

# Ravi Ramamoorthi

Computer Science and Engineering  
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## EDUCATION

- 6/98-8/02 **Stanford University**  
Ph.D. in Computer Science (Research Area: Computer Graphics and Computer Vision)  
Thesis: *A Signal-Processing Framework for Forward and Inverse Rendering*
- 9/94-6/98 **California Institute of Technology**  
B.S. in Engineering and Applied Science, M.S. in Computer Science, M.S. in Physics

## EMPLOYMENT

- 3/16– **University of California, San Diego**, Ronald L. Graham Chair of Computer Science  
7/15– Director, UC San Diego Center for Visual Computing  
7/14– Professor of CSE; affiliate in ECE
- 7/09– 6/14 **University of California, Berkeley**, Associate Professor of EECS (promoted to full 7/1/14)
- 1/09– 6/09 **University of California, Berkeley**, Acting Associate Professor of EECS
- 1/07–12/08 **Columbia University**, Associate Professor of Computer Science (tenure effective 7/1/08)
- 9/02–12/06 **Columbia University**, Assistant Professor of Computer Science

## AWARDS AND HONORS

*ACM SIGGRAPH Academy*, for groundbreaking theoretical work in mathematical representations of visual appearance, and for translating these into computational methods with wide practical impact, Aug 2019.

*ACM Fellow* for contributions to computer graphics rendering and physics-based computer vision, Dec 2017.

*edX Prize for Exceptional Contributions in Online Teaching and Learning* (One of 10 finalists in all subjects worldwide; only recipient in computer science and only two-time finalist; presented Vancouver, Dec 2017).

*IEEE Fellow* elevation for contributions to foundations of computer graphics and computer vision, Jan 2017.

*edX Prize for Exceptional Contributions in Online Teaching and Learning* (One of 11 finalists worldwide for inaugural edX prize; announced and finalists presented at edX global forum in Paris, Nov 2016).

*Ronald L. Graham Chair of Computer Science* Inaugural holder of endowed chair, UC San Diego, Jan 2016.

*ACM Distinguished Scientist* elevation for significant impact on the computing field, Nov 2015.

*5 Google and Google Virtual Reality Research Awards*, 2014-2018.

*Okawa Foundation Research Grant* “A Digital Visual Appearance Pipeline in Computer Graphics” (6 awards in the USA in Information Technology in 2011), Nov 2011.

*Eurographics Recognition of Service Award*, for service as papers co-chair of EGSR, Eurographics, 2011.

*Best Paper and Image Awards*: Best paper at 2011 ACM Symposium on Interactive 3D graphics, Honorable mention for best paper at SciVis 2014, Cover image of inaugural Siggraph Asia 2008, Inset page of Siggraph 2011, Cover of 2012 Computer Graphics Forum, Cover of April 2013 ACM Transactions on Graphics.

*Presidential Early Career Award for Scientists and Engineers* (The PECASE is conferred by the President and is the highest honor bestowed by the US Govt on early career researchers), White House, Dec 19, 2008.

*ACM SIGGRAPH Significant New Researcher Award* (highest early career award for computer graphics researchers; 1 award made per year among all “new” academic/industrial researchers), Aug 2007. See video introducing my work at <https://www.youtube.com/watch?v=qpyCXqXGe7I>

*ONR Young Investigator Award* “Mathematical Models of Illumination and Reflectance for Image Understanding and Machine Vision” (2 awards per year in computer science), Office of Naval Research, Mar 2007.

*Sloan Fellowship in Computer Science* (16 awards per year in computer science to junior faculty; only award in computer graphics in 2005), Alfred P. Sloan Foundation, Sep 2005.

*NSF CAREER Award*, “Mathematical and Computational Fundamentals of Visual Appearance for Computer Graphics” (usually 3 awards per year in computer graphics), National Science Foundation, Feb 2005.

*Stanford Graduate Fellowship* (awarded to 1% of PhD applicants), 1998-2002.

*Green Prize for Creative Scholarship*, California Institute of Technology (1 or 2 awards made per year among all undergraduates for outstanding research), 1997.

*2<sup>nd</sup> All-India Rank*, IIT JEE (of 200,000+ candidates for the Indian Institute of Technology), 1994.

*2<sup>nd</sup> Place Worldwide*, International Computer Problem Solving Contest, Elementary BASIC Division, 1992.

## IMPACT SUMMARY

- *Academic Research Impact*
  - *Publications and Citations:* More than 150 papers, including 75 at ACM SIGGRAPH/TOG (among top 10 most productive all-time SIGGRAPH authors worldwide over entire career), with an h-number of 57 (11,000+ total citations). 33 of my papers are cited 100+ times according to Google Scholar. 6 of these are cited more than 400 times. See page 9 for publications.
  - *Awards:* Six major early career awards including White House PECASE and ACM Siggraph Significant New Researcher. Elevated to both IEEE and ACM fellow in 2017, and inducted into SIGGRAPH Academy in 2019. Six best paper and cover images as listed on page 1. Students won industry/govt fellowships for our work: Microsoft (Ren Ng, Charles Han), Intel (Ryan Overbeck), ATI (Charles Han), NSF (Michael Tao, Pratul Srinivasan), NDSEG (Pratul Srinivasan), Siebel (Brandon Wang), NVIDIA (Soham Mehta, LingQi Yan, Lifan Wu), Adobe (Zexiang Xu), Google (Tiancheng Sun). LingQi Yan won the 2019 ACM SIGGRAPH Outstanding Doctoral Dissertation Award, the first winner in the sub-area of rendering. Earlier, he received the 2017-18 CV Ramamoorthy Distinguished Research Award for best graduate research at UC Berkeley CS, the first time in 22 years of this award it was given to a computer graphics student. Jingwen Wang won the 2017-18 UCSD CSE M.S. research award for best masters research, while Zexiang Xu received the 2018-19 UCSD CSE Ph.D. research award, the first such awards in computer graphics in both cases. Former postdoc Manmohan Chandraker won the CVPR 2014 best paper award for line of work started at Berkeley, and subsequently a 2018 NSF CAREER Award.
- *Educational Impact:* Developed complete graphics curricula at Berkeley, Columbia, UCSD. Taught first-ever open online computer graphics course (edX, Nov 5–Dec 17, 2012), with 15,000 registered students of whom 892 received completion certificates. With re-offerings Mar–Apr and Oct–Dec 2013–20, total of more than 100,000 registered students in all 10+ classes, with more than 2,500 completions. Licensing by XuetangX for translation (public offering in Mandarin in Fall 2014). Public online lectures available at <http://www.youtube.com/user/raviramamoorthi> have received more than 500,000 views and 3,000+ subscribers. UCSD CSE 167x featured as one of top 3 courses among all MOOCs on Class Central Aug 2015. Open courseware available <http://inst.eecs.berkeley.edu/~cs184/fa12/onlinelectures.html> Currently offered as part of first professional certificate in virtual reality. I was one of 11 finalists across all subject areas worldwide for *inaugural edX Prize for exceptional contributions in online teaching and learning* in 2016, and again in 2017 (only Computer Science recipient and only two-time finalist).
- *Mentoring Impact and Students:* 23 Postdoctoral, Ph.D. students graduated; see page 5 (4 advisees currently tenure-track faculty in US, 6 in research labs, many collaborators).
- *Most Significant Industrial Impact:* Spherical Harmonic (SH) Lighting, introduced in my dissertation (2001, 2002) [5,76] is now standard in video games (e.g., Halo series) and movies (a standard feature in RenderMan 16, from mid-2011). It is also now included in standard textbooks (OpenGL red book, Real-Time Rendering book, PBRT). Weta Digital received an Academy of Motion Pictures Technical Certificate in 2014 for their implementation of SH lighting in Avatar (2010). Spherical harmonics are also the method of choice for modeling environment illumination in many computer vision applications. Importance sampling methods (2003, 2004) [8,10] are now widely adopted in movie production, built into RenderMan 16. I have consulted and collaborated with Pixar in this regard [92,93]. Methods based on unstructured light in spacetime stereo (2003) [79,114] are widely used in 3D RGBD sensors. Early work (2009) on sampling and reconstruction for Monte Carlo (MC) rendering [30,31] has inspired MC denoising algorithms used in almost all production renderers, and is identified as seminal in a EuroGraphics STAR report [101]. Subsequent work (2012) developed the first real-time reconstruction methods for denoising interactive physically-based renders [41], which has inspired modern real-time AI-based denoisers, integral to NVIDIA's real-time raytracing software (Optix 5 in 2017) and hardware (RTX real-time raytracing chips in 2018). As a result, physically-based (raytraced) rendering with denoising is now a reality, and an integral part of both offline and real-time rendering pipelines. Our new fur reflectance model (2015) [52] has been used for all animal fur in the movie War for the Planet of the Apes (Weta Digital special effects, 2017), nominated for a visual effects Oscar. New glint models (2014–16) [49,55] have been used in commercial renderers (AutoDesk Fusion 360) and video games (glints off snow in Rise of the Tomb Raider, 2016).
- *Research Groups:* Key role in building leading multi-faculty research groups: Visual Computing Lab (VCL) at UC Berkeley and Columbia Vision and Graphics Center (CVGC). Founder and Director of the UC San Diego Center for Visual Computing <http://viscomp.ucsd.edu>. See page 7 for details.

