

# BOLEI ZHOU

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## Research Interests

Computer Vision, Machine Learning, Artificial Intelligence

## Education

<b>Massachusetts Institute of Technology</b> Ph.D., Computer Science – Advisor: Antonio Torralba – Thesis: Deep and Interpretable Scene Understanding – Thesis Committee: Aude Oliva, William T. Freeman	Aug 2013 – July 2018
<b>Chinese University of Hong Kong</b> M.Phil., Information Engineering – Thesis: Modeling Collective Crowd Behaviors in Videos – Advisor: Xiaoou Tang	Aug 2010 – July 2012
<b>Shanghai Jiao Tong University, China</b> B.Eng., Biomedical Engineering – Thesis: Motion Perception Model and its Application	Aug 2006 – July 2010

## Awards and Honors

Facebook Ph.D. Fellowship in Computer Vision	2016-2018
BRC Fellowship Award	2017
MIT Ho-Ching and Han-Ching Fund Award	2013
MIT Greater China Computer Science Fellowship	2013
Faculty's Outstanding Thesis Award in CUHK	2012
Microsoft Research Asia Fellowship	2011
Postgraduate Studentship in the Chinese University of Hong Kong	2010-2012
Outstanding Undergraduate Thesis of Shanghai Jiao Tong University	2010

## Press Coverage

<a href="#">Quartz</a> : Track AI's decisions back to single neurons	2017
<a href="#">MIT News</a> : Peering into neural networks	2017
<a href="#">TechCrunch</a> : A fully automated way to peer inside neural nets	2017
<a href="#">MIT CSAIL News</a> : Scene parsing and scene classification challenges	2016
<a href="#">TechCrunch</a> : AI Project designed to recognize scenes identifies objects too	2015
<a href="#">MIT News</a> : Object recognition for free	2015

## Journal Publications

1. **B. Zhou**, A. Lapedriza, A. Khosla, A. Oliva, and A. Torralba. "Places: A 10 million Image Database for Scene Recognition." IEEE transaction on Pattern Analysis and Machine Intelligence (**TPAMI**), 2017. [\[Places dataset\]](#) [\[PlacesCNN\]](#) [\[demo\]](#)
2. **B. Zhou\***, D. Bau\*, A. Oliva, A. Torralba. "Interpreting Deep Visual Representations via Network Dissection." Under minor revision of IEEE transaction on Pattern Analysis and Machine Intelligence (**TPAMI**), 2017 (arXiv:1711.05611), 2017 [\[webpage\]](#)

3. **B. Zhou**, X. Tang, H. Zhang and X. Wang. "Measuring Crowd Collectiveness." IEEE transaction on Pattern Analysis and Machine Intelligence (**TPAMI**), 2014. [\[webpage\]](#)
4. **B. Zhou**, X. Tang and X. Wang. "Learning Collective Crowd Behaviors with Dynamic Pedestrian-Agents." International Journal of Computer Vision (**IJCV**), 2014. [\[webpage\]](#)
5. L.Liu, **B. Zhou**, J. Zhao, B.D.Ryan. "C-IMAGE: City Cognitive Mapping through Geo-tagged Photos." GeoJournal, Springer, 2016.

