Sparsification Plots. To assess the quality of the uncertainty measures, we use so-called sparsification plots, which are commonly used for this purpose [1,33,19,20]. Such plots reveal on how much the estimated uncertainty coincides with the true errors. If the estimated variance is a good representation of the model uncertainty, and the pixels with the highest variance are removed gradually, the error should monotonically decrease. Such a plot of our method is shown in Figure 3. The best possible ranking of uncertainties is ranking by the true error to the ground-truth. We refer to this curve as *Oracle Sparsification*. Figure 3 reveals that our uncertainty estimate is very close to this oracle.

Sparsification Error. For each approach the oracle is different, hence a comparison among approaches using a single sparsification plot is not possible. To this end, we introduce a measure, which we call *Sparsification Error*. It is defined as the difference between the sparsification and its oracle. Since this measure normalizes the oracle out, a fair comparison of different methods is possible. In Figure 4a, we show sparsification errors for all methods we present in this paper. To quantify the sparsification error with a single number, we use the Area Under the Sparsification Error curve ($AUSE$).

Uncertainty Estimates and Multi-Hypotheses Networks for Optical Flow, ECCV 2018

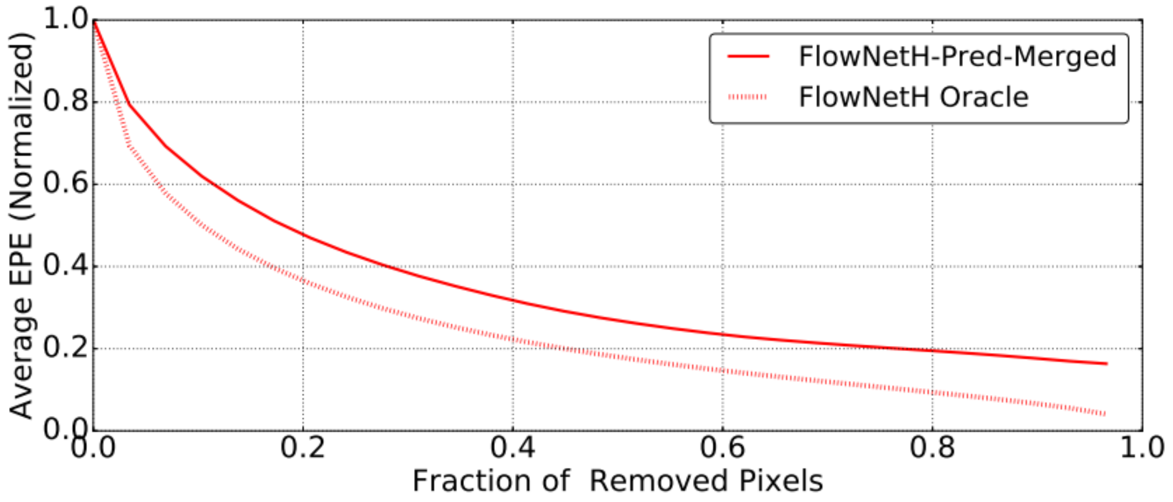


Fig. 3: Sparsification plot of FlowNetH-Pred-Merged for the Sintel train clean dataset. The plot shows the average endpoint error (AEPE) for each fraction of pixels having the highest uncertainties removed. The oracle sparsification shows the lower bound by removing each fraction of pixels ranked by the ground-truth endpoint error. Removing 20 percent of the pixels results in halving the average endpoint error.

