

The KITTI Vision Benchmark Suite

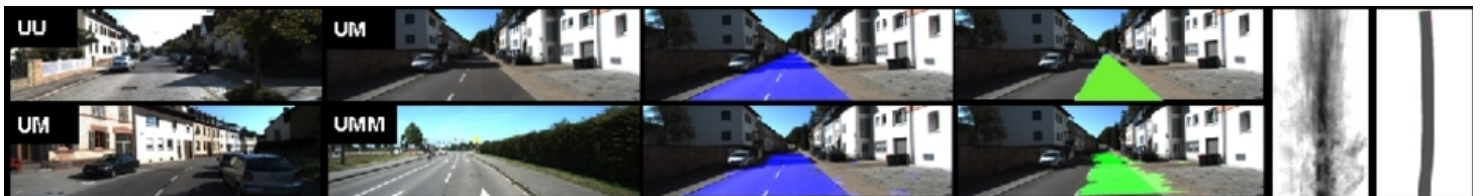
A project of [Karlsruhe Institute of Technology](#)
and [Toyota Technological Institute at Chicago](#)



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[A. Geiger](#) | [P. Lenz](#) | [C. Stiller](#) | [R. Urtasun](#) **Road/Lane Detection Evaluation 2013**

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This benchmark has been created in collaboration with [Jannik Fritsch](#) and Tobias Kuehnl from [Honda Research Institute Europe GmbH](#). The road and lane estimation benchmark consists of 289 training and 290 test images. It contains three different categories of road scenes:

- uu - urban unmarked (98/100)
- um - urban marked (95/96)
- umm - urban multiple marked lanes (96/94)
- urban - combination of the three above

Ground truth has been generated by manual annotation of the images and is available for two different road terrain types: road - the road area, i.e. the composition of all lanes, and lane - the ego-lane, i.e., the lane the vehicle is currently driving on (only available for category "um"). Ground truth is provided for training images only.

- [Download base kit with: left color images, calibration and training labels \(0.5 GB\)](#)
- [Download right color image extension \(0.5 GB\)](#)

Samsara EX1039
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IPR2026-00034





- [Download grayscale image extension \(0.3 GB\)](#)
- [Download Velodyne laser point extension \(1 GB\)](#)
- [Download OXTS GPS/IMU extension \(1 MB\)](#)
- [Download development kit \(1 MB\)](#)
- [Mapping of training set to raw data sequences \(1 MB\)](#)

We evaluate road and lane estimation performance in the bird's-eye-view space. For the classical pixel-based evaluation we use established measures as discussed in our [ITSC 2013 publication](#). MaxF: Maximum F1-measure, AP: Average precision as used in PASCAL VOC challenges, PRE: Precision, REC: Recall, FPR: False Positive Rate, FNR: False Negative Rate (the four latter measures are evaluated at the working point MaxF), F1: F1 score, HR: Hit rate. For the novel behavior-based evaluation a corridor with the vehicle width (2.2m) is fitted to the lane estimation processing result and evaluation is performed for 3 different distance values: 20 m, 30 m, and 40 m. We refer to our [ITSC 2013 publication](#) for more details.

IMPORTANT NOTE: On 09.02.2015 we have improved the accuracy of the ground truth and re-calculated the results for all methods. Please download the devkit and the dataset with the improved ground truth for training again, if you have downloaded the files prior to 09.02.2015. Please consider reporting these new number for all future submissions. The last leaderboards right before the changes can be found [here!](#)


Important Policy Update: As more and more non-published work and re-implementations of existing work is submitted to KITTI, we have established a new policy: from now on, only submissions with significant novelty that are leading to a peer-reviewed paper in a conference or journal are allowed. Minor modifications of existing algorithms or student research projects are not allowed. Such work must be evaluated on a split of the training set. To ensure that our policy is adopted, new users must detail their status, describe their work and specify the targeted venue during registration. Furthermore, we will regularly delete all entries that are 6 months old but are still anonymous or do not have a paper associated with them. For conferences, 6 month is enough to determine if a paper has been accepted and to add the bibliography information. For longer review cycles, you need to resubmit your results.

Additional information used by the methods

-  Stereo: Method uses left and right (stereo) images
-  Laser Points: Method uses point clouds from Velodyne laser scanner
-  GPS: Method uses GPS information
-  Additional training data: Use of additional data sources for training (see details)

Road Estimation Evaluation


UM_ROAD

Method	Setting	Code	MaxF	AP	PRE	REC	FPR	FNR	Runtime	Environment	Compare
1	GLoDeR		97.31 %	92.66 %	97.36 %	97.26 %	1.20 %	2.74 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
2	DiPFormer		97.29 %	92.66 %	97.37 %	97.20 %	1.20 %	2.80 %	0.01 s	1 GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
S. Chen, T. Han, C. Zhang, W. Liu, J. Su, Z. Wang and G. Cai: Depth Matters: Exploring Deep Interactions of RGB-D for Semantic Segmentation in Traffic Scenes . arXiv preprint arXiv:2409.07995 2024.											
3	LiDAR-DHMT		97.29 %	92.66 %	97.37 %	97.20 %	1.20 %	2.80 %	0.01 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>
4	UdeerLID+		97.26 %	93.54 %	97.38 %	97.15 %	1.19 %	2.85 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised . 2024.											
5	SNE-RoadSegV2		97.25 %	93.52 %	97.48 %	97.03 %	1.14 %	2.97 %	0.03 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
Y. Feng, Y. Ma, Q. Chen, I. Pitas and R. Fan: SNE-RoadSegV2: Advancing Heterogeneous Feature Fusion and Fallibility Awareness for Freespace Detection . 2024.											
6	RoadFormer+		97.17 %	93.41 %	97.09 %	97.24 %	1.33 %	2.76 %	0.04 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Huang, J. Li, N. Jia, Y. Sun, C. Liu, Q. Chen and R. Fan: RoadFormer+: Delivering RGB-X Scene Parsing through Scale-Aware Information Decoupling and Advanced Heterogeneous Feature Fusion . IEEE Transactions on Intelligent Vehicles 2024.											
7	PLARD	 code	97.05 %	93.53 %	97.18 %	96.92 %	1.28 %	3.08 %	0.16 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
Z. Chen, J. Zhang and D. Tao: Progressive LiDAR adaptation for road detection . IEEE/CAA Journal of Automatica Sinica 2019.											
8	RoadFormer		97.02 %	93.34 %	96.84 %	97.20 %	1.45 %	2.80 %	0.07 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
J. Li, Y. Zhang, P. Yun, G. Zhou, Q. Chen and R. Fan: RoadFormer: Duplex Transformer for RGB-Normal Semantic Road Scene Parsing . IEEE Transactions on Intelligent Vehicles 2024.											

9	SNE-RoadSeg+		96.95 %	93.60 %	96.99 %	96.90 %	1.37 %	3.10 %	0.08 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, P. Cai and M. Liu: SNE-RoadSeg+: Rethinking depth-normal translation and deep supervision for freespace detection . 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2021.											
10	UdeerLID		96.94 %	93.62 %	97.09 %	96.79 %	1.32 %	3.21 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised . 2024.											
11	Pseudo-LiDAR		96.87 %	93.71 %	97.35 %	96.40 %	1.20 %	3.60 %	0.46 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Sun, H. Zhang and W. Yin: Pseudo-LiDAR-Based Road Detection . IEEE Transactions on Circuits and Systems for Video Technology (T-CSVT) 2022.											
12	MemRoadNet	code	96.55 %	93.58 %	96.46 %	96.64 %	1.61 %	3.36 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
ERROR: Wrong syntax in BIBTEX file.											
13	Evi-RoadSeg	code	96.51 %	92.94 %	95.90 %	97.13 %	1.89 %	2.87 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
F. Xue†, Y. Chang†, W. Xu, W. Liang, F. Sheng and A. Ming: Evidence-based Real-time Road Segmentation with RGB-D Data Augmentation . Transactions on Intelligent Transportation Systems (T-ITS) 2024.											
14	USNet	code	96.46 %	92.78 %	96.32 %	96.60 %	1.68 %	3.40 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
Y. Chang, F. Xue, F. Sheng, W. Liang and A. Ming: Fast Road Segmentation via Uncertainty-aware Symmetric Network . IEEE International Conference on Robotics and Automation (ICRA) 2022.											
15	DFM-RTFNet		96.46 %	93.66 %	96.58 %	96.33 %	1.55 %	3.67 %	0.08 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, Y. Sun and M. Liu: Dynamic fusion module evolves drivable area and road anomaly detection: A benchmark and algorithms . IEEE Transactions on Cybernetics 2021.											
16	SNE-RoadSeg	code	96.42 %	93.67 %	96.59 %	96.26 %	1.55 %	3.74 %	0.18 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
R. Fan, H. Wang, P. Cai and M. Liu: SNE-RoadSeg: Incorporating Surface Normal Information into Semantic Segmentation for Accurate Freespace Detection . ECCV 2020.											
17	3MT-RoadSeg	 code	96.13 %	93.42 %	96.20 %	96.06 %	1.73 %	3.94 %	0.07 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
E. Milli,  Erkent and A. Yilmaz: Multi-Modal Multi-Task (3MT) Road Segmentation . IEEE Robotics and Automation Letters 2023.											
18	LRDNet+	 code	96.10 %	92.00 %	96.89 %	95.32 %	1.39 %	4.68 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
19	LRDNet(S)	 code	96.01 %	92.47 %	96.60 %	95.43 %	1.53 %	4.57 %	.009 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
20	LRDNet(L)	 code	96.01 %	91.83 %	96.84 %	95.19 %	1.41 %	4.81 %	0.1 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
21	RBANet		95.78 %	89.14 %	94.92 %	96.66 %	2.36 %	3.34 %	0.16 s	GPU @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
J. Sun, S. Kim, S. Lee, Y. Kim and S. Ko: Reverse and Boundary Attention Network for Road Segmentation . Proceedings of the IEEE International Conference on Computer Vision Workshops 2019.											
22	NIM-RTFNet		95.71 %	93.56 %	95.84 %	95.59 %	1.89 %	4.41 %	0.05 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, Y. Sun and M. Liu: Applying Surface Normal Information in Drivable Area and Road Anomaly Detection for Ground Mobile Robots . 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2020.											
23	CLCFNet	 code	95.65 %	89.49 %	95.31 %	96.00 %	2.15 %	4.00 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.											
24	LidCamNet	 code	95.62 %	93.54 %	95.77 %	95.48 %	1.92 %	4.52 %	0.15 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Caltagirone, M. Bellone, L. Svensson and M. Wahde: LiDAR-Camera Fusion for Road Detection Using Fully Convolutional Neural Networks . Robotics and Autonomous Systems 2018.											

25	V2FedR	code	95.21 %	88.30 %	94.00 %	96.46 %	2.81 %	3.54 %	0.05 s	GPU @ >3.5 Ghz (Python)	<input type="checkbox"/>
26	CLCFNet (LiDAR)		95.16 %	89.18 %	94.97 %	95.36 %	2.30 %	4.64 %	0.02 s	GPU @ 1.5 Ghz (C/C++)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.											
27	TVFNet		94.96 %	89.17 %	94.95 %	94.97 %	2.30 %	5.03 %	0.04 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Yang, J. Alvarez and H. Kong: Two-View Fusion based Convolutional Neural Network for Urban Road Detection . IROS 2019.											
28	LC-CRF		94.91 %	86.41 %	91.92 %	98.11 %	3.93 %	1.89 %	0.18 s	GPU @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Tang, J. Yang and H. Kong: Road Detection through CRF based LiDAR-Camera Fusion . ICRA 2019.											
29	RBNet		94.77 %	91.42 %	95.16 %	94.37 %	2.19 %	5.63 %	0.18 s	GPU @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
Z. Chen and Z. Chen: RBNet: A Deep Neural Network for Unified Road and Road Boundary Detection . International Conference on Neural Information Processing 2017.											
30	SSLGAN		94.62 %	89.50 %	95.32 %	93.93 %	2.10 %	6.07 %	700ms	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
X. Han, J. Lu, C. Zhao, S. You and H. Li: Semisupervised and Weakly Supervised Road Detection Based on Generative Adversarial Networks . IEEE Signal Processing Letters 2018.											
31	LFD-RoadSeg	code	94.58 %	93.42 %	95.20 %	93.98 %	2.16 %	6.02 %	.004 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
H. Zhou, F. Xue, Y. Li, S. Gong, Y. Li and Y. Zhou: Exploiting Low-Level Representations for Ultra-Fast Road Segmentation . IEEE Transactions on Intelligent Transportation Systems 2024.											
32	RGB36-Cotrain		94.55 %	93.12 %	94.81 %	94.29 %	2.35 %	5.71 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: Lidar-Camera Co-Training for Semi- Supervised Road Detection . arXiv preprint arXiv:1911.12597 2019.											
33	HA-DeepLabv3+		94.38 %	92.72 %	94.70 %	94.06 %	2.40 %	5.94 %	0.06 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>
R. Fan, H. Wang, P. Cai, J. Wu, M. Bocus, L. Qiao and M. Liu: Learning collision-free space detection from stereo images: Homography matrix brings better data augmentation . IEEE/ASME Transactions on Mechatronics 2021.											
34	TEDNet	code	94.24 %	92.43 %	93.45 %	95.04 %	3.04 %	4.96 %	0.09 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
M. Bayón-Gutiérrez, M. García- Ordás, H. Alaiz Moretón, J. Avelaira-Mata, S. Rubio-Martín and J. Benítez-Andrades: TEDNet: Twin Encoder Decoder Neural Network for 2D Camera and LiDAR Road Detection . Logic Journal of the IGPL 2024.											
35	BJN		94.17 %	89.16 %	94.95 %	93.41 %	2.26 %	6.59 %	0.02 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
B. Yu, D. Lee, J. Lee and S. Kee: Free Space Detection Using Camera-LiDAR Fusion in a Bird's Eye View Plane . Sensors 2021.											
36	DEEP-DIG		94.16 %	93.41 %	95.02 %	93.32 %	2.23 %	6.68 %	0.14 s	GPU @ 3.5 Ghz (Python + C/C++)	<input type="checkbox"/>
J. Muñoz-Bulnes, C. Fernandez, I. Parra, D. Fernández-Llorca and M. Sotelo: Deep Fully Convolutional Networks with Random Data Augmentation for Enhanced Generalization in Road Detection . Workshop on Deep Learning for Autonomous Driving on IEEE 20th International Conference on Intelligent Transportation Systems 2017.											
37	CLRDR		94.06 %	92.13 %	94.32 %	93.80 %	2.57 %	6.21 %	0.05 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
M. Bayón-Gutiérrez, J. Benítez- Andrades, S. Rubio-Martín, J. Avelaira-Mata, H. Alaiz-Moretón and M. García-Ordás: Roadway Detection Using Convolutional Neural Network Through Camera and LiDAR Data . Hybrid Artificial Intelligent Systems 2022.											
38	Hadamard-FCN		94.06 %	90.89 %	94.62 %	93.50 %	2.42 %	6.50 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
M. Oeljeklaus: An Integrated Approach for Traffic Scene Understanding from Monocular Cameras . 2021.											
39	StixelNet II		94.05 %	85.85 %	91.30 %	96.98 %	4.21 %	3.02 %	1.2 s	1 core @ 3.0 Ghz (Matlab + C/C++)	<input type="checkbox"/>
N. Garnett, S. Silberstein, S. Oron, E. Fetaya, U. Verner, A. Ayash, V. Goldner, R. Cohen, K. Horn and D. Levi: Real-time category-based and general obstacle detection for autonomous driving . 5th Workshop on Computer Vision for Road Scene Understanding and Autonomous Driving (CVRSUAD'17, IEEE-ICCV 2017 Workshop) 2017.											
40	MultiNet	code	93.99 %	93.24 %	94.51 %	93.48 %	2.47 %	6.52 %	0.17 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
M. Teichmann, M. Weber, J. Zoellner, R. Cipolla and R. Urtasun: MultiNet: Real-time Joint Semantic Reasoning for Autonomous Driving . CoRR 2016.											
41	ChipNet		93.73 %	87.62 %	93.25 %	94.21 %	3.11 %	5.79 %	12 ms	GPU @ 1.5 Ghz (Keras)	<input type="checkbox"/>


Y. Lyu, L. Bai and X. Huang: [ChipNet: Real-Time LiDAR Processing for Drivable Region Segmentation on an FPGA](#). IEEE Transactions on Circuits and Systems I: Regular Papers 2019.

