

# Sundeep Jolly

U.S. Citizen

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*Ph.D. student and researcher at the MIT Media Lab with primary research interests in computational optical methods and integrated photonic devices for novel three-dimensional imaging and display technologies.*

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## Education

- 2012-2017 **Massachusetts Institute of Technology**, Cambridge, MA  
**Ph.D.**, Media Arts and Sciences (*concentration in Optical Engineering*), MIT Media Lab  
Advisor: V. Michael Bove, Jr., Ph.D.  
Thesis: *Holographic Augmented Reality: Towards Near-to-Eye Electroholography via Guided-Wave Acousto-Optics*
- 2010-2012 **Massachusetts Institute of Technology**, Cambridge, MA  
**S.M.**, Media Arts and Sciences (*concentration in Optical Engineering*), MIT Media Lab  
Advisor: V. Michael Bove, Jr., Ph.D.  
Thesis: *An Updatable Three-Dimensional Display via Direct Optical Fringe Writing of Computer-Generated Holographic Stereograms in Photorefractive Polymer*
- 2008-2009 **Georgia Institute of Technology**, Atlanta, GA  
**M.S.**, Electrical and Computer Engineering (*concentration in Optics and Photonics*)  
Advisor: Levent Degertekin, Ph.D.  
Project: *Fresnel Regime Wave Optics Modeling for Diffraction-Based Micromachined Optical Microphones with Integrated Optical Readout*
- 2004-2008 **Georgia Institute of Technology**, Atlanta, GA  
**B.S.**, Electrical Engineering (*concentration in Optics and Photonics*)  
Advisor: Ali Adibi, Ph.D.  
Thesis: *Cylindrical-Beam Volume Holograms Recorded in Reflection Geometry for Diffuse-Source Spectroscopy*
- 2004-2008 **Georgia Institute of Technology**, Atlanta, GA  
**B.S.**, Physics
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## Research Interests

*Applied Optics and Photonics*: digital and computer-generated holography, three-dimensional display, computational light field imaging and display, augmented reality displays, volume holography, photorefractive materials, integrated optics and nanophotonics, Fourier optics and optical information processing

*Applied Signal Processing*: phase-space optics, image processing, statistical signal processing, optimal control, Kalman and particle filtering

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## Experience

### Research

- 2010-Present **Object-Based Media Group**, *MIT Media Lab, Massachusetts Institute of Technology*  
Advisor: V. Michael Bove, Jr., Ph.D.  
*Current research focuses on the development and implementation of novel signal processing algorithms for efficient computation of computer-generated display holograms alongside investigations into integrated optical architectures for spatial light modulation in holographic video displays. Previously investigated updatable three-dimensional holographic displays based around the direct fringe writing of computer-generated holographic gratings into photorefractive polymers.*
- 2008-2009 **Micromachined Sensors and Transducers Laboratory**, *G. W. Woodruff School of Mechanical Engineering, Georgia Institute of Technology*  
Advisor: Levent Degertekin, Ph.D.  
*Research focused on the modeling and analysis of an interferometric displacement sensing scheme for micro-opto-acoustic transducers. MATLAB and ZEMAX models were developed and employed for analyses and optimization of optical performance resulting in the design of a micro-optical element for inclusion in a complete sensing package.*
- 2005-2008 **Photonics Research Group**, *School of Electrical and Computer Engineering, Georgia Institute of Technology*  
Advisor: Ali Adibi, Ph.D.  
*Research focused on the design and development of compact, diffuse-source optical spectrometers with volume holographic dispersive elements. The candidacy and optimization of volume holograms for the spectroscopic application was investigated, culminating in a study of the role of the holographic recording geometry on dispersive performance.*
- 2006 **Quantum and Nonlinear Optics Research Group**, *Department of Physics, University of Arkansas*  
Advisor: Min Xiao, Ph.D.  
*Research focused on the nonlinear optical characterization of ferroelectric thin films with the refinement of a novel pump-probe technique.*

## Professional & Industrial

- 2016 **Apple, Inc.**, Cupertino, CA  
Display Exploration Engineering Intern
- 2009-2010 **Johns Hopkins University Applied Physics Laboratory**, Laurel, MD  
Research Engineer, Air and Missile Defense Department  
*Research focused on the design and development of novel multi-sensor, multi-target tracking algorithms for future phased-array radar systems.*
- 2008 **NASA Ames Research Center**, Mountain View, CA  
Research Engineering Intern, Intelligent Systems Division  
*Research focused on the characterization of wire fault modalities using time-domain reflectometry techniques in support of efforts to develop a wire-fault signature database.*
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## Publications & Talks

