

# Pranav H. Bende

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## EDUCATION

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- **Master of Engineering in Robotics** May '17  
University of Maryland, College Park, MD GPA: 3.57/4.0
- **Bachelor of Technology, Mechanical Engineering** August '15  
Minors in Systems and Control Engineering GPA: 3.14/4.0  
Indian Institute of Technology, Bombay, India

## INTERNSHIP EXPERIENCE

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- **Axle Informatics LLC, Rockville, MD | Robotics Intern** June '16- Dec. '16
  - Worked on an **autonomous aerial vehicle** for pick and place operations with a robotic arm mounted on it
  - Performed tests on **ROS (Robot Operating System)** by coding the path planning and image processing algorithms
  - Designed a **gimbal arm** to make trajectory planning of the gripper autonomous
- **COMSOL, Bangalore, India | Mechanical Engineering Intern** May '14- June '14
  - **Performed FEA on various beam structures** under various loading conditions, for their stiffness in the design of various components of a planetary rover viz. rocker bogie suspension system and robotic arm
  - **Optimized** the design to **increase strength to weight ratio, decreased the mass of rocker bogie system by 50%**
  - Modeled the working of **universal gripper mechanism** and performed **dynamic analysis** to examine forces and moments on joints and linkages

## KEY TECHNICAL PROJECTS

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- **Design of a Planetary Rover | Hardware Team Lead of UMD Rover team** Sept. '16 – May '17
  - Designed an **optimized model of rocker bogie suspension system** for a 6 wheeled planetary rover using design constraints and **obstacle traversability** constraints by applying **Nelder Mead optimization**
  - Studied **wheel soil interaction** and obtained the optimal wheel dimensions for a specified payload and lunar soil
  - Developed a **sensing system** for making the rover **autonomous** by monitoring the wheels' positions, the orientation of rocker bogie system and the chassis and by **planning an optimal path** by mapping the terrain
- **Parameter Estimation of Robotic Arm** Sept. '16 – Dec. '16
  - Studied various algorithms like system and frequency response methods, **correlation based methods, least squares estimation** (linear and nonlinear), sine wave testing for parameter estimation
  - Researched different techniques for **dynamic system identification**, subspace based identification, model structure identification and **recursive system identification**
  - Applied **nonlinear least squares** to **estimate the inertial parameters** of a **3 degrees of freedom robotic arm** by providing exciting trajectories to all the joints and sensing joint torques, position, velocity and acceleration
- **Autonomous Micro Aerial Vehicle (AMAV) | UMD AMAV Team member** Sept. '15 – March '16
  - Modeled the structure of the aerial vehicle along with the mounts for the camera, battery, controller board, etc. in Autodesk Inventor and performing mass optimization of the same considering various materials.
  - Worked on navigation and modeling control for the AMAV using ROS (Robot Operating System)
- **Survey on Motion planning of Planetary Rovers** Jan. '16 – May '16
  - Studied several algorithms like **A\*, D\*, RRT, RRG** which are being used to **plan the motion of planetary rovers on uneven terrains** considering various parameters like terrain slope, power consumption, mechanical stability, etc.
  - **Analyzed and compared** the techniques and algorithms used to arrive at the best possible method
- **Fuel Injection System in Common-rail Diesel Engines, Bachelor's Thesis** July '14- Dec. '14
  - **Researched** the ways to **optimize fuel consumption** and lower noise in **common-rail diesel engine** by implementing control on the fuel injection system
  - Conducted study on fine tuning of relevant parameters like number of injections per stroke, the timing of injections and fuel input per injection to achieve the same
- **Mars Society India** July '13- June '15
  - **IIT Bombay Mars Rover Team | Team Lead**
    - Designed and fabricated a tele-operated planetary rover to participate in research events and competitions like **University Rover Challenge, USA**
    - Modeled CAD and **built dexterous robotic hand** with six degrees of freedom and universal gripper as end effector

- Analysed and optimized the structure specific to the tasks in the competition including collecting soil samples, fitting pipes and lifting weights
- Studied feasibility of **articulated and independent suspension mechanisms** and analyzed their ability to overcome obstacles of varying heights based on factors like energy efficiency, toppling stability
- Designed and tested electronic differential and a steering mechanism based on **Ackermann function**

#### ➤ **Arkaroola MARS Robot Challenge**

*July '14*

(Organized by Mars Society Australia and Saber Astronautics in Arkaroola, South Australia)

- Tested the rover on various tasks that are expected to be performed on **Martian terrains**
- Completed the tasks like traversing challenging rocky terrains (average rock size of the order of 20 cm with the wheel's diameter of 30cm) and collecting **bio-geologically important soil samples** using onboard robotic arm

#### • **Finite Element Modeling of Drilling in Composites**

*July '13- Nov. '13*

- Designed a **static model of drilling in carbon/epoxy fiber** and analyzed stress and strain distribution in different plies which are oriented in different directions
- Compared the results with steel and established the **directional properties** of carbon/epoxy fiber

#### • **Universal Gripper**

*May '13- June '13*

- Designed and fabricated a gripper that can act on objects of varied shapes within a certain size limit
- Modeled **under-actuated linkage** based finger mechanism for gripping large objects viz. hammer, light weight hand tools and **jamming mechanism using suction** to grip small objects viz. screws and drill-bits

### **PUBLICATION**

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- **“Design, Modeling and Control of a 6 degrees of freedom Robotic Arm with Specific Application in Planetary Exploration Missions”** published in 44<sup>th</sup> Student Conference, 65<sup>th</sup> International Astronautical Congress, Toronto, September 2014  
**Authors:** Pranav B., Aditya R. Rachana A. et al

### **TECHNICAL SKILLS**

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- **Computer Aided Design Software:** SolidWorks, Autodesk Inventor
- **Analysis Software:** COMSOL Multiphysics, ANSYS, MATLAB, Simulink, Mathematica, Robot Operating System (ROS)
- **Operating systems:** Windows, Linux

### **LEADERSHIP ROLES**

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- **Mentored** 36 freshmen to participate in robotics competitions like wireless car race and line follower, organized by **Student Technical Activity Body, IIT Bombay**
- Co-ordinated the **Give-a-Coin Campaign**, Techfest (Asia's largest Student Technical festival) initiative for the **promotion of financial child adoption**, held in **32 colleges** across India and managed **9000 donors** for the cause