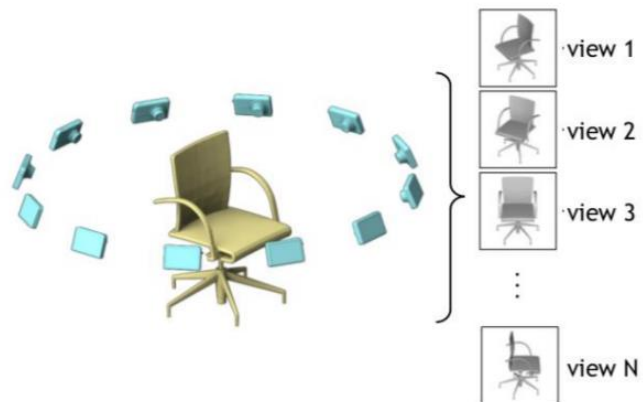




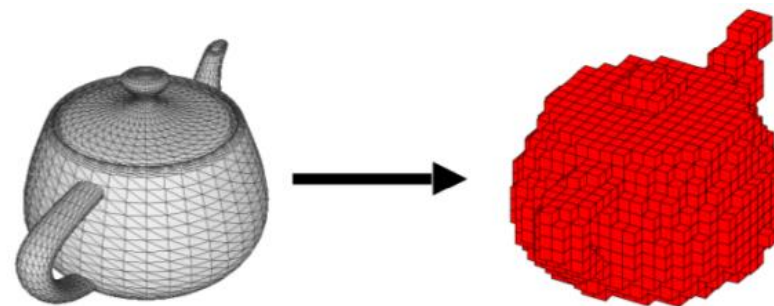
Deep Space Probing for Point Cloud Analysis

Yirong Yang, Bin Fan, Yongcheng Liu, Hua Lin, Jiyong Zhang,
Xin Liu, Xinyu Cai, Shiming Xiang and Chunhong Pan

