PORTFOLIO VIPUL P. GADEKAR

Waqt aane dey bata denge tujhe ae Aasman …. Hum abhi se kya bataye kya humarey dil mein hai.
(Let the time to reveal come oh Sky …. How should we tell right away what we hold in our heart.) - Ram Prasad Bismil

Hello! Welcome to Vipul's work desk.

Hi! I am Vipul Gadekar, a post-graduate student engineer in Aerospace Engineering at Arizona State University (Go Sun Devils!). I have completed my Bachelor of Engineering in Mechanical Engineering from Y.C.C.E, Nagpur, India.

Since childhood, I have been fascinated by flying airplanes, fast race cars, and simple mechanisms alike. Combine that with my keen interest in innovative engineering, I aim to build my career in the mechanical, aerospace, and advanced tech industry.

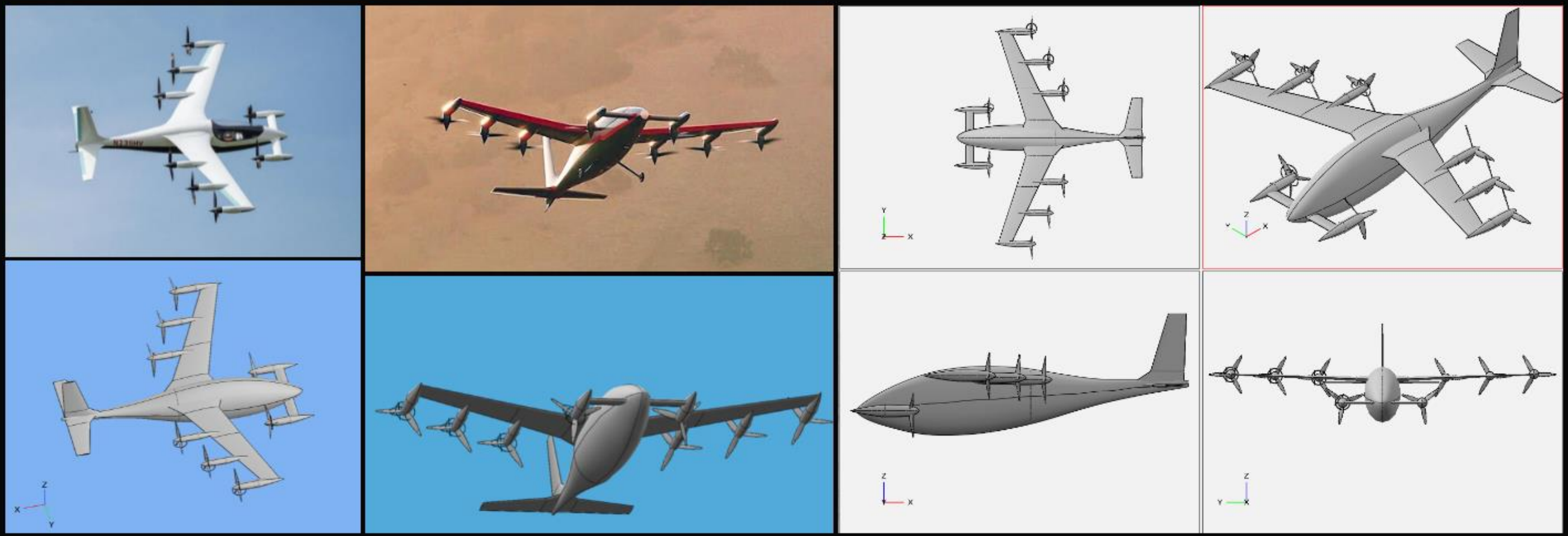
After gaining technical knowledge from the classes and some valuable lessons from internships, I look forward to utilizing my skills for coming up with creative technical solutions for new products and systems development.

