# Amit Agrawal

**Principal Scientist, Amazon**
LinkedIn | Google Scholar | Website

## Summary

Principal Scientist with 20+ years of experience at the intersection of AI research, generative/multimodal models, computer vision, and computational photography, transforming advanced research into scalable products used by millions of customers worldwide. My work spans 50+ U.S. patents, 55+ peer-reviewed publications in top-tier venues (CVPR/ICCV/ECCV/SIGGRAPH) with 12,000+ citations (h-index 50), establishing a track record of high-impact research and innovation. I thrive on bridging cutting-edge AI research with customer-focused product delivery, leading teams from concept to deployment.

## Research Interests

Generative AI • Multimodal/LLM–Vision Systems • Deep Learning • Computer Vision • Computational Photography

## Education

**Ph.D., Electrical & Computer Engineering** | University of Maryland, College Park *2001-2006*
*Advisor: Prof. Rama Chellappa*

**M.S., Electrical & Computer Engineering** | University of Maryland
*Advisor: Prof. Rama Chellappa* *2001-2003*

**B.Tech., Electrical Engineering** | Indian Institute of Technology (IIT), Kanpur *1996-2000*

## Professional Experience

**Principal Scientist** | Amazon *2017 – Present*
**Focus:** Generative AI, Multimodal Systems, Deep Learning, Computer Vision, Recommendation Systems

- **Strategic AI Leadership** - Led research teams to deliver flagship AI features—from Amazon Halo's 3D body modeling to real-time size-recommendation algorithms—resulting in tangible improvements in business metrics and elevated customer satisfaction
- **Generative AI & Avatars**: Developed GANs and diffusion-based pipelines for fashion applications enabling realistic image/video generation guided by pose and segmentation, identity-consistent personalization and audio-driven talking avatars
- **Multimodal Innovation**: Designed LLM + vision systems for summarizing review-driven size insights, and tabular data extraction from images using vision-language models
- **3D Computer Vision**: Led the launch of Amazon Halo's 3D body composition feature, delivering a first-of-its-kind V1 product. Developed optimization-based registration methods, differentiable rendering techniques, and synthetic data pipelines.
- **Research Leadership**: Published peer-reviewed papers at top-tier venues (CVPR/ICCV/ECCV) — consistently driving high-quality, impactful AI/ML research
- **Mentoring**: Supervised and mentored multiple PhD students and early-career researchers, providing guidance on research design, publication strategy, and career development.

**Senior Research Scientist** | Amazon Lab126 *2013 – 2017*

**Focus:** Deep Learning (Supervised/Unsupervised), Computer Vision, Computational Photography

- Conducted advanced research in deep learning, focusing on both supervised and unsupervised learning methodologies.
- Developed and prototyped innovative computer vision and computational photography techniques for consumer devices like Echo Look, driving customer engagement and enhancing user experience

**Member Research Staff** | Mitsubishi Electric Research Labs (MERL) *2006 – 2013*

- Foundational research in computational photography and geometric computer vision for non-central cameras, including wide-angle imaging and underwater imaging
- Designed and developed novel imaging systems spanning catadioptric cameras, light-field imaging, and solutions for motion blur, narrow depth of field, low frame rate and lens glare

**Graduate Research Assistant** | University of Maryland *2001 – 2006*

Research areas: Gradient-domain algorithms, Computational photography

**DSP Engineer** | Hughes Software Systems *2000 – 2001*

Digital signal processing for fax protocols

## Research Impact

**Google Scholar:** h-index 49, 10,000+ citations

**Publications:** 55+ peer-reviewed (20 CVPR, 12 ICCV/ECCV, 8 SIGGRAPH/Eurographics)

**Patents:** 50+ issued U.S. patents

**Media:** MIT Tech Review, Wired, Amazon Science

## Selected Awards

- Best Poster, 3D Humans Workshop, CVPR 2019
- Best Paper, PeopleCap Workshop, ECCV 2018
- Best Paper Runner-up, Fashion Workshop, ECCV 2018
- Director's Award, MERL, 2009
- ICASSP Student Paper Contest Winner, IMDSP category, 2005
- Best trainee project award, Hughes Software Systems, 2000
- Winner, Hardware Design Contest, Techkriti, IIT Kanpur, 2000

## Skills

Generative AI • Diffusion Models/GANs • Text-to-Image Personalization • Talking Avatars • LLMs & Vision-Language Models • Recommendation Algorithms • Computer Vision: 2D/3D Modeling, Semantic Segmentation, Human Pose Estimation, Differentiable Rendering • Causal Inference • Privacy-Preserving ML • Computational Photography