## SELECTED INVITED TALKS (since 2005)

- Jan-Aug 2019 “Light Fields: From Shape Recovery to Sparse Reconstruction”, *Electronic Imaging [Jan 2019] San Jose, Google Los Angeles, SPIE Applied Optical Metrology, San Diego*
- Jan 2018 “Deep HDR Dynamic Image Reconstruction”, *Invited Speaker at SPIE Electronic Imaging 2018, San Jose*
- Jul 2017 “Light Fields: From Shape Recovery to Sparse Reconstruction”, *Keynote at Light Fields for Computer Vision CVPR Workshop, Honolulu*
- Nov 2016 “Sampling and Reconstruction of High-Dimensional Visual Appearance”, *Seminar at Max Planck Institute, Saarbrucken*
- Dec 2015 “Sampling and Reconstruction of High-Dimensional Visual Appearance”, *Keynote at International Symposium on Visual Computing, Las Vegas*
- Sep 2015 “Filtering Environment Illumination for Interactive Physically-Based Rendering in Mixed Reality” *Invited Speaker, Future of Virtual Reality Conference, San Diego*
- May 2015 “Sampling and Reconstruction of High-Dimensional Visual Appearance”, *Computer Science Seminar, UC Irvine*
- Feb 2014 “Sampling and Reconstruction of High-Dimensional Visual Appearance”, *Distinguished Lecture, University of California, San Diego, ECE Colloquium [Dec 2014]*
- Oct-Nov 2013 “Sampling and Reconstruction of High-Dimensional Visual Appearance”, *Keynote at CAD/Graphics 2013, Hong Kong (co-located with SIGGRAPH Asia), ICT USC*
- Jan 2013 “Sparse and Multiresolution Representations of Visual Appearance”, *Speaker in Invited Session, Joint Mathematics Meeting 2013, San Diego*
- Oct 2012 “Physics-Based Vision: From Complex Lighting to Volumetric Scattering”, *Keynote at 2012 ECCV Color and Photometry Workshop*
- Dec 2011 “Moving Gradients: A Path-Based Method for Plausible Image Interpolation”, *Invited Speaker, Ebay Vision Day*
- Aug 2011 “Sparse and Multiresolution Representations of Visual Appearance”, *Keynote at SPIE Wavelets and Sparsity XIV*
- Aug 2011 “High Quality Real-Time Rendering”, *Lucas Arts*
- Feb-Mar 2011 “Sampling and Reconstruction of High-Dimensional Visual Appearance”, *University of Maryland, NUS, ASTAR Singapore, MIT [Oct 2010]*
- Oct 2010 “Computational Models of Visual Appearance for Computer Vision”, *ONR*
- Jul-Aug 2009 “Lighting, Reflections and Rendering: Appearance for Computer Graphics”, *Industrial Light and Magic, Adobe, Pacific Data Images, UC Berkeley [Oct 2008]*
- Feb-Apr 2008 “Representations of Visual Appearance for Computer Graphics and Vision”, *Universities of California at Berkeley, San Diego, Los Angeles, IIIT Hyderabad [Jul 08]*
- Oct 2007 “High Quality Real-Time Rendering”, *University of Washington, Bungie Studios Seattle*
- Sep 2007 “Representations of Visual Appearance for Computer Graphics and Vision”, *University of Pennsylvania, University of North Carolina at Chapel Hill*
- May 2007 “Spherical (De)Convolution for Inverse Rendering”, *Columbia University interdisciplinary Workshop on Inverse Problems*
- Mar 2007 “Fast and Accurate Soft Shadows using a Real-Time Beam Tracer”, *Intel Corporation*
- Nov 2006 “High Quality Real-Time Rendering”, *Princeton University*
- May-June 2006 “Representations of Visual Appearance for Computer Graphics”, *University of California at Berkeley, University of Washington, Microsoft Research, Cornell University*
- June 2006 “Data-Driven Appearance Representations”, *Mitsubishi Electric Research Laboratories, Carnegie Mellon University*
- May 2006 “Spherical Convolution in Computer Graphics and Vision”, *SIAM Imaging Science Conference, Minneapolis*
- Apr-Oct. 2005 “Signal-Theoretic Representations of Visual Appearance”, *Carnegie Mellon University, Massachusetts Institute of Technology, Stevens Institute of Technology, University of California San Diego, IIIT Hyderabad, Harvard University*

## TEACHING

CS 348a (Stanford)	Computer Graphics: Mathematical Methods. Teaching Assistant, winter 1999.
CS 148 (Stanford)	Introductory Computer Graphics, Summer 2001. Instructor for course.
SIGGRAPH 2002	Course Organizer (with Marschner): Acquiring Material Models by Inverse Rendering
COMS 4160 (Columbia)	Computer Graphics. Redesigned introductory undergraduate graphics course, and taught it each year, usually in fall. Spring 2003 (45 students), Fall 2003 (28 students), Fall 2004 (39 students), Fall 2005 (39 students), Fall 2006 (39 students), Spring 2008 (35 students), Fall 2008 (25 students)
COMS 4162 (Columbia)	Advanced Computer Graphics. Developed new undergraduate course. Spring 2005 (25 students), Spring 2006 (14 students). Was intended to be offered in alternate years.
COMS 6160 (Columbia)	Topics in Computer Graphics. Developed new graduate course taught every two years (content changes with each offering). Fall 2002 COMS 6998 Appearance Models (9 students), Fall 2004 Real-Time High Quality Rendering (23 students), Spring 2007 Visual Appearance Representations for Rendering (17 students).
CS 283 (Berkeley)	Developed CS 283 (earlier 294-13) as the basic graduate graphics course, taught yearly in the fall. First version co-taught with Prof. O'Brien in Fall 2009 (21 students), and sole instructor in Fall 2010 (8 students) and Spring 2013 (21 students).
CS 184 (Berkeley)	Reorganized, modernized and taught CS 184, Foundations of Computer Graphics (undergraduate graphics course) in Spring 2010 (77 students), Spring 2012 (90 students), Fall 2012 (94 students). Developed widely viewed online lectures and course material: <a href="http://inst.eecs.berkeley.edu/~cs184/fa12/onlinelectures.html">http://inst.eecs.berkeley.edu/~cs184/fa12/onlinelectures.html</a>
CSE 184.1x/167x (edX)	Taught first-ever open online computer graphics course on edX (6 week class covering key material in CS 184). First offering Nov 5–Dec 17, 2012; next offerings Mar 18–Apr 29, Oct 7–Nov 18, 2013, Oct 6–Nov 17, 2014. Offered as first UC San DiegoX course CSE 167x after transition to UCSD Aug 17–Sep 28, 2015; self-paced Dec 1, 2015–Mar 31, 2016; May 1–Sep 30, 2016. Now part of virtual reality professional certificate, Jun 1, 2017–Aug 31, 2017; re-offered 2017–18, 2018–19. First offering: 15,000 enrolled students; 892 received completion certificates; Second: 20,000 students, 535 completions; Third: 21,000 students, 520 completions; Fourth: 7,500 students; 200 completions. First UC San Diego X CSE 167x offering: 19,000 students, 324 completions; 321 self-paced completions. Licensed by Queen Rania Foundation and XuetaoX for translation into Arabic and Mandarin respectively. Mandarin MOOC offered in Fall 2014.
CSE 274 (UCSD)	Topics in Computer Graphics. New graduate course to cover advanced topics (content may change with each offering). Winter 2015 Real-Time High Quality Rendering (CSE 291, 16 students), Fall 2015 (15 students). Winter 2018 Sampling and Reconstruction of Visual Appearance (18 students). Offered Fall 2018 and annually.
CSE 167 (UCSD)	Computer Graphics. Modernized graphics course, including first use of edX edge, code and image graders, and modern OpenGL 3.1. Wi17 (120 students), Wi19 (140).
CSE 163 (UCSD)	Advanced Computer Graphics. New course follow-on to CSE 167, Spr 2015 (CSE 190, 34 students), Win 2016 (35 students), Spr 2017 (59 students), Spr 2018 (35 students).

