

Object Co-detection

Yu Xiang Sid Yingze Bao Silvio Savarese University of Michigan at Ann Arbor, USA





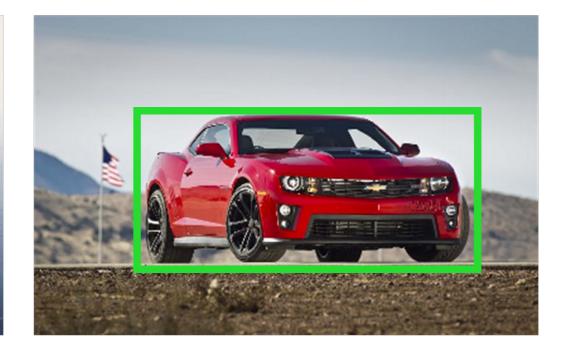
Object Co-detection Problem

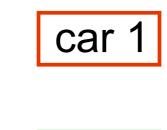
Goals

- (1) Detect objects in all images.
- (2) Recognize same object instance in different images (matching objects).
- (3) Estimate the viewpoint transformation between matching objects.









car 2

Motivations

(1) Better detection accuracy than single-image methods

Hard to detect due to the occlusions.







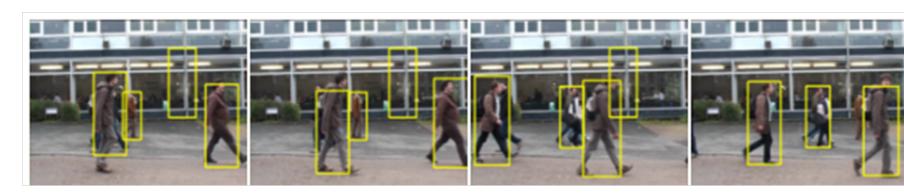




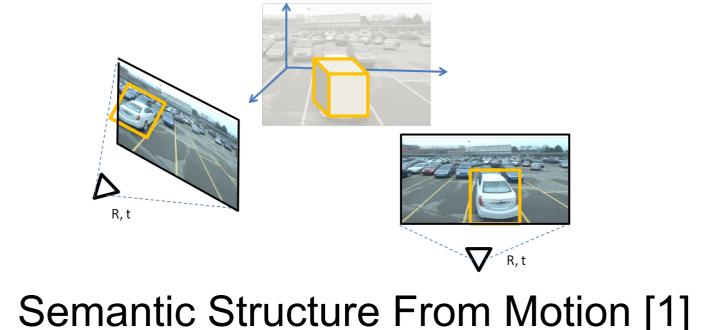
images makes detection easier.

Pose variation makes low-level feature matching unreliable.

- (2) Better matching accuracy than methods based on low-level features.
- (3) Helpful in solving other problems.



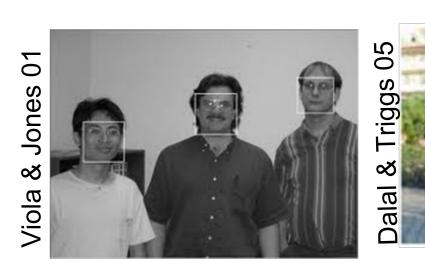
Tracking by detection

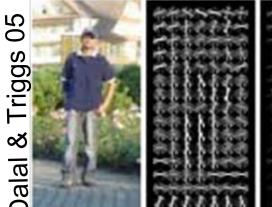


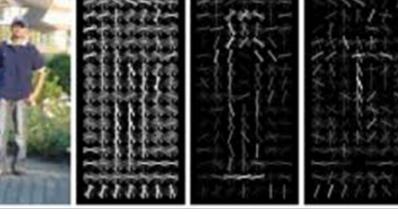
Challenges

- (1) Object appearance variations (pose changes and self-occlusions).
- (2) Input images may contain different backgrounds.

