Alap Kshirsagar

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EDUCATION

Postgraduate

Cornell University — August 2017-Ongoing
- Doctor of Philosophy (PhD), Mechanical Engineering
- Area of Study: Human-Robot Interaction
- Thesis Committee: Prof. Guy Hoffman, Prof. Hadas Kress-Gazit, Prof. Mark Campbell
- GPA: 4/4 (8 semesters)

Indian Institute of Technology-Madras (IITM) — July 2015-May 2017
- Master of Technology (MTech), Mechanical Engineering
- Specialization: Mechanical Design
- CGPA: 9.07/10
- *Winter Semester 2016-17 at RWTH Aachen, Germany*

Undergraduate

Indian Institute of Technology-Bombay (IITB) — July 2010-April 2014
- Bachelor of Technology (BTech Honours), Mechanical Engineering
- Minor: Aerospace Engineering
- CGPA: 8.78/10

KEY AWARDS/ACHIEVEMENTS

- *Research Academic Internship scholarship* by 'Israeli Council for Higher Education' — 2019
- *IIT Master Sandwich scholarship* by 'German Academic Exchange Service *(DAAD)'*
- *S.N. Bose scholarship* by 'Indo-US Science and Technology forum' — 2016
- *Gandhian Young Technological Innovation Award* by 'Society for Research and Initiatives for Sustainable Technologies and Institutions, India' — 2013
- *Institute Technical Special Mention*, awarded to 12 out of 7000 students, for notable contribution in robotics activities at IIT Bombay — 2012
- *Top 1%* in National Standard Examination in Physics, Chemistry and Astronomy — 2010
- KVPY (*Kishore Vaigyanik Protsahan Yojana or Young Scientist Initiative*) fellowship, initiated by Department of Science and Technology, Govt. of India — 2010
- *All India Rank 289* in IIT-Joint Entrance Examination amongst 470,000 candidates — 2010
- *National Talent Search Scholarship* by NCERT, Govt. of India, awarded to top 750 students in the country on the basis of 3 tier examination — 2008

PUBLICATIONS/PRESENTATIONS

- **A. Kshirsagar,** G. Hoffman and A. Biess, "Evaluating Guided Policy Search for Human-Robot Handovers", IEEE Robotics and Automation Letters 6 (2) : 3933-3940, 2021
- **A. Kshirsagar,** M. Lim, S. Christian and G. Hoffman, "Robot Gaze Behaviors in Human-to-Robot Handovers", IEEE Robotics and Automation Letters 5(4):6552-6558, 2020
- **A. Kshirsagar,** H. Kress-Gazit, G. Hoffman, "*Specifying and Synthesizing Human-Robot Handovers",* IEEE/RSJ International Conference on Intelligent Systems and Robots (IROS), Macau, 4-8 November 2019
- **A. Kshirsagar,** H. Kress-Gazit, G. Hoffman, "*Human-Robot Handovers with Signal Temporal Logic Specifications",* IEEE International Conference on Robot and Human Interactive Communication, 14-18 October 2019 (Best Late Breaking Report Award)
- **A. Kshirsagar,** B. Dreyfuss, G. Ishai, O. Heffetz, G. Hoffman, "*Monetary-Incentive Competition between*

Humans and Robots: Experimental Results", ACM/IEEE International Conference on Human-Robot Interaction (HRI), Daegu, South Korea, 11-14 March 2019