## STUDENT COLLABORATORS AND ADVISEES

### Current Ph.D. (co-)advisees (9)

- Pratul Srinivasan [NSF/NDSEG Fellowship] (Berkeley with Ren Ng, since Aug 2014)
- Jiyang Yu [Qualcomm FMA Fellow] (UCSD ECE, since Jul 2015)
- Lifan Wu [NVIDIA Fellowship] (UCSD, since Sep 2015)
- Sai Bi (UCSD, since Sep 2015)
- Zexiang Xu [Powell-Bundle, Adobe Fellowship; PhD Research Award] (UCSD, since Sep 2015)
- Alexandr Kuznetsov (UCSD, since Sep 2016)
- Tiancheng Sun [Jacobs, SHORE, Google Fellowship] (UCSD, since Sep 2017)  
*Winner Grand Prize, ACM Undergraduate Student Research Competition 2018*
- Kai-En Lin (UCSD, since Sep 2018)
- Mohammad Shafiei (UCSD, since Sep 2018)

**Current UCSD MS advisees (2):** Andrew Bauer (since Jan 2019), Owen Jow (since Jan 2019)

## ALUMNI

- *Postdoc (9):*
  - Simon Premoze [was at ILM] (Oct 2003–Mar 2005)
  - Craig Donner [now at DeepMind] (Oct 2007-Aug 2009)
  - Adrien Bousseau [Eurographics 2011 PhD Award, now researcher at INRIA Sophia-Antipolis] (Nov 2009-Oct 2010)
  - Manmohan Chandraker [now faculty at UCSD; also head of vision at NEC Labs] (Sep 2009-May 2011)
  - Huamin Wang [now Associate Professor at Ohio State] (Oct 2009-May 2011)
  - Milos Hasan [now at AutoDesk] (Oct 2010-Sep 2012)
  - Dikpal Reddy [now at Light (earlier NVIDIA Research)] (Sep 2011-Jun 2013)
  - Eno Toeppel [was at Magic Leap] (Oct 2013-Sep 2014)
  - Nima Khademi Kalantari [now Assistant Professor at Texas A&M University] (Jan 2016-Jun 2018)
- *Ph.D. students (13):*
  - Aner Ben-Artzi [started at Sony] (since Jan 2003: Ph.D. deposit May, 2007)
  - Bo Sun [now at Intu Financial] (since Jan 2004 : Ph.D. deposit Aug, 2008)
  - Dhruv Mahajan [now at Facebook Research] (since Jan 2006 : Ph.D. deposit Aug, 2009)
  - Ryan Overbeck [now at Google] (since Sep 2006 : Ph.D. deposit Aug, 2009)
  - Jinwei Gu [now at NVIDIA Research] (since Sep 2005 : Ph.D. deposit *with distinction* May, 2010)
  - Charles Han [now at Google] (since Jan 2006 : Ph.D. deposit Jun 2011)
  - Kevin Egan [now at DE Shaw] (since Sep 2006 : Ph.D. deposit Aug 2011)
  - Jiamin Bai [now at Light] (since Jan 2010 : Ph.D. deposit Dec 2014)
  - Soham Mehta [now at Light] (since Aug 2011 : Ph.D. deposit May 2015)
  - Michael Tao [now at Apple] (since Aug 2010 : Ph.D. deposit Sep 2015)
  - Ting-Chun Wang [now at NVIDIA Resarch] (since Sep 2013 : Ph.D. deposit May 2017)
  - Ling-Qi Yan [SIGGRAPH PhD Award, now faculty UCSB] (since Aug 2013: Ph.D. deposit Jun 2018)
  - Zachary Murez [now at Magic Leap] (since Sep 2014 : Ph.D. deposit Jun 2018)
- *Ph.D. (co-)advisee (1):* Jason Lawrence [now at Google; was tenured faculty at Univ. Virginia, NSF CAREER Award 2008] (Princeton, advisor Szymon Rusinkiewicz, since Jun 2003: Ph.D. Jun 2006)
- *Ph.D. student collaborators:* Ren Ng [Microsoft Fellow, winner of 2006 ACM doctoral dissertation award, founder of Lytro, now assistant professor at Berkeley, winner of Sloan Fellowship] (Stanford, advisor Pat Hanrahan, May 2002-Jan 2004), Sameer Agarwal (UCSD, advisor Serge Belongie, Jan 2003), Srinivasa Narasimhan [now director CMU RI] (advisor Shree Nayar, Jan 2003-Jan 2006), Todd Zickler [now chaired professor at Harvard] (Yale, advisor Peter Belhumeur, Nov 2002–Feb 2005), Ira Kemelmacher Shlizerman [now faculty at University of Washington] (Weizmann Institute, advisor Ronen Basri, Jun–Aug 2006), Diego Nehab [now faculty at IMPA] (Princeton, advisor Szymon Rusinkiewicz, Jun 2003-Jun 2007), Pieter Peers [now faculty at College of William and Mary] (KU Leuven, advisor Phil Dutre, Oct-Dec 2005), Oliver Cossairt [NSF Fellow, now faculty at Northwestern] (advisor Shree Nayar, Aug 2007–Jan 2008), Rob Carroll (advisor Maneesh Agrawala, Aug 2010-Jan 2011), Florian Hecht (Sep 2009-Aug 2011), Charles de Rousiers (INRIA, advisor Nicolas Holzschuch, Mar-Sep 2010), Shuang Zhao [now faculty at UC Irvine] (Cornell, advisor Kavita Bala, Jul 2012-Jun 2014), Jannik Boll-Nielsen (DTU, Aug 2014-Jan 2016), Tzu-Mao Li (MIT, advisor Fredo Durand, Sep 2014-Jun 2017), Jun-Yan Zhu [winner of 2018 SIGGRAPH Doctoral Dissertation Award, now faculty at CMU] (Berkeley, advisor Alyosha Efros, Jan 2016-Jan 2017), Zhengqin Li (UCSD, advisor Manmohan Chandraker, Nov 2016-), Benjamin Mildenhall (Berkeley, advisor Ren Ng, Sep 2017-).
- *M.S.:* Sebastian Enrique [now at Electronic Arts] (Sep 2003–Jun 2005), Kalyan Sunkavalli [researcher at Adobe after Ph.D. at Harvard] (Sep 2004–Jul 2006), Dhruv Mahajan [M.S. thesis, then Ph.D. ] (Sep 2004–Dec 2005), Ryan Overbeck [M.S. thesis, then Ph.D. ] (Sep 2004–Dec 2005), Chien-I Tu [was Ph.D. at Texas A&M] (Jun–Sep 2005), Nandan Dixit [now at Google] (Sep 2005–Dec 2006), Yu-Ting Tseng [now at Google] (Sep 2007–Dec 2008), Eric Risser [now entrepreneur after Ph.D. at Trinity, Dublin] (Sep 2007–Dec 2008), Fu-Chung Huang [now at NVIDIA research after Ph.D. at Berkeley] (Jan–Dec 2009), Brandon Wang [Siebel Scholar, now at Pixar] (M.S., Sep 2012–Jun 2013), Chiwei Tseng [now at DreamWorks] (M.S. thesis, Oct 2014–Jun 2015), Krishna Mullia [now at Adobe] (M.S., Oct 2014–Jun 2015), Jong-Chyi Su [now Ph.D. at UMass] (M.S., Oct 2014–Jun 2015), Muhammad Riaz [now at Apple] (M.S., Oct 2014–Aug 2016), Matteo Mannino (M.S., Jan 2015–Jun 2017), Weilun Sun (M.S. Sep 2015–Sep 2017), Jingwen Wang [UCSD CSE MS Research Award 2018] (M.S. Sep

2016-Jun 2018), Jean Choi [now at VectorZero] (M.S. Oct 2017-Jun 2018), Shradha Agarwal [now at Adobe] (M.S. Oct 2017-Jun 2018).

