Alankar Kotwal

Detailed Resume

Education

2012–Present **Dual Degree, B. Tech and M.Tech in Electrical Engineering**,
Indian Institute of Technology, Bombay, *CPI – 8.92/10.*
Specialization: Communication and Signal Processing, Minor Degree: Computer Sciences and Engineering

2010–2012 **Intermediate Examination**,
Ratanbai Walbai Junior College of Science, Mumbai, *Percentage – 93.83.*

2001–2010 **Matriculation**,
SVPT's Saraswati Vidyalaya, Thane, *Percentage – 95.27.*

Achievements

2012 **Gold Medal, International Olympiad on Astronomy and Astrophysics**,
Brazil, International Rank 4, Special Prize for Best Data Analysis.

2011 **Bronze Medal, International Earth Sciences Olympiad**,
Italy, Special Prize for Best Performance in Hydrosphere section.

2012 **All India Rank 105**, *IIT-JEE*,
among around 5,90,000 participants for entrance to the IITs.

2009–2012 **Olympiad Orientation-cum-Selection Camps**,
Selected for the following camps, among the top 30 students in India (Astronomy: 2012 & 2010, Earth Sciences: 2011, Junior Sciences: 2010 & 2009).

2010 **Kishore Vaigyanik Protsahan Yojana Scholarship**,
Awarded by the Government of India to students interested in research.

2008 **National Talent Search Examination Scholarship**,
Awarded by the Government of India to students interested in research.

2011–2012 **Infosys Award for Olympiad Medallists**.

2013 **Inter-IIT Messier Marathon**,
Secured IIT Bombay the second position by putting on board 72 messier objects including the entire Virgo cluster of galaxies.

2013 **Other competitions**,
Won the Innovation Cell recruitment contest for freshmen and the Astronomy Quiz conducted by the Astronomy Club, IITB in 2012 and BITS Goa in 2013.

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Experience: Electrical Engineering and Computer Sciences

2014–Present **Fourier Ptychographic Microscopy for Reflective Imaging**,
The LV Prasad Eye Institute and MIT Media Labs.

- Studied and implemented the technique named Fourier Ptychographic Microscopy for wide-field, high-resolution static imaging
- Analyzed the physics of the system for the case of transmissive imaging in detail using Fourier optics.
- Developing a reflective analogue of this method with special emphasis on eye imaging.

2014 **Google Summer of Code**,
See the Astronomy and Astrophysics section below.

2013–Present **Computer Vision, The IITB Mars Rover Team**,
A Student Initiative at IITB.

- Work in 2014:
  - Heading the image processing subsystem
  - Exploring stereo vision and structure from motion for autonomous rover navigation
  - Implementation of illumination correction and denoising for camera images
  - Design, implementation and testing of a new algorithm for rover navigation and obstacle avoidance
  - Implementation of the rover software stack on ROS
- Work in 2013:
  - Programming manual controls and safety on-board
  - Hardware interfacing for peripherals on-board and debugging

2014 **The Arkaroola Mars Robot Challenge**,
A joint venture of the Mars Society Australia and Saber Astronautics.

- Tested the Mars Rover prototype developed by the IITB Rover Team in the harsh conditions of the Australian outback
- Participated in a series of exercises in Mars operations research conducted by Saber Astronautics which included simulated extra-vehicular activities in simulated space-suits
- Explored Arkaroola geology and studied its similarities to Martian geology

2014 **Gravitational Lens Identification Using Image Processing Techniques**,
A PCA-based Method for Identifying Lenses in Databases,
Prof. A. Rajwade and S. Awate, Department of Computer Sciences,
Indian Institute of Technology Bombay.

- Improvised on source-subtraction algorithms for lens subtraction
- Implemented the algorithm in Matlab and got a good identification rate lenses

2014 **Microprocessor Design**,
Design, Implementation and Validation of Three Processors in Verilog,
Prof. V. Singh, Department of Electrical Engineering,
Indian Institute of Technology Bombay.

- Designed and simulated a pipelined processor with the Little Computer Architecture
- Designed, implemented and tested a multi-cycle RISC processor using the LC-3b ISA
- Designed a CISC processor with reduced 8085 architecture

2014 **Temperature Controller on a CPLD**,
A Peltier-Plate Based Fast-Response P-Controller for Temperature Control,
Prof. J. Mukherjee, Department of Electrical Engineering,
Indian Institute of Technology Bombay.

