

Alankar Kotwal

RESEARCH INTERESTS	I am passionate about Computer and Medical Vision, Machine Learning, Optimization, Estimation Theory, Astrophysics and Cosmology. I also like Robotics, Networks & Security and Graphics.	
EDUCATION	Indian Institute of Technology Bombay , Mumbai, India	<i>July 2012 – Present</i>
	Fifth Year, Dual Degree (Bachelor & Master of Technology), Department of Electrical Engineering Specialization: <i>Communication and Signal Processing</i> , CGPA: 8.92/10.00	
PUBLICATIONS	<ul style="list-style-type: none">• Kotwal, A., Rajwade, A. V., Velmurugan, R., <i>Optimizing Codes for Source Separation In Compressed Video Recovery</i>, arXiv preprint coming soon. Draft here.• Kotwal, A., Bhalodia, R., Awate, S., <i>Joint Desmoking and Denoising of Laparoscopy Images</i> (oral), Proc. of the International Symposium on Biomedical Imaging, 2016. Paper here.• Clarke, J. et al., <i>Field Robotics, Astrobiology and Mars Analogue Research on the Arkaroola Mars Robot Challenge Expedition</i>, Proc. of the Australian Space Research Conference, 2014. Paper here.	
RESEARCH INTERNSHIPS	The AIR Lab, Carnegie Mellon University Robotics Institute <i>Guide: Prof. Sebastian Scherer & Stephen Nuske</i>	<i>Summer 2015</i>
	Stereo Odometry from a Downward-facing Stereo Camera on an Aerial Vehicle <ul style="list-style-type: none">• Developed correlation-based tracking for aerial vehicles with a downward-facing stereo camera• Estimated height, pitch and roll jointly using a robust gradient-descent homography fit between stereo pairs, and position with rigid tracking across frames & achieved performance comparable to, maximum speeds and height ranges better 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>	<i>Summer 2014</i>
	A Pixel-Level Machine Learning Method for Calculating Photometric Redshifts <ul style="list-style-type: none">• Used broad-band pixel flux extracted from SDSS in a machine learning algorithm for redshifts• Accomplished classification of sources into galaxies, stars and background based on pixel features• Worked 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>	<i>Winter 2014</i>
	Super-Resolution with Fourier Ptychographic Microscopy <ul style="list-style-type: none">• Worked on understanding and implementing Fourier Ptychographic Microscopy for microscopy slides• Analyzed possible extensions of this method to imaging reflective surfaces like the eye	
RESEARCH PROJECTS	A New Bayesian Framework for Laparoscopic Image Dehazing and Denoising <i>Guide: Prof. Suyash Awate, CSE, IITB</i>	<i>January 2015 – Present</i>
	<ul style="list-style-type: none">• Developed a Bayesian inference problem for jointly undoing the effect of surgical smoke and noise on laparoscopy images for better contrast and post-processing (like segmentation and 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• Surveyed laparoscopy experts about quality of our results compared to the existing algorithms and found a statistically significant trend that this method yields superior results	
	Coded Source Separation for Compressed Video Recovery <i>Guide: Prof. Ajit Rajwade, CSE & Prof. V. Rajbabu, EE, IITB</i>	<i>Master's Thesis December 2015 – Present</i>
	<ul style="list-style-type: none">• Studied applications of the principles of compressed sensing to video for compression along time• Relaxed the need for a dictionary on space and time and strictly smooth motion using a source-separation approach and designed positive sensing matrices with low mutual coherence for this• Currently optimizing upper bounds tighter than coherence on the restricted isometry constant and improving reconstruction bounds with partially known support	
	The IITB Mars Rover Project	<i>May 2013 – Present</i>
	<ul style="list-style-type: none">• Building a prototype Mars rover capable of extra-terrestrial robotics with a rocker-bogie suspension• Designed circuits for on-board control and interfaced peripherals, currently developing localization and autonomous navigation and exploring the role of machine vision for automating rover operations• 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	