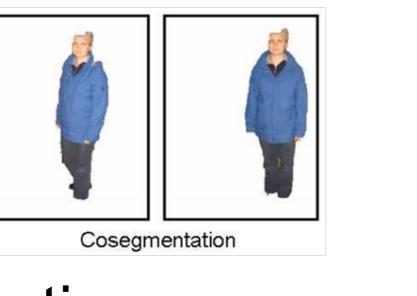
Related Problems



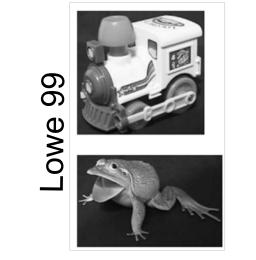








Single image object detection





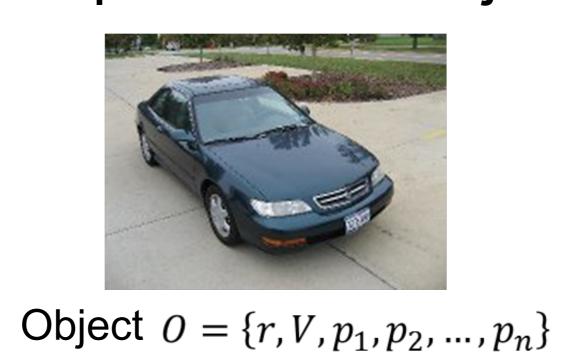
Single instance detection

Co-segmentation

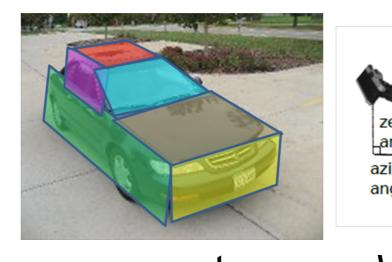
Region Matching

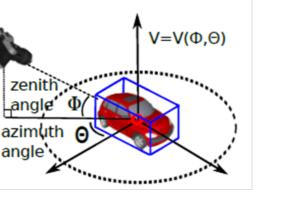
Our Framework

Represent an object by a part-based model.



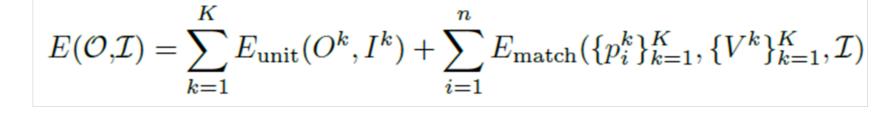




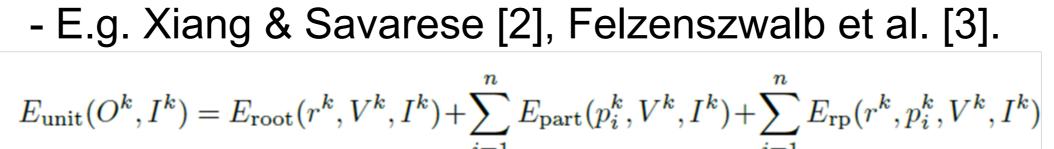


Energy Formulation

Object detection are obtained by maximizing:



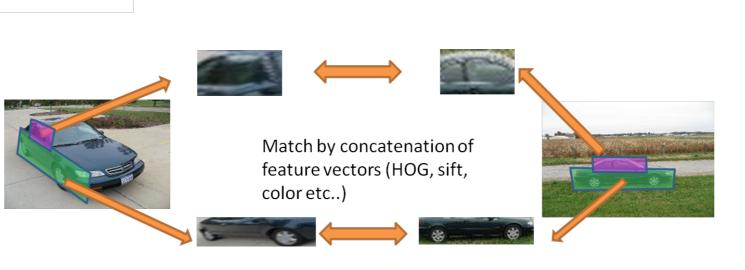






- Rectifying parts based on estimated poses

- Matching by using combination of features

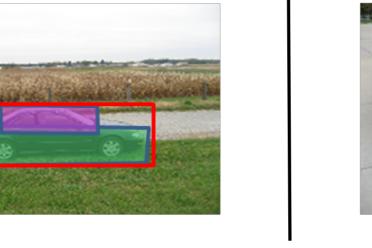


K input images

Advantages of the Co-detection Framework

- (1) Handle object pose variations and self-occlusions.
- (2) Reject false alarms produced by a single-image detector



