Object Detection on Monocular Images with Two-Dimensional Canonical Correlation Analysis

Zifan Yu, Suya You

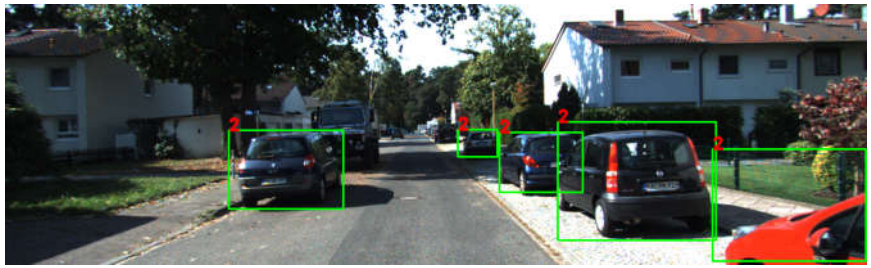
USC Viterbi School of Engineering

DEVCOM ARMAMENTS CENTER

Task and Our Contributions

- Object detection on monocular images with two-dimensional Canonical Analysis (2DCCA) to fuse the correlated features of the RGB images with the correlated features of the estimated depth data。

- Extending one-dimensional CCA based deep learning methods to two-dimensional CCA by an approximate method (2D-CCA layer) .



USC Viterbi School of Engineering

DEVCOM ARMAMENTS CENTER

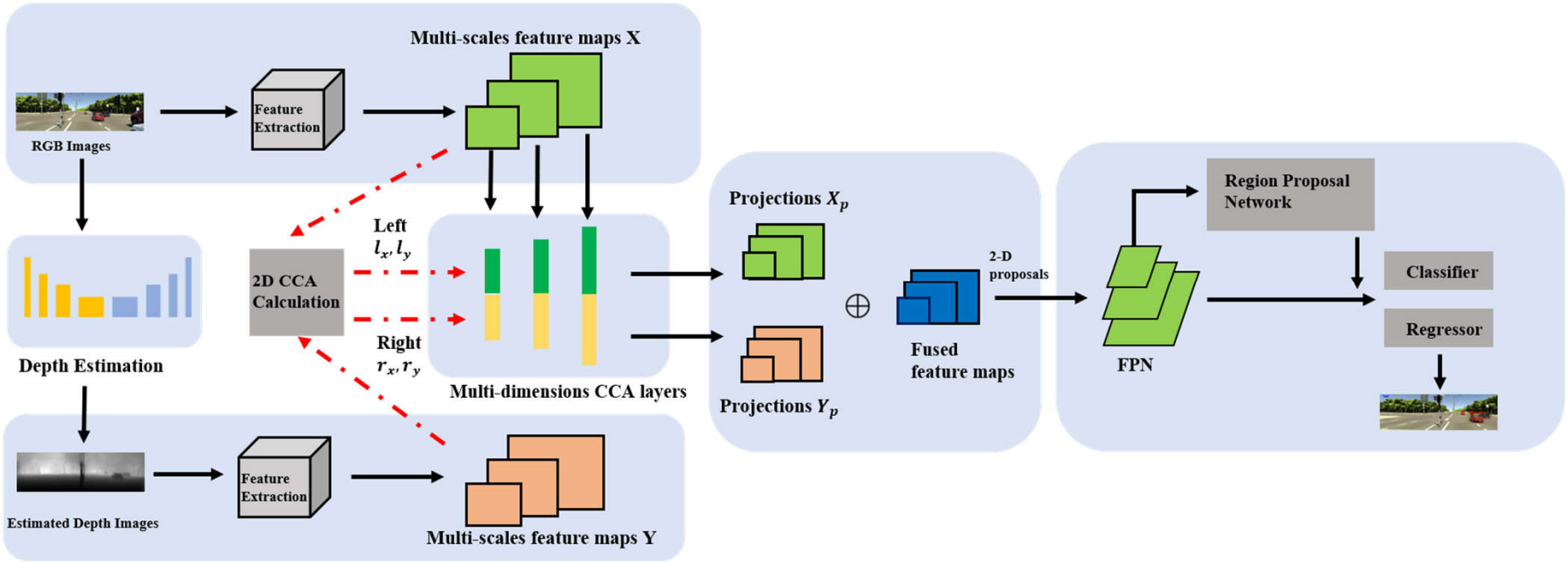
Previous CCA based Deep learning Methods

- Applying 1DCCA on feature vectors by flattening feature maps for the image classification task.
- Utilizing correlation as a regularization term of objective function without directly using transformed features by CCA.
- Facing the singularity problem of covariance matrice in case of high-dimensional features with small batch size.

