

# Kshitij Anand

5<sup>th</sup> Year Dual Degree Graduate Student

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## Education

Indian Institute of Technology (IIT) Kharagpur	Kharagpur, India
Major – Integrated B.Tech. & M.Tech. in Aerospace Engineering   <u>Core GPA: 9.40/10</u>	<i>Expected 2023</i>
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)	
Seth Anandram Jaipuria School	Ghaziabad, India
High School   Final Year National Board: 99.4% (Score: 497/500)	<i>March, 2018</i>
<ul style="list-style-type: none"><li>Science (PCM) National Rank 1   Overall (All Streams) National Rank 3</li></ul>	

## 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

Graduate Student Member, M.N. Faruqui Innovation Centre, IIT Kharagpur	Kharagpur, India
<ul style="list-style-type: none"><li>Guide: Dr. Aditya Bandopadhyay, IIT Kharagpur</li><li>Project: Modularized Manufacturing of Fixed Wing UAV for surveillance and remote monitoring</li><li>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></li><li>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</li><li>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</li></ul>	
Graduate Student Member, Bio-Inspired Aero-Hydrodynamics Research Lab, IIT Kharagpur	Kharagpur, India
<ul style="list-style-type: none"><li>Guide: Dr. Sunil Manohar Dash, IIT Kharagpur</li><li>Master's Thesis: Systematic numerical study of unsteady aerodynamics of tandem insect wings subject to a novel modified form of the Eldredge Function</li><li>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</li><li><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></li><li><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</li></ul>	
Summer Research Intern, eAviation Research Group, Technical University of Munich	Munich, Germany
<ul style="list-style-type: none"><li>Guide: Dr. Sophie Armanini, TU Munich</li><li>Project: Dynamic Modelling of Heave-Stroke-Pitch actuated FWMAV with independent contralateral wings</li><li>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</li><li>Mechanical model of a tandem FWMAV with <i>independent actuation mechanism for heave-stroke and pitch</i> was developed</li><li>Dynamic modelling of FWMAV was done using <i>Lagrange-Hamiltonian formulation</i> to be used in stability analysis</li></ul>	

- Guide: Dr. Sunil Manohar Dash, IIT Kharagpur
- Batchelor'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

- 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

- 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

- 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

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### 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

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<b>Programming</b>	C++   Python   MATLAB   AVR Assembly   Prolog
<b>Frameworks</b>	NumPy   Pandas   Matplotlib   Seaborn   TensorFlow   Keras   PyTorch   OpenCV   Arduino   RaspberryPi
<b>Software</b>	ANSYS Fluent   ANSYS Mechanical   SolidWorks   Coppelia Simulator   ROS-PX4-Gazebo
<b>HPC</b>	Slurm Manager (used with ANSYS Fluent to execute CFD Simulations)

### Leadership Positions

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- **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