The KITTI Vision Benchmark Suite

A project of Karlsruhe Institute of Technology and Toyota Technological Institute at Chicago


- home
- setup
- stereo
  - Stereo 2012
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  - Flow 2015
- scene flow
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Object Detection Evaluation 2012

The object detection and object orientation estimation benchmark consists of 7481 training images and 7518 test images, comprising a total of 80.256 labeled objects. All images are color and saved as png. For evaluation, we compute precision-recall curves for object detection and orientation-similarity-recall curves for joint object detection and orientation estimation. In the latter case not only the object 2D bounding box has to be located correctly, but also the orientation estimate in bird's eye view is evaluated. To rank the methods we compute average precision and average orientation similiarity. We require that all methods use the same parameter set for all test pairs. Our development kit provides details about the data format as well as MATLAB / C++ utility functions for reading and writing the label files.

- Download left color images of object data set (12 GB)
- Download right color images, if you want to use stereo information (12 GB)
- Download the 3 temporally preceding frames (left color) (36 GB)
- Download the 3 temporally preceding frames (right color) (36 GB)
- Download Velodyne point clouds, if you want to use laser information (29 GB)
- Download camera calibration matrices of object data set (16 MB)
- Download training labels of object data set (5 MB)
- Download object development kit (1 MB)
- Download pre-trained LSVM baseline models (5 MB) used in Joint 3D Estimation of Objects and Scene Layout (NIPS 2011). These models are referred to as LSVM-MDPM-sv (supervised version) and LSVM-MDPM-us (unsupervised version) in the tables below.
- Download reference detections (L-SVM) for training and test set (800 MB)
- Qianli Liao (NYU) has put together code to convert from KITTI to PASCAL VOC file format (documentation included, requires Emacs).
- Karl Rosaen (U.Mich) has released code to convert between KITTI, KITTI tracking, Pascal VOC, Udacity, CrowdAI and AUTTI formats.

We evaluate object detection performance using the PASCAL criteria and object detection and orientation estimation performance using the measure discussed in our CVPR 2012 publication. For **cars** we require an **overlap of 70%**, while for pedestrians and cyclists we require an overlap of 50% for a detection. Detections in don't care areas or detections which are smaller than the minimum size do not count as false positive. Difficulties are defined as follows:

- **Easy:** Min. bounding box height: 40 Px, Max. occlusion level: Fully visible, Max. truncation: 15 %

- **Moderate:** Min. bounding box height: 25 Px, Max. occlusion level: Partly occluded, Max. truncation: 30 %
- **Hard:** Min. bounding box height: 25 Px, Max. occlusion level: Difficult to see, Max. truncation: 50 %

All methods are ranked based on the moderately difficult results. Note that for the hard evaluation ~2 % of the provided bounding boxes have not been recognized by humans, thereby upper bounding recall at 98 %. Hence, the hard evaluation is only given for reference.

Additional information used by the methods

- Stereo: Method uses left and right (stereo) images
- Flow: Method uses optical flow (2 temporally adjacent images)
- Multiview: Method uses more than 2 temporally adjacent images
- Laser Points: Method uses point clouds from Velodyne laser scanner
- Additional training data: Use of additional data sources for training (see details)

Car

	Method	Setting	Code	Moderate	Easy	Hard	Runtime	Environment	Compare
1	DuEye			**92.65 %**	91.43 %	86.18 %	4 s	GPU @ 2.5 Ghz (C/C++)	
2	BM-NET			91.84 %	91.36 %	81.98 %	0.5 s	GPU @ 2.5 Ghz (C/C++)	
3	RV-CNN			91.67 %	91.28 %	85.43 %	3.5 s	GPU @ 2.5 Ghz (Python + C/C++)	
4	eagle			91.28 %	91.06 %	85.66 %	4 s	GPU @ 2.5 Ghz (C/C++)	
5	Genome			90.63 %	90.85 %	85.82 %	4 s	GPU @ 2.5 Ghz (C/C++)	
6	TuSimple			90.34 %	91.30 %	82.63 %	1.6 s	GPU @ 2.5 Ghz (Python + C/C++)	
7	SAIT			90.32 %	92.97 %	80.39 %	0.15 s	GPU @ >3.5 Ghz (Python + C/C++)	
8	RRC		code	90.19 %	93.66 %	**86.97 %**	3.6 s	GPU @ 2.5 Ghz (Python + C/C++)	
J. Ren, X. Chen, J. Liu, W. Sun, J. Pang, Q. Yan, Y. Tai and L. Xu: Accurate Single Stage Detector Using Recurrent Rolling Convolution. CVPR 2017.									
9	Direwolf			90.06 %	**96.41 %**	80.64 %	0.5 s	GPU @ 2.5 Ghz (C/C++)	
10	Deep MANTA			90.03 %	95.77 %	80.62 %	0.7 s	GPU @ 2.5 Ghz (Python + C/C++)	
F. Chabot, M. Chaouch, J. Rabarisoa, C. Teulière and T. Chateau: Deep MANTA: A Coarse-to-fine Many-Task Network for joint 2D and 3D vehicle analysis from monocular image. CVPR 2017.									
11	sensekitti			90.03 %	91.19 %	81.69 %	4.5 s	GPU @ 2.5 Ghz (Python + C/C++)	
12	NVDriveNet-H			89.81 %	90.92 %	83.76 %	0.15s	GPU @ 2.5 Ghz (Python + C/C++)	
13	Allspark			89.72 %	90.36 %	78.89 %	0.7 s	GPU @ 2.5 Ghz (C/C++)	
14	SINet_VGG			89.60 %	90.60 %	77.75 %	0.2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
15	DJML			89.39 %	91.18 %	79.59 %	2.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
16	HSR2			89.34 %	94.46 %	79.10 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
17	uickitti			89.23 %	90.83 %	79.46 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
18	SINet_PVA			89.21 %	91.91 %	76.33 %	0.11 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
19	Pie			89.19 %	89.39 %	78.72 %	1.2 s	1 core @ 2.5 Ghz (C/C++)	
20	Deep3DBox			89.04 %	92.98 %	77.17 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
A. Mousavian, D. Anguelov, J. Flynn and J. Kosecka: 3D Bounding Box Estimation Using Deep Learning and Geometry. CVPR 2017.									
21	DeepStereoOP			89.04 %	93.45 %	79.58 %	3.4 s	GPU @ 3.5 Ghz (Matlab + C/C++)	
C. Pham and J. Jeon: Robust Object Proposals Re-ranking for Object Detection in Autonomous Driving Using Convolutional Neural Networks. Signal Processing: Image Communiation 2017.									
22	SubCNN			89.04 %	90.81 %	79.27 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	
Y. Xiang, W. Choi, Y. Lin and S. Savarese: Subcategory-aware Convolutional Neural Networks for Object Proposals and Detection. IEEE Winter Conference on Applications of Computer Vision (WACV) 2017.									
23	MS-CNN		code	89.02 %	90.03 %	76.11 %	0.4 s	GPU @ 2.5 Ghz (C/C++)	
Z. Cai, Q. Fan, R. Feris and N. Vasconcelos: A Unified Multi-scale Deep Convolutional Neural Network for Fast Object Detection. ECCV 2016.									
24	HM_SSD_RCNN			89.02 %	94.41 %	78.84 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
25	CPCD			88.88 %	93.48 %	79.33 %	3 s	1 core @ 2.5 Ghz (C/C++)	
26	SDP+RPN			88.85 %	90.14 %	78.38 %	0.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
F. Yang, W. Choi and Y. Lin: Exploit All the Layers: Fast and Accurate CNN Object Detector with Scale Dependent Pooling and Cascaded Rejection Classifiers. Proceedings of the IEEE International Conference on Computer Vision and Pattern Recognition 2016. S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards real-time object detection with region proposal networks. Advances in Neural Information Processing Systems 2015.									

