Swadhin Agrawal

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Education

IISER Bhopal			**Aug. 2020 – Present**
PhD in Robotics,		*8.67 CPI*	*Bhopal, Madhya Pradesh*
Supervisor: Prof. Sujit P.B,			
Co-supervisor: Dr Andreagiovanni Reina			
IISER Bhopal			**Aug. 2015 – May 2020**
BS-MS,		*8.54 CPI*	*Bhopal, Madhya Pradesh*
Physics (major), EECS (minor),			
Supervisor: Dr Deepak Kumar			
Gangadhar Meher Junior College			**May. 2013 – May 2015**
Higher secondary school		*84.5 %*	*Sambalpur, Odisha*

Relevant Coursework

- Control Systems
- Theory of Computation
- Intelligent robotics
- Model verification
- Introduction to ML
- Network Science
- Computational Geometry
- Linear Algebra
- Math Methods I & II
- Multivariable Calculus
- Probability and Statistics
- Behavioral Biology
- Self-Driving Cars
- SLAM

Technical Skills

Languages: Python, C, C++, C#, MATLAB

Markup Languages: HTML, Latex, XML

Script Languages: Bash, Docker

Developer Tools: VS Code, Blender, OpenFoam

Frameworks: Linux, GitHub, ROS 1, ROS 2, Docker Containers

Simulators: Unity, Gazebo, Webots

Python libraries: Statmodels, Pandas, Numpy, Matplotlib, Multiprocessing, Numba, Ray

Teaching Activities

IISER Bhopal	**Aug 2023 – Dec 2023**
Teaching Assistant,	*Bhopal, MP*
Control systems ECS323	
IISER Bhopal	**Jan 2023 – May 2023**
Teaching Assistant,	*Bhopal, MP*
Introduction to programming ECS102	
IISER Bhopal	**Aug 2022 – Dec 2022**
Teaching Assistant,	*Bhopal, MP*
Computer Organization ECS409	
IISER Bhopal	**Jan 2021 – May 2022**
Teaching Assistant,	*Bhopal, MP*
Data structures and algorithms ECS202	
IISER Bhopal	**Aug 2021 – Nov 2021**
Teaching Assistant,	*Bhopal, MP*
Control systems ECS323	
IISER Bhopal	**Jan 2021 – May 2021**
Teaching Assistant,	*Bhopal, MP*
Introduction to programming ECS102	
IISER Bhopal	**Aug 2020 – Nov 2020**
Teaching Assistant,	*Bhopal, MP*
Control systems ECS323	

Academic Activities

University of Konstanz, Max-Planck Institute of Animal Behaviour
Jan 2024 – March 2024

Visiting Researcher under Dr Liang Li, — *Konstanz, Germany*

Combing evolutionary game theory to collective behavior

Understanding the fundamental mechanisms underlying collective behavior is pivotal in the study of collective behavior. Classical models, such as the Vicsek or Couzin models, often neglect psychological influences, operating on the assumption that each individual strictly adheres to predefined rules. These models then add noise to account for the variations observed in collective formations. However, in the natural world, agents—be they animals or humans—do not always act rationally or in line with these rules. There are instances where individuals might disregard a rule, even if adherence would yield optimal collective outcomes. In this study, we employ evolutionary game theory to investigate how the psychology of individuals impacts collective intelligence. Specifically, we simplify psychological effects into two categories: collaborators, who follow the rules, and defectors, who do not. Our aim is to determine if the presence of defectors can, in certain contexts, benefit the collective.

IISER Bhopal
May 2019 – May 2020

MS Thesis, — *Bhopal, MP*

Effect of Gaussian curvature on frictional interaction between an ultra-thin film and a soft-substrate

* In this project, we explored the role of geometry in modifying the strength of adhesion and hence friction between a few nano-meter thin polystyrene film and a soft hydrogel substrate using RGB image processing techniques on acquired data through long timed imaging.
* In our experiments, we loaded the ultra-thin films on top of the swollen hydrogel surfaces that shrink over time due to the homogeneous evaporation of water.
* By measuring the compression of the film and the shrinking rate of the surface through image analysis using MATLAB, we found that the frictional interaction between the substrate and the film depends on the underlying Gaussian curvature of the substrate.
* As part of the thesis, I also designed the automated experimental setup using Laser and (Olympus & Nikon) DSLR camera, both controlled through Arduino UNO.

