Arijit Dasgupta

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Portfolio: **arijitnoobstar.github.io**

Research Interests: *Embodied & Cognitive Artificial Intelligence, Robotics, Reinforcement Learning, Causal Reasoning, Machine Learning for Robotics, Computer & Machine Vision, Systems Integration, Mechanical Design & Systems, Developmental Psychology for Artificial Intelligence*

Education

- **National University of Singapore** Singapore
  Bachelor of Engineering - Honours in Mechanical Engineering *Aug 2018 - May 2022*
  Minor in Computer Science; University Scholars Programme
  GPA: 4.86/5 (Highest Distinction), 17 A+ from 34 Courses completed
  Selected Courses: *Deep Learning for Robotics, Data Structures & Algorithms, Writing & Critical Thinking, Discrete Structures, Probability & Statistics, Quantum Computing, Machine Vision, Programming Methodology, Feedback Control Systems, Mechanical Systems Design, Small Aircraft & Unmanned Aerial Systems*

- **National Junior College** Singapore
  Singapore-Cambridge GCE Advanced Level - 7 Distinctions *Jan 2014 - Dec 2015*

Research Experience

- **A*STAR, Institute for Infocomm Research** Singapore
  Cognitive Artificial Intelligence & Robotics (under Dr Cheston Tan) *May 2021 - Present*
  - Developing a 3D vision only Synthetic Dataset that showcases impossible and possible scenes, which an artificial agent must discriminate using the Violation-of-Expectation (VOE) paradigm.
  - The discrimination requires an understanding of a myriad of intuitive physical reasoning concepts. The scenes are heavily guided and inspired by infant physical reasoning experiments conducted by psychologists using the VOE paradigm.

- **National University of Singapore** Singapore
  Drone Vision & Control (under Dr Sutthiphong Srigrarom) *Feb 2021 - May 2021*
  - Designed and investigated multiple drone path planning methodologies for projectile interception with a depth camera. All tests were conducted in a Gazebo simulation with the control and software architecture embedded into the Robot Operating System (ROS).
  - Trajectory predicted paths were found to be effective at predicting the ball path and intercepting it using a straight-line shortest path planner.

- **National University of Singapore** Singapore
  Deep Reinforcement Learning (under Dr Guillaume Sartoretti) *Aug 2020 - April 2021*
  - Collaborated with a peer to investigate different artificially intelligent approaches to playing the board game Onitama beyond human-level. Real time agents using Minimax and Monte-Carlo Tree Search were first developed as competing agents to train a Deep Reinforcement Learning agent using DDPG.
  - Tested numerous neural network structures to learn valid moves and good moves simultaneously. A branched neural network was highly effective in learning valid board game moves.

- **DSO National Laboratories** Singapore
  Machine Learning for Network Protocols (under Bugsy Teo) *June 2020 - Dec 2020*
  - Introduced a novel unsupervised deep learning approach to automated protocol reverse engineering. A variety of deep learning architectures were used to generate encoded semantic information of data packets for clustering into unknown protocols
  - Developed enigma, a software framework API written in Python to simplify the usability and flexibility of testing and conducting automatic reverse-engineered protocol analysis using multiple machine learning techniques from various domains.
  - Investigated multiple unsupervised machine learning techniques as baselines for comparison against the deep learning approach

- **Temasek Laboratories, Centre for Aerodynamics & Propulsion** Singapore
  Physics-Informed Machine Learning (under Dr Murali Damodaran) *Dec 2019 - Apr 2020*
  - Investigated the use of Physics-Informed Neural Networks (PINNs) to predict fundamental fluid dynamics flow problems.
  - Developed PINNs using Tensorflow that successfully predicted the viscous and incompressible flow around a 2D cylinder and the 2D cavity flow to a high degree of accuracy. It can predict the pressure and velocity fields for a given Reynolds number.
- **A*STAR, Institute of High Performance Computing** Singapore
  Computational Fluid Dynamics (under Dr Harish Gopalan) *Feb 2018 - May 2018*
  - Investigated the Negative Magnus Effect on the flow past a rotating cylinder at different angular velocities using Reynold-averaged Navier Stokes (RANS) models in OpenFOAM.
  - Studied the effect of varying the mesh motion methodologies, turbulence intensities and transitional RANS models in detecting the Negative Magnus Effect.
  - Solo-presented the work during AIAA Scitech 2020 at Orlando, Florida.
- **A*STAR, Institute for Infocomm Research** Singapore
  Information Retrieval & Speech Recognition (under Dr Lim Boon Pang) *June 2014 - Dec 2014*
  - Developed & investigated an algorithm to improve song-title information retrieval via speech recognition in noisy conditions with different types of noises against text-based baselines.
  - This work successfully made it to the finals of the Singapore Science & Engineering Fair, with a Merit award.