27	Re-3DOP		88.72 %	93.39 %	79.22 %	3 s	1 core @ 2.5 Ghz (C/C++)	
28	Mono3D	code	88.66 %	92.33 %	78.96 %	4.2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
	X. Chen, K. Kundu, Z. Zhang, H. Ma, S. Fidler and R. Urtasun: Monocular 3D Object Detection for Autonomous Driving. CVPR 2016.							
29	3DOP	code	88.64 %	93.04 %	79.10 %	3s	GPU @ 2.5 Ghz (Matlab + C/C++)	
	X. Chen, K. Kundu, Y. Zhu, A. Berneshawi, H. Ma, S. Fidler and R. Urtasun: 3D Object Proposals for Accurate Object Class Detection. NIPS 2015.							
30	MM-MRFC		88.45 %	90.63 %	78.32 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	
31	SYVO		88.34 %	89.44 %	72.04 %	0.13 s	GPU @ 2.5 Ghz (C/C++)	
32	MV3D		87.67 %	89.11 %	79.54 %	0.36 s	GPU @ 2.5 Ghz (Python + C/C++)	
	X. Chen, H. Ma, J. Wan, B. Li and T. Xia: Multi-View 3D Object Detection Network for Autonomous Driving. CVPR 2017.							
33	TWSNet		87.61 %	89.19 %	71.19 %	0.48 s	GPU @ 3.5 Ghz (Matlab + C/C++)	
34	WRInception		87.46 %	88.57 %	77.79 %	0.06 s	GPU @ 2.5 Ghz (C/C++)	
35	CNN based		87.25 %	87.75 %	77.38 %	1s	1 core @ 2.5 Ghz (C/C++)	
36	UI		87.18 %	87.83 %	78.35 %	0.4 s	GPU @ 2.5 Ghz (C/C++)	
37	tbd		87.13 %	91.85 %	78.16 %	1 s	1 core @ 2.5 Ghz (C/C++)	
38	PNET		83.60 %	81.77 %	74.07 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)	
39	SDP+CRC (ft)		83.53 %	90.33 %	71.13 %	0.6 s	GPU @ 2.5 Ghz (C/C++)	
	F. Yang, W. Choi and Y. Lin: Exploit All the Layers: Fast and Accurate CNN Object Detector with Scale Dependent Pooling and Cascaded Rejection Classifiers. Proceedings of the IEEE International Conference on Computer Vision and Pattern Recognition 2016.							
40	Faster R-CNN	code	81.84 %	86.71 %	71.12 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	
	S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards Real- Time Object Detection with Region Proposal Networks. NIPS 2015.							
41	ANM		81.29 %	85.23 %	69.32 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	
42	MV3D (LIDAR)		79.24 %	87.00 %	78.16 %	0.24 s	GPU @ 2.5 Ghz (Python + C/C++)	
	X. Chen, H. Ma, J. Wan, B. Li and T. Xia: Multi-View 3D Object Detection Network for Autonomous Driving. CVPR 2017.							
43	RefineNet		79.17 %	89.88 %	66.38 %	0.20 s	GPU @ 2.5 Ghz (Matlab + C++)	
	R. Rajaram, E. Bar and M. Trivedi: RefineNet: Iterative Refinement for Accurate Object Localization. Intelligent Transportation Systems Conference 2016.							
44	spLBP		77.39 %	87.18 %	60.59 %	1.5 s	8 cores @ 2.5 Ghz (Matlab + C/C++)	
	Q. Hu, S. Paisitkriangkrai, C. Shen, A. Hengel and F. Porikli: Fast Detection of Multiple Objects in Traffic Scenes With a Common Detection Framework. IEEE Trans. Intelligent Transportation Systems 2016.							
45	SceneNet		77.22 %	86.91 %	68.24 %	0.03 s	GPU @ 2.5 Ghz (C/C++)	
46	Reinspect	code	76.65 %	88.13 %	66.23 %	2s	1 core @ 2.5 Ghz (C/C++)	
	R. Stewart, M. Andriluka and A. Ng: End-to-End People Detection in Crowded Scenes. CVPR 2016.							
47	Regionlets		76.45 %	84.75 %	59.70 %	1 s	>8 cores @ 2.5 Ghz (C/C++)	
	X. Wang, M. Yang, S. Zhu and Y. Lin: Regionlets for Generic Object Detection. T-PAMI 2015. W. Zou, X. Wang, M. Sun and Y. Lin: Generic Object Detection with Dense Neural Patterns and Regionlets. British Machine Vision Conference 2014. C. Long, X. Wang, G. Hua, M. Yang and Y. Lin: Accurate Object Detection with Location Relaxation and Regionlets Relocalization. Asian Conference on Computer Vision 2014.							
48	AOG	code	75.94 %	84.80 %	60.70 %	3 s	4 cores @ 2.5 Ghz (Matlab)	
	T. Wu, B. Li and S. Zhu: Learning And-Or Models to Represent Context and Occlusion for Car Detection and Viewpoint Estimation. TPAMI 2016. B. Li, T. Wu and S. Zhu: Integrating Context and Occlusion for Car Detection by Hierarchical And-Or Model. ECCV 2014.							
49	Pose-RCNN		75.80 %	88.43 %	66.57 %	2 s	>8 cores @ 2.5 Ghz (Python)	
50	3DVP	code	75.77 %	87.46 %	65.38 %	40 s	8 cores @ 3.5 Ghz (Matlab + C/C++)	
	Y. Xiang, W. Choi, Y. Lin and S. Savarese: Data-Driven 3D Voxel Patterns for Object Category Recognition. IEEE Conference on Computer Vision and Pattern Recognition 2015.							
51	SubCat	code	75.46 %	84.14 %	59.71 %	0.7 s	6 cores @ 3.5 Ghz (Matlab + C/C++)	
	E. Ohn-Bar and M. Trivedi: Learning to Detect Vehicles by Clustering Appearance Patterns. T-ITS 2015.							
52	AR-FCN		75.43 %	79.69 %	65.75 %	0.19 s	GPU @ 2.5 Ghz (C/C++)	
53	XXX		75.34 %	84.16 %	67.98 %	>5 s	1 core @ 2.5 Ghz (C/C++)	
54	FD2		74.81 %	87.14 %	66.08 %	0.01 s	GPU @ >3.5 Ghz (Python + C/C++)	
55	FD		71.59 %	78.05 %	62.01 %	0.01 s	GPU @ >3.5 Ghz (Python)	
56	AOG-View		71.16 %	83.38 %	57.11 %	3 s	1 core @ 2.5 Ghz (Matlab, C/C++)	
	B. Li, T. Wu and S. Zhu: Integrating Context and Occlusion for Car Detection by Hierarchical And-Or Model. ECCV 2014.							
57	FCNN		70.67 %	87.69 %	61.49 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	
58	MV-RGBD-RF		69.92 %	76.40 %	57.47 %	4 s	4 cores @ 2.5 Ghz (C/C++)	

A. Gonzalez, D. Vazquez, A. Lopez and J. Amores: On-Board Object Detection: Multicue, Multimodal, and Multiview Random Forest of Local Experts.. IEEE Trans. on Cybernetics 2016.
A. Gonzalez, G. Villalonga, J. Xu, D. Vazquez, J. Amores and A. Lopez: Multiview Random Forest of Local Experts Combining RGB and LIDAR data for Pedestrian Detection. IEEE Intelligent Vehicles Symposium (IV) 2015.

59	SmartCNN		69.54 %	67.29 %	55.88 %	1 s	1 core @ 2.5 Ghz (C/C++)
60	Vote3Deep		68.24 %	76.79 %	63.23 %	1.5 s	4 cores @ 2.5 Ghz (C/C++)

M. Engelcke, D. Rao, D. Zeng Wang, C. Hay Tong and I. Posner: Vote3Deep: Fast Object Detection in 3D Point Clouds Using Efficient Convolutional Neural Networks. ArXiv e-prints 2016.

61	GPVL		67.89 %	80.53 %	58.23 %	10 s	1 core @ 2.5 Ghz (C/C++)
62	GVPL		67.78 %	79.88 %	57.69 %	1 s	8 cores @ 2.5 Ghz (Matlab + C/C++)
63	ZGC		67.75 %	84.69 %	58.57 %	0.12 s	1 core @ 2.5 Ghz (C/C++)
64	QHY		67.55 %	84.53 %	58.28 %	0.1 s	1 core @ 2.5 Ghz (C/C++)
65	BdCost48LDCF		66.66 %	77.37 %	55.51 %	5 s	1 core @ 2.5 Ghz (C/C++)
66	BdCost48-25C		66.27 %	77.59 %	55.68 %	4 s	1 core @ 2.5 Ghz (C/C++)
67	OC-DPM		65.95 %	74.94 %	53.86 %	10 s	8 cores @ 2.5 Ghz (Matlab)

B. Pepik, M. Stark, P. Gehler and B. Schiele: Occlusion Patterns for Object Class Detection. IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2013.

68	RCNN		65.43 %	82.20 %	50.92 %	0.08 s	GPU @ 2.5 Ghz (Python + C/C++)
69	DPM-VOC+VP		64.71 %	74.95 %	48.76 %	8 s	1 core @ 2.5 Ghz (C/C++)

B. Pepik, M. Stark, P. Gehler and B. Schiele: Multi-view and 3D Deformable Part Models. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) 2015.

70	HL		64.69 %	80.59 %	50.50 %	0.16 s	1 core @ 2.5 Ghz (C/C++)
71	LCNN		64.53 %	78.72 %	56.52 %	1 s	1 core @ 2.5 Ghz (C/C++)
72	NMF-CNN		62.88 %	79.07 %	52.67 %	0.1 s	GPU @ 2.5 Ghz (Matlab + C/C++)
73	MDPM-un-BB		62.16 %	71.19 %	48.43 %	60 s	4 core @ 2.5 Ghz (MATLAB)

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.

