Pardeep KUMAR

L2 Researcher - Software Integration Engineer (Robotics)
ACENTAURI (AI & Efficient Algorithms for Autonomous Robotics), Centre Inria d'Université Côte d'Azur
Sophia Antipolis, France

Date of Birth: 06/05/1993
246 Bd de la Madeleine
Nice 06000, France
+33 6 22 47 60 79
pardeep.kvirvani@gmail.com
pvirvani *Pardeep-Kumar-53*

About Me

As an experienced Postdoctoral researcher in Robotics, I possess the ability to create software solutions for complex robotics systems that are user-friendly. I have expertise in algorithm design for manipulating micro-objects in 3D space and path planning. In addition, I have practical knowledge in navigation, mapping, and SLAM using ROS. I am passionate about collaborating on industrial projects (Robotics, Embedded, IoT) and engaging in R&D activities that allow me to develop and expand my skills.

Objective

My passion lies in excelling as an academic in Computer Science/Engineering, driven by a deep commitment to delivering the highest quality education and nurturing the next generation of computer scientists and engineers. I aspire to ignite a love for the subject among students through dynamic lectures, interactive hands-on exercises, and real-world applications of computer science and engineering concepts. My ultimate goal is to foster critical thinking, problem-solving, and innovation, while continuously staying abreast of the latest developments in the field, ensuring that my teaching remains forward-looking and relevant. Moreover, I am dedicated to providing guidance and mentorship to students, assisting them in achieving their academic and career aspirations, while actively contributing to the ongoing enhancement of the computer science curriculum.

Areas of Interest

I am very much interested to work in the areas of AI & Robotics (Manipulation, Path Planning, Navigation, and Localization, etc.), Intelligent/Autonomous Systems, Control & Automation, IoT.

Education

Oct 2017 – Dec 2021 **Ph.D., Automatique**.
FEMTO-ST Institut, Université Bourgogne Franche-Comté, Besançon, France

Sept 2014 – August 2016 **M.E. Electrical Engineering (Control & Automation)**.
Graduate School of Engineering Sciences and Information Technology (GSESIT), Faculty of Engineering Sciences & Technology(FEST), Hamdard University, Karachi, Pakistan

Sept 2010 – August 2014 **B.E., Computer Systems Engineering**.
Hamdard Institute of Engineering & Technology (HIET), Faculty of Engineering Sciences & Technology (FEST), Hamdard University, Karachi, Pakistan

Publications

Journal Articles

2021 Pardeep Kumar, Michaël Gauthier, and Redwan Dahmouche. Path planning for 3-d in-hand manipulation of micro-objects using rotation decomposition. *Micromachines*, volume 12, page 986. Multidisciplinary Digital Publishing Institute, 2021.

2016 P Kumar and MF Khan. Using inductance to tune left handed material. *Asian Journal of Engineering, Sciences & Technology*, 2016.

Conference Proceedings

2021 Pardeep Kumar, Redwan Dahmouche, and Michael Gauthier. Planning in-hand dexterous micro-manipulation using 3-d rotations decomposition. In *2021 IEEE 17th International Conference on Automation Science and Engineering (CASE)*, pages 2085–2091. IEEE, 2021.

2018 Joël Bafumba Liseli, Redwan Dahmouche, Pardeep Kumar, Jean-Antoine Seon, and Michaël Gauthier. Enhancing in-hand dexterous micro-manipulation for real-time applications. In *2018 IEEE 14th International Conference on Automation Science and Engineering (CASE)*, pages 1605–1611. IEEE, 2018.

Work & Research Projects

August 2023 – * ***Researcher (L2) - Software Integration Engineer (EU AgrifoodTEF)***, *AI & Efficient Algorithms for Autonomous Robotics (ACENTAURI)*, Inria, Sohia Antipolis.

In my current role, I serve as a dedicated Research and Development Engineer, focusing on the cutting-edge "Multi-Robot Mobile Laboratory on Software Aspects" project. My responsibilities encompass a diverse set of tasks, where I play a pivotal role as a Software Integration Engineer to develop a Central Monitoring and Control System from different robots. In this capacity, I am charged with ensuring the seamless interaction of hardware and software components within our mobile laboratory, thereby facilitating the efficient execution of experimental procedures and data collection. In addition to my technical role, I also work as the Project Coordinator for the prestigious European Commission AgrifoodTEF initiative. In this capacity, I represent ACENTAURI - Inria, to our partners throughout France and Europe.

Tools: Vue.JS, ROS, ROS2, roswebtools, roslibjs, ros3djs, Python, Flask, Git

Project Manager: **Philippe Martinet**

Team Manager **Ezio Malis**

July 2022 – June 2023 ***Jeune Chercheur - Chef de Projet Logicielle (ANR Prog4Yu)***, *Laboratoire d'Informatique de Grenoble (LIG)*, Université Grenoble Alpes, Grenoble.