Uncertainty Estimates and Multi-Hypotheses Networks for Optical Flow, ECCV 2018

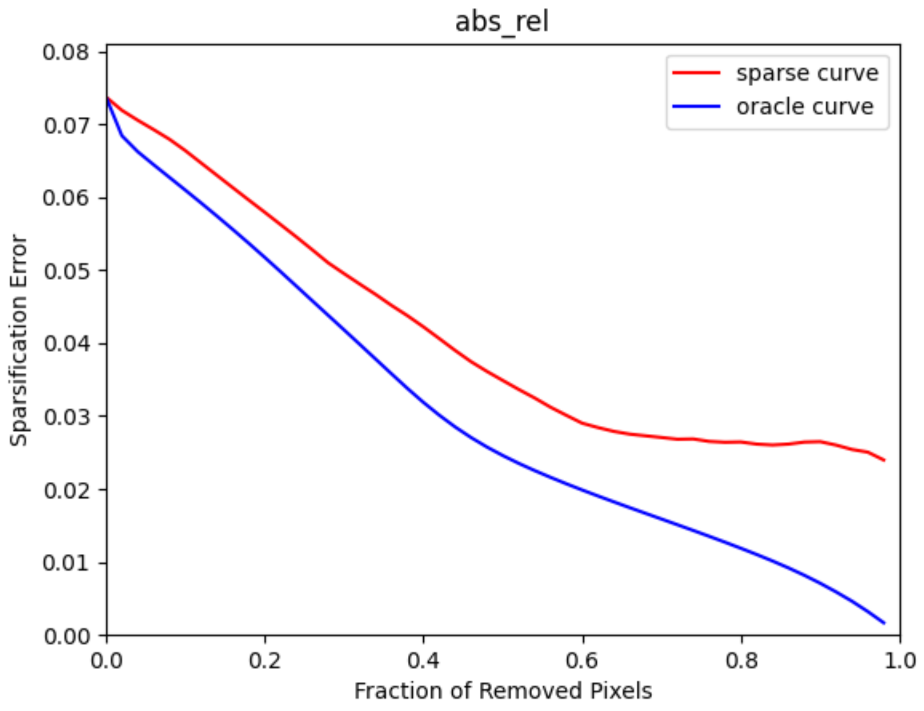
Sparsification Curve

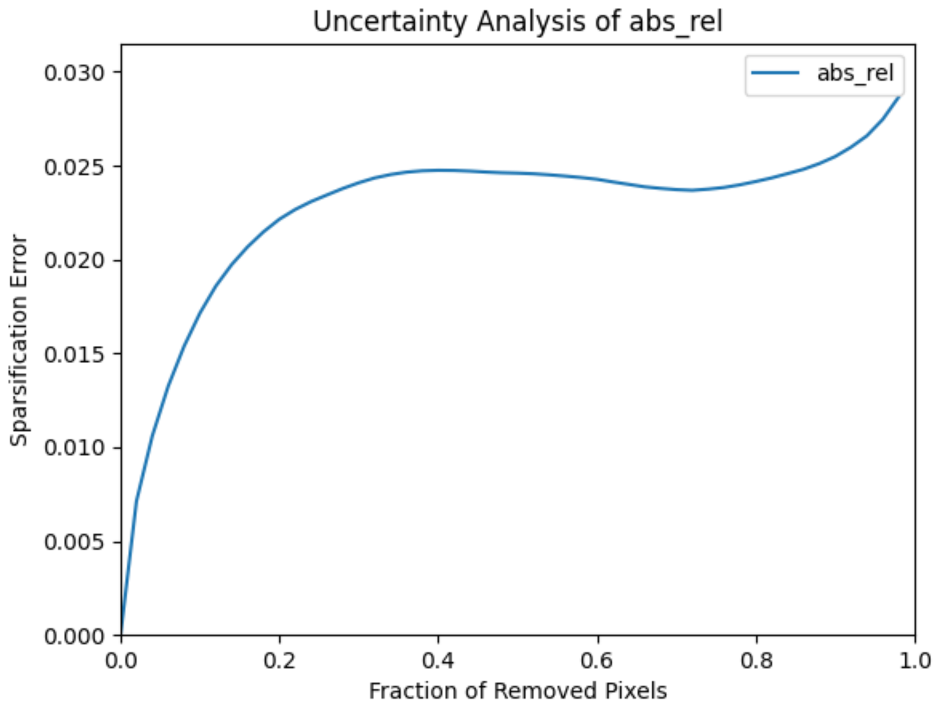
- 将深度图像按照 uncertainty 的降序进行排序，然后每次取掉这些深度值的2%（不放回），然后对剩下的部分进行误差的计算。这种方法就可以计算 uncertainty 低的地方是不是计算出来的误差也会比较低。（曲线1）

- 同时绘制一条理想的曲线，理想的 sparsification plot 是根据深度误差的降序进行绘制的，也就是和上面采用相同的办法，每次抽取掉2%深度误差高（与depth gt比）的点，用剩下的点计算误差，这条曲线称为oracle。

Sparsification Curve

$$\text{Abs Rel} = \frac{1}{||\mathcal{I}||} \sum_{p \in \mathcal{I}} \frac{|d(p) - d^*(p)|}{d^*(p)}$$





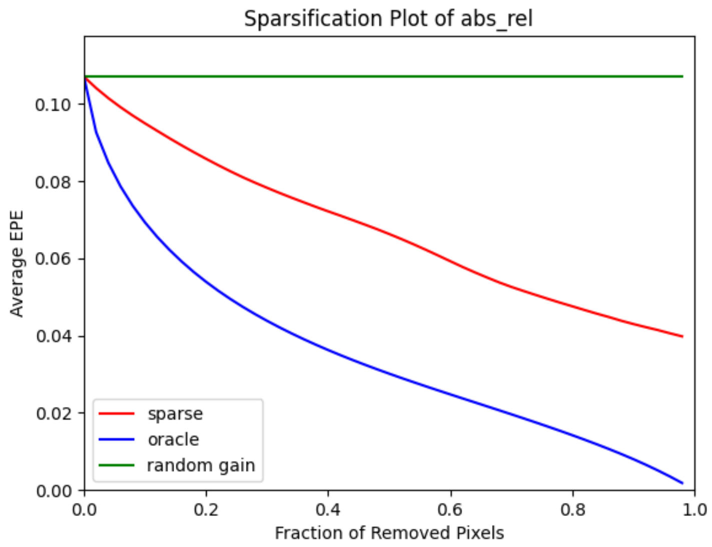
Sparse curve – oracle curve

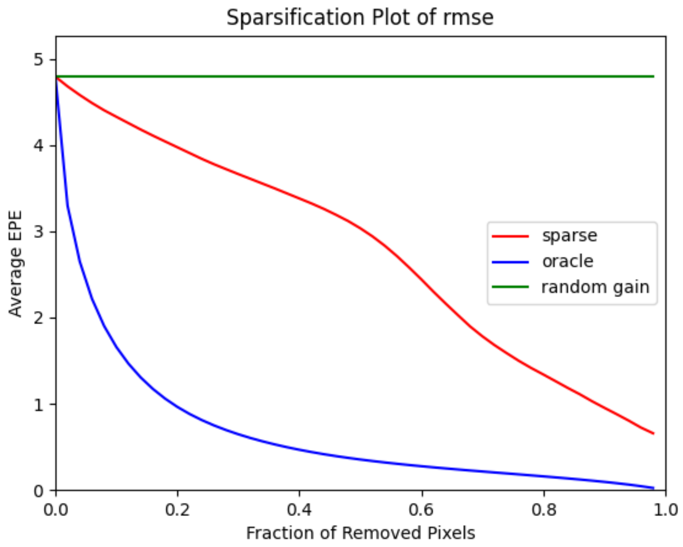
$$\text{Abs Rel} = \frac{1}{||\mathcal{I}||} \sum_{p \in \mathcal{I}} \frac{|d(p) - d^*(p)|}{d^*(p)}$$

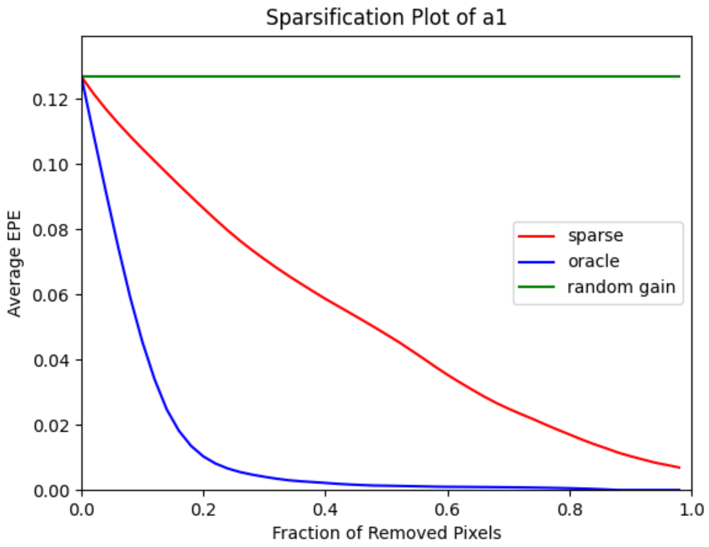
$$\text{RMSE} = \sqrt{\frac{1}{||\mathcal{I}||} \sum_{p \in \mathcal{I}} (d(p) - d^*(p))^2}$$

$$\delta < 1.25^k = \frac{1}{||\mathcal{I}||} \sum_{p \in \mathcal{I}} \max\left(\frac{d}{d^*}, \frac{d^*}{d}\right) < 1.25^k$$