- **A. Kshirsagar,** A. Guha, *"Design optimization of rocker bogie system and development of look-up table for reconfigurable wheels for a planetary rover",* International Journal of Vehicle Structures and Systems, 8.2:58-66, 2016
- **A. Kshirsagar,** R. Pant, K. Bodi, *"Dynamic simulation of breakaway aerostat with emergency deflation valves",* 16th AIAA Aviation Technology, Integration and Operations Conference, AIAA Aviation, Washington D.C., USA, 13-17 June 2016
- S. Loharkar, **A. Kshirsagar,** R.S. Pant, "*Design and Fabrication of a portable semi-rigid airship",* Annual Technical Volume of Aerospace Engineering Division Board, Institution of Engineers (India), 2015-16
- **A. Kshirsagar**, V. Sharma, R.S. Pant, *"Design and Development of a Dismantable Semi Rigid Remotely Controlled Airship*", 10th International Airship Convention and Exhibition, Friedrichshafen, Germany, 16-18 April, 2015
- A. Rajagopal, P. Bende, S. Yadav, R. Agarwal, A. Sathawane, **A. Kshirsagar**, M.C. Hemanth, N. Kumar, P. Gatkine, "*Design, Modelling and Control of a 6 Degrees of Freedom Robotic Arm with specific applications in Planetary Exploration Missions*", 65th International Astronautical Congress, Toronto, Canada, 29 September-3 October, 2014
- **A. Kshirsagar**, D. Harursampath and B. R. Gupta, "*VAM applied to Dimensional Reduction of Non-linear Multifunctional Film Fabric Laminates*", 12th International Conference of Numerical Analysis and Applied Mathematics, Rhodes, Greece, 22-28 September 2014
- **A. Kshirsagar**, A. Tejwani, V. Singh, G. Bhat, N. Singh, A. Yadav, A. Berlia, K. Saboo, U. Patil, S. Prasad, "*Mechatronic Design, Fabrication and Analysis of a Small-Size Humanoid Robot-"Parinat"*, International Journal of Current Engineering and Technology, April 2014, 58-62

RESEARCH EXPERIENCE

Graduate Research Assistant, Cornell University — August 2017 – Ongoing

Project Topic: Evaluating Guided Policy Search for Human-Robot Handovers
Collaborators: Dr. Guy Hoffman (Cornell), Dr. Armin Biess (BGU-Israel)

- Investigating reinforcement learning method "Guided Policy Search" for the task for human-robot object handovers in simulation environment MuJoCo and Franka-Emika Panda robot.

Project Topic: Gaze Behaviours in Human-Robot Handovers
Collaborators: Dr. Guy Hoffman (Cornell), Melanie Lim (Cornell), Shemar Christian (Cornell)

- Investigating the impact of gaze behaviours on human-to-robot object handovers with a Kinova Jaco-2 robot and a simple tablet head robot.

Project Topic: Specifying and Synthesizing Human-Robot Handovers
Collaborators: Dr. Guy Hoffman (Cornell), Dr. Hadas-Kress Gazit (Cornell)

- Investigating automatic synthesis of robot controllers for human-robot handovers from formal specifications written in Signal Temporal Logic.

Project Topic: Interactive Fabrication with Augmented Reality and a Robotic 3D Printer
Collaborators: Dr. Huaishu Peng (UMD-College Park), Dr. François Guimbretière (Cornell), Dr. Guy Hoffman (Cornell)

- Developing an interactive fabrication system to provide a fast, precise, hands-on and in-situ modeling experience with an augmented reality CAD editor and a robotic arm 3D printer

Project Topic: Decision Making with a Robot
Collaborators: Dr. Guy Hoffman (Cornell), Dr. Ori Heffetz (Cornell and HUJI), Guy Ishai (HUJI), Bnaya Dreyfuss (HUJI)

- Studying how people make decisions in the presence of robots when there are monetary rewards at stake

Master's thesis, RWTH Aachen and IIT Madras August 2016 - May 2017

Project Topic: iGPS based motion control of robotic manipulator using Robot Operating System (ROS)
German Advisor: Univ.-Prof. Burkhard Corves, Institut für Getriebetechnik und Maschinendynamik
Indian Advisor: Dr. Sourav Rakshit, Mechanical Engineering Department

- Devised algorithms for accurate control of robotic manipulator using indoor GPS (iGPS) feedback
- Developed ROS packages for iGPS based motion control of Universal Robot-5 manipulator
- Evaluated accuracy of iGPS based motion control algorithms using Gazebo model and actual UR-5 robot

Visiting Student Researcher, MSC Lab, University of California Berkeley May 2016 – July 2016

Project Topic: Robotic manipulation of deformable objects
Advisor: Prof. Masayoshi Tomizuka, Cheryl and John Neerhout, Jr. Distinguished Professor

- Developed a novel image processing algorithm to extract tangent space data from digital colour images of one dimensional (1-D) deformable objects like ropes, wires etc.
- Built framework in MATLAB for obtaining manipulation trajectory of 1-D deformable objects during 'robot learning from demonstration' scenarios
- Developed simulation of 1-D deformable object manipulation tasks by industrial robots FANUC LRmate200iD, using Remote Application Programming Interface (API) between V-REP and MATLAB

Junior Research Fellow, Lighter-Than-Air Systems Lab, IIT Bombay September 2014 – June 2015