Background



multi-view images



volumetric data



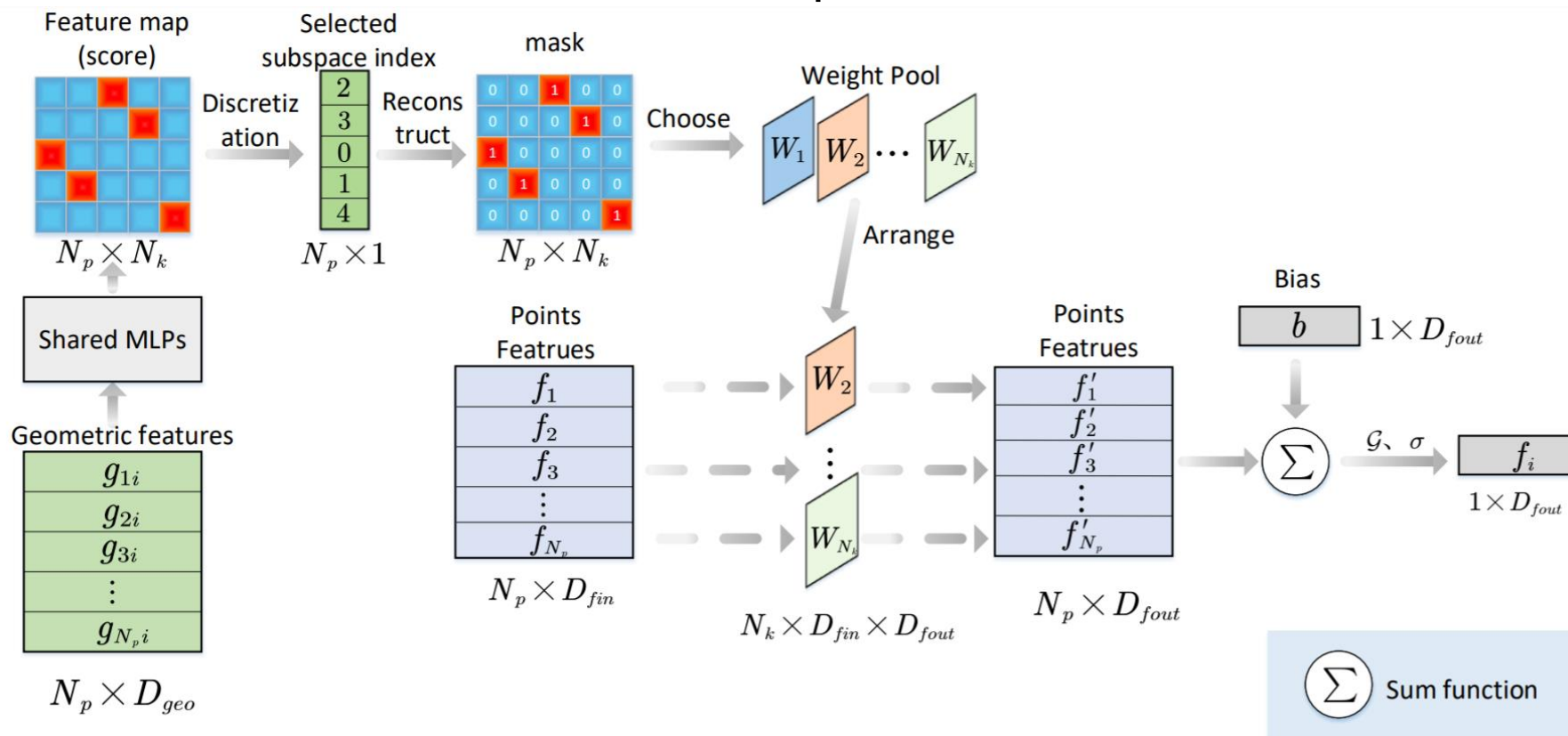
depth image



point cloud

The Pipeline of SPConv(naive)

Naïve Pipeline



The Pipeline of SPConv(efficient)

