# Alankar Kotwal

CONTACT
INFORMATION

Newell Simon Hall 1502E
Carnegie Mellon University

*Phone:* +1 (412) 616-5496
*E–Mail:* aloo@cmu.edu

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

- Achieved better speed and height ranges than the Pixhawk PX4FLOW camera without an IMU

**Laboratory for Cosmological Data Mining, University of Illinois, Urbana–Champaign**
*Guide: Prof. Robert Brunner, under Google Summer of Code*                    *Summer 2014*
**A Pixel-Level Machine Learning Method for Calculating Photometric Redshifts**
- 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**
*Guide: Dr. Ashutosh Richhariya, Scientist, LVPEI*                    *Winter 2014*
**Super–Resolution with Fourier Ptychographic Microscopy**
- 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
- 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**
*Machine Learning, Math Fundamentals for Robotics*
**IITB: Computer Science and Engineering**
*Machine Learning, Convex Optimization, Computer Vision, Medical Image Processing, Digital Image Processing, Computer Graphics, Computer Networks, Algorithms, Discrete Mathematics*

**IITB: Electrical Engineering**
*Estimation and Identification, Adaptive Signal Processing, Speech Processing, Matrix Computations, Information Theory, Advanced Probability, Communication Networks*

**IITB: Physics and Mathematics**
*Astrophysics, The General Theory of Relativity, Electromagnetic Waves, Electricity & Magnetism, Classical Mechanics, Differential Equations, Linear Algebra, Complex Analysis, Calculus*

TECHNICAL SKILLS

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|---|---|
| **Programming** | C/C++, Python, Bash, Matlab, Verilog, SQL, HTML, PHP, LaTeX |
| **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

**Prof. Suyash Awate**, CSE
IITB | E–Mail | Webpage

**Prof. Ajit Rajwade**, CSE
IITB | E–Mail | Webpage

**Prof. Sebastian Scherer**, Robotics Institute
CMU | E–Mail | Webpage

**Dr. Ashutosh Richhariya**
LVPEI | E–Mail | Webpage

**Prof. Mayank Vahia**, Astrophysics
TIFR | E–Mail | Webpage

**Dr. Aniket Sule**, Astronomy
HBCSE–TIFR | E–Mail | Webpage

**Prof. Rajbabu Velmurugan**, EE
IITB | E–Mail | Webpage

**Dr. Manojendu Choudhury**, Astrophysics
UM–DAE CBS | E–Mail | Webpage