- *B.S.*: Makiko Yasui [Theodore Bashkow award] (SEAS 2004), Zeyar Htet (SEAS 2005), Ray Ming-Yeh [Computer Science Scholarship award] (SEAS 2005), Matthew Schulkind (SEAS 2006), Michael Tao (B.S. 2010, continued Ph.D.), Brandon Wang (B.S. 2012, continued M.S.), Nicholas Estorga (B.S. 2013 Dec), Ki-Fung Woody Chow (B.S. 2013 Dec), Ziyang Li (B.S. 2019, now Ph.D. at UPenn).

**FUNDING (total PI allocation of approx. \$10M, of combined funding of more than \$13M)**

“Hardware for Light Field and 3D Geometric Learning in Scene Understanding” [PI] with H. Su. ONR \$494,850 Jun 1, 2019 – May 31, 2020.

“Learning-Based 4D Light Field Synthesis from Sparse Images for Virtual Reality” [PI] Google Research Award \$85,000 Apr 2018.

UCSD Center for Visual Computing, membership fees Samsung, Cubic, BASF, Cognex \$220,000 2017-19.

“Coatings Designed for Sensors” [co-PI] with M. Chandraker, BASF \$150,000 Dec 1, 2017 - Sep 30, 2018.

“Scalable Photorealistic Rendering for Augmented Reality on Mobile Devices” [PI] with J. Schulze, Samsung \$350,000 Dec 15, 2017 - Dec 14, 2018.

“Computer Vision and Scene Understanding with Light Field Imaging” [PI] ONR \$500,000 Sep 1, 2017 – Sep 30, 2020.

“Fast Photorealistic Computer Graphics Rendering of Non-Smooth Surfaces” [PI] with S. Marschner (Cornell), NSF \$987,537 Sep 1, 2017–Aug 31, 2021.

“High-Fidelity Shape, Reflectance from Light Field Cameras” [PI] Google Res. Award \$78,500 Apr 2017.

“Detailed Shape and Reflectance Capture with Light Field Cameras” [PI] with S. Rusinkiewicz (Princeton), NSF \$500,000 Sep 1, 2016–Aug 31, 2019.

“Photo-Realistic 3D Face Scan & Rendering” [PI] Qualcomm gift \$50,000, Aug 2016–present.

“Real-Time Photorealistic Rendering for Augmented Reality” [PI] with J. Schulze, Google Virtual Reality Research Award \$100,000 May 2016.

“Unified Multi-Cue 3D Depth Estimation from Light Field Images” [PI] Google Research Award \$74,500 Apr 2016.

“Multi-Scale Reflectance Models” [PI] Autodesk BUILD Grant (gift) \$96,000 Feb 2016.

UC San Diego Center for Visual Computing, membership fees Samsung, Cubic \$130,000 Jan 2016, 2017.

“Unified Multi-Cue Depth Estimation from Sparse Multi-Camera, Dense Light Fields” [PI] Nokia Gift \$48,821 Dec 2015–present.

“Limits and Algorithms for Shape Inference from Multi-View and Multi-Light Light Field Images” [PI] Draper \$60,000 Nov 2015–Jun 2016.

“Geometric 3D Shape, Illumination and Reflectance from RGBD Images and Videos” [PI] Sony \$200,000 Apr 2015–Sep 2017. (Additional \$50,000 gift to VisComp Center to support Visiting Industrial Fellow Ebi Hiroaki).

Licensing fees for CS 184.1x (Queen Rania Foundation) \$49,980 Apr 2015, transferred to UCSD.

“Sampling and Reconstruction for Computer Graphics Rendering and Imaging” [PI] with F. Durand (MIT), \$500,000 Sep 1, 2014–Aug 31, 2017, transferred in full to UCSD.

“Shape Recovery and Image Understanding with non-Lambertian Reflectance” [PI] ONR \$450,000 Jun 2014–May 2017 (transferred to UCSD, Jan 1, 2015–Feb 28, 2018).

“On Relating Visual Elements to City Statistics” [PI] Google Research Award \$71,500 Apr 2014.

“Combining 2D and 3D: Using RGBZ to estimate geometric shape, illumination and reflectance” [PI] Sony \$125,000 Apr 2014–Sep 2015 (returned to Sony after PI’s departure for UCSD).

“Light Field 3D Depth Estimation and Video Stabilization” [PI] Nokia \$100,000 Sep 1, 2013 – Jul 31, 2015.

“Multi-Cue 3D Depth Estimation from Light Field Images” [PI] Samsung GRO grant, \$100,000 Oct 1, 2013  
Curriculum Development Grants for CS 184 in 2012-2013: Fung Institute [co-PI] with J. O’Brien \$20,000;  
UC Berkeley Center for Teaching and Learning Instructional Improvement Grant [PI] \$3,000.

“Sparse Reconstruction and Frequency Analysis for Computer Graphics Rendering and Imaging” [PI] with F. Durand (MIT), \$500,000 Oct 1, 2011 - Sep 30, 2015.

Intel Science and Technology Center for Visual Computing: “Scalable Visual Rendering” and “Semantic Models of Urban Environments”, \$400,000 Apr 2011 – present.

“Beyond Flat Images: Acquiring, Processing and Fabricating Visually Rich Material Appearance” [one of 6

PIs], \$3,000,000 Sep 1, 2010 - Aug 31, 2017 (\$257,000 transferred to UCSD).

“Computational Models of Appearance for Computer Vision and Image Understanding” [PI] ONR PECASE Program, \$1,000,000 Apr 1, 2009 - Mar 31, 2014.

NavTeQ contract, [coPI] with Maneesh Agrawala, \$92,355 Nov 2011 – Jun 2013.

Okawa Foundation Research Grant, \$10,000 Nov 2011 – present.

Gift from Pixar Animation Studios [PI], \$75,000 Mar 1, 2009 – present.

Gift from Intel Corporation [PI], \$15,000 + \$25,000 equipment, Dec 2009 – present.

Gift from Adobe [PI], \$25,000, Mar 2010 – present, \$6,000 May 2011 – present, \$17,700 Dec 2011 – present, \$7,000 Oct 2012 – present, \$40,000 Oct 2013 – present, \$17,000 Oct 2016 – present, \$24,000 Oct 2017 – present, \$42,500 Oct 2018 – present.

Gift from NVIDIA [PI], \$10,000 + equipment, Mar 2010 – present.

“Theory and Algorithms for High Quality Real-Time Rendering and Lighting/Material Design in Computer Graphics” [PI] with H. Jensen (UCSD), NSF CPA \$320,000 Sep 1, 2007 - Aug 31, 2010.

“Mathematical Models of Illumination and Reflectance for Image Understanding and Machine Vision” [PI], ONR Young Investigator Program \$350,000 + \$30,000 matching funds Jun 1, 2007 - May 31, 2010.

Gift from Adobe Research [PI], \$68,000 Oct 1, 2007 – present.

“Fast and Accurate Volumetric Rendering of Scattering Phenomena in Computer Graphics” [co-PI] with S. Nayar, S. Narasimhan (CMU, PI), NSF CPA \$400,000 Mar 1, 2006 - Feb 28, 2010.

“Sloan Fellowship in Computer Science”, Alfred P. Sloan Foundation \$45,000 Sep 1, 2005 - Aug 31, 2009.

“CAREER: Mathematical and Computational Fundamentals of Visual Appearance for Computer Graphics” [PI], NSF CCF Graphics and Visualization \$425,000 +\$45,000 matching funds Feb 1, 2005 - Jan 31, 2011.

“Restore the Trustworthiness of Digital Photographs: Blind Detection of Digital Photograph Tampering” [co-PI] with S. Chang [PI], NSF Cyber Trust program, \$740,000 Sep 1, 2004 - Aug 31, 2008.

“Real-Time Rendering and Interaction with Complex Illumination and Materials” [PI], Intel Corporation AIM Program, \$75000 + \$15000 equipment, Dec 1, 2003 – Aug 2009.

“Real-Time Visualization and Rendering of Complex Scenes” [PI] with H. Jensen (UCSD), NSF program on Numeric, Symbolic and Geometric Computation CCF \$434,734 Dec 15, 2003 - Nov 30, 2007.