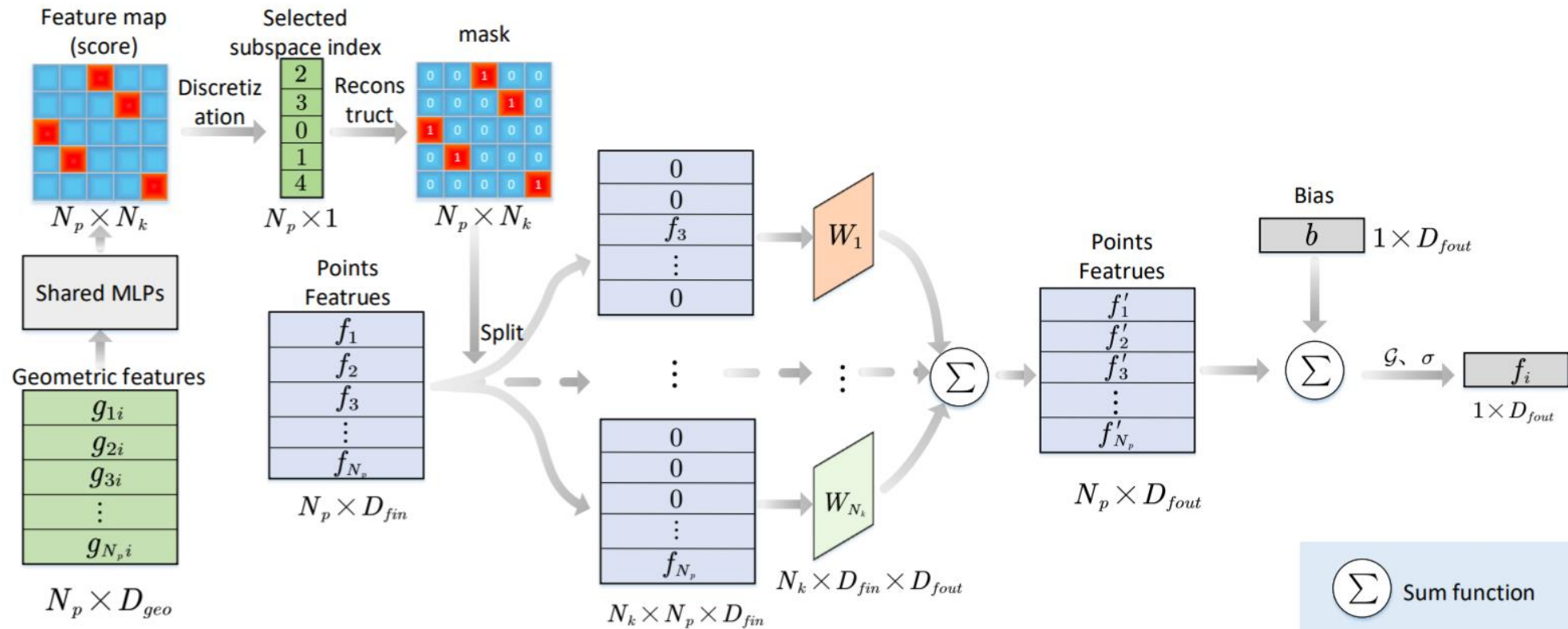


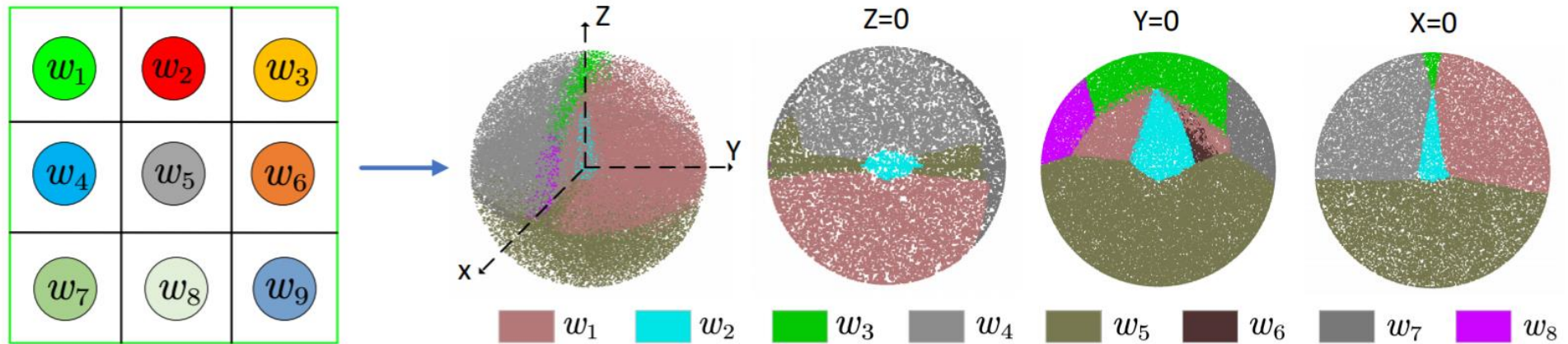
Fig. 2. The pipeline of SPConv. The N_p means the number of points in the neighborhood. N_k means the number of weights. D_* means the dimension of $*$.

GPU Memory Optimize

- We need to generate weight for each point before optimize.
- Some points shares a weight after the optimize.
- Suppose the batch size is 32 and there are 512 local regions, and there are 64 local points in each local region. The dimension of input and output features are 64. The memory usage before optimize is 16 GB for a layer, while it can be reduced to 2.5GB after the optimize.