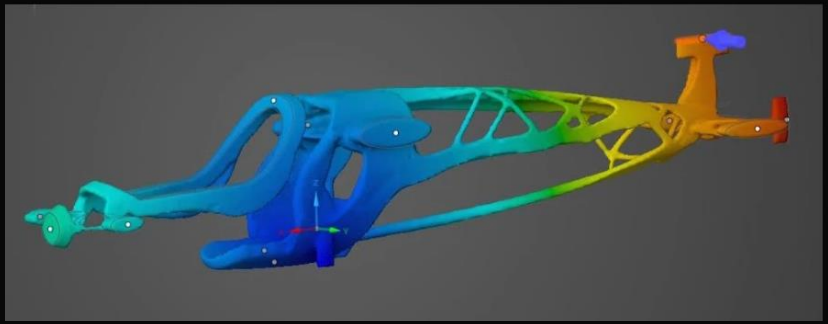
My favorite hobbies include making and flying aeroplane models, painting and sketching. In my free time you would find me reading non-fiction books or spending time outdoors for a hike.

Digital Design of Kitty Hawk Heaviside H2 for Fuseage Topological Optimization Study

Kittyhawk Heaviside is one of the few vehicles which have been extensively flight-tested and is a benchmark for validating the UAM technology. The vehicle design seems to be much more focused on personal transportation than a ride-sharing platform, unlike other competitors. It'll be interesting to see Kitty Hawk's path to certification and scalability in the coming years.

The model is prepared from publically available resources, patent information, images and is intended to be used as a free resource for doing further engineering/market analysis. This model was used to undertake a fuselage structural concept using topology optimization in Ansys. The flight loads were estimated using the publically available performance numbers and applied in multiple use cases to obtain a sound design. The next phase of this project is to convert the T.O results into manufacturable designs using geodetic construction principles.