42 [DDN](#)  93.65 % 88.55 % 94.28 % 93.03 % 2.57 % 6.97 % 2 s GPU @ 2.5 Ghz (Python + C/C++)

R. Mohan: [Deep Deconvolutional Networks for Scene Parsing](#). 2014.

43 [RoadNet3](#) 93.54 % 92.64 % 93.65 % 93.44 % 2.89 % 6.56 % 300 ms GPU @ GTX950M (Python +Tensorflow)

Y. Lyu, L. Bai and X. Huang: [Road Segmentation using CNN and Distributed LSTM](#). 2019 IEEE International Symposium on Circuits and Systems (ISCAS) 2019.


44 [HID-LS](#)  93.10 % 86.38 % 91.89 % 94.33 % 3.79 % 5.67 % 0.25 s 1 cores @ 3.0 Ghz (C/C++)

S. Gu, Y. Zhang, J. Yang and H. Kong: [Lidar-based urban road detection by histograms of normalized inverse depths and line scanning](#). ECMR 2017.

S. Gu, Y. Zhang, X. Yuan, J. Yang, T. Wu and H. Kong: [Histograms of the Normalized Inverse Depth and Line Scanning for Urban Road Detection](#). IEEE Trans. Intelligent Transportation Systems 2019.

45 [RGB36-Super](#) 93.04 % 91.85 % 93.62 % 92.46 % 2.87 % 7.54 % 0.1 s 1 core @ 2.5 Ghz (C/C++)

L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: [Lidar-Camera Co-Training for Semi- Supervised Road Detection](#). arXiv preprint arXiv:1911.12597 2019.

46 [LoDNN](#)  92.75 % 89.98 % 90.09 % 95.58 % 4.79 % 4.42 % 18 ms GPU @ 2.5 Ghz (Torch)

L. Caltagirone, S. Scheidegger, L. Svensson and M. Wahde: [Fast LIDAR-based Road Detection Using Fully Convolutional Neural Networks](#). IEEE Intelligent Vehicles Symposium 2017.

47 [Up-Conv-Poly](#) [code](#) 92.20 % 88.85 % 92.57 % 91.83 % 3.36 % 8.17 % 0.08 s GPU @ 2.5 Ghz (Python + C/C++)


G. Oliveira, W. Burgard and T. Brox: [Efficient Deep Methods for Monocular Road Segmentation](#). IROS 2016.

48 [OFA Net](#) [code](#) 92.08 % 82.73 % 87.87 % 96.72 % 6.08 % 3.28 % 0.04 s GPU @ 1.5 Ghz (Python)

S. Zhang, Z. Zhang, L. Sun and W. Qin: [One For All: A Mutual Enhancement Method for Object Detection and Semantic Segmentation](#). Applied Sciences 2019.

49 [RoadNet-RT](#) 91.99 % 92.54 % 92.75 % 91.24 % 3.25 % 8.76 % 8m s GPU @ 2.5 Ghz (Python)

L. Bai, Y. Lyu and X. Huang: [RoadNet-RT: High Throughput CNN Architecture and SoC Design for Real-Time Road Segmentation](#). arXiv preprint arXiv:2006.07644 2020.

50 [MixedCRF](#)  91.57 % 84.68 % 90.02 % 93.19 % 4.71 % 6.81 % 6s 1 core @ 2.5 Ghz (Matlab + C/C++)


X. Han, H. Wang, J. Lu and C. Zhao: [Road detection based on the fusion of Lidar and image data](#). 2017.

51 [FTP](#) 91.20 % 90.60 % 91.11 % 91.29 % 4.06 % 8.71 % 0.28 s GPU @ 2.5 Ghz (C/C++)


A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: [Map-Supervised Road Detection](#). IEEE Intelligent Vehicles Symposium Proceedings 2016.

52 [ALO-AVG-MM](#) [code](#) 91.15 % 83.82 % 89.07 % 93.33 % 5.22 % 6.67 % 0.0296 sec GeForce GTX 1080 GPU (Python)

F. Reis, R. Almeida, E. Kijak, S. Malinowski, S. Guimaraes and Z. Jr.: [Combining convolutional side-outputs for road image segmentation](#). 2019 International Joint Conference on Neural Networks (IJCNN) - \textbf{Accepted} 2019.

53 [HybridCRF](#)  90.99 % 85.26 % 90.65 % 91.33 % 4.29 % 8.67 % 1.5 s 1 core @ 2.5 Ghz (C/C++)

L. Xiao, R. Wang, B. Dai, Y. Fang, D. Liu and T. Wu: [Hybrid conditional random field based camera-LIDAR fusion for road detection](#). Information Sciences 2018.

54 [NNP](#)  90.50 % 87.95 % 91.43 % 89.59 % 3.83 % 10.41 % 5 s 4 cores @ 2.5 Ghz (Matlab)


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.

55 [Up-Conv](#) 90.48 % 88.20 % 91.30 % 89.67 % 3.90 % 10.33 % 0.05 s GPU @ 2.5 Ghz (C/C++)


G. Oliveira, W. Burgard and T. Brox: [Efficient Deep Methods for Monocular Road Segmentation](#). IROS 2016.

56 [HIM](#) 90.07 % 79.98 % 90.79 % 89.35 % 4.13 % 10.65 % 7 s >8 cores @ 2.5 Ghz (Python + C/C++)


D. Munoz, J. Bagnell and M. Hebert: [Stacked Hierarchical Labeling](#). European Conference on Computer Vision (ECCV) 2010.

57 [LidarHisto](#)  [code](#) 89.87 % 83.03 % 91.28 % 88.49 % 3.85 % 11.51 % 0.1 s 1 core @ 2.5 Ghz (C/C++)

L. Chen, J. Yang and H. Kong: [Lidar-histogram for fast road and obstacle detection](#). 2017 IEEE International Conference on Robotics and Automation (ICRA) 2017.

58 [FusedCRF](#)  89.55 % 80.00 % 84.87 % 94.78 % 7.70 % 5.22 % 2 s 1 core @ 2.5 Ghz (C/C++)

L. Xiao, B. Dai, D. Liu, T. Hu and T. Wu: [CRF based Road Detection with Multi-Sensor Fusion](#). Intelligent Vehicles Symposium (IV) 2015.

59 [BMCF](#)  89.42 % 83.13 % 88.31 % 90.55 % 5.46 % 9.45 % 2.5 s 1 core @ 2.5 Ghz (C/C++)

L. Wang, T. Wu, Z. Xiao, L. Xiao, D. Zhao and J. Han: [Multi-cue road boundary detection using stereo vision](#). 2016 IEEE International Conference on Vehicular Electronics and Safety (ICVES) 2016.

60 [FCN-LC](#) 89.36 % 78.80 % 89.35 % 89.37 % 4.85 % 10.63 % 0.03 s GPU Titan X


C. Mendes, V. Frémont and D. Wolf: [Exploiting Fully Convolutional Neural Networks for Fast Road Detection](#). IEEE Conference on Robotics and Automation (ICRA) 2016.

61 [CB](#) 88.89 % 82.17 % 87.26 % 90.58 % 6.03 % 9.42 % 2 s 1 core @ 3.4 Ghz (Python) + GPU

C. Mendes, V. Frémont and D. Wolf: [Vision-Based Road Detection using Contextual Blocks](#). 2015.

62 [SPRAY](#) 88.14 % 91.24 % 88.60 % 87.68 % 5.14 % 12.32 % 45 ms NVIDIA GTX 580 (Python + OpenCL)

T. Kuehnl, F. Kummert and J. Fritsch: [Spatial Ray Features for Real-Time Ego-Lane Extraction](#). Proc. IEEE Intelligent Transportation Systems 2012.

63 [ProbBoost](#)  87.48 % 80.13 % 85.02 % 90.09 % 7.23 % 9.91 % 2.5 min >8 cores @ 3.0 Ghz (C/C++)

G. Vitor, A. Victorino and J. Ferreira: [A probabilistic distribution approach for the classification of urban roads in complex environments](#). Workshop on Modelling, Estimation, Perception and Control of All Terrain Mobile Robots on IEEE International Conference on Robotics and Automation (ICRA) 2014.

64 [MAP](#) 87.33 % 89.62 % 85.77 % 88.95 % 6.73 % 11.05 % 0.28s GPU


A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: [Map-Supervised Road Detection](#). IEEE Intelligent Vehicles Symposium Proceedings 2016.

65 [CN24](#) 86.32 % 89.19 % 87.80 % 84.89 % 5.37 % 15.11 % 30 s >8 cores @ 2.5 Ghz (C/C++)

C. Brust, S. Sickert, M. Simon, E. Rodner and J. Denzler: [Convolutional Patch Networks with Spatial Prior for Road Detection and Urban Scene Understanding](#). VISAPP 2015 - Proceedings of the 10th International Conference on Computer Vision Theory and Applications, Berlin, Germany, 11-14 March, 2015 2015.

66 [multi-task CNN](#) 85.95 % 81.28 % 77.40 % 96.64 % 12.86 % 3.36 % 25.1 ms GPU @ 2.0 Ghz (Python)


M. Oeljeklaus, F. Hoffmann and T. Bertram: [A Fast Multi-Task CNN for Spatial Understanding of Traffic Scenes](#). IEEE Intelligent Transportation Systems Conference 2018.

67 [GRES3D+VELO](#)  85.43 % 83.04 % 82.69 % 88.37 % 8.43 % 11.63 % 60 ms 4 cores @ 2.8 Ghz (C/C++)


P. Shinzato: [Estimation of obstacles and road area with sparse 3D points](#). 2015.

68 [StixelNet](#) 85.33 % 72.14 % 81.21 % 89.89 % 9.48 % 10.11 % 1 s GPU @ 2.5 Ghz (C/C++)


D. Levi, N. Garnett and E. Fetaya: [StixelNet: A Deep Convolutional Network for Obstacle Detection and Road Segmentation](#). 26TH British Machine Vision Conference (BMVC) 2015.

69 [SPlane + BL](#)  85.23 % 88.66 % 83.43 % 87.12 % 7.89 % 12.88 % 2 s 1 core @ 3.0 Ghz (C/C++)


N. Einecke and J. Eggert: [Block-Matching Stereo with Relaxed Fronto-Parallel Assumption](#). IV 2014.

70 [geo+gpr+crf](#)  85.13 % 72.24 % 81.33 % 89.29 % 9.34 % 10.71 % 30 s 1 core @ 2.0 Ghz (C/C++)


Z. Xiao, B. Dai, H. Li, T. Wu, X. Xu, Y. Zeng and T. Chen: [Gaussian process regression-based robust free space detection for autonomous vehicle by 3-D point cloud and 2-D appearance information fusion](#). International Journal of Advanced Robotic Systems 2017.

71 [RES3D-Velo](#)  83.81 % 73.95 % 78.56 % 89.80 % 11.16 % 10.20 % 0.36 s 1 core @ 2.5 Ghz (C/C++)

P. Shinzato, D. Wolf and C. Stiller: [Road Terrain Detection: Avoiding Common Obstacle Detection Assumptions Using Sensor Fusion](#). Intelligent Vehicles Symposium (IV) 2014.