74	SubCat48LDCF		61.79 %	68.71 %	47.46 %	5 s	1 core @ 2.5 Ghz (Matlab + C/C++)
75	NMRDO		61.72 %	72.42 %	54.06 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)
76	DPM-C8B1		60.99 %	74.33 %	47.16 %	15 s	4 cores @ 2.5 Ghz (Matlab + C/C++)

J. Yebes, L. Bergasa and M. García-Garrido: Visual Object Recognition with 3D-Aware Features in KITTI Urban Scenes. Sensors 2015.
J. Yebes, L. Bergasa, R. Arroyo and A. Lázaro: Supervised learning and evaluation of KITTI's cars detector with DPM. IV 2014.

77	HgCNN		60.10 %	65.83 %	52.29 %	1 s	1 core @ 2.5 Ghz (C/C++)
78	ACF-SC		58.66 %	69.11 %	45.95 %	<0.3 s	1 core @ >3.5 Ghz (Matlab + C/C++)

C. Cadena, A. Dick and I. Reid: A Fast, Modular Scene Understanding System using Context-Aware Object Detection. Robotics and Automation (ICRA), 2015 IEEE International Conference on 2015.

79	LSVM-MDPM-sv		57.44 %	71.70 %	46.58 %	10 s	4 cores @ 3.0 Ghz (C/C++)

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.
A. Geiger, C. Wojek and R. Urtasun: Joint 3D Estimation of Objects and Scene Layout. NIPS 2011.

80	frd		55.80 %	68.87 %	48.04 %	2 s	1 core @ 2.5 Ghz (C/C++)
81	LSVM-MDPM-us	code	55.42 %	66.53 %	41.04 %	10 s	4 cores @ 3.0 Ghz (C/C++)

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.

82	ACF		54.74 %	55.89 %	42.98 %	0.2 s	1 core @ >3.5 Ghz (Matlab + C/C++)

P. Doll\'ar, R. Appel, S. Belongie and P. Perona: Fast Feature Pyramids for Object Detection. PAMI 2014.
P. Doll\'ar: Piotr's Image and Video Matlab Toolbox (PMT). .

83	VeloFCN		53.59 %	71.06 %	46.92 %	1 s	GPU @ 2.5 Ghz (Python + C/C++)

B. Li, T. Zhang and T. Xia: Vehicle Detection from 3D Lidar Using Fully Convolutional Network. RSS 2016 .

84	MLSmoke		52.59 %	69.30 %	43.82 %	1 s	1 core @ 2.5 Ghz (C/C++)
85	Vote3D		47.99 %	56.80 %	42.57 %	0.5 s	4 cores @ 2.8 Ghz (C/C++)

D. Wang and I. Posner: Voting for Voting in Online Point Cloud Object Detection. Proceedings of Robotics: Science and Systems 2015.

86	YOLO		35.74 %	47.69 %	29.65 %	0.03 s	GPU @ 1.0 Ghz (C/C++)
87	CSoR	code	26.13 %	34.79 %	22.69 %	3.5 s	4 cores @ >3.5 Ghz (Python + C/C++)

L. Plotkin: PyDriver: Entwicklung eines Frameworks für räumliche Detektion und Klassifikation von Objekten in Fahrzeugumgebung. 2015.

88	R-CNN_VGG		26.06 %	32.40 %	20.91 %	10 s	GPU @ 2.5 Ghz (Matlab + C/C++)
89	mBoW		23.76 %	36.02 %	18.44 %	10 s	1 core @ 2.5 Ghz (C/C++)

J. Behley, V. Steinhage and A. Cremers: Laser-based Segment Classification Using a Mixture of Bag-of-Words. Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2013.

90	YOLOv2	code	19.21 %	28.35 %	15.94 %	0.02 s	GPU @ 3.5 Ghz (C/C++)	

J. Redmon, S. Divvala, R. Girshick and A. Farhadi: You only look once: Unified, real-time object detection. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition 2016.
J. Redmon and A. Farhadi: YOLO9000: Better, Faster, Stronger. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition 2017.

Table as LaTeX | Only published Methods

Pedestrian

	Method	Setting	Code	Moderate	Easy	Hard	Runtime	Environment	Compare
1	TuSimple			**77.03 %**	**86.65 %**	**72.42 %**	1.6 s	GPU @ 2.5 Ghz (Python + C/C++)	
2	RRC		code	75.33 %	84.95 %	70.39 %	3.6 s	GPU @ 2.5 Ghz (Python + C/C++)	

J. Ren, X. Chen, J. Liu, W. Sun, J. Pang, Q. Yan, Y. Tai and L. Xu: Accurate Single Stage Detector Using Recurrent Rolling Convolution. CVPR 2017.

3	iFDT			74.30 %	85.04 %	68.86 %	2.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
4	Allspark			74.24 %	84.73 %	68.60 %	0.7 s	GPU @ 2.5 Ghz (C/C++)	
5	TiCNN			74.02 %	83.97 %	68.87 %	0.5 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
6	MS-CNN		code	73.70 %	83.92 %	68.31 %	0.4 s	GPU @ 2.5 Ghz (C/C++)	

Z. Cai, Q. Fan, R. Feris and N. Vasconcelos: A Unified Multi-scale Deep Convolutional Neural Network for Fast Object Detection. ECCV 2016.

7	Pie			73.17 %	84.86 %	67.55 %	1.2 s	1 core @ 2.5 Ghz (C/C++)	
8	SAIT			72.62 %	84.54 %	67.94 %	0.15 s	GPU @ >3.5 Ghz (Python + C/C++)	
9	uickitti			71.84 %	83.49 %	67.00 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
10	GN			71.65 %	82.03 %	65.00 %	1 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
11	SubCNN			71.33 %	83.28 %	66.36 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	

Y. Xiang, W. Choi, Y. Lin and S. Savarese: Subcategory-aware Convolutional Neural Networks for Object Proposals and Detection. IEEE Winter Conference on Applications of Computer Vision (WACV) 2017.

12	IVA		code	70.70 %	83.63 %	64.67 %	0.4 s	GPU @ 2.5 Ghz (C/C++)	

Y. Zhu, J. Wang, C. Zhao, H. Guo and H. Lu: Scale-adaptive Deconvolutional Regression Network for Pedestrian Detection. ACCV 2016.
S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards real-time object detection with region proposal networks. Advances in neural information processing systems 2015.

13	SDP+RPN			70.16 %	80.09 %	64.82 %	0.4 s	GPU @ 2.5 Ghz (Python + C/C++)	

F. Yang, W. Choi and Y. Lin: Exploit All the Layers: Fast and Accurate CNN Object Detector with Scale Dependent Pooling and Cascaded Rejection Classifiers. Proceedings of the IEEE International Conference on Computer Vision and Pattern Recognition 2016.
S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards real-time object detection with region proposal networks. Advances in Neural Information Processing Systems 2015.

14	MM-MRFC			70.02 %	82.18 %	64.74 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	
15	WRInception			68.72 %	79.94 %	63.44 %	0.06 s	GPU @ 2.5 Ghz (C/C++)	
16	3DOP		code	67.47 %	81.78 %	64.70 %	3s	GPU @ 2.5 Ghz (Matlab + C/C++)	

X. Chen, K. Kundu, Y. Zhu, A. Berneshawi, H. Ma, S. Fidler and R. Urtasun: 3D Object Proposals for Accurate Object Class Detection. NIPS 2015.

17	DeepStereoOP			67.32 %	81.82 %	65.12 %	3.4 s	GPU @ 3.5 Ghz (Matlab + C/C++)	

C. Pham and J. Jeon: Robust Object Proposals Re-ranking for Object Detection in Autonomous Driving Using Convolutional Neural Networks. Signal Processing: Image Communiation 2017.

18	sensekitti			67.29 %	79.58 %	62.28 %	4.5 s	GPU @ 2.5 Ghz (Python + C/C++)	
19	Re-3DOP			67.27 %	80.87 %	64.02 %	3 s	1 core @ 2.5 Ghz (C/C++)	
20	Mono3D		code	66.68 %	80.35 %	63.44 %	4.2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	

X. Chen, K. Kundu, Z. Zhang, H. Ma, S. Fidler and R. Urtasun: Monocular 3D Object Detection for Autonomous Driving. CVPR 2016.

21	IVA		code	66.50 %	78.09 %	61.60 %	1 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
22	HM_SSD_RCNN			66.40 %	81.92 %	59.21 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
23	HSR2			65.91 %	81.02 %	63.03 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
24	Faster R-CNN		code	65.90 %	78.86 %	61.18 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	

S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards Real- Time Object Detection with Region Proposal Networks. NIPS 2015.

25	Tx			65.06 %	77.33 %	59.48 %	2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	

26	DJML		64.91 %	76.56 %	58.96 %	2.4 s	GPU @ 2.5 Ghz (Python + C/C++)
27	PNET		64.66 %	77.16 %	60.40 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)
28	tbd		64.56 %	79.58 %	61.27 %	1 s	1 core @ 2.5 Ghz (C/C++)
29	SDP+CRC (ft)		64.19 %	77.74 %	59.27 %	0.6 s	GPU @ 2.5 Ghz (C/C++)

F. Yang, W. Choi and Y. Lin: Exploit All the Layers: Fast and Accurate CNN Object Detector with Scale Dependent Pooling and Cascaded Rejection Classifiers. Proceedings of the IEEE International Conference on Computer Vision and Pattern Recognition 2016.