## Selected Publications

For details, visit amitkagrawal.com

### Journal Publications

1. M.D. Majmudar, S. Chandra, S. Kennedy, A. Agrawal, M. Sippel, P. Ramu, A. Chaudhri, A. Criminisi, B. Smith, S.B. Heymsfield, F. Cody, 'Smartphone Camera Based Assessment of Adiposity: A Multi-Site Validation Study', **medRxiv**, 2021
2. M. Gupta, A. Agrawal, A. Veeraraghavan & S. G. Narasimhan, 'A Practical Approach to 3D Scanning in the Presence of Inter-reflections, Subsurface Scattering and Defocus', International Journal of Computer Vision (**IJCV**), 2012
3. Y. Taguchi, A. Agrawal, A. Veeraraghavan, S. Ramalingam & R. Raskar, 'Axial-Cones: Modeling Spherical Catadioptric Cameras for Wide-Angle Light Field Rendering', ACM Transactions on Graphics (**SIGGRAPH Asia**), Vol. 29, Issue 5, Dec 2010
4. A. Agrawal, A. Veeraraghavan & R. Raskar, 'Reinterpretable Imager: Towards Variable Post Capture Space, Angle & Time Resolution in Photography', Computer Graphics Forum (**Eurographics**), Vol. 29, Issue 2, pages 763-773, May 2010
5. A. Agrawal, Y. Xu & R. Raskar, 'Invertible Motion Blur in Video', ACM Transactions on Graphics (**SIGGRAPH**), Vol. 28, Issue 3, Aug 2009
6. A. Agrawal, Y. Sun, J. Barnwell & R. Raskar, 'Vision Guided Robot System for Picking Objects by Casting Shadows', International Journal of Robotics Research (**IJRR**) 2009
7. D. Lanman, R. Raskar, A. Agrawal, & G. Taubin, 'Shield Fields: Modeling and Capturing 3D Occluders', ACM Transactions on Graphics (**SIGGRAPH Asia**), Vol. 27, Issue 5, Dec 2008
8. R. Raskar, A. Agrawal, C. Wilson & A. Veeraraghavan, 'Glare Aware Photography: 4D Ray Sampling for Reducing Glare Effects of Camera Lenses', ACM Transactions on Graphics (**SIGGRAPH**), Vol. 27, Issue 3, Aug 2008
9. A. Veeraraghavan, R. Raskar, A. Agrawal, A. Mohan & J. Tumblin, 'Dappled Photography: Mask Enhanced Cameras for Heterodyned Light Fields and Coded Aperture Refocusing', ACM Transactions on Graphics (**SIGGRAPH**), Vol. 26, Issue 3, July 2007
10. A. Agrawal & R. Chellappa, 'Robust Ego-Motion Estimation and 3D Model Refinement using Surface Parallax', IEEE Transactions on Image Processing (**TIP**), Vol. 15, No. 5, May 2006
11. R. Raskar, A. Agrawal & J. Tumblin, 'Coded Exposure Photography: Motion Deblurring using Fluttered Shutter', ACM Transactions on Graphics (**SIGGRAPH**), Vol. 25, Issue 3, July 2006
12. A. Agrawal, R. Raskar, S.K. Nayar & Y. Li, 'Removing Photography Artifacts using Gradient Projection and Flash-Exposure Sampling', ACM Transactions on Graphics (**SIGGRAPH**), Vol. 24, Issue 3, July 2005

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**Supervised & Unsupervised Learning**

