

# MANMOHAN CHANDRAKER

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## EDUCATION

2003 – 2009      **University of California, San Diego**  
Ph.D. in Computer Science  
Thesis: *From Pictures to 3D: Global Optimization for Scene Reconstruction*

1999 – 2003      **Indian Institute of Technology, Bombay**  
B.Tech. in Electrical Engineering

## WORK EXPERIENCE

2016 – Present	University of California, San Diego	Assistant Professor
2015 – 2016	NEC Labs America	Department Head
2014 – 2015	NEC Labs America	Senior Researcher
2011 – 2014	NEC Labs America	Researcher
2009 – 2011	University of California, Berkeley	Postdoctoral Scholar
May – Dec 2008	Honda Research Institute	Intern
Jun – Sep 2006	Microsoft Research Cambridge	Summer Intern

## RESEARCH INTERESTS

Shape and perception with complex materials and illumination  
3D scene understanding and recognition for autonomous driving  
Real-time structure-from-motion and robotic navigation  
Semantics and recognition for dense 3D reconstruction  
Global light transport in computer vision and graphics  
Optimization methods in geometric reconstruction

## HONORS

2016      Outstanding Reviewer Award at ECCV  
2016      Business Contribution Award at NEC Labs America  
2015      Business Contribution Award at NEC Labs America  
2014      IEEE Computer Society Best Paper Award at CVPR  
2013      SPOT Recognition Award at NEC Labs America  
2012      SPOT Recognition Award at NEC Labs America  
2011      IEEE PAMI Special Issue on Best Papers of CVPR 2011  
2010      UCSD nominee for ACM Doctoral Dissertation Award  
2009      IEEE Computer Society Outstanding Reviewer Award at ICCV  
2009      CSE Dissertation Award for Best Thesis at UCSD  
2007      Marr Prize Honorable Mention for Best Paper at ICCV  
2003      UC San Diego and Cal(IT)<sup>2</sup> Fellowship  
2002      Best Undergraduate Research Survey (EE, IIT-Bombay), 2002  
1999      Ranked in top 30 in Indian National Chemistry Olympiad  
1998      Ranked 1<sup>st</sup> in state in Regional Mathematics Olympiad  
1997      Ranked 2<sup>nd</sup> in India in Association of Mathematics Teachers' Talent Tests  
1997      National Talent Search Scholarship from Govt. of India (ranked 9<sup>th</sup> in state)

## SUMMARY OF IMPACT

- *Academic:* My publications have appeared at highly selective venues, including several oral presentations at CVPR, ICCV and ECCV (acceptance rates 3–5%). My work has been recognized with the Best Paper Award at CVPR 2014, Marr Prize Honorable Mention at ICCV 2007 and a PAMI Special Issue on Best Papers of CVPR 2011. My Ph.D. thesis won the Best Thesis Award at UCSD and was nominated for the ACM Dissertation Award.

- *Industrial:* My team’s work on 3D scene understanding for autonomous driving has established new research and business directions at NEC. It has attracted significant research funding and led to collaborations with leading automobile manufacturers. Our research in image recognition has been deployed globally for security applications.

## PUBLICATIONS

### Journal Articles <sup>††</sup>

1. **M. Chandraker**. *The Information Available to a Moving Observer on Shape Recovery with Unknown Isotropic BRDF*. IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI 38(7):1283-1297, July 2016. [**Special Issue, Best Papers of CVPR 2014**]
2. **M. Chandraker**, J. Bai and R. Ramamoorthi. *On Differential Photometric Reconstruction with Unknown, Isotropic BRDFs*. IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI 35(12):2941-2955, December 2013 [**Special Issue, Best Papers of CVPR 2011**].
3. **M. Chandraker**, J. Bai, T.-T Ng and R. Ramamoorthi. *On the Duality of Forward and Inverse Light Transport*. IEEE Transactions on Pattern Analysis and Machine Intelligence, PAMI 33(10):2122-2128, October 2011.
4. **M. Chandraker**, S. Agarwal, D.J. Kriegman and S. Belongie. *Globally Optimal Algorithms for Stratified Autocalibration*. International Journal of Computer Vision, IJCV 90(2):236-254, November 2010. [**Special Issue, Best Papers of ICCV 2007**]
5. F. Kahl, S. Agarwal, **M. Chandraker**, D.J. Kriegman and S. Belongie. *Practical Global Optimization for Multiview Geometry*. International Journal of Computer Vision, IJCV 79(3):271-284, September 2008.