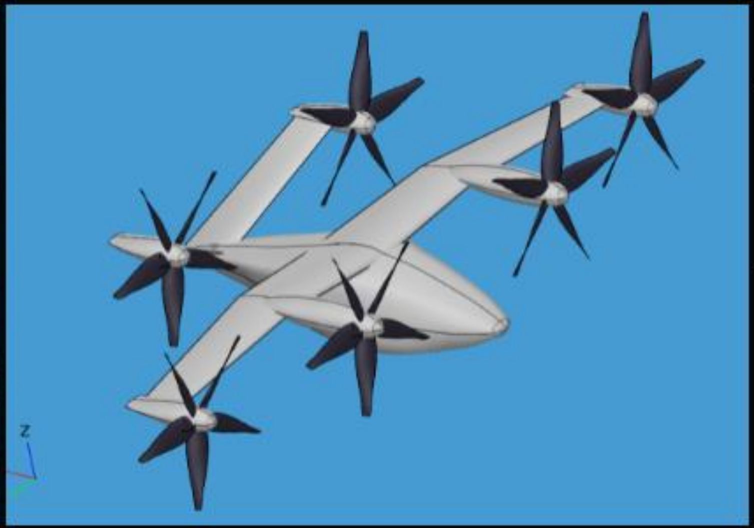


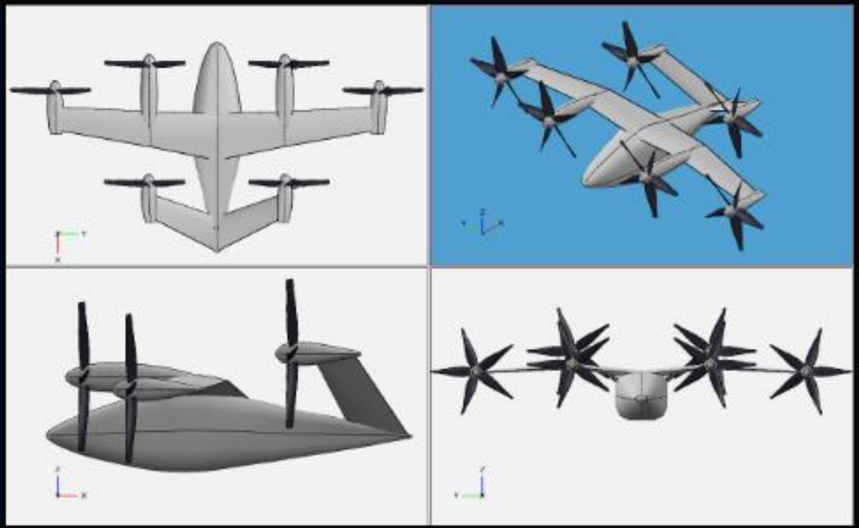


Digital Design of Joby S4

Joby Aviation is a new-age aerospace company leading the Advanced Air Mobility (AAM) space with their S4 EVTOL vehicle. The Joby S4 is a six-prop, electric propulsion aircraft with tilt-rotors for vertical take-off and landing. It can carry one pilot and 4 passengers with a claimed cruise speed of 200mph and 150 miles of range. The vehicle is currently being flight tested and is in process of being certified by FAA (Aug'21).

The model is being created using OpenVSP, Solidworks and will be processed through VSPAero, Ansys etc. for detailed analysis for aerodynamic, structural analysis.
The aim of this project is to understand the design of this pioneering EVTOL.

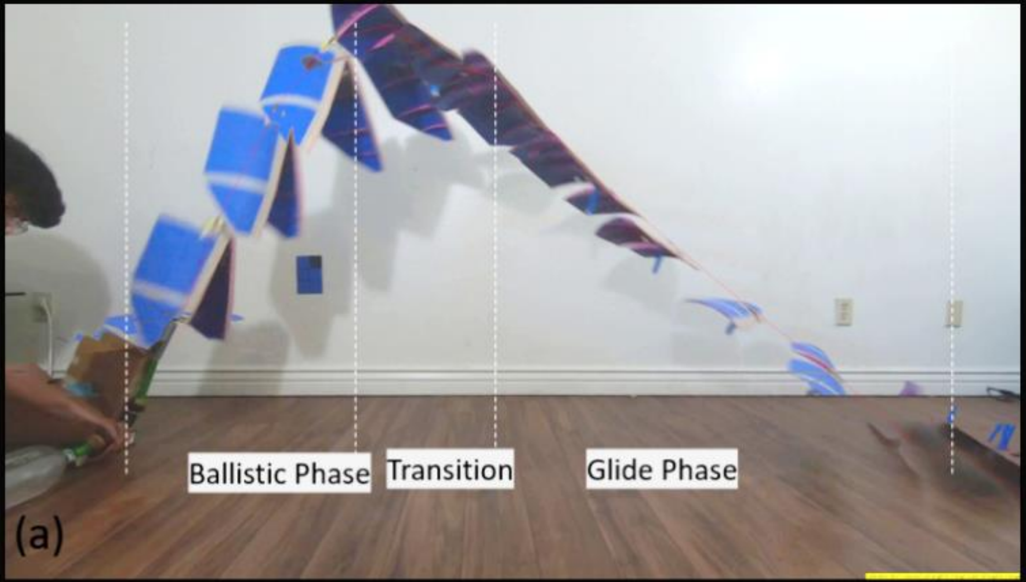




Master's Thesis : Design of Wings for Jump-Gliding in a Laminate, Bipedal Robot

I was a member of ASU IDEALABS under Prof. Daniel Aukes. At IDEALab, where we worked on creating robots that integrate bioinspiration with foldable, compliant, laminate manufacturing techniques (think origami). I worked on the design of wing-stabilized, two-legged platform that would walk, run, hop and jump. The aim of the project is to generate a reliable model for recreating multiple designs optimized for various phases of locomotion as required. The developed design proposes a unique unactuated mechanism design for self-deployment of wings during jump phase.

