

Occlusion-aware R-CNN: Detecting Pedestrians in a Crowd

Motivation



(a) Inter-class Occlusion



(b) Intra-class Occlusion

- Occlusion is one of the most significant challenges in detecting pedestrian, especially in the crowded scenes.
- Inter-class Occlusion: A pedestrian is occluded by stuff or objects from other categories.
- Intra-class Occlusion: A pedestrian is occluded by other pedestrians, which also referred to as crowd occlusion.
- Inter-class occlusion causes some pedestrian features to be lost and brings in some noise features, which increases the difficulty in pedestrian classification.
- Intra-class occlusion significantly increases the difficulty in pedestrian localization and makes the detector sensitive to the threshold of NMS.

Contribution

- \succ Proposing a new occlusion-aware R-CNN method, which uses a new designed AggLoss to enforce proposals to be close to the corresponding objects, as well as minimize the internal region distances of proposals associated with the same objects.
- Designing a new PORolPooling unit to replace the RolPooling layer in the second Fast R-CNN module to integrate the prior structure information of human body with visibility prediction into the network.
- Achieving state-of-the-art performance on four challenging pedestrian detection datasets, i.e., CityPersons, Caltech, ETH, and INRIA.

Shifeng Zhang¹, Longyin Wen², Xiao Bian², Zhen Lei¹, Stan Z. Li¹

¹CBSR & NLPR, Institute of Automation, Chinese Academy of Sciences ²GE Global Research



- compactly than that of the baseline detector.
- the baseline detector, which indicates that it is less sensitive to the NMS threshold. The scores in the parentheses of the legend are the mean and variance of the miss rate on the curve.

- 5 parts: $P_1 \ P_2 \ P_3 \ P_4 \ P_5$
- scores: $o_1 \, \circ \, o_2 \, \circ \, o_3 \, \circ \, o_4 \, \circ \, o_5$ (5 scalars)











Model Analysis										
od		Scale	Backbone	Reasonable	Heavy	Partial	Bare			
ster RCNN		× 1	VGG-16	15.4	-	-	-			
		× 1.3	VGG-16	12.8	-	-	-			
n Loss		× 1	ResNet-50	13.2	56.9	16.8	7.6			
		× 1.3	ResNet-50	11.6	55.3	14.8	7.0			
_OSS	PORol									
		× 1	VGG-16	14.4	59.4	18.4	7.9			
\checkmark	\checkmark	× 1	VGG-16	12.8	55.7	15.3	6.7			
		× 1.3	VGG-16	12.5	54.5	16.8	6.8			
\checkmark		× 1.3	VGG-16	11.4	52.6	13.8	6.2			
	\checkmark	× 1.3	VGG-16	11.7	53.0	14.8	6.6			
\checkmark	\checkmark	× 1.3	VGG-16	11.0	51.3	13.7	5.9			

Results on Benchmarks								
lethod	Backbone	Scale	Reasonable	Reasonable_Small				
Faster RCNN	VGG-16	× 1.3	12.97	37.24				
Ilsion Loss	ResNet-50	× 1.5	11.48	15.67				
R-CNN	VGG-16	× 1.3	11.32	14.19				

- 64.2% HOG
-47.0% DBN-Isol
 45.3% JointDeep
45.0% RandForest
45.0% LDCF
-44.8% FisherBoost
43.5% Roerei
40.6% SDN
-40.0% Franken
 37.4% SpatialPooling
= 30.2% RPN+BF
-24.5% OR-CNN (Ours)