Beyond PASCAL: A Benchmark for 3D Object Detection in the Wild

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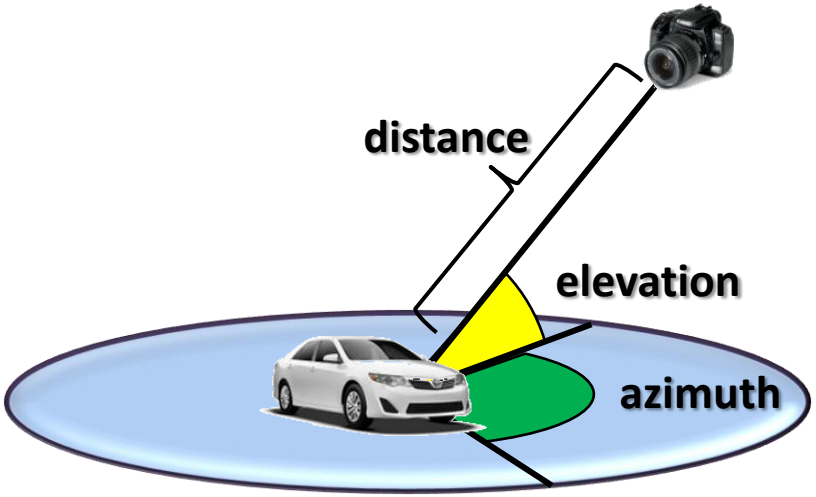
In IEEE Winter Conference on Applications of Computer Vision (WACV), 2014.

Goal

- Build a large scale dataset for 3D object detection and pose estimation



3D Object Dataset

	#category	#instance	Non-centered objects	Dense viewpoint	3D Shape
3D Object [1]	10	100	✘	✘	✘

[1] S. Savarese and L. Fei-Fei. 3d generic object categorization, localization and pose estimation. In ICCV, 2007.

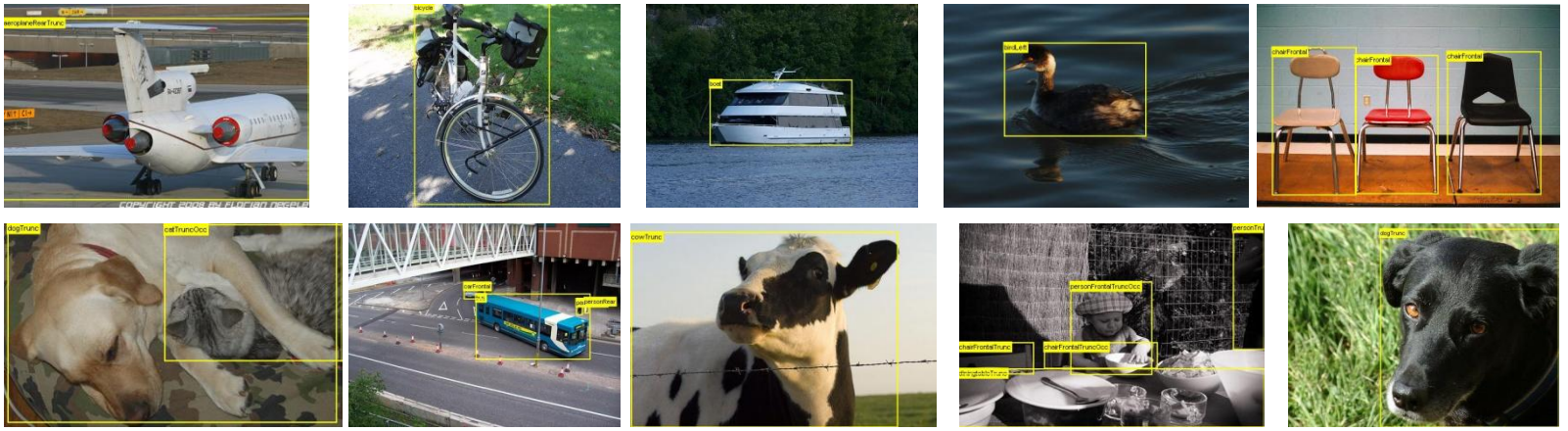
EPFL Car Dataset

	#category	#instance	Non-centered objects	Dense viewpoint	3D Shape
3D Object [1]	10	100	✘	✘	✘
EPFL Car [2]	1	20	✘	✓	✘

[2] M. Ozuysal, V. Lepetit, and P. Fua. Pose estimation for category specific multiview object localization. In CVPR, 2009.