72 [SCRFPPFHGSP](#)  83.73 % 72.89 % 82.13 % 85.39 % 8.47 % 14.61 % 5 s 8 cores @ 2.5 Ghz (C/C++, Matlab)

I. Gheorghie: [Semantic Segmentation of Terrain and Road Terrain for Advanced Driver Assistance Systems](#). 2015.

73 [GRES3D+SELAS](#)  83.69 % 84.61 % 78.31 % 89.88 % 11.35 % 10.12 % 110 ms 4 core @ 2.8 Ghz (C/C++)

P. Shinzato: [Estimation of obstacles and road area with sparse 3D points](#). 2015.

74	HistonBoost		83.68 %	72.79 %	82.01 %	85.42 %	8.54 %	14.58 %	2.5 min	>8 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, A. Victorino and J. Ferreira: Comprehensive Performance Analysis of Road Detection Algorithms Using the Common Urban Kitti-Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application on IEEE Intelligent Vehicles Symposium (IV) 2014.											
75	PGM-ARS		80.97 %	69.11 %	77.51 %	84.76 %	11.21 %	15.24 %	0.05 s	i74700MQ @ 2.1Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: Fast Pixelwise Road Inference Based on Uniformly Reweighted Belief Propagation . Proc. IEEE Intelligent Vehicles Symposium 2015.											
76	RES3D-Stereo		78.98 %	80.06 %	75.94 %	82.27 %	11.88 %	17.73 %	0.7 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato, D. Gomes and D. Wolf: Road estimation with sparse 3D points from stereo data . Intelligent Transportation Systems (ITSC), 2014 IEEE 17th International Conference on 2014.											
77	BM		78.90 %	66.06 %	69.53 %	91.19 %	18.21 %	8.81 %	2 s	2 cores @ 2.5 Ghz (Matlab)	<input type="checkbox"/>
B. WANG, V. Fremont and S. Rodriguez Florez: Color-based Road Detection and its Evaluation on the KITTI Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application, IEEE Intelligent Vehicles Symposium 2014.											
78	SPlane		78.19 %	76.41 %	72.03 %	85.50 %	15.13 %	14.50 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.											
79	SRF		76.43 %	83.24 %	75.53 %	77.35 %	11.42 %	22.65 %	0.2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, B. Dai, D. Liu, D. Zhao and T. Wu: Monocular Road Detection Using Structured Random Forest . Int J Adv Robot Syst 2016.											
80	CN24		76.28 %	79.29 %	72.44 %	80.55 %	13.96 %	19.45 %	20 s	>8 cores @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
C. Brust, S. Sickert, M. Simon, E. Rodner and J. Denzler: Convolutional Patch Networks with Spatial Prior for Road Detection and Urban Scene Understanding . VISAPP 2015 - Proceedings of the 10th International Conference on Computer Vision Theory and Applications, Berlin, Germany, 11-14 March, 2015 2015.											
81	CN		73.69 %	76.68 %	69.18 %	78.83 %	16.00 %	21.17 %	2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Alvarez, T. Gevers, Y. LeCun and A. Lopez: Road Scene Segmentation from a Single Image . ECCV 2012 2012.											
82	ARSL-AMI		71.97 %	61.04 %	78.03 %	66.79 %	8.57 %	33.21 %	0.05 s	4 cores @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: CRF-based semantic labeling in miniaturized road scenes . Proc. IEEE Intelligent Transportation Systems 2014.											
83	ANN		62.83 %	46.77 %	50.21 %	83.91 %	37.91 %	16.09 %	3 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, D. Lima, A. Victorino and J. Ferreira: A 2D/3D Vision Based Approach Applied to Road Detection in Urban Environments . Intelligent Vehicles Symposium (IV), 2013 IEEE 2013.											

[Table as LaTeX](#) | [Only published Methods](#)

UMM_ROAD

Method	Setting	Code	MaxF	AP	PRE	REC	FPR	FNR	Runtime	Environment	Compare
1	GLoDeR		98.19 %	94.79 %	97.87 %	98.52 %	2.36 %	1.48 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
2	DiPFormer		98.19 %	94.80 %	97.88 %	98.50 %	2.34 %	1.50 %	0.01 s	1 GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
S. Chen, T. Han, C. Zhang, W. Liu, J. Su, Z. Wang and G. Cai: Depth Matters: Exploring Deep Interactions of RGB-D for Semantic Segmentation in Traffic Scenes . arXiv preprint arXiv:2409.07995 2024.											
3	LiDAR-DHMT		98.19 %	94.80 %	97.88 %	98.50 %	2.34 %	1.50 %	0.01 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>
4	RoadFormer+		98.15 %	95.46 %	98.07 %	98.23 %	2.12 %	1.77 %	0.04 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Huang, J. Li, N. Jia, Y. Sun, C. Liu, Q. Chen and R. Fan: RoadFormer+: Delivering RGB-X Scene Parsing through Scale-Aware Information Decoupling and Advanced Heterogeneous Feature Fusion . IEEE Transactions on Intelligent Vehicles 2024.											
5	RoadFormer		98.15 %	95.60 %	98.07 %	98.23 %	2.13 %	1.77 %	0.07 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>

J. Li, Y. Zhang, P. Yun, G. Zhou, Q. Chen and R. Fan: [RoadFormer: Duplex Transformer for RGB-Normal Semantic Road Scene Parsing](#). IEEE Transactions on Intelligent Vehicles 2024.

6 [SNE-RoadSeg+](#) 98.13 % 95.52 % 98.01 % 98.25 % 2.19 % 1.75 % 0.08 s GPU @ 2.5 Ghz (Python)

H. Wang, R. Fan, P. Cai and M. Liu: [SNE-RoadSeg+: Rethinking depth-normal translation and deep supervision for freespace detection](#). 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2021.

7 [SNE-RoadSegV2](#) 98.10 % 95.63 % 97.98 % 98.22 % 2.23 % 1.78 % 0.03 s GPU @ 2.5 Ghz (Python)


Y. Feng, Y. Ma, Q. Chen, I. Pitas and R. Fan: [SNE-RoadSegV2: Advancing Heterogeneous Feature Fusion and Fallibility Awareness for Freespace Detection](#). 2024.

8 [Pseudo-LiDAR](#) 98.05 % 95.63 % 97.89 % 98.21 % 2.33 % 1.79 % 0.46 s GPU @ 2.5 Ghz (Python)


L. Sun, H. Zhang and W. Yin: [Pseudo-LiDAR-Based Road Detection](#). IEEE Transactions on Circuits and Systems for Video Technology (T-CSVT) 2022.

9 [UdeerLID+](#) 98.02 % 95.50 % 97.80 % 98.25 % 2.43 % 1.75 % 0.01 s 1 core @ 2.5 Ghz (C/C++)

T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: [UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised](#). 2024.

10 [LRDNet+](#)  [code](#) 97.98 % 94.28 % 97.67 % 98.29 % 2.58 % 1.71 % 0.01 s GPU @ 2.5 Ghz (Python)


A. Khan, J. Shao, Y. Rao, L. She and H. Shen: [LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection](#). IEEE Transactions on Multimedia 2025.

11 [LRDNet\(L\)](#)  [code](#) 97.91 % 93.96 % 97.45 % 98.37 % 2.83 % 1.63 % 0.1 s GPU @ 2.5 Ghz (Python)

A. Khan, J. Shao, Y. Rao, L. She and H. Shen: [LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection](#). IEEE Transactions on Multimedia 2025.

12 [UdeerLID](#) 97.90 % 95.58 % 97.64 % 98.17 % 2.61 % 1.83 % 0.01 s 1 core @ 2.5 Ghz (C/C++)


T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: [UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised](#). 2024.

13 [LRDNet\(S\)](#)  [code](#) 97.82 % 94.29 % 97.39 % 98.25 % 2.90 % 1.75 % .009 s GPU @ 2.5 Ghz (Python)

A. Khan, J. Shao, Y. Rao, L. She and H. Shen: [LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection](#). IEEE Transactions on Multimedia 2025.

14 [Evi-RoadSeg](#) [code](#) 97.80 % 95.25 % 97.50 % 98.10 % 2.77 % 1.90 % 0.01 s GPU @ 2.5 Ghz (Python)

F. Xue†, Y. Chang†, W. Xu, W. Liang, F. Sheng and A. Ming: [Evidence-based Real-time Road Segmentation with RGB-D Data Augmentation](#). Transactions on Intelligent Transportation Systems (T-ITS) 2024.

15 [PLARD](#)  [code](#) 97.77 % **95.64** % 97.75 % 97.79 % 2.48 % 2.21 % 0.16 s GPU @ 2.5 Ghz (Python)

Z. Chen, J. Zhang and D. Tao: [Progressive LiDAR adaptation for road detection](#). IEEE/CAA Journal of Automatica Sinica 2019.

16 [USNet](#) [code](#) 97.68 % 95.13 % 97.28 % 98.09 % 3.02 % 1.91 % 0.02 s GPU @ 1.5 Ghz (Python)


Y. Chang, F. Xue, F. Sheng, W. Liang and A. Ming: [Fast Road Segmentation via Uncertainty-aware Symmetric Network](#). IEEE International Conference on Robotics and Automation (ICRA) 2022.

17 [SNE-RoadSeg](#) [code](#) 97.47 % 95.63 % 97.32 % 97.61 % 2.96 % 2.39 % 0.18 s GPU @ 2.5 Ghz (Python)

R. Fan, H. Wang, P. Cai and M. Liu: [SNE-RoadSeg: Incorporating Surface Normal Information into Semantic Segmentation for Accurate Freespace Detection](#). ECCV 2020.

18 [MemRoadNet](#) [code](#) 97.46 % 95.57 % 97.07 % 97.86 % 3.25 % 2.14 % 0.01 s GPU @ 2.5 Ghz (Python)

ERROR: Wrong syntax in BIBTEX file.

19 [3MT-RoadSeg](#)  [code](#) 97.46 % 95.54 % 97.30 % 97.62 % 2.97 % 2.38 % 0.07 s GPU @ 2.5 Ghz (Python)

E. Milli,  Erkent and A. Yilmaz: [Multi-Modal Multi-Task \(3MT\) Road Segmentation](#). IEEE Robotics and Automation Letters 2023.

20 [DFM-RTFNet](#) 97.45 % 95.63 % 97.33 % 97.58 % 2.94 % 2.42 % 0.08 s GPU @ 2.5 Ghz (Python)

H. Wang, R. Fan, Y. Sun and M. Liu: [Dynamic fusion module evolves drivable area and road anomaly detection: A benchmark and algorithms](#). IEEE Transactions on Cybernetics 2021.

21 [RBANet](#) 97.38 % 92.67 % 96.70 % 98.08 % 3.68 % 1.92 % 0.16 s GPU @ 1.5 Ghz (Python + C/C++)

J. Sun, S. Kim, S. Lee, Y. Kim and S. Ko: [Reverse and Boundary Attention Network for Road Segmentation](#). Proceedings of the IEEE International Conference on Computer Vision Workshops 2019.

22	CLCFNet		97.24 %	93.84 %	97.99 %	96.51 %	2.18 %	3.49 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.											
23	LC-CRF		97.08 %	92.06 %	96.03 %	98.16 %	4.46 %	1.84 %	0.18 s	GPU @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Tang, J. Yang and H. Kong: Road Detection through CRF based LiDAR-Camera Fusion . ICRA 2019.											
24	LidCamNet		97.08 %	95.51 %	97.28 %	96.88 %	2.98 %	3.12 %	0.15 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Caltagirone, M. Bellone, L. Svensson and M. Wahde: LIDAR-Camera Fusion for Road Detection Using Fully Convolutional Neural Networks . Robotics and Autonomous Systems 2018.											
25	CLCFNet (LiDAR)		96.88 %	93.71 %	97.85 %	95.94 %	2.32 %	4.06 %	0.02 s	GPU @ 1.5 Ghz (C/C++)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.											
26	NIM-RTFNet		96.79 %	95.61 %	97.03 %	96.54 %	3.25 %	3.46 %	0.05 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, Y. Sun and M. Liu: Applying Surface Normal Information in Drivable Area and Road Anomaly Detection for Ground Mobile Robots . 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2020.											
27	RGB36-Cotrain		96.75 %	95.39 %	96.84 %	96.66 %	3.46 %	3.34 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: Lidar-Camera Co-Training for Semi- Supervised Road Detection . arXiv preprint arXiv:1911.12597 2019.											
28	SSLGAN		96.72 %	92.99 %	97.05 %	96.40 %	3.22 %	3.60 %	700ms	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
X. Han, J. Lu, C. Zhao, S. You and H. Li: Semisupervised and Weakly Supervised Road Detection Based on Generative Adversarial Networks . IEEE Signal Processing Letters 2018.											
29	V2FedR	code	96.61 %	91.12 %	94.99 %	98.29 %	5.70 %	1.71 %	0.05 s	GPU @ >3.5 Ghz (Python)	<input type="checkbox"/>
30	LFD-RoadSeg	code	96.59 %	95.40 %	96.29 %	96.90 %	4.11 %	3.10 %	.004 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
H. Zhou, F. Xue, Y. Li, S. Gong, Y. Li and Y. Zhou: Exploiting Low-Level Representations for Ultra-Fast Road Segmentation . IEEE Transactions on Intelligent Transportation Systems 2024.											
31	TVFNet		96.47 %	93.16 %	97.24 %	95.71 %	2.98 %	4.29 %	0.04 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Yang, J. Alvarez and H. Kong: Two-View Fusion based Convolutional Neural Network for Urban Road Detection . IROS 2019.											
32	BJN		96.29 %	93.98 %	98.14 %	94.52 %	1.97 %	5.48 %	0.02 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
B. Yu, D. Lee, J. Lee and S. Kee: Free Space Detection Using Camera-LiDAR Fusion in a Bird's Eye View Plane . Sensors 2021.											
33	Hadamard-FCN		96.26 %	93.32 %	95.63 %	96.90 %	4.86 %	3.10 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
M. Oeljeklaus: An Integrated Approach for Traffic Scene Understanding from Monocular Cameras . 2021.											
34	StixelNet II		96.22 %	91.24 %	95.13 %	97.33 %	5.48 %	2.67 %	1.2 s	1 core @ 3.0 Ghz (Matlab + C/C++)	<input type="checkbox"/>
N. Garnett, S. Silberstein, S. Oron, E. Fetaya, U. Verner, A. Ayash, V. Goldner, R. Cohen, K. Horn and D. Levi: Real-time category-based and general obstacle detection for autonomous driving . 5th Workshop on Computer Vision for Road Scene Understanding and Autonomous Driving (CVRSUAD'17, IEEE-ICCV 2017 Workshop) 2017.											
35	MultiNet	code	96.15 %	95.36 %	95.79 %	96.51 %	4.67 %	3.49 %	0.17 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
M. Teichmann, M. Weber, J. Zoellner, R. Cipolla and R. Urtasun: MultiNet: Real-time Joint Semantic Reasoning for Autonomous Driving . CoRR 2016.											
36	HA-DeepLabv3+		96.10 %	95.03 %	95.48 %	96.73 %	5.03 %	3.27 %	0.06 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>
R. Fan, H. Wang, P. Cai, J. Wu, M. Bocus, L. Qiao and M. Liu: Learning collision-free space detection from stereo images: Homography matrix brings better data augmentation . IEEE/ASME Transactions on Mechatronics 2021.											
37	RBNet		96.06 %	93.49 %	95.80 %	96.31 %	4.64 %	3.69 %	0.18 s	GPU @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
Z. Chen and Z. Chen: RBNet: A Deep Neural Network for Unified Road and Road Boundary Detection . International Conference on Neural Information Processing 2017.											
38	LoDNN		96.05 %	95.03 %	95.79 %	96.31 %	4.66 %	3.69 %	18 ms	GPU @ 2.5 Ghz (Torch)	<input type="checkbox"/>

