

Alankar Kotwal

CONTACT INFORMATION

Newell Simon Hall 1502E
Carnegie Mellon University

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RESEARCH INTERESTS

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, orientation using a robust homography fit between stereo pairs, position with rigid tracking, achieved better speed and height ranges than the Pixhawk camera without an inertial unit

	Laboratory for Cosmological Data Mining, University of Illinois, Urbana–Champaign <i>Guide: Prof. Robert Brunner, under Google Summer of Code</i> Summer 2014				
	A Pixel-Level Machine Learning Method for Calculating Photometric Redshifts <ul style="list-style-type: none">Classified sources into galaxies, stars and background based on broad-band pixel fluxWorked on creating an image extraction, alignment, cleaning, segmentation and learning pipeline on SDSS images and on performance improvement and got a reasonably good error rate				
	Srujana – Center for Innovation, L. V. Prasad Eye Institute <i>Guide: Ashutosh Richhariya, Ophthalmic Biophysics, LVPEI</i> Winter 2014				
	Super–Resolution with Fourier Ptychographic Microscopy <ul style="list-style-type: none">Worked on understanding and implementing Fourier Ptychographic Microscopy for microscopy slidesAnalyzed possible extensions of this method to imaging reflective surfaces like the eye				
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 AnalysisRepresented 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 presentationAwarded the Undergraduate Research Award for an exceptional Master’s project at IITB.				
MENTORING EXPERIENCE	Teaching Assistant CS663: Digital Image Processing Prof. S. Awate and Prof. A. Rajwade Autumn 2015-16 CS736: Medical Image Processing Prof. S. Awate Spring 2015-16 EE638: Estimation and Identification Prof. N. Khaneja Autumn 2016-17 EE708: Information Theory and Coding Prof. S. B. Pillai Spring 2016-17				
	Resource Person, Indian Astronomy Olympiad Programme May ’13, May ’14, May ’17 Involved in mentoring high-school students in Astronomy for their selection to the international Astronomy Olympiads, and in setting up challenging questions and evaluating students.				
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 and trying to cook it. I especially enjoy classic rock music and people who enjoy my interests.				
REFERENCES	<table><tr><td>Prof. Suyash Awate, CSE IITB E-Mail Webpage Dr. Sebastian Scherer, Robotics Institute CMU E-Mail Webpage Prof. Mayank Vahia, Astrophysics TIFR E-Mail Webpage Prof. Rajbabu Velmurugan, EE IITB E-Mail Webpage</td><td>Prof. Ajit Rajwade, CSE IITB E-Mail Webpage Ashutosh Richhariya, Ophthalmic Biophysics LVPEI E-Mail Webpage Dr. Aniket Sule, Astronomy HBCSE–TIFR E-Mail Webpage Dr. Manojendu Choudhury, Astrophysics UM–DAE CBS E-Mail Webpage</td></tr></table>			Prof. Suyash Awate , CSE IITB E-Mail Webpage Dr. Sebastian Scherer , Robotics Institute CMU E-Mail Webpage Prof. Mayank Vahia , Astrophysics TIFR E-Mail Webpage Prof. Rajbabu Velmurugan , EE IITB E-Mail Webpage	Prof. Ajit Rajwade , CSE IITB E-Mail Webpage Ashutosh Richhariya , Ophthalmic Biophysics LVPEI E-Mail Webpage Dr. Aniket Sule , Astronomy HBCSE–TIFR E-Mail Webpage Dr. Manojendu Choudhury , Astrophysics UM–DAE CBS E-Mail Webpage
Prof. Suyash Awate , CSE IITB E-Mail Webpage Dr. Sebastian Scherer , Robotics Institute CMU E-Mail Webpage Prof. Mayank Vahia , Astrophysics TIFR E-Mail Webpage Prof. Rajbabu Velmurugan , EE IITB E-Mail Webpage	Prof. Ajit Rajwade , CSE IITB E-Mail Webpage Ashutosh Richhariya , Ophthalmic Biophysics LVPEI E-Mail Webpage Dr. Aniket Sule , Astronomy HBCSE–TIFR E-Mail Webpage Dr. Manojendu Choudhury , Astrophysics UM–DAE CBS E-Mail Webpage				