Visualization Results

The Space Probing results



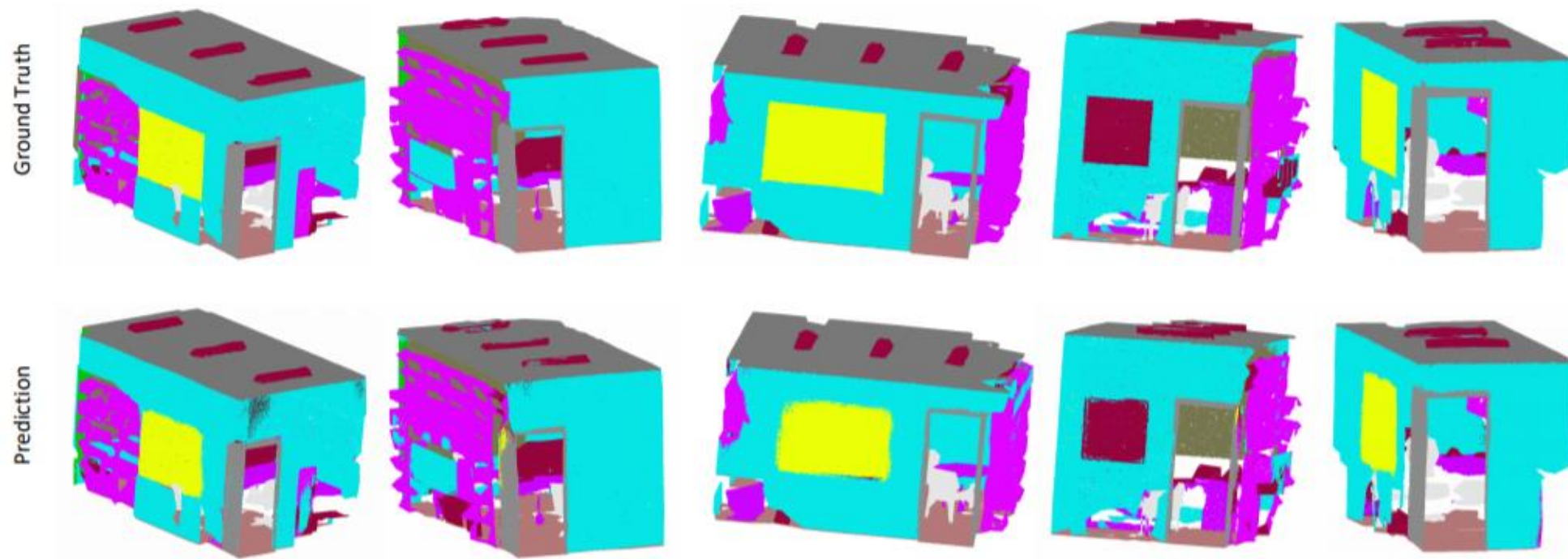
The result of classification exp.

Method	Input	#points	OA(%)
PointNet[8]	pnts	1k	89.2
PointNet++[9]	pnts	1k	90.7
Spec-GCN[21]	pnts	1k	91.5
PointConv[11]	pnts	1k	92.5
PointCNN[22]	pnts	1k	92.2
DGCNN[23]	pnts	1k	92.2
PCNN[24]	pnts	1k	92.3
RSCNN[16]	pnts	1k	92.2
DensePoint[25]	pnts	1k	92.8
ShellNet[26]	pnts	1k	93.1
Ours	pnts	1k	93.8
SO-Net[27]	pnts	2k	90.9
PointNet++[9]	pnts & nors	5k	91.9
SpiderCNN[28]	pnts & nors	5k	92.4
GeoCNN[29]	pnts & nors	1k	93.4

The result of segmentation exp.

Method	OA	mAcc	mIoU	ceiling	floor	wall	beam	column	window	door	table	chair	sofa	bookcase	board	clutter
PointNet[8]	-	48.98	41.09	88.80	97.33	69.80	0.05	3.92	46.26	10.76	58.93	52.61	5.85	40.28	26.38	33.22
SegCloud[30]	-	57.35	48.92	90.06	96.05	69.86	0.00	18.37	38.35	23.12	70.40	75.89	40.88	58.42	12.96	41.60
PointCNN[22]	85.91	63.86	57.26	92.31	98.24	79.41	0.00	17.60	22.77	62.09	74.39	80.59	31.67	66.67	62.05	56.74
PointWeb[31]	86.97	66.64	60.28	91.95	98.48	79.39	0.00	21.11	59.72	34.81	76.33	88.27	46.89	69.30	64.91	52.46
SPG[32]	86.38	66.50	58.04	89.35	96.87	78.12	0.00	42.81	48.93	61.58	84.66	75.41	69.84	52.60	2.10	52.22
PCCN[33]	-	67.01	58.27	92.26	96.20	75.89	0.27	5.98	69.49	63.45	66.87	65.63	47.28	68.91	59.10	46.22
PAT[34]	-	70.83	60.07	93.04	98.51	72.28	1.00	41.52	85.05	38.22	57.66	83.64	48.12	67.00	61.28	33.64
Ours	88.21	68.44	62.08	97.61	98.90	96.65	0.00	11.51	62.40	70.68	85.75	93.25	68.31	77.53	57.44	69.73