L. Caltagirone, S. Scheidegger, L. Svensson and M. Wahde: Fast LIDAR-based Road Detection Using Fully Convolutional Neural Networks . IEEE Intelligent Vehicles Symposium 2017.												
39	TEDNet		code	95.94 %	95.31 %	96.21 %	95.67 %	4.14 %	4.33 %	0.09 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
M. Bayón-Gutiérrez, M. García- Ordás, H. Alaiz Moretón, J. Avelaira-Mata, S. Rubio-Martín and J. Benítez-Andrades: TEDNet: Twin Encoder Decoder Neural Network for 2D Camera and LiDAR Road Detection . Logic Journal of the IGPL 2024.												
40	RoadNet3			95.88 %	95.46 %	96.37 %	95.40 %	3.95 %	4.60 %	300 ms	GPU @ GTX950M (Python +Tensorflow)	<input type="checkbox"/>
Y. Lyu, L. Bai and X. Huang: Road Segmentation using CNN and Distributed LSTM . 2019 IEEE International Symposium on Circuits and Systems (ISCAS) 2019.												
41	Up-Conv-Poly		code	95.52 %	92.86 %	95.37 %	95.67 %	5.10 %	4.33 %	0.08 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
G. Oliveira, W. Burgard and T. Brox: Efficient Deep Methods for Monocular Road Segmentation . IROS 2016.												
42	DEEP-DIG			95.45 %	95.41 %	95.49 %	95.41 %	4.96 %	4.59 %	0.14 s	GPU @ 3.5 Ghz (Python + C/C++)	<input type="checkbox"/>
J. Muñoz-Bulnes, C. Fernandez, I. Parra, D. Fernández-Llorca and M. Sotelo: Deep Fully Convolutional Networks with Random Data Augmentation for Enhanced Generalization in Road Detection . Workshop on Deep Learning for Autonomous Driving on IEEE 20th International Conference on Intelligent Transportation Systems 2017.												
43	OFA Net		code	95.43 %	89.10 %	92.78 %	98.24 %	8.41 %	1.76 %	0.04 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Zhang, Z. Zhang, L. Sun and W. Qin: One For All: A Mutual Enhancement Method for Object Detection and Semantic Segmentation . Applied Sciences 2019.												
44	CLRD			95.41 %	94.83 %	95.23 %	95.59 %	5.26 %	4.41 %	0.05 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
M. Bayón-Gutiérrez, J. Benítez- Andrades, S. Rubio-Martín, J. Avelaira-Mata, H. Alaiz-Moretón and M. García-Ordás: Roadway Detection Using Convolutional Neural Network Through Camera and LiDAR Data . Hybrid Artificial Intelligent Systems 2022.												
45	HID-LS			94.89 %	91.46 %	95.37 %	94.42 %	5.04 %	5.58 %	0.25 s	1 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Yang and H. Kong: Lidar-based urban road detection by histograms of normalized inverse depths and line scanning . EICMR 2017.												
S. Gu, Y. Zhang, X. Yuan, J. Yang, T. Wu and H. Kong: Histograms of the Normalized Inverse Depth and Line Scanning for Urban Road Detection . IEEE Trans. Intelligent Transportation Systems 2019.												
46	ChipNet			94.87 %	91.31 %	95.21 %	94.53 %	5.23 %	5.47 %	12 ms	GPU @ 1.5 Ghz (Keras)	<input type="checkbox"/>
Y. Lyu, L. Bai and X. Huang: ChipNet: Real-Time LiDAR Processing for Drivable Region Segmentation on an FPGA . IEEE Transactions on Circuits and Systems I: Regular Papers 2019.												
47	DDN			94.17 %	92.70 %	96.73 %	91.74 %	3.41 %	8.26 %	2 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
R. Mohan: Deep Deconvolutional Networks for Scene Parsing . 2014.												
48	FCN-LC			94.09 %	90.26 %	94.05 %	94.13 %	6.55 %	5.87 %	0.03 s	GPU Titan X	<input type="checkbox"/>
C. Mendes, V. Frémont and D. Wolf: Exploiting Fully Convolutional Neural Networks for Fast Road Detection . IEEE Conference on Robotics and Automation (ICRA) 2016.												
49	ALO-AVG-MM		code	94.05 %	90.96 %	94.82 %	93.29 %	5.60 %	6.71 %	0.0296 sec	GeForce GTX 1080 GPU (Python)	<input type="checkbox"/>
F. Reis, R. Almeida, E. Kijak, S. Malinowski, S. Guimaraes and Z. Jr.: Combining convolutional side-outputs for road image segmentation . 2019 International Joint Conference on Neural Networks (IJCNN) - \textbf{Accepted} 2019.												
50	RoadNet-RT			93.98 %	95.19 %	94.47 %	93.49 %	6.01 %	6.51 %	8m s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Bai, Y. Lyu and X. Huang: RoadNet-RT: High Throughput CNN Architecture and SoC Design for Real-Time Road Segmentation . arXiv preprint arXiv:2006.07644 2020.												
51	RGB36-Super			93.90 %	94.39 %	94.70 %	93.11 %	5.73 %	6.89 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: Lidar-Camera Co-Training for Semi- Supervised Road Detection . arXiv preprint arXiv:1911.12597 2019.												
52	Up-Conv			93.89 %	92.62 %	94.57 %	93.22 %	5.89 %	6.78 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
G. Oliveira, W. Burgard and T. Brox: Efficient Deep Methods for Monocular Road Segmentation . IROS 2016.												
53	HIM			93.55 %	90.38 %	94.18 %	92.92 %	6.31 %	7.08 %	7 s	>8 cores @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
D. Munoz, J. Bagnell and M. Hebert: Stacked Hierarchical Labeling . European Conference on Computer Vision (ECCV) 2010.												

54	LidarHisto		code	93.32 %	93.19 %	95.39 %	91.34 %	4.85 %	8.66 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Chen, J. Yang and H. Kong: Lidar-histogram for fast road and obstacle detection . 2017 IEEE International Conference on Robotics and Automation (ICRA) 2017.												
55	StixelNet			93.26 %	87.15 %	90.63 %	96.06 %	10.92 %	3.94 %	1 s	GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
D. Levi, N. Garnett and E. Fetaya: StixelNet: A Deep Convolutional Network for Obstacle Detection and Road Segmentation . 26TH British Machine Vision Conference (BMVC) 2015.												
56	FTP			92.98 %	92.89 %	91.84 %	94.15 %	9.20 %	5.85 %	0.28 s	GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: Map-Supervised Road Detection . IEEE Intelligent Vehicles Symposium Proceedings 2016.												
57	MixedCRF			92.75 %	90.24 %	94.03 %	91.50 %	6.39 %	8.50 %	6s	1 core @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
X. Han, H. Wang, J. Lu and C. Zhao: Road detection based on the fusion of Lidar and image data . 2017.												
58	BMCF			92.21 %	87.99 %	91.55 %	92.89 %	9.43 %	7.11 %	2.5 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Wang, T. Wu, Z. Xiao, L. Xiao, D. Zhao and J. Han: Multi-cue road boundary detection using stereo vision . 2016 IEEE International Conference on Vehicular Electronics and Safety (ICVES) 2016.												
59	HybridCRF			91.95 %	86.44 %	94.01 %	89.98 %	6.30 %	10.02 %	1.5 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, R. Wang, B. Dai, Y. Fang, D. Liu and T. Wu: Hybrid conditional random field based camera-LIDAR fusion for road detection . Information Sciences 2018.												
60	PGM-ARS			91.76 %	84.80 %	88.05 %	95.80 %	14.30 %	4.20 %	0.05 s	i74700MQ @ 2.1Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: Fast Pixelwise Road Inference Based on Uniformly Reweighted Belief Propagation . Proc. IEEE Intelligent Vehicles Symposium 2015.												
61	ProbBoost			91.36 %	84.92 %	88.18 %	94.78 %	13.97 %	5.22 %	2.5 min	>8 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, A. Victorino and J. Ferreira: A probabilistic distribution approach for the classification of urban roads in complex environments . Workshop on Modelling, Estimation, Perception and Control of All Terrain Mobile Robots on IEEE International Conference on Robotics and Automation (ICRA) 2014.												
62	NNP			91.34 %	88.65 %	91.07 %	91.60 %	9.87 %	8.40 %	5 s	4 cores @ 2.5 Ghz (Matlab)	<input type="checkbox"/>
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.												
63	multi-task CNN			91.15 %	87.45 %	85.08 %	98.15 %	18.92 %	1.85 %	25.1 ms	GPU @ 2.0 Ghz (Python)	<input type="checkbox"/>
M. Oeljeklaus, F. Hoffmann and T. Bertram: A Fast Multi-Task CNN for Spatial Understanding of Traffic Scenes . IEEE Intelligent Transportation Systems Conference 2018.												
64	SRF			90.77 %	92.44 %	89.35 %	92.23 %	12.08 %	7.77 %	0.2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, B. Dai, D. Liu, D. Zhao and T. Wu: Monocular Road Detection Using Structured Random Forest . Int J Adv Robot Syst 2016.												
65	RES3D-Velo			90.60 %	85.38 %	85.96 %	95.78 %	17.20 %	4.22 %	0.36 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato, D. Wolf and C. Stiller: Road Terrain Detection: Avoiding Common Obstacle Detection Assumptions Using Sensor Fusion . Intelligent Vehicles Symposium (IV) 2014.												
66	CB			90.55 %	85.40 %	92.75 %	88.45 %	7.60 %	11.55 %	2 s	1 core @ 3.4 Ghz (Python) + GPU	<input type="checkbox"/>
C. Mendes, V. Frémont and D. Wolf: Vision-Based Road Detection using Contextual Blocks . 2015.												
67	MAP			89.97 %	92.14 %	87.47 %	92.62 %	14.58 %	7.38 %	0.28s	GPU	<input type="checkbox"/>
A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: Map-Supervised Road Detection . IEEE Intelligent Vehicles Symposium Proceedings 2016.												
68	SPRAY			89.69 %	93.84 %	89.13 %	90.25 %	12.10 %	9.75 %	45 ms	NVIDIA GTX 580 (Python + OpenCL)	<input type="checkbox"/>
T. Kuehnl, F. Kummert and J. Fritsch: Spatial Ray Features for Real-Time Ego-Lane Extraction . Proc. IEEE Intelligent Transportation Systems 2012.												
69	ARSL-AMI			89.56 %	82.82 %	85.87 %	93.59 %	16.93 %	6.41 %	0.05 s	4 cores @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: CRF-based semantic labeling in miniaturized road scenes . Proc. IEEE Intelligent Transportation Systems 2014.												

70	FusedCRF		89.51 %	83.53 %	86.64 %	92.58 %	15.69 %	7.42 %	2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, B. Dai, D. Liu, T. Hu and T. Wu: CRF based Road Detection with Multi-Sensor Fusion . Intelligent Vehicles Symposium (IV) 2015.											
71	BM		89.41 %	80.61 %	83.43 %	96.30 %	21.02 %	3.70 %	2 s	2 cores @ 2.5 Ghz (Matlab)	<input type="checkbox"/>
B. WANG, V. Fremont and S. Rodriguez Florez: Color-based Road Detection and its Evaluation on the KITTI Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application, IEEE Intelligent Vehicles Symposium 2014.											
72	HistonBoost		88.73 %	81.57 %	84.49 %	93.42 %	18.85 %	6.58 %	2.5 min	>8 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, A. Victorino and J. Ferreira: Comprehensive Performance Analysis of Road Detection Algorithms Using the Common Urban Kitti-Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application on IEEE Intelligent Vehicles Symposium (IV) 2014.											
73	geo+gpr+crf		88.20 %	82.33 %	85.32 %	91.27 %	17.26 %	8.73 %	30 s	1 core @ 2.0 Ghz (C/C++)	<input type="checkbox"/>
Z. Xiao, B. Dai, H. Li, T. Wu, X. Xu, Y. Zeng and T. Chen: Gaussian process regression-based robust free space detection for autonomous vehicle by 3-D point cloud and 2-D appearance information fusion . International Journal of Advanced Robotic Systems 2017.											
74	GRES3D+VELO		88.19 %	88.65 %	83.98 %	92.85 %	19.48 %	7.15 %	60 ms	4 cores @ 2.8 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato: Estimation of obstacles and road area with sparse 3D points . 2015.											
75	SCRFPPFHGSP		87.96 %	83.16 %	90.01 %	86.01 %	10.50 %	13.99 %	5 s	8 cores @ 2.5 Ghz (C/C++, Matlab)	<input type="checkbox"/>
I. Gheorghe: Semantic Segmentation of Terrain and Road Terrain for Advanced Driver Assistance Systems . 2015.											
76	GRES3D+SELAS		87.57 %	90.52 %	85.92 %	89.28 %	16.08 %	10.72 %	110 ms	4 core @ 2.8 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato: Estimation of obstacles and road area with sparse 3D points . 2015.											
77	CN		86.21 %	84.40 %	82.85 %	89.86 %	20.45 %	10.14 %	2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Alvarez, T. Gevers, Y. LeCun and A. Lopez: Road Scene Segmentation from a Single Image . ECCV 2012 2012.											
78	RES3D-Stereo		83.62 %	85.74 %	79.81 %	87.81 %	24.42 %	12.19 %	0.7 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato, D. Gomes and D. Wolf: Road estimation with sparse 3D points from stereo data . Intelligent Transportation Systems (ITSC), 2014 IEEE 17th International Conference on 2014.											
79	SPlane		82.28 %	82.83 %	76.85 %	88.53 %	29.32 %	11.47 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.											
80	SPlane + BL		82.04 %	85.56 %	75.11 %	90.39 %	32.93 %	9.61 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.											
81	ANN		80.95 %	68.36 %	69.95 %	96.05 %	45.35 %	3.95 %	3 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, D. Lima, A. Victorino and J. Ferreira: A 2D/3D Vision Based Approach Applied to Road Detection in Urban Environments . Intelligent Vehicles Symposium (IV), 2013 IEEE 2013.											

[Table as LaTeX](#) | [Only published Methods](#)

UU_ROAD

Method	Setting	Code	MaxF	AP	PRE	REC	FPR	FNR	Runtime	Environment	Compare
1	SNE-RoadSegV2		97.08 %	92.87 %	96.83 %	97.34 %	1.04 %	2.66 %	0.03 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
Y. Feng, Y. Ma, Q. Chen, I. Pitas and R. Fan: SNE-RoadSegV2: Advancing Heterogeneous Feature Fusion and Fallibility Awareness for Freespace Detection . 2024.											
2	UdeerLID+		97.07 %	93.04 %	97.19 %	96.95 %	0.91 %	3.05 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised . 2024.											
3	SNE-RoadSeg+		97.04 %	92.97 %	96.84 %	97.24 %	1.03 %	2.76 %	0.08 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, P. Cai and M. Liu: SNE-RoadSeg+: Rethinking depth-normal translation and deep supervision for freespace detection . 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2021.											