MVS Log Likelihood

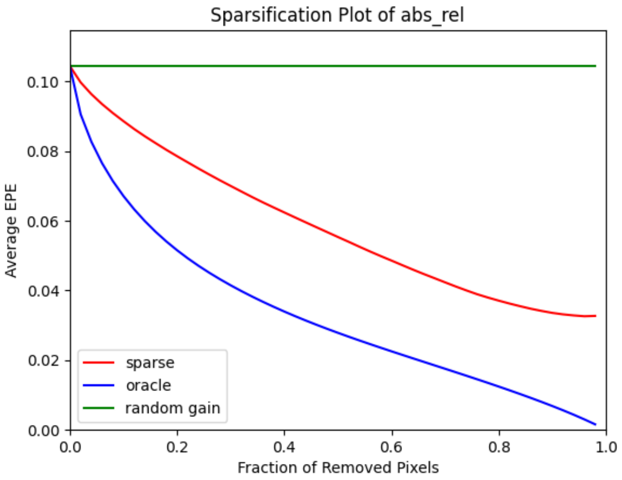


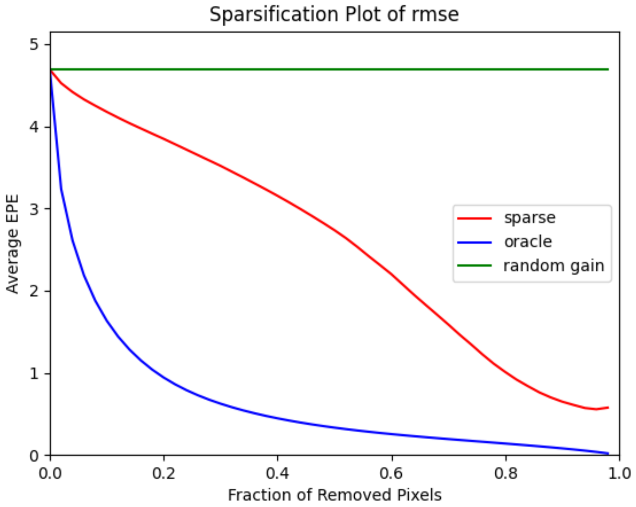


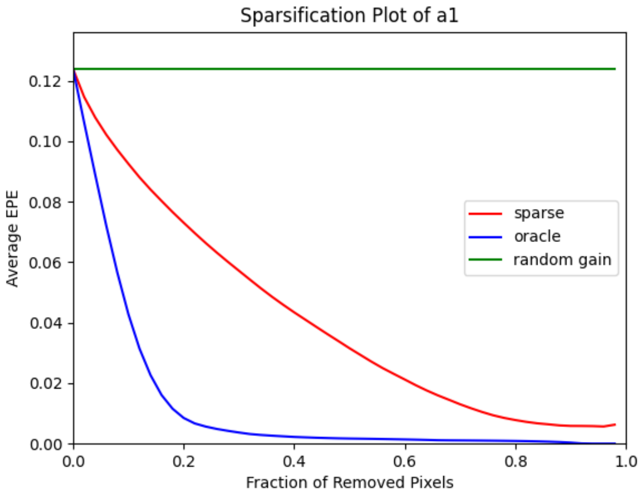


Abs_rel ↓	Sq_rel ↓	Rmse ↓	Rmse_log ↓	$\delta < 1.25$ ↑	$\delta < 1.25^2$ ↑	$\delta < 1.25^3$ ↑
0.107	0.840	4.793	0.197	0.873	0.956	0.979

