Dhruv Kool Rajamani

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2015 - 2019	**BTech., Graduation**	Mechatronics Engineering, Manipal Institute of Technology, KA	$8.83^{/10}$
2012 - 2014	**AISSCE, CBSE Delhi**	Vasant Valley School, Delhi	$95.00^{\%}$

Interests

Legged Locomotion, Central Pattern Generators, Rehabilitative and Assistive Devices, Nonlinear Control

Achievements

- Best Rover team from Asia, 8th out of 82 teams at the University Rover Challenge, Utah, 2017 (URC). (*link*)
- Offered INSIPIRE scholarship by DST, Government of India for top 1% score in AISSCE 2014 – Declined
- Best paper presentation at the iACT-2017 conference, ISA Bangalore.

Internships

- **BioRob (link)** — Prof. Auke Jan Ijspeert, Dr.Hamed Razavi, Jonathan Arreguit
  École polytechnique fédérale de Lausanne (EPFL) — *January 2018 - Present*
  - **Implementation of novel walking controller COMAN Robot(COmpliant HuMANoid Platform) [1]:**
    Objective: Design a simulator to validate experiments conducted on the COMAN for a continuum of gaits using a single control structure.
    - Developed simulators for OROCOS-RTT and ROS along with the appropriate analysis tools. (Simulation Packages)
    - Tested continuum of gaits (stepping, active balance, and walking) with a single controller. (Video)

    Outcome: Worked with various robotics frameworks (ROS, OROCOS, YARP), performed gait analysis, conducted extensive reviews on postural control and benefits of the emerging gait controller used, to traditional ZMP methods.
  - **Development of a Neuromechanical framework to study animal locomotion [2]:**
    Objective: Develop a simulator along with appropriate analysis tools to conduct extensive gait analysis of modular tetrapoda models, such as lesion studies, evolutionary studies, etc.
    - Developed a simulator on ROS and Gazebo with custom real time analysis tools (PyQt, NetworkX, etc) with custom GUI.
    - Implemented a neuromechanical controller using Central Pattern Generators (CPGs) on a centipede and a salamander.
    - Conducting lesion studies on a centipede and analysed gait characteristics.

    Outcome: Gained proficiency in Subversion Control and Project Management, implemented a novel closed loop controller for modular tetrapods (single controller for varying body parts).
- **Autonomous Robotics Lab (link)** — Dr.Sudipto Mukherjee
  Indian Institute of Technology, Delhi — *2017 – 2018*
  - **Development of an Underactuated Flexible Manipulator using Differential Flatness:**
    Objective: Design a flexible manipulator on MATLAB with just 2 non-colinear forces acting as input.
    - Successfully flattened a 4-link planar manipulator and implemented a differentially flat controller.
    - Implemented trajectory tracking. (video)

    Outcome: Conducted extensive research on Differential Flatness, comparitive analysis of holonomic and non-holonomic constraints, performed a detailed review on differentially flat orthotic and prosthetic devices.

Experience

- **Biorobotics Group** — Manipal Institute of Technology, KA
  Co-Founder — *2018 - Present*

  The Biorobotics Group is a community of mixed researchers from EPFL and Manipal, collaborating on projects on bioinspired robotics.
  - **Neuromechanical model of a Humanoid:**
    Leading a team of 8 researchers on developing a neuromechanical controller for the COMAN using Central Pattern Generators.
  - **ROS Package for the Pleurobot:**
    Leading a team of 6 researchers on developing a ROS Package for the Pluerobot (BioRob, EPFL) with CPGs.
  - **Tutorials for ROS and Robotics:**
    Created tutorials to learn ROS, Gazebo, and Robot Dynamics and Control using a linear inverted pendulum model.

[1] This work is supported by the Horizon 2020 Work Programme. (https://cogimon.eu/)
[2] This work is supported by the Human Frontier Science Program (HFSP) for the Robotics-Inspired Biology project. (Gain access to this repo)

- **Teaching Assistant** — Manipal Institute of Technology, KA
  MTE-3003, MTE-2211 — *2018 - Present*
  - **Robot Dynamics and Control (MTE-3003):**
    Teaching Robot Dynamics through ROS and evaluating final research project.
  - **CAD & Kinematics Lab (MTE-2211):**
    Teaching and evaluating 3D kinematic models on CATIA V6.
- **Mars Rover Manipal (link)** — Manipal Institute of Technology, KA
  Robotic Arm Lead, Research Lead, Mechanical Member — *2015 - 2017*
  - **Development of a Mars Rover Prototype:**
    Developed a Mars Rover prototype that can traverse harsh Martian like terrain and steep gradients of approximately 1m height.
    * Participated at the University Rover Challenge, UT - 2017 and stood 8th. (URC-2017)
    * Presented the Rover at various conferences. (Critical Design Review) [2]
  - **Robotic Arm Lead:**
    Superevised a team of 6 interdisciplinary researchers to develop an detachable 6DOF Manipulator module for the Rover.
    * The arm has a 6kg payload and a 1.5m reach.
    * Self adapting gripper to perform screwing, grasping, retreiving, etc tasks, published. [1, 3-4]

Projects

- Obstacle detection and Path planning for an autonomous robot using computer vision and fuzzy logic.
- Traffic Detection using a Kalman Filter and Feature detection in MATLAB.
- LQR based control of a 3-link Linear Inverted Pendulum on a cart (LIP).

Technical Skills

Programming	C++, Python, C#, MATLAB, Simulink, Embedded C, LaTeX, Arduino, HTML, CSS, JS
Robotics Software	ROS, OROCOS, GazeboSim, RViz
CAD & CAM	ANSYS Mechanical Workbench, ADAMS, Soliworks, CATIA V6, AutoCAD, Blender

Publications & Presentations

1. **Rajamani, D. K.** , et al. **Design and development of a linear jawed gripper for unstructured environments.** Manipal Journal of Science and Technology 3, no. 1 (June 2018). [link]
2. **Rajamani, D. K.**, et al. **Design Overview of a Planetary Exploration Rover for Unstructured Terrain.** 3rd International and 18th National Conference on Machines & Mechanisms.
3. **Rajamani, D. K.**, et. all. **Design and Development of a Linear Jawed Gripper for Unstructured Environments.** International Conference on Applied Sciences, Engineering & Technology.(ISBN: 978-93-5279-058-6)
4. **Rajamani, D. K.**, et. all. **A comparative Analysis ofIndustrial Grade Parallel Gripper and Linear Grippers.** ISAB Industrial Automationand Control TechEvent Day, ISA Bangalore. (Best Paper Award)