As a young researcher holding the responsibility of software project manager, my task is to develop an interface for the collaborative robot (ABB YuMi Cobot). This interface helps the non-technical industrial production operators to interact with the cobot to perform the required tasks. This project comprises many individual modules, including Automated Planning, Robot Perception, and Control. My responsibility is to develop the interface in such a way that all these modules are combined together, and can be called when specific functionality is required to be performed. Moreover, the available modules are programmed for a specific task, thus my responsibility also includes generalizing these modules to carry out different tasks.

Tools: Vue.JS (Quasar Framework), ROS, Python, Flask, Git

Directors: **Damien Pellier**, *Maître de conférences - HDR.*

Humbert Fiorino, *Associate Professor, Université Grenoble Alpes.*

Jan 2021 – June 2022 ***Job Searching, E-Learning, MOOC***.

Oct 2017 – Dec 2021 ***Doctorant - "Development and Analysis of a Path Planner for Dexterous In-Hand Manipulation of Micro-Objects in 3D"***, *FEMTO-ST Institut*, Univeristé de Bourgogne Franche-Comté, Besançon.

The goal of this research was to develop a path planner that can dexterously manipulate the micro-objects in 3D space. To develop such a system, first, we studied physics at the micro-scale as the adhesive forces are dominant over gravitational forces. Previously, adhesive forces were seen as a disturbance in micro-manipulation systems, but our study shows that it is possible to take advantage of these adhesive forces; as these adhesive forces help to stabilize the manipulated object during the manipulation process. Secondly, we propose to enhance the capabilities of the current planar (2-D) dexterous manipulation system in the state of the art. The direct extension of the currently available 2-D manipulation system for micro-objects involves an exponential increase in complexity. Thus, we propose an approach that allows dexterously manipulating the micro-objects in 3-D space with reduced complexity. Our approach reduces the exponential complexity to moderate linear (i.e. 3 times of planar manipulation). The main idea of this approach is to decompose a 3-D rotation into 3 individual rotations over 2 orthogonal axes. Moreover, we also formalize an approach for sampling grasping points (contact points) on the object's surface that satisfies the initial constraint for rotation decomposition. For fingers' path planning, we utilize a graph search algorithm (A^*) and formalize its cost function and heuristic function that enables us to continue the manipulation process. The proposed strategy has a wide area of application in both microscale and macroscale robotics, and problems related to graph search model.

Tools: Matlab, C++

Advisors : **Michaël Gauthier**, *Senior Scientist (CNRS).*

Redwan Dahmouche, *Associate Professor, Université de Bourgogne Frache-Comté.*

Feb 2016 – June 2016 ***Using Inductance to Tune Left Handed Material***.

Left Handed Materials (LHM) are artificial materials that have negative permittivity, permeability, and negative refractive index. These materials can bend light, and are widely used in microwave devices. One main issue with LHM is its fixed frequency band. Many approaches using capacitance have been proposed in the literature. In our work, we, propose an approach that uses inductance to solve the problem of the fixed frequency band of LHM. We compare the analytical results of our proposed work (inductance) with the published results in the literature (capacitance) and are found in good agreement. Through this technique, a wide variety of tunable microwave devices can be designed, and it is also possible to design the already tunable LHM-based devices using this work.

Tools: Matlab

Advisor : **Muhammad Faisal Khan**, *Associate Professor, HIET, Hamdard University Karachi.*

Other Projects

Robotics Software Engineer

Jan 2021 – May 2021 **Home Service Robot**, *Simulation*, ROS, Gazebo, C++, RTAB-Map, Teleop, rviz.

This is the capstone project of the Robotics Software Engineering Nanodegree program that combines all the learned concepts to build a home service robot to map the environment and navigate it to transport objects.

Jan 2021 – May 2021 **World Mapping and Localization**, *Simulation*, ROS, Gazebo, C++, RTAB-Map, Teleop.

In this SLAM project, the rtabmap-ros package was used to generate 2D occupancy grid and 3D octomap of the simulated environment.

Jan 2021 – May 2021 **Robot Localization**, *Simulation*, ROS, Gazebo, C++, AMCL Package, Navigation Stack, PGM Map Creator.

Using Adaptive Monte Carlo Localization algorithm, the robot is accurately localized inside a map in gazebo simulated environment. Since it was a simulation, the map of gazebo environment was generated using "pgm map creator" package.

Jan 2021 – May 2021 **Ball Chasing Robot**, *Simulation*, ROS, Gazebo, C++.

A simple simulation to learn ROS essentials, where a mobile robot is used to chase/move in the direction of a white ball.