Robert Bosch Center for Cyber-Physical Systems
May 2019 – July 2019

Intern under Dr Raghu Krishnapuram, — *Bangalore, Karnataka*

Depth estimation from Monocular image sequences using machine learning methods

- This project was a part of the MBZIRC 2020 competition. In this project, our target was to use a monocular camera and estimate the depth of the objects in the scene.
- We explored various kinds of existing methods like using Convolutional Neural Networks, Geometrical approaches and Dense Nets.
- We tried to reinvent Struct2Depth by Google Brain, DEEPTAM and Demon by LMB-Freiburg, SFMLearner by Tinghui Zhou et al., Disparity learning due to time (in SFMLearner) as well as Space Disparity Learning (MonoDepth by Godard et al.).

IISER Bhopal
June 2018 – July 2018

Intern under Dr Kushal Kumar Shah, — *Bhopal, MP*

On finding the exact Analytical solution of Fokker Planck Equation for Plasma

- In this project, we made an attempt to find the exact solution for the Fokker Planck Equation derived for a Paul trap which was a higher-order & higher degree multivariable partial differential equation.
- This equation gives rise to Riccati Equations, which we did rethinking and made an attempt to solve numerically in Python in order to understand the possibilities of finding the exact solutions. Results of this project can be found in the website link provided above.
- As a part of the internship, we also presented poster of our work at the Plasma conference held at University of Delhi, in 2018. Our work has also been acknowledge as the preliminary work which was published in AIP Physics of Plasma.

Poornaprajna Institute of Scientific Research
May 2017 – July 2017

Intern under Dr R Srikant, — *Bangalore, Karnataka*

On Approximating Universal Quantum Computation

- Here, I learned the basic aspects of Qubits and Quantum Computation, Quantum Gates and Circuits.
- Also, I used the IBM Quantum Gates and created Quantum gates in Mathematica using a software package called QETLAB.
- I explored Quantum Computation and Quantum Information from McMahon and Nielsen and Chuang's books.

Challenges

MBZIRC 2023 | *Semi-Finalist Team LUNA , Student Leader* **Dec 2021 - Aug 2022**

- Implemented the decentralized swarm motion algorithm for inspection and payload lifting from the target vessel in ROS2, Gazebo Ignition MBZIRC environment and Docker.
- Implemented pick and place task for the Robotic arm.
- Implemented lawn-mower algorithm for target vessel search on a delta-fixed-wing vehicle.
- Implemented PID controlled go-to-goal algorithm for unmanned surface vehicle.

VORC 2020 | *Team Unmet dependencies, Student Leader* **Nov 2020 - Dec 2020**

- Participated in the competition to get exposure to the latest software frameworks like Docker and ROS1.

Scientific Reviews

Journal of Aerospace Engineering 2023 | *Journal* **2023**

COCOON 2022 | *Conference* **2022**

Swarm Intelligence | *Special Issue, Springer* **June 2021**

Publications

Conferences

1. Swadhin Agrawal, Sujit P. Baliyarasimhuni, and Andreagiovanni Reina. Response threshold distributions to improve best-of-n decisions in minimalistic robot swarms. In *Swarm Intelligence*, pages 350–359, Cham, 2022

Fellowships

Junior Research Fellowship	**Aug 2020 – Present**
Institute	*IISER'B*
Innovation in Science Pursuit for Inspired Research Fellowship	**Aug 2015 – May 2020**
DST-Inspire	*IISER'B*
FAAC Travel Grant	**Nov 2022**
For attending ANTS 2022 Conference	*IISER'B*

Societies & Memberships

IEEE Robotics & Automation Society (RAS)	**2020 - Present**
Student Member	
Society for the Study of Evolution (SSE)	**2020 - Present**
Student Member	

Invited talks

Summer Outreach Program	**2022**
Robotics in Lab and Field	*IISER'B*
American India Foundation	**Dec 2022**
Role Model Interaction	*IISER'B*

Leadership

Alternate Team Leader **2021-2022**
MBZIRC 2023 *Team LUNA, IISER'B*

Founder & Coordinator **2018-2020**
Rocket & Satellite Designing Club *IISER'B*

Secretary **Nov 2017 - May 2018**
Sports Council *IISER'B*

Coordinator **2016**
Computer Science & Programming Club *IISER'B*

Awards

10th Bhopal Vigyan Mela **2023**
2nd Vigyan Pavillion Prize, Research category *Bhopal*

Student of the Year **2015**
Principal *Gangadhar Meher Junior College*

Workshops & Summer/Winter schools

Summer school on Multi-Robot Systems **Aug 2022**
Participant *Czech Technical University, Prague*

Winter school on SLAM in deformable environments **July 2021**
Participant (2nd prize on challenge) *University of Sydney*

Extracurricular & FunFacts

India International Science Fest 2022 **Jan 2023**
Participant *MNIT Bhopal, India*

Hobbies

- Playing Guitar
- Martial Arts
- Gardening
- Basketball
- Kabaddi
- Photography