PASCAL VOC Dataset

	#category	#instance	Non-centered objects	Dense viewpoint	3D Shape
3D Object [1]	10	100	✘	✘	✘
EPFL Car [2]	1	20	✘	✓	✘
PASCAL VOC [3]	20	27,450	✓	✘	✘



[3] M. Everingham, L. Van Gool, C. K. I.Williams, J.Winn, and A. Zisserman. The pascal visual object classes (voc) challenge. IJCV, 2010.

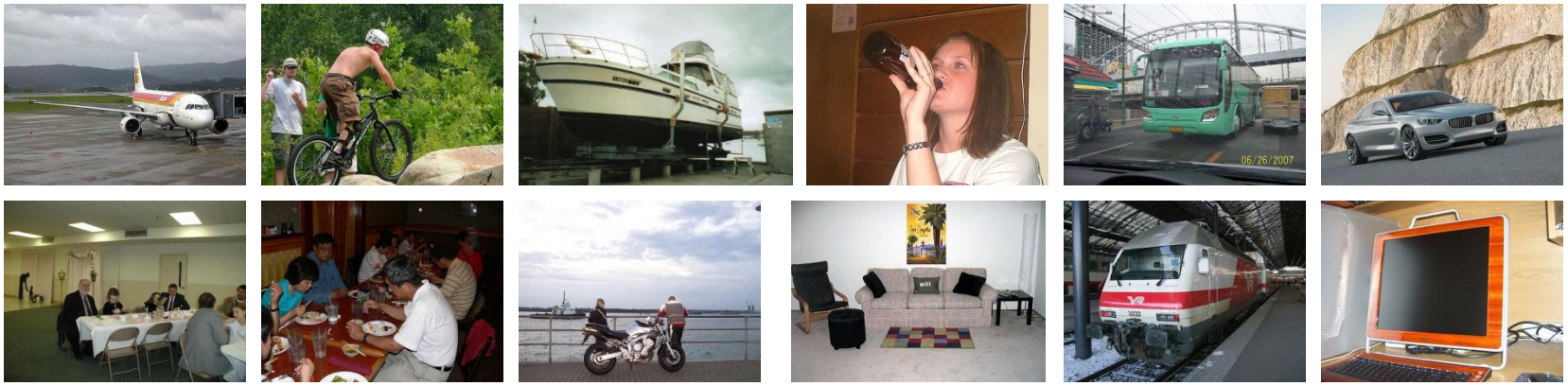
KITTI Dataset

	#category	#instance	Non-centered objects	Dense viewpoint	3D Shape
3D Object [1]	10	100	✘	✘	✘
EPFL Car [2]	1	20	✘	✓	✘
PASCAL VOC [3]	20	27,450	✓	✘	✘
KITTI [4]	3	80,256	✓	✓	✘