USC Viterbi School of Engineering

DEVCOM ARMAMENTS CENTER

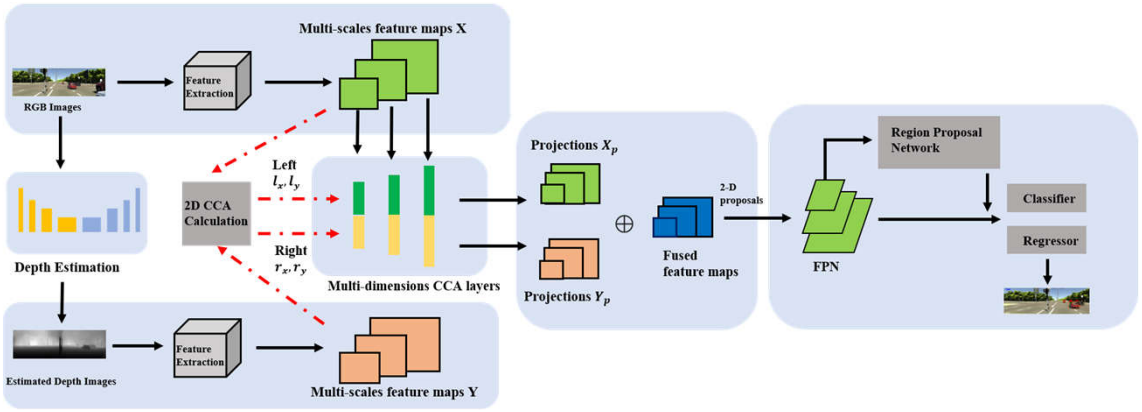
Our pipeline

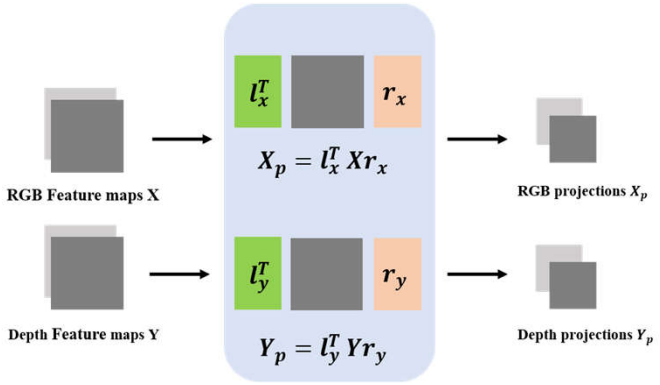


USC Viterbi School of Engineering

DEVCOM ARMAMENTS CENTER

Our pipeline





$$X_t = l_x^T X r_x \ , \ Y_t = l_y^T Y r_y$$

$$max\ corr(X_t, Y_t) = max\ corr(l_x^T X r_x, l_y^T Y r_y)$$

- 2DCCA is calculated in an iteration way
- 2D-CCA layer has two pairs of trainable parameters. The parameters are initialized by calculating 2DCCA transformations. Every x epochs to update the parameters by calculating 2DCCA.

USC Viterbi School of Engineering

DEVCOM ARMAMENTS CENTER

Results

Results of Kitti:

	mAP		mRecall		mIoU	
	iou=0.7	*iou=0.5*	*iou=0.7*	*iou=0.5*	*iou=0.7*	*iou=0.5*
Faster-RCNN RGBD	48.60	57.13	50.96	59.55	72.13	72.33
Faster-RCNN 2DCCA	41.72	57.94	44.74	61.47	67.88	70.04

Results of Virtual Kitti:

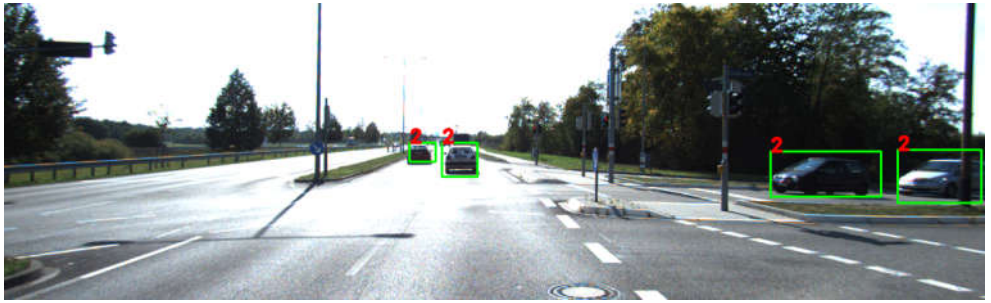
	Validation			Test		
	mAP	*mRecall*	*mIoU*	*mAP*	*mRecall*	*mIoU*
Faster-RCNN RGBD	98.01	96.69	91.31	98.29	97.18	91.80
Faster-RCNN 2DCCA	97.29	94.11	88.31	98.02	95.60	88.87

Results of different fusing operation :

	mAP		mRecall		mIoU	
	iou=0.7	*iou=0.5*	*iou=0.7*	*iou=0.5*	*iou=0.7*	*iou=0.5*
+	37.33	54.23	39.81	57.95	64.59	67.50
$\oplus$	41.72	57.94	44.74	61.47	67.88	70.04

Results of different 2D-CCA calculation frequency:

	mAP	mRecall	mIoU
CCA Initial	46.64	48.05	62.42
$X = 10$	57.94	61.47	70.04
$X = 20$	42.21	44.67	59.07



USC Viterbi School of Engineering

DEVCOM ARMAMENTS CENTER

Thank you !

If any questions, please email zifanyu@usc.edu.

USC Viterbi School of Engineering

DEVCOM ARMAMENTS CENTER