## Conference Publications

6. H. Zhao, X. Puig, **B. Zhou**, S. Fidler, and A. Torralba. "Open Vocabulary Scene Parsing." International Conference on Computer Vision (**ICCV'17**), 2017.
7. Y. Li, W. Ouyang, **B. Zhou**, K. Wang, and X. Wang. "Scene Graph Generation from Objects, Phrases and Region Captions." International Conference on Computer Vision (**ICCV'17**), 2017.
8. **B. Zhou**, H. Zhao, X. Puig, S. Fidler, A. Barriuso and A. Torralba. "Scene Parsing through ADE20K Dataset." Computer Vision and Pattern Recognition (**CVPR'17**), 2017. [\[webpage\]](#)[\[ADE dataset\]](#)
9. D. Bau\*, **B. Zhou**\*, A. Khosla, A. Oliva. and A. Torralba. "Network Dissection: Quantifying Interpretability of Deep Visual Representations." Computer Vision and Pattern Recognition (**CVPR'17**) **Oral** (3% acceptance rate), 2017. \* indicates equal contribution. [\[webpage\]](#)
10. S. Li, T. Xiao, H. Li, **B. Zhou**, D. Yue, and X. Wang. "Person Search with Natural Language Description." Computer Vision and Pattern Recognition (**CVPR'17**), 2017.
11. J. Wong, V. Kee, T. Le, S. Wagner, G. Mariottini, A. Schneider, L. Hamilton, R. Chiaplakatty, M. Herbert, D. Johnson, J. Wu, **B. Zhou**, and A. Torralba. "SepICP: Integrated Deep Semantic Segmentation and Pose Estimation." IEEE International Conference on Intelligent Robots and Systems (**IROS'17**) **Oral**.
12. **B. Zhou**, A. Khosla, A. Lapedriza, A. Oliva, and A. Torralba. "Learning Deep Features for Discriminative Localization." Computer Vision and Pattern Recognition (**CVPR'16**), 2017. [\[webpage\]](#)
13. Z. Wang, **B. Zhou**, S. Jegelka. "Optimization as Estimation with Gaussian Processes in Bandit Settings." Artificial Intelligence and Statistics (**AISTATS'16**) **Oral** (6% acceptance rate).
14. **B. Zhou**, A. Khosla, A. Lapedriza, A. Oliva, and A. Torralba. "Object Detectors Emerge in Deep Scene CNNs." International Conference on Learning Representations (**ICLR'15**) **Oral**.
15. **B. Zhou**, V. Jagadeesh, and R. Piramuthu. "Discovering Visual Concepts from Weakly Labeled Image Collections." Proceedings of 26th IEEE Conference on Computer Vision and Pattern Recognition (**CVPR'15**).
16. **B. Zhou**, J. Xiao, A. Lapedriza, A. Torralba, and A. Aude "Learning Deep Features for Scene Recognition using PLACES Database." Advances in Neural Information Processing Systems 27 (**NIPS'14**), **Spotlight** (3.7% acceptance rate). [\[webpage\]](#) [\[demo\]](#)
17. **B. Zhou**, L. Liu, A. Oliva and A. Torralba. "Recognizing City Identity via Attribute Analysis of Geo-tagged Images." Proceedings of 13th European Conference on Computer Vision (**ECCV'14**).
18. **B. Zhou**, X. Tang and X. Wang. "Measuring Crowd Collectiveness." Proceedings of 26th IEEE Conference on Computer Vision and Pattern Recognition (**CVPR'13**), **Oral** (3% acceptance rate).
19. **B. Zhou**, X. Tang and X. Wang. "Coherent Filtering: Detecting Coherent Motions from Crowd Clusters." Proceedings of 12th European Conference on Computer Vision (**ECCV'12**).
20. **B. Zhou**, X. Wang and X. Tang. "Understanding Collective Crowd Behaviors: Learning a Mixture Model of Dynamic Pedestrian-Agents." Proceedings of 25th IEEE Conference on Computer Vision and Pattern Recognition (**CVPR'12**), **Oral** (2.5% acceptance rate).

21. M. Zhu and **B. Zhou**. "Modeling Manifold Ways of Scene Perception". Proceedings of 18th International Conference On Neural Information Processing (**ICONIP'12**).
22. **B. Zhou**, X. Wang and X. Tang. "Random Field Topic Model for Semantic Region Analysis in Crowded Scenes from Tracklets." Proceedings of 24th IEEE Conference on Computer Vision and Pattern Recognition (**CVPR'11**).
23. **B. Zhou**, X. Hou and L. Zhang. "A phase discrepancy analysis of object motion. " Proceedings of 10th Asian Conference on Computer Vision (**ACCV'10**).
24. **B. Zhou** and L.Zhang. "Scene Gist: a holistic generative model of natural image". in Proceedings of 9th Asian Conference on Computer Vision (**ACCV'09**).
25. **B. Zhou** and L. Zhang. "A hierarchical model for visual perception." Proceedings of 2rd International Conference on Cognitive Neurodynamics (**ICCN'09**).