The project began in Fall 2019 and is a part of my thesis project for completion of the M.S degree at ASU. The thesis project focused on application of the compliant, anisotropic linkage with detailed aerodynamic design of wings for jump-gliding and development of a Python dynamics model. The Python model was developed using Python SymPy, SciPy and NumPy libraries to solve equations of motion for the body obtained by Kane's method. The dynamics model was validated by testing the wing prototype designs in ballistic launch with video analysis.



[(a) Designed compliance linkage and wings working in tandem to achieve hybrid jump-gliding locomotion in the testing phase.]

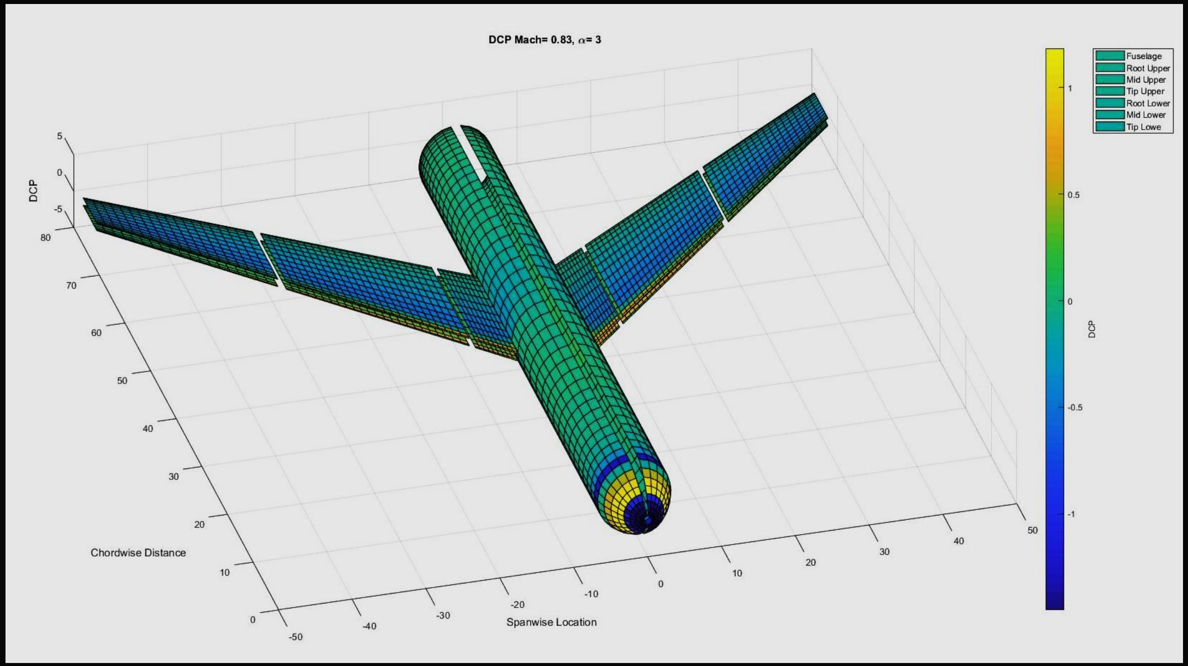
Parametric Design of Transonic Wing

This goal of this project was to design a wing that met the lift criterion at cruise conditions with subcritical flow over the upper surface of the wing and an elliptical lift distribution. An iterative process using the concepts of superposition and perturbation effects was employed here.

A potential flow panel method code called 'VORLAX' was used to determine the effectiveness of the aerodynamic perturbations incorporated in each iteration and the perturbation that should be incorporated into the next iteration.

