Learning to Drop Points for LiDAR Scan Synthesis

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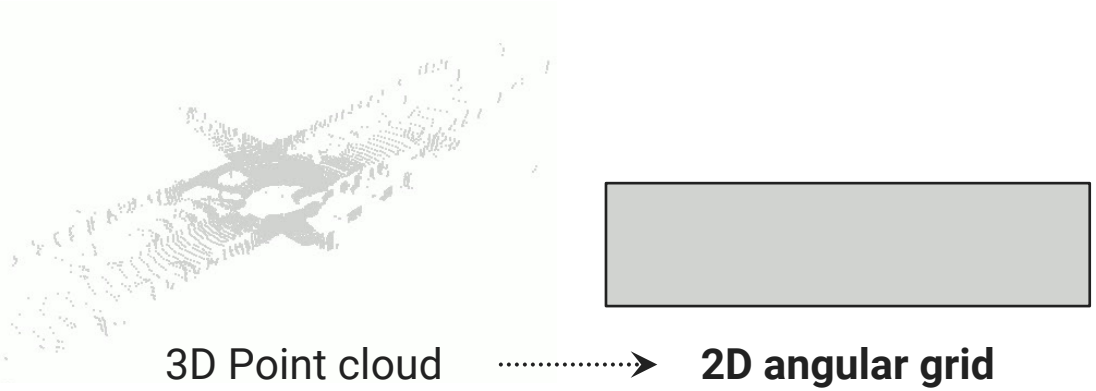
Introduction

We propose **a noise-aware 2D GAN for 3D LiDAR data**

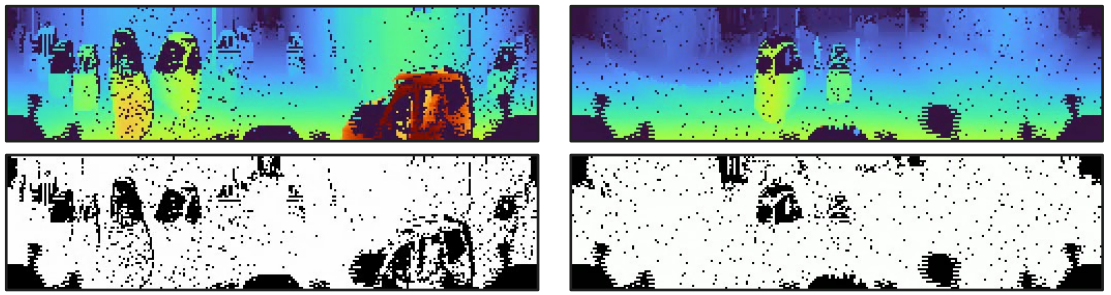
Motivation

- Generative modeling for restoring LQ data
- Modeling LiDAR point clouds is non-trivial
- **A bijective 2D angular grid** is effective for generative modeling [Caccia et al. IROS'19]



Challenges

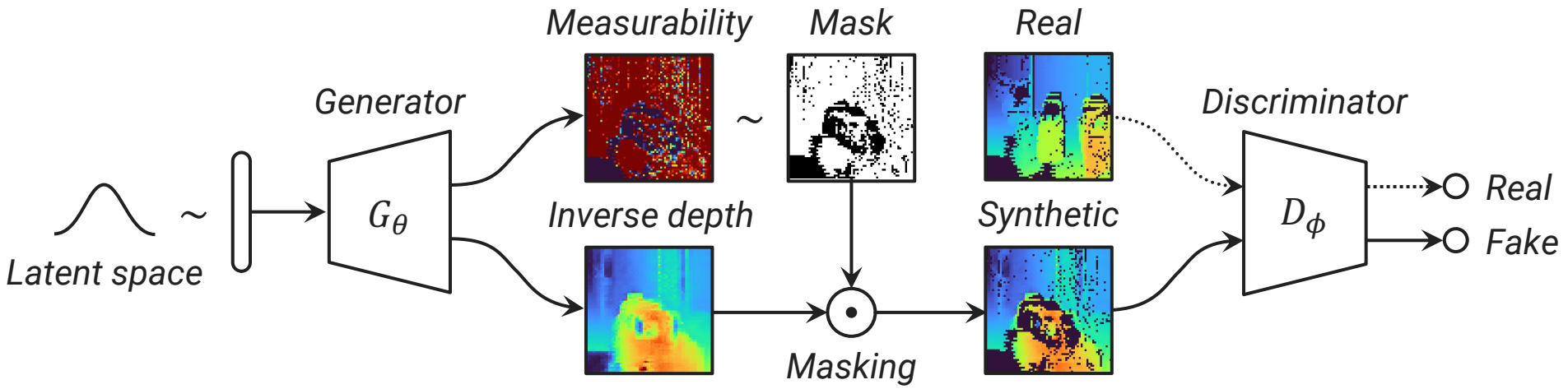
- The 2D representation is noisy!
- A laser measurement often involves missing points (**dropout noise on 2D**)
- Training GANs is susceptible