## ArXiv Preprints

26. **B. Zhou**, A. Andonian, A. Torralba . "Temporal Relational Reasoning in Videos." arXiv:1711.08496, 2017. (CVPR'18 submission)
27. Y. Li, N. Duan, **B. Zhou**, X. Chu, W. Ouyang, X. Wang. "Visual Question Generation as Dual Task of Visual Question Answering." arXiv:1709.07192, 2017. (CVPR'18 submission)
28. **B. Zhou**, H. Zhao, X. Puig, S. Fidler, A. Barriuso and A. Torralba. "Semantic Understanding of Scenes through ADE20K Dataset." arXiv:1608.05442, 2016.
29. **B. Zhou**, S. Sukhbaatar, A. Szlam, R. Fergus, Yuandong Tian. "Simple Baseline for Visual Question Answering." arXiv:1512.02167, 2016.
30. D. Wei, **B. Zhou**, A. Torralba, W. Freeman. "Understanding Intra-Class Knowledge inside CNN." arXiv:1507.02379, 2015.

## Workshop Papers

31. **B. Zhou\***, D. Bau\*, A. Oliva, and A. Torralba. "Comparing the Interpretability of the Deep Visual Representations via Network Dissection." NIPS'17 Workshop on Interpreting, Explaining, and Visualizing Deep Learning.
32. **B. Zhou\***, D. Bau\*, A.Oliva, and A. Torralba. "Quantifying Interpretations of Deep Visual Representations." ICML'17 Workshop on Visualization for Deep Learning.
33. D. Bau\*, **B. Zhou\***, A. Khosla, A. Oliva. and A. Torralba. "Network Dissection: Quantifying Interpretability of Deep Visual Representations." CVPR'17 Scene Understanding Workshop (SUNw), 2017.
34. **B. Zhou**, A. Khosla, A. Lapedriza, A. Oliva, and A. Torralba. "Object Detectors Emerge from Training CNNs for Scene Recognition." CVPR'15 Scene Understanding Workshop (SUNw), 2015.
35. **B. Zhou**, X. Tang, X. Wang. "Measurability of Crowd Collectiveness in Dynamic Scenes." CVPR'13 Scene Understanding Workshop (SUNw), 2013.

## Talks

### **Interpreting Deep Visual Representations via Network Dissection**

VASC seminar at Carnegie Mellon University, Nov. 2017

New England Computer Vision Workshop, Nov.2017

### **Interpreting Deep Visual Representations**

ICML'17 workshop on Visualization for Deep Learning, Sydney

CVPR'17 Tutorial on Deep Learning for Objects and Scenes, Hawaii

**Network Dissection: Quantifying the Interpretability of Deep Visual Representations**  
CVPR'17, Hawaii

**Understand and Leverage the Internal Representations of CNNs**  
Guest Lecture of the Computer Vision course at Tufts, Mar. 2017  
Cornell Tech, Sept 2016  
Harvard, April 2016  
Boston University, Nov. 2015

**Challenges in Deep Scene Understanding**  
ECCV'16 ILSVRC and COCO joint workshop, Oct. 2016, Amsterdam.

**Object Detectors Emerge in Deep Scene CNNs**  
ICLR'15, May 2015, San Diego

**Learning Deep Features for Scene Recognition**  
NIPS'14, Dec. 2014, Montreal

**Measuring Crowd Collectiveness**  
CVPR'13, June 2013, Portland.

**Understanding Crowd Behaviors**  
CVPR'12, June 2012, Rhode Island.

## Work Experiences

**Research Assistant at CSAIL MIT** Oct 2013 – Present  
Computer Vision Group

- developing tools to understand and interpret deep neural networks
- working on visual scene understanding, such as scene recognition and relation reasoning.