13. V. Jayasundara, A. Agrawal, N. Heron, A. Shrivastava, L.S. Davis, 'FlexNeRF: Photorealistic Free-viewpoint Rendering of Moving Humans from Sparse Views', **CVPR** 2023
14. R. Khirodkar, V. Chari, A. Agrawal, A. Tyagi, 'Multi-Hypothesis Pose Networks: Rethinking Top-Down Pose Estimation', **ICCV** 2021
15. S. Tripathi, S. Ranade, A. Tyagi & A. Agrawal, 'PoseNet3D: Unsupervised 3D Human Shape and Pose Estimation', **3DV** 2020 (oral presentation)
16. V. Kulharia, S. Chandra, A. Agrawal, P. Torr & A. Tyagi, 'Box2Seg: Attention Weighted Loss and Discriminative Feature Learning for Weakly Supervised Segmentation', **ECCV** 2020
17. B. M. Smith, V. Chari, A. Agrawal, J. Rehg & R. Sever, 'Towards Accurate 3D Human Body Reconstruction from Silhouettes', **3DV** 2019 (oral presentation)
18. C. Chen, A. Tyagi, A. Agrawal, D. Drover, Rohith MV, S. Stojanov & J. Regh, 'Unsupervised 3D Pose Estimation with Geometric Self-Supervision', **CVPR** 2019
19. S. Tripathi, S. Chandra, A. Agrawal, A. Tyagi, J. Regh & V. Chari, 'Learning to Generate Synthetic Data Via Compositing', **CVPR** 2019
20. D. Drover, Rohith MV, C. Chen, A. Agrawal, A. Tyagi & C.P. Huynh, 'Can 3D Pose be Learned from 2D Projections Alone?', **Best Paper**, ECCV 2018 PeopleCap Workshop
21. C.P. Huynh, A. Ciptadi, A. Tyagi & A. Agrawal, 'CRAFT: Complementary Recommendations Using Adversarial Feature Transformer', **Best Paper Runner-Up**, ECCV 2018 First Workshop on Computer Vision For Fashion, Art and Design

22. H. Zhang, K. Dana, J. Shi, Z. Zhang, X. Wang, A. Tyagi & A. Agrawal, 'Context Encoding for Semantic Segmentation', **CVPR** 2018 (oral presentation)

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**Computer Vision & Computational Photography**

23. A. Agrawal, 'Extrinsic Camera Calibration Without A Direct View Using A Spherical Mirror', **ICCV** 2013
24. S. Tambe, A. Veeraraghavan & A. Agrawal, 'Towards Motion-Aware Light Field Video For Dynamic Scenes', **ICCV** 2013
25. A. Agrawal & S. Ramalingam, 'Single Image Calibration of Multi-Axial Imaging Systems', **CVPR** 2013
26. Y. Taguchi, A. Agrawal & O. Tuzel, 'Motion-Aware Structured Light using Spatio-Temporal Decodeable Patterns', **ECCV** 2012
27. A. Agrawal, S. Ramalingam, Y. Taguchi & V. Chari, 'A Theory of Multi-Layer Flat Refractive Geometry', **CVPR** 2012 (oral presentation)
28. D. Wu, A. Velten, M. Toole, A. Agrawal & R. Raskar, 'Decomposing Global Light Transport using Time of Flight Imaging', **CVPR** 2012 (oral presentation)
29. N. Shroff, A. Veeraraghavan, Y. Taguchi, O. Tuzel, A. Agrawal & R. Chellappa, 'Variable Focus Video: Reconstructing Depth and Video for Dynamic Scenes', **ICCP** 2012 (oral presentation)
30. V. Chari, A. Agrawal, Y. Taguchi & S. Ramalingam, 'Convex Bricks: A New Primitive for Visual Hull Modeling and Reconstruction', **ICRA** 2012 (oral presentation)
31. A. Agrawal, Y. Taguchi & S. Ramalingam, 'Beyond Alhazen's Problem: Analytical Projection Model for Non-Central Catadioptric Cameras with Quadric Mirrors', **CVPR** 2011 (oral presentation)
32. M. Gupta, A. Agrawal, A. Veeraraghavan & S. Narasimhan, 'Structured Light 3D Scanning in Presence of Global Illumination', **CVPR** 2011
33. A. Agrawal, Y. Taguchi & S. Ramalingam, 'Analytical Forward Projection for Axial Non-Central Dioptric and Catadioptric Cameras', **ECCV** 2010 (oral presentation)
34. M. Gupta, A. Agrawal, A. Veeraraghavan, & S. Narasimhan, 'Flexible Voxels for Motion Aware Videography', **ECCV** 2010
35. A. Sankarnarayanan, A. Veeraraghavan, O. Tuzel, & A. Agrawal, 'Image Invariants for Smooth Reflective Surfaces', **ECCV** 2010
36. A. Agrawal, M. Gupta, A. Veeraraghavan, & S. Narasimhan, 'Optimal Coded Sampling for Temporal Super-Resolution', **CVPR** 2010
37. Y. Taguchi, A. Agrawal, S. Ramalingam, & A. Veeraraghavan, 'Axial Light Fields for Curved Mirrors: Reflect Your Perspective, Widen Your View', **CVPR** 2010 (oral presentation)
38. A. Sankarnarayanan, A. Veeraraghavan, O. Tuzel, & A. Agrawal, 'Specular Surface Reconstruction using Sparse Reflection Correspondences', **CVPR** 2010
39. M-Y Liu, O. Tuzel, A. Veeraraghavan, R, Chellappa, A. Agrawal & H. Okuda, 'Pose Estimation in Heavy Clutter using a Multi-Flash Camera', **ICRA** 2010
40. A. Agrawal & R. Raskar, 'Optimal Single Image Capture for Motion Deblurring', **CVPR** 2009
41. A. Agrawal & Y. Xu, 'Coded Exposure Deblurring: Optimized Codes for PSF Estimation and Invertibility', **CVPR** 2009
42. D. Reddy, A. Agrawal & R. Chellappa, 'Enforcing Integrability by Error Correction using L-1 Minimization', **CVPR** 2009
43. J. Chang, R. Raskar & A. Agrawal, '3D Pose Estimation and Segmentation using Specular Cues', **CVPR** 2009
44. A. Veeraraghavan, A. Agrawal, R. Raskar, A. Mohan & J. Tumblin, 'Non Refractive Modulators for Capturing Scene Appearance and Depth', **CVPR** 2008
45. T. Koh, A. Agrawal, R. Raskar, S. Morgan, N. Miles & B.H. Gills, 'Detecting and Segmenting Un-occluded Items by Actively Casting Shadows', **ACCV** 2007 (oral presentation)
46. A. Agrawal & R. Raskar, 'Resolving Objects at Higher Resolution from a Single Motion-Blurred Image', **CVPR** 2007 (oral presentation)
47. A. Agrawal, R. Raskar & R. Chellappa, 'Edge Suppression by Gradient Field Transformation using Cross-Projection Tensors', **CVPR** 2006