30	Pose-RCNN		63.40 %	77.53 %	57.49 %	2 s	>8 cores @ 2.5 Ghz (Python)
31	CFM		63.26 %	74.22 %	56.44 %	<2 s	GPU @ 2.5 Ghz (Matlab + C/C++)

Q. Hu, P. Wang, C. Shen, A. Hengel and F. Porikli: Pushing the Limits of Deep CNNs for Pedestrian Detection. IEEE Transactions on Circuits and Systems for Video Technology 2017.

32	PCN		62.08 %	74.56 %	56.68 %	0.6 s	
33	RPN+BF	code	61.29 %	75.45 %	56.08 %	0.6 s	GPU @ 2.5 Ghz (Matlab + C/C++)

L. Zhang, L. Lin, X. Liang and K. He: Is Faster R-CNN Doing Well for Pedestrian Detection?. ECCV 2016.

34	RB		61.15 %	77.12 %	55.12 %	0.6 s	GPU @ 2.5 Ghz (Matlab + C/C++)
35	Regionlets		61.15 %	73.14 %	55.21 %	1 s	>8 cores @ 2.5 Ghz (C/C++)

X. Wang, M. Yang, S. Zhu and Y. Lin: Regionlets for Generic Object Detection. T-PAMI 2015.
W. Zou, X. Wang, M. Sun and Y. Lin: Generic Object Detection with Dense Neural Patterns and Regionlets. British Machine Vision Conference 2014.
C. Long, X. Wang, G. Hua, M. Yang and Y. Lin: Accurate Object Detection with Location Relaxation and Regionlets Relocalization. Asian Conference on Computer Vision 2014.

36	LC		60.67 %	69.89 %	54.47 %	1 s	1 core @ 2.5 Ghz (Matlab + C/C++)
37	ens		60.64 %	72.14 %	54.59 %		
38	CompACT-Deep		58.74 %	70.69 %	52.71 %	1 s	1 core @ 2.5 Ghz (Matlab + C/C++)

Z. Cai, M. Saberian and N. Vasconcelos: Learning Complexity-Aware Cascades for Deep Pedestrian Detection. ICCV 2015.

39	FichaDet		58.69 %	69.50 %	52.97 %	0.2 s	4 cores @ 2.5 Ghz (C/C++)
40	DeepParts		58.67 %	70.49 %	52.78 %	~1 s	GPU @ 2.5 Ghz (Matlab)

Y. Tian, P. Luo, X. Wang and X. Tang: Deep Learning Strong Parts for Pedestrian Detection. ICCV 2015.

41	p2dv		56.98 %	68.48 %	50.99 %	1 s	1 core @ 2.5 Ghz (C/C++)
42	D-TSF		56.77 %	68.44 %	50.77 %	1 s	1 core @ 2.5 Ghz (C/C++)

ERROR: Wrong syntax in BIBTEX file.

43	FilteredICF		56.75 %	67.65 %	51.12 %	~ 2 s	>8 cores @ 2.5 Ghz (Matlab + C/C++)

S. Zhang, R. Benenson and B. Schiele: Filtered Channel Features for Pedestrian Detection. CVPR 2015.

44	FD2		56.65 %	71.11 %	51.62 %	0.01 s	GPU @ >3.5 Ghz (Python + C/C++)
45	MV-RGBD-RF		56.59 %	73.30 %	49.63 %	4 s	4 cores @ 2.5 Ghz (C/C++)

A. Gonzalez, D. Vazquez, A. Lopez and J. Amores: On-Board Object Detection: Multicue, Multimodal, and Multiview Random Forest of Local Experts.. IEEE Trans. on Cybernetics 2016.
A. Gonzalez, G. Villalonga, J. Xu, D. Vazquez, J. Amores and A. Lopez: Multiview Random Forest of Local Experts Combining RGB and LIDAR data for Pedestrian Detection. IEEE Intelligent Vehicles Symposium (IV) 2015.

46	ACNet+Cascad		56.23 %	64.80 %	50.67 %	2.5 s	1 core @ 3.5 Ghz (Matlab)
47	Vote3Deep		55.37 %	68.39 %	52.59 %	1.5 s	4 cores @ 2.5 Ghz (C/C++)

M. Engelcke, D. Rao, D. Zeng Wang, C. Hay Tong and I. Posner: Vote3Deep: Fast Object Detection in 3D Point Clouds Using Efficient Convolutional Neural Networks. ArXiv e-prints 2016.

48	FD		55.10 %	66.84 %	49.82 %	0.01 s	GPU @ >3.5 Ghz (Python)
49	pAUCEnsT		54.49 %	65.26 %	48.60 %	60 s	1 core @ 2.5 Ghz (Matlab + C/C++)

S. Paisitkriangkrai, C. Shen and A. Hengel: Pedestrian Detection with Spatially Pooled Features and Structured Ensemble Learning. arXiv 2014.

50	ANM		54.02 %	70.43 %	49.83 %	0.05 s	GPU @ 2.5 Ghz (C/C++)
51	PDV2		53.74 %	65.39 %	49.47 %	3.7 s	1 core @ 3.0 Ghz Matlab (C/C++)

J. Shen, X. Zuo, J. Li, W. Yang and H. Ling: A novel pixel neighborhood differential statistic feature for pedestrian and face detection . Pattern Recognition 2017.

52	ACFD	code	50.91 %	61.61 %	45.51 %	0.2 s	4 cores @ >3.5 Ghz (C/C++)
53	ZGC		50.42 %	66.84 %	42.79 %	0.12 s	1 core @ 2.5 Ghz (C/C++)
54	R-CNN		50.13 %	61.61 %	44.79 %	4 s	GPU @ 3.3 Ghz (C/C++)

J. Hosang, M. Omran, R. Benenson and B. Schiele: Taking a Deeper Look at Pedestrians. arXiv 2015.

55	SSD1		50.03 %	63.78 %	47.15 %	0.255 s	GPU @ 2.5 Ghz (python+ C/C++)
56	NMF-CNN		49.26 %	65.16 %	45.51 %	0.1 s	GPU @ 2.5 Ghz (Matlab + C/C++)
57	ACF		47.29 %	60.11 %	42.90 %	1 s	1 core @ 3.5 Ghz (Matlab + C/C++)

P. Doll\'ar, R. Appel, S. Belongie and P. Perona: Fast Feature Pyramids for Object Detection. PAMI 2014.

58	Fusion-DPM		code	46.67 %	59.51 %	42.05 %	~ 30 s	1 core @ 3.5 Ghz (Matlab + C/C++)

C. Premebida, J. Carreira, J. Batista and U. Nunes: Pedestrian Detection Combining RGB and Dense LIDAR Data. IROS 2014.

59	ACF-MR		46.23 %	58.82 %	42.10 %	0.6 s	1 core @ 3.5 Ghz (C/C++)

R. Rajaram, E. Ohn-Bar and M. Trivedi: Looking at Pedestrians at Different Scales: A Multi-resolution Approach and Evaluations. T-ITS 2016.

60	HA-SSVM		45.51 %	56.36 %	41.08 %	21 s	1 core @ >3.5 Ghz (Matlab + C/C++)

J. Xu, S. Ramos, D. Vázquez and A. López: Hierarchical Adaptive Structural SVM for Domain Adaptation. IJCV 2016.

61	DPM-VOC+VP		44.86 %	59.48 %	40.37 %	8 s	1 core @ 2.5 Ghz (C/C++)

B. Pepik, M. Stark, P. Gehler and B. Schiele: Multi-view and 3D Deformable Part Models. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) 2015.

62	ACF-SC		44.49 %	51.53 %	40.38 %	<0.3 s	1 core @ >3.5 Ghz (Matlab + C/C++)

C. Cadena, A. Dick and I. Reid: A Fast, Modular Scene Understanding System using Context-Aware Object Detection. Robotics and Automation (ICRA), 2015 IEEE International Conference on 2015.

63	SquaresICF		code	44.42 %	57.33 %	40.08 %	1 s	GPU @ >3.5 Ghz (C/C++)

R. Benenson, M. Mathias, T. Tuytelaars and L. Gool: Seeking the strongest rigid detector. CVPR 2013.

64	AR-FCN		43.88 %	53.16 %	35.58 %	0.19 s	GPU @ 2.5 Ghz (C/C++)
65	QHY		43.42 %	60.08 %	42.31 %	0.1 s	1 core @ 2.5 Ghz (C/C++)
66	SubCat		42.34 %	54.67 %	37.95 %	1.2 s	6 cores @ 2.5 Ghz (Matlab + C/C++)

E. Ohn-Bar and M. Trivedi: Fast and Robust Object Detection Using Visual Subcategories. Computer Vision and Pattern Recognition Workshops Mobile Vision 2014.