“An Electronic Field Guide: Plant Exploration and Discovery in the 21st Century” [co-PI] with P. Belhumeur [PI], S. Feiner, D. Jacobs (UMD), J. Kress (Smithsonian), NSF ITR \$2,224,000 Sep 1, 2003 - Aug 31, 2010.

## RESEARCH GROUPS

Key role, with colleagues, in building leading multi-faculty research groups: UC San Diego Center for Visual Computing (VisComp; started Apr 2015), Visual Computing Lab (VCL) at UC Berkeley (started Jul 2011) and Columbia Vision and Graphics Center (CVGC; started Jan 2003). Significant increase in impact and visibility of graphics and vision research. Columbia went from no SIGGRAPH papers in prior four years to leading all universities with 10 papers at SIGGRAPH 2006. Berkeley went from a 20% yield of graphics PhD admits in 2009/10 to arguably being the leading graphics group within the VCL in 2013-14. At UCSD, I have played a key leadership role as founder and inaugural director of the UC San Diego Center for Visual Computing <http://viscomp.ucsd.edu> with faculty spanning vision and graphics in computer science, virtual reality in CalIT2, and visual processing in cognitive science, and with at least three new junior faculty hires in computer science. UCSD faculty had 20 papers at CVPR 2017. This is one of the first three new agile research centers launched in the Jacobs School of Engineering, with significant industry support from 10+ industrial sponsors. VisComp launched Apr 16, 2015 at the Jacobs Research Expo. Press includes an article at UT San Diego, <http://www.utsandiego.com/news/2015/mar/13/sony-UCSD-computing/>

## PROFESSIONAL SERVICE

Area Chair, IEEE CVPR 2019

Co-Chair, International Conference on Computational Photography, 2018; best paper committee 2019.

Co-Chair, Eurographics Symposium on Rendering, 2011. *Given Eurographics Recognition of Service Award*

Associate Editor, ACM Transactions on Graphics, 2006 – 2016

Associate Editor, IEEE Transactions on Pattern Analysis and Machine Intelligence, 2009 – 2013

IEEE-CS Fellows Evaluation Committee, 2017, 2018

ACM SIGGRAPH Doctoral Dissertation Awards Committee, 2017, 2018

NSF Panelist and Reviewer, 2005 - 2016

Proposal Reviewer for Austrian, Cyprus, Science Foundation, KAUST, 2005, 2006, 2010, 2015

Ravi Ramamoorthi (7/17)  
 ravir@cs.ucsd.edu  
 Aug 31, 2019

Program Committee and Papers Sort, SIGGRAPH ASIA conference, 2009, 2010, 2014, 2016, 2017, 2019  
 Posters and Technical Briefs Committee, SIGGRAPH ASIA conference, 2013  
 Program Committee, SIGGRAPH conference, 2006, 2007  
 Program Committee, EGSR (Eurographics Symposium on Rendering), 2005, 2006, 2007, 2009, 2012, 2013  
 Program Committee, CVPR (Conf, on Computer Vision and Pattern Recognition), 2003,2007,2010,2016-17  
 Program Committee, ICCV (International Conference on Computer Vision), 2003, 2009  
 Program Committee, ECCV (European Conference on Computer Vision), 2004, 2006  
 Program Committee, ACCV (Asian Conference on Computer Vision), 2006  
 Reviewer for SIGGRAPH, Eurographics, Eurographics Symposium on Rendering, IEEE Computer Graphics and Applications, IEEE TVCG, IEEE PAMI, Computer Vision and Image Understanding, . . .

## DIVERSITY AND OUTREACH

Online graphics course CSE 167x draws a very diverse audience worldwide across many ethnic groups and socioeconomic backgrounds, many of whom would otherwise have no access to computing education. Community TAs and others come from Australia, Turkey, Russia, Argentina and include shopkeepers without any formal degrees, high school students, and engineers/managers without formal computer science training. More than 100,000 registrations to date. Plans underway to include CSE 167x in Kiron refugee program.

As Director for the Center of Visual Computing, led conversation on Visual Computing for a program on UCSD-TV in the Computing Primetime Series (premiere 8/24/2015). 400,000+ views online, drawing broad general audience into computing, <http://ucsd.tv/search-details.aspx?showID=29675>.

Interview on Waskul TV: advances in interactive rendering to a general audience Jul 2013, 20,000+ views.

## DEPARTMENTAL AND UNIVERSITY SERVICE AT UCSD

- *Vice-Chair for Academic Personnel:* CSE Department Vice-Chair Jul 2016–Jun 2019, for academic personnel merits/promotions. Regular consultations with department chair, CSE and Dean’s AP staff.
- *Senate Committee on Research Grants, General Campus:* Engineering representative on academic senate committee for internal university senate research and bridge grants (Jul 2016–Jun 2019).
- *Search Committee, Director for Online Education:* (UCSD, 2017).
- *Liaison for UCSD-edX:* Leading role in facilitating UCSD-edX agreement for offering of open online courses. Meetings with deans, academic senate, associate vice-chancellor, edX CEO. Agreement was signed by executive vice-chancellor in Apr 2015 with my CSE 167x as first UC San DiegoX course Aug 2015. UCSD-edX agreement covered in news article in This Week @UC San Diego. UCSD now has several edX courses including micromasters and first professional certificate in virtual reality.
- *GCCP-UCRP Bug Resolution:* Noticed and followed up to resolve key bug in UCRP retirement credit for GCCP participants at UCSD (and other UCs). Discussions with dean, heads of UCSD payroll, head of academic compensation, director of UCOP retirement. New NSTP title codes introduced Jul 2015 for 15-16 academic year, and retroactive correction of UCRP credit completed Oct 2015.
- *Director, UC San Diego Center for Visual Computing:* (Apr 2015–present). Managing relationships with faculty, industrial partners, organizing events including first annual retreat with 9 industrial sponsors at La Jolla Shores Hotel May 20-21, 2016. Next retreats with 45 participants at La Jolla Shores Hotel on May 25-26, 2017 and 60 participants Jun 7-8, 2018; May 30-31, 2019. Overall leadership, and speaking at key events, including keynote at Corporate Affiliates program dinner, Jacobs Research Expo 2015, and presentation to UCSD Foundation and Alumni Board.
- *Distinguished Lecture Series:* Organized list of speakers and CSE 292 course for Fall 2014 DLS.
- *Faculty Recruiting Committee:* CSE Faculty Recruiting 2014-2015; 2018-19. Reviewing about 100 applicants in vision/graphics/robotics and overall shortlist, making recommendations for interview and comments on candidate talks and interviews.
- *PhD Admissions Committee:* CSE PhD admissions committee 2014-2015. Reviewing 50+ applicants, recommending admission and attending admissions meetings. Organized vision/graphics visit day, involving scheduling, and meetings with 8-10 admitted Ph.D. students, each year 2015–present.
- *Buildings and Grounds Committee:* CSE committee to advise on issues related to space and building construction 2014–2016. Designed and oversaw construction/renovation of new center for visual computing laboratory in CSE 4127 (design started Oct 2014; construction completed summer 2016). seminar series, with talks every week. Also administered course CSE 290. Fall 2014–present.