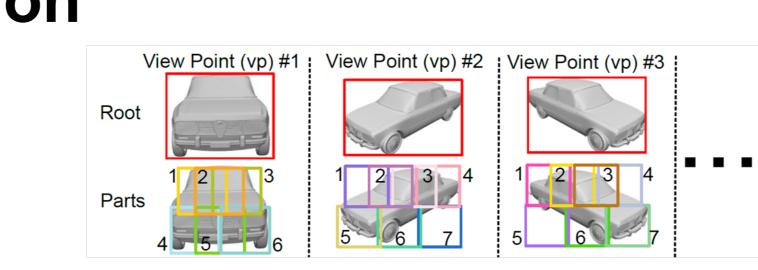






Using 2D Object Representation

- Treat different poses as different categories. - Cannot match objects with large pose variation.
- More choices to compute unitary potential. - e.g. Leibe et al. 04, Felzenszwalb et al. 09, Bourdev et al. 09, Yang & Ramanan 11



References

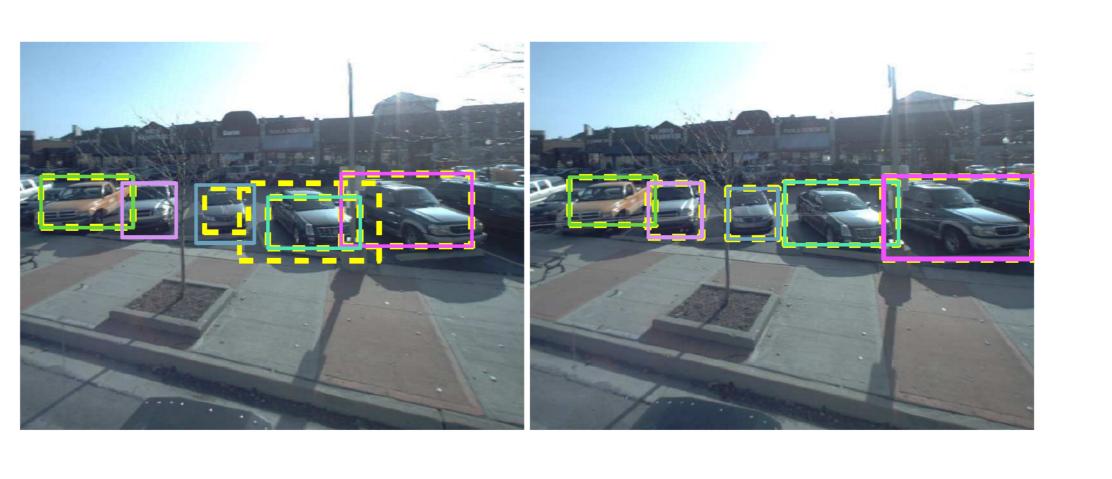
- [1] Y. Bao, S. Savarese, Semantic Structure From Motion, CVPR 2011
- [2] Y. Xiang, S. Savarese. Estimating the aspect layout of object categories. CVPR 2012. [3] P. Felzenszwalb, R. Girshick, D. McAllester, D. Ramanan. Object detection with discriminatively trained part-based models. PAMI 2010.
- [4] D. Lowe. Object recognition from local scale-invariant features. ICCV 1999.
- [5] S. Lazebnik, C. Schmid, J. Ponce. Spatial pyramid matching for recognizing natural scene categories. CVPR 2006 [6] A. Ess, B. Leibe, L. van Gool, Depth and Appearance for Mobile Scene Analysis, ICCV 2007
- [7] S. Savarese, L. Fei-Fei, 3d Generic Object Categorization, Localization and Pose Estimation, ICCV 2007