67	HL		42.31 %	58.55 %	34.87 %	0.16 s	1 core @ 2.5 Ghz (C/C++)
68	RCNN		42.16 %	58.37 %	34.88 %	0.08 s	GPU @ 2.5 Ghz (Python + C/C++)
69	Fast-RCNN-SS		41.57 %	52.68 %	35.25 %	1 s	GPU @ 2.0 Ghz (Matlab + C/C++)
70	NMRDO		40.59 %	54.87 %	39.75 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)
71	ACFK	code	40.23 %	48.83 %	33.57 %	0.07 s	1 core @ >3.5 Ghz (C/C++)
72	ACF		39.81 %	44.49 %	37.21 %	0.2 s	1 core @ >3.5 Ghz (Matlab + C/C++)

P. Doll\'ar, R. Appel, S. Belongie and P. Perona: Fast Feature Pyramids for Object Detection. PAMI 2014.
P. Doll\'ar: Piotr's Image and Video Matlab Toolbox (PMT). .

73	ACF_M		39.36 %	47.74 %	35.95 %	0.1 s	1 core @ 2.5 Ghz (C/C++)
74	LSVM-MDPM-sv		39.36 %	51.75 %	35.95 %	10 s	4 cores @ 3.0 Ghz (C/C++)

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.
A. Geiger, C. Wojek and R. Urtasun: Joint 3D Estimation of Objects and Scene Layout. NIPS 2011.

75	PCNN		39.07 %	53.37 %	37.91 %	1 s	1 core @ 2.5 Ghz (C/C++)
76	CNN		38.98 %	52.84 %	38.31 %	1 s	1 core @ 2.5 Ghz (C/C++)
77	LSVM-MDPM-us	code	38.35 %	45.50 %	34.78 %	10 s	4 cores @ 3.0 Ghz (C/C++)

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.

78	Vote3D			35.74 %	44.48 %	33.72 %	0.5 s	4 cores @ 2.8 Ghz (C/C++)

D. Wang and I. Posner: Voting for Voting in Online Point Cloud Object Detection. Proceedings of Robotics: Science and Systems 2015.

79	mBoW			31.37 %	44.28 %	30.62 %	10 s	1 core @ 2.5 Ghz (C/C++)

J. Behley, V. Steinhage and A. Cremers: Laser-based Segment Classification Using a Mixture of Bag-of-Words. Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2013.

80	DPM-C8B1			29.03 %	38.96 %	25.61 %	15 s	4 cores @ 2.5 Ghz (Matlab + C/C++)

J. Yebes, L. Bergasa and M. García-Garrido: Visual Object Recognition with 3D-Aware Features in KITTI Urban Scenes. Sensors 2015.
J. Yebes, L. Bergasa, R. Arroyo and A. Lázaro: Supervised learning and evaluation of KITTI's cars detector with DPM. IV 2014.

81	YOLO		24.35 %	25.63 %	17.50 %	0.03 s	GPU @ 1.0 Ghz (C/C++)
82	R-CNN_VGG		23.14 %	29.06 %	22.15 %	10 s	GPU @ 2.5 Ghz (Matlab + C/C++)
83	YOLOv2	code	16.19 %	20.64 %	15.43 %	0.02 s	GPU @ 3.5 Ghz (C/C++)

J. Redmon, S. Divvala, R. Girshick and A. Farhadi: You only look once: Unified, real-time object detection. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition 2016.
J. Redmon and A. Farhadi: YOLO9000: Better, Faster, Stronger. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition 2017.

84	BIP-HETERO		13.38 %	14.85 %	13.25 %	~2 s	1 core @ 2.5 Ghz (C/C++)

A. Mekonnen, F. Lerasle, A. Herbulot and C. Briand: People Detection with Heterogeneous Features and Explicit Optimization on Computation Time. Pattern Recognition (ICPR), 2014 22nd International Conference on 2014.

Table as LaTeX | Only published Methods

Cyclist

	Method	Setting	Code	Moderate	Easy	Hard	Runtime	Environment	Compare
1	RRC		code	**76.47 %**	84.71 %	65.46 %	3.6 s	GPU @ 2.5 Ghz (Python + C/C++)	
	J. Ren, X. Chen, J. Liu, W. Sun, J. Pang, Q. Yan, Y. Tai and L. Xu: Accurate Single Stage Detector Using Recurrent Rolling Convolution. CVPR 2017.								
2	Pie			76.25 %	84.62 %	**67.57 %**	1.2 s	1 core @ 2.5 Ghz (C/C++)	
3	SAIT			76.13 %	83.88 %	66.60 %	0.15 s	GPU @ >3.5 Ghz (Python + C/C++)	
4	TiCNN			75.83 %	84.28 %	66.50 %	0.5 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
5	TuSimple			75.59 %	84.15 %	66.35 %	1.6 s	GPU @ 2.5 Ghz (Python + C/C++)	
6	Allspark			75.47 %	**84.88 %**	66.35 %	0.7 s	GPU @ 2.5 Ghz (C/C++)	
7	MS-CNN		code	75.46 %	84.06 %	66.07 %	0.4 s	GPU @ 2.5 Ghz (C/C++)	
	Z. Cai, Q. Fan, R. Feris and N. Vasconcelos: A Unified Multi-scale Deep Convolutional Neural Network for Fast Object Detection. ECCV 2016.								
8	Deep3DBox			74.16 %	83.94 %	64.84 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
	A. Mousavian, D. Anguelov, J. Flynn and J. Kosecka: 3D Bounding Box Estimation Using Deep Learning and Geometry. CVPR 2017.								
9	SDP+RPN			73.74 %	81.37 %	65.31 %	0.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
	F. Yang, W. Choi and Y. Lin: Exploit All the Layers: Fast and Accurate CNN Object Detector with Scale Dependent Pooling and Cascaded Rejection Classifiers. Proceedings of the IEEE International Conference on Computer Vision and Pattern Recognition 2016. S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards real-time object detection with region proposal networks. Advances in Neural Information Processing Systems 2015.								
10	sensekitti			72.56 %	82.39 %	64.00 %	4.5 s	GPU @ 2.5 Ghz (Python + C/C++)	
11	SubCNN			71.06 %	79.48 %	62.68 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	
	Y. Xiang, W. Choi, Y. Lin and S. Savarese: Subcategory-aware Convolutional Neural Networks for Object Proposals and Detection. IEEE Winter Conference on Applications of Computer Vision (WACV) 2017.								
12	uickitti			70.90 %	78.40 %	62.54 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
13	DJML			70.26 %	79.41 %	61.84 %	2.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
14	3DOP		code	68.94 %	78.39 %	61.37 %	3s	GPU @ 2.5 Ghz (Matlab + C/C++)	
	X. Chen, K. Kundu, Y. Zhu, A. Berneshawi, H. Ma, S. Fidler and R. Urtasun: 3D Object Proposals for Accurate Object Class Detection. NIPS 2015.								
15	Pose-RCNN			68.79 %	80.79 %	60.40 %	2 s	>8 cores @ 2.5 Ghz (Python)	
16	Re-3DOP			68.31 %	78.08 %	60.73 %	3 s	1 core @ 2.5 Ghz (C/C++)	
17	Vote3Deep			67.88 %	79.92 %	62.98 %	1.5 s	4 cores @ 2.5 Ghz (C/C++)	
	M. Engelcke, D. Rao, D. Zeng Wang, C. Hay Tong and I. Posner: Vote3Deep: Fast Object Detection in 3D Point Clouds Using Efficient Convolutional Neural Networks. ArXiv e-prints 2016.								
18	IVA		code	67.47 %	80.17 %	59.66 %	0.4 s	GPU @ 2.5 Ghz (C/C++)	
	Y. Zhu, J. Wang, C. Zhao, H. Guo and H. Lu: Scale-adaptive Deconvolutional Regression Network for Pedestrian Detection. ACCV 2016. S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards real-time object detection with region proposal networks. Advances in neural information processing systems 2015.								
19	Mono3D		code	66.36 %	76.04 %	58.87 %	4.2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
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21	HM_SSD_RCNN			65.57 %	78.24 %	57.66 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
22	HSR2			64.92 %	74.75 %	57.49 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
23	tbd			63.81 %	75.49 %	56.26 %	1 s	1 core @ 2.5 Ghz (C/C++)	
24	Faster R-CNN		code	63.35 %	72.26 %	55.90 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	
	S. Ren, K. He, R. Girshick and J. Sun: Faster R-CNN: Towards Real- Time Object Detection with Region Proposal Networks. NIPS 2015.								
25	WRInception			62.85 %	77.21 %	55.80 %	0.06 s	GPU @ 2.5 Ghz (C/C++)	
26	SDP+CRC (ft)			61.31 %	74.08 %	53.97 %	0.6 s	GPU @ 2.5 Ghz (C/C++)	
	F. Yang, W. Choi and Y. Lin: Exploit All the Layers: Fast and Accurate CNN Object Detector with Scale Dependent Pooling and Cascaded Rejection Classifiers. Proceedings of the IEEE International Conference on Computer Vision and Pattern Recognition 2016.								
27	IVA		code	61.11 %	69.26 %	54.28 %	1 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
28	Regionlets			58.72 %	70.41 %	51.83 %	1 s	>8 cores @ 2.5 Ghz (C/C++)	
	X. Wang, M. Yang, S. Zhu and Y. Lin: Regionlets for Generic Object Detection. T-PAMI 2015. W. Zou, X. Wang, M. Sun and Y. Lin: Generic Object Detection with Dense Neural Patterns and Regionlets. British Machine Vision								

Conference 2014.
C. Long, X. Wang, G. Hua, M. Yang and Y. Lin: Accurate Object Detection with Location Relaxation and Regionlets Relocalization. Asian Conference on Computer Vision 2014.

