

IRENE GRACE KAROT POLSON

Undergraduate at Indian Institute of Technology, Kanpur | IIT Kanpur

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EDUCATION

Indian Institute of Technology, Kanpur

July 2018 - May 2022

Bachelor of Technology in Aerospace Engineering

CPI: 8.76

Member of Society of Aerospace Engineers | Aquatics Team

Maharishi Vidya Mandir, Chennai

May 2016 - March 2018

XII Graduation

Percentage: 97.2%

Top 0.1 Scorer in Computer Science and Physics

RESEARCH EXPERIENCE

Derivative-free Adaptive Satellite Attitude Control

April 2021 – Present

Advisor: Dr. Dipak Kumar Giri

Indian Institute of Technology, Kanpur

- Developed adaptive controllers with derivative free weight update laws to make a fault-tolerant attitude controller for satellite systems. The satellite system and states were represented using modified Rodrigues parameters.
- Currently working on machine learning and evolutionary optimisation techniques' applications on adaptive laws and control as a part of my undergraduate project.
- Exploring the use of evolutionary optimisation techniques such as Genetic algorithm in online parameter correction and optimisation.

Autonomous Multi-Drone Systems to Large Structure Inspections

March 2021 – Present

Advisor: Dr. Debasish Ghose

Indian Institute of Science, Bangalore

- As a selected candidate for the Indian National Academy of Engineering Mentorship Program, we worked on the development of a 3D coverage path planning algorithm using Lissajous curves and its application on large structural inspections.
- The drone's controller developed carries out trajectory tracking using PD controller. The program is executed using desktop prototyping of ROS/Gazebo system into MATLAB using Desktop Prototyping. The visual data captured can be used for complete 3D remodelling of the structure.

Control System Design using Bond graph Representation

March - June 2021

Advisor: Dr. N. Selvaganesan

Indian Institute of Space Science and Technology

- Developed a power-based graphical representation of system and its PID position and altitude controller using bond graph approach. Reduced bond graph model is derived and feedback is obtained from inertial elements of the reduced model.
- The entire closed-loop MIMO system is represented using 20SIM bond graph software and the simulations are performed to meet satisfactory stable responses under tracking and disturbance conditions

Wingtip Vortices Parameter Estimation to Analyse Instabilities

Nov 2019 – Dec 2020

Advisor: Dr. Navrose

Indian Institute of Technology, Kanpur

- Verification of Batchelor and Lamb-Oseen Models at low Reynolds using curve fitting of simulation data for $Re=1000$ using MATLAB curve fitting tools and VisIT flow visualisation.
- Analysis of instability in wingtip vortices and capture the formation of vortices by performing an extensive analysis for flows with various Reynolds number for both single wing and split wing configurations.

WORK EXPERIENCE

Airbus Internship

Aircraft and Flight Analytics Group | Airbus India Pvt Ltd

April - Sept 2021

Bangalore, India

- Developing an algorithm to automatically identify and classify commercial air-crafts into training, delivery, test flights. It was developed in Java using flight parameters and black-box data.

Controls System Development Intern

Range Aerospace Pvt Ltd | Start Up Team

Sept 2020 - Feb 2021

Bangalore, India

- Automating the process of parameter estimation of PID controllers in a control system simultaneously. Found optimal gains using evolutionary optimization techniques such as Genetic Algorithm
- Using PX4 simulator for the simulation environment with Quadcopter simulation using JMAVsim or connections to Pixhawk. MAVLink connections through UDP ports were used to MATLAB for optimization and parameter setting.

Zeus Numerix Summer Intern

Target Flight Recognition from Satellite Data

May - Sept 2020

Pune, India

- Implementation of Kalman Filter over Neural Networks to perform target tracking on passive Radar signal bearing angles. Using the bearing angles and timestamps, we predict the target trajectory.
- Classify satellite images into classes of military targets using PyTorch and Sci-Kit learn libraries. Worked with a dataset of planes (25000+ images) to do binary classification and a dataset of different classes of ships (8000+) to do multiclass classification.

PUBLICATIONS

- [1] **I. G. Karot** and D.K. Giri, Derivative-free adaptive satellite attitude control, Indian Control Conference 7, Dec 20-22 December 2021, in press.
- [2] **I. G. Karot**, M. Kumar and N. Selvaganesan, Control System Design for MIMO System using Bond graph Representation - Quadcopter as a Case Study, Indian Control Conference 7, in press.
- [3] **I. G. Karot**, New one IISc Control System Design for MIMO System using Bond graph Representation - Quadcopter as a Case Study, Indian Control Conference 7, in press.