4	RoadFormer+		97.02 %	92.33 %	96.75 %	97.29 %	1.06 %	2.71 %	0.04 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Huang, J. Li, N. Jia, Y. Sun, C. Liu, Q. Chen and R. Fan: RoadFormer+: Delivering RGB-X Scene Parsing through Scale-Aware Information Decoupling and Advanced Heterogeneous Feature Fusion . IEEE Transactions on Intelligent Vehicles 2024.											
5	RoadFormer		97.02 %	92.78 %	96.61 %	97.43 %	1.12 %	2.57 %	0.07 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
J. Li, Y. Zhang, P. Yun, G. Zhou, Q. Chen and R. Fan: RoadFormer: Duplex Transformer for RGB-Normal Semantic Road Scene Parsing . IEEE Transactions on Intelligent Vehicles 2024.											
6	Pseudo-LiDAR		96.93 %	93.08 %	96.78 %	97.09 %	1.05 %	2.91 %	0.46 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Sun, H. Zhang and W. Yin: Pseudo-LiDAR-Based Road Detection . IEEE Transactions on Circuits and Systems for Video Technology (T-CSVT) 2022.											
7	GLoDeR		96.93 %	91.00 %	96.38 %	97.49 %	1.19 %	2.51 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
8	LiDAR-DHMT		96.91 %	91.17 %	96.53 %	97.30 %	1.14 %	2.70 %	0.01 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>
9	DiPFormer		96.83 %	91.21 %	96.57 %	97.09 %	1.12 %	2.91 %	0.01 s	1 GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
S. Chen, T. Han, C. Zhang, W. Liu, J. Su, Z. Wang and G. Cai: Depth Matters: Exploring Deep Interactions of RGB-D for Semantic Segmentation in Traffic Scenes . arXiv preprint arXiv:2409.07995 2024.											
10	Evi-RoadSeg	code	96.52 %	92.43 %	95.94 %	97.10 %	1.34 %	2.90 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
F. Xue†, Y. Chang†, W. Xu, W. Liang, F. Sheng and A. Ming: Evidence-based Real-time Road Segmentation with RGB-D Data Augmentation . Transactions on Intelligent Transportation Systems (T-ITS) 2024.											
11	UdeerLID		96.32 %	92.99 %	96.20 %	96.44 %	1.24 %	3.56 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised . 2024.											
12	DFM-RTFNet		96.26 %	93.01 %	96.16 %	96.35 %	1.25 %	3.65 %	0.08 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, Y. Sun and M. Liu: Dynamic fusion module evolves drivable area and road anomaly detection: A benchmark and algorithms . IEEE Transactions on Cybernetics 2021.											
13	LRDNet+	 code	96.18 %	90.03 %	95.94 %	96.42 %	1.33 %	3.58 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
14	USNet	code	96.11 %	91.71 %	95.86 %	96.37 %	1.36 %	3.63 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
Y. Chang, F. Xue, F. Sheng, W. Liang and A. Ming: Fast Road Segmentation via Uncertainty-aware Symmetric Network . IEEE International Conference on Robotics and Automation (ICRA) 2022.											
15	LRDNet (L)	 code	96.10 %	89.59 %	95.97 %	96.22 %	1.32 %	3.78 %	0.1 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
16	SNE-RoadSeg	code	96.03 %	93.03 %	96.22 %	95.83 %	1.23 %	4.17 %	0.18 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
R. Fan, H. Wang, P. Cai and M. Liu: SNE-RoadSeg: Incorporating Surface Normal Information into Semantic Segmentation for Accurate Freespace Detection . ECCV 2020.											
17	PLARD	 code	95.95 %	95.25 %	96.25 %	95.65 %	1.21 %	4.35 %	0.16 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
Z. Chen, J. Zhang and D. Tao: Progressive LiDAR adaptation for road detection . IEEE/CAA Journal of Automatica Sinica 2019.											
18	LRDNet(S)	 code	95.78 %	90.75 %	95.62 %	95.95 %	1.43 %	4.05 %	.009 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
19	CLCFNet	 code	95.68 %	88.37 %	94.75 %	96.63 %	1.75 %	3.37 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.											
20	3MT-RoadSeg	 code	95.63 %	92.77 %	95.37 %	95.89 %	1.52 %	4.11 %	0.07 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
E. Milli,  Erkent and A. Yilmaz: Multi-Modal Multi-Task (3MT) Road Segmentation . IEEE Robotics and Automation Letters 2023.											

21	MemRoadNet	code	95.37 %	92.76 %	95.08 %	95.66 %	1.61 %	4.34 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
ERROR: Wrong syntax in BIBTEX file.											
22	CLCFNet (LiDAR)		95.25 %	88.02 %	94.36 %	96.16 %	1.87 %	3.84 %	0.02 s	GPU @ 1.5 Ghz (C/C++)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.											
23	NIM-RTFNet		95.11 %	92.94 %	95.91 %	94.32 %	1.31 %	5.68 %	0.05 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, Y. Sun and M. Liu: Applying Surface Normal Information in Drivable Area and Road Anomaly Detection for Ground Mobile Robots . 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2020.											
24	RBA.Net		94.91 %	86.35 %	92.53 %	97.42 %	2.56 %	2.58 %	0.16 s	GPU @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
J. Sun, S. Kim, S. Lee, Y. Kim and S. Ko: Reverse and Boundary Attention Network for Road Segmentation . Proceedings of the IEEE International Conference on Computer Vision Workshops 2019.											
25	LidCamNet		94.54 %	92.74 %	94.64 %	94.45 %	1.74 %	5.55 %	0.15 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Caltagirone, M. Bellone, L. Svensson and M. Wahde: LIDAR-Camera Fusion for Road Detection Using Fully Convolutional Neural Networks . Robotics and Autonomous Systems 2018.											
26	RGB36-Cotrain		94.53 %	92.54 %	94.60 %	94.46 %	1.76 %	5.54 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: Lidar-Camera Co-Training for Semi- Supervised Road Detection . arXiv preprint arXiv:1911.12597 2019.											
27	SSLGAN		94.40 %	87.84 %	94.17 %	94.63 %	1.91 %	5.37 %	700ms	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
X. Han, J. Lu, C. Zhao, S. You and H. Li: Semisupervised and Weakly Supervised Road Detection Based on Generative Adversarial Networks . IEEE Signal Processing Letters 2018.											
28	V2FedR	code	94.07 %	86.50 %	92.69 %	95.49 %	2.45 %	4.51 %	0.05 s	GPU @ >3.5 Ghz (Python)	<input type="checkbox"/>
29	LC-CRF		94.01 %	85.24 %	91.31 %	96.88 %	3.00 %	3.12 %	0.18 s	GPU @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Tang, J. Yang and H. Kong: Road Detection through CRF based LiDAR-Camera Fusion . ICRA 2019.											
30	MultiNet	code	93.69 %	92.55 %	94.24 %	93.14 %	1.85 %	6.86 %	0.17 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
M. Teichmann, M. Weber, J. Zoellner, R. Cipolla and R. Urtasun: MultiNet: Real-time Joint Semantic Reasoning for Autonomous Driving . CoRR 2016.											
31	TVFNet		93.65 %	87.57 %	93.87 %	93.43 %	1.99 %	6.57 %	0.04 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Yang, J. Alvarez and H. Kong: Two-View Fusion based Convolutional Neural Network for Urban Road Detection . IROS 2019.											
32	LFD-RoadSeg	code	93.49 %	92.19 %	93.46 %	93.52 %	2.13 %	6.48 %	.004 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
H. Zhou, F. Xue, Y. Li, S. Gong, Y. Li and Y. Zhou: Exploiting Low-Level Representations for Ultra-Fast Road Segmentation . IEEE Transactions on Intelligent Transportation Systems 2024.											
33	StixelNet II		93.40 %	85.01 %	91.05 %	95.87 %	3.07 %	4.13 %	1.2 s	1 core @ 3.0 Ghz (Matlab + C/C++)	<input type="checkbox"/>
N. Garnett, S. Silberstein, S. Oron, E. Fetaya, U. Verner, A. Ayash, V. Goldner, R. Cohen, K. Horn and D. Levi: Real-time category-based and general obstacle detection for autonomous driving . 5th Workshop on Computer Vision for Road Scene Understanding and Autonomous Driving (CVRSUAD'17, IEEE-ICCV 2017 Workshop) 2017.											
34	HA-DeepLaby3+		93.24 %	91.83 %	93.19 %	93.28 %	2.22 %	6.72 %	0.06 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>
R. Fan, H. Wang, P. Cai, J. Wu, M. Bocus, L. Qiao and M. Liu: Learning collision-free space detection from stereo images: Homography matrix brings better data augmentation . IEEE/ASME Transactions on Mechatronics 2021.											
35	RBNet		93.21 %	89.18 %	92.81 %	93.60 %	2.36 %	6.40 %	0.18 s	GPU @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
Z. Chen and Z. Chen: RBNet: A Deep Neural Network for Unified Road and Road Boundary Detection . International Conference on Neural Information Processing 2017.											
36	Hadamard-FCN		93.14 %	90.00 %	93.31 %	92.98 %	2.17 %	7.02 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
M. Oeljeklaus: An Integrated Approach for Traffic Scene Understanding from Monocular Cameras . 2021.											
37	BJN		93.13 %	87.59 %	93.89 %	92.38 %	1.96 %	7.62 %	0.02 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>

B. Yu, D. Lee, J. Lee and S. Kee: [Free Space Detection Using Camera-LiDAR Fusion in a Bird's Eye View Plane](#). Sensors 2021.

38 [RoadNet3](#) 92.95 91.93 93.32 92.58 2.16 % 7.42 % 300 ms GPU @ GTX950M (Python +Tensorflow)

Y. Lyu, L. Bai and X. Huang: [Road Segmentation using CNN and Distributed LSTM](#). 2019 IEEE International Symposium on Circuits and Systems (ISCAS) 2019.

39 [ChipNet](#) 92.91 84.95 90.98 94.91 3.06 % 5.09 % 12 ms GPU @ 1.5 Ghz (Keras)

Y. Lyu, L. Bai and X. Huang: [ChipNet: Real-Time LiDAR Processing for Drivable Region Segmentation on an FPGA](#). IEEE Transactions on Circuits and Systems I: Regular Papers 2019.

40 [TEDNet](#) [code](#) 92.78 91.08 91.86 93.71 2.71 % 6.29 % 0.09 s GPU @ 2.5 Ghz (Python)

M. Bayón-Gutiérrez, M. García- Ordás, H. Alaiz Moretón, J. Aveleira-Mata, S. Rubio-Martín and J. Benítez-Andrades: [TEDNet: Twin Encoder Decoder Neural Network for 2D Camera and LiDAR Road Detection](#). Logic Journal of the IGPL 2024.

41 [Up-Conv-Poly](#) [code](#) 92.65 89.20 92.85 92.45 2.32 % 7.55 % 0.08 s GPU @ 2.5 Ghz (Python + C/C++)

G. Oliveira, W. Burgard and T. Brox: [Efficient Deep Methods for Monocular Road Segmentation](#). IROS 2016.

42 [OFA Net](#) [code](#) 92.62 83.12 88.97 96.58 3.90 % 3.42 % 0.04 s GPU @ 1.5 Ghz (Python)

S. Zhang, Z. Zhang, L. Sun and W. Qin: [One For All: A Mutual Enhancement Method for Object Detection and Semantic Segmentation](#). Applied Sciences 2019.

43 [CLR D](#) 92.41 90.16 92.30 92.52 2.52 % 7.48 % 0.05 s GPU @ 2.5 Ghz (Python)

M. Bayón-Gutiérrez, J. Benítez- Andrades, S. Rubio-Martín, J. Aveleira-Mata, H. Alaiz-Moretón and M. García-Ordás: [Roadway Detection Using Convolutional Neural Network Through Camera and LiDAR Data](#). Hybrid Artificial Intelligent Systems 2022.

44 [LoDNN](#) 92.29 90.35 90.81 93.81 3.09 % 6.19 % 18 ms GPU @ 2.5 Ghz (Torch)

L. Caltagirone, S. Scheidegger, L. Svensson and M. Wahde: [Fast LIDAR-based Road Detection Using Fully Convolutional Neural Networks](#). IEEE Intelligent Vehicles Symposium 2017.

45 [Up-Conv](#) 91.89 89.44 92.59 91.20 2.38 % 8.80 % 0.05 s GPU @ 2.5 Ghz (C/C++)

G. Oliveira, W. Burgard and T. Brox: [Efficient Deep Methods for Monocular Road Segmentation](#). IROS 2016.

46 [DDN](#) 91.76 86.84 93.06 90.50 2.20 % 9.50 % 2 s GPU @ 2.5 Ghz (Python + C/C++)

R. Mohan: [Deep Deconvolutional Networks for Scene Parsing](#). 2014.

47 [DEEP-DIG](#) 91.27 91.77 91.32 91.22 2.82 % 8.78 % 0.14 s GPU @ 3.5 Ghz (Python + C/C++)

J. Muñoz-Bulnes, C. Fernandez, I. Parra, D. Fernández-Llorca and M. Sotelo: [Deep Fully Convolutional Networks with Random Data Augmentation for Enhanced Generalization in Road Detection](#). Workshop on Deep Learning for Autonomous Driving on IEEE 20th International Conference on Intelligent Transportation Systems 2017.

48 [RGB36-Super](#) 91.15 90.16 89.68 92.68 3.48 % 7.32 % 0.1 s 1 core @ 2.5 Ghz (C/C++)

L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: [Lidar-Camera Co-Training for Semi- Supervised Road Detection](#). arXiv preprint arXiv:1911.12597 2019.

49 [RoadNet-RT](#) 90.79 91.67 91.79 89.80 2.62 % 10.20 % 8m s GPU @ 2.5 Ghz (Python)

L. Bai, Y. Lyu and X. Huang: [RoadNet-RT: High Throughput CNN Architecture and SoC Design for Real-Time Road Segmentation](#). arXiv preprint arXiv:2006.07644 2020.