29	PNET		58.60 %	74.27 %	51.66 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)
30	ANM		52.95 %	69.91 %	46.80 %	0.05 s	GPU @ 2.5 Ghz (C/C++)
31	ZGC		48.02 %	64.32 %	40.71 %	0.12 s	1 core @ 2.5 Ghz (C/C++)
32	FD2		44.13 %	61.84 %	40.35 %	0.01 s	GPU @ >3.5 Ghz (Python + C/C++)
33	maxFtr+ROI		43.58 %	48.38 %	38.73 %	0.25 s	4 cores @ 2.5 Ghz (C/C++)

W. Tian and M. Lauer: Detection and Orientation Estimation for Cyclists by Max Pooled Features. International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP) 2017.

34	MV-RGBD-RF		42.61 %	52.97 %	37.42 %	4 s	4 cores @ 2.5 Ghz (C/C++)

A. Gonzalez, D. Vazquez, A. Lopez and J. Amores: On-Board Object Detection: Multicue, Multimodal, and Multiview Random Forest of Local Experts.. IEEE Trans. on Cybernetics 2016.
A. Gonzalez, G. Villalonga, J. Xu, D. Vazquez, J. Amores and A. Lopez: Multiview Random Forest of Local Experts Combining RGB and LIDAR data for Pedestrian Detection. IEEE Intelligent Vehicles Symposium (IV) 2015.

35	QHY		42.30 %	59.15 %	41.28 %	0.1 s	1 core @ 2.5 Ghz (C/C++)
36	NMF-CNN		42.11 %	56.14 %	37.45 %	0.1 s	GPU @ 2.5 Ghz (Matlab + C/C++)
37	AR-FCN		41.83 %	58.08 %	33.99 %	0.19 s	GPU @ 2.5 Ghz (C/C++)
38	RCNN		40.36 %	56.67 %	33.07 %	0.08 s	GPU @ 2.5 Ghz (Python + C/C++)
39	HL		39.07 %	54.45 %	32.63 %	0.16 s	1 core @ 2.5 Ghz (C/C++)
40	pAUCEnsT		38.03 %	51.62 %	33.38 %	60 s	1 core @ 2.5 Ghz (Matlab + C/C++)

S. Paisitkriangkrai, C. Shen and A. Hengel: Pedestrian Detection with Spatially Pooled Features and Structured Ensemble Learning. arXiv 2014.

41	FD		36.58 %	50.51 %	32.31 %	0.01 s	GPU @ >3.5 Ghz (Python)
42	NMRDO		33.43 %	45.02 %	27.79 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)
43	Vote3D		31.24 %	41.43 %	28.60 %	0.5 s	4 cores @ 2.8 Ghz (C/C++)

D. Wang and I. Posner: Voting for Voting in Online Point Cloud Object Detection. Proceedings of Robotics: Science and Systems 2015.

44	DPM-VOC+VP		31.08 %	42.43 %	28.23 %	8 s	1 core @ 2.5 Ghz (C/C++)

B. Pepik, M. Stark, P. Gehler and B. Schiele: Multi-view and 3D Deformable Part Models. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) 2015.

45	LSVM-MDPM-us	code	29.88 %	38.84 %	27.31 %	10 s	4 cores @ 3.0 Ghz (C/C++)

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.

46	LSVM-MDPM-sv		29.24 %	37.71 %	27.52 %	10 s	4 cores @ 3.0 Ghz (C/C++)

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.
A. Geiger, C. Wojek and R. Urtasun: Joint 3D Estimation of Objects and Scene Layout. NIPS 2011.

47	DPM-C8B1		29.04 %	43.49 %	26.20 %	15 s	4 cores @ 2.5 Ghz (Matlab + C/C++)

J. Yebes, L. Bergasa and M. García-Garrido: Visual Object Recognition with 3D-Aware Features in KITTI Urban Scenes. Sensors 2015.
J. Yebes, L. Bergasa, R. Arroyo and A. Lázaro: Supervised learning and evaluation of KITTI's cars detector with DPM. IV 2014.

48	R-CNN_VGG		28.76 %	37.74 %	25.84 %	10 s	GPU @ 2.5 Ghz (Matlab + C/C++)
49	ACF_M		27.50 %	35.04 %	26.21 %	0.1 s	1 core @ 2.5 Ghz (C/C++)
50	mBoW		21.62 %	28.00 %	20.93 %	10 s	1 core @ 2.5 Ghz (C/C++)

J. Behley, V. Steinhage and A. Cremers: Laser-based Segment Classification Using a Mixture of Bag-of-Words. Proc. of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2013.

51	YOLO		13.96 %	17.93 %	13.83 %	0.03 s	GPU @ 1.0 Ghz (C/C++)
52	YOLOv2	code	4.55 %	4.55 %	4.55 %	0.02 s	GPU @ 3.5 Ghz (C/C++)

J. Redmon, S. Divvala, R. Girshick and A. Farhadi: You only look once: Unified, real-time object detection. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition 2016.
J. Redmon and A. Farhadi: YOLO9000: Better, Faster, Stronger. Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition 2017.