### Refereed Conferences <sup>‡‡</sup>

6. C. Choy, J. Gwak, S. Savarese and **M. Chandraker**. *Universal Correspondence Network*. Neural Information Processing Systems, NIPS 2016. [**oral presentation**] [*to appear*]
7. X. Yu, F. Zhou and **M. Chandraker**. *Deep Deformation Network for Object Landmark Localization*. European Conference on Computer Vision, ECCV 2016. [*to appear*]
8. T.-C. Wang, E. Hiroaki, J. Zhu, **M. Chandraker**, A. Efros and R. Ramamoorthi. *A 4D Light-Field Dataset and CNN Architectures for Material Recognition*. European Conference on Computer Vision, ECCV 2016. [*to appear*]
9. A. Kanazawa, D. Jacobs and **M. Chandraker**. *WarpNet: Weakly Supervised Matching for Single-View Reconstruction*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2016.
10. T.-C. Wang, **M. Chandraker**, A. Efros and R. Ramamoorthi. *SVBRDF-Invariant Shape and Reflectance Recovery from Light Fields*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2016. [**oral presentation**]
11. V. Dhiman, Q.-H. Tran, J. Corso and **M. Chandraker**. *A Continuous Occlusion Model for Road Scene Understanding*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2016.
12. C.-Y. Chen, W. Choi and **M. Chandraker**. *Atomic Scenes for Scalable Traffic Scene Recognition*. IEEE Winter Conference on Applications of Computer Vision, WACV 2016.
13. S. Song and **M. Chandraker**. *High Accuracy 3D Object Localization for Autonomous Driving Using SFM and Detection Cues*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2015. [**oral presentation**]

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<sup>††</sup>IEEE PAMI and IJCV have among the highest ISI impact factors across all computer science categories. In 2011, PAMI was ranked second in computer science, with ISI 4.908. In 2008, IJCV was ranked fourth with ISI 5.358.

<sup>‡‡</sup>ICCV, CVPR and ECCV are premier conferences in computer vision. For each, typical number of submissions is around 2000. Overall acceptance rates are about 20% and oral presentations have an acceptance rate of about 3–5%.

14. **M. Chandraker**. *On Joint Shape and Material Recovery from Motion Cues*. European Conference on Computer Vision, ECCV 2014.
15. **M. Chandraker**. *What Camera Motion Reveals About Shape with Unknown BRDF*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2014. [**oral presentation, 4% accepted**] [**Best Paper Award**] \*\*
16. S. Song and **M. Chandraker**. *Robust Scale Estimation in Real-Time Monocular SFM for Autonomous Driving*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2014.
17. **M. Chandraker**, D. Reddy, Y. Wang and R. Ramamoorthi. *What Motion Reveals About Shape with Unknown BRDF and Lighting*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2013. [**oral presentation, 4% accepted**]
18. Y. Bao, **M. Chandraker**, Y. Lin and S. Savarese. *Dense Object Reconstruction with Semantic Priors*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2013. [**oral presentation, 4% accepted**]
19. S. Song and **M. Chandraker**. *Parallel, Real-Time Monocular Visual Odometry*. IEEE Conference on Robotics and Automation, ICRA 2013.
20. **M. Chandraker** and R. Ramamoorthi. *What an Image Reveals About Material Reflectance*. IEEE International Conference on Computer Vision, ICCV 2011. [**oral presentation, 3% accepted**]
21. **M. Chandraker**, J. Bai and R. Ramamoorthi. *A Theory of Differential Photometric Stereo for General Isotropic BRDFs*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2011. [**oral presentation, 3.5% accepted**]
22. J. Bai, **M. Chandraker**, T.-T. Ng and R. Ramamoorthi. *A Dual Theory of Inverse and Forward Light Transport*. European Conference on Computer Vision, ECCV 2010.
23. **M. Chandraker**, J. Lim and D.J. Kriegman. *Moving in Stereo: Efficient Structure and Motion Using Lines*. IEEE International Conference on Computer Vision, ICCV 2009.
24. **M. Chandraker** and D.J. Kriegman. *Globally Optimal Bilinear Programming for Computer Vision Applications*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2008. [**oral presentation, 4% accepted**]
25. **M. Chandraker**, S. Agarwal, D.J. Kriegman and S. Belongie. *Globally Optimal Affine and Metric Upgrades in Stratified Autocalibration*. IEEE International Conference on Computer Vision, ICCV 2007. [**oral presentation, 4% accepted**] [**Marr Prize Honorable Mention for Best Paper**]\*\*
26. A. Agarwal, S. Izadi, **M. Chandraker** and A. Blake. *High Precision Multi-touch Sensing on Surfaces using Overhead Cameras*. IEEE Tabletop 2007.
27. **M. Chandraker**, S. Agarwal and D.J. Kriegman. *ShadowCuts: Photometric Stereo with Shadows*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2007.
28. **M. Chandraker**, S. Agarwal, F. Kahl, D. Nistér and D.J. Kriegman. *Autocalibration via Rank-Constrained Estimation of the Absolute Quadric*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2007.
29. S. Agarwal, **M. Chandraker**, F. Kahl, D.J. Kriegman and S. Belongie. *Practical Global Optimization for Multiview Geometry*. European Conference on Computer Vision, ECCV 2006. [**oral presentation, 5% accepted**]
30. **M. Chandraker**, F. Kahl and D.J. Kriegman. *Reflections on the Generalized Bas-Relief Ambiguity*. IEEE Conference on Computer Vision and Pattern Recognition, CVPR 2005. [**oral presentation, 5% accepted**]

