Avnish Kumar

Curriculum Vitae

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Homepage

Research Interest

System Modelling, Flight mechanics, Robot path-planning, Multi-agent system: Consensus dynamics, Computer-vision, autonomy and decision making

Education

2009–2014 **Dual-Degree(B.Tech+M.Tech)**, *Indian Institute of Technology(IIT)*, Bombay, India.
Majoring in Aerospace Engineering with specialisation in System Dynamics and Controls.

Publications

2012 "Attitude Determination and Control of Pratham, IIT Bombay's First Student Satellite", presented at the *1st IAA Conference on Dynamics and Controls of Space Systems(DyCoSS)*, Porto, Portugal. pdf

2012 "GPS-INS integration for Improved Autonomous Navigation of Aircrafts", presented at the *International Conference on Navigation and Communication(NAVCOM)*, Hyderabad, India. pdf

2013 "Measurement of Total Electron Count(TEC) using Faraday Rotation", published in the *Indian Journal of Radio & Space Physics (IJRSP), Vol. 42, pp. 197-203*, India. pdf

2010 "System Engineering and Integration of Pratham, IIT Bombay's First Student Satellite", presented at the *International Astronautical Conference*, Prague, Czech Republic. pdf

Awards

2012 **Gandhian Technological Innovation Award**, Society for Research and Initiatives for Sustainable Technologies and Institutions(SRISTI), IIM Ahemdabad.

2007 Excellence award for standing in top 1% in Physics and Chemistry olympiad in country.

2006 Recipient of the Air Force Benevolent Scholarship for being **valedictorian** in high school.

Experience

Research

2010-2012 **Pratham**, *IIT Bombay's First Student Satellite*.

Guides Aerospace Department faculty, IIT Bombay and Scientists from ISRO

Electrical Sub-system, Head

- Joined the electrical subsystem team after passing a rigorous selection process.
- Engineered the software running on the on-board computer of the satellite.
- Optimized the control law to run on a limited resources microcontroller.

Controls Sub-system, member

- Involved in mathematical modelling and model selection required for control of the satellite.
- Implemented a real-time satellite-environment simulator (HILS) using Matlab, Simulink, xPC Target packages along with National Instruments Data Acquisition hardware.
- The satellite environment model includes GPS data, magnetic field of Earth, atmospheric drag, solar torques and satellite dynamics.

2013–Present **Computer-Vision based Robot Navigation**, *Final Year Thesis*.

Guide Prof. Leena Vachhani, Systems and Control Engineering Department, IIT Bombay

• Developing a computer vision based obstacle avoidance algorithm for a mobile ground robot to navigate an indoor area containing unkown obstacles.

• We are using only a monocular web-camera as the primary sensors. The intention is to not depend upon any intrinsic depth-measuring sensor.

May-Dec '12 **GPS aided INS for Autonomous Navigation of Aircrafts**.

Guide Prof. Hari Hablani, Aerospace Engineering Department, IIT Bombay

• Analyzed mathematical models for GPS receivers and inertial navigation system (INS).

• Simulated aircraft kinematics, Inertial Sensors (Gyro & Accelerometer) and GPS in MATLAB-Simulink.

• Designed a generic Tightly-Coupled Extended Kalman Filter for GPS-INS Integration to estimate sensor bias and aircraft navigation errors.

• Investigated effect of GPS receiver jamming; evaluated solution strategies to make the algorithm robust.

Jul-Nov '12 **Conceptual Design of replacement for Boeing 737/Airbus A320**.

Guide Prof. Scott Eberhardt, Aerospace Engineering Department, IIT Bombay

• Followed a systematic design procedure to develop the configuration for the aircraft including the cabin, wing and engine sizing, and weight estimates.

• Conducted trade studies on wing area and span for best aerodynamic efficiency.

• Carried out sizing of the tail section to achieve the required stability and flexibility in CG position.

Internship

May-Sep '13 **Google Summer of Code (GSoC)**.

Mentor Prof. Bart Massey, Computer Science Department, Portland State University (PSU)

• Engineered the code to integrate Optic-Flow sensing capability in the quadrotor of the Aerial Vehicle Team of PSU.

• Designed a Optic-Flow based cascading controller for drift control of the quadrotor. This controller augments the inertial sensors based controller.

May-June 2010 **Digital Audio Player**, *Electronics Club Summer Project*, IIT Bombay.

code • Fabricated a low cost 2-channel digital audio player using an AVR microcontroller.

• Developed a memory constrained FAT32 filesystem driver for accessing an SD card.

Teaching

July-Nov '13 Teaching Assistant for the course of "AE695 : State Space Methods for Flight Vehicles", IIT Bombay

Jan-May '14 Teaching Assistant for the course of "AE773 : Applied Mechatronics", IIT Bombay

2013-present Student Mentorship at Mars Society India (at IITB) of students designing the next generation of Mars rover that can work alongside human explorers in the field.

Computing skills

OS Extremely proficient in Linux

Languages Knowledge of C, C++, Python, Matlab, Assembly

Web Experienced in HTML, CSS

VCS git, mercurial(hg), svn

Microcontroller Skilled Programmer of AVR, PIC and Arduino

Simulators Well versed in Simulink, Familiar with ROS, LTSpice, Eagle, Netlogo

Publishing	Good grasp of LaTeX, Libreoffice
Scientific Python	Well versed in using scipy, numpy, scikit-learn and a range of other scientific python libraries

Relevant Courses

IIT Bombay — Department and Institute core courses and electives

- Computer Programming and Utilization
- Applied Mechatronics
- Complexity in Aerospace Systems
- Data Analysis and Interpretation
- Linear Algebra
- Motion Planning and Coordination of Autonomous Vehicles
- Flight Mechanics
- Navigation and Guidance
- Control Systems Lab
- Calculus
- Differential Equations

Coursera/Udacity — Massive open online courses(MOOC) conducted by Professors from various universities

- Machine Learning, *Instructor*: Prof. Andrew Ng, Stanford University
- Artificial Intelligence for Robotics, *Instructor*: Prof. Sebastian Thrun, Stanford University
- Data Structures and Algorithms, *Instructor*: Prof. Robert Sedgewick, Princeton University

Co-Curricular Activities

2010-present — Student Mentor of the younger students at the Electronics Club of IIT Bombay.

2009 — Won the Circuit Design competition organized, annually, by the Electronics Club, IIT Bombay.

2011 — First place at pan-Mumbai technical competition for developing an unique aerodynamic based anti-collision system for vehicles.

- Gold Medallist in 400m Relay Race at Inter-school sports tournament.
- Bronze Medallist in Basketball at Inter-school sports tournament.
- Fluent speaker of English and Hindi.
- Avid interest in travelling and the SETI project.

Membership

2013-present — ACM, Association for Computing Machinery

2012 — Student's Technical Activities Body, IIT Bombay

2009-present — Web and Coding Club, IIT Bombay