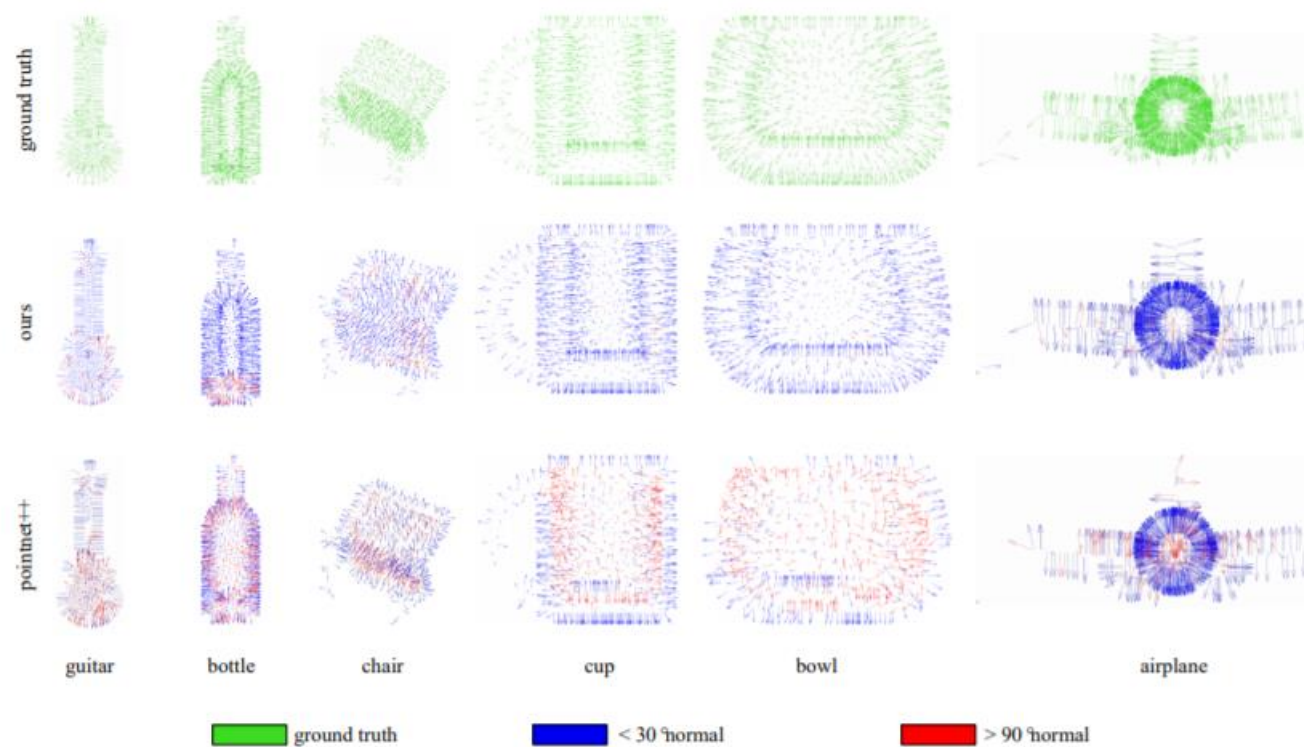
The result of segmentation exp.



The result of normal vector prediction exp.

Method	#points	loss
PointNet[8]	1k	0.47
PointNet++[9]	1k	0.29
MCCConv[36]	1k	0.16
PCNN[24]	1k	0.19
RSCNN[16]	1k	0.151
Ours	1k	0.146

The result of normal vector prediction exp.



Thanks!