

# Alankar Kotwal

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RESEARCH INTERESTS	I am passionate about Medical Vision, Robots in Surgery, Computational Imaging & Optics, Estimation, Learning, Optimization, Astrophysics and Cosmology. I also like Networks and Graphics.	
EDUCATION	<b>Indian Institute of Technology Bombay</b> , Mumbai, India	July 2012 – Present
	Fifth Year, Dual Degree (Bachelor & Master of Technology), Department of <a href="#">Electrical Engineering</a> Specialization: <i>Signal Processing</i> , <b>CGPA: 9.08/10.00</b> , Minor: <i>Computer Science and Engineering</i>	
PUBLICATIONS AND PREPRINTS	<ul style="list-style-type: none"><li>• Baid, A., Kotwal, A., Bhalodia, R., Awate, S., <i>Joint Desmoking, Despeckling, and Denoising of Laparoscopy Images via Graphical Models with Variational Bayesian Expectation Maximization</i>. Accepted for the <a href="#">14<sup>th</sup> International Symposium on Biomedical Imaging (2017)</a>. Paper <a href="#">here</a>.</li><li>• Kotwal, A., Rajwade, A. V., <i>Optimizing Codes for Source Separation in Compressed Video Recovery and Color Image Demosaicing</i>. To be submitted. Preprint: <a href="#">arXiv:1609.02135 [cs.CV]</a>.</li><li>• Kotwal, A., Bhalodia, R., Awate, S., <i>Joint Desmoking and Denoising of Laparoscopy Images</i> (oral), Proc. of the <a href="#">13<sup>th</sup> International Symposium on Biomedical Imaging (2016)</a>. Paper <a href="#">here</a>.</li><li>• Clarke, J. et al., <i>Field Robotics, Astrobiology and Mars Analogue Research on the Arkaroola Mars Robot Challenge</i>, Proc. of the <a href="#">14<sup>th</sup> Australian Space Research Conference 2014</a>. Paper <a href="#">here</a>.</li></ul>	
RESEARCH INTERNSHIPS	<b>The AIR Lab, Carnegie Mellon University Robotics Institute</b>	Summer 2015
	Guide: <i>Prof. Sebastian Scherer &amp; Stephen Nuske</i> <b>Stereo Odometry from a Downward-facing Stereo Camera on an Aerial Vehicle</b> <ul style="list-style-type: none"><li>• Developed correlation-based tracking for aerial vehicles with a downward-facing stereo camera</li><li>• 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</li></ul>	
	<b>Laboratory for Cosmological Data Mining, University of Illinois, Urbana–Champaign</b>	Summer 2014
	Guide: <i>Prof. Robert Brunner, under Google Summer of Code</i> <b>A Pixel-Level Machine Learning Method for Calculating Photometric Redshifts</b> <ul style="list-style-type: none"><li>• Classified sources into galaxies, stars and background based on broad-band pixel flux</li><li>• 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</li></ul>	
	<b>Srujana – Center for Innovation, L. V. Prasad Eye Institute</b>	Winter 2014
	Guide: <i>Ashutosh Richhariya, Ophthalmic Biophysics, LVPEI</i> <b>Super-Resolution with Fourier Ptychographic Microscopy</b> <ul style="list-style-type: none"><li>• Worked on understanding and implementing Fourier Ptychographic Microscopy for microscopy slides</li><li>• Analyzed possible extensions of this method to imaging reflective surfaces like the eye</li></ul>	
RESEARCH PROJECTS	<b>A New Bayesian Framework for Laparoscopic Image Dehazing and Denoising</b>	January 2015 – Present
	Guide: <i>Prof. Suyash Awate, CSE, IITB</i> <ul style="list-style-type: none"><li>• 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)</li><li>• 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</li></ul>	
	<b>Optimizing Sensing Matrices for Compressed Sampling Recovery</b>	Master's Thesis
	Guide: <i>Prof. Ajit Rajwade, CSE &amp; Prof. V. Rajbabu, EE, IITB</i> December 2015 – Present <ul style="list-style-type: none"><li>• Studied applications of the principles of compressed sensing to video for compression along time</li><li>• 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</li><li>• Currently optimizing general sensing matrices using error bounds verifiable in polynomial time</li></ul>	
	<b>The IITB Mars Rover Project</b>	May 2013 – Present
	<ul style="list-style-type: none"><li>• Building a prototype Mars rover capable of extra-terrestrial robotics with a rocker-bogie suspension</li><li>• 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</li><li>• Participated in a simulated Martian expedition in the Australian outback, at the <a href="#">Arkaroola Mars Robot Challenge</a> and at the Mars Society's <a href="#">Mars Desert Research Station</a>, Utah</li></ul>	