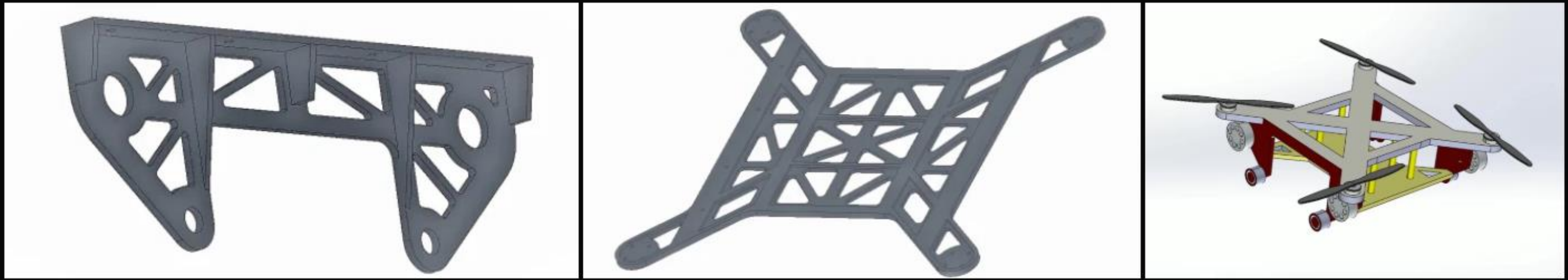
The VORLAX output was post-processed through a MATLAB GUI created to speed up the iterative process.

The project was undertaken as a part of Advanced Aerodynamics (MAE510) class in Fall 2018 with a project colleague.



Design of a muti-domain Tank-Quadcopter Drone

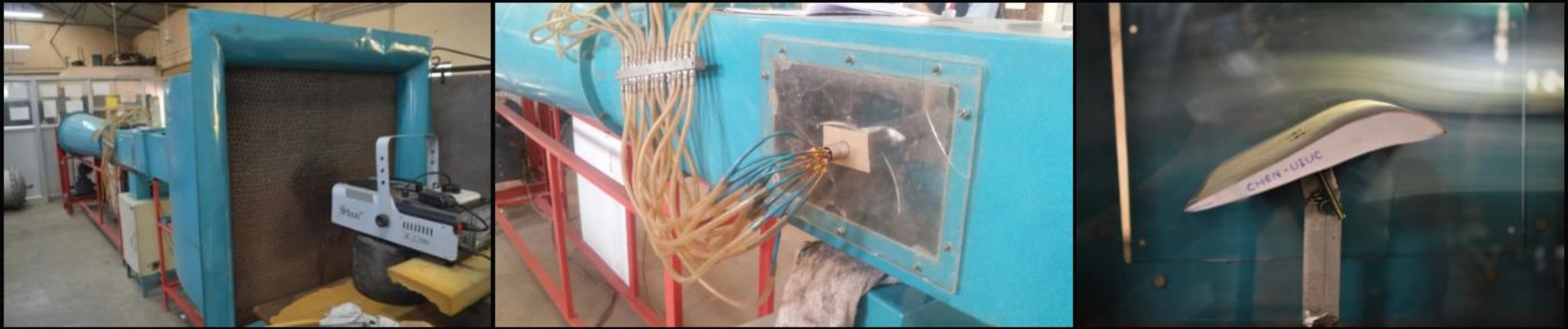
The project involved design of a drone having two modes of motion: aerial motion using quadcopter configuration and terrestrial motion using tank tracks; with power to carry a payload of 10-12 kgs. I was responsible for the configuration, chassis design along with the aero-propulsion system. The challenge of the project was to optimize the system parameters to maximize performance, endurance which was done with selective application of composite materials. The drone was to be primarily made from aluminium, with composite reinforcements to reduce costs. Most of the design and assembly of the drone was done on PTC Creo while the mechanical analysis was done on ANSYS software with iterative design reviews. The project was undertaken from June 2017 to December 2017. It is not possible to share the detail images and numbers of the drone at this point. (Project team: 2 members)



[*Image Left to Right: (1) Support Plate for Tank Tracks ; (2) Quadcopter mount plate. Both design iterations were made in PTC Creo.* (3) Complete structural assembly configuration for illustration purposes.]

