

Kshitij Anand

5th Year Dual Degree Graduate Student

 +91-8860994760 | kshitijanand.iitkgp@gmail.com | [Website](#)

Education

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| Indian Institute of Technology (IIT) Kharagpur | Kharagpur, India |
| Major – Integrated B.Tech. & M.Tech. in Aerospace Engineering <u>Core GPA: 9.40/10</u> | Expected 2023 |
| Minor – Computer Science & Engineering <u>Additional GPA: 8.5/10</u> | |
| <u>Micro-Specialisation</u> - Artificial Intelligence and Applications (under Centre for Excellence in Artificial Intelligence, IIT Kharagpur) | |

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| Seth Anandram Jaipuria School | Ghaziabad, India |
| High School Final Year National Board: 99.4% (Score: 497/500) | March, 2018 |

- Science (PCM) National Rank 1 | Overall (All Streams) National Rank 3

Conferences/Competitions/Academic Honours

- *A numerical study on three-dimensional flapping dragonfly wings with optimized input kinematics for hovering and forward flight* – **K. Anand**, S. Armanini, & S. M. Dash [[Presented at APS-DFD Conference 2022](#)]
- **Winner (Gold) Team** – Inter IIT Tech Meet 10.0 – Developed an embedded system for monitoring mechanical health of transport vehicles equipped with nRF communication for onboard comms. and GPS-LoRA-WAN connectivity
- Awarded **DAAD-WISE Scholarship** for pursuing summer internship at TU Munich in 2022
- Awarded **MITACS Globalink Research Scholarship** for pursuing summer internship at University of Calgary in 2021
- Awarded **Boeing University Relations Scholarship** for excellent academic performance and participation in undergraduate research in 2021 by the Dept. of Aerospace Engineering, IIT Kharagpur

Work and Research Experience

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| Graduate Student Member, M.N. Faruqui Innovation Centre, IIT Kharagpur | Kharagpur, India |
| <ul style="list-style-type: none">• Guide: Dr. Aditya Bandopadhyay, IIT Kharagpur• Project: Modularized Manufacturing of Fixed Wing UAV for surveillance and remote monitoring• Performed conceptual and detailed design of a <i>manually controlled fixed-wing UAV (T-tail) with prototype</i> manufactured from modular parts made of <i>3D-printed PLA, wood and carbon composite materials</i>• UAV features <i>on-board camera for visual monitoring</i> and <i>STM PMod-NAV (9-axis gyro) board used to log flight path data</i> with an aim to perform control effectiveness study leading to enhancement of final product• Automatic control will be added using the <i>Pixhawk PX4 autopilot (supported with the ROS-MAVLink-QGroundControl environment)</i> with an aim to achieve repeated sorties over a pre-designated flight path at designated altitudes over the area of interest | October 2022 - Current |

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| Graduate Student Member, Bio-Inspired Aero-Hydrodynamics Research Lab, IIT Kharagpur | Kharagpur, India |
| <ul style="list-style-type: none">• Guide: Dr. Sunil Manohar Dash, IIT Kharagpur• Master's Thesis: Systematic numerical study of unsteady aerodynamics of tandem insect wings subject to a novel modified form of the Eldredge Function• Numerical Study using CFD techniques (ANSYS Fluent) conducted to <i>test the validity and required improvements in the 2D aerodynamic force model proposed by van Veen et. al. (2022)</i> for the case of tandem flapping insect wings in 2D and 3D• <i>Dynamic and Overset meshing methods</i> are being used in conjunction to improve accuracy and reduce computation time with <i>PISO algorithm (neighbour skewness correction adjusted by dynamic meshing parameters)</i>• <i>A constant term dependent on angular velocity has been empirically derived</i> to accommodate forewing-hindwing vortex-vortex interactions in the previous model; spanwise vortex shedding and added mass effects were found to <i>contribute less than 2% to time averaged lift and thrust forces</i> for the used input kinematics and are neglected in the model | July 2022 - Current |

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| Summer Research Intern, eAviation Research Group, Technical University of Munich | Munich, Germany |
| <ul style="list-style-type: none">• Guide: Dr. Sophie Armanini, TU Munich• Project: Dynamic Modelling of Heave-Stroke-Pitch actuated FWMAV with independent contralateral wings• 3D CFD simulations were performed for a <i>novel optimized kinematic profile (modified from Eldredge function to incorporate advance ratios for stroke and heave motions w.r.t. pitch motion)</i> for tandem dragonfly wings to derive aerodynamic force model• Mechanical model of a tandem FWMAV with <i>independent actuation mechanism for heave-stroke and pitch</i> was developed• Dynamic modelling of FWMAV was done using <i>Lagrange-Hamiltonian formulation</i> to be used in stability analysis | May 2022 – July 2022 |

- Guide: Dr. Sunil Manohar Dash, IIT Kharagpur
- Bachelor's Thesis: Investigation of rotational effects in flapping wings July 2021 – March 2022
- Examination (using CFD Techniques -ANSYS Fluent) and mathematical modelling of the *rotational effects in aerodynamic forces on stroking, pitching, and combined stroking-pitching 2D and 3D rectangular plate* with aspect ratios, flow Reynolds Number and reduced frequency similar to those of insect flight based on the dragonfly

Summer Intern, Robotarium Lab, University of Calgary | 4Front Robotics Inc.

