Shashank Ramesh

Mechanical Engineering
Integrated MTech in Robotics
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🎓 Education

Program	Institute	CGPA / %	Year of Completion
Mechanical Engineering Dual Degree	Indian Institute of Technology, Madras	**9.39/10**	2021(Expected)
12th Class	VVS SPPUC, Bangalore	**97.33%**	2016
10th Class	VVS SPHS, Bangalore	**96.96%**	2014

📑 Publications

- **Journal** – Nagamanikandan G., Shashank R., Asokan T., "Design of a Variable Stiffness Joint Module to Quickly Change the Stiffness and to Reduce the Power Consumption", in IEEE Access, vol. 8, pp. 138318-138330, 2020, doi: 10.1109/ACCESS.2020.3012031.
- **Patent (Filed)** – Nagamanikandan G., Shashank R., Asokan T., "A Device for Adjusting Joint Stiffness", IDF No.1861

📋 Research Experience

➢ **Final Year Research Project** | Manipulator Robotics Group, Eng. Design Dept., IIT Madras   May'20 – Present
  Guide: Prof. Sandipan Bandyopadhyay

- **Workspace and Singularity analysis of a 5R Parallel Manipulator**
  - Formulated an analytical method for finding the maximal singularity free disks in the workspace of a 5R manipulator
  - Derived the conditions on link lengths of a 5R manipulator for it to be free of gain-type singularities in its workspace
  - Characterized the singularity manifold of a 5R manipulator based on the nature of its double points for different link lengths

- **Workspace characterisation of a 3-R$\underline{P}$S Parallel Manipulator**
  - Characterised the workspace of the manipulator based on the nature of forward kinematic solutions for different link lengths
  - Derived the condition on actuator states for the manipulator to have odd repeated solutions for the forward kinematics
  - Compared various methods in the literature for finding the principle screws and identified the method relevant to the study

➢ **Variable Stiffness Joint Module** | Robotics Lab, Eng. Design Dept., IIT Madras   Oct'18 – July'20
  Guide: Prof. Asokan Thondiyath, Research Scholar: Nagamanikandan Govindan

- Designed a novel cam based variable stiffness mechanism (VSM) that consumes zero power for maintaining a stiffness value
- Conducted a literature survey on variable stiffness actuators and researched on their mechanism and control algorithms used
- Synthesized a cam profile for maintaining the VSM in static equilibrium by orienting the friction cones at the contact points
- Performed system identification on the 2-DOF[1] brachiator robot using the grey-box modelling technique in MATLAB
- Implemented an optimal controller on a 2-DOF[1] brachiator robot for trajectory planning with minimum power consumption, using the OptimTraj library in MATLAB

➢ **Digitization of Gear Design** | Design of Machine Elements   July'18 – Nov'18
  Guide: Prof. Ratna Kumar Annabattula

- Developed a GUI[2] using python Tkinter library for automating the design of spur and helical gears based on AGMA standards
- Automated the generation of gear production drawings using PDF library in python with the dimensions of the gear as inputs
- Designed a 5-speed automatic transmission gearbox with two helical planetary gear sets using the gear design GUI

⚙ Technical Experience

➢ **Mechatronics Engineer** | Internship at F. T. Motors, Sina Mobility   May'19 – June'19
  The company works on building self-balancing two-wheeled vehicles

- Formulated the forward dynamics of a control moment gyroscope using the Lagrangian method in Wolfram Mathematica
- Implemented LQR[3] control on a single axis control moment gyroscope for the stabilization of a two-wheeled vehicle
- Designed an embedded controller based on ATMega328 microcontroller for the digital control of orientation and motion of a two-wheeled vehicle

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[1] Degree of Freedom   [2] Graphical User Interface   [3] Linear Quadratic Regulator

➢ **Team Lead** | Anveshak, Center for Innovation (CFI), IIT Madras   Aug'17 – June'19
  Guide: Prof. Asokan Thondiyath. The team works on building Field Robots and Space Rovers

