# LiDPM: Rethinking Point Diffusion for Lidar Scene Completion

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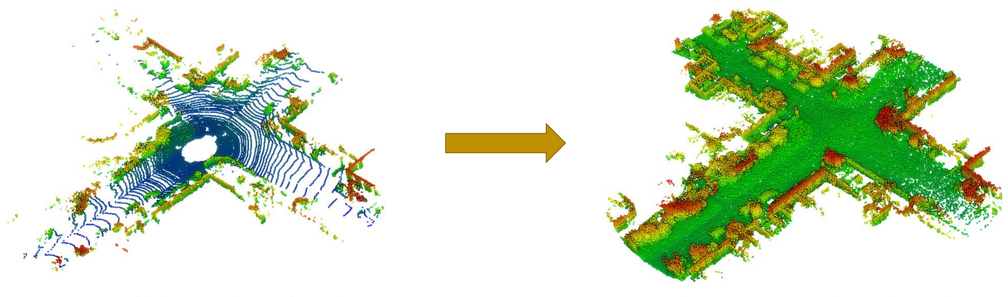
## Task: pointwise large-scale scene completion



sparse lidar point cloud — dense GT point cloud

**Project page** **Code available!**

## Shortcomings of prior work:

- object-level architectures don't scale up to the scene level,
- "local diffusion" (re)formulation requires regularisation,
- no inherent extension to unconditional scene generation task.

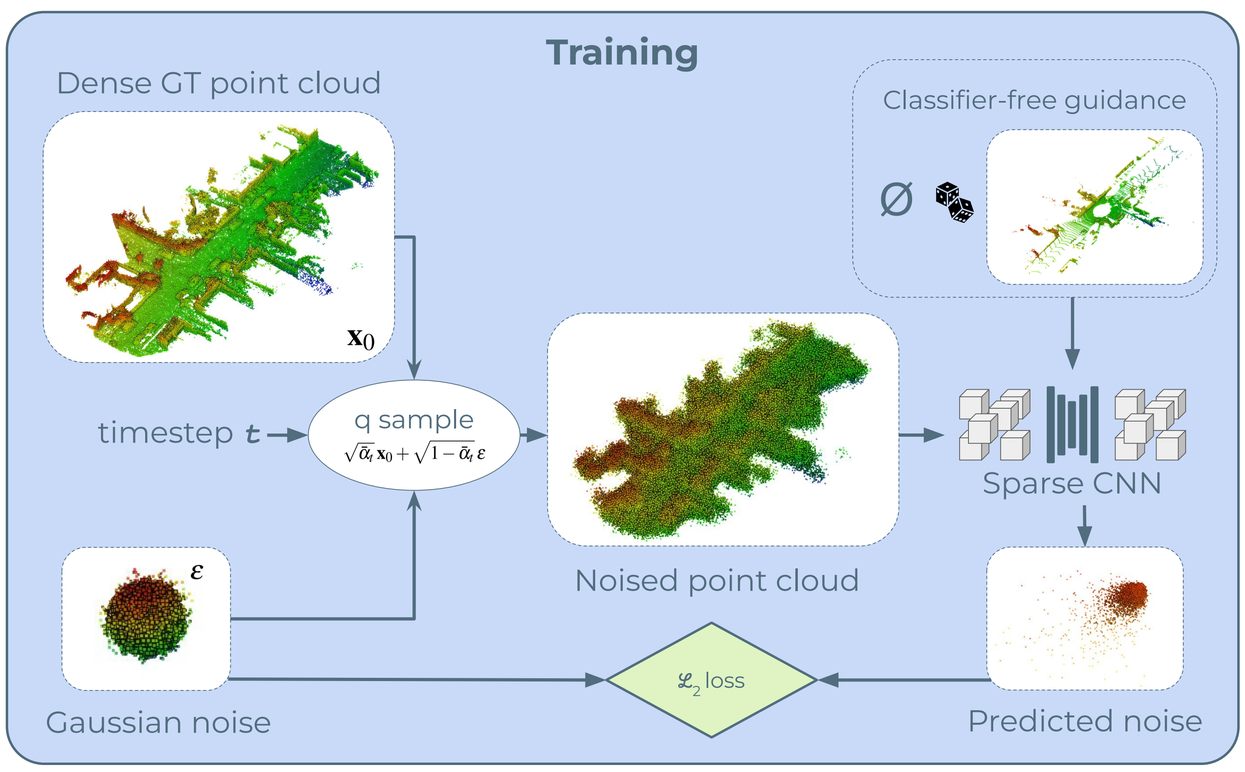
## Main contribution

We show that vanilla DDPM can be applied to large-scale non-normalized point clouds, i.e., "global diffusion" at a scene level.