Table as LaTeX | Only published Methods

Object Detection and Orientation Estimation Evaluation

Cars

Method	Setting	Code	Moderate	Easy	Hard	Runtime	Environment	Compare

1	Deep MANTA		**89.86 %**	**95.72 %**	**80.39 %**	0.7 s	GPU @ 2.5 Ghz (Python + C/C++)	
F. Chabot, M. Chaouch, J. Rabarisoa, C. Teulière and T. Chateau: Deep MANTA: A Coarse-to-fine Many-Task Network for joint 2D and 3D vehicle analysis from monocular image. CVPR 2017.								
2	uickitti		88.79 %	90.70 %	78.84 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
3	Deep3DBox		88.75 %	92.90 %	76.76 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
A. Mousavian, D. Anguelov, J. Flynn and J. Kosecka: 3D Bounding Box Estimation Using Deep Learning and Geometry. CVPR 2017.								
4	SubCNN		88.62 %	90.67 %	78.68 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	
Y. Xiang, W. Choi, Y. Lin and S. Savarese: Subcategory-aware Convolutional Neural Networks for Object Proposals and Detection. IEEE Winter Conference on Applications of Computer Vision (WACV) 2017.								
5	DJML		88.27 %	90.57 %	78.30 %	2.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
6	DeepStereoOP		86.86 %	92.04 %	77.34 %	3.4 s	GPU @ 3.5 Ghz (Matlab + C/C++)	
C. Pham and J. Jeon: Robust Object Proposals Re-ranking for Object Detection in Autonomous Driving Using Convolutional Neural Networks. Signal Processing: Image Communiation 2017.								
7	Mono3D	code	86.62 %	91.01 %	76.84 %	4.2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
X. Chen, K. Kundu, Z. Zhang, H. Ma, S. Fidler and R. Urtasun: Monocular 3D Object Detection for Autonomous Driving. CVPR 2016.								
8	3DOP	code	86.10 %	91.44 %	76.52 %	3s	GPU @ 2.5 Ghz (Matlab + C/C++)	
X. Chen, K. Kundu, Y. Zhu, A. Berneshawi, H. Ma, S. Fidler and R. Urtasun: 3D Object Proposals for Accurate Object Class Detection. NIPS 2015.								
9	Pose-RCNN		75.41 %	88.34 %	66.07 %	2 s	>8 cores @ 2.5 Ghz (Python)	
10	XXX		75.22 %	84.09 %	67.87 %	>5 s	1 core @ 2.5 Ghz (C/C++)	
11	3DVP	code	74.59 %	86.92 %	64.11 %	40 s	8 cores @ 3.5 Ghz (Matlab + C/C++)	
Y. Xiang, W. Choi, Y. Lin and S. Savarese: Data-Driven 3D Voxel Patterns for Object Category Recognition. IEEE Conference on Computer Vision and Pattern Recognition 2015.								
12	SubCat	code	74.42 %	83.41 %	58.83 %	0.7 s	6 cores @ 3.5 Ghz (Matlab + C/C++)	
E. Ohn-Bar and M. Trivedi: Learning to Detect Vehicles by Clustering Appearance Patterns. T-ITS 2015.								
13	BdCost48LDCF		65.63 %	76.54 %	54.56 %	5 s	1 core @ 2.5 Ghz (C/C++)	
14	BdCost48-25C		65.61 %	76.95 %	55.02 %	4 s	1 core @ 2.5 Ghz (C/C++)	
15	OC-DPM		64.42 %	73.50 %	52.40 %	10 s	8 cores @ 2.5 Ghz (Matlab)	
B. Pepik, M. Stark, P. Gehler and B. Schiele: Occlusion Patterns for Object Class Detection. IEEE Conference on Computer Vision and Pattern Recognition (CVPR) 2013.								
16	AOG-View		63.31 %	76.70 %	50.34 %	3 s	1 core @ 2.5 Ghz (Matlab, C/C++)	
B. Li, T. Wu and S. Zhu: Integrating Context and Occlusion for Car Detection by Hierarchical And-Or Model. ECCV 2014.								
17	DPM-VOC+VP		61.84 %	72.28 %	46.54 %	8 s	1 core @ 2.5 Ghz (C/C++)	
B. Pepik, M. Stark, P. Gehler and B. Schiele: Multi-view and 3D Deformable Part Models. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) 2015.								
18	NMRDO		59.55 %	70.51 %	51.91 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)	
19	LSVM-MDPM-sv		56.69 %	70.86 %	45.91 %	10 s	4 cores @ 3.0 Ghz (C/C++)	
P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.								
A. Geiger, C. Wojek and R. Urtasun: Joint 3D Estimation of Objects and Scene Layout. NIPS 2011.								
20	GVPL		54.32 %	63.14 %	46.24 %	1 s	8 cores @ 2.5 Ghz (Matlab + C/C++)	
21	VeloFCN		52.84 %	70.58 %	46.14 %	1 s	GPU @ 2.5 Ghz (Python + C/C++)	
B. Li, T. Zhang and T. Xia: Vehicle Detection from 3D Lidar Using Fully Convolutional Network. RSS 2016 .								
22	DPM-C8B1		50.32 %	59.51 %	39.22 %	15 s	4 cores @ 2.5 Ghz (Matlab + C/C++)	
J. Yebes, L. Bergasa and M. García-Garrido: Visual Object Recognition with 3D-Aware Features in KITTI Urban Scenes. Sensors 2015.								
J. Yebes, L. Bergasa, R. Arroyo and A. Lázaro: Supervised learning and evaluation of KITTI's cars detector with DPM. IV 2014.								
23	HSR2		45.74 %	49.18 %	40.91 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
24	Allspark		45.33 %	47.24 %	39.81 %	0.7 s	GPU @ 2.5 Ghz (C/C++)	
25	WRInception		45.05 %	46.75 %	40.69 %	0.06 s	GPU @ 2.5 Ghz (C/C++)	
26	HM_SSD_RCNN		44.61 %	48.34 %	40.47 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
27	sensekitti		44.57 %	47.32 %	41.44 %	4.5 s	GPU @ 2.5 Ghz (Python + C/C++)	
28	DuEye		42.06 %	39.97 %	39.28 %	4 s	GPU @ 2.5 Ghz (C/C++)	
29	FD		39.81 %	44.14 %	34.80 %	0.01 s	GPU @ >3.5 Ghz (Python)	
30	FD2		39.50 %	47.54 %	35.39 %	0.01 s	GPU @ >3.5 Ghz (Python + C/C++)	
31	CPCD		39.02 %	37.90 %	34.23 %	3 s	1 core @ 2.5 Ghz (C/C++)	
32	Re-3DOP		38.46 %	37.92 %	33.91 %	3 s	1 core @ 2.5 Ghz (C/C++)	
33	UI		38.10 %	38.55 %	34.44 %	0.4 s	GPU @ 2.5 Ghz (C/C++)	

34	Direwolf		36.93 %	39.69 %	33.38 %	0.5 s	GPU @ 2.5 Ghz (C/C++)	
35	ZGC		36.55 %	45.25 %	32.07 %	0.12 s	1 core @ 2.5 Ghz (C/C++)	
36	SYVO		36.28 %	36.76 %	29.56 %	0.13 s	GPU @ 2.5 Ghz (C/C++)	
37	QHY		36.24 %	45.66 %	31.53 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	
38	HL		34.92 %	43.13 %	27.91 %	0.16 s	1 core @ 2.5 Ghz (C/C++)	
39	ANM		32.72 %	34.26 %	28.06 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	
40	SceneNet		31.98 %	36.26 %	28.41 %	0.03 s	GPU @ 2.5 Ghz (C/C++)	
41	AOG	code	30.77 %	33.79 %	24.75 %	3 s	4 cores @ 2.5 Ghz (Matlab)	

T. Wu, B. Li and S. Zhu: Learning And-Or Models to Represent Context and Occlusion for Car Detection and Viewpoint Estimation. TPAMI 2016.
B. Li, T. Wu and S. Zhu: Integrating Context and Occlusion for Car Detection by Hierarchical And-Or Model. ECCV 2014.

42	FCNN		28.85 %	35.19 %	25.25 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	
43	NMF-CNN		26.37 %	32.69 %	20.48 %	0.1 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
44	CSoR	code	25.38 %	33.97 %	21.95 %	3.5 s	4 cores @ >3.5 Ghz (Python + C/C++)	

L. Plotkin: PyDriver: Entwicklung eines Frameworks für räumliche Detektion und Klassifikation von Objekten in Fahrzeugumgebung. 2015.

45	SubCat48LDCF		24.37 %	26.21 %	18.74 %	5 s	1 core @ 2.5 Ghz (Matlab + C/C++)	
46	frd		22.23 %	27.63 %	19.39 %	2 s	1 core @ 2.5 Ghz (C/C++)	

Table as LaTeX | Only published Methods

Pedestrians

	Method	Setting	Code	Moderate	Easy	Hard	Runtime	Environment	Compare
1	uickitti			**66.83 %**	**78.93 %**	**62.06 %**	1.5 s	GPU @ 2.5 Ghz (C/C++)	
2	SubCNN			66.28 %	78.45 %	61.36 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	

Y. Xiang, W. Choi, Y. Lin and S. Savarese: Subcategory-aware Convolutional Neural Networks for Object Proposals and Detection. IEEE Winter Conference on Applications of Computer Vision (WACV) 2017.

3	Pose-RCNN			59.90 %	73.95 %	54.27 %	2 s	>8 cores @ 2.5 Ghz (Python)	
4	3DOP		code	59.80 %	72.94 %	57.03 %	3s	GPU @ 2.5 Ghz (Matlab + C/C++)	

X. Chen, K. Kundu, Y. Zhu, A. Berneshawi, H. Ma, S. Fidler and R. Urtasun: 3D Object Proposals for Accurate Object Class Detection. NIPS 2015.

5	DeepStereoOP			59.28 %	72.82 %	56.85 %	3.4 s	GPU @ 3.5 Ghz (Matlab + C/C++)	

C. Pham and J. Jeon: Robust Object Proposals Re-ranking for Object Detection in Autonomous Driving Using Convolutional Neural Networks. Signal Processing: Image Communiation 2017.

6	Mono3D		code	58.15 %	71.15 %	54.94 %	4.2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	

X. Chen, K. Kundu, Z. Zhang, H. Ma, S. Fidler and R. Urtasun: Monocular 3D Object Detection for Autonomous Driving. CVPR 2016.

7	DJML			58.12 %	69.35 %	52.62 %	2.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
8	DPM-VOC+VP			39.83 %	53.55 %	35.73 %	8 s	1 core @ 2.5 Ghz (C/C++)	

B. Pepik, M. Stark, P. Gehler and B. Schiele: Multi-view and 3D Deformable Part Models. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) 2015.

9	Allspark			38.99 %	43.71 %	36.22 %	0.7 s	GPU @ 2.5 Ghz (C/C++)	
10	sensekitti			37.50 %	43.27 %	35.10 %	4.5 s	GPU @ 2.5 Ghz (Python + C/C++)	
11	Re-3DOP			36.28 %	44.46 %	34.34 %	3 s	1 core @ 2.5 Ghz (C/C++)	
12	ACF_M			35.49 %	43.58 %	32.42 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	
13	LSVM-MDPM-sv			35.49 %	47.00 %	32.42 %	10 s	4 cores @ 3.0 Ghz (C/C++)	

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.
A. Geiger, C. Wojek and R. Urtasun: Joint 3D Estimation of Objects and Scene Layout. NIPS 2011.

14	WRInception			35.12 %	40.32 %	32.48 %	0.06 s	GPU @ 2.5 Ghz (C/C++)	
15	HM_SSD_RCNN			34.37 %	41.89 %	30.73 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
16	SubCat			34.18 %	44.32 %	30.76 %	1.2 s	6 cores @ 2.5 Ghz (Matlab + C/C++)	

E. Ohn-Bar and M. Trivedi: Fast and Robust Object Detection Using Visual Subcategories. Computer Vision and Pattern Recognition Workshops Mobile Vision 2014.