Supervised/Co-Supervised Projects (Undergraduate Level)

Sept 2016 – June 2017 RFID-based Attendance and Class Monitoring System.

Sept 2016 – June 2017 Control and Automation of Green House using Arduino.

Sept 2016 – June 2017 Raspberry-Pi based Smart Notifications System.

Personal Final Year Project (Undergraduate Level)

Sept 2013 – July 2014 Development and Implementation of Hamming Code for Double Bit Error Detection and Correction (DEDC) for Space Applications on FPGA.

Academic Experience

August 2016 – July 2017 ***Lecturer***, HIET-FEST, Hamdard University, Karachi.

Courses Tought Digitial Logic Design, Object Oriented Programming, Instrumentation and Measurement, Database Management System

May 2015 – July 2016 ***Lab Engineer***, HIET-FEST, Hamdard University, Karachi

Labs Conducted Computer Aided Engineering Design, Database Management System, Internet/Web Programming, Embedded Systems, Data Structures & Algorithms, Linear Control Systems.

Sept 2014 – April 2015 ***Lab Engineer***, FCIT, Indus University, Karachi

Courses and Labs Conducted Computer Programming (Theory + Lab), Digital Logic Design (Theory+Lab), Software Engineering (Lab), Computer Networks (Theory), Introduction to Computers (Theory+Lab)

Certifications

Coursera ***Foundations of Robot Motion***, Northwestern University, US

Coursera ***Aerial Robotics***, University of Pennsylvania, US

Udacity ***Robotics Software Engineer*** *(Nanodegree)*, US

Coursera ***Crash Course on Python***, Google

Vue.JS Forge ***Vue.JS Forge***, VueSchool.io

Fellowships & Awards

Sept 2017 – Dec 2021 ***Ph.D. Fellowship*** by Higher Education Commission (HEC), Pakistan in collaboration with Campus France, France.

Sept 2010 – August 2014 ***ICT Scholarship*** by Department of Information & Communication Technology (ICT), Pakistan for 4 years of Undergraduate Studies (Bachelor of Engineering in Computer Systems Engineering).

Skills

Programming Languages

C, C++, Python, JAVA

Hardware Programming and Simulations

MATLAB & Simulink, Embedded C, Verilog HDL, Ladder Logic (for PLCs)

Web Development

HTML, CSS, JavaScript (VueJS, NodeJS), Flask, PHP & MySQL

Robotics

ROS, ROS2, Gazebo, CoppeliaSim, MoveIt, roswebtools, roslibjs, ros3djs

OS & Tools

Windows, Linux (Ubuntu/Fedora), Git, Bash, LaTeX

Position of Responsibility

Sept 2018 – August 2019 **Secretary of IEEE Post-Graduate Student Branch**, FEMTO-ST Institut, Université Bourgogne Franche-Comté, France.

Sept 2012 – August 2013 **Joint Secretary of IEEE Student Branch**, HIET, Hamdard University, Karachi.

Co-Curricular/Extra-Curricular Activities

- Mentoring and guiding students of the minority community, emphasizing the importance of ethical, moral, and religious values at Hamdard University.
- Various Seminars on Continuing Professional Development (CPD).
- Arranged and Managed different events at Hamdard University, Karachi, Pakistan.
- Attended and Participated in many Technical Conferences and Workshops.
- Organized a video Lecture on Professional Skills Development demonstrated by Mr. Bala Prasanna (IEEE Senior Member/ IBM Program Manager/ Executive Committee Member USA) on the account of IEEE Day (October 2, 2012).
- Participated in IEEE-Xtreme 6.0 International Programming Competition. (October 20, 2012).
- Selected as Quality Assurance Officer two times by Ministry of IT in collaboration with NUCES-FAST Islamabad for one of the Teaching Centers of Prime Minister's National ICT R&D Fund - Ministry of IT, Pakistan program.

Referees

Michael Gauthier
Senior Scientist, CNRS
FEMTO-ST Institut
Univ. Bourgogne Franche-Comté
✉ michael.gauthier@femto-st.fr

Redwan Dahmouche
Associate Professor (MCF)
FEMTO-ST Institut
Univ. Bourgogne Franche-Comté
✉ redwan.dahmouche@femto-st.fr

Damien Pellier
MCF - HDR
Laboratoire d'Informatique de Grenoble (LIG)
Université Grenoble Alpes
✉ damien.pellier@univ-grenoble-alpes.fr

Humbert Fiorino
MCF
Laboratoire d'Informatique de Grenoble (LIG)
Université Grenoble Alpes
✉ humbert.fiorino@univ-grenoble-alpes.fr

Philippe Martinet
Research Director
Inria
✉ philippe.martinet@inria.fr

Ezio Malis
Research Scientist
Inria
✉ ezio.malis@inria.fr