## PUBLICATIONS

### SIGGRAPH AND TOG<sup>1</sup>

1. “Fast Construction of Accurate Quaternion Splines” by **R. Ramamoorthi** and A. Barr. *In proceedings of SIGGRAPH 1997*, pages 287–292.
2. “Creating Generative Models from Range Images” by **R. Ramamoorthi** and J. Arvo. *In proceedings of SIGGRAPH 1999*, pages 195–204.
3. “Efficient Image-Based Methods for Rendering Soft Shadows” by M. Agrawala, **R. Ramamoorthi**, A. Heirich and L. Moll. *In proceedings of SIGGRAPH 2000*, pages 375–384.
4. “A Signal-Processing Framework for Inverse Rendering” by **R. Ramamoorthi** and P. Hanrahan. *In proceedings of SIGGRAPH 2001*, pages 117–128.
5. “An Efficient Representation for Irradiance Environment Maps” by **R. Ramamoorthi** and P. Hanrahan. *In proceedings of SIGGRAPH 2001*, pages 497–500.
6. “Frequency Space Environment Map Rendering” by **R. Ramamoorthi** and P. Hanrahan. *ACM Transactions on Graphics 21(3) [SIGGRAPH 2002]*, pages 517–526.
7. “All-Frequency Shadows Using Non-Linear Wavelet Lighting Approximation” by R. Ng, **R. Ramamoorthi** and P. Hanrahan. *ACM Transactions on Graphics 22(3) [SIGGRAPH 2003]*, pages 376–381.
8. “Structured Importance Sampling of Environment Maps” by S. Agarwal, **R. Ramamoorthi**, S. Belongie and H. Jensen. *ACM Transactions on Graphics 22(3) [SIGGRAPH 2003]*, pages 605–612.
9. “Triple Product Wavelet Integrals for All-Frequency Relighting” by R. Ng, **R. Ramamoorthi** and P. Hanrahan. *ACM Transactions on Graphics 23(3) [SIGGRAPH 2004]*, pages 477–487.
10. “Efficient BRDF Importance Sampling Using a Factored Representation” by J. Lawrence, S. Rusinkiewicz and **R. Ramamoorthi**. *ACM Transactions on Graphics 23(3) [SIGGRAPH 2004]*, pages 494–503.
11. “A Signal-Processing Framework for Reflection” by **R. Ramamoorthi** and P. Hanrahan. *ACM Transactions on Graphics, 23(4)*, pages 1004–1042, Oct 2004.
12. “Efficiently Combining Positions and Normals for Precise 3D Geometry” by D. Nehab, S. Rusinkiewicz, J. Davis and **R. Ramamoorthi**. *ACM Transactions on Graphics 24(3) [SIGGRAPH 2005]*, pages 536–543.
13. “A Practical Analytic Single Scattering Model for Real-Time Rendering” by B. Sun, **R. Ramamoorthi**, S. Narasimhan and S. Nayar. *ACM Transactions on Graphics 24(3) [SIGGRAPH 2005]*, pages 1040–1049.
14. “Inverse Shade Trees for Non-Parametric Material Representation and Editing” by J. Lawrence, A. Ben-Artzi, C. Decoro, W. Matusik, H. Pfister, **R. Ramamoorthi** and S. Rusinkiewicz. *ACM Transactions on Graphics 25(3) [SIGGRAPH 2006]*, pages 735–745.
15. “A Compact Factored Representation of Heterogeneous Subsurface Scattering” by P. Peers, K. von Berge, W. Matusik, **R. Ramamoorthi**, J. Lawrence, S. Rusinkiewicz and P. Dutre. *ACM Transactions on Graphics 25(3) [SIGGRAPH 2006]*, pages 746–753.
16. “Time-Varying Surface Appearance: Acquisition, Modeling and Rendering” by J. Gu, C. Tu, **R. Ramamoorthi**, P. Belhumeur, W. Matusik and S. Nayar. *ACM Transactions on Graphics 25(3) [SIGGRAPH 2006]*, pages 762–771.
17. “Real-Time BRDF Editing in Complex Lighting” by A. Ben-Artzi, R. Overbeck and **R. Ramamoorthi**. *ACM Transactions on Graphics 25(3) [SIGGRAPH 2006]*, pages 945–954.
18. “Acquiring Scattering Properties of Participating Media by Dilution” by S. Narasimhan, M. Gupta, C. Donner, **R. Ramamoorthi**, S. Nayar and H. Jensen. *ACM Transactions on Graphics 25(3) [SIGGRAPH 2006]*, pages 1003–1012.
19. “A First Order Analysis of Lighting, Shading, and Shadows” by **R. Ramamoorthi**, D. Mahajan and P. Belhumeur. *ACM Transactions on Graphics, 26(1), Article 2, 2:1–2:21, Jan 2007*.

<sup>1</sup>The ACM SIGGRAPH conference (and since 2008, SIGGRAPH Asia) is the leading venue for publishing research in computer graphics, with acceptance rates ranging from 15% – 25%. Since 2002, the proceedings have also been published as a special issue of the ACM Transactions on Graphics (TOG), the leading journal in graphics. Moreover since 2008, regular TOG papers are also presented at SIGGRAPH, further blurring the distinction. The EuroGraphics Symposium on Rendering (EGSR) is the leading venue for rendering research (second only to the SIGGRAPH conference), and has a competitive acceptance rate of 30 – 40%. Since 2008, the proceedings also appear in a special Computer Graphics Forum journal issue. Both SIGGRAPH and EGSR papers are fully reviewed, and considered terminal publications. In computer vision, the leading journals are the IEEE Transactions on Pattern Analysis and Machine Intelligence (PAMI), and the International Journal of Computer Vision (IJCV). Leading conferences are IEEE CVPR, ICCV and ECCV. Papers in these conferences are rigorously reviewed, with acceptance rates around 25%, and currently well below 3% for oral presentations.

20. “Frequency Domain Normal Map Filtering” by C. Han, B. Sun, **R. Ramamoorthi** and E. Grinspun. *ACM Transactions on Graphics* 26(3) [SIGGRAPH 2007], article 28, 28:1–28:11.
21. “A Theory of Locally Low Dimensional Light Transport” by D. Mahajan, I. Kemelmacher Shlizerman, **R. Ramamoorthi** and P. Belhumeur. *ACM Transactions on Graphics* 26(3) [SIGGRAPH 2007], article 62, 62:1–62:9.
22. “A Precomputed Polynomial Representation for Interactive BRDF Editing with Global Illumination” by A. Ben-Artzi, K. Egan, **R. Ramamoorthi** and F. Durand. *ACM Transactions on Graphics* 27(2), Article 13, 13:1–13:13, Apr 2008. Presented at SIGGRAPH 2008 TOG papers session on Rendering Materials.
23. “Multiscale Texture Synthesis” by C. Han, E. Risser, **R. Ramamoorthi** and E. Grinspun. *ACM Transactions on Graphics*, 27(3) [SIGGRAPH 2008], article 51, 51:1–51:8.
24. “Light Field Transfer: Global Illumination Between Real and Synthetic Objects” by O. Cossairt, S. Nayar and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 27(3) [SIGGRAPH 2008], article 57, 57:1–57:6.
25. “A Layered, Heterogeneous Reflectance Model for Acquiring and Rendering Human Skin” by C. Donner, T. Weyrich, E. D’Eon, **R. Ramamoorthi** and S. Rusinkiewicz. *ACM Transactions on Graphics*, 27(5) [SIGGRAPH Asia 2008], article 140, 140:1–140:12. **Front Cover Image of Inaugural SIGGRAPH Asia.**
26. “Compressive Light Transport Sensing” by P. Peers, D. Mahajan, B. Lamond, A. Ghosh, W. Matusik, **R. Ramamoorthi** and P. Debevec. *ACM Transactions on Graphics* 28(1), Article 3, 3:1–3:18, Jan 2009. Presented at SIGGRAPH 2009.
27. “Affine Double and Triple Product Wavelet Integrals for Rendering” by B. Sun and **R. Ramamoorthi**. *ACM Transactions on Graphics* 28(2), Article 14, 14:1–14:17, Apr 2009. Presented at SIGGRAPH 2009.
28. “An Empirical BSSRDF Model” by C. Donner, J. Lawrence, **R. Ramamoorthi**, T. Hachisuka, H. Jensen and S. Nayar. *ACM Transactions on Graphics* 28(3) [SIGGRAPH 2009], Article 30, 30:1–30:10.
29. “Moving Gradients: A Path-Based Method for Plausible Image Interpolation” by D. Mahajan, F. Huang, W. Matusik, **R. Ramamoorthi**, and P. Belhumeur. *ACM Transactions on Graphics* 28(3) [SIGGRAPH 2009], Article 42, 42:1–42:11.
30. “Frequency Analysis and Sheared Reconstruction for Rendering Motion Blur” by K. Egan, Y. Tseng, N. Holzschuch, F. Durand and **R. Ramamoorthi**. *ACM Transactions on Graphics* 28(3) [SIGGRAPH 2009], Article 93, 93:1–93:13.
31. “Adaptive Wavelet Rendering” by R. Overbeck, C. Donner and **R. Ramamoorthi**. *ACM Transactions on Graphics* 28(5) [SIGGRAPH Asia 2009], Article 140, 140:1–140:12, Dec 2009.
32. “Removing Image Artifacts Due to Dirty Camera Lenses and Thin Occluders” by J. Gu, **R. Ramamoorthi**, P. Belhumeur and S. Nayar. *ACM Transactions on Graphics* 28(5) [SIGGRAPH Asia 2009], Article 144, 144:1–144:10, Dec 2009.
33. “Example-Based Wrinkle Synthesis for Clothing Animation” by H. Wang, F. Hecht, **R. Ramamoorthi** and J. O’Brien. *ACM Transactions on Graphics* 29(4) [SIGGRAPH 2010], Article 107, 107:1–107:8.
34. “Multi-Resolution Isotropic Strain Limiting” by H. Wang, J. O’Brien and **R. Ramamoorthi**. *ACM Transactions on Graphics* 29(6) [SIGGRAPH Asia 2010], Article 156, 156:1–156:10, Dec 2010.
35. “Frequency Analysis and Sheared Filtering for Shadow Light Fields of Complex Occluders” by K. Egan, F. Hecht, F. Durand and **R. Ramamoorthi**. *ACM Transactions on Graphics* 30(2), Article 9, 9:1–9:13, Apr 2011. Presented at SIGGRAPH 2011.
36. “Illumination Decomposition for Material Recoloring with Consistent Interreflections” by R. Carroll, M. Agrawala and **R. Ramamoorthi**. *ACM Transactions on Graphics* 30(4) [SIGGRAPH 2011], Article 43, 43:1–43:9.
37. “Data-Driven Elastic Models for Cloth: Modeling and Measurement” by H. Wang, J. O’Brien and **R. Ramamoorthi**. *ACM Transactions on Graphics* 30(4) [SIGGRAPH 2011], Article 71, 71:1–71:11.
38. “Practical Filtering for Efficient Ray-Traced Directional Occlusion” by K. Egan, F. Durand and **R. Ramamoorthi**. *ACM Transactions on Graphics* 30 (6) [SIGGRAPH Asia 2011], Article 180, 180:1–180:10.
39. “Selectively De-Animating Video” by J. Bai, A. Agarwala, M. Agrawala and **R. Ramamoorthi**. *ACM Transactions on Graphics* 31(4) [SIGGRAPH 2012], Article 66, pages 66:1–66:10.
40. “A Theory of Monte Carlo Visibility Sampling” by **R. Ramamoorthi**, J. Anderson, M. Meyer and D. Nowrouzezahrai. *ACM Transactions on Graphics* 31(5), Article 121, 121:1–121:16, Oct 2012. Presented at SIGGRAPH 2012.
41. “Axis-Aligned Filtering for Interactive Sampled Soft Shadows” by S. Mehta, B. Wang and **R. Ra-**