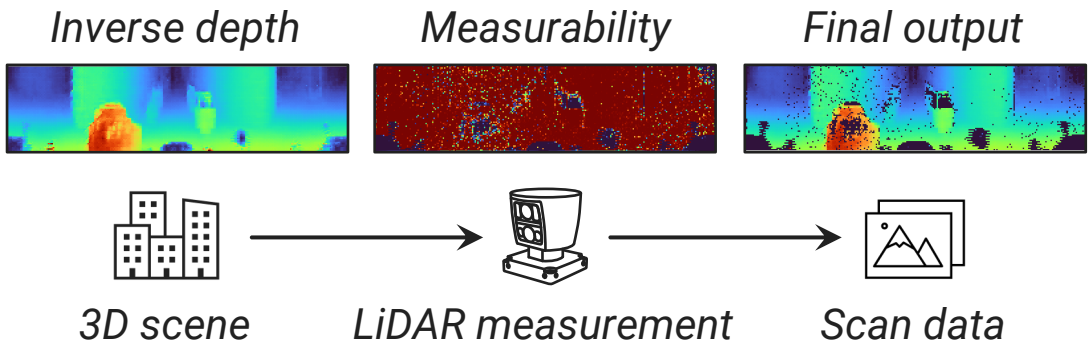
Samples from KITTI dataset [Geiger et al. IJRR'13]

Approach

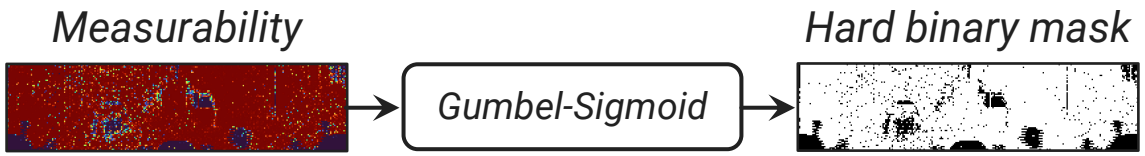
Idea: learning depth maps with measurement uncertainty as 2D styles



