Jason Holloway

Computational Imaging Reseach Scientist

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Research interests

Computational Photography, Computational Imaging, and Computer Vision.

Research focus: I am interested in solving pernicious problems in imaging, such as resolving features below the diffraction limit, seeing through scattering media, and capturing images efficiently. A key component in my research is demonstrating a physically realizable system to prove the efficacy of proposed solutions.

Prior research projects: I have previously worked on (i) synthetic apertures for visible imaging (ii) generalized assorted camera arrays and cross-channel image registration (iii) hyperspectral image classification (iv) visible light communication using smartphones (v) compressive sampling and recovery of high speed video and (vi) blind deblurring of single images with spatially varying blur kernels.

Education

2010–2016 Ph.D.—Rice University, Houston, TX. Advisor: Ashok Veeraraghavan
Ph.D. in Electrical Engineering received September 2016
Master of Science degree in Electrical Engineering received May 2013

2006–2010 BS—Clarkson University, Potsdam, NY.
Bachelor of Science degrees with honors in Electrical Engineering and Physics

Professional Experience

Work Experience

2018-2019 Computational Imaging Research Scientist—Light, Bridgewater, NJ.

- Improved image fusion quality and performance for Nokia 9 Pureview camera modules; introduced temporal HDR to increase dyanmic range
- Refined cross-module fusion to increase output resolution and SNR
- Led three-month research effort to improve matching quality and speed between camera pairs with different focal lengths

2014 Consultant—Light, Palo Alto, CA.
Consulted on early computational photography stages with the flagship product

2013 Research Intern—Adobe Systems, Inc., San Jose, CA.
Summer intern working in the Imagination Lab of Adobe Research under the guidance of Sunil Hadap

2012 Research Intern—Texas Instruments, Dallas, TX.

Summer intern working in the Imaging Branch of the R&D center under the guidance of Umit Batur

Research Experience

2017–2018 Postdoctoral Researcher—Northwestern University, Evanston, IL.
Advisor: Oliver Cossairt

2016–2017 Postdoctoral Researcher—Columbia University, New York, NY. Advisor: Shree Nayar

2010–2016 Research Asst.—Rice University, Houston, TX. Advisor: Ashok Veeraraghavan
PhD research

Summer 2015 Research Asst.—Northwestern University, Evanston, IL. Advisor: Oliver Cossairt
Research in Fourier Ptychography

Publications

Journal Papers

J. Holloway, Y. Wu, M. K. Sharma, O. Cossairt, and A. Veeraraghavan, "Savi: Synthetic apertures for long-range, sub-diffraction limited visible imaging using Fourier ptychography," *Science Advances*, vol. 3, no. 4, 2017.

J. Holloway, M. S. Asif, M. K. Sharma, N. Matsuda, R. Horstmeyer, O. Cossairt, and A. Veeraraghavan, "Toward long distance, sub-diffraction imaging using coherent camera arrays," *IEEE Transactions on Computational Imaging*, vol. 2, pp. 251–265, Sept 2016.

J. Holloway, K. Mitra, S. Koppal, and A. Veeraraghavan, "Generalized assorted camera arrays: Robust cross-channel registration and applications," *Image Processing, IEEE Transactions on*, vol. 24, pp. 823–835, March 2015.

A. Luttman, E. Bollt, and J. Holloway, "An optical flow approach to analyzing species density dynamics and transport," *Journal of Computational Mathematics*, vol. 30, no. 3, pp. 249–261, 2012.

High-Impact Conference Proceedings

A. Kappeler, S. Ghosh, J. Holloway, O. Cossairt, and A. Katsaggelos, "Ptychnet : CNN based Fourier ptychography," in *Image Processing (ICIP), 2017 IEEE International Conference on*, IEEE, Accepted, to appear.

S. Honnungar, J. Holloway, A. K. Pediredla, A. Veeraraghavan, and K. Mitra, "Focal-sweep for large aperture time-of-flight cameras," in *Image Processing (ICIP), 2016 IEEE International Conference on*, pp. 953–957, IEEE, 2016.

J. Holloway, T. Priya, A. Veeraraghavan, and S. Prasad, "Image classification in natural scenes: Are a few selective spectral channels sufficient?," in *Image Processing (ICIP), 2014 21st IEEE International Conference on*, Oct 2014.

J. Holloway, A. C. Sankaranarayanan, A. Veeraraghavan, and S. Tambe, "Flutter shutter video camera for compressive sensing of videos," in *IEEE International Conference on Computational Photography*, (Seattle, WA), April 2012.

Other Publications

R. Latimer, J. Holloway, A. Veeraraghavan, and A. Sabharwal, "Socialsync: Sub-frame synchronization in a smartphone camera network," in *ECCV 2014: Workshop on Light Fields for Computer Vision*, 2014.