- mamoorthi**, *ACM Transactions on Graphics* 31(6) [SIGGRAPH Asia 2012], Article 163, 163:1–163:10, Dec 2012.
42. “Interactive Albedo Editing in Path-Traced Volumetric Materials” by M. Hasan and **R. Ramamoorthi**. *ACM Transactions on Graphics* 32(2), Article 11, 11:1–11:11, Apr 2013. **Cover Image for Apr 2013 TOG**. Presented at SIGGRAPH 2013.
43. “Gloss Perception in Painterly and Cartoon Rendering” by A. Bousseau, J. O’Shea, F. Durand, **R. Ramamoorthi** and M. Agrawala. *ACM Transactions on Graphics* 32(2), Article 18, 18:1–18:13. Presented at SIGGRAPH 2013.
44. “Axis-Aligned Filtering for Interactive Physically-Based Diffuse Indirect Lighting” by S. Mehta, B. Wang, **R. Ramamoorthi** and F. Durand. *ACM Transactions on Graphics* 32(4) [SIGGRAPH 2013], Article 96, 96:1–96:11.
45. “Modular Flux Transfer: Efficient Rendering of High-Resolution Volumes with Repeated Structures” by S. Zhao, M. Hasan, **R. Ramamoorthi** and K. Bala. *ACM Transactions on Graphics* 32(4) [SIGGRAPH 2013], Article 131, 131:1–131:11.
46. “Factored Axis-Aligned Filtering for Rendering Multiple Distribution Effects” by S. Mehta, J. Yao, **R. Ramamoorthi** and F. Durand. *ACM Transactions on Graphics* 33(4) [SIGGRAPH 2014], Article 57, 57:1–57:12.
47. “High-Order Similarity Relations in Radiative Transfer” by S. Zhao, **R. Ramamoorthi** and K. Bala. *ACM Transactions on Graphics* 33(4) [SIGGRAPH 2014], Article 104, 104:1–104:12.
48. “Discrete Stochastic Microfacet Models” by W. Jakob, M. Hasan, L. Yan, J. Lawrence, **R. Ramamoorthi** and S. Marschner. *ACM Transactions on Graphics* 33(4) [SIGGRAPH 2014], Article 115, 115:1–115:10.
49. “Rendering Glints on High-Resolution Normal-Mapped Specular Surfaces” by L. Yan, M. Hasan, W. Jakob, J. Lawrence, S. Marschner and **R. Ramamoorthi**. *ACM Transactions on Graphics* 33(4) [SIGGRAPH 2014], Article 116, 116:1–116:9.
50. “A Light Transport Framework for Lenslet Light Field Cameras” by C. Liang and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 34(2), Article 16, 16:1–16:19, Apr 2015. Presented at SIGGRAPH 2015.
51. “On Optimal, Minimal BRDF Sampling for Reflectance Acquisition” by J. Nielsen, H. Jensen and **R. Ramamoorthi**. *ACM Transactions on Graphics* 34(6) [SIGGRAPH Asia 2015], Article 186, 186:1–186:11.
52. “Physically-Accurate Fur Reflectance: Modeling, Measurement and Rendering” by L. Yan, C. Tseng, H. Jensen and **R. Ramamoorthi**. *ACM Transactions on Graphics* 34(6) [SIGGRAPH Asia 2015], Article 185, 185:1–185:13.
53. “Anisotropic Gaussian Mutations for Metropolis Light Transport through Hessian-Hamiltonian Dynamics” by T. Li, J. Lehtinen, **R. Ramamoorthi**, W. Jakob and F. Durand. *ACM Transactions on Graphics* 34(6) [SIGGRAPH Asia 2015], Article 209, 209:1–209:13.
54. “Fast 4D Sheared Filtering for Interactive Rendering of Distribution Effects” by L. Yan, S. Mehta, **R. Ramamoorthi** and F. Durand. *ACM Transactions on Graphics*, 35(1), Article 7, 7:1–7:13. Presented at SIGGRAPH 2016.
55. “Position-Normal Distributions for Efficient Rendering of Specular Microstructure” by L. Yan, M. Hasan, S. Marschner and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 35(4) [SIGGRAPH 2016], Article 56, 56:1–56:9. *Press coverage in PhysOrg, Digital Trends, Eureka Alert, Tech Crunch etc.*
56. “Downsampling Scattering Parameters for Rendering Anisotropic Media” by S. Zhao, L. Wu, F. Durand and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 35(6) [SIGGRAPH Asia 2016], Article 166, 166:1–166:11.
57. “Minimal BRDF Sampling for Two-Shot Near-Field Reflectance Acquisition” by Z. Xu, J. Nielsen, J. Yu, H. Jensen, and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 35(6) [SIGGRAPH Asia 2016], Article 188, 188:1–188:12.
58. “Learning-Based View Synthesis for Light Field Cameras” by N. Kalantari, T. Wang and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 35(6) [SIGGRAPH Asia 2016], Article 193, 193:1–193:10.
59. “Antialiasing Complex Global Illumination Effects in Path-space” by L. Belcour, L. Yan, **R. Ramamoorthi** and D. Nowrouzezahrai. *ACM Transactions on Graphics*, 36(1), Article 9, 9:1–9:13, Jan 2017. Presented at SIGGRAPH 2017.