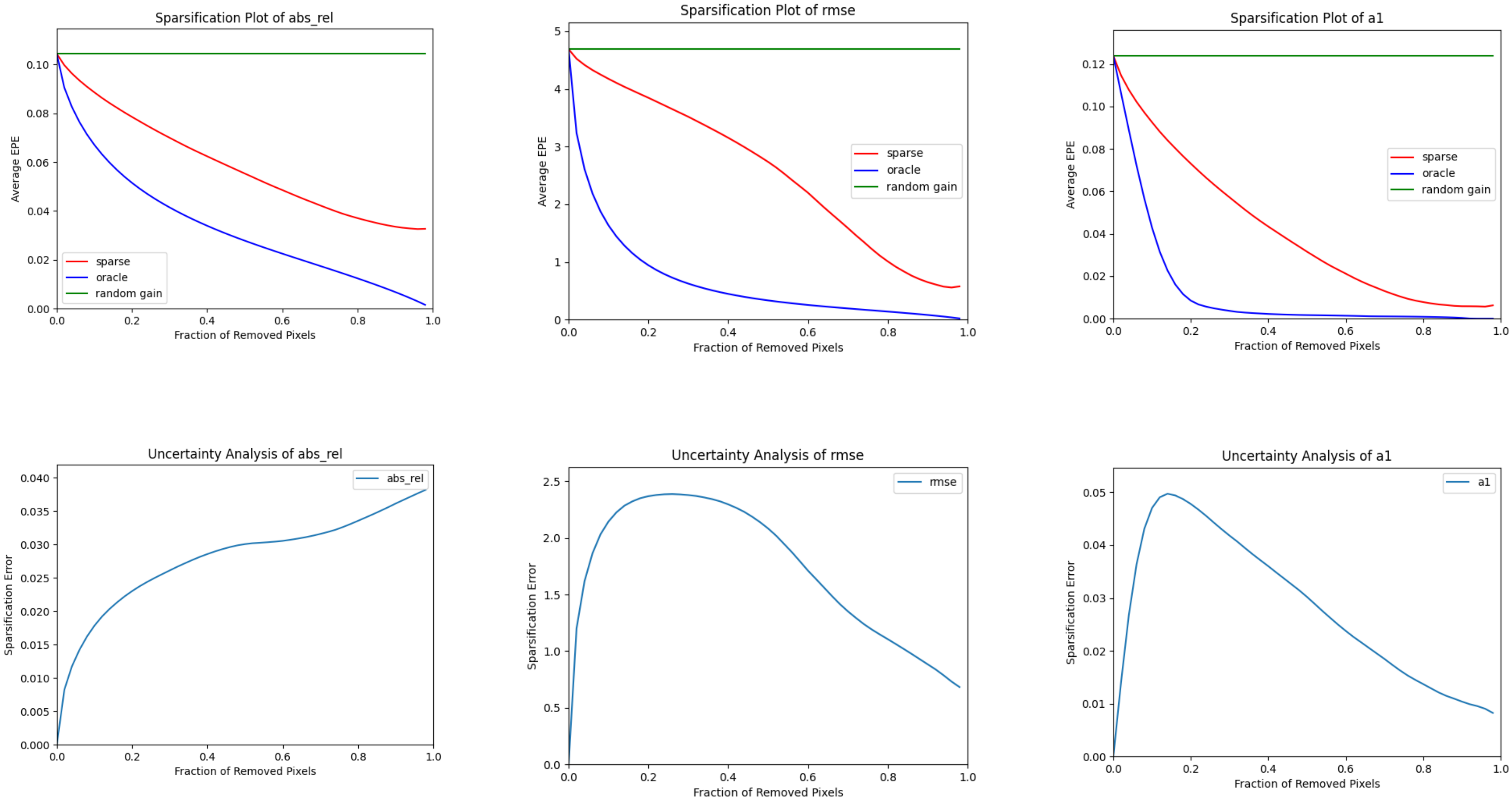
Mono Self-Teaching







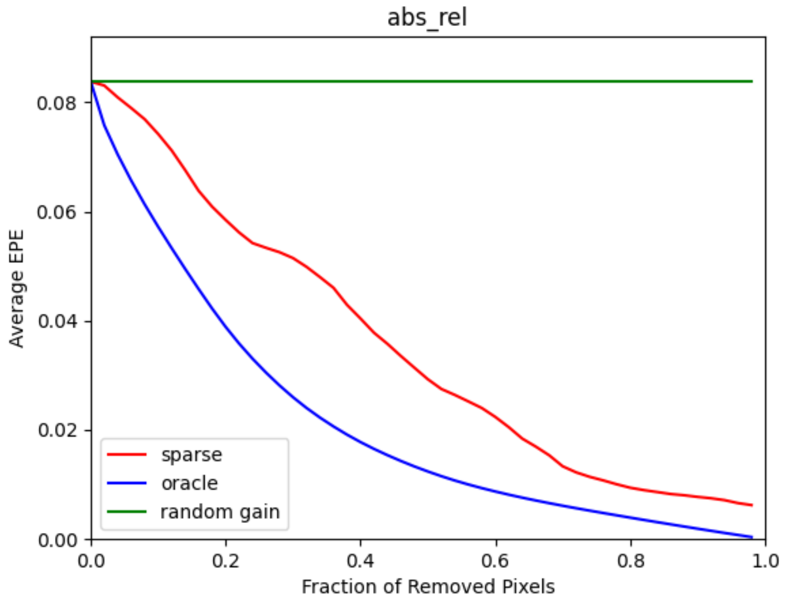
Abs_rel ↓	Sq_rel ↓	Rmse ↓	Rmse_log ↓	$\delta < 1.25$ ↑	$\delta < 1.25^2$ ↑	$\delta < 1.25^3$ ↑
0.104	0.799	4.689	0.192	0.876	0.957	0.980