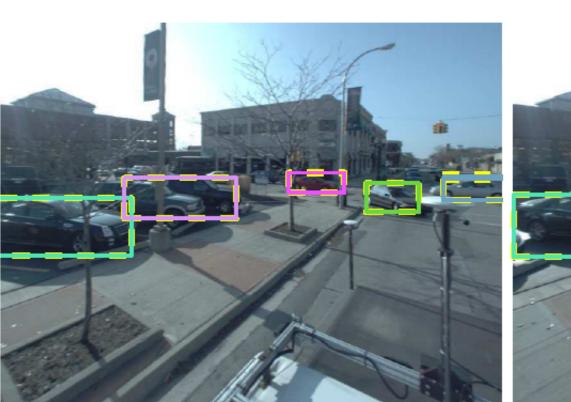
Acknowledgement

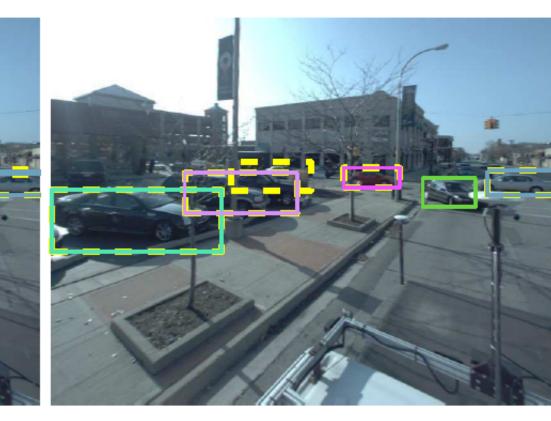
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Experiments

Car dataset (300 image pairs) [1]





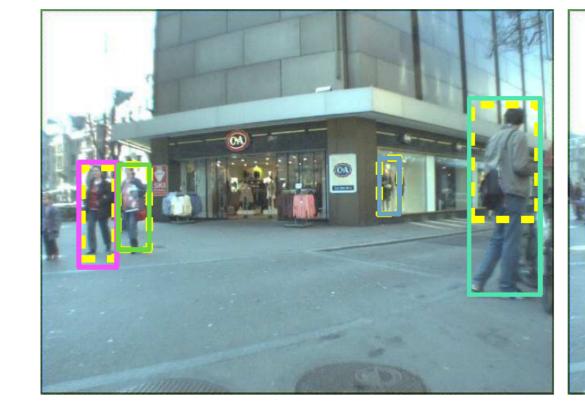


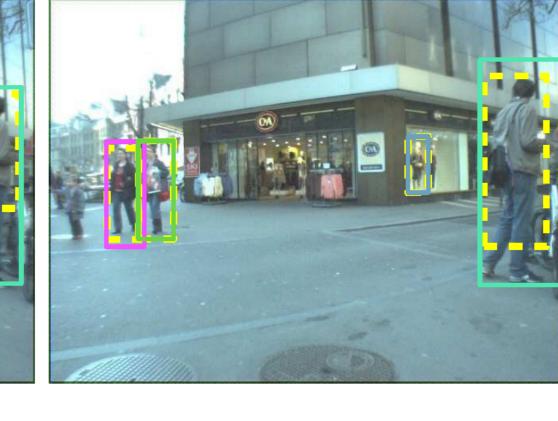
Pedestrian dataset (200 image pairs) [6]

