MICKY

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RESEARCH INTERESTS

I am passionate about learning advanced stage aircraft design and bringing innovation in the field. Designing aircraft engine nozzles, compressors, turbines, air intake and rocket nozzles is what that fascinates and excites me a lot. On pure computational side, I am interested in augmenting my knowledge about parallelization techniques/algorithms and implementing them by harnessing the power of GPUs.

EDUCATION

Indian Institute Of Technology *July 2014 - Present*
Final Year, Bachelor of Technology, Department of Aerospace Engineering
Pursuing Honors in Aerospace Engineering

CGPA : 7.2/10

PUBLICATIONS

Micky, Mukhopadhyay S., Dr Rajkumar S.Pant, *"Conceptual Sizing of Long Range Transport Aircraft"*, Proc. of the 24th AIDAA International Conference (2017), Italy. Paper here.

INTERNSHIPS

General Electric *Summer 2017*
NURBS Surface Generation

· During the manufacturing of a product some deviations come and in order to know the performance of the manufactured part a CAD of the manufactured part is required. The first step towards that is scanning the part for generating its point cloud data and then making a CAD out of that. I generated a NURBS(Non-Uniform Rational Basis Spline) surface of the component from its point cloud data using MATLAB^{TM} & Octave. The code was tested with the turbine blades of an aircraft engine and it performed accurately.

Crack Detection Using CNN

· Over time, parts of an aircraft engine or any machine deteriorate and develop cracks. Currently, finding the deterioration level of components is done manually. Checking for cracks is an important factor in gauging the health of a part. In this project I tried automating the crack detection process using artificial intelligence. Images of aircraft engine's components were preprocessed using Python for extracting more data out of the limited number of images. The images data was then trained using Convolutional Neural Networks in R and the trained model was tested on new images. The developed method can detect cracks even in fairly low resolution images to a very high accuracy.

Google Summer Of Code *Summer 2017*
Parallelizing "KSOLVE" Solver In MOOSE

· Neuronal and multiscale simulations are computationally demanding, they require large number of very similar calculations. One of the core problems in this domain is to rapidly perform detailed single-neuron calculations. In MOOSE (Multiscale Object-Oriented Simulation Environment) one such solver is "KSOLVE". The two methods I worked on for parallelization were OpenMP and NVIDIA Cuda®. Results obtained from OpenMP showed very less to no improvement in computation time. It was then parallelized using Cuda® and a significant reduction in computation time was observed. Details here.

National Center Of Excellence In Technology For Internal Security *Summer 2016*
Controlling The Mobility of A Tele-Operated Rover

· In this project the team was dedicated toward making a tele-operated bot to be used in dense jungles. I worked on developing the mobility system of the bot. It had 2 flippers and were controlled precisely using encoder feedback. In order to make the bot follow a specific path the rpm of its wheels has to be set precisely and this was achieved by closed loop feedback control using PID algorithm. Also the bot had a DSMD (Deep Search Metal Detector) attached in front of it. Using the rotation of DSDM and velocity of the bot a simulation was done in MATLAB to know the area that the DSMD covers. Forward sweep and the rotation rate of DSMD were optimized so as to cover the maximum area.

RESEARCH PROJECTS

Flame Instabilities In Micro-Combustors *July 2017 - Present*
Undergraduate Thesis | Guide: Prof. Sudarshan Kumar

· Flames in micro-combustors show stunning behaviour when observed through a high speed camera. A flame can have instabilities like rotation or pulsation in a micro-combustor. In the first phase of the thesis, experiments were done using LPG-air premixed mixture for different equivalence ratios and mixture velocities in a micro-combustor. Images and videos of the flames were taken using high-speed camera to observe the very interesting phenomena of rotating and pulsating flames. Regime diagrams, flammability limits and effect of flow velocity and equivalence ratio on flame length and position of flame were studied. In the second phase, the videos would be analyzed to explain the phenomena of rotating and pulsating flames complemented by simulations of flames in micro-combustors.

Conceptual Sizing Of A Long Range Transport Aircraft *Jan'17 - April'17*
Supervised Learning Project | Guide: Professor Rajkumar S. Pant

· Conceptual sizing of an aircraft involves various modules like constraint analysis, aerodynamic coefficients estimation, weight breakdown, range payload diagram, program cost and direct operating cost. In this project the conceptual analysis of Boeing 787-8 aircraft was carried out and the results were validated against that of PIANO^{TM} software. The process was modularized using Python such that it can be extended to other long range transport aircrafts.

Inverse Airfoil Design Using XFOIL *Jan'17-April'17*
Supervised Learning Project | Guide: Professor A.M. Pradeep

· In inverse airfoil design process an airfoil is generated for given pressure/velocity distribution using a standard airfoil and some optimization algorithm. In this project we created an open source platform to develop airfoil from its pressure distribution. An initial airfoil and desired pressure distribution is fed to the platform, based on the difference of current and desired C_p plot calculated from XFOIL the algorithm changes the airfoil shape. The solution converges until the error is less than the threshold and outputs the desired airfoil. The algorithm was able to achieve over 90% accuracy for symmetric airfoils in subsonic flow. Code here.

Mars Rover Team, IIT Bombay *July'15 - July'17*
Working towards designing and fabrication of a tele-operated planetary rover

· The IITB Mars Rover project is a student initiative at IIT Bombay to build a prototype Mars rover capable of extra-terrestrial robotics and to participate in the University Rover Challenge at the Mars Society Mars Desert Research Station, Utah. I worked in the electrical team of the project and was primarily involved towards the development of the mobility of the rover. We designed and implemented closed loop feedback control system using PID algorithm for the mobility of a 6-wheel rocker-bogie suspension rover and a 6-DOF robotic arm using ROS (Robotic Operating System).