50 [HID-LS](#) 89.81 82.33 88.11 91.58 4.03 % 8.42 % 0.25 s 1 cores @ 3.0 Ghz (C/C++)

S. Gu, Y. Zhang, J. Yang and H. Kong: [Lidar-based urban road detection by histograms of normalized inverse depths and line scanning](#). ECMR 2017.

S. Gu, Y. Zhang, X. Yuan, J. Yang, T. Wu and H. Kong: [Histograms of the Normalized Inverse Depth and Line Scanning for Urban Road Detection](#). IEEE Trans. Intelligent Transportation Systems 2019.

51 [FTP](#) 89.62 88.93 89.10 90.14 3.59 % 9.86 % 0.28 s GPU @ 2.5 Ghz (C/C++)

A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: [Map-Supervised Road Detection](#). IEEE Intelligent Vehicles Symposium Proceedings 2016.

52 [ALO-AVG-MM](#) [code](#) 89.45 79.87 85.40 93.90 5.23 % 6.10 % 0.0296 sec GeForce GTX 1080 GPU (Python)

F. Reis, R. Almeida, E. Kijak, S. Malinowski, S. Guimaraes and Z. Jr.: [Combining convolutional side-outputs for road image segmentation](#). 2019 International Joint Conference on Neural Networks (IJCNN) - ttextbfAccepted 2019.

53	HybridCRF		88.53 %	80.79 %	86.41 %	90.76 %	4.65 %	9.24 %	1.5 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	
L. Xiao, R. Wang, B. Dai, Y. Fang, D. Liu and T. Wu: Hybrid conditional random field based camera-LIDAR fusion for road detection . Information Sciences 2018.												
54	LidarHisto		code	86.55 %	81.13 %	90.71 %	82.75 %	2.76 %	17.25 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Chen, J. Yang and H. Kong: Lidar-histogram for fast road and obstacle detection . 2017 IEEE International Conference on Robotics and Automation (ICRA) 2017.												
55	FCN-LC		86.27 %	75.37 %	86.65 %	85.89 %	4.31 %	14.11 %	0.03 s	GPU Titan X	<input type="checkbox"/>	
C. Mendes, V. Frémont and D. Wolf: Exploiting Fully Convolutional Neural Networks for Fast Road Detection . IEEE Conference on Robotics and Automation (ICRA) 2016.												
56	CB		86.13 %	75.21 %	86.47 %	85.80 %	4.38 %	14.20 %	2 s	1 core @ 3.4 Ghz (Python) + GPU	<input type="checkbox"/>	
C. Mendes, V. Frémont and D. Wolf: Vision-Based Road Detection using Contextual Blocks . 2015.												
57	StixelNet		86.06 %	72.05 %	82.61 %	89.82 %	6.16 %	10.18 %	1 s	GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	
D. Levi, N. Garnett and E. Fetaya: StixelNet: A Deep Convolutional Network for Obstacle Detection and Road Segmentation . 26TH British Machine Vision Conference (BMVC) 2015.												
58	HIM		85.76 %	76.18 %	87.65 %	83.95 %	3.86 %	16.05 %	7 s	>8 cores @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>	
D. Munoz, J. Bagnell and M. Hebert: Stacked Hierarchical Labeling . European Conference on Computer Vision (ECCV) 2010.												
59	MixedCRF		85.69 %	75.12 %	80.17 %	92.02 %	7.42 %	7.98 %	6s	1 core @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>	
X. Han, H. Wang, J. Lu and C. Zhao: Road detection based on the fusion of Lidar and image data . 2017.												
60	NNP		85.55 %	76.90 %	85.36 %	85.75 %	4.79 %	14.25 %	5 s	4 cores @ 2.5 Ghz (Matlab)	<input type="checkbox"/>	
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.												
61	BMCF		85.46 %	74.07 %	85.06 %	85.86 %	4.91 %	14.14 %	2.5 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	
L. Wang, T. Wu, Z. Xiao, L. Xiao, D. Zhao and J. Han: Multi-cue road boundary detection using stereo vision . 2016 IEEE International Conference on Vehicular Electronics and Safety (ICVES) 2016.												
62	FusedCRF		84.49 %	72.35 %	77.13 %	93.40 %	9.02 %	6.60 %	2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	
L. Xiao, B. Dai, D. Liu, T. Hu and T. Wu: CRF based Road Detection with Multi-Sensor Fusion . Intelligent Vehicles Symposium (IV) 2015.												
63	MAP		84.44 %	87.17 %	83.66 %	85.23 %	5.42 %	14.77 %	0.28s	GPU	<input type="checkbox"/>	
A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: Map-Supervised Road Detection . IEEE Intelligent Vehicles Symposium Proceedings 2016.												
64	GRES3D+VELO		84.14 %	80.20 %	80.57 %	88.03 %	6.92 %	11.97 %	60 ms	4 cores @ 2.8 Ghz (C/C++)	<input type="checkbox"/>	
P. Shinzato: Estimation of obstacles and road area with sparse 3D points . 2015.												
65	RES3D-Velo		83.63 %	72.58 %	77.38 %	90.97 %	8.67 %	9.03 %	0.36 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	
P. Shinzato, D. Wolf and C. Stiller: Road Terrain Detection: Avoiding Common Obstacle Detection Assumptions Using Sensor Fusion . Intelligent Vehicles Symposium (IV) 2014.												
66	SPRAY		82.71 %	87.19 %	82.16 %	83.26 %	5.89 %	16.74 %	45 ms	NVIDIA GTX 580 (Python + OpenCL)	<input type="checkbox"/>	
T. Kuehnl, F. Kummert and J. Fritsch: Spatial Ray Features for Real-Time Ego-Lane Extraction . Proc. IEEE Intelligent Transportation Systems 2012.												
67	GRES3D+SELAS		82.70 %	83.95 %	78.54 %	87.32 %	7.77 %	12.68 %	110 ms	4 core @ 2.8 Ghz (C/C++)	<input type="checkbox"/>	
P. Shinzato: Estimation of obstacles and road area with sparse 3D points . 2015.												
68	geo+gpr+crf		81.00 %	69.74 %	79.78 %	82.27 %	6.79 %	17.73 %	30 s	1 core @ 2.0 Ghz (C/C++)	<input type="checkbox"/>	
Z. Xiao, B. Dai, H. Li, T. Wu, X. Xu, Y. Zeng and T. Chen: Gaussian process regression-based robust free space detection for autonomous vehicle by 3-D point cloud and 2-D appearance information fusion . International Journal of Advanced Robotic Systems 2017.												
69	SCRFPPFHGSP		80.78 %	70.80 %	81.07 %	80.50 %	6.13 %	19.50 %	5 s	8 cores @ 2.5 Ghz (C/C++, Matlab)	<input type="checkbox"/>	
I. Gheorghe: Semantic Segmentation of Terrain and Road Terrain for Advanced Driver Assistance Systems . 2015.												

70	ProbBoost		80.76 %	68.70 %	85.25 %	76.72 %	4.33 %	23.28 %	2.5 min	>8 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, A. Victorino and J. Ferreira: A probabilistic distribution approach for the classification of urban roads in complex environments . Workshop on Modelling, Estimation, Perception and Control of All Terrain Mobile Robots on IEEE International Conference on Robotics and Automation (ICRA) 2014.											
71	multi-task CNN		80.45 %	75.87 %	68.63 %	97.19 %	14.48 %	2.81 %	25.1 ms	GPU @ 2.0 Ghz (Python)	<input type="checkbox"/>
M. Oeljeklaus, F. Hoffmann and T. Bertram: A Fast Multi-Task CNN for Spatial Understanding of Traffic Scenes . IEEE Intelligent Transportation Systems Conference 2018.											
72	PGM-ARS		79.94 %	67.77 %	77.37 %	82.67 %	7.88 %	17.33 %	0.05 s	i74700MQ @ 2.1Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: Fast Pixelwise Road Inference Based on Uniformly Reweighted Belief Propagation . Proc. IEEE Intelligent Vehicles Symposium 2015.											
73	RES3D-Stereo		78.75 %	73.60 %	77.63 %	79.90 %	7.50 %	20.10 %	0.7 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato, D. Gomes and D. Wolf: Road estimation with sparse 3D points from stereo data . Intelligent Transportation Systems (ITSC), 2014 IEEE 17th International Conference on 2014.											
74	BM		78.43 %	62.46 %	70.87 %	87.80 %	11.76 %	12.20 %	2 s	2 cores @ 2.5 Ghz (Matlab)	<input type="checkbox"/>
B. WANG, V. Fremont and S. Rodriguez Florez: Color-based Road Detection and its Evaluation on the KITTI Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application, IEEE Intelligent Vehicles Symposium 2014.											
75	SRF		76.07 %	79.97 %	71.47 %	81.31 %	10.57 %	18.69 %	0.2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, B. Dai, D. Liu, D. Zhao and T. Wu: Monocular Road Detection Using Structured Random Forest . Int J Adv Robot Syst 2016.											
76	HistonBoost		74.19 %	63.01 %	77.43 %	71.22 %	6.77 %	28.78 %	2.5 min	>8 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, A. Victorino and J. Ferreira: Comprehensive Performance Analysis of Road Detection Algorithms Using the Common Urban Kitti-Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application on IEEE Intelligent Vehicles Symposium (IV) 2014.											
77	SPlane + BL		74.02 %	79.61 %	65.15 %	85.68 %	14.93 %	14.32 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.											
78	SPlane		73.30 %	69.11 %	65.39 %	83.38 %	14.38 %	16.62 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.											
79	CN		72.25 %	66.61 %	71.96 %	72.54 %	9.21 %	27.46 %	2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Alvarez, T. Gevers, Y. LeCun and A. Lopez: Road Scene Segmentation from a Single Image . ECCV 2012 2012.											
80	ARSL-AMI		70.33 %	61.97 %	83.33 %	60.84 %	3.97 %	39.16 %	0.05 s	4 cores @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: CRF-based semantic labeling in miniaturized road scenes . Proc. IEEE Intelligent Transportation Systems 2014.											
81	ANN		54.07 %	36.61 %	39.28 %	86.69 %	43.67 %	13.31 %	3 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, D. Lima, A. Victorino and J. Ferreira: A 2D/3D Vision Based Approach Applied to Road Detection in Urban Environments . Intelligent Vehicles Symposium (IV), 2013 IEEE 2013.											

[Table as LaTeX](#) | [Only published Methods](#)







URBAN_ROAD

Method	Setting	Code	MaxF	AP	PRE	REC	FPR	FNR	Runtime	Environment	Compare
1	GLoDeR		97.60 %	92.89 %	97.29 %	97.91 %	1.50 %	2.09 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
2	LiDAR-DHMT		97.59 %	92.93 %	97.33 %	97.84 %	1.48 %	2.16 %	0.01 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>
3	DiPFormer		97.57 %	92.94 %	97.34 %	97.79 %	1.47 %	2.21 %	0.01 s	1 GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>




S. Chen, T. Han, C. Zhang, W. Liu, J. Su, Z. Wang and G. Cai: [Depth Matters: Exploring Deep Interactions of RGB-D for Semantic Segmentation in Traffic Scenes](#). arXiv preprint arXiv:2409.07995 2024.

4	RoadFormer+		97.56 %	93.74 %	97.43 %	97.69 %	1.42 %	2.31 %	0.04 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Huang, J. Li, N. Jia, Y. Sun, C. Liu, Q. Chen and R. Fan: RoadFormer+: Delivering RGB-X Scene Parsing through Scale-Aware Information Decoupling and Advanced Heterogeneous Feature Fusion . IEEE Transactions on Intelligent Vehicles 2024.											
5	UdeerLID+		97.55 %	93.98 %	97.46 %	97.65 %	1.40 %	2.35 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised . 2024.											
6	SNE-RoadSegV2		97.55 %	93.98 %	97.57 %	97.53 %	1.34 %	2.47 %	0.03 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
Y. Feng, Y. Ma, Q. Chen, I. Pitas and R. Fan: SNE-RoadSegV2: Advancing Heterogeneous Feature Fusion and Fallibility Awareness for Freespace Detection . 2024.											
7	RoadFormer		97.50 %	93.85 %	97.16 %	97.84 %	1.57 %	2.16 %	0.07 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
J. Li, Y. Zhang, P. Yun, G. Zhou, Q. Chen and R. Fan: RoadFormer: Duplex Transformer for RGB-Normal Semantic Road Scene Parsing . IEEE Transactions on Intelligent Vehicles 2024.											
8	SNE-RoadSeg+		97.50 %	93.98 %	97.41 %	97.58 %	1.43 %	2.42 %	0.08 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, P. Cai and M. Liu: SNE-RoadSeg+: Rethinking depth-normal translation and deep supervision for freespace detection . 2021 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2021.											
9	Pseudo-LiDAR		97.42 %	94.09 %	97.30 %	97.54 %	1.49 %	2.46 %	0.46 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Sun, H. Zhang and W. Yin: Pseudo-LiDAR-Based Road Detection . IEEE Transactions on Circuits and Systems for Video Technology (T-CSVT) 2022.											
10	UdeerLID		97.22 %	94.02 %	97.15 %	97.29 %	1.57 %	2.71 %	0.01 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
T. Ni, X. Zhan, T. Luo, W. Liu, Z. Shi and J. Chen: UdeerLID+: Integrating LiDAR, Image, and Relative Depth with Semi-Supervised . 2024.											
11	Evi-RoadSeg	code	97.08 %	93.54 %	96.57 %	97.59 %	1.91 %	2.41 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
F. Xue†, Y. Chang†, W. Xu, W. Liang, F. Sheng and A. Ming: Evidence-based Real-time Road Segmentation with RGB-D Data Augmentation . Transactions on Intelligent Transportation Systems (T-ITS) 2024.											
12	PLARD	 code	97.03 %	94.03 %	97.19 %	96.88 %	1.54 %	3.12 %	0.16 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
Z. Chen, J. Zhang and D. Tao: Progressive LiDAR adaptation for road detection . IEEE/CAA Journal of Automatica Sinica 2019.											
13	LRDNet+	 code	96.95 %	92.22 %	96.88 %	97.02 %	1.72 %	2.98 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
14	USNet	code	96.89 %	93.25 %	96.51 %	97.27 %	1.94 %	2.73 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
Y. Chang, F. Xue, F. Sheng, W. Liang and A. Ming: Fast Road Segmentation via Uncertainty-aware Symmetric Network . IEEE International Conference on Robotics and Automation (ICRA) 2022.											
15	LRDNet(L)	 code	96.87 %	91.91 %	96.73 %	97.01 %	1.81 %	2.99 %	0.1 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
16	DFM-RTFNet		96.78 %	94.05 %	96.62 %	96.93 %	1.87 %	3.07 %	0.08 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, Y. Sun and M. Liu: Dynamic fusion module evolves drivable area and road anomaly detection: A benchmark and algorithms . IEEE Transactions on Cybernetics 2021.											
17	SNE-RoadSeg	code	96.75 %	94.07 %	96.90 %	96.61 %	1.70 %	3.39 %	0.18 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
R. Fan, H. Wang, P. Cai and M. Liu: SNE-RoadSeg: Incorporating Surface Normal Information into Semantic Segmentation for Accurate Freespace Detection . ECCV 2020.											
18	LRDNet(S)	 code	96.74 %	92.54 %	96.79 %	96.69 %	1.76 %	3.31 %	.009 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
A. Khan, J. Shao, Y. Rao, L. She and H. Shen: LRDNet: Lightweight LiDAR Aided Cascaded Feature Pools for Free Road Space Detection . IEEE Transactions on Multimedia 2025.											
19	MemRoadNet	code	96.66 %	93.95 %	96.46 %	96.87 %	1.96 %	3.13 %	0.01 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>

ERROR: Wrong syntax in BIBTEX file.