Publications

- **Dasgupta, A., Yan, Y., Ong, C., Teo, B. & Lim, A. (2021). Exploring Unsupervised Learning Methods for Automated Protocol Analysis.** ***Submitted to the IEEE Symposium Series on Computational Intelligence 2021.***
- **Tan, J., Dasgupta, A., Agrawal, A., & Srigrarom, S. (2021). Trajectory Prediction & Path Planning for an Object Intercepting UAV with a Mounted Depth Camera.** ***Submitted to the International Conference on Control, Automation and Systems 2021.***
- **Dasgupta, A., Gopalan, H., & Chandar, D. (2020). Investigation of Flow Past Rotating Cylinder using Transitional RANS models for different Mesh Motion Methodologies. In AIAA Scitech 2020 Forum (p. 1587).**

Industrial Experience

- **A*STAR, Advanced Remanufacturing and Technology Centre** Singapore
  Robotics Software Development *May 2018 - Aug 2018*
  - Developed an Autonomous Ground Vehicle (AGV) fleet controller using Robotic Operating System (ROS) C++, in the Gazebo simulation environment.
  - The AGV fleet controller allows the control of single/multiple AGV(s) transport orders, similar to a virtual fleet manager for mobile industrial robots, through an easy-to-use User Interface (UI).
- **Singapore Armed Forces, 23rd Battalion Singapore Artillery** Singapore
  Rocket System Operator *Apr 2016 - Feb 2018*
  - Operationally trained in operating and driving the High Mobility Artillery Rocket System (HIMARS) manufactured by Lockheed Martin and eight other military vehicles.
  - Involved in the maintenance, navigational and firing operations of the rocket system & contributed to Exercise Forging Sabre 2017 in Arizona, USA. Acquired a myriad of soft-skills including leadership, perseverance, effective communication, conflict resolution, critical observation and teamwork.

Projects

- **Flapping-Wing Micro-Aerial Vehicle (Deep Reinforcement Learning & Flapping Wing Flight)**: Modified the design of a state-of-the-art Flapping-Wing Micro-Aerial Vehicle (FW-MAV). Contributed to the design, manufacturing and assembly process. Developed a setup to train the FW-MAV to learn to fly using deep reinforcement learning in a controlled environment with infrared cameras. The software was built in ROS with C++ & Python. (May '21)
- **Teaching a simulated Spider Robot to Walk using AI (Deep Reinforcement Learning)**: Created a CAD model of a Spider Robot using SolidWorks and put it into a PyBullet simulation environment in collaboration with a peer as part of a course project. Successfully made the robot walk in a straight line using DDPG despite having a high number of configurable joints. Topped the entire cohort among graduate students as a third-year undergraduate. (Nov '20)
- **University Rover Challenge 2020 (Mechanical Design & Electronics)**: Designed, manufactured and assembled a 6-wheel rocker-bogie rover as part of the NUS Mars Rover Team. Specially in charge of the mobility system of the rover in terms of Computer-Aided Design, team-strategy, welding liaison & manufacturing. Competition was cancelled in lieu of COVID-19. (Apr '20)
- **AIAA Design Build Fly Competition 2019 (Aerospace Design)**: Designed, manufactured and assembled an Unmanned Aerial Vehicle (UAV) as part of the NUS UAV Team 2019. In charge of Computer-Aided Design, flight theoretical calculations, team strategy & management, manufacturing, electronics & soldering, assembling and logistics handling. Represented NUS for the competition in Arizona, USA. (Apr '19)

Honors and Awards

- A*STAR Undergraduate Scholarship - 2018 to 2022
- University Scholars Programme Senior Honour Roll - 2020
- Defence Science & Technology Agency Brainhack (AI) Finalist - 2020
- NUS Faculty of Engineering Dean's List × 2 - 2019 & 2020
- University Scholars Programme Honour Roll - 2019
- Young Defence Scientists Programme Academic Award (Physics) - 2016
- Singapore Indian Development Association Excellence Award × 2 - 2014 & 2016
- NTU-IEEE Science Symposium Overall Champion - 2015
- Distinction for the NJC Science Research Programme - 2015

Technical & Soft Skills

- **Languages**: Python, C/C++, MATLAB, R, Bash, LaTeX
- **Frameworks**: ROS, Scikit, TensorFlow, Keras, PyTorch, GIT, SolidWorks (CSWA Accredited)
- **Soft Skills**: Science Research, Communication, Leadership, Resource Management, Team Player, Problem-solving, Conflict-Resolution

Volunteering Experience

Ministry of Health Office for Healthcare Transformation Singapore
Bengali Translator for COVID-19 Patients *Apr 2020 - Nov 2020*

- Provided emergency Bengali translation services to COVID-19 patients during Singapore's migrant worker COVID outbreak via an on-call service in shifts.
- Translated for over 15 patients & front-line doctors at the National Centre for Infectious Diseases

Healthserve - NGO for Migrant Workers Singapore
Bengali Translator for Migrant Workers *Apr 2020 - June 2020*

- Surveyed Bengali migrant workers on their emotional health & translated COVID-19 related information posters for Bengali migrant workers living in dormitories.