COURSE PROJECTS	<b>Improved Methods for Compressed Sensing Recovery</b>		<i>CS709: Convex Optimization</i>
	Guide: <a href="#">Prof. Ganesh Ramakrishnan</a> , 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 <a href="#">here</a> .		
	<b>Hidden Markov Model Part-of-Speech Tagging</b>		<i>EE638: Estimation and Identification</i>
	Guide: <a href="#">Prof. Navin Khaneja</a> , EE, IITB		<i>Autumn 2015-16</i>
ASTROPHYSICS PROJECTS	<b>Laparoscopic Image Dehazing with Dark Channel Prior</b>		<i>CS736: Medical Image Processing</i>
	Guide: <a href="#">Prof. Suyash Awate</a> , 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.		
	<b>Stereo Odometry via Point Cloud Registration</b>		<i>CS763: Computer Vision</i>
	Guide: <a href="#">Prof. Ajit Rajwade</a> , CSE, IITB		<i>Spring 2014-15</i>
ACHIEVEMENTS AND AWARDS	<b>Gravitational Lens Separation with PCA</b>		<i>CS663: Digital Image Processing</i>
	Guide: <a href="#">Prof. Suyash Awate</a> & <a href="#">Prof. Ajit Rajwade</a> , 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.		
	<b>Detection of Short Gamma-ray Bursts from Astrosat Data</b>		<i>PH426: Astrophysics</i>
	Guide: <a href="#">Prof. Vikram Rentala</a> , PH, IITB		<i>Spring 2015-16</i>
MENTORING EXPERIENCE	<b>Processing and Inference from CCD Images</b>		<i>NIUS, Astronomy</i>
	Guide: <a href="#">Prof. Priya Hasan</a> , MANUU, Hyderabad		<i>December 2015</i>
	We analyzed raw data for the globular cluster NGC2419 taken at the <a href="#">HCT</a> , post-processed it and extracted the variation of magnitudes of stars in the cluster on the scale of a day. Code <a href="#">here</a> .		
	<b>An X-Ray Study of Black Hole Candidate X Norma X-1</b>		<i>NIUS, Astronomy</i>
	Guide: <a href="#">Prof. Manojendu Choudhury</a> , Center for Basic Sciences		<i>December 2013</i>
TECHNICAL SKILLS	<b>Estimation of Photometric Redshifts Using Machine Learning</b>		<i>NIUS, Astronomy</i>
	Guide: <a href="#">Prof. Ninan Sajeeth Philip</a> , 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"> <li>Represented India at the <a href="#">6<sup>th</sup> International Olympiad on Astronomy and Astrophysics</a>, Brazil, 2012. Won a Gold Medal with International Rank 4 and a special prize for Best Data Analysis</li> <li>Represented India at the <a href="#">5<sup>th</sup> International Earth Sciences Olympiad</a>, Italy, 2011. Won a Bronze Medal and prizes for best performance in the Hydrosphere section and the team presentation</li> <li>Secured All India Rank (AIR) 105 in <a href="#">IIT-JEE</a> amongst half a million candidates</li> <li>Awarded <a href="#">KVPY Scholarship</a> 2011 and <a href="#">NTSE Scholarship</a> 2008 by the Govt. of India</li> </ul>		
	<b>Teaching Assistant</b>		
	CS663: Digital Image Processing	<a href="#">Prof. S. Awate</a> and <a href="#">Prof. A. Rajwade</a>	<i>Autumn 2015-16</i>
	CS736: Medical Image Processing	<a href="#">Prof. S. Awate</a>	<i>Spring 2015-16</i>
	EE638: Estimation and Identification	<a href="#">Prof. N. Khaneja</a>	<i>Autumn 2016-17</i>
	<b>Resource Person, Indian Astronomy Olympiad Programme</b>		<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.		
	<b>Programming</b>	C/C++, Python, Bash, Matlab, Verilog, SQL, HTML, PHP, L <sup>A</sup> T <sub>E</sub> X	
	<b>Software Packages</b>	ROS/Gazebo, OpenCV, The Point Cloud Library	
	<b>Science Software</b>	Python packages: NumPy, SciPy and Matplotlib, GNUPlot, Scikit-learn	
	<b>Hardware</b>	Common Microprocessors, CPLDs and FPGAs, Embedded Platforms	