Calibration and Experimentation on Low-Speed Wind Tunnel

The project was undertaken as the Senior year design project for completion of my undergraduate degree in Mechanical Engineering. It involved calibration of an existing open-circuit, subsonic wind tunnel. The load-cells sensing the force exerted on the mount were calibrated by construction of a load pulley system to find any possible error percentage and noise, which was later adjusted in the data collected. We undertook design of experiments on various sections such as surface pressure gradient of submerged bodies to understand fluid physics and tried using various flow-visualization methods. The project involved technical presentations and external evaluation for completion of degree. (Project team: 3 members)



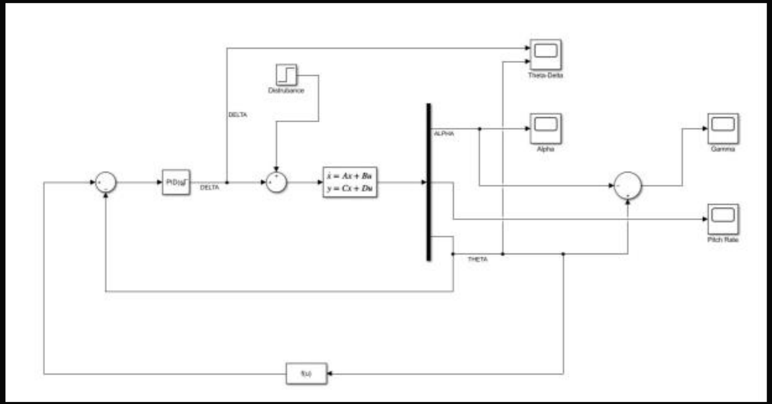
[Image Left to Right. (1)Open-circuit wind tunnel ; (2) Tube apparatus for surface pressure gradient measurement ; (3) Flow visualization over a UIUC high-lift aerofoil]

Design of controller for autonomous landing of a fixed-wing UAV

A landing phase of an aircraft is a tricky operation domain as the system is flying on it's aerodynamic limits and the margin of error is very slim. The operationally UAVs might be completely autonomous for most of the mission, but it's landing is done by line-of-sight pilot procedure. Moreover, the current Auto Landing Systems (ALS) are only present in passenger aviation sector to compliment the pilot and cannot be used in most weather conditions. Thus there is a need for design of a fully autonomous landing control system, especially for an UAV to extend it's mission envelope.

The project involved system modeling, identification, analysis for design of a controller in the control system for autonomous landing. The system modeling and identification is done using State-Space modeling which is then used for the design of an adequate controller in Matlab/Simulink. Two types of controllers were explored in the scope of this project: Sliding Mode Controller and P.I.D Controller.

This project was initiated as a part of EGR 598 : System Control and Optimization class under Prof. Wenlong Zhang for Fall 2019 semester. I have continued working on the project, trying out various versions of SISO and MIMO control methods.



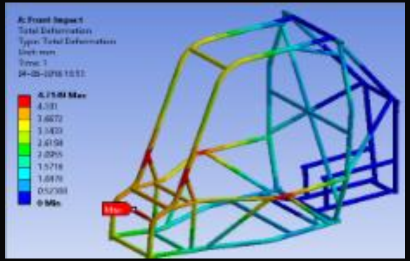
(Modified PID loop in Simulink)

Design and Build of a RC plane with an IC engine

I have always been passionate for flying and thus I knew my career goal even before joining engineering college. Thus to get an early start, me and my friends started building a 6-feet wingspan Remote Controlled (RC) airplane powered by a small 11cc nitro internal combustion engine with guidance from a veteran aeromodelling expert. The plane was made primarily from balsa wood and thus required us to learn some important engineering techniques. The plane was made over the period of 3-4 months in the summer of 2013 and I learnt to fly the plane over the consecutive months. This design and long build process provided me with valuable hands-on experience and my first experience of taking a technical project from start to finish. The plane, named "Bolt" by us, is still in excellent flying conditions and has never had a major crash. The engine underwent a complete overhaul last year due to failure of one of the crankshaft bearings. The complete overhaul work was done by myself. (Project team: 3 members)

