

## **SEOUL NATIONAL UNIV.** VISION & LEARNING

# Improving Occlusion and Hard Negative Handling for Single-Stage Pedestrian Detectors Junhyug Noh Soochan Lee Beomsu Kim Gunhee Kim



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Caltech test			CityPersons val				
None	Partial	Heavy	Reasonable	All	None	Partial	Heavy
21.58	36.07	63.65	28.42	43.90	20.48	28.64	62.61
18.76	34.65	59.87	26.33	41.90	19.38	25.57	60.01
17.79	<b>29.68</b>	56.53	26.69	41.92	19.26	26.32	61.56
<u>16.83</u>	30.82	57.77	26.29	40.88	18.22	26.22	58.57
18.97	34.37	57.55	23.36	38.01	14.23	22.65	52.50
16.12	31.94	57.02	20.45	36.36	12.36	20.08	51.99
<u>14.95</u>	27.44	63.57	21.41	36.76	13.18	20.13	50.30
16.59	25.68	53.77	<u>19.19</u>	<u>34.09</u>	10.77	18.69	50.18
14.55	27.89	53.80	22.54	35.61	16.91	21.95	50.66
12.22	27.52	50.46	19.01	33.95	13.18	18.16	51.48
<b>12.03</b>	26.52	55.10	19.71	34.32	13.28	19.11	49.02
13.06	29.57	51.53	18.99	<u>33.52</u>	12.70	19.33	48.42
11.23	25.23	44.13	19.70	34.37	15.75	18.90	51.88
8.88	26.14	44.11	18.25	33.16	13.79	17.65	49.47
9.00	24.28	42.42	18.45	<u>31.67</u>	12.82	17.96	46.60
10.00	<u>21.11</u>	45.80	<u>16.77</u>	31.71	<u>11.15</u>	<u>16.05</u>	48.52

None	Partial	Heavy	
21.58	36.07	63.65	
9.46	40.14	<u>56.60</u>	
8.76	<u>34.65</u>	59.87	
8.97	34.37	57.55	
7.40	<u>31.69</u>	<u>53.90</u>	
6.12	31.94	57.02	
4.55	27.89	53.80	
3.69	27.85	50.02	
2.22	27.52	50.46	
1.23	25.23	44.13	
0.72	25.80	44.81	
8.88	26.14	<u>44.11</u>	

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methods	Total	Model	Receline	Additional	methods	Total	
+ Grid cls.	Iotai	Niddei	Dasenne	+ Part score	+ Grid cls.	Total	
0.04	29.62	SqueezeDet+ [4]	23.02	0.89	0.54	24.45	
0.06	268.86	YOLOv2 [3]	32.19	0.70	1.12	34.01	
0.06	97.77	SSD [2]	32.50	1.08	1.18	34.76	
0.09	347.23	DSSD [1]	84.36	0.97	1.55	86.88	
∕/B)		(d) Inference time (in <i>ms</i> )					
	methods + Grid cls. 0.04 0.06 0.06 0.09	methods Total   + Grid cls. Total   0.04 29.62   0.06 268.86   0.06 97.77   0.09 347.23	methods     Total     Model       + Grid cls.     Total     Model       0.04     29.62     SqueezeDet+ [4]       0.06     268.86     YOLOv2 [3]       0.06     97.77     SSD [2]       0.09     347.23     DSSD [1]	methods + Grid cls.     Total     Model     Baseline       0.04     29.62     SqueezeDet+ [4]     23.02       0.06     268.86     YOLOv2 [3]     32.19       0.06     97.77     SSD [2]     32.50       0.09     347.23     DSSD [1]     84.36       MB)     (d) Inferentiation	methods     Total     Model     Baseline     Additional       0.04     29.62     SqueezeDet+ [4]     23.02     0.89       0.06     268.86     YOLOv2 [3]     32.19     0.70       0.09     347.23     DSSD [2]     32.50     1.08       MB)     (d) Inference time (in	methods + Grid cls.     Total     Model     Baseline     Additional methods + Part score     + Grid cls.       0.04     29.62     SqueezeDet+ [4]     23.02     0.89     0.54       0.06     268.86     YOLOv2 [3]     32.19     0.70     1.12       0.06     97.77     SSD [2]     32.50     1.08     1.18       0.09     347.23     DSSD [1]     84.36     0.97     1.55       MB)     (d) Inference time (in ms)	