**Research Intern at Facebook AI Research** May 2016 – Sept 2016  
Vision Team

- developed reinforcement learning algorithms for visual navigation inside images
- worked with Larry Zitnick and Yuandong Tian

**Research Intern at Facebook AI Research** June 2015 – Sept 2015  
Vision Team

- developed vision and text model for visual question answering
- worked with Rob Fergus, Arthur Szlam, and Yuandong Tian

**Intern Research Scientist at eBay Research Labs** May 2014 – Aug 2014  
Vision Group

- developed novel algorithms to discover concepts from weakly labeled image collections

**Summer Intern at Microsoft Research Asia** May 2013 – Aug 2013  
Knowledge Mining Group

- developed a tool to analyze user migration among online communities, applied to analyze the large-scale user records from Bing Search Engine

**Research Assistant at The Chinese University of Hong Kong** Aug 2010 – May 2013  
Multimedia Laboratory

- worked on activity recognition and crowd behavior analysis in videos

**Undergraduate Research Assistant at Shanghai Jiao Tong University** Jan 2009 – July 2010  
MOE-Microsoft Key Laboratory of Intelligent Computing

- worked on object detection in videos

## Professional Services

**Panelist**, NIPS'17 Interpretable Machine Learning Symposium  
**Program Committee**, ICML'17 workshop on Visualization for Deep Learning  
**Co-Organizer**, the Joint COCO and Places Recognition Challenge Workshop at ICCV'17  
**Organizer**, the Places Challenge 2017 at ICCV'17  
**Organizer and Lecturer**, Tutorial on Deep Learning for Objects and Scenes at CVPR'17  
**Organizer**, 5th Scene Understanding Workshop(SUNw) at CVPR'17  
**Organizer**, Places365 Challenge 2016 and Scene Parsing Challenge 2016 at ECCV'16  
**Co-organizer**, ILSVRC'16 (ImageNet) challenge workshop at ECCV'16  
**Organizer**, Places2 Scene Recognition Challenge at ICCV'15  
**Chair**, the MIT Vision Seminar  
**Conference reviewer**: BMVC'17, ICCV'17, CVPR'17, ECCV'16, CVPR'16, ICCV'15, CVPR'15, ECCV'14, ACCV'14, CVPR'13  
**Journal reviewer**: International Journal on Computer Vision, The Visual Computer, Computer Vision and Image Understanding, IEEE Trans on PAMI, IEEE Trans on NNLS, IEEE Trans on Image Processing, IEEE Trans on SMC., IEEE Trans on CSVT, PLOS ONE, Signal Processing: Image Communication, Pattern Recognition

## Teaching Experiences

- MIT Sloan Business School and MIT CSAIL** Sept 2017 – Dec 2017  
Course Facilitator for MIT online Course: Artificial Intelligence: Implications for Business Strategy
- Developed and reviewed materials of AI technologies for business applications
  - Opened online sessions with more than 700 participants
  - Instructor: Thomas Malone and Daniela Rus
- Massachusetts Institute of Technology** Sept 2015 – Dec 2015  
Teaching Assistant for MIT 6.869 Advances in Computer Vision
- Developed course materials and assignments for deep neural networks
  - Developed the Mini-Places Classification challenge as student's final project
  - Instructors: Aude Oliva and Yusuf Aytar
- Chinese University of Hong Kong** Sept 2012 – Dec 2012  
Teaching Assistant for CUHK IEMS5707 Multimedia Coding and Processing
- Developed course materials and assignments, gave tutorials on image processing.
  - Instructor: Xiaou Tang