60. “An Efficient and Practical Near and Far Field Fur Reflectance Model” by L. Yan, H. Jensen and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 36(4) [SIGGRAPH 2017], Article 67, 67:1–67:13.
61. “Patch-Based Optimization for Image-Based Texture Mapping” by S. Bi, N. Kalantari and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 36(4) [SIGGRAPH 2017], Article 106, 106:1–106:11.
62. “Light Field Video Capture Using a Learning-Based Hybrid Imaging System” by T. Wang, J. Zhu, N. Kalantari, A. Efros and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 36(4) [SIGGRAPH 2017], Article 133, 133:1–133:13.
63. “Deep High Dynamic Range Imaging of Dynamic Scenes” by N. Kalantari and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 36(4) [SIGGRAPH 2017], Article 144, 144:1–144:12.
64. “A BSSRDF Model for Efficient Rendering of Fur with Global Illumination” by L. Yan, W. Sun, H. Jensen and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 36(6) [SIGGRAPH Asia 2017], Article 208, 208:1–208:13.
65. “Analytic Spherical Harmonic Coefficients for Polygonal Area Lights” by J. Wang and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 37(4) [SIGGRAPH 2018], Article 54, 54:1–54:11.
66. “Rendering Specular Microgeometry with Wave Optics” by L. Yan, M. Hasan, B. Walter, S. Marschner and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 37(4) [SIGGRAPH 2018], Article 75, 75:1–75:10.
67. “Deep Image-Based Relighting from Optimal Sparse Samples” by Z. Xu, K. Sunkavalli, S. Hadap and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 37(4) [SIGGRAPH 2018], Article 126, 126:1–126:13.
68. “Learning to Reconstruct Shape and Spatially-Varying Reflectance from a Single Image” by Z. Li, Z. Xu, **R. Ramamoorthi**, K. Sunkavalli and M. Chandraker. *ACM Transactions on Graphics*, 37(6) [SIGGRAPH Asia 2018], Article 269, 269:1–269:11.
69. “Connecting Measured BRDFs to Analytic BRDFs by Data-Driven Diffuse-Specular Separation” by T. Sun, H. Jensen and **R. Ramamoorthi**. *ACM Transactions on Graphics*, 37(6) [SIGGRAPH Asia 2018], Article 273, 273:1–273:15.
70. “Local Light Field Fusion: Practical View Synthesis with Prescriptive Sampling Guidelines” by B. Mildenhall, P. Srinivasan, R. Ortiz-Canyon, N. Kalantari, **R. Ramamoorthi**, R. Ng and A. Kar. *ACM Transactions on Graphics* 38(4) [SIGGRAPH 2019], Article 29, 29:1–29:14.
71. “Deep View Synthesis from Sparse Photometric Images” by Z. Xu, S. Bi, K. Sunkavalli, S. Hadap, H. Su and **R. Ramamoorthi**. *ACM Transactions on Graphics* 38(4) [SIGGRAPH 2019], Article 76, 76:1–76:13.
72. “Single Image Portrait Relighting” by T. Sun, J. Barron, Y. Tsai, Z. Xu, X. Yu, G. Fyffe, C. Rhemann, J. Busch, P. Debevec and **R. Ramamoorthi**. *ACM Transactions on Graphics* 38(4) [SIGGRAPH 2019], Article 79, 79:1–79:12.
73. “Accurate appearance preserving prefiltering for rendering displacement-mapped surfaces” by L. Wu, S. Zhao, L. Yan and **R. Ramamoorthi**. *ACM Transactions on Graphics* 38(4) [SIGGRAPH 2019], Article 137, 137:1–137:14.
74. “A Differential Theory of Radiative Transfer” by C. Zhang, L. Wu, C. Zheng, I. Gkioulekas, **R. Ramamoorthi** and S. Zhao. *ACM Transactions on Graphics* 38(6) [SIGGRAPH Asia 2019], to appear.
75. “Learning Generative Models for Rendering Specular Microgeometry” by A. Kuznetsov, M. Hasan, Z. Xu, L. Yan, B. Walter, N. Kalantari, S. Marschner and **R. Ramamoorthi**. *ACM Transactions on Graphics* 38(6) [SIGGRAPH Asia 2019], to appear.

#### ARCHIVAL JOURNALS (excluding TOG)

76. “On the Relationship between Radiance and Irradiance: Determining the Illumination from Images of a Convex Lambertian Object” by **R. Ramamoorthi** and P. Hanrahan. *Journal of the Optical Society of America A*, volume 18(10), Oct 2001, pages 2448–2459.
77. “Analytic PCA Construction for Theoretical Analysis of Lighting Variability in Images of a Lambertian Object” by **R. Ramamoorthi**. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 24(10), 1322–1333, Oct 2002.
78. “A Fourier Theory for Cast Shadows” by **R. Ramamoorthi**, M. Koudelka and P. Belhumeur. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 27(2), 288–295, Feb 2005.
79. “Spacetime Stereo: A Unifying Framework for Depth from Triangulation” by J. Davis, D. Nehab, **R. Ramamoorthi** and S. Rusinkiewicz. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 27(2), 296–302, Feb 2005.

80. “Efficient Shadows from Sampled Environment Maps” by A. Ben-Artzi, **R. Ramamoorthi** and M. Agrawala. *Journal of Graphics Tools*, 11(1), 13–36, Jan 2006.
81. “Reflectance Sharing: Predicting Appearance from a Sparse Set of Images of a Known Shape” by T. Zickler, **R. Ramamoorthi**, S. Enrique and P. Belhumeur. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 28(8), 1287–1302, Aug 2006.
82. “First Steps Toward an Electronic Field Guide for Plants” by G. Agarwal, P. Belhumeur, S. Feiner, D. Jacobs, W. Kress, **R. Ramamoorthi**, N. Dixit, D. Mahajan, H. Ling, R. Russell, S. Shirdhonkar, K. Sunkavalli and S. White. *Taxon*, 55(3), 597–610, Aug 2006.
83. “Time-Varying BRDFs” by B. Sun, K. Sunkavalli, **R. Ramamoorthi**, P. Belhumeur and S. Nayar. *IEEE Transactions on Visualization and Computer Graphics*, 13(3), 595–609, May 2007.
84. “A Theory of Frequency Domain Invariants: Spherical Harmonic Identities for BRDF/Lighting Transfer and Image Consistency” by D. Mahajan, **R. Ramamoorthi** and B. Curless. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 30(2), 197–213, Feb 2008.
85. “An Analysis of the In-Out BRDF Factorization for View-Dependent Relighting” by D. Mahajan, Y. Tseng and **R. Ramamoorthi**, *Computer Graphics Forum* 27(4) [EGSR 2008], pages 1137–1145, Jun 2008.
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127. “Large Ray Packets for Real-time Whitted Ray Tracing” by R. Overbeck, **R. Ramamoorthi** and W. Mark. *IEEE Symposium on Interactive Ray Tracing 2008*.
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133. “What an Image Reveals about Material Reflectance” by M. Chandraker and **R. Ramamoorthi**. *IEEE International Conference on Computer Vision (ICCV) 2011*, pages 1076–1083. **Oral presentation 3% accepted.**
134. “Frequency-Space Decomposition and Acquisition of Light Transport under Spatially Varying Illumination” by D. Reddy, **R. Ramamoorthi** and B. Curless. *European Conference on Computer Vision (ECCV) 2012*, pages VI-596–VI-610, Oct 2012. **Oral presentation 4% accepted.**
135. “What Object Motion Reveals About Shape With Unknown BRDF and Lighting” by M. Chandraker, D. Reddy and **R. Ramamoorthi**. *Conference on Computer Vision and Pattern Recognition (CVPR 2013)*, Jun 2013. **Oral presentation 4% accepted.**
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165. “Dynamic Splines with Constraints for Animation” by **R. Ramamoorthi**, C. Ball and A. Barr. *Caltech Tech. Report CS-TR-97-03*.
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168. “Analysis of Planar Light Fields from Homogeneous Convex Curved Surfaces under Distant Illumination” by **R. Ramamoorthi** and P. Hanrahan. *Human Vision and Electronic Imaging VI 2001, pages 195–208*.
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## CONSULTING

- *Pixar Animation Studios*: 3/2009-12/2011: Spherical Harmonic Lighting, Importance Sampling, Efficient Visibility. Adoption in Renderman 16 and publications [40,92,93].
- *Lytro*: 3/2012-4/2013: Analysis of Light Field Camera Resolution [50].
- *Pelican Imaging*: 5/2013-6/2014, on Technical Advisory Board till 6/2015: US Patent 10089740 (approved 10/2018) “System and Methods for Depth Regularization and Semiautomatic Interactive Matting Using RGB-D Images” by M. Srikanth, **R. Ramamoorthi**, K. Venkataraman, P. Chatterjee.
- *KL Gates*: 5/2014: Legal expert declaration in patent involving stereo imaging.
- *Light*: 7/2015–3/2016: Occasional consulting on computational imaging and 3D reconstruction.