- Supervised the implementation of a path planning algorithm for a 3R articulated robotic arm using python in ROS[4] framework
- Conducted boot camp sessions on robotics for 3 weeks covering concepts on robot kinematics, dynamics, and control
- Encouraged the team towards innovating novel mechanisms by allocating more funds to the research and development sector
- Engineered a flexible gripper finger by cascading two four-bar linkages designed for form enclosing the grasped object
- Designed an embedded controller PCB[5] in Autodesk Eagle with daisy chaining and customized motor speed control capability
- Guided the electronics group towards designing circuitry for signal isolation from power devices and battery monitoring system

⬡ Projects

➢ **Adaptive Positioning Collaborative Robot (CoBots)** | A.I. in Manufacturing   Jan'19 – May'19
  Guide: Prof. G. L. Samuel

- Improved the adaptability of CoBots with factory workers by adding features like position tracking and human detection
- Devised a visual servoing algorithm based on HSV[6] object detection and centre of intensity for position tracking of objects
- Enhanced the safety of CoBots by including human detection using Convolutional Neural Network with YOLO[7] architecture

➢ **Walking Beam Indexer Mechanism** | Kinematics and Dynamics of Machinery   July'17 – Nov'17
  Guide: Prof. P. Chandramouli

- Synthesized a walking beam mechanism for the desired motion curve and indexing rate using the graphical approach
- Optimized the link lengths of the mechanism for a near straight-line motion of the beam by studying its coupler curves
- Demonstrated the functioning of the mechanism by building a physical model based on the synthesized link lengths

➢ **Automatic Lighting System**   June'17 – May'18

- Developed an indoor light automation module which uses an infra-red sensor to switch the light based on human occupancy
- Devised a programmable logic controller for the two-step intensity control of a streetlight based on pedestrian activity
- Programmed ATtiny85 chip in Atmel Studio 7.0 for switching the light based on interrupt signals from an infra-red sensor

⬤ Position of Responsibility

➢ **iBoT Club Coordinator** | CFI, IIT Madras   Aug'17 – May'18

- Guided over 10 teams towards building floor-sweeping robots in the Cleaning Bots Session organized by CFI
- Conducted sessions on embedded system covering concepts on motor drivers, Arduino controller and control algorithms

◎ Relevant Course Work

- Nonlinear Control System
- Modern Control Theory
- Multi-Body Dynamics
- Introduction to Robotics

- Design, Analysis and Control of Manipulators
- Principles of guidance for autonomous vehicles
- Mechanics and Control of Serial Robots
- Artificial Intelligence in Manufacturing

- Nonsmooth analysis in control
- Real Analysis
- CNC and Adaptive Control
- Probability and Statistics

🐞 Skills

- **Mathematical Tools**: MATLAB, Simulink, Wolfram Mathematica
- **Programming Languages**: C/C++, Python, ROS[4], Arduino IDE, Embedded C (Atmel Studio 7.0)
- **CAD Tools**: AutoCAD, Autodesk Fusion 360, Solidworks, Autodesk Eagle
- **Software Tools:** LaTeX, Inkscape, Microsoft Office, Unity 3D, Davinci Resolve
- **Other Skills:** Product Design, Prototyping, Project Management, Teaching

🏅 Achievements

- Selected for an internship at the University of Manitoba – Winnipeg, Canada, for working on the project "Intelligent Anti-Vibration Control of Industrial Manufacturing Robots" under Mitacs Globalink Research Program 2020.
- Conducted a workshop on 3D modelling in Autodesk Fusion 360 organized by Mechanica 2019, IIT Madras
- Anveshak placed 1st in the Indian Rover Challenge 2019 among the shortlisted 18 teams held at Manipal Institute of Technology
- Anveshak placed 12th among 96 teams from all over the world in University Rover Challenge 2019 organized by the Mars Society
- Cleaning bots session set the Asia and India Book of Records for building 45 bots sweeping 750 sq.ft of area

[4] Robotic Operating System   [5] Printed Circuit Board   [6] Hue Saturation Value   [7] You Look Only Once