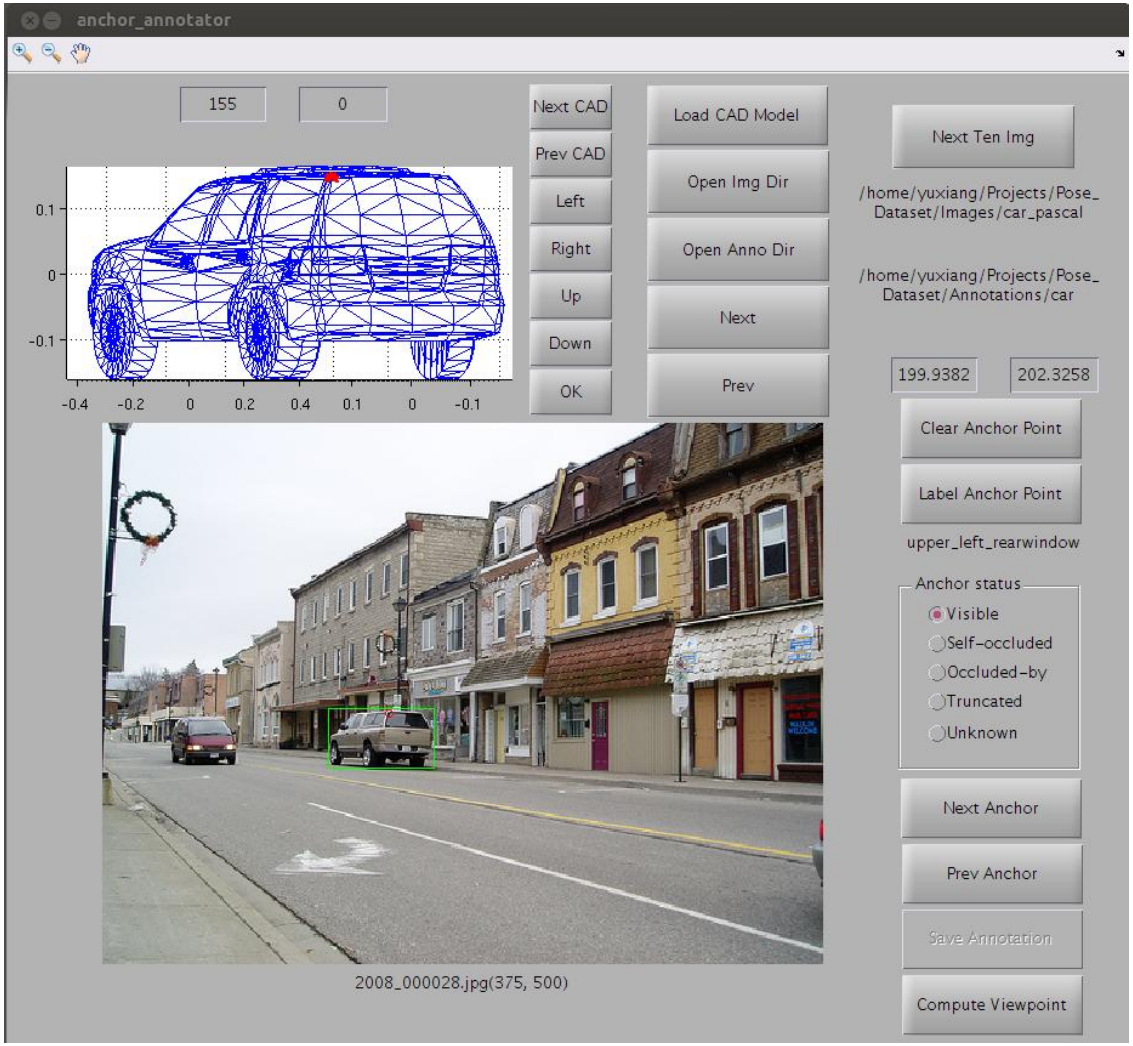
[4] A. Geiger, P. Lenz, and R. Urtasun. Are we ready for autonomous driving? the kitti vision benchmark suite. In CVPR, 2012.

Our Contribution: PASCAL3D+

	#category	#instance	Non-centered objects	Dense viewpoint	3D Shape
3D Object [1]	10	100	✘	✘	✘
EPFL Car [2]	1	20	✘	✓	✘
PASCAL VOC [3]	20	27,450	✓	✘	✘
KITTI [4]	3	80,256	✓	✓	✘
PASCAL3D+ (Ours)	**12**	**30,899**	✓	✓	✓