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\*\*IEEE CVPR is the highest rated publication venue for computer vision and seventh-highest across all engineering and computer sciences, according to Google Scholar metrics.

\*\*The Marr Prize is one of the top honors in computer vision, awarded once in two years to the best paper at ICCV.

31. **M. Chandraker**, C. Stock and A. Pinz. *Real-Time Camera Pose in a Room*. International Conference on Computer Vision Systems, ICVS 2003.
32. C. Stock, U. Mühlmann, **M. Chandraker** and A. Pinz. *Subpixel Corner Detection for Tracking Applications using CMOS Camera Technology*. Austrian Association of Pattern Recognition, AAPR 2002.

### Refereed Book Chapters

33. **M. Chandraker**. *The Bas-Relief Ambiguity*. Computer Vision: A Reference Guide (ed. K. Ikeuchi), pages 43–46.

### PATENT APPLICATIONS

- C. Choy and **M. Chandraker**. *End-to-End Fully Convolutional Feature Learning for Patch Similarity*. NEC Labs America.
- X. Yu, F. Zhou and **M. Chandraker**. *Deep Deformation Network for Object Landmark Localization*. NEC Labs America.
- G. Chen, W. Choi, E. Lau, E. Wong and **M. Chandraker**. *Baby Detection for e-Gate Environments*. NEC Labs America.
- X. Yu, E. Lau, E. Wong and **M. Chandraker**. *Liveness Detection for Antispoof Face Recognition*. NEC Labs America.
- A. Kanazawa and **M. Chandraker**. *Unsupervised Matching in Fine-Grained Datasets for Single-View Object Reconstruction*. NEC Labs America.
- V. Dhiman and **M. Chandraker**. *Continuous Occlusion Models for Traffic Participant Interactions in 3D Road Scene Understanding*. NEC Labs America.
- C.-Y. Chen, W. Choi and **M. Chandraker**. *Atomic Scenes for Scalable Traffic Scene Recognition*. NEC Labs America.
- M. Chandraker** and S. Song. *Monocular 3D Object Localization Using Dense Tracking and Object Detection*. NEC Labs America.
- M. Chandraker**. *Shape and Dichromatic BRDF Estimation Using Camera Motion*. NEC Labs America.
- M. Chandraker**. *Shape and Material from Object Motion with Application to Relighting*. NEC Labs America.
- D. Tran and **M. Chandraker**. *Trajectory Features and Supervised Distance Metrics for Hierarchical Video Segmentation*. NEC Labs America.
- M. Chandraker**. *Shape from Camera Motion for Unknown Material Reflectance*. NEC Labs America.
- M. Chandraker** and S. Song. *Monocular 3D Localization for Autonomous Driving Using Adaptive Ground Plane Estimation*. NEC Labs America.
- M. Chandraker**, S. Song, X. Wang and Y. Lin. *Moving Object Localization in 3D Using a Single Camera*. NEC Labs America.
- M. Chandraker**, D. Reddy, Y. Wang and R. Ramamoorthi. *Shape from Motion for Unknown, Arbitrary Lighting and Reflectance*. NEC Labs America.
- S. Song and **M. Chandraker**. *Real-Time Monocular Structure from Motion for Autonomous Driving*. NEC Labs America.
- Y. Bao, **M. Chandraker**, Y. Lin and S. Savarese. *Semantic Dense 3D Reconstruction*. NEC Labs America.
- S. Song and **M. Chandraker**. *Parallel, Real-Time Monocular Visual Odometry*. NEC Labs America.