48. A. Agrawal, R. Raskar & R. Chellappa , 'What is the Range of Surface Reconstructions from a Gradient Field?', **ECCV** 2006 (oral presentation)
49. A. Agrawal, R. Chellappa & R. Raskar, 'An Algebraic Approach to Surface Reconstruction from Gradient Fields', **ICCV** 2005
50. J. Tumblin, A. Agrawal & R. Raskar, 'Why I want A Gradient Camera', **CVPR** 2005
51. A. Agrawal & R. Chellappa, 'Moving Object Segmentation and Dynamic Scene Reconstruction using Two Frames', IEEE **ICASSP** 2005. Winner of student paper contest (IMDSP category)
52. A. Agrawal & R. Chellappa, 'Fusing Depth and Video using Rao-Blackwellized Particle Filter', First International Conference on Pattern Recognition and Machine Intelligence **PRMI**, 2005 (oral presentation)
53. A. Agrawal & R. Chellappa, 'Robust Ego-Motion Estimation and 3D Model Refinement in Scenes with Varying Illumination', IEEE **MOTION** 2005 (oral presentation)
54. A. Agrawal & R. Chellappa, 'Robust Ego-Motion Estimation and 3D Model Refinement using Depth Based Parallax Model', IEEE **ICIP**, 2004 (oral presentation)
55. A. Agrawal & R. Chellappa, '3D Model Refinement using Surface-Parallax', IEEE **ICASSP**, 2004
56. H. Gupta, A. Agrawal, T. Pruthi, C. Shekhar & R. Chellappa, 'An Experimental Evaluation of Linear and Kernel Based Methods for Face Recognition', IEEE **WACV** 2002 (oral presentation)

## Tutorials, Courses and Invited Talks

• Computational Cameras: Exploiting Spatial-Angular Temporal Tradeoffs in Photography', Invited talk at Nokia Research Center (NRC), Bangalore, Feb 2013
• Keynote, PROCAMS 2012
• A. Agrawal & S. Ramalingam, 'Multi-View Geometry and Computational Photography using Non-Classical Cameras', ECCV 2012 Tutorial
• A. Agrawal & R. Horstmeyer, 'Light Fields in Computational Photography', CVPR 2011 Tutorial
• A. Agrawal, A. Veeraraghavan, S. Narasimhan, A. Mohan, 'Coded Computational Imaging', CVPR 2010 Tutorial
• A. Agrawal & R. Raskar, 'Differential Techniques for Analysis and Synthesis in Vision and Graphics', CVPR 2008 Tutorial
• Coding and Modulation in Cameras: Computational Photography beyond Photo Manipulations, CMU VASC Seminar, Mar 2008
• A. Agrawal & R. Raskar, 'Gradient Domain Manipulation Techniques in Vision and Graphics', ICCV 2007 Tutorial
• Surface Reconstruction from Gradient Fields, Computer Graphics Group, MIT, Apr 2007