Annotation Tool



CAD alignment



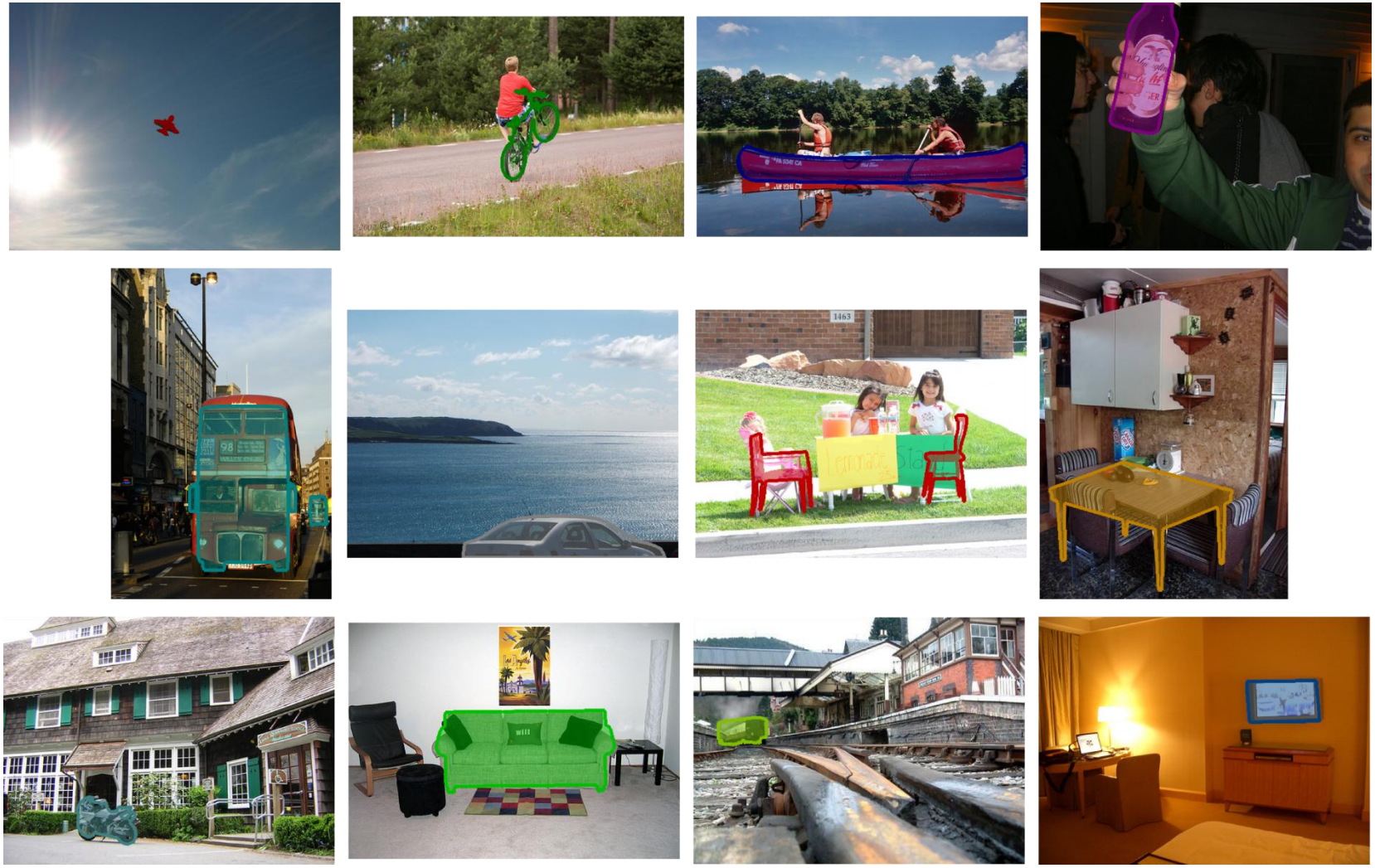




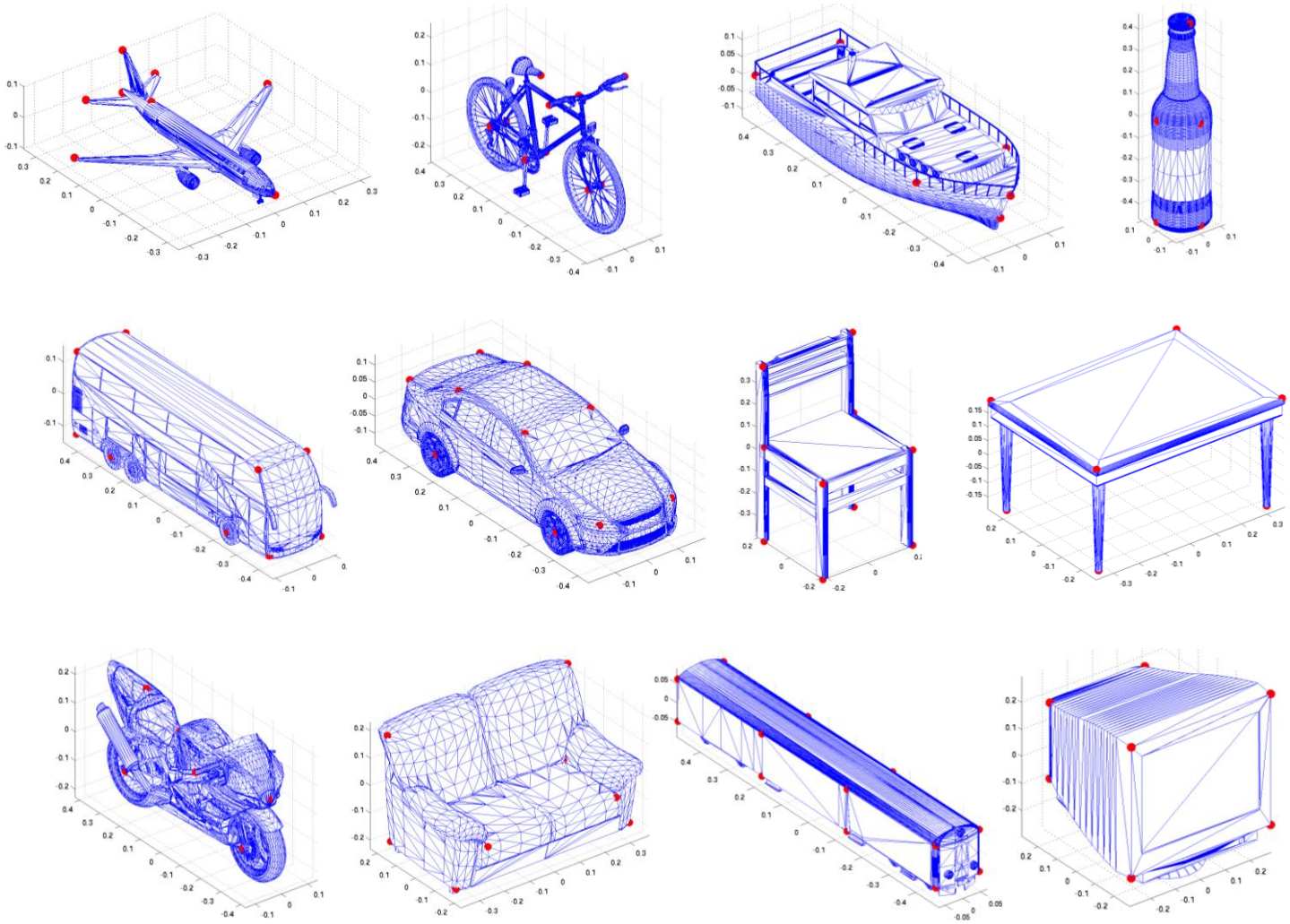




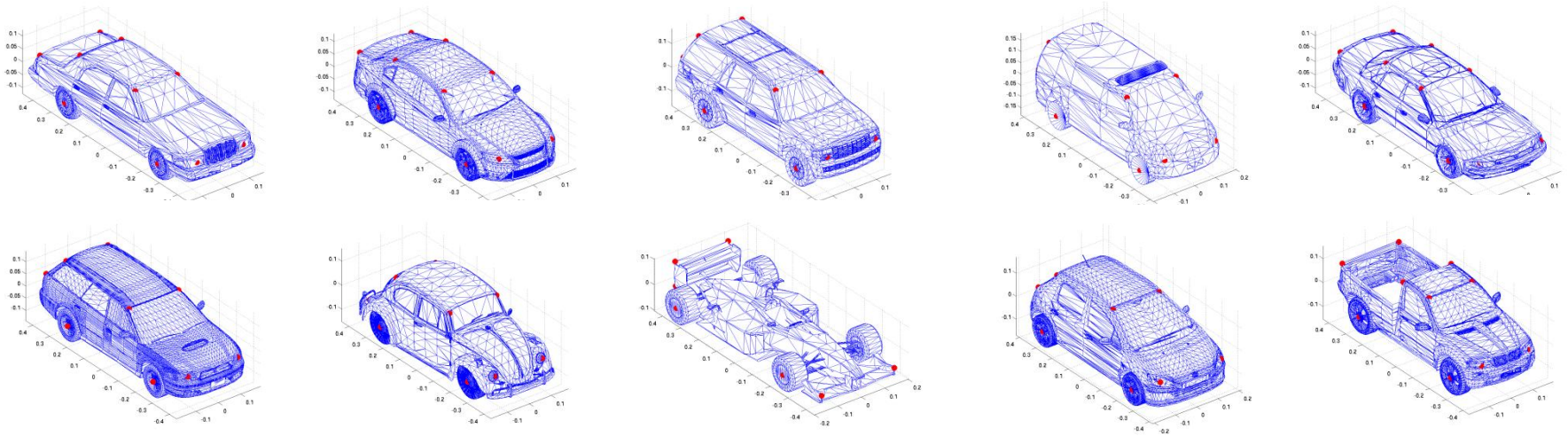

CAD alignment



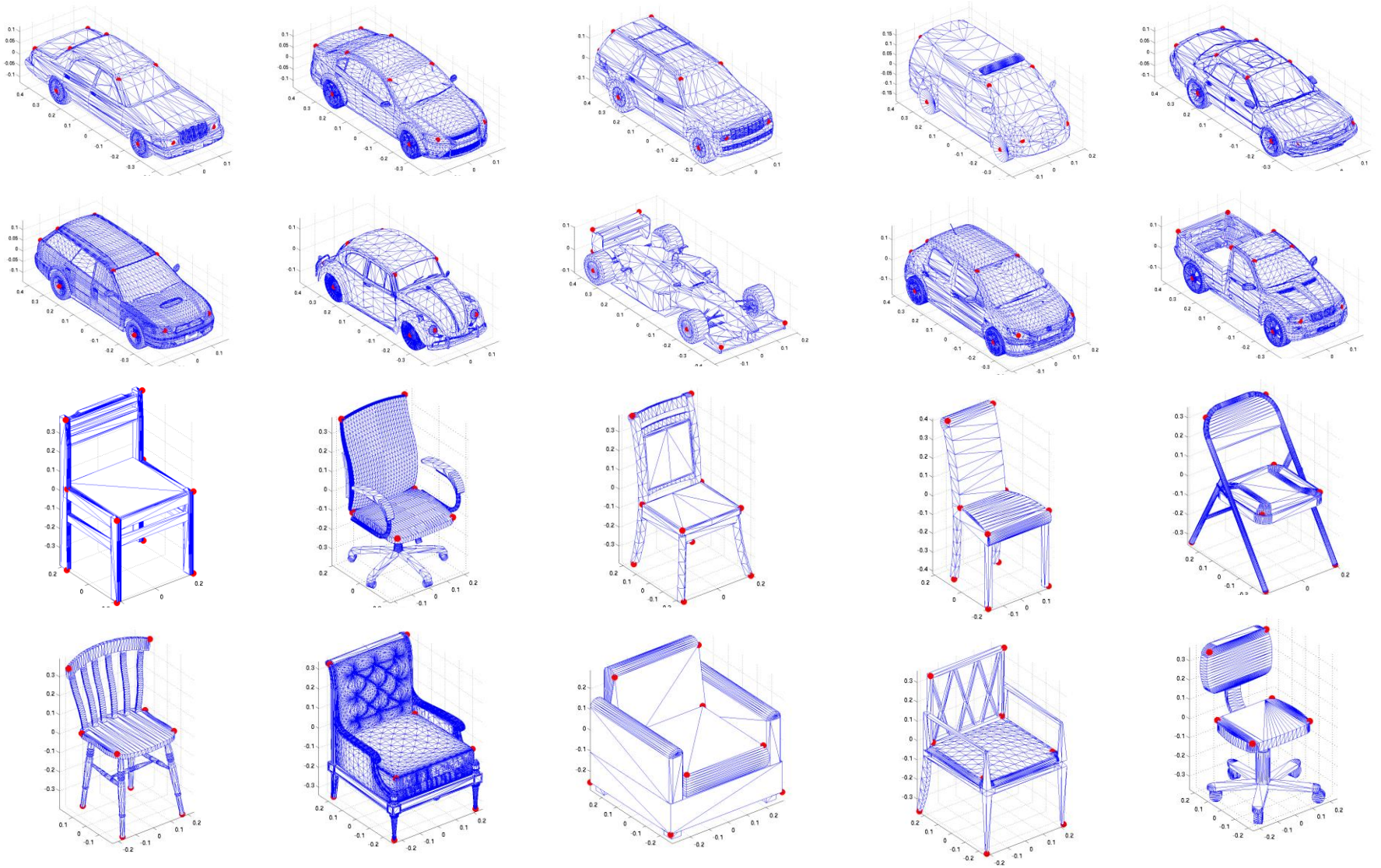