### Refereed journal articles

- D. E. Smalley, S. McLaughlin, C. Leach, J. Kimball, V. M. Bove, and **S. Jolly**, "Progress on characterization and optimization of leaky-mode modulators for holographic video," *Journal of Micro/Nanolithography, MEMS, and MOEMS*, vol. 14, no. 4 (2015).
- G. Ye, **S. Jolly**, V. M. Bove, Q. Dai, R. Raskar, and G. Wetzstein, "Toward BxDF Display using Multilayer Diffraction," *ACM Transactions on Graphics (Proceedings of SIGGRAPH Asia 2014)*, vol. 33, no. 6 (2014).
- D. E. Smalley, Q. Smithwick, V. M. Bove, J. Barabas, and **S. Jolly**, "Anisotropic leaky-mode modulator for holographic video displays," *Nature*, vol. 498, pp. 313-317 (2013).
- S. Jolly**, D. E. Smalley, J. Barabas, and V. M. Bove, "Direct Fringe Writing Architecture for Photorefractive Polymer-based Holographic Displays: Analysis and Implementation," *Optical Engineering*, vol. 52, no. 5, 055801 (2013).
- B. Bicen, **S. Jolly**, K. Jeelani, C. Garcia, N. A. Hall, F. L. Degertekin, Q. Su, W. Cui, and R.N. Miles, "Integrated optical displacement detection and electrostatic actuation for directional optical microphones with micromachined biomimetic diaphragms," *IEEE Sensors*, vol. 9, no. 12, pp. 1933-1941 (2009).
- S. Liu, **S. Jolly**, M. Xiao, Z. Yuan, J. Liu, C. Chen, and W. Zhu, "Domain microstructures and ferroelectric phase transition in  $\text{Pb}_{0.35}\text{Sr}_{0.65}\text{TiO}_3$  films studied by second harmonic generation," *Journal of Applied Physics* **101**, 104118 (2007).

### Refereed conference proceedings

- S. Jolly**, N. Savidis, B. Datta, D. E. Smalley, and V. M. Bove, "Near-to-eye electroholography via guided-wave acousto-optics for augmented reality," *Proceedings of SPIE Practical Holography XXXI: Materials and Applications* (2017).
- N. Savidis, **S. Jolly**, B. Datta, M. Moebius, T. Karydis, E. Mazur, N. Gershenfeld, and V. M. Bove, "Progress in fabrication of waveguide spatial light modulators via femtosecond laser micromachining," *Proceedings of SPIE*

*Advanced Fabrication Technologies for Micro/Nano Optics and Photonics X*, (2017).

B. Datta, N. Savidis, M. Moebius, **S. Jolly**, E. Mazur, and V. M. Bove, “Direct-laser metal writing of surface acoustic wave transducers for integrated-optic spatial light modulators in lithium niobate,” *Proceedings of SPIE Advanced Fabrication Technologies for Micro/Nano Optics and Photonics X*, (2017).

**S. Jolly**, N. Savidis, B. Datta, V. M. Bove, and D. E. Smalley, “Progress in off-plane computer-generated waveguide holography for near-to-eye 3-D display,” *Proceedings of SPIE Practical Holography XXX: Materials and Applications* (2016).

N. Savidis, **S. Jolly**, B. Datta, T. Karydis, and V. M. Bove, “Fabrication of waveguide spatial light modulators via femtosecond laser micromachining,” to appear in *Proceedings of SPIE Advanced Fabrication Technologies for Micro/Nano Optics and Photonics IX* (2016).

**S. Jolly**, E. Dreshaj, N. Savidis, D. E. Smalley, and V. M. Bove, “Progress in full-color holographic displays based around anisotropic leaky-mode modulators,” *Proceedings of the 10th International Symposium on Display Holography* (2015).

V. M. Bove, **S. Jolly**, N. Savidis, B. Datta, and D. E. Smalley, “A computer-generated waveguide hologram for near-to-eye 3-D display,” *Proceedings of the 10th International Symposium on Display Holography* (2015).

E. Dreshaj, **S. Jolly**, and V. M. Bove, “Holosuite: an exploration into holographic telepresence and interaction,” *Proceedings of the 10th International Symposium on Display Holography* (2015).

**S. Jolly**, E. Dreshaj, and V. M. Bove, “Computation of Fresnel holograms and diffraction-specific coherent panoramagrams for full-color holographic displays based on anisotropic leaky-mode modulators,” *Proceedings of SPIE Practical Holography XXIX: Materials and Applications* (2015).