20	3MT-RoadSeg		code	96.60 %	93.90 %	96.46 %	96.73 %	1.95 %	3.27 %	0.07 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
E. Milli,  , Erkent and A. Yilmaz: Multi-Modal Multi-Task (3MT) Road Segmentation . IEEE Robotics and Automation Letters 2023.												
21	CLCFNet			96.38 %	90.85 %	96.38 %	96.39 %	1.99 %	3.61 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.												
22	RBA.Net			96.30 %	89.72 %	95.14 %	97.50 %	2.75 %	2.50 %	0.16 s	GPU @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
J. Sun, S. Kim, S. Lee, Y. Kim and S. Ko: Reverse and Boundary Attention Network for Road Segmentation . Proceedings of the IEEE International Conference on Computer Vision Workshops 2019.												
23	LidCamNet			96.03 %	93.93 %	96.23 %	95.83 %	2.07 %	4.17 %	0.15 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
L. Caltagirone, M. Bellone, L. Svensson and M. Wahde: LiDAR-Camera Fusion for Road Detection Using Fully Convolutional Neural Networks . Robotics and Autonomous Systems 2018.												
24	NIM-RTFNet			96.02 %	94.01 %	96.43 %	95.62 %	1.95 %	4.38 %	0.05 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
H. Wang, R. Fan, Y. Sun and M. Liu: Applying Surface Normal Information in Drivable Area and Road Anomaly Detection for Ground Mobile Robots . 2020 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2020.												
25	CLCFNet (LiDAR)			95.97 %	90.61 %	96.12 %	95.82 %	2.13 %	4.18 %	0.02 s	GPU @ 1.5 Ghz (C/C++)	<input type="checkbox"/>
S. Gu, J. Yang and H. Kong: A Cascaded LiDAR-Camera Fusion Network for Road Detection . ICRA 2021.												
26	LC-CRF			95.68 %	88.34 %	93.62 %	97.83 %	3.67 %	2.17 %	0.18 s	GPU @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Tang, J. Yang and H. Kong: Road Detection through CRF based LiDAR-Camera Fusion . ICRA 2019.												
27	V2FedR		code	95.58 %	88.81 %	94.14 %	97.07 %	3.33 %	2.93 %	0.05 s	GPU @ >3.5 Ghz (Python)	<input type="checkbox"/>
28	RGB36-Cotrain			95.55 %	93.71 %	95.68 %	95.42 %	2.37 %	4.58 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: Lidar-Camera Co-Training for Semi- Supervised Road Detection . arXiv preprint arXiv:1911.12597 2019.												
29	SSLGAN			95.53 %	90.35 %	95.84 %	95.24 %	2.28 %	4.76 %	700ms	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
X. Han, J. Lu, C. Zhao, S. You and H. Li: Semisupervised and Weakly Supervised Road Detection Based on Generative Adversarial Networks . IEEE Signal Processing Letters 2018.												
30	TVFNet			95.34 %	90.26 %	95.73 %	94.94 %	2.33 %	5.06 %	0.04 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Yang, J. Alvarez and H. Kong: Two-View Fusion based Convolutional Neural Network for Urban Road Detection . IROS 2019.												
31	LFD-RoadSeg		code	95.21 %	93.71 %	95.35 %	95.08 %	2.56 %	4.92 %	.004 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
H. Zhou, F. Xue, Y. Li, S. Gong, Y. Li and Y. Zhou: Exploiting Low-Level Representations for Ultra-Fast Road Segmentation . IEEE Transactions on Intelligent Transportation Systems 2024.												
32	RBNet			94.97 %	91.49 %	94.94 %	95.01 %	2.79 %	4.99 %	0.18 s	GPU @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
Z. Chen and Z. Chen: RBNet: A Deep Neural Network for Unified Road and Road Boundary Detection . International Conference on Neural Information Processing 2017.												
33	BJN			94.89 %	90.63 %	96.14 %	93.67 %	2.07 %	6.33 %	0.02 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
B. Yu, D. Lee, J. Lee and S. Kee: Free Space Detection Using Camera-LiDAR Fusion in a Bird's Eye View Plane . Sensors 2021.												
34	StixelNet II			94.88 %	87.75 %	92.97 %	96.87 %	4.04 %	3.13 %	1.2 s	1 core @ 3.0 Ghz (Matlab + C/C++)	<input type="checkbox"/>
N. Garnett, S. Silberstein, S. Oron, E. Fetaya, U. Verner, A. Ayash, V. Goldner, R. Cohen, K. Horn and D. Levi: Real-time category-based and general obstacle detection for autonomous driving . 5th Workshop on Computer Vision for Road Scene Understanding and Autonomous Driving (CVRSUAD'17, IEEE-ICCV 2017 Workshop) 2017.												
35	MultiNet		code	94.88 %	93.71 %	94.84 %	94.91 %	2.85 %	5.09 %	0.17 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
M. Teichmann, M. Weber, J. Zoellner, R. Cipolla and R. Urtasun: MultiNet: Real-time Joint Semantic Reasoning for Autonomous Driving . CoRR 2016.												
36	Hadamard-FCN			94.85 %	91.48 %	94.81 %	94.89 %	2.86 %	5.11 %	0.02 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
M. Oeljeklaus: An Integrated Approach for Traffic Scene Understanding from Monocular Cameras . 2021.												

37	HA-DeepLabv3+		94.83 %	93.24 %	94.77 %	94.89 %	2.88 %	5.11 %	0.06 s	1 core @ 2.5 Ghz (Python)	<input type="checkbox"/>	
R. Fan, H. Wang, P. Cai, J. Wu, M. Bocus, L. Qiao and M. Liu: Learning collision-free space detection from stereo images: Homography matrix brings better data augmentation . IEEE/ASME Transactions on Mechatronics 2021.												
38	TEDNet		code	94.62 %	93.05 %	94.28 %	94.96 %	3.17 %	5.04 %	0.09 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
M. Bayón-Gutiérrez, M. García- Ordás, H. Alaiz Moretón, J. Avelaira-Mata, S. Rubio-Martín and J. Benítez-Andrades: TEDNet: Twin Encoder Decoder Neural Network for 2D Camera and LiDAR Road Detection . Logic Journal of the IGPL 2024.												
39	RoadNet3		94.44 %	93.45 %	94.69 %	94.18 %	2.91 %	5.82 %	300 ms	GPU @ GTX950M (Python +Tensorflow)	<input type="checkbox"/>	
Y. Lyu, L. Bai and X. Huang: Road Segmentation using CNN and Distributed LSTM . 2019 IEEE International Symposium on Circuits and Systems (ISCAS) 2019.												
40	CLRD			94.20 %	92.66 %	94.25 %	94.14 %	3.16 %	5.86 %	0.05 s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>
M. Bayón-Gutiérrez, J. Benítez- Andrades, S. Rubio-Martín, J. Avelaira-Mata, H. Alaiz-Moretón and M. García-Ordás: Roadway Detection Using Convolutional Neural Network Through Camera and LiDAR Data . Hybrid Artificial Intelligent Systems 2022.												
41	LoDNN			94.07 %	92.03 %	92.81 %	95.37 %	4.07 %	4.63 %	18 ms	GPU @ 2.5 Ghz (Torch)	<input type="checkbox"/>
L. Caltagirone, S. Scheidegger, L. Svensson and M. Wahde: Fast LIDAR-based Road Detection Using Fully Convolutional Neural Networks . IEEE Intelligent Vehicles Symposium 2017.												
42	ChipNet			94.05 %	88.29 %	93.57 %	94.53 %	3.58 %	5.47 %	12 ms	GPU @ 1.5 Ghz (Keras)	<input type="checkbox"/>
Y. Lyu, L. Bai and X. Huang: ChipNet: Real-Time LiDAR Processing for Drivable Region Segmentation on an FPGA . IEEE Transactions on Circuits and Systems I: Regular Papers 2019.												
43	DEEP-DIG		93.98 %	93.65 %	94.26 %	93.69 %	3.14 %	6.31 %	0.14 s	GPU @ 3.5 Ghz (Python + C/C++)	<input type="checkbox"/>	
J. Muñoz-Bulnes, C. Fernandez, I. Parra, D. Fernández-Llorca and M. Sotelo: Deep Fully Convolutional Networks with Random Data Augmentation for Enhanced Generalization in Road Detection . Workshop on Deep Learning for Autonomous Driving on IEEE 20th International Conference on Intelligent Transportation Systems 2017.												
44	Up-Conv-Poly		code	93.83 %	90.47 %	94.00 %	93.67 %	3.29 %	6.33 %	0.08 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
G. Oliveira, W. Burgard and T. Brox: Efficient Deep Methods for Monocular Road Segmentation . IROS 2016.												
45	OFA Net		code	93.74 %	85.37 %	90.36 %	97.38 %	5.72 %	2.62 %	0.04 s	GPU @ 1.5 Ghz (Python)	<input type="checkbox"/>
S. Zhang, Z. Zhang, L. Sun and W. Qin: One For All: A Mutual Enhancement Method for Object Detection and Semantic Segmentation . Applied Sciences 2019.												
46	DDN		93.43 %	89.67 %	95.09 %	91.82 %	2.61 %	8.18 %	2 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>	
R. Mohan: Deep Deconvolutional Networks for Scene Parsing . 2014.												
47	HID-LS			93.11 %	87.33 %	92.52 %	93.71 %	4.18 %	6.29 %	0.25 s	1 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
S. Gu, Y. Zhang, J. Yang and H. Kong: Lidar-based urban road detection by histograms of normalized inverse depths and line scanning . ECMR 2017.												
S. Gu, Y. Zhang, X. Yuan, J. Yang, T. Wu and H. Kong: Histograms of the Normalized Inverse Depth and Line Scanning for Urban Road Detection . IEEE Trans. Intelligent Transportation Systems 2019.												
48	RGB36-Super		92.94 %	92.29 %	93.14 %	92.74 %	3.77 %	7.26 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	
L. Caltagirone, S. Lennart, M. Wahde and M. Sanfridson: Lidar-Camera Co-Training for Semi- Supervised Road Detection . arXiv preprint arXiv:1911.12597 2019.												
49	RoadNet-RT		92.55 %	93.21 %	92.94 %	92.16 %	3.86 %	7.84 %	8m s	GPU @ 2.5 Ghz (Python)	<input type="checkbox"/>	
L. Bai, Y. Lyu and X. Huang: RoadNet-RT: High Throughput CNN Architecture and SoC Design for Real-Time Road Segmentation . arXiv preprint arXiv:2006.07644 2020.												
50	Up-Conv		92.39 %	90.24 %	93.03 %	91.76 %	3.79 %	8.24 %	0.05 s	GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	
G. Oliveira, W. Burgard and T. Brox: Efficient Deep Methods for Monocular Road Segmentation . IROS 2016.												
51	ALO-AVG-MM		code	92.03 %	85.64 %	90.65 %	93.45 %	5.31 %	6.55 %	0.0296 sec	GeForce GTX 1080 GPU (Python)	<input type="checkbox"/>
F. Reis, R. Almeida, E. Kijak, S. Malinowski, S. Guimaraes and Z. Jr.: Combining convolutional side-outputs for road image segmentation . 2019 International Joint Conference on Neural Networks (IJCNN) - \textbf{Accepted} 2019.												
52	FTP		91.61 %	90.96 %	91.04 %	92.20 %	5.00 %	7.80 %	0.28 s	GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>	