CAD Models



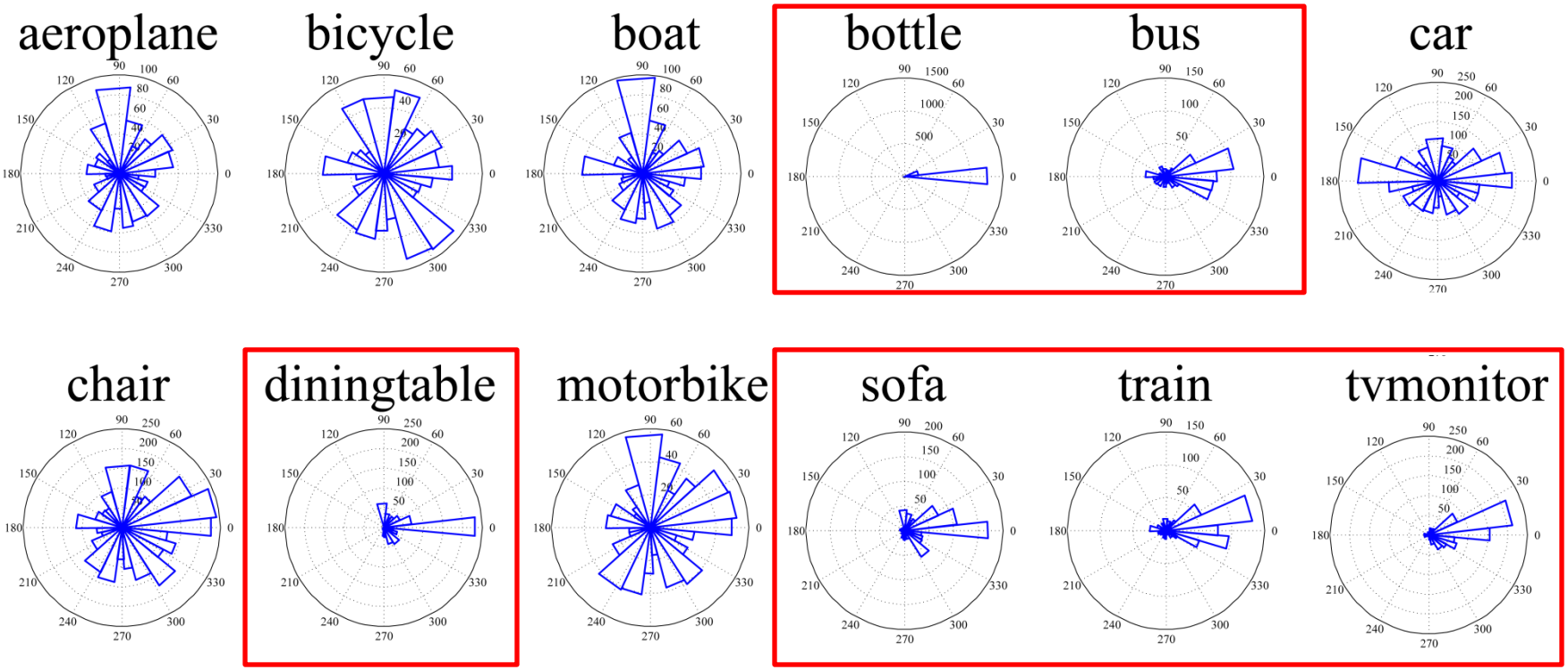
CAD Models



CAD Models

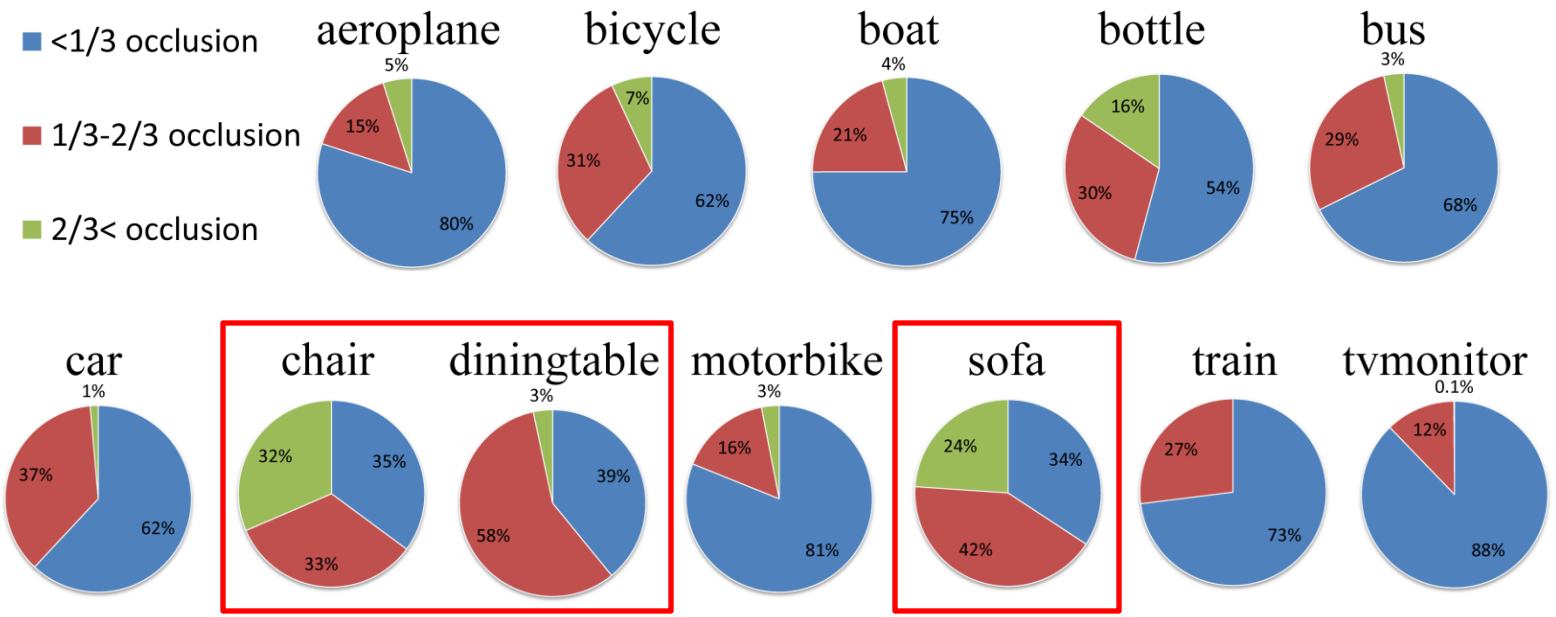


Statistics



Viewpoint Distribution

Statistics



Occlusion Percentage

Object Detection and Viewpoint Estimation

	DPM with 24 Views
Detection	29.5
Viewpoint	12.1

• DPM: P. F. Felzenszwalb, R. B. Girshick, D. McAllester, and D. Ramanan. Object detection with discriminatively trained part based models. PAMI, 2010.

PASCAL3D+ website: http://cvgl.stanford.edu/projects/pascal3d.html
Welcome to submit your results!

Conclusion

- PASCAL3D+: a large scale 3D object detection dataset in the wild
- Benchmark both 2D and 3D object detection methods
- Benefit research in 3D object detection and pose estimation

Our Future Work

- More categories ≈100
- More CAD models per category
- Improve alignment with CAD models