M. Chandraker and K. Yu. *Shape from Differential Motion with Unknown Reflectance*. NEC Labs America.

M. Chandraker and J. Lim. *Line-Based Stereo Structure and Motion Solvers*. Honda Research Institute, USA Inc.

## SELECTED TALKS

Joint Shape and Material Recovery from Motion. *IIT-Hyderabad, India, 2014*.

Towards Monocular 3D Scene Understanding for Autonomous Driving. *IIT-Bombay, India, 2014*.

What Camera Motion Reveals about Shape with Unknown BRDF. *CVPR 2014, Columbus, Ohio*.

What Object Motion Reveals about Shape with Unknown BRDF and Lighting. *CVPR 2013, Portland, Oregon*.

What an Image Reveals about Material Reflectance. *ICCV 2011, Barcelona, Spain*.

Differential Photometric Reconstruction for Unknown BRDF and Lighting. *CVPR 2011, Colorado Springs, Colorado*.

Complex Reflectance and Light Transport in 3D Reconstruction. *EECS Seminar, UC Merced, January 2011*.

From Pictures to 3D: A Global Optimization Approach. *Invited Talk, Data Mining and Optimization Session, INFORMS 2009, San Diego*.

New Methods in Geometric and Photometric 3D Reconstruction. *UC Berkeley, April 2009*.

Better, Faster, Stronger Optimization for Structure and Motion. *University of North Carolina, Chapel Hill, February 2009*.

Globally Optimal Bilinear Programming. *CVPR 2008, Anchorage, Alaska*.

Globally Optimal Stratified Autocalibration. *ICCV 2007, Rio de Janeiro, Brazil*.

Practical Global Optimization for Multiview Geometry. *ECCV 2006, Graz, Austria*.

Inter-reflections Resolve the Generalized Bas-Relief Ambiguity. *CVPR 2005, San Diego*.

## ACADEMIC SERVICES

Tutorial and Workshop Chair, International Conference on 3D Vision, 2016

Area Chair, IEEE Conference on Computer Vision and Pattern Recognition, 2016

Area Chair, Indian Conference on Computer Vision, Graphics and Image Processing, 2014, 2016

Program Committee, IEEE Conference on Computer Vision and Pattern Recognition

Program Committee, IEEE International Conference on Computer Vision

Program Committee, European Conference on Computer Vision (Springer)

Reviewer, IEEE Transactions on Pattern Analysis and Machine Intelligence

Reviewer, International Journal of Computer Vision (Springer)

Reviewer, IEEE Transactions on Robotics

Reviewer, IEEE Transactions on Image Processing

Reviewer, ACM Transaction on Graphics, SIGGRAPH and SIGGRAPH Asia

## TEACHING EXPERIENCE

Summer 2011 CS 121: Introduction to Artificial Intelligence Stanford University  
(*Guest Lecturer*)

Winter 2008 CSE 252B: Graduate Computer Vision II University of California, San Diego  
(*Guest Lecturer*)

Spring 2006 CSE 152: Introduction to Computer Vision University of California, San Diego  
(*Teaching Assistant, rated 4.6 out of 5*)

## **STUDENT MENTORSHIP**

*NEC PhD internship program:* Ying Xiong (Harvard, 2011), Shiyu Song (UCSD, 2012-2014), Yingze Bao (U. Michigan Ann Arbor, 2012), Du Tran (Dartmouth, 2013), Chenliang Xu (SUNY Buffalo and U. Michigan Ann Arbor, 2014), Vikas Dhiman (SUNY Buffalo and U. Michigan Ann Arbor, 2014), Chao-Yeh Chen (UT Austin, 2014), Angjoo Kanazawa (U. Maryland, 2015), Christopher Choy (Stanford University, 2015).

*Served on PhD committee:* Shiyu Song (UCSD, 2014).

## **REFERENCES**

Available on request.