COURSE PROJECTS

City Air Ambulance *Autumn 2017*

Guides: Prof. G.R Shevare, Prof R.K Pant & Prof A. Chatterjee | AE429: Aircraft Design Lab

· In a metropolitan area like Mumbai, car ambulances can not reach the patient in time due to traffic. So, we designed a novel Tilt-rotor ambulance for transporting a person in life threatening conditions to a nearby hospital. The tilt rotor would cruise at an altitude of around 2500m at 0.3 Mach. The range of the aircraft is 20km and can cover it in less than 6 minutes. Details here.

Compressor Designing And Fabrication *Spring 2017*

Guide: Prof. Bhaskar Roy | AE458: Turbomachines

· Designed a centrifugal compressor which consists of 24 radial vanes and a diffuser. The design pressure ratio was 1.03. It was 3D Printed using PA12 material and an efficiency of 50% was achieved.

Design And Fabrication of Savonius Wind Turbine *Spring 2017*

Guide: Prof. Bhaskar Roy | AE458: Turbomachines

· A savonius wind turbine consisting of two cup shaped blades was designed and manufactured using 3D printing. An efficiency of 10% was obtained at 1500 rpm and a wind speed of 10m/s.

Supersonic Serpentine Intake Design *Autumn 2016*

Guide: Prof. Bhaskar Roy | AE658: Design of Powerplants For Aircrafts

· A supersonic serpentine intake for a M=2 MRCA(BPR < 1.0) was designed. MRCA F22 Raptor was taken as a reference and a double wedged intake with 3 shocks anchored at one point was designed. Losses due friction were also considered and a pressure recovery factor of 86% was achieved.

Propeller Design For A Low Speed Aircraft *Autumn 2016*

Guide: Prof. Bhaskar Roy | AE658: Design of Powerplants For Aircrafts

· A three bladed propeller was designed for an aircraft consisting of 4 passengers, flight speed of 300 Kmph and the service ceiling of 5000 m. Blade element theory was used to design the constant chord propeller. The designed propeller had 10 sections of different airfoils and an efficiency of 81% at the design point.

Designing Powerplant Configuration *Autumn 2016*

Guide: Prof. Bhaskar Roy | AE658: Design of Powerplants For Aircrafts

· Designed a power plant configuration for a light combat aircraft. The aircraft would engage in combat at 5000m altitude and do reconnaissance at 15 km altitude. MQ9 Reaper was taken as a reference aircraft.

Optimization For Finding The Best Gift *Autumn 2016*

Guide: Prof. R.P.Shimpi | AE310: Engineering Design Optimization

· The idea is to maximize the satisfaction level of a person by giving a custom made gift(creating a gift from a given number of different items) under budget constraints. For achieving maximum satisfaction level simple genetic algorithm was used to find out the contents of the optimum gift.

Parallelization Using Various Tools *Spring 2016*

Guide: Asst. Prof. S. Gopalakrishnan | ME766: High Performance Scientific Computing

· The Power Method Algorithm for finding the greatest eigenvalue and the matrix multiplication code were parallelized using Open MP and CUDA.

Autonomous Bot *Spring 2015*

Guide: Prof. Kavi J Arya | CS101: Computer Programming and Utilization

· Worked on Firebird V Atmega 2560 bot to make it an obstacle avoider. The inputs from sharp IR and proximity sensors were used as a feedback system to detect the obstacle and then change its motion accordingly.

ACHIEVEMENTS AND AWARDS

Accepted as a Google Summer of Code Student to contribute for open source software MOOSE *2017*
Awarded the prestigious KVPY fellowship & attended the Vijyoshi Camp 2013 held at IISC *2012*
Cleared PRE-RMO (Regional Mathematics Olympiad) in the Punjab region *2012*
Awarded the prestigious National Talent Search Examination Scholarship by NCERT *2009*

TECHNICAL SKILLS

Programming Languages	Python, C++, MATLAB, Cuda, OpenMP & MPI
Python Packages	Matplotlib, NumPy, Jupyter, Plotly & Skimage
Software & Tools	OpenVSP, SolidWorks, Ansys, XFOIL, Eagle, R
	HTML, LaTeX, Excel, Vim & Git

POSITIONS OF RESPONSIBILITY

Web Manager *July'16 - May'17*
Aerospace Engineering Association (AEA) | Aerospace Engineering Department

· Designed a website for Aerospace Engg. Association and handled the updation Of Aerospace Department's main website. Organized and managed a department trip of 120+ people to Tikona Fort and conducted Fresher's 2016 department orientation.

Mentor At RC Plane Competition *September 2015*
Aeromodelling Club IIT Bombay

· Mentored 12 students in the RC Plane event & managed the events along with the managers for the smooth execution of the event.

EXTRA CURRICULAR

Selected for the 50th Inter IIT Football Camp in IIT Bombay *December'14*
Part of IIT Bombay football team in Mumbai District Football Association (MDFA) *September'14*
Successfully completed Basic Mountaineering Course organized by ABVIMAS, Manali *May'15-June'15*

OTHER INTERESTS

Other than my academic interests, Mountaineering is the thing that I love the most, I try never missing a chance for rock climbing, biking or trekking. Apart from that I enjoy playing football and reading dystopian novels like George Orwells 1984. I also like to make portraits and write poems.

KEY COURSES

Core Courses	*Aircraft Design, Aircraft Design Lab, Turbomachines*
	Design Of Powerplants for Aircrafts, Rocket Propulsion
	Aircraft Propulsion, Modeling & Simulation,
	Data Analysis & Interpretation
Interdisciplinary Courses	*Computer Programming and Utilization, Differential Equations,*
	Calculus & High Performance Scientific Computing

REFERENCES

Prof. A.M. Pradeep, Aerospace IITB
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