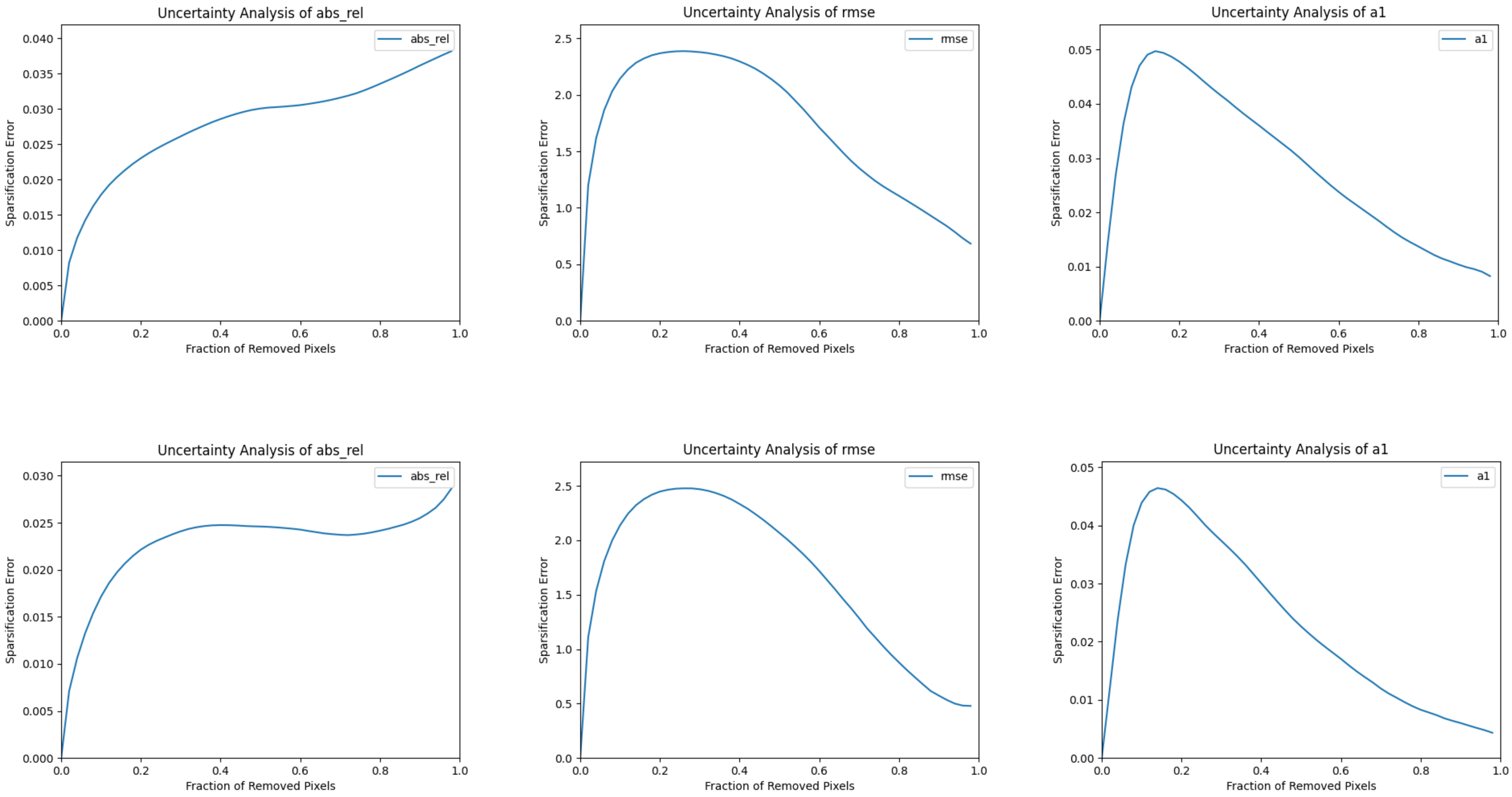

Sparsification Plot of abs_rel
Average EPE
Fraction of Removed Pixels
sparse
oracle
random gain
Sparsification Plot of rmse
Average EPE
Fraction of Removed Pixels
sparse
oracle
random gain
Sparsification Plot of a1
Average EPE
Fraction of Removed Pixels
sparse
oracle
random gain
Uncertainty Analysis of abs_rel
Sparsification Error
Fraction of Removed Pixels
abs_rel
Uncertainty Analysis of rmse
Sparsification Error
Fraction of Removed Pixels
rmse
Uncertainty Analysis of a1
Sparsification Error
Fraction of Removed Pixels
a1

- 两个评价指标AUSE以及AURG

- AUSE是Area Under the Sparsification Error， 越低越好， 计算方法就是用uncertainty降序的曲线1减去oracle曲线， 主要评价不确定度和实际的误差的关系

- AURG是Area Under the Random Gain， 越高越好，其中一条曲线是在所有点计算出来的误差， 不进行任何删除， 另一条曲线就是1中的曲线， 用不删除的曲线减去曲线1， 如果相差越大证明不确定度估计是有效果的



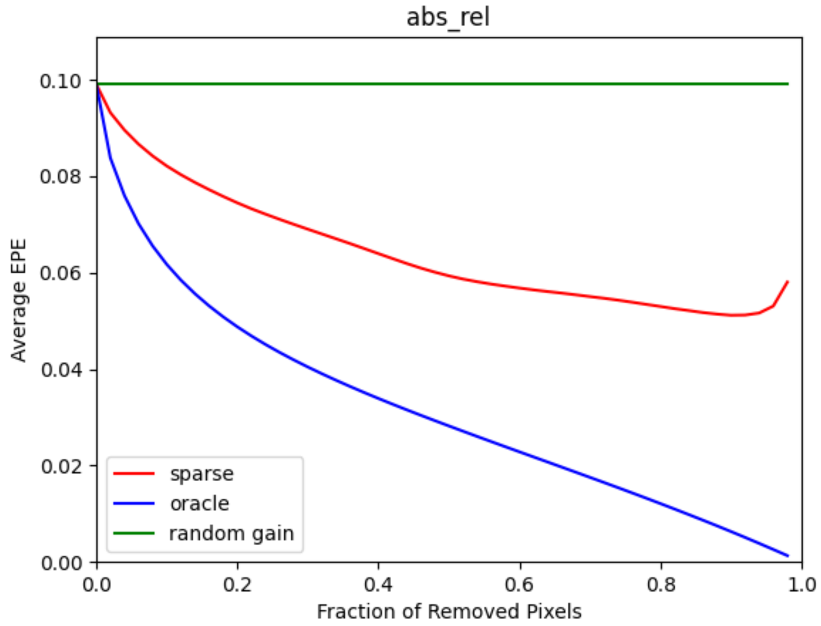

Uncertainty Analysis of abs_rel
abs_rel
Sparsification Error
Fraction of Removed Pixels
Uncertainty Analysis of rmse
rmse
Sparsification Error
Fraction of Removed Pixels
Uncertainty Analysis of a1
a1
Sparsification Error
Fraction of Removed Pixels
Uncertainty Analysis of abs_rel
abs_rel
Sparsification Error
Fraction of Removed Pixels
Uncertainty Analysis of rmse
rmse
Sparsification Error
Fraction of Removed Pixels
Uncertainty Analysis of a1
a1
Sparsification Error
Fraction of Removed Pixels

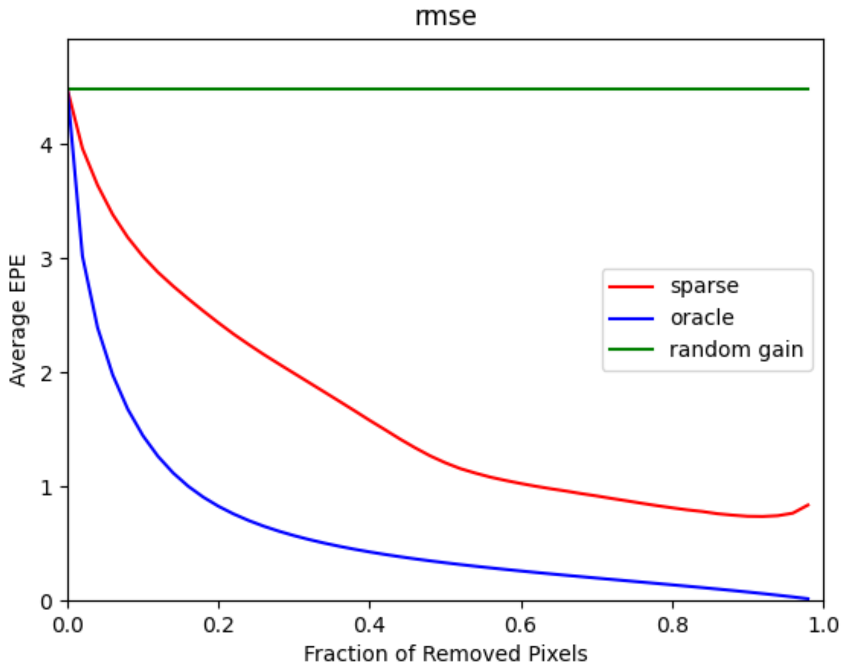
	Abs_rel ↓	Sq_rel ↓	Rmse ↓	Rmse_log ↓	$\delta < 1.25$ ↑	$\delta < 1.25^2$ ↑	$\delta < 1.25^3$ ↑
Log	0.107	0.840	4.793	0.197	0.873	0.956	0.979
Self-Teach	**0.104**	**0.799**	**4.689**	**0.192**	**0.876**	**0.957**	**0.980**

