Appendix

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1 Method

1.1 Coordinate transformation among LiDAR, camera and EGB image in DAIR-V2X dataset

If the LiDAR coordinate system is regarded as the world coordinate system, the 3D coordinate of point W could be:

$$W_{world} = \begin{bmatrix} x_{world} \\ y_{world} \\ z_{world} \end{bmatrix} \tag{1}$$

We also have the camera coordinate and image coordinate of point W as

$$W_{cam} = \begin{bmatrix} x_{cam} \\ y_{cam} \\ z_{cam} \end{bmatrix}, W_{img} = \begin{bmatrix} x_{img} \\ y_{img} \end{bmatrix} \tag{2}$$

Its world homogeneous coordinate in camera coordinate system and its camera homogeneous coordinate in image coordinate system are

$$W_{world\_h} = \begin{bmatrix} x_{world} \\ y_{world} \\ z_{world} \\ 1 \end{bmatrix}, W_{img\_h} = \begin{bmatrix} x_{img} \\ y_{img} \\ 1 \end{bmatrix} \tag{3}$$

Suppose that E is the transformation matrix from LiDAR coordinate system to camera coordinate system and I is the transformation matrix from camera coordinate system to image coordinate system, The inverse matrix of E and matrix I are

$$E^{-1}_{4\times4} = \begin{bmatrix} r_{x1} & r_{y1} & r_{z1} & t_x \\ r_{x2} & r_{y2} & r_{z2} & t_y \\ r_{x3} & r_{y3} & r_{z3} & t_z \\ 0 & 0 & 0 & 1 \end{bmatrix}, I_{3\times3} = \begin{bmatrix} f_x & 0 & u \\ 0 & f_y & v \\ 0 & 0 & 1 \end{bmatrix} \tag{4}$$

Generally, E and I are the extrinsic matrix and intrinsic matrix of camera, which are given by dataset [1].

Then we have

$$W_{cam\_h} = E_{4\times4} * W_{world_h}, W_{img} = \frac{1}{z_c am} * I_{3\times3} * W_{cam} \tag{5}$$

1.2 Generate preference map

We visualize four typical cases when generating one cell of preference map, which are shown in Fig 1.

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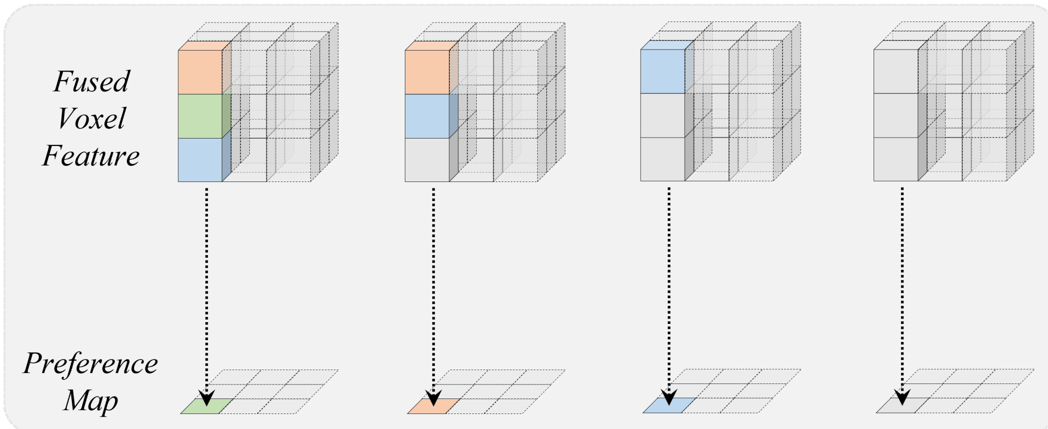


Figure 1: Four typical cases when generating one cell of preference map.

2 Experiments

2.1 Detailed settings of architecture

We follow the default settings in OpenCOOD [2] codebase, which is also shown in Tab 2.

Table 1: Details of unified network architecture.