R. LiKamWa, D. Ramirez, and J. Holloway, "Styrofoam: A tightly packed coding scheme for camera-based visible light communication," in *ACM MobiCom 2014: 1st ACM Workshop on Visible Light Communication Systems*, 2014.

J. Holloway and C. Navasca, "Recovering tensor data from incomplete measurement via compressive sampling," in *Signals, Systems and Computers, 2009 Conference Record of the Forty-Third Asilomar Conference on*, pp. 1310–1314, Nov. 2009.

Ph.D. Dissertation

2016

Synthetic Apertures for Visible Imaging Using Fourier Ptychography
Advisor–Ashok Veeraraghavan

Abstract: In long-range imaging, spatial resolution is predominantly limited by diffraction blur. Diffraction blur is a fundamental limit that is determined by the diameter of the lens used in the imaging system. In principle, the diameter of a lens can be increased to circumvent diffraction. In reality, cost and manufacturing limitations place a limit on the maximum diameter that can be achieved. Therefore, computational methods are required to super-resolve the observed, blurry image and recover spatial resolution lost to diffraction.

Macroscopic Fourier ptychography is proposed as a practical means to create a synthetic aperture for visible imaging to achieve sub-diffraction limit spatial resolution. In this thesis, two principle barriers to implementing Fourier ptychography are addressed and resolved. First, a prototype imaging system is introduced to recover high-resolution long distance images in a reflection imaging geometry. Second, an image space regularization technique is developed to reconstruct optically rough surfaces that exhibit speckle. Experimental results demonstrate, for the first time, a macroscopic Fourier ptychography imaging system to achieve sub-diffraction resolution of optically rough objects in a reflection geometry. Spatial resolution is increased six-fold over any single captured image.

Master's Thesis

2013

Increasing Temporal, Structural, and Spectral Resolution in Images Using Exemplar–Based Priors
Advisor–Ashok Veeraraghavan

Abstract: In the past decade, camera manufacturers have offered smaller form factors, smaller pixel sizes (leading to higher resolution images), and faster processing chips to increase the performance of consumer cameras. However, these conventional approaches have failed to capitalize on the spatio–temporal redundancy inherent in images, nor have they adequately provided a solution for finding 3D point correspondences for cameras sampling different bands of the visible spectrum. We pose the following question: Given the repetitious nature of image patches, and appropriate camera architectures, can statistical models be used to increase temporal, structural, or spectral resolution?

We propose a two-stage solution to facilitate image reconstruction; 1) design a linear camera system that optically encodes scene information and 2) recover full scene information using prior models learned from statistics of natural images. By leveraging the tendency of small regions to repeat throughout an image or video, we are able to learn prior models from patches pulled from exemplar images. The quality of this approach will be demonstrated for two application domains, using low-speed video cameras for high-speed video acquisition and multi-spectral fusion using an array of cameras. We also investigate a conventional approach

for finding 3D correspondence that enables a generalized assorted array of cameras to operate in multiple modalities, including multi-spectral, high dynamic range, and polarization imaging of dynamic scenes.

Academic Experience

Professional Service

2015, 2016 Media Chair—ICCP Conference, Rice University and Northwestern University
2016 Program Committee—CCD Workshop at CVPR conference
2014-2016 Reviewer—TCI, ICCV, ICIP, CVPR

Teaching Experience

2012 Teaching Asst.—ELEC 241-Fundamentals of Electrical Engineering, Rice University
Independently organized and ran a weekly 2-hour review session for 50 students, kept independent office hours for student questions, helped organized and coordinate 11 undergraduate course assistants and 5 graduate graders

2009-2010 Teaching Asst.—PH131-Physics I/PH132-Physics II, Clarkson University
Ran a 2-hour lab and recitation section for 20 students and provided 2 hours of office hour support weekly. Graded homework for my section and helped grade exams for 500 students.

Awards

2017 Ralph Budd Thesis Award—Rice George R. Brown School of Engineering
2016 Inaugural ECE Distinguished Student Service Award—Rice ECE
2015 Best PhD Presenter Award—Rice ECE Department Affiliate's Day
2012 SCREECH 2nd place overall—Rice Engineering research pitch competition
2012 SCREECH 1st place entrepreneurship—Rice Engineering research pitch competition
2012 Ken Kennedy Institute 4th place—Rice Engineering one-slide research contest
2011 NSF Graduate Student Fellowship—Honorable Mention
2010 Distinguished TI Fellowship—Awarded to promising incoming PhD students
2010 Frederica Clarkson Award—Valedictorian Award, Clarkson University
2009 Exemplary Presentation Award—MathFest '09
2009 Kristin Bandy Craig Memorial Scholarship—Clarkson University