A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: Map-Supervised Road Detection . IEEE Intelligent Vehicles Symposium Proceedings 2016.											
53	HybridCRF		90.81 %	86.01 %	91.05 %	90.57 %	4.90 %	9.43 %	1.5 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, R. Wang, B. Dai, Y. Fang, D. Liu and T. Wu: Hybrid conditional random field based camera-LIDAR fusion for road detection . Information Sciences 2018.											
54	FCN-LC		90.79 %	85.83 %	90.87 %	90.72 %	5.02 %	9.28 %	0.03 s	GPU Titan X	<input type="checkbox"/>
C. Mendes, V. Frémont and D. Wolf: Exploiting Fully Convolutional Neural Networks for Fast Road Detection . IEEE Conference on Robotics and Automation (ICRA) 2016.											
55	LidarHisto	 code	90.67 %	84.79 %	93.06 %	88.41 %	3.63 %	11.59 %	0.1 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Chen, J. Yang and H. Kong: Lidar-histogram for fast road and obstacle detection . 2017 IEEE International Conference on Robotics and Automation (ICRA) 2017.											
56	HIM		90.64 %	81.42 %	91.62 %	89.68 %	4.52 %	10.32 %	7 s	>8 cores @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
D. Munoz, J. Bagnell and M. Hebert: Stacked Hierarchical Labeling . European Conference on Computer Vision (ECCV) 2010.											
57	MixedCRF		90.59 %	84.24 %	89.11 %	92.13 %	6.20 %	7.87 %	6s	1 core @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
X. Han, H. Wang, J. Lu and C. Zhao: Road detection based on the fusion of Lidar and image data . 2017.											
58	BMCF		89.75 %	84.15 %	89.02 %	90.49 %	6.15 %	9.51 %	2.5 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Wang, T. Wu, Z. Xiao, L. Xiao, D. Zhao and J. Han: Multi-cue road boundary detection using stereo vision . 2016 IEEE International Conference on Vehicular Electronics and Safety (ICVES) 2016.											
59	NNP		89.68 %	86.50 %	89.67 %	89.68 %	5.69 %	10.32 %	5 s	4 cores @ 2.5 Ghz (Matlab)	<input type="checkbox"/>
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.											
60	StixelNet		89.12 %	81.23 %	85.80 %	92.71 %	8.45 %	7.29 %	1 s	GPU @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
D. Levi, N. Garnett and E. Fetaya: StixelNet: A Deep Convolutional Network for Obstacle Detection and Road Segmentation . 26TH British Machine Vision Conference (BMVC) 2015.											
61	CB		88.97 %	79.69 %	89.50 %	88.44 %	5.71 %	11.56 %	2 s	1 core @ 3.4 Ghz (Python) + GPU	<input type="checkbox"/>
C. Mendes, V. Frémont and D. Wolf: Vision-Based Road Detection using Contextual Blocks . 2015.											
62	FusedCRF		88.25 %	79.24 %	83.62 %	93.44 %	10.08 %	6.56 %	2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, B. Dai, D. Liu, T. Hu and T. Wu: CRF based Road Detection with Multi-Sensor Fusion . Intelligent Vehicles Symposium (IV) 2015.											
63	MAP		87.80 %	89.96 %	86.01 %	89.66 %	8.04 %	10.34 %	0.28s	GPU	<input type="checkbox"/>
A. Laddha, M. Kocamaz, L. Navarro-Serment and M. Hebert: Map-Supervised Road Detection . IEEE Intelligent Vehicles Symposium Proceedings 2016.											
64	ProbBoost		87.78 %	77.30 %	86.59 %	89.01 %	7.60 %	10.99 %	2.5 min	>8 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, A. Victorino and J. Ferreira: A probabilistic distribution approach for the classification of urban roads in complex environments . Workshop on Modelling, Estimation, Perception and Control of All Terrain Mobile Robots on IEEE International Conference on Robotics and Automation (ICRA) 2014.											
65	SPRAY		87.09 %	91.12 %	87.10 %	87.08 %	7.10 %	12.92 %	45 ms	NVIDIA GTX 580 (Python + OpenCL)	<input type="checkbox"/>
T. Kuehnl, F. Kummert and J. Fritsch: Spatial Ray Features for Real-Time Ego-Lane Extraction . Proc. IEEE Intelligent Transportation Systems 2012.											
66	multi-task CNN		86.81 %	82.15 %	78.26 %	97.47 %	14.92 %	2.53 %	25.1 ms	GPU @ 2.0 Ghz (Python)	<input type="checkbox"/>
M. Oeljeklaus, F. Hoffmann and T. Bertram: A Fast Multi-Task CNN for Spatial Understanding of Traffic Scenes . IEEE Intelligent Transportation Systems Conference 2018.											
67	RES3D-Velo		86.58 %	78.34 %	82.63 %	90.92 %	10.53 %	9.08 %	0.36 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato, D. Wolf and C. Stiller: Road Terrain Detection: Avoiding Common Obstacle Detection Assumptions Using Sensor Fusion . Intelligent Vehicles Symposium (IV) 2014.											
68	GRES3D+VELO		86.07 %	84.34 %	82.16 %	90.38 %	10.81 %	9.62 %	60 ms	4 cores @ 2.8 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato: Estimation of obstacles and road area with sparse 3D points . 2015.											





69	PGM-ARS		85.69 %	73.83 %	82.34 %	89.33 %	10.56 %	10.67 %	0.05 s	i74700MQ @ 2.1Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: Fast Pixelwise Road Inference Based on Uniformly Reweighted Belief Propagation . Proc. IEEE Intelligent Vehicles Symposium 2015.											
70	geo+gpr+crf		85.56 %	74.21 %	82.81 %	88.50 %	10.12 %	11.50 %	30 s	1 core @ 2.0 Ghz (C/C++)	<input type="checkbox"/>
Z. Xiao, B. Dai, H. Li, T. Wu, X. Xu, Y. Zeng and T. Chen: Gaussian process regression-based robust free space detection for autonomous vehicle by 3-D point cloud and 2-D appearance information fusion . International Journal of Advanced Robotic Systems 2017.											
71	GRES3D+SELAS		85.09 %	86.86 %	82.27 %	88.10 %	10.46 %	11.90 %	110 ms	4 core @ 2.8 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato: Estimation of obstacles and road area with sparse 3D points . 2015.											
72	SCRFPPFHGSP		84.93 %	76.31 %	85.37 %	84.49 %	7.98 %	15.51 %	5 s	8 cores @ 2.5 Ghz (C/C++, Matlab)	<input type="checkbox"/>
I. Gheorghe: Semantic Segmentation of Terrain and Road Terrain for Advanced Driver Assistance Systems . 2015.											
73	HistonBoost		83.92 %	73.75 %	82.24 %	85.66 %	10.19 %	14.34 %	2.5 min	>8 cores @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, A. Victorino and J. Ferreira: Comprehensive Performance Analysis of Road Detection Algorithms Using the Common Urban KITTI-Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application on IEEE Intelligent Vehicles Symposium (IV) 2014.											
74	BM		83.47 %	72.23 %	75.90 %	92.72 %	16.22 %	7.28 %	2 s	2 cores @ 2.5 Ghz (Matlab)	<input type="checkbox"/>
B. WANG, V. Fremont and S. Rodriguez Florez: Color-based Road Detection and its Evaluation on the KITTI Road Benchmark . Workshop on Benchmarking Road Terrain and Lane Detection Algorithms for In-Vehicle Application, IEEE Intelligent Vehicles Symposium 2014.											
75	SRF		82.44 %	87.37 %	80.60 %	84.36 %	11.18 %	15.64 %	0.2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
L. Xiao, B. Dai, D. Liu, D. Zhao and T. Wu: Monocular Road Detection Using Structured Random Forest . Int J Adv Robot Syst 2016.											
76	RES3D-Stereo		81.08 %	81.68 %	78.14 %	84.24 %	12.98 %	15.76 %	0.7 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
P. Shinzato, D. Gomes and D. Wolf: Road estimation with sparse 3D points from stereo data . Intelligent Transportation Systems (ITSC), 2014 IEEE 17th International Conference on 2014.											
77	ARSL-AMI		80.36 %	70.23 %	83.24 %	77.67 %	8.61 %	22.33 %	0.05 s	4 cores @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
M. Passani, J. Yebes and L. Bergasa: CRF-based semantic labeling in miniaturized road scenes . Proc. IEEE Intelligent Transportation Systems 2014.											
78	SPlane + BL		79.63 %	83.90 %	72.59 %	88.17 %	18.34 %	11.83 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.											
79	CN		79.02 %	78.80 %	76.64 %	81.55 %	13.69 %	18.45 %	2 s	1 core @ 2.5 Ghz (C/C++)	<input type="checkbox"/>
J. Alvarez, T. Gevers, Y. LeCun and A. Lopez: Road Scene Segmentation from a Single Image . ECCV 2012 2012.											
80	SPlane		78.69 %	77.16 %	71.96 %	86.80 %	18.63 %	13.20 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.											
81	ANN		67.70 %	52.50 %	54.19 %	90.17 %	41.98 %	9.83 %	3 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
G. Vitor, D. Lima, A. Victorino and J. Ferreira: A 2D/3D Vision Based Approach Applied to Road Detection in Urban Environments . Intelligent Vehicles Symposium (IV), 2013 IEEE 2013.											

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Lane Estimation Evaluation

UM_LANE






Method	Setting Code	MaxF	AP	PRE	REC	FPR	FNR	Runtime	Environment	Compare
1 CyberMELD+PLARD	code	94.44 %	88.59 %	95.95 %	92.97 %	0.69 %	7.03 %	0.18 s	8 cores @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
X. Wang, Y. Qian, C. Wang and M. Yang: Map-Enhanced Ego-Lane Detection in the Missing Feature Scenarios . IEEE Access 2020.										

2	CyberMELD		code	93.56 %	88.58 %	95.94 %	91.30 %	0.68 %	8.70 %	0.05 s	8 core @ 1.5 Ghz (C/C++)	<input type="checkbox"/>
X. Wang, Y. Qian, C. Wang and M. Yang: Map-Enhanced Ego-Lane Detection in the Missing Feature Scenarios . IEEE Access 2020.												
3	RoadNet3			91.47 %	91.01 %	91.78 %	91.17 %	1.44 %	8.83 %	300 ms	GPU @ GTX950M (Python +Tensorflow)	<input type="checkbox"/>
Y. Lyu, L. Bai and X. Huang: Road Segmentation using CNN and Distributed LSTM . 2019 IEEE International Symposium on Circuits and Systems (ISCAS) 2019.												
4	RBNet			90.54 %	82.03 %	94.92 %	86.56 %	0.82 %	13.44 %	0.18 s	GPU @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
Z. Chen and Z. Chen: RBNet: A Deep Neural Network for Unified Road and Road Boundary Detection . International Conference on Neural Information Processing 2017.												
5	Up-Conv-Poly		code	89.88 %	87.52 %	92.01 %	87.84 %	1.34 %	12.16 %	0.08 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
G. Oliveira, W. Burgard and T. Brox: Efficient Deep Methods for Monocular Road Segmentation . IROS 2016.												
6	SPRAY			83.42 %	86.84 %	84.76 %	82.12 %	2.60 %	17.88 %	45 ms	NVIDIA GTX 580 (Python + OpenCL)	<input type="checkbox"/>
T. Kuehnl, F. Kummert and J. Fritsch: Spatial Ray Features for Real-Time Ego-Lane Extraction . Proc. IEEE Intelligent Transportation Systems 2012.												
7	SPlane + BL			69.63 %	73.78 %	80.01 %	61.63 %	2.71 %	38.37 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.												
8	SCRFFPFHGSP			57.22 %	39.34 %	41.78 %	90.79 %	22.28 %	9.21 %	5 s	8 cores @ 2.5 Ghz (C/C++, Matlab)	<input type="checkbox"/>
I. Gheorghie: Semantic Segmentation of Terrain and Road Terrain for Advanced Driver Assistance Systems . 2015.												

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Behaviour Evaluation

UM_LANE

Method	Setting	Code	PRE-20	F1-20	HR-20	PRE-30	F1-30	HR-30	PRE-40	F1-40	HR-40	Runtime	Environment	<input type="checkbox"/>	
1	CyberMELD		code	99.17 %	99.23 %	99.11 %	98.64 %	98.00 %	97.55 %	94.57 %	89.66 %	90.79 %	0.05 s	8 core @ 1.5 Ghz (C/C++)	<input type="checkbox"/>
X. Wang, Y. Qian, C. Wang and M. Yang: Map-Enhanced Ego-Lane Detection in the Missing Feature Scenarios . IEEE Access 2020.															
2	CyberMELD+PLARD		code	99.18 %	99.36 %	99.29 %	98.70 %	98.20 %	97.17 %	96.74 %	90.80 %	90.79 %	0.18 s	8 cores @ 1.5 Ghz (Python + C/C++)	<input type="checkbox"/>
X. Wang, Y. Qian, C. Wang and M. Yang: Map-Enhanced Ego-Lane Detection in the Missing Feature Scenarios . IEEE Access 2020.															
3	RBNet			99.24 %	99.33 %	99.21 %	98.74 %	97.34 %	95.92 %	95.56 %	87.21 %	81.58 %	0.18 s	GPU @ 2.5 Ghz (Matlab + C/C++)	<input type="checkbox"/>
Z. Chen and Z. Chen: RBNet: A Deep Neural Network for Unified Road and Road Boundary Detection . International Conference on Neural Information Processing 2017.															
4	RoadNet3			99.18 %	99.21 %	99.07 %	98.39 %	97.23 %	95.57 %	94.57 %	83.72 %	80.26 %	300 ms	GPU @ GTX950M (Python +Tensorflow)	<input type="checkbox"/>
Y. Lyu, L. Bai and X. Huang: Road Segmentation using CNN and Distributed LSTM . 2019 IEEE International Symposium on Circuits and Systems (ISCAS) 2019.															
5	Up-Conv-Poly		code	99.06 %	98.84 %	98.45 %	97.57 %	95.27 %	93.14 %	90.11 %	83.72 %	77.63 %	0.08 s	GPU @ 2.5 Ghz (Python + C/C++)	<input type="checkbox"/>
G. Oliveira, W. Burgard and T. Brox: Efficient Deep Methods for Monocular Road Segmentation . IROS 2016.															
6	SPRAY			97.58 %	96.74 %	96.38 %	96.59 %	94.16 %	92.06 %	87.64 %	78.57 %	62.16 %	45 ms	NVIDIA GTX 580 (Python + OpenCL)	<input type="checkbox"/>
T. Kuehnl, F. Kummert and J. Fritsch: Spatial Ray Features for Real-Time Ego-Lane Extraction . Proc. IEEE Intelligent Transportation Systems 2012.															
7	SPlane + BL			95.53 %	92.88 %	91.21 %	91.89 %	87.12 %	74.28 %	79.79 %	47.13 %	0.00 %	2 s	1 core @ 3.0 Ghz (C/C++)	<input type="checkbox"/>
N. Einecke and J. Eggert: Block-Matching Stereo with Relaxed Fronto-Parallel Assumption . IV 2014.															
8	SCRFFPFHGSP			94.88 %	87.95 %	82.98 %	87.91 %	78.90 %	71.95 %	60.64 %	43.68 %	38.16 %	5 s	8 cores @ 2.5 Ghz (C/C++, Matlab)	<input type="checkbox"/>

I. Gheorghe: [Semantic Segmentation of Terrain and Road Terrain for Advanced Driver Assistance Systems](#). 2015.
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Related Datasets

- [Multi-Lane-Detection-Dataset](#): Dataset for multiple lane detection.
- [Road Scene Layout from a Single Image](#): Dataset for road area estimation.
- [MIT Street Scenes](#): Dataset for semantic road scene understanding.
- [Cambridge-driving Labeled Video Database \(CamVid\)](#): Dataset for semantic road scene understanding.
- [Daimler Scene Labeling Dataset](#): Dataset for semantic road scene understanding including stereo images.
- [ROMA \(ROad MARKings\)](#): Dataset for performance evaluation of road marking extraction algorithms.

Citation

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

```
@inproceedings{Fritsch2013ITSC,  
  author = {Jannik Fritsch and Tobias Kuehnl and Andreas Geiger},  
  title = {A New Performance Measure and Evaluation Benchmark for Road Detection Algorithms},  
  booktitle = {International Conference on Intelligent Transportation Systems (ITSC)},  
  year = {2013}  
}
```



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