

Alankar Kotwal

CONTACT INFORMATION

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Carnegie Mellon University

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RESEARCH INTERESTS

I work with Prof. Ioannis Gkioulekas at Carnegie Mellon on interferometric light transport probing. In general, I am passionate about Computational Imaging & Optics, Medical Vision, Astrophysics and Cosmology. I would like to explore Networks, Theoretical Machine Learning and Optimization.

EDUCATION

Carnegie Mellon University

August 2017 – Present

Doctor of Philosophy Program, [The Robotics Institute](#)

Indian Institute of Technology Bombay

July 2012 – June 2017

Dual Degree (Bachelor & Master of Technology), Department of [Electrical Engineering](#)

PUBLICATIONS

- Baid, A., Kotwal, A. *et al.*, *Laparoscopic Image Restoration using a Unified Bayesian Graphical Model for Simultaneous Removal of Smoke, Specular Highlights, and Noise*. Submitted to [IEEE Transactions on Medical Imaging](#).
- Kotwal, A., Rajwade, A., *Optimizing Matrices for Compressed Sensing using Existing Goodness Measures: Negative Results, And An Alternative*. Submitted to [IEEE Transactions on Computational Imaging](#).
- Kotwal, A., Rajwade, A. V., *Optimizing Codes for Source Separation in Compressed Video Recovery and Color Image Demosaicing*. To be submitted. Preprint: [arXiv:1609.02135 \[cs.CV\]](#).
- Baid, A., Kotwal, A., Bhalodia, R., Awate, S., *Joint Desmoking, Specularity Removal, and Denoising of Laparoscopy Images via Graphical Models and Bayesian Inference*. Proc. of the [14th International Symposium on Biomedical Imaging \(2017\)](#). Paper [here](#).
- Kotwal, A., Bhalodia, R., Awate, S., *Joint Desmoking and Denoising of Laparoscopy Images*, Proc. of the [13th International Symposium on Biomedical Imaging \(2016\)](#). Paper [here](#).
- Clarke, J. *et al.*, *Field Robotics, Astrobiology and Mars Analogue Research on the Arkaroola Mars Robot Challenge*, Proc. of the [14th Australian Space Research Conference 2014](#). Paper [here](#).

RESEARCH PROJECTS

A Bayesian Framework for Laparoscopic Image Dehazing and Denoising

Guide: [Prof. Suyash Awate](#), CSE, IITB

January 2015 – June 2017

- Developed a Bayesian inference problem for jointly undoing the effect of surgical smoke, specularities and noise on laparoscopy images for better contrast and post-processing (like instrument tracking)
- Tested this method extensively on simulated and real images yielding significant improvement over state of the art dehazing algorithms in terms of numerical and perceptual accuracy

Optimizing Sensing Matrices for Compressed Sampling Recovery

Master's Thesis

Guide: [Prof. Ajit Rajwade](#), CSE & [Prof. V. Rajbabu](#), EE, IITB

December 2015 – June 2017

- Explored coherence minimization for optimizing reconstruction in structured compressed sensing
- Discovered a sensing matrix structure where coherence minimization worsens reconstruction
- Concluded that looseness of worst-case coherence error bound causes this worsening
- Demonstrated an average-case error-based design procedure, and showed reconstruction improvement in the structure where coherence fails

The IITB Mars Rover Project

May 2013 – June 2017

- Built a prototype Mars rover capable of extra-terrestrial robotics with a rocker-bogie suspension
- Participated in a simulated Martian expedition in the Australian outback, at the [Arkaroola Mars Robot Challenge](#) and at the Mars Society's [Mars Desert Research Station](#), Utah

RESEARCH INTERNSHIPS

The AIR Lab, Carnegie Mellon University Robotics Institute

Guide: [Prof. Sebastian Scherer](#) & [Stephen Nuske](#)

Summer 2015

Stereo Odometry from a Downward-facing Stereo Camera on an Aerial Vehicle

- Developed correlation-based tracking for aerial vehicles with a downward-facing stereo camera
- Estimated height and orientation using a robust homography fit between stereo pairs and position with rigid tracking

	<ul style="list-style-type: none"> Achieved better speed and height ranges than the Pixhawk PX4FLOW camera without an IMU 	
	Laboratory for Cosmological Data Mining, University of Illinois, Urbana–Champaign <i>Guide: Prof. Robert Brunner, under Google Summer of Code Summer 2014</i>	
	A Pixel-Level Machine Learning Method for Calculating Photometric Redshifts	
	<ul style="list-style-type: none"> Developed an image extraction, alignment, cleaning and segmentation pipeline on optical images of objects in the sky obtained by the Sloan Digital Sky Survey Classified these objects into galaxies, stars and background, and estimated photometric redshifts based on broad-band pixel flux with patterns learnt on objects with known redshifts and classes 	
	Srujana – Center for Innovation, L. V. Prasad Eye Institute <i>Guide: Dr. Ashutosh Richhariya, Scientist, LVPEI Winter 2014</i>	
	Super-Resolution with Fourier Ptychographic Microscopy	
	<ul style="list-style-type: none"> Explored the trade-offs between wide-field and high resolutions in traditional optical imaging Studied and implemented Fourier Ptychography as a computational imaging method to work around this trade-off, learning the basics of Fourier optics in the process 	
ACHIEVEMENTS AND AWARDS	<ul style="list-style-type: none"> Represented India at the 6th International Olympiad on Astronomy and Astrophysics, Brazil, 2012. Won a Gold Medal with International Rank 4 and a special prize for Best Data Analysis Represented India at the 5th International Earth Sciences Olympiad, Italy, 2011. Won a Bronze Medal and prizes for best performance in the Hydrosphere section and the team presentation Awarded the Undergraduate Research Award for an exceptional Master’s project at IITB. 	
KEY COURSEWORK	CMU: Robotics <i>Machine Learning, Math Fundamentals for Robotics</i> IITB: Computer Science and Engineering <i>Machine Learning, Convex Optimization, Computer Vision, Medical Image Processing, Digital Image Processing, Computer Graphics, Computer Networks, Algorithms, Discrete Mathematics</i> IITB: Electrical Engineering <i>Estimation and Identification, Adaptive Signal Processing, Speech Processing, Matrix Computations, Information Theory, Advanced Probability, Communication Networks</i> IITB: Physics and Mathematics <i>Astrophysics, The General Theory of Relativity, Electromagnetic Waves, Electricity & Magnetism, Classical Mechanics, Differential Equations, Linear Algebra, Complex Analysis, Calculus</i>	
TECHNICAL SKILLS	Programming	C/C++, Python, Bash, Matlab, Verilog, SQL, HTML, PHP, L ^A T _E X
	Software Packages	ROS/Gazebo, OpenCV, The Point Cloud Library, Matplotlib, GNUPlot
OTHER INTERESTS	Other than my academic interests, I like biking, long walks, swimming, socializing, eating good food and trying to cook it. I especially enjoy classic rock music and people who enjoy my interests.	
REFERENCES	<div> Prof. Suyash Awate, CSE IITB E-Mail Webpage Prof. Sebastian Scherer, Robotics Institute CMU E-Mail Webpage Prof. Mayank Vahia, Astrophysics TIFR E-Mail Webpage Prof. Rajbabu Velmurugan, EE IITB E-Mail Webpage </div> <div> Prof. Ajit Rajwade, CSE IITB E-Mail Webpage Dr. Ashutosh Richhariya LVPEI E-Mail Webpage Dr. Aniket Sule, Astronomy HBCSE–TIFR E-Mail Webpage Dr. Manojendu Choudhury, Astrophysics UM–DAE CBS E-Mail Webpage </div>	