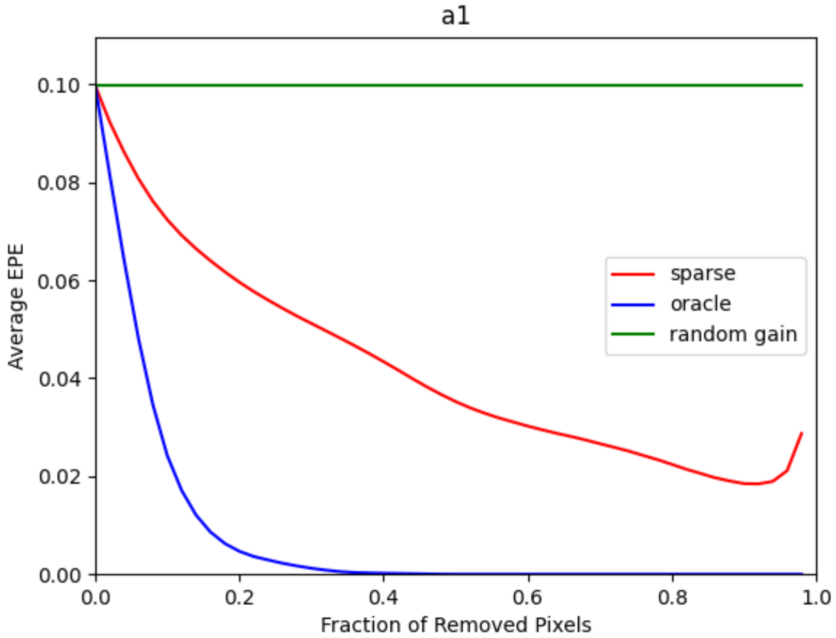
Figure 1. Depth estimation on KITTI Eigen Split Test Set (697 images)

	Abs_rel		Rmse		$\delta \geq 1.25$	
	AUSE ↓	AURG ↑	AUSE ↓	AURG ↑	AUSE ↓	AURG ↑
Log	0.032	0.040	2.092	2.042	0.040	0.075
Self-Teach	**0.025**	**0.046**	**1.899**	**2.154**	**0.029**	**0.083**

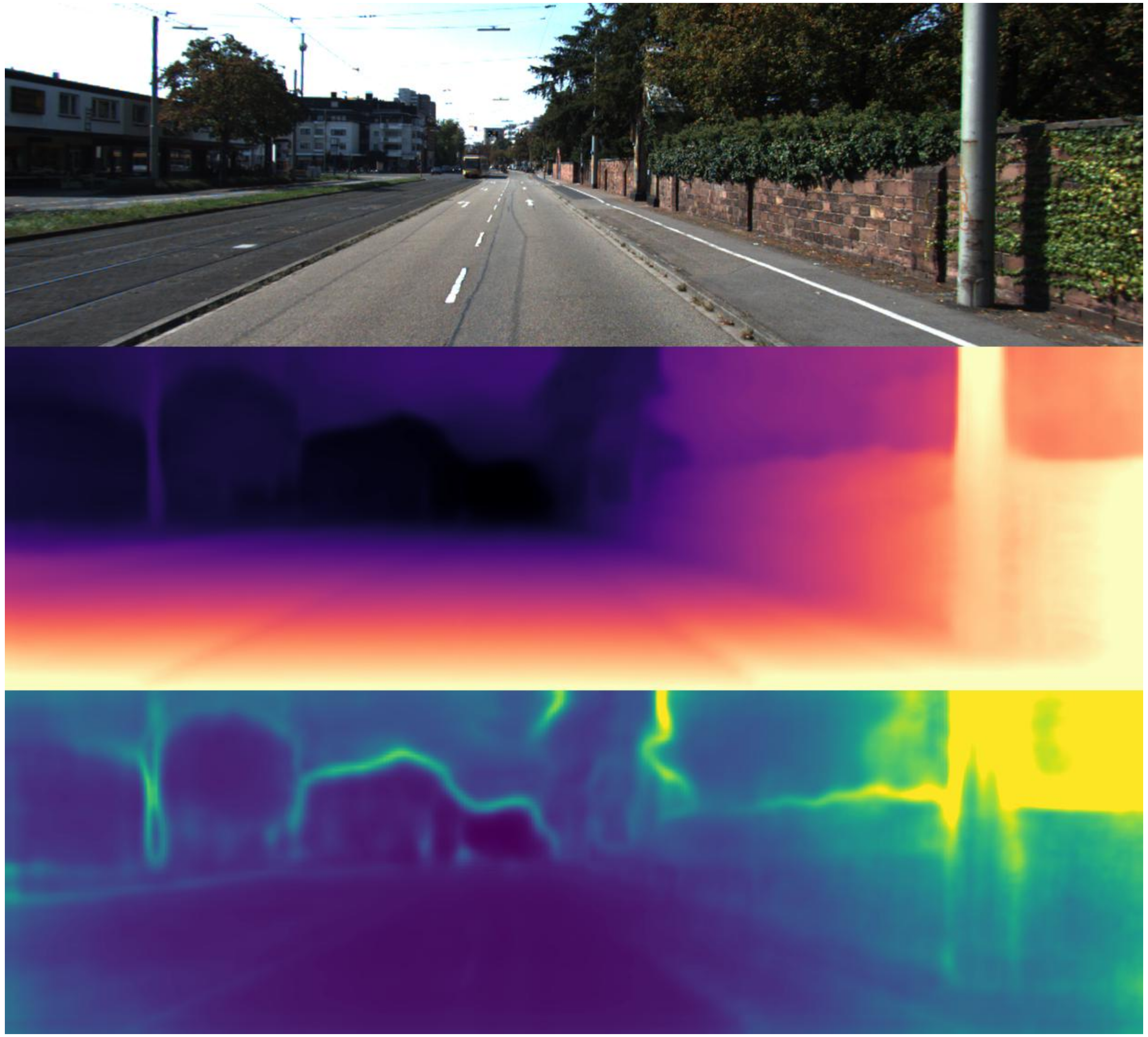
Figure 2. Uncertainty estimation on KITTI Eigen Split Test Set (697 images)

