Research Project 3: Introduction to Research 2025/2026 Project Descriptions

September 24, 2025

Introduction

This document contains all the project descriptions for the RP3 unit. It is intended that you use a word search function in your PDF reader to find projects that may interest you. The project descriptions are offered to showcase the types of projects offered and guide the project development after the advisor allocation. The project description does not need to be executed verbatim, but they should be helpful to get started.

You can search by project type of which there are the following categories: Analytical, Design, Experimental, Simulation, Software, and Theoretical.

There is also the option to look through the skills that may be developed which include: Additive Manufacturing, Aerodynamics, Artificial Intelligence & Machine Learning, Avionics, Computer