17	HSR2			33.86 %	41.48 %	32.48 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
18	Tx			33.82 %	39.55 %	30.97 %	2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	

19	RB		33.70 %	43.32 %	30.29 %	0.6 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
20	NMRDO		33.06 %	44.55 %	31.83 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)	
21	SSD1		32.66 %	41.64 %	30.50 %	0.255 s	GPU @ 2.5 Ghz (python+ C/C++)	
22	RPN+BF	code	32.55 %	40.91 %	29.52 %	0.6 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
L. Zhang, L. Lin, X. Liang and K. He: Is Faster R-CNN Doing Well for Pedestrian Detection?. ECCV 2016.								
23	NMF-CNN		30.94 %	40.13 %	28.65 %	0.1 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
24	ANM		30.04 %	39.60 %	27.56 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	
25	FD2		28.57 %	35.54 %	26.00 %	0.01 s	GPU @ >3.5 Ghz (Python + C/C++)	
26	ACF		28.46 %	35.69 %	26.18 %	1 s	1 core @ 3.5 Ghz (Matlab + C/C++)	
P. Doll\'ar, R. Appel, S. Belongie and P. Perona: Fast Feature Pyramids for Object Detection. PAMI 2014.								
27	FD		27.77 %	33.18 %	25.06 %	0.01 s	GPU @ >3.5 Ghz (Python)	
28	ZGC		26.42 %	34.53 %	22.57 %	0.12 s	1 core @ 2.5 Ghz (C/C++)	
29	HL		24.21 %	32.28 %	20.43 %	0.16 s	1 core @ 2.5 Ghz (C/C++)	
30	DPM-C8B1		23.37 %	31.08 %	20.72 %	15 s	4 cores @ 2.5 Ghz (Matlab + C/C++)	
J. Yebes, L. Bergasa and M. García-Garrido: Visual Object Recognition with 3D-Aware Features in KITTI Urban Scenes. Sensors 2015. J. Yebes, L. Bergasa, R. Arroyo and A. Lázaro: Supervised learning and evaluation of KITTI's cars detector with DPM. IV 2014.								
31	ACF-MR		23.18 %	29.33 %	21.00 %	0.6 s	1 core @ 3.5 Ghz (C/C++)	
R. Rajaram, E. Ohn-Bar and M. Trivedi: Looking at Pedestrians at Different Scales: A Multi-resolution Approach and Evaluations. T-ITS 2016.								
32	QHY		21.79 %	30.54 %	21.41 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	

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Cyclists

	Method	Setting	Code	Moderate	Easy	Hard	Runtime	Environment	Compare
1	uickitti			**63.69 %**	71.04 %	**56.34 %**	1.5 s	GPU @ 2.5 Ghz (C/C++)	
2	SubCNN			63.65 %	72.00 %	56.32 %	2 s	GPU @ 3.5 Ghz (Python + C/C++)	
Y. Xiang, W. Choi, Y. Lin and S. Savarese: Subcategory-aware Convolutional Neural Networks for Object Proposals and Detection. IEEE Winter Conference on Applications of Computer Vision (WACV) 2017.									
3	Pose-RCNN			62.87 %	**75.49 %**	55.47 %	2 s	>8 cores @ 2.5 Ghz (Python)	
4	Deep3DBox			59.87 %	69.16 %	52.50 %	1.5 s	GPU @ 2.5 Ghz (C/C++)	
A. Mousavian, D. Anguelov, J. Flynn and J. Kosecka: 3D Bounding Box Estimation Using Deep Learning and Geometry. CVPR 2017.									
5	DJML			59.71 %	69.59 %	52.89 %	2.4 s	GPU @ 2.5 Ghz (Python + C/C++)	
6	3DOP		code	58.68 %	70.13 %	52.35 %	3s	GPU @ 2.5 Ghz (Matlab + C/C++)	
X. Chen, K. Kundu, Y. Zhu, A. Berneshawi, H. Ma, S. Fidler and R. Urtasun: 3D Object Proposals for Accurate Object Class Detection. NIPS 2015.									
7	DeepStereoOP			55.69 %	69.20 %	48.95 %	3.4 s	GPU @ 3.5 Ghz (Matlab + C/C++)	
C. Pham and J. Jeon: Robust Object Proposals Re-ranking for Object Detection in Autonomous Driving Using Convolutional Neural Networks. Signal Processing: Image Communiation 2017.									
8	Mono3D		code	54.97 %	65.56 %	48.77 %	4.2 s	GPU @ 2.5 Ghz (Matlab + C/C++)	
X. Chen, K. Kundu, Z. Zhang, H. Ma, S. Fidler and R. Urtasun: Monocular 3D Object Detection for Autonomous Driving. CVPR 2016.									
9	Allspark			43.03 %	49.80 %	37.00 %	0.7 s	GPU @ 2.5 Ghz (C/C++)	
10	sensekitti			42.12 %	46.41 %	36.62 %	4.5 s	GPU @ 2.5 Ghz (Python + C/C++)	
11	maxFtr+ROI			38.28 %	41.82 %	34.27 %	0.25 s	4 cores @ 2.5 Ghz (C/C++)	
W. Tian and M. Lauer: Detection and Orientation Estimation for Cyclists by Max Pooled Features. International Joint Conference on Computer Vision, Imaging and Computer Graphics Theory and Applications (VISIGRAPP) 2017.									
12	HSR2			36.83 %	41.73 %	32.26 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
13	HM_SSD_RCNN			36.26 %	44.69 %	31.31 %	0.15 s	1 core @ 2.5 Ghz (C/C++)	
14	WRInception			34.20 %	41.42 %	29.61 %	0.06 s	GPU @ 2.5 Ghz (C/C++)	
15	Re-3DOP			29.60 %	31.39 %	27.37 %	3 s	1 core @ 2.5 Ghz (C/C++)	
16	ZGC			26.50 %	36.20 %	22.24 %	0.12 s	1 core @ 2.5 Ghz (C/C++)	
17	FD2			24.55 %	35.33 %	21.81 %	0.01 s	GPU @ >3.5 Ghz (Python + C/C++)	
18	ANM			24.05 %	31.01 %	21.12 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	

19 QHY	23.90 %	33.59 %	22.74 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	
20 NMRDO	23.53 %	31.47 %	19.81 %	0.1 s	GPU @ 2.5 Ghz (Python + C/C++)	
21 DPM-VOC+VP	23.17 %	30.52 %	21.58 %	8 s	1 core @ 2.5 Ghz (C/C++)	

B. Pepik, M. Stark, P. Gehler and B. Schiele: Multi-view and 3D Deformable Part Models. IEEE Transactions on Pattern Analysis and Machine Intelligence (TPAMI) 2015.

22 LSVM-MDPM-sv	23.14 %	28.89 %	22.28 %	10 s	4 cores @ 3.0 Ghz (C/C++)	

P. Felzenszwalb, R. Girshick, D. McAllester and D. Ramanan: Object Detection with Discriminatively Trained Part-Based Models. PAMI 2010.

A. Geiger, C. Wojek and R. Urtasun: Joint 3D Estimation of Objects and Scene Layout. NIPS 2011.

23 ACF_M	22.07 %	27.54 %	21.45 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	
24 HL	21.40 %	29.81 %	17.63 %	0.16 s	1 core @ 2.5 Ghz (C/C++)	
25 FD	21.35 %	30.37 %	18.20 %	0.01 s	GPU @ >3.5 Ghz (Python)	
26 DPM-C8B1	19.25 %	27.25 %	17.95 %	15 s	4 cores @ 2.5 Ghz (Matlab + C/C++)	

J. Yebes, L. Bergasa and M. García-Garrido: Visual Object Recognition with 3D-Aware Features in KITTI Urban Scenes. Sensors 2015.

J. Yebes, L. Bergasa, R. Arroyo and A. Lázaro: Supervised learning and evaluation of KITTI's cars detector with DPM. IV 2014.

27 NMF-CNN	16.77 %	21.97 %	15.09 %	0.1 s	GPU @ 2.5 Ghz (Matlab + C/C++)	

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Related Datasets

- PASCAL3D+: Augments 12 rigid object classes of PASCAL VOC 2012 with 3D annotations.
- The PASCAL Visual Object Classes Challenges: Dataset and benchmarks for object class recognition.
- TME Motorway Dataset: 28 video sequences with vehicle annotations captured from VisLab's BRAiVE vehicle.
- LabelMe: Online annotation tool to build image databases for computer vision research.
- MIT Street Scenes: Street-side images with labels for 9 object categories (including cars, pedestrians, buildings, trees).
- Daimler Pedestrian Datasets: Datasets focusing on pedestrian detection for autonomous driving.
- Caltech Pedestrian Detection Benchmark: 10 hours of video with 350.000 annotated pedestrian bounding boxes.
- Robust Multi-Person Tracking from Mobile Platforms: Videos with annotated pedestrians captured from a stroller.

Citation

When using this dataset in your research, we will be happy if you cite us:

```
@INPROCEEDINGS{Geiger2012CVPR,
  author = {Andreas Geiger and Philip Lenz and Raquel Urtasun},
  title = {Are we ready for Autonomous Driving? The KITTI Vision Benchmark Suite},
  booktitle = {Conference on Computer Vision and Pattern Recognition (CVPR)},
  year = {2012}
}
```