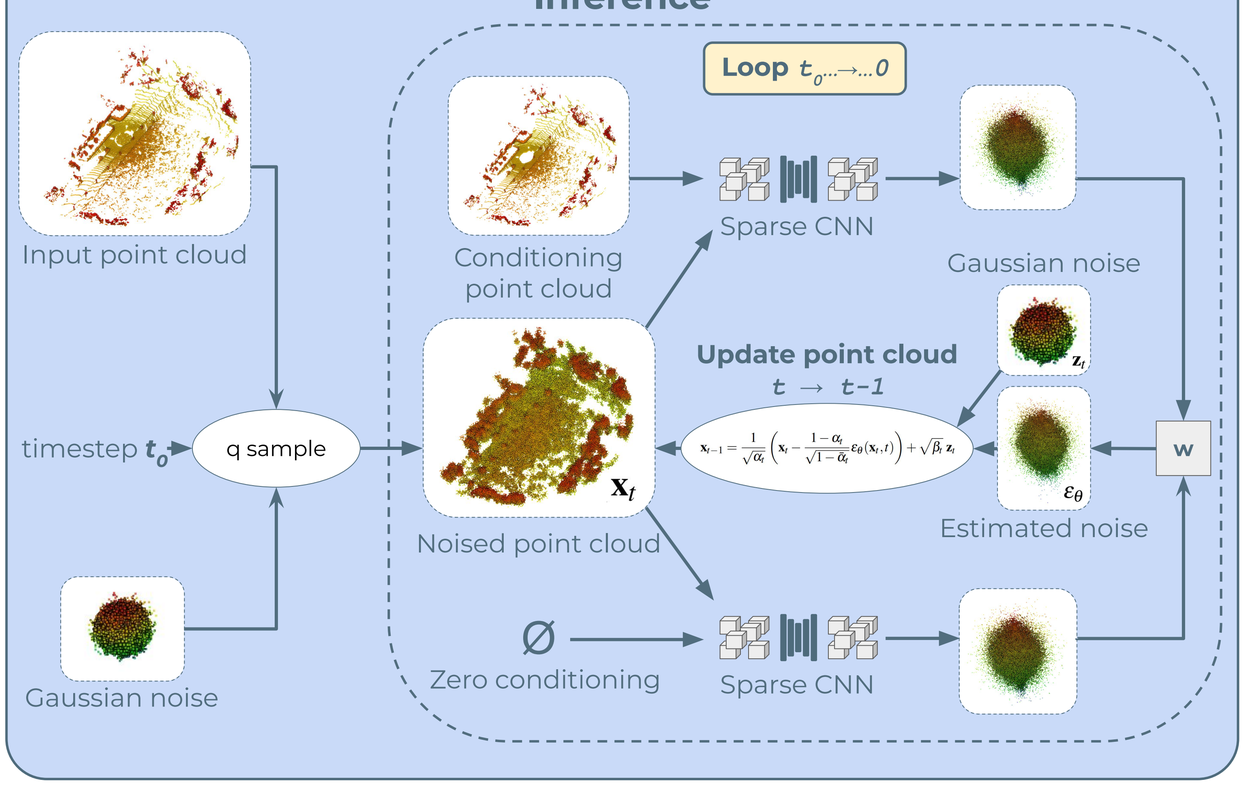
### LiDPM strengths:

- does not require any additional regularization,
- opens up the possibility to **generate** scene-level point clouds,
- outperforms local diffusion for scene completion on SemKITTI [1].