PROJECTS AND PROGRAMS

Vehicle Shape Optimisation For Minimization Of Sonic Boom

AE311- Compressible Aerodynamics, Indian Institute of Technology, Kanpur

July - Dec 2020

- Optimizing super-sonic flight by the minimization of pressure perturbations generated by the aircraft during supersonic flight. We adopted a simplified sonic-boom prediction method to analyse the effects of flight Mach Number on different aircraft geometries.
- These pressure perturbations can be obtained by leveraging linearized analysis with some corrections built-in so that non-linear effects can also be modeled in terms of F-function, as defined by Whitman with the help of numerical methods.

Numerical Implementation of 2D Panel Methods

AE211- Incompressible Aerodynamics, Indian Institute of Technology Kanpur

Jan - March 2020

- Formulated and Implemented Source-panel and Vortex-Panel methods for flow past an Airfoil using MATLAB. The shape of the airfoil is obtained by simulation using traditional airfoil equation. Source or Vortex panels were arranged such that they summed up close to zero and created the required flow past airfoil.

Composite Material Aircraft

May - July 2019

Aeromodelling Club, Indian Institute of Technology Kanpur

- Modelling of a Twin-boom pusher Aircraft on XFLR5 to analyse stability and design. Fabrication of a composite material twin-boom pusher aircraft using Vacuum Packing and Laser cutting of Balsa for wingtip Margins.
- Designed and animated a CAD model of the wings using AutoCAD for laser balsa cutting. The model had detachable wings and fuselage and successful flying of the aircraft using remote control.

Remote Innovation Management Program

20th July - 25th July 2020

Prof Bryan Cassady, FastBridge Consulting, Remote Training Program

- Business frameworks: JTBD (Jobs to be done), Lean Start-up and Business model Innovation. Tools to clarify and build ideas: TRUE NORTH, Spark Decks, The 4Ps, Effective problem definition. Continue into an internship: SparkAI, to guide clients to new insights in related/adjacent fields of research without overwhelming them with new information.

RELEVANT COURSEWORK

Optimal Space Flight Control	Automatic Control of Rockets and Spacecrafts
Autonomous Unmanned Aerial Systems	Virtual Instrumentation and Sensors
Aircraft Control Systems	Applied Numerical Methods
Flight Mechanics	Space Dynamics
Partial Differential Equations	Complex Variables

TECHNICAL STRENGTHS

Tools for Controls	PX4 Autopilot, JMAVsim, ROS, MAVLink Protocols, Gazebo
Scientific Visualization	Tecplot, Paraview Immersive, ViSIT, XFLR5, Curvefitting Toolkit
Machine Learning	ANNs, CNNs, Linear & logistic Regression, Regularisation Techniques
Programing Languages	C, C++, PYTHON, Matlab, Octave
Libraries	PyTorch, TensorFlow, Sci-Kit Learn, Pandas, Numpy, Matplotlib, PIL
Other Skills	Autocad, Fusion360, NI LabVIEW, Excel, Unity

SCHOLASTIC ACHIEVEMENTS

2018	Joint Entrance Exam Mains : AIR 2851 in 13 Lakh candidates
2018	Joint Entrance Exam Advanced : AIR 4371 in 2.3 Lakh candidates
2018	Computer Science and Physics Top 0.1 % Scorer — CBSE — Chennai, India
2017	KVPY Fellowship Rank : 613 — IISc Bangalore-Government of India
2016	NTSE Scholarship Stage 1 - Tamil Nadu — Government of India

CO-CURRICULAR ACHIEVEMENTS

2019	Bronze in 4x50m Freestyle Relay	54th Inter-IIT Aquatics Meet
2019	Bronze in 4x50m Medley Relay	53rd Inter-IIT Aquatics Meet
2018	Best incoming sportsperson	IIT Kanpur
2018	Pushpa Garg Scholarship	IIT Kanpur
2013	Rock and Pop Vocals	Trinity - Music
2014, '13, '10	National Aquatics Meet	CBSE Aquatics Meet

POSITIONS OF RESPONSIBILITY

Society of Aerospace Engineers

Batch Representative Y18

Acted as a mediator between the committee and fellow batch mates. Conducted multiple workshops for the Aerospace Department students and also organised the department Freshers and Farewell.

Aquatics Institute Team

Institute Secretary & Summer Camp Captain

Ensured the smooth conduction on Summer Camp Aquatics and also organised a 5KM Long swimming event. Organized annual Interhall Sports Competition, Inferno. Also conducted Aaghaaz (Freshers' Interhall sports competition) and some workshops.