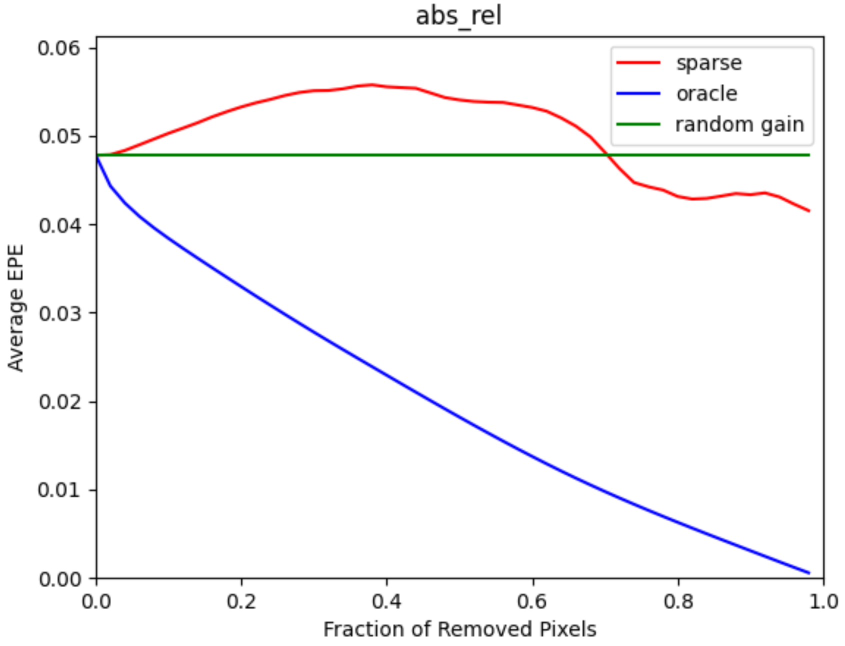

abs_rel
Average EPE
Fraction of Removed Pixels
0.00
0.02
0.04
0.06
0.08
0.10
0.0
0.2
0.4
0.6
0.8
1.0
sparse
oracle
random gain


rmse
Average EPE
Fraction of Removed Pixels
0
1
2
3
4
0.0
0.2
0.4
0.6
0.8
1.0
sparse
oracle
random gain

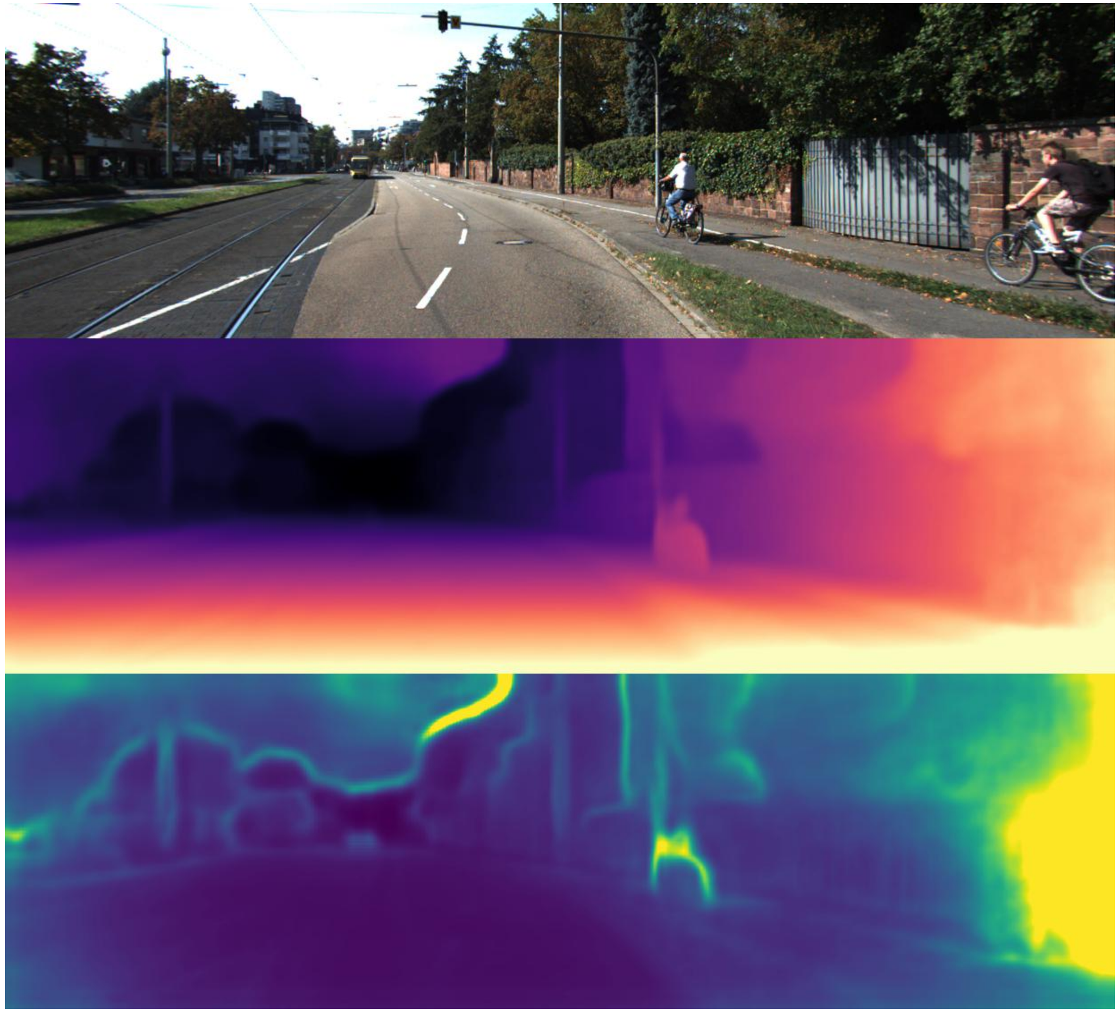

a1
Average EPE
Fraction of Removed Pixels
0.00
0.02
0.04
0.06
0.08
0.10
0.0
0.2
0.4
0.6
0.8
1.0
sparse
oracle
random gain