COURSE PROJECTS	Improved Methods for Compressed Sensing Recovery		<i>CS709: Convex Optimization</i>
	Guide: Prof. Ganesh Ramakrishnan , CSE, IITB		<i>Autumn 2015-16</i>
	Using convex approximations to the compressed sensing recovery problem, we reconstructed near-exact versions of images at extremely low compressions, with proofs of correctness. Code here .		
	Hidden Markov Model Part-of-Speech Tagging		<i>EE638: Estimation and Identification</i>
	Guide: Prof. Navin Khaneja , EE, IITB		<i>Autumn 2015-16</i>
ASTROPHYSICS PROJECTS	Laparoscopic Image Dehazing with Dark Channel Prior		<i>CS736: Medical Image Processing</i>
	Guide: Prof. Suyash Awate , CSE, IITB		<i>Spring 2014-15</i>
	We applied the Dark Channel Prior method for landscape image dehazing to surgical smoke-affected laparoscopic images, accelerated it in time and got good results.		
	Stereo Odometry via Point Cloud Registration		<i>CS763: Computer Vision</i>
	Guide: Prof. Ajit Rajwade , CSE, IITB		<i>Spring 2014-15</i>
ACHIEVEMENTS AND AWARDS	Gravitational Lens Separation with PCA		<i>CS663: Digital Image Processing</i>
	Guide: Prof. Suyash Awate & Prof. Ajit Rajwade , CSE, IITB		<i>Autumn 2014-15</i>
	Lensed images of galaxies have rare arc-like artifacts that can be used to calculate the mass of the lens. We used Anscombe denoising followed by PCA to subtract sources and detect arcs.		
	Detection of Short Gamma-ray Bursts from Astrosat Data		<i>PH426: Astrophysics</i>
	Guide: Prof. Vikram Rentala , PH, IITB		<i>Spring 2015-16</i>
MENTORING EXPERIENCE	Processing and Inference from CCD Images		<i>NIUS, Astronomy</i>
	Guide: Prof. Priya Hasan , MANUU, Hyderabad		<i>December 2015</i>
	We analyzed raw data for the globular cluster NGC2419 taken at the HCT , post-processed it and extracted the variation of magnitudes of stars in the cluster on the scale of a day. Code here .		
	An X-Ray Study of Black Hole Candidate X Norma X-1		<i>NIUS, Astronomy</i>
	Guide: Prof. Manojendu Choudhury , Center for Basic Sciences		<i>December 2013</i>
TECHNICAL SKILLS	Estimation of Photometric Redshifts Using Machine Learning		<i>NIUS, Astronomy</i>
	Guide: Prof. Ninan Sajeeth Philip , IUCAA, Pune		<i>December 2012</i>
	Here, we trained a neural network to calculate photometric redshifts and used SDSS data and its redshifted versions to train it, getting good predictions for redshift.		
	<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 Secured All India Rank (AIR) 105 in IIT-JEE amongst half a million candidates Awarded KVPY Scholarship 2011 and NTSE Scholarship 2008 by the Govt. of India 		
	Teaching Assistant		
	CS663: Digital Image Processing	Prof. S. Awate and Prof. A. Rajwade	<i>Autumn 2015-16</i>
	CS736: Medical Image Processing	Prof. S. Awate	<i>Spring 2015-16</i>
	EE638: Estimation and Identification	Prof. N. Khaneja	<i>Autumn 2016-17</i>
	Resource Person, Indian Astronomy Olympiad Programme		<i>May 2013, May 2014</i>
	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.		
	Programming	C/C++, Python, Bash, Matlab, Verilog, SQL, HTML, PHP, L ^A T _E X	
	Software Packages	ROS/Gazebo, OpenCV, The Point Cloud Library	
	Science Software	Python packages: NumPy, SciPy and Matplotlib, GNUPlot, Scikit-learn	
	Hardware	Common Microprocessors, CPLDs and FPGAs, Embedded Platforms	