IRENE GRACE KAROT POLSON

Undergraduate at Indian Institute of Technology, Kanpur | IIT Kanpur
irenegracekp.github.io

EDUCATION

Indian Institute of Technology, Kanpur *July 2018 - May 2022*
Bachelor of Technology in Aerospace Engineering *CPI: 8.8/10.0*
Member of Society of Aerospace Engineers | Aquatics Team

RESEARCH EXPERIENCE

Derivative-free Adaptive Satellite Attitude Control April 2021 – Present
Advisor: Dr. Dipak Kumar Giri, ICC7 Paper *Indian Institute of Technology, Kanpur*

- Developed adaptive controllers with derivative free weight update laws to make a fault-tolerant MRP attitude controller for satellite systems.
- Currently working on machine learning and evolutionary optimisation techniques' applications on adaptive laws and control as a part of my undergraduate research project.

Autonomous Multi-Drone Systems to Large Structure Inspections March 2021 – Present
Advisor: Dr. Debasish Ghose, ACC Paper *Indian Institute of Science, Bangalore*

- Selected as a candidate for the Indian National Academy of Engineering Mentorship Program 2021-22.
- Development of a 3D coverage path planning algorithm using Lissajous curves where the drone's controller carries out trajectory tracking using desktop prototyping of ROS/Gazebo system into MATLAB.

Control System Design using Bond graph Representation March - June 2021
Advisor: Dr. N. Selvaganesan, ICC7 Paper *Indian Institute of Space Science and Technology*

- Developed a power-based graphical representation of system and its controller using bond graph approach. Reduced model is derived and is used to obtain feedback.
- The entire closed-loop MIMO system is represented using 20SIM software and the simulations were 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, Report *Indian Institute of Technology, Kanpur*

- Analysis of instability in wingtip vortices and the formation of vortices using Parameter estimation.
- 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.

TECHNICAL EXPERIENCE

Airbus Internship April - Sept 2021
Aircraft and Flight Analytics Group | Airbus India Pvt Ltd *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 Sept 2020 - Feb 2021
Range Aerospace Pvt Ltd | Start Up Team *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 with simulation using JMAVsim or serial connections to Pixhawk, MAVLink connections were made through UDP ports to MATLAB for optimization and parameter setting.

Zeus Numerix Summer Intern May – Sept 2020
Target Flight Recognition from Satellite Data *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 using data-sets (25000+ images) of planes.

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. Paper
[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, accepted, in press. Paper
[3] **I. G. Karot**, S. Nath and D. Ghosh, Autonomous Drone Systems for Large Structure Inspections, American Control Conference, under review. Paper

SELECTED PROJECTS

Vehicle Shape Optimisation For Minimization Of Sonic Boom July - Dec 2020
AE311- Compressible Aerodynamics, Report *Indian Institute of Technology, Kanpur*

- Optimizing super-sonic flight by the minimization of pressure perturbations generated by the aircraft during supersonic flight using a simplified sonic-boom prediction method.
- Leveraged a 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 Jan - March 2020
AE211- Incompressible Aerodynamics, Report *Indian Institute of Technology, Kanpur*

- 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 and arranged such that that the panels summed up close to zero and created the required flow past airfoil.

Composite Material Aircraft May - July 2019
Aeromodelling Club, Report *Indian Institute of Technology, Kanpur*

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

RELEVANT COURSEWORK

Controls	Optimal Space Flight Control, Aircraft Control Systems, Automatic Control Of Rockets And Spacecrafts, Flight Mechanics
Dynamics	Space Dynamics, Dynamics
Programming	Applied Numerical Methods, Introduction To Computing, Virtual Instrumentation And Sensors, Aircraft Systems Design
Mathematics	Complex Variables, Partial Differential Equations, Ordinary Differential Equations
Coursera	Machine Learning, Control Of Nonlinear Spacecraft Attitude Motion, Kinematics: Describing The Motions Of Spacecraft

TECHNICAL STRENGTHS

Tools for Controls	PX4 Autopilot, JMAVsim, ROS, MAVLink Protocols, Gazebo
Machine Learning	ANNs, CNNs, Linear & logistic Regression, Regularisation Techniques
Programing Languages	MATLAB/Simulink, C, C++, Python
Scientific Visualization	Tecplot, Paraview Immersive, ViSIT, XFLR5, Curvefitting Toolkit
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 1.3 million 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

POSITIONS OF RESPONSIBILITY

Society of Aerospace Engineers Batch Representative Y18

Acted as a liaison 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.