Calgary, Canada

- Guide: Dr. Alejandro Ramirez Serrano, University of Calgary May 2021 – July 2021
- Project: Conceptual Design of a Highly Transitional and Manoeuvrable UAV
- Designed *PID controller for flight mode transition* with an objective to *minimize vertical height loss*
- *Proposed conceptual design for the internal structure, wings, winglets, and landing gear mechanism* for a transitional UAV based on market survey and general sizing mechanism for UAVs
- Constructed the *detailed mechanical design of the front and rear landing gears* guided by simulated stress analysis and force (input) response analysis

Senior Mentor, DIY Lab, Indian Institute of Technology, Kharagpur

Kharagpur, India

- Embedded and Control Systems Design Mentor October 2019 – March 2020
- Developed several in-house projects using mobile robots with basic features (Line Follower, Obstacle Detection, Light Detection and Follower) in the process of guiding and training freshman year students
- Specialised focus on 3D printing, mechanical design, using development boards (Arduino, RPi) to implement controllers

NIUS Fellow, Indian Institute of Science Education and Research

Kolkata, India

- National Initiative on Undergraduate Sciences (NIUS) Fellow appointed by *HBCSE-TIFR, Mumbai*
- Project: *Quantum Image Representation and Encryption* September 2019 – January 2021
- Implemented a secure framework for transferring greyscale images over a quantum computer network using affine transform and keys (based on logistic mapping)

Term Projects

- Pintle Injector Design for Liquid-Propellant Thrusters used for powering a small-scale VTOL station
- Course Instructor: Dr. Srinibas Karmakar, IIT Kharagpur
 - A survey on available pintle injectors was performed to obtain an estimate of values of pintle length and swirl velocity required for the thrust needed by the VTOL station | Multiphase (LOx and Petrol) CFD simulations were performed for 3 potential injector designs to perform a comparative study
- Implementation of the Batched Cholesky Decomposition Algorithm on an NVIDIA GPU using CUDA
- Course Instructor: Dr. Soumyajit Dey, IIT Kharagpur
 - Undertaken as a term project for the subject 'High-Performance Computing', we developed an efficient implementation of batched Cholesky decomposition as proposed by Gates et al using the CUDA library in C++ | Validation of the experimental results was performed with respect to the findings in the paper
- Mathematical Modelling of the interaction of Rotor downwash with fixed wings in a transitional UAV
- Course Instructor: Dr. Sandeep Saha, IIT Kharagpur
 - A survey of experimental and simulation methods to determine the effect of rotor downwash on fixed wings (e.g. Bell V-22 Osprey) was performed to determine the parameters such as rotor positioning, distance from the wing, and rotor speed vs inclination to prepare a mechanical model and simulations were performed to investigate the aerodynamic forces
- Construction of a Mid-Size Wind Tunnel with a Digital Data Acquisition System
- Course Instructor: Dr. Sandeep Saha, IIT Kharagpur
 - Constructed a mid-size open suction wind tunnel [Total length: 8 feet; Test section: (1-foot x 1-foot) x 3 feet] **at home** (*due to COVID lockdowns*) equipped with a settling chamber, a pitot tube, and a Digital Data Acquisition System running on an RPi board | 3D printed standard air foil (NACA 0012 and 2412) were placed in the wind tunnel to verify the accuracy of the wind tunnel | Maximum averaged error observed was 11% in determining C_L and 8% in C_D values

Coursework Information

Curriculum Courses

Fluid Dynamics / Aerodynamics / CFD: Introductory Aerodynamics | Low-Speed Aerodynamics | High-Speed Aerodynamics | Viscous Flow Theory | Computational Fluid Dynamics | Advanced Fluid Mechanics

Control Theory / Mechanics / Dynamics / Robotics: Introduction to Flight Vehicle Controls | Automatic Control of Aircraft | Linear Systems and Control | Introduction to Flight Mechanics | Flight Dynamics and Stability | Aircraft Design and Optimisation | Embedded Sensing, Actuation, Interfacing and Control

Computer Science / Math / AI: Algorithms and Data Structures (C++) | Image Processing | High-Performance Computing | Machine Learning | Artificial Intelligence and its Applications | Deep Learning Foundations and Applications | Linear Algebra for AI & ML | Single Variable and Multivariate Calculus | Linear Algebra | Vector Calculus

MOOCs: Probability and Statistics | Aerial Robotics | Modern Robotics | Deep Learning

Skills

Programming C++ | Python | MATLAB | AVR Assembly | Prolog

Frameworks NumPy | Pandas | Matplotlib | Seaborn | TensorFlow | Keras | PyTorch | OpenCV | Arduino | RaspberryPi

Software ANSYS Fluent | ANSYS Mechanical | SolidWorks | Coppelia Simulator | ROS-PX4-Gazebo

HPC Slurm Manager (used with ANSYS Fluent to execute CFD Simulations)

Leadership Positions

- **Secretary, Aerospace Engineering Society, IIT Kharagpur | 2018-2020**
 - Responsible for boosting the research morale of undergraduate students by organizing workshops and interactive sessions with senior undergraduate and graduate students
- **Governor, Literary Society, IIT Kharagpur | 2020-2021**
 - Responsible for publication of the Annual Magazine of IIT Kharagpur | Responsible for conducting meetups and performance-based events for literary enthusiasts at the institution