Team Acira 2017 : SAE India BAJA

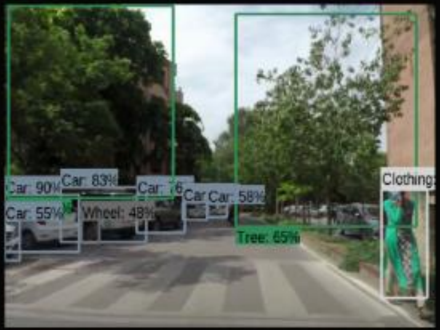
After successfully leading the college go-kart team, I participated in the college team Acira building an All Terrain Vehicle (ATV) for competing in SAE India BAJA engineering competition. The physics and vehicle-dynamics engineering involved in the design of an ATV was vastly different to that of go-karts, which I had ample experience in. We successfully participated in the technical and dynamic rounds of the competition, but couldn't take part in the final race due to break down of a braking component. I worked on the DFMEA & PFMEA charts, fabrication team and also the business model pitch. The project was worked on for about 9 months and involved the complete life cycle of engineering design. This project helped me to gain so much additional flexibility in applications of my engineering knowledge to varying goals. (Project team: 23 members)

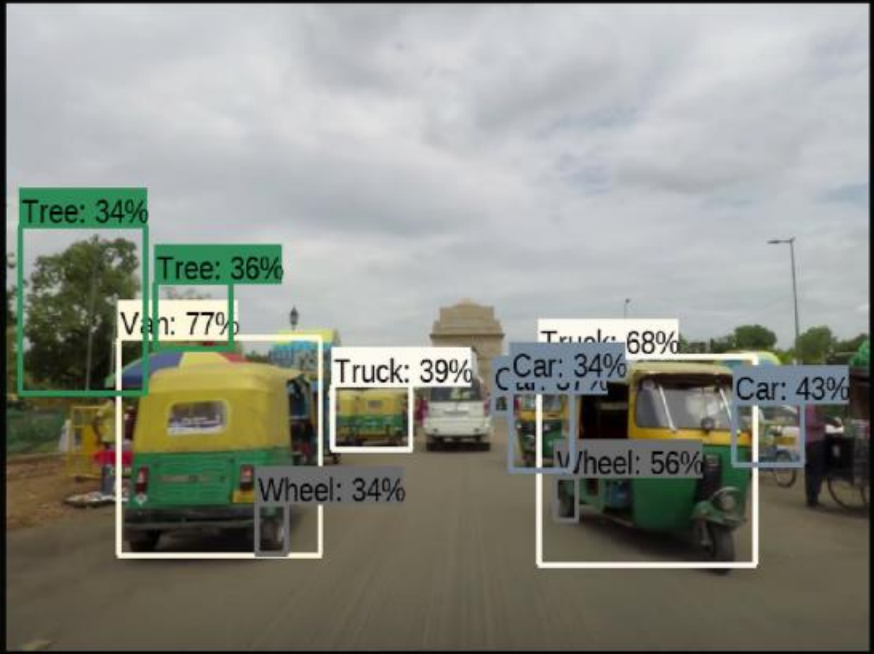


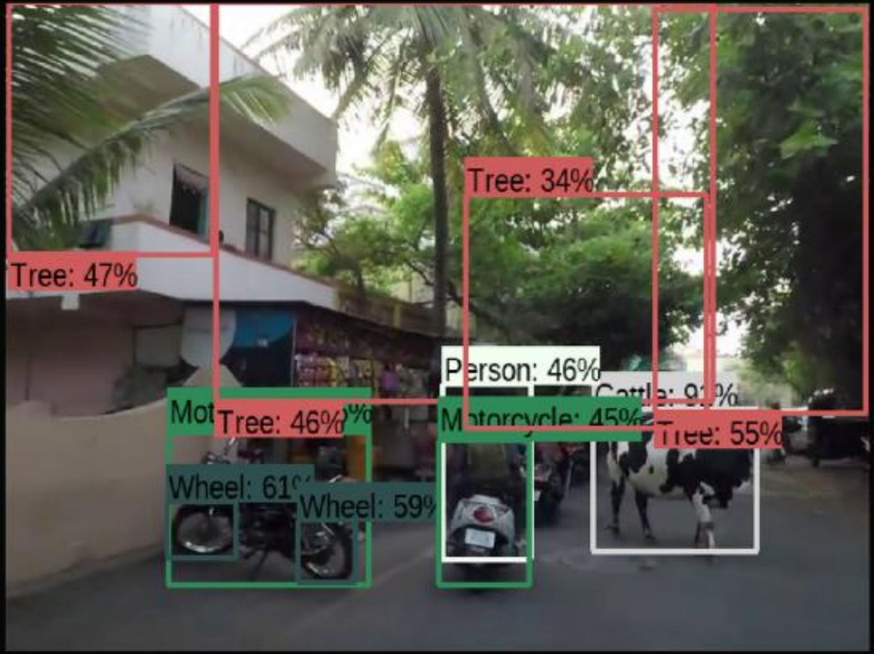
Evaluation of current CAV video perception system algorithms on Indian roads.

Most of the current CAV research is being done in North America, especially U.S.A, where the road infrastructure and driving environment is far more disciplined and better than some of the "third world', developing nations. This project aims to undertake evaluation of current CA perception system video-processing algorithms that were designed for the Western roads to be tested on data from Indian rod conditions. I hoped to discover some specific areas of shortcomings through this evaluation, which would help us modify or generate more robust algorithms or identify areas of improvements in sensors, vehicle structure or environment infrastructure. The project was executed on open-source Tensorflow Hub platform with the code accessed via Google Colab.

This project was done as a part of EGR 598: Connected & Automated Vehicles class under Prof. Jeffery Wishart for Fall 2019 semester.







DYNAROOF : Automatic Sun Roof System