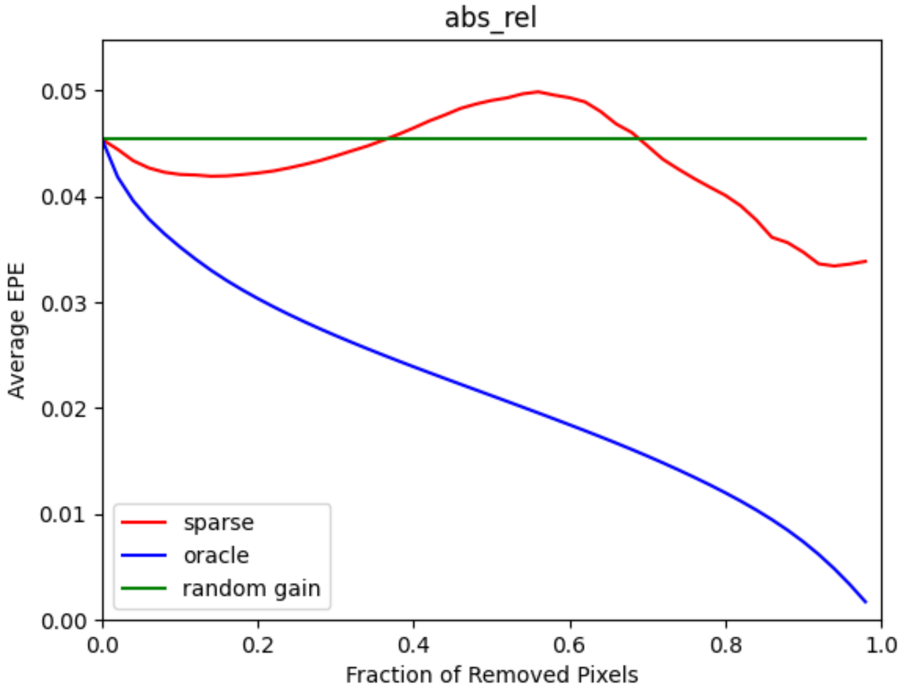
Mono bad cases

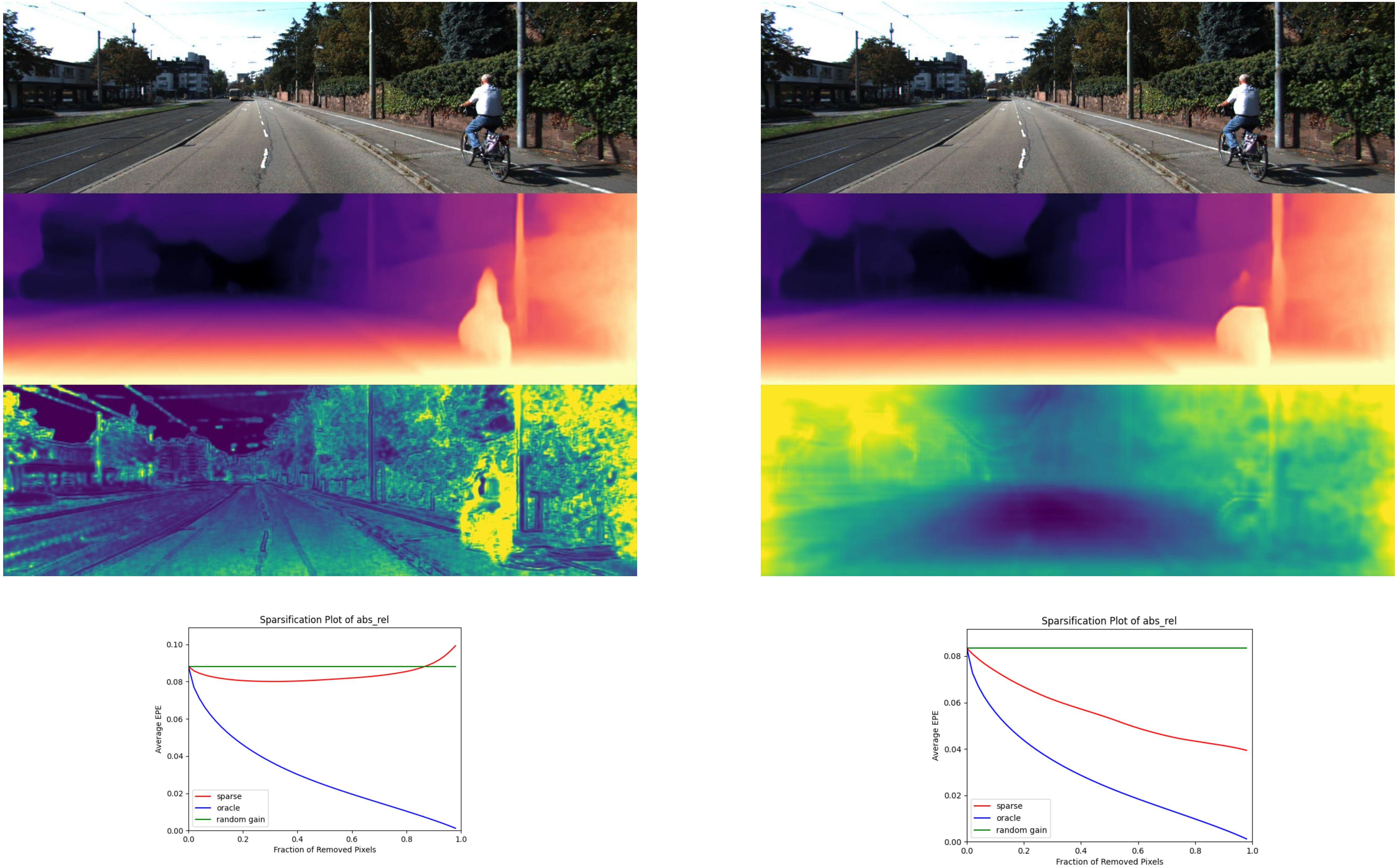




Mono bad cases






Sparsification Plot of abs_rel
Average EPE
Fraction of Removed Pixels
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oracle
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