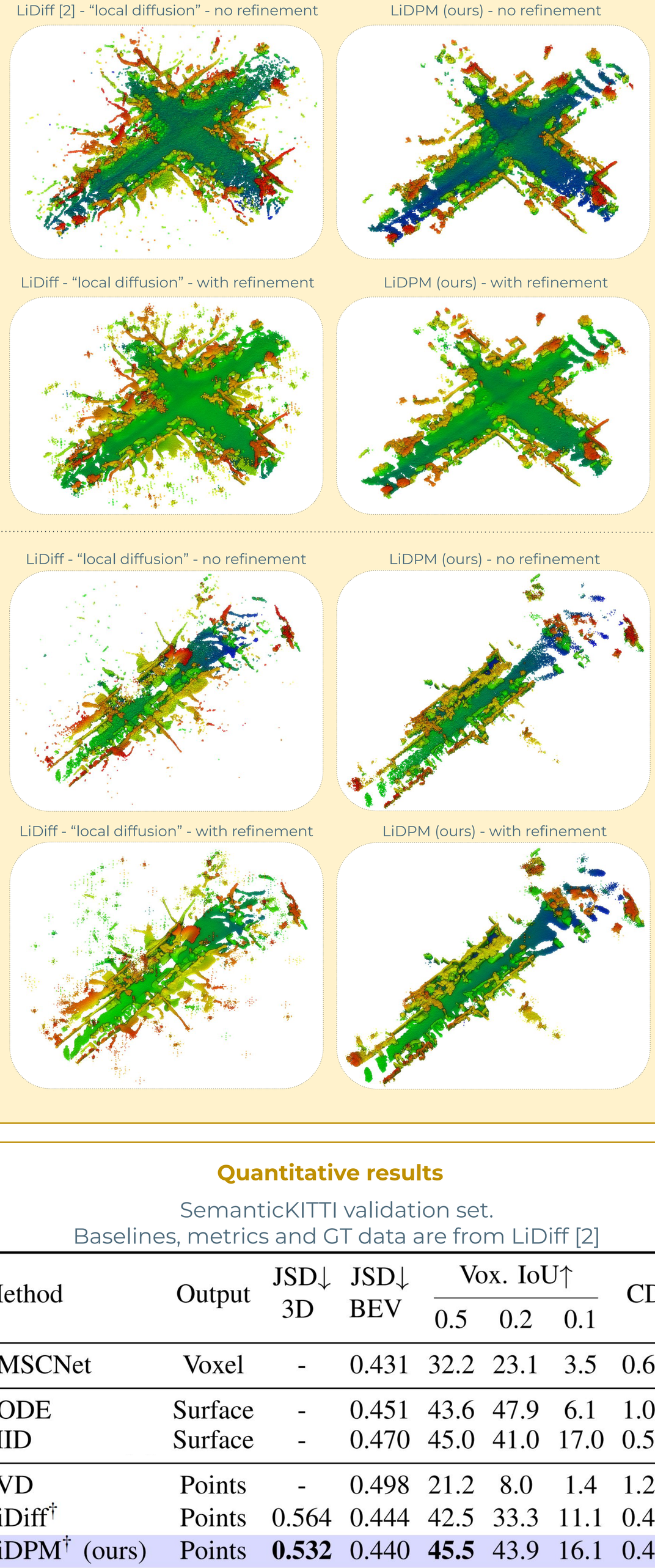
## Training




## Inference




## Qualitative comparison




## Quantitative results

SemanticKITTI validation set.
Baselines, metrics and GT data are from LiDiff [2]

| Method | Output | JSD↓ 3D | JSD↓ BEV | Vox. IoU↑ 0.5 | Vox. IoU↑ 0.2 | Vox. IoU↑ 0.1 | CD↓ |
|---|---|---|---|---|---|---|---|
| LMSCNet | Voxel | - | 0.431 | 32.2 | 23.1 | 3.5 | 0.641 |
| LODE | Surface | - | 0.451 | 43.6 | 47.9 | 6.1 | 1.029 |
| MID | Surface | - | 0.470 | 45.0 | 41.0 | 17.0 | 0.503 |
| PVD | Points | - | 0.498 | 21.2 | 8.0 | 1.4 | 1.256 |
| LiDiff† | Points | 0.564 | 0.444 | 42.5 | 33.3 | 11.1 | 0.434 |
| LiDPM† (ours) | Points | **0.532** | 0.440 | **45.5** | 43.9 | 16.1 | 0.446 |
| LiDiff | Points | 0.573 | 0.416 | 40.7 | 38.9 | 24.8 | **0.376** |
| LiDPM (ours) | Points | 0.542 | **0.403** | 44.4 | **44.0** | **27.6** | 0.377 |

†: diffusion only, *i.e.*, without post-processing (refinement)

## References

[1] J. Behley, M. Garbade, A. Milioto, J. Quenzel, S. Behnke, C. Stachniss, J. Gall. *SemanticKITTI: A Dataset for Semantic Scene Understanding of LiDAR Sequences.* CVPR, 2019.
[2] L. Nunes, R. Marcuzzi, B. Mersch, J. Behley, C. Stachniss. *Scaling diffusion models to real-world 3d lidar scene completion.* CVPR, 2024.