Advisor: Prof. Rajkumar Pant, Aerospace Engineering Department
Project 1: Trajectory simulation of breakaway aerostat

- Developed a MATLAB code for trajectory simulations of ascent and descent of a tethered aerostat after accidental tether breakage, to predict performance of payload recovery device

Project 2: Design and development of a dismantle-able semi rigid airship

- Designed and built a prototype of remotely controlled semi-rigid airship with a dismantle-able frame to provide structural strength and ability to mount propulsion units on off-gondola locations

B.Tech. Project, IIT Bombay August 2013- April 2014

Project Topic: Design Optimization and Motion Dynamics of Mobility System for Mars Rover
Advisor: Prof. Anirban Guha, Mechanical Engineering Department

- Evaluated and compared the performance of various mobility systems based on metrics like obstacle climbing capability, power consumption and effective ground pressure
- Developed a physics based motion dynamics simulation tool in MATLAB, incorporating the forward dynamics of rocker bogie system, wheel-soil interaction mechanics and drive motor characteristics
- Analysed the effect of wheel dimensions on mobility performance of rocker bogie system and devised look-up tables for autonomous reconfiguration of wheel dimensions

Summer Research Internship, NMCAD Lab, IISc Bangalore May 2013- July 2013

Project Topic: VAM based modelling of Film-Fabric Laminates
Advisor: Prof. D. Harursampath, Aerospace Engineering Department

- Developed asymptotically correct constitutive model of multi-layered film-fabric laminates with potential application in reliable design of High Altitude Airship envelopes
- Implemented the nonlinear 3-D hyperelastic shell formulation for 3 layers followed by dimensional reduction based on Variational Asymptotic Method, using MATHEMATICA

Student Investigator, RuTAG, IIT Bombay Jan 2012- Nov 2013

Project Topic: Design of Fabric Cutting Machine for Mat-making Handlooms
Advisor: Prof. Suhas Joshi, Mechanical Engineering

- Designed, fabricated and tested various prototypes of human powered as well as electric fabric cutting machine to increase the productivity of mat-making handlooms operated by visually challenged people
- Selected for funding from 'Rural Technology Action Group' (RuTAG) initiated by Principle Scientific Advisor to Govt. of India.

MAJOR STUDENT PROJECTS

Mars Society-India , Executive Member and Head of Mechanical Subsystem Feb 2013 – May 2014

- Led the 10-member Mechanical sub-system of IITB Rover project

- Designed and manufactured rover's mobility system as well as robotic arm to accomplish various mission objectives like astronaut assistance, sample collection, equipment servicing and terrain traversing
- Participated in Arkaroola Mars Robot Challenge-2014, a 14 day expedition organized by Mars Society Australia and Saber Astronautics, to test the rover's capabilities

'Parinat', Head of Mechanical Subsystem — Sept 2012-May 2014

- Led the 12 member Mechanical sub-division of IIT Bombay's first student humanoid robot project
- Conceptualized and built a small size humanoid robot with 12 degrees of freedom, capable of demonstrating basic human motions like straight walking and turning

TEACHING EXPERIENCE

Human-Robot Interaction: Algorithms and Experiments, Cornell University — Fall 2018

- Graduate Teaching Assistant for Dr. Guy Hoffman

TECHNICAL SKILLS

Programming	Robot Operating System, Python, C++, MATLAB, Mathematica, Arduino
Robots	UR-5, Kinova Jaco2, WidowX Mark III
CAD packages	Creo, Solidworks, Autodesk Inventor, AutoCAD
Simulation tools	V-REP, Gazebo, ANSYS, Autodesk Simulation Multiphysics, MSC/ Adams View
Documentation	LaTeX

RELEVANT COURSES

Robotics	○ Human-Robot Interaction ○ Mechatronic Systems	○ Formal Methods for Robotics ○ Mechanics and Control of Robot Manipulators
Mechanical Engineering	○ Product Design ○ Machine Design	○ Micro-Electro-Mechanical Systems ○ Kinematics and Dynamics of Machines
EE/CS	○ Computer Vision ○ Artificial Intelligence	○ Machine Learning for Intelligent Systems ○ Computer programming and utilization
Aerospace Engineering	○ Spaceflight Mechanics ○ Aircraft Design	○ Aerospace Propulsion ○ Spaceflight Navigation and Guidance
Mathematics	○ Differential Equations ○ Linear Algebra	○ Numerical Analysis ○ Data Interpretation and Analysis