Experience: Astronomy and Astrophysics

2014 **Google Summer of Code**,
A New Pixel-Level Method for Determination of Photometric Redshifts,
Prof. R. J. Brunner and M. C. Kind, Laboratory for Cosmological Data Mining, University of Illinois at Urbana-Champaign.

- Developed the software package image-photo-z implementing this new method
- Worked with SDSS photometry data and extracted pixel-level information for training machine learning algorithms: k-nearest neighbour algorithm and trees for photo-z
- Worked on parallel programming and performance enhancement for this method
- Validated the approach and got consistent predictions for redshifts in the testing set

2013 **National Initiative for Undergraduate Studies – Astronomy**,
An X-Ray Study of Black Hole Candidate X Norma X-1,
Prof. Manojendu Choudhury, Center for Basic Sciences, University of Mumbai.

- Analysed statistically timing information from RXTE to detect quasi-periodic oscillations and find their possible relation to accretion disk thickening and synchrotron jets
- Fitted the spectra obtained with a thermal and non-thermal power-law distribution to obtain essential system parameters and observed unusual oscillations in the inner radius
- Working on finding a possible cause for these oscillations

2012 **National Initiative for Undergraduate Studies – Astronomy**,
Estimation of Photometric Redshifts Using Machine Learning Techniques,
Prof. Ninan Sajeeth Philip, Inter University Center for Astronomy and Astrophysics, Pune.

- Estimated redshift data from colour index information obtained from SDSS data artificial neural networks
- Worked on generation of training data from available data by redshifting spectra

2013-2014 **Resource Person**,
Indian National Astronomy Olympiad Programme,
Homi Bhabha Center for Science Education.

- Selected twice as a Student Facilitator and a Resource Person for the Indian Astronomy Olympiad OCSC (Orientation-Cum-Selection Camp) for mentoring camp students, handling academic and organizational arrangements and aiding in evaluations
- Involved in the selection and rigorous training of the 3 member Indian National team which won 3 Gold Medals at the International Astronomy Olympiad 2013 held in Lithuania
- Involved in generating problems for the Indian National Astronomy Olympiad which is conducted as a part of selection of students for the camp

2014 **Gravitational Lens Identification**,
See the Computer Sciences section above.

Research Interests

Electrical Engineering and Computer Sciences.

- 3D shape reconstruction using computer vision techniques
- Robot navigation using stereo vision and structure from motion
- Efficient algorithms for robot navigation using geometry of visual field
- Processor architecture
- Hardware description and simulation

Astronomy and Astrophysics.

- Cosmology and the large-scale structure of the universe
- Stellar populations, structure and evolution
- Applications of computer vision to astronomy
- Data mining and its applications for handling astronomical data

Things I'd like to do.

- Logic minimization
- Operations research in relation to Mars missions

Relevant Skills

Languages.

C/C++, Python, Shell Scripting, Java, Matlab, SQL, HTML/CSS, LaTeX

Science Software.

Python packages: NumPy, SciPy and Matplotlib, GNUPlot, Scikit-learn, Astropy, SExtractor, SDSS tools

Special Software.

ROS/Gazebo, OpenCV, SPICE Circuit Simulation, EAGLE PCB Design, SolidWorks CAD, AutoCAD, LabView

Hardware.

Microprocessor Architectures: 8051, 8085, AVR and PIC, CPLDs and FPGAs, Embedded Platforms: Arduino, RaspberryPi, Beaglebone, and so on, standard digital logic families

Relevant Courses Undertaken

Physics and Mathematics.

The General Theory of Relativity, Electromagnetic Waves, Electricity and Magnetism, Classical Mechanics, Differential Equations, Linear Algebra, Complex Analysis, Calculus

Computer Sciences.

Digital Image Processing, Design and Analysis of Algorithms, Data Structures and Algorithms, Discrete Mathematics

Electrical Engineering.

Probability and Random Processes, Communication Systems, Microprocessors, Signals and Systems, Digital and Analog Systems, Electrical Machines and Power Electronics, Electronic Devices and Circuits, Network Theory