Blocks	Settings
Voxel Feature Encoder (VFE)	use normalization and absolute 3D coordinates, 64 filters
PointPillar Scatter	64-channel output
BEV backbone	ResNet backbone with ordered layers=[3, 4, 5], strides=[2, 2, 2], filters=[64, 128, 256], upsample_strides=[1, 2, 4], upsample_filters=[128, 128, 128]
Shrink Header	shrink from 384 channels to 256 channels with stride 3
Detect Head	256-channel output with 2 anchors

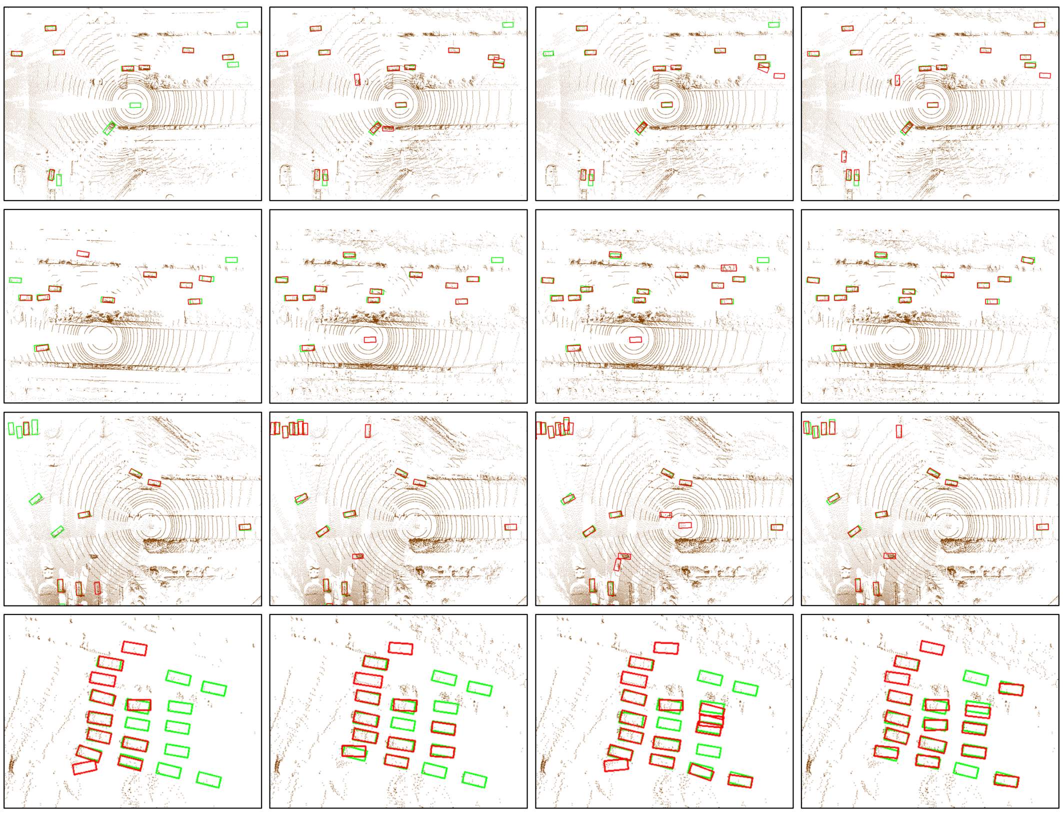
2.2 Detailed settings of experiments

Table 2: Details of unified network architecture.

Method	optimizer	lr schedule	initial lr
No Fusion	Adam	multistep	1e-3
Late Fusion	Adam	multistep	1e-3
When2com (CVPR'20)	Adam	multistep	1e-3
V2VNet (ECCV'20)	Adam	multistep	1e-3
DiscoNet (NeurIPS'21)	Adam	multistep	2e-3
CoBEVT (CoRL'22)	Adam	multistep	2e-3
V2X-ViT (ECCV'22)	Adam	multistep	2e-3
Where2comm (NeurIPS'22)	Adam	multistep	2e-3
BM2CP	Adam	multistep	1e-3

2.3 More Visualizations

Fig 2 shows more comparisons with *No Fusion*, *V2X-ViT* and *Where2comm*.



(a) No Fusion (b) V2X-ViT (c) Where2comm (d) BM2CP

Figure 2: More qualitative results in DAIR-V2X dataset. Ground truths are colored in green and predictions are colored in red.

References

[1] H. Yu, Y. Luo, M. Shu, Y. Huo, Z. Yang, Y. Shi, Z. Guo, H. Li, X. Hu, J. Yuan, et al. Dair-v2x: A large-scale dataset for vehicle-infrastructure cooperative 3d object detection. In *Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pages 21361–21370, 2022.

[2] R. Xu, H. Xiang, X. Xia, X. Han, J. Li, and J. Ma. Opv2v: An open benchmark dataset and fusion pipeline for perception with vehicle-to-vehicle communication. In *2022 International Conference on Robotics and Automation (ICRA)*, pages 2583–2589. IEEE, 2022.