D. Henrie, B. Haymore, M. Zhang, D. Smalley, D. Alrabidi, **S. Jolly**, and V. M. Bove, “Progress on a low-cost holographic video monitor,” *Imaging and Applied Optics 2014 (Proc. Digital Holography and Three-Dimensional Display)* (2014).

**S. Jolly**, D. E. Smalley, J. Barabas, and V. M. Bove, “Computational architecture for full-color holographic displays based on anisotropic leaky-mode modulators,” *Proceedings of SPIE Practical Holography XXVIII: Materials and Applications* (2014).

**S. Jolly**, J. Barabas, D. E. Smalley, and V. M. Bove, “Progress in updatable photorefractive polymer-based holographic displays via direct optical writing of computer-generated fringe patterns,” *Proceedings of SPIE Practical Holography XXVII: Materials and Applications* (2013).

**S. Jolly** and V. M. Bove, “Direct optical fringe writing of diffraction specific coherent panoramagrams in photorefractive polymer for updatable holographic three-dimensional display,” *Proceedings of the 9th International Symposium on Display Holography* (2012).

D. E. Smalley, Q. Smithwick, J. Barabas, V. M. Bove, **S. Jolly**, and C. DellaSilva, “Holovideo for everyone: a low-cost holovideo monitor,” *Proceedings of the 9th International Symposium on Display Holography* (2012).

J. Barabas, **S. Jolly**, D. E. Smalley, and V. M. Bove, “Depth perception and user interface in digital holographic television,” *Proceedings of SPIE Practical Holography XXVI: Materials and Applications* (2012).

J. Barabas, **S. Jolly**, D. E. Smalley, and V. M. Bove, “Diffraction specific coherent panoramagrams of real scenes,” *Proceedings of SPIE Practical Holography XXV: Materials and Applications* (2011).

## Invited talks

**S. Jolly**, N. Savidis, B. Datta, D. E. Smalley, and V. M. Bove, “Integrated Optics for Flat-Panel Holographic Video Displays,” Harvard Photonics Centennial Conference, Cambridge, MA, USA (2017).

**S. Jolly**, D. E. Smalley, J. Barabas, and V. M. Bove, “Advances In End-to-End Holographic Television Systems,” The Holography Conference, New Delhi, India (2013).

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## Patents and Patents Pending

V. M. Bove, S. Jolly, and D. E. Smalley, “Transparent Flat-Panel Holographic Display,” U. S. Patent Application No. 2016/0223988, Aug. 4, 2016.

S. Jolly, N. Savidis, V. M. Bove, B. Datta, and D. E. Smalley, “Near-to-Eye Holographic Display,” U. S. Provisional Patent Application No. 62365973, July, 22, 2016.

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## Skills & Competencies

*Applied Mathematics:* Fourier analysis and signal/image processing, linear and nonlinear optimization, Kalman and particle filtering, machine learning, ordinary and partial differential equations

*Technical Computing:* MATLAB, Maple, Mathematica,  $\text{\TeX}$  &  $\text{\LaTeX}$

*Computer-aided Design:* ZEMAX, AutoCAD, SolidWorks & SolidEdge

*Laboratory:* LabVIEW, VEE, electronic and optical test & measurement, optical prototyping

*Microfabrication and Nanofabrication:* mask alignment (contact photolithography), e-beam lithography, scanning electron microscopy, reactive ion etching, interference lithography, chemical vapor deposition

*Software Development:* C/C++, CUDA

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## Honors & Awards

2014	NVIDIA Graduate Fellowship Finalist
2013	NVIDIA Graduate Fellowship Finalist
2008	ECE Undergraduate Research Option Designation (Georgia Tech)
2007	President’s Undergraduate Research Award (Georgia Tech)
2006	President’s Undergraduate Research Award (Georgia Tech)
2006	ECE Undergraduate Research Award (Georgia Tech)
2004	National Merit Scholar

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## Professional Service

Reviewer, *Applied Optics*

Reviewer, *Journal of the Optical Society of America A*

Reviewer, *Optical Engineering*

Reviewer, ACM SIGGRAPH

Reviewer, *Chinese Optics Letters*

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## Professional Affiliations

Institute of Electrical and Electronics Engineers (IEEE)

IEEE Photonics Society

Optical Society of America (OSA)

International Society for Optical Engineering (SPIE)

Association for Computing Machinery (ACM)