cameras: up to 30.000 points

Nvidia GeForce RTX 4090

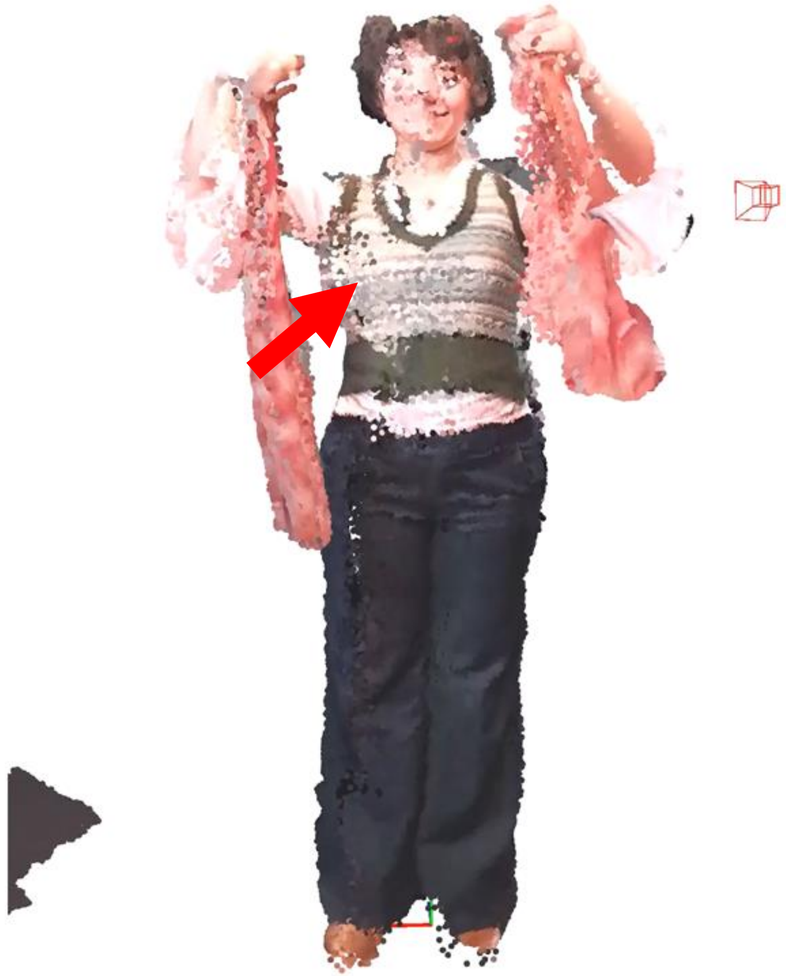


Results: Visual Ablation



Results: Real World Dataset

Raw



With Completion

Results: Real World Dataset

Raw

With Completion

Results: Real World Dataset

Raw

With Completion

Limitations & Future Work

Limitations

- For visual reconstruction still quite noisy
- Real-time (30fps) only up to 30.000 points

Future Work

- Using color and connectivity information in TinyFlowNet
- Custom neural network implementation (instead of LibTorch)
- Larger training set

Conclusion

- Novel method for temporal point cloud completion
  - GPU-Pipeline that manages a point set over time
  - **TinyFlowNet** that predicts motion of occluded points
  - Real-time for 100k (1 camera) or 30k (3 cameras)
  - Areas that are occluded for a short time are preserved well.

- Source code available: https://github.com/muehlenb/TemPCC

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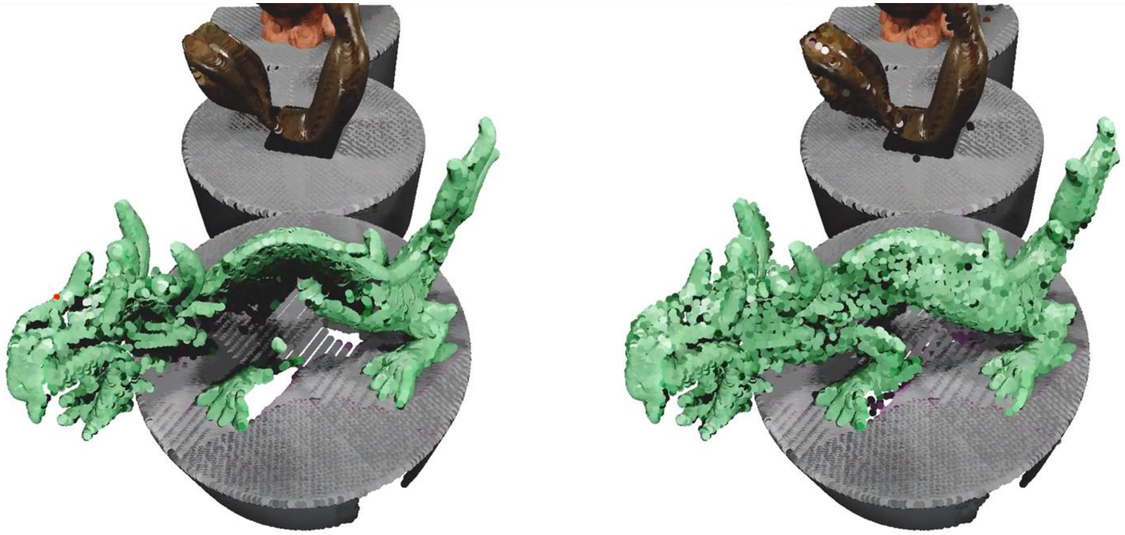
Thank you very much for your attention!



No Completion

With Completion

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References

[1] CWIPC-SXR Dataset, MMSys'21: Ignacio Reimat, Evangelos Alexiou, Jack Jansen, Irene Viola, Shishir Subramanyam and Pablo Cesar. CWIPC-SXR: Point Cloud dynamic human dataset for Social XR. MMSys'21, 2021.

[2] **Autonomous Surgical Lighting, ACM Health 2025:** Andre Mühlenbrock, Hendrik Huscher, Verena Nicole Uslar, Timur Cetin, Rene Weller, Dirk Weyhe, and Gabriel Zachmann. A Novel, Autonomous, Module-Based Surgical Lighting System. ACM Health, 2025.

[3] Motion2fusion, Mingsong Dou, Philip Davidson, Sean Ryan Fanello, Sameh Khamis, Adarsh Kowdle, Christoph Rhemann, Vladimir Tankovich, and Shahram Izadi. 2017. Motion2fusion: real-time volumetric performance capture. ACM ToG, 2017.

[4] Function4D, CVPR 2021: Tao Yu, Zerong Zheng, kaiwen Guo, Pengpeng Liu, Qionghai Dai, Yebin Liu. Function4D: Real-time Human Volumetric Capture from Very Sparse Consumer RGBD Sensors. CVPR 2021.

[5] ODGNet, AAAI 2024: Pingping Cai, Deja Scott, Xiaoguang Li, Song Wang. Orthogonal Dictionary Guided Shape Completion Network for Point Cloud. AAAI 2024.

[6] PDFlow, ICRA 2015: M. Jaimez, M. Souiai, J. Gonzalez-Jimenez and D. Cremers. A primal-dual framework for real-time dense RGB-D scene flow. ICRA 2015.