1. Learning to drop points on 2D angular grid



2. A differentiable relaxation to model dropout noises

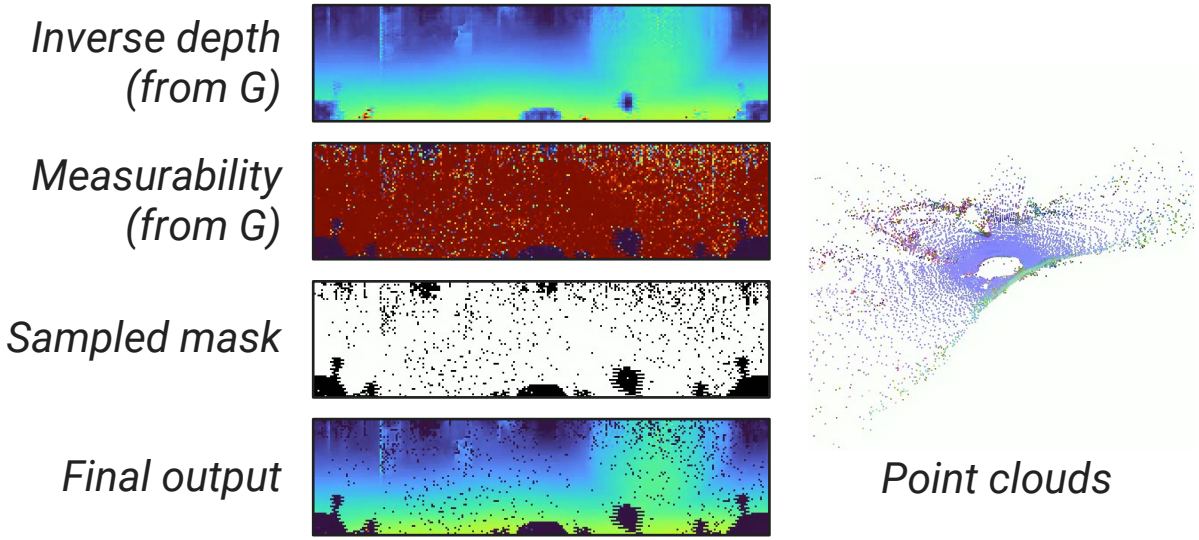


Differentiable Bernoulli sampler
using Gumbel-Sigmoid distribution

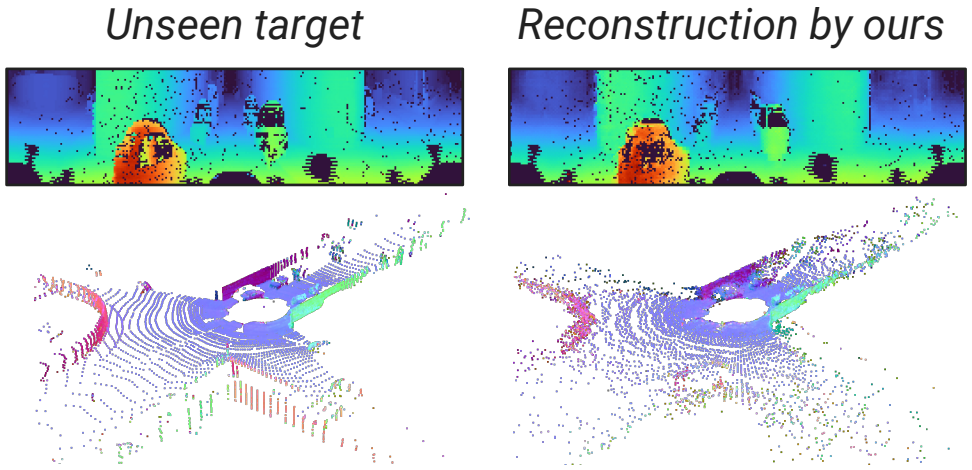
[Jang et al. ICLR'17] [Maddison et al. ICLR'17]

Results

Synthesis by sampling latents



Reconstruction by optimizing latents

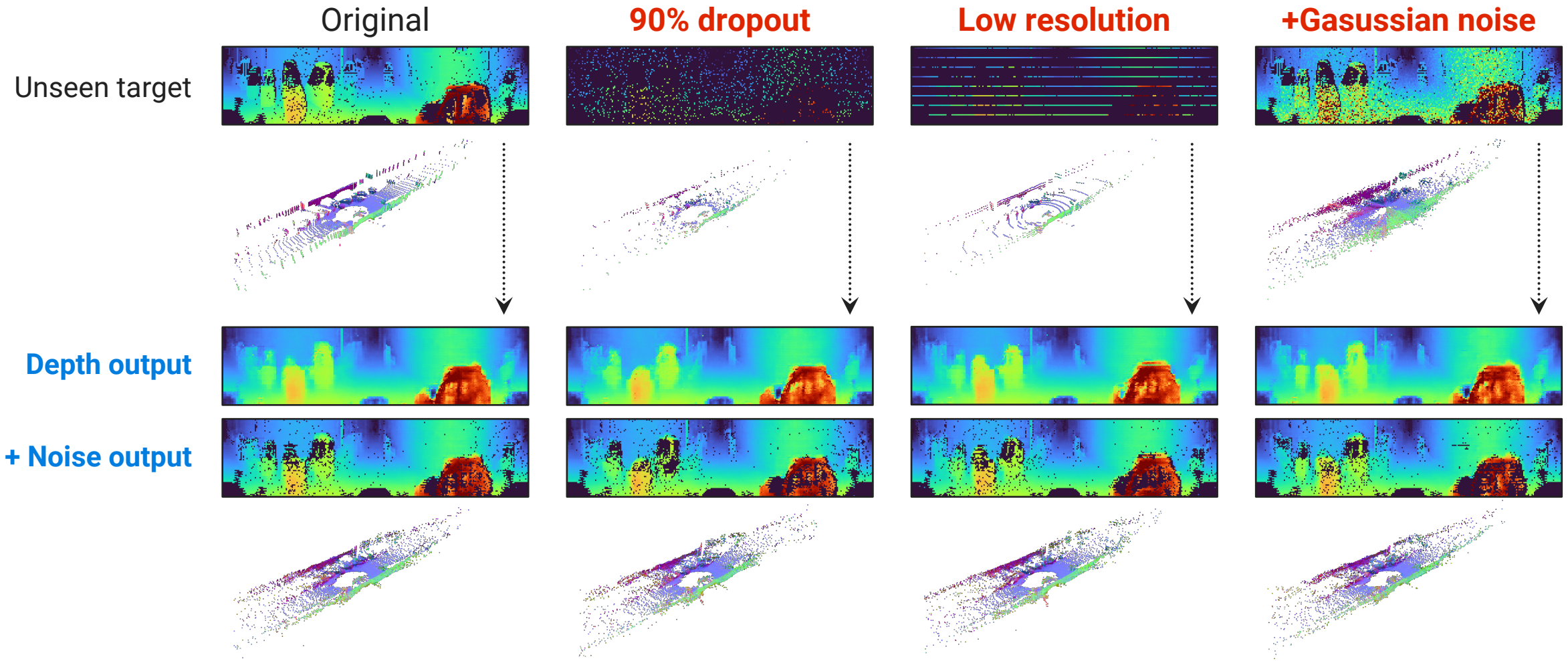


	Baseline (Standard GAN)	Ours
3D quality & diversity (1-nearest neighbor accuracy)	99.99 ⟶	**94.62**
2D quality (Sliced Wasserstein distance)	0.158 ⟶	**0.151**

	Baseline (Standard GAN)	Ours
3D error (Chamfer distance)	5.31 ⟶	**1.64**
2D error (Root mean squared error)	0.280 ⟶	**0.155**

Application

The trained generator can be used as **a generative scene prior**
to improve incomplete/unreliable observations



Our code is available at https://github.com/kazuto1011/dusty-gan