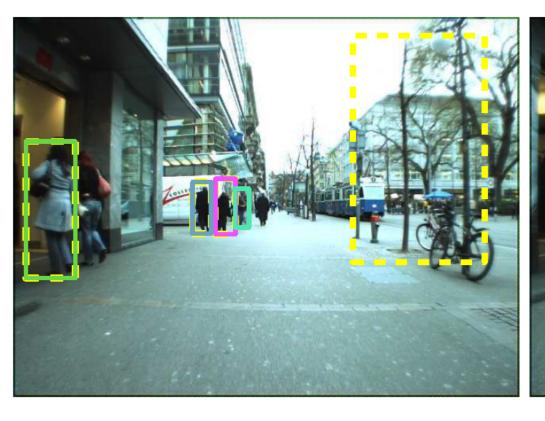
Object detection Accuracy

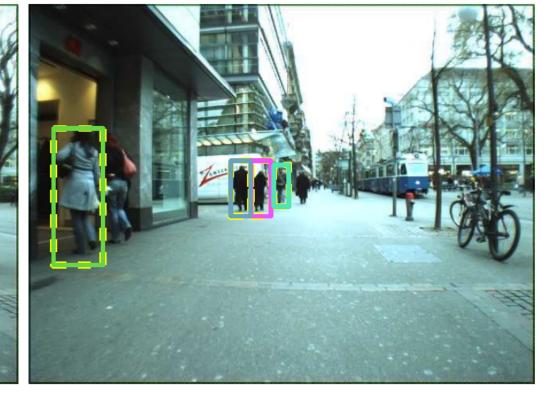
Single Instance Detection Accuracy

different poses





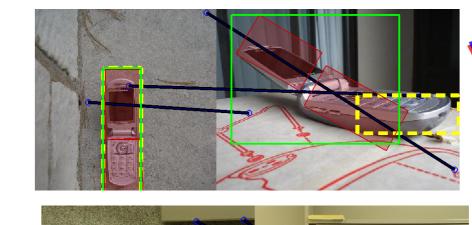




3D Object dataset (500 image pairs for each category) [7]



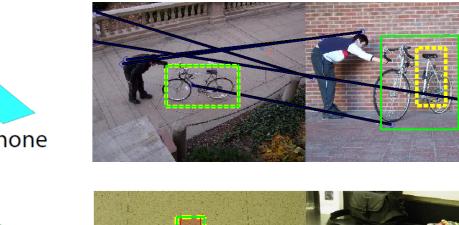
same pose

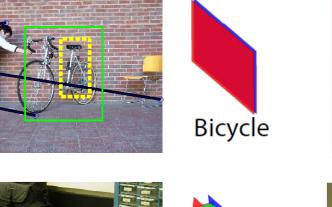


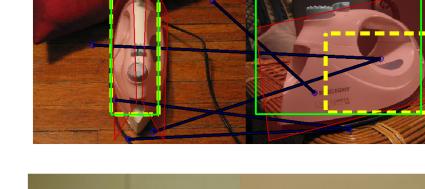
Single image detectorCar, Pedestrian [3]

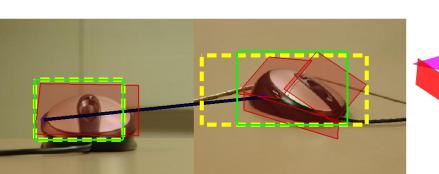
- 3D Object [2]

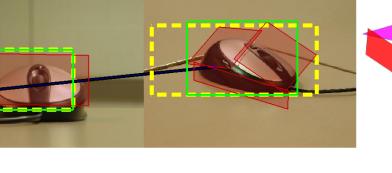
Ours (Co-detector)

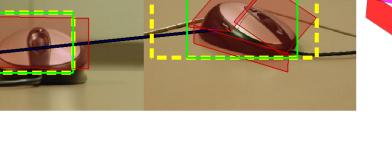




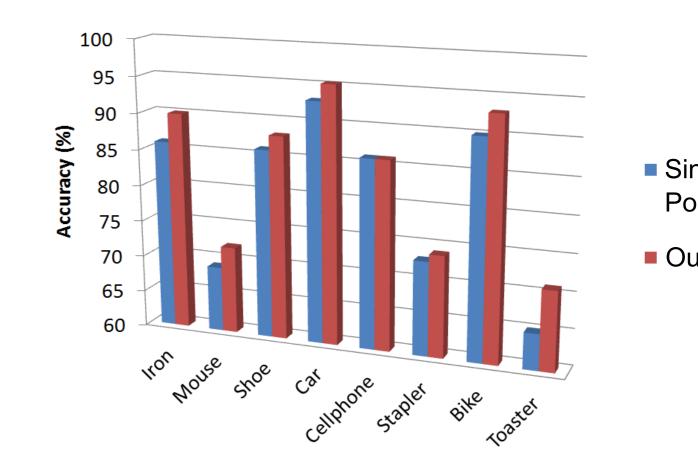








Pose Estimation Accuracy



Object Matching Accuracy