## Exhibits, Demos & Tech Shows

• Amazon Echo Look Demo, CVPR 2017
• Structure Light 3D Scanning in Presence of Global Illumination, Demo at CVPR 2011
• A Practical and Robust System for Object Detection and Pose Estimation in Heavy Clutter using Active Illumination, Demo at CVPR 2010
• 3D Sensing Technology for Cell Robot Manufacturing, Mitsubishi Electric Press Release, Tokyo, 2008
• Depth Edges in Real-Time using Multi-flash Camera, Demo at CVPR 2005
• Camera Non-photo, Collision Senses, Cambridge, MA, 2004

## Professional Activities

• Guest Editor, IEEE Signal Processing Magazine special issue on Computational Photography and Displays, Sep 2016
• Industry Chair, ICCP 2015 and ICCP 2016

• Organizer, $2^{nd}$ IEEE International Workshop on Computational Cameras and Displays (CCD/PROCAMS), held in conjunction with CVPR 2013
• PhD Thesis Committee Member for Donald Dansereau, University of Sydeny, 2013
• Program Committee Member: ICCP 2012, ICCP 2011, ICCP 2010, PROCAMS 2012, OMNIVIS 2011, WACV 2011
• SIGGRAPH Asia 2011, 2010 Sketches and Posters Committee Member
• SIGGRAPH 2009 General Submissions Jury Member

## US Patents

50 Patents Issued, 10+ pending at Amazon

- 11,526,697 Three-dimensional pose estimation
- 11,450,008 Segmentation using attention-weighted loss and discriminative feature learning
- 11,423,630 Three-dimensional body composition from two-dimensional images
- 11,069,131 Predictive personalized three-dimensional body models
- 10,909,349 Generation of synthetic image data using three-dimensional models
- 10,860,836 Generation of synthetic image data for computer vision models
- 10,582,149 Preview streaming of video data
- 10,482,925 Frame selection of video data
- 10,325,372 Intelligent auto-cropping of images
- 10,282,857 Self-validating structured light depth sensor system
- 10,217,195 Generation of semantic depth of field effect
- 10,198,823 Segmentation of object image data from background image data
- 10,027,883 Primary user selection for head tracking
- 9,965,865 Image data segmentation using depth data
- 9,959,480 Pixel-structural reference image feature extraction
- 9,866,820 Online calibration of cameras
- 9,818,451 Frame selection of video data
- 9,792,688 Position detection device
- 9,750,420 Facial feature selection for heart rate detection
- 9,729,865 Object detection and tracking
- 9,697,433 Pixel-structural reference image feature extraction
- 9,605,981 Absolute encoder
- 9,578,279 Preview streaming of video data
- 9,513,623 Method for generating trajectory for numerical control process
- 9,462,230 Catch-up video buffering
- 9,423,281 Self-calibrating single track absolute rotary encoder
- 9,298,974 Object identification through stereo association
- 8,811,767 Structured light for 3D shape reconstruction subject to global illumination
- 8,805,057 Method and system for generating structured light with spatio-temporal patterns for 3D scene reconstruction
- 8,630,446 Method and system for determining projections in non-central catadioptric optical systems
- 8,605,991 Method for generating visual hulls for 3D objects as sets of convex polyhedra from polygonal silhouettes
- 8,493,432 Digital Refocusing for Wide-Angle Images Using Axial-Cone Cameras
- 8,472,698 System and Method for Determining Poses of Objects
- 8,405,763 Video Camera For Reconstructing Varying Spatio-Temporal Resolution Videos
- 8,274,573 Method and system for generating high temporal resolution video from low temporal resolution videos
- 8,229,294 Cameras with varying spatio-angular-temporal resolutions
- 8,229,244 Multi-image deblurring
- 8,229,242 Method for reconstructing surfaces of specular object from sparse reflection correspondences
- 8,223,259 Increasing temporal resolution of signals

- 8,155,447 Determining points of parabolic curvature on surfaces of specular objects
- 8,134,786 Method and system for determining projections in non-central catadioptric optical systems
- 7,983,487 Method and system for locating and picking objects using active illumination
- 7,965,936 4D light field cameras
- 7,780,364 Apparatus and method for reducing glare in images
- 7,639,289 Increasing object resolutions from a motion-blurred image
- 7,580,620 Method for deblurring images using optimized temporal coding patterns
- 7,454,136 Method and apparatus for acquiring HDR flash images
- 7,443,443 Method and apparatus for enhancing flash and ambient images
- 7,403,707 Method for estimating camera settings adaptively
- 7,038,185 Camera for directly generating a gradient image