

中, 考虑使用深度网络提取更能表现物体三维形状的低层特征进行识别和形态估计, 通过 RGB 和深度特征的融合提高目标识别和检测精度。

参考文献(References)

- [1] Huang Z C, Liu Z Y. Feature integration and S-D probability correction based RGB-D saliency detection[J]. *Journal of Image and Graphics*, 2016, 21(10) : 1392-1401. [黄子超, 刘政怡.特征融合与 S-D 概率矫正的 RGB-D 显著检测 [J]. *中国图象图形学报*, 2016, 21(10) : 1392-1401.] [DOI:10.11834/jig.20161014]
- [2] Su B Y, Ma J Y, Peng Y S, et al. Fast point cloud registration based on RGB-D data [J] . *Journal of Image and Graphics*, 2017, 22(5):0643-0655. [苏本跃, 马金字, 彭玉升等. 面向 RGB-D 深度数据的快速点云配准方法 [J]. *中国图象图形学报*, 2017, 22(5):0643-0655.][DOI:10.11834/jig.160602]
- [3] Papageorgiou C, Poggio T. A Trainable System for Object Detection[J]. *International Journal of Computer Vision*, 2015, 38(1):15-33.
- [4] J Hosang, R Benenson, P Dollár, B Schiele. What Makes for Effective Detection Proposals[J]. *IEEE Transactions on Pattern Analysis and Machine Intelligence*. 2016, 38(4):814-830.[DOI:10.1109/TPAMI.2015.2465908]
- [5] Cheng M M, Zhang Z, Lin W Y, et al. BING: Binarized Normal Gradients for Objectness Estimation at 300fps[C]// *Computer Vision and Pattern Recognition(CVPR)*, 2014 IEEE Conference on Columbus, OH, USA. IEEE, 2014:3286-3293.[DOI: 10.1109/CVPR.2014.414]
- [6] Zitnick C L, Dollár P. Edge Boxes: Locating Object Proposals from Edges.[M]// *Computer Vision ECCV 2014*. Springer International Publishing, 2014:391-405.
- [7] Uijlings J R R, Sande K E A V D, Gevers T, et al. Selective Search for Object Recognition[J]. *International Journal of Computer Vision*, 2013. 104(2):154-171.[DOI:10.1007/s11263-013-0620-5]
- [8] Zheng Yin, Chen Quanqi, Zhang Yujin. Deep learning and its new progress in object and behavior recognition[J]. *Journal of Image and Graphics*, 2014, 19(02):175-184. [郑胤, 陈权琦, 章毓晋. 深度学习及其在目标和行为识别中的新进展 [J]. *中国图象图形学报*, 2014, 19(02):175-184.] [DOI:10.11834/jig.20140202]
- [9] Girshick R, Donahue J, Darrell T, et al. Rich Feature Hierarchies for Accurate Object Detection and Semantic Segmentation[J]. 2013: 580-587.
- [10] Girshick R. Fast R-CNN[C]// *IEEE International Conference on Computer Vision*. Santiago, IEEE Computer Society, 2015:1440-1448.
- [11] Kanezaki A, Harada T. 3D Selective Search for obtaining object candidates[C]// *Ieee/rsj International Conference on Intelligent Robots and Systems*. Hamburg, IEEE, 2015:82-87. [DOI: 10.1109/IROS.2015.7353358]
- [12] Ren S, He K, Girshick R, et al. Faster R-CNN: Towards Real-Time Object Detection with Region Proposal Networks[J]. *IEEE Transactions on Pattern Analysis & Machine Intelligence*, 2017, 39(6):1137-1149.
- [13] Gupta S, Girshick R, Arbeláez P, et al. Learning Rich Features from RGB-D Images for Object Detection and Segmentation[M]// *Computer Vision – ECCV 2014*. Springer International Publishing, 2014:345-360.
- [14] Wolf L, Hassner T, Taigman Y. Effective Unconstrained Face Recognition by Combining Multiple Descriptors and Learned Background Statistics[J]. *IEEE Transactions on Pattern Analysis & Machine Intelligence*, 2011, 33(10):1978-1990.[DOI:10.1109/TPAMI.2010.230]
- [15] Dalai N, Tfiggs B. Histograms of Oriented Gradients for human Detection[C]// *Proceedings of IEEE Computer Society Conference on Computer Vision and Pattern Recognition*. San Diego, IEEE Press, 2015:886-893. [DOI:10.1109/CVPR.2005.177]
- [16] RUSU R B, BRADSKI G, THIBAUX R, et al. Fast 3D recognition and pose using the viewpoint feature histogram[C]// *2010 IEEE/RSJ International Conference on Intelligent Robots*

and Systems(IROS). Taipei, IEEE, 2010:2155-2162.[DOI:10.1109/IROS.2010.5651280]

[17] STEDER B, RUSU R B, KONOLIGE K, et al. Point feature extraction on 3D range scans taking into account object boundaries [C] // Robotics and Automation(ICRA), 2011 IEEE International Conference on Shanghai. 2011:2601-2608.[DOI: 10.1109/ICRA.2011.5980187]

[18] BO L, REN X, et al. Object recognition with hierarchical kernel descriptors[C]//2011 IEEE Conference on Computer Vision and Pattern Recognition(CVPR). IEEE,2011:1729-1736.

[19] Tang S, Wang X, Lv X, et al. Histogram of oriented normal vectors for object recognition with a depth sensor[C]//Asian Conference on Computer Vision. Springer-Verlag,2013:525- 538.

[20] Achanta R, Shaji A, Smith K, et al. SLIC Super-pixels Compared to State-of-the-Art Super-pixel Methods[J]. IEEE Transactions on Pattern Analysis & Machine Intelligence, 2012, 34(11):2274.

[21] Bucak S S, Jin R, Jain A K. Multiple Kernel Learning for Visual Object Recognition: A Review.[J]. IEEE Transactions on Pattern Analysis & Machine Intelligence, 2014,36(7):1354-1369.[DOI:10.1109/TPAMI.2013.212]

[22] Rakotomamonjy A, Bach F R, Canu S, et al. Simplemkl[J]. Journal of Machine Learning Research, 2008, 9(3):2491-2521.[]

[23] Lai K, Bo Liefeng, Ren Xiaofeng, et al. A Large-scale Hierarchical Multi-view RGB-D Object Dataset[C]//Proceedings of IEEE International Conference on Robotics and Automation. Washington D. C, USA: IEEE Press, 2011:1817-1824[DOI:10.1109/ICRA.2011.5980382]