The project involved document study and preliminary design of an automatic, modular sun-roof system which would change the configuration of the roof shades in response to the change in daylight, with an aim to maximize the room/space luminance. It involved real-time measurement of incident sun-light intensity and processing of data to open modular roof tiles to illuminate interior spaces of structures, with an aim to reduce energy usage and implement under green building technologies. It was worked on as an entry into Larsen&Turbo TechGium 2017 engineering innovation competition. I was eliminated at the state semi-finals level, but received positive feedback for coming up with a simple, elegant solution for daylight energy savings.

Academic Courses I have completed :

Computational Fluid Dyanmics (Project based Summer School – VNIT, India) ,
Aircraft Design (NPTEL Online Certification) ,
Aircraft Stability and Control (NPTEL Online Certification) ,
Linear Algebra (MAE 501-ASU) ,
Partial Differential Equations (MAE 502-ASU) ,
Advanced Aerodynamics (MAE 564-ASU) ,
Experimental Methods for Thermal & Fluid Processes (MAE 504-ASU) ,
Design of Aerospace Structures (MAE 526-ASU) ,
Dynamics and Vibrations (MAE 510-ASU) ,
System Control and Optimization (EGR 598-ASU) ,
Connected and Automated Vehicles (EGR 598-ASU) ,
Perception Theory and Product Design (PHY 598 – ASU).

Past Learning

In the recent years of engineering education, I have contributed to numerous academic and outside projects on mechanical design, engineering modeling, simulation.

Future Prospects

I am interested in applying my skills of varied engineering techniques to generate innovative solutions in mechanical, aerospace tech industries.

Present Work

My portfolio showcases various technical and personal projects over past few years. Please do follow my site to get updated and get in touch for more information.

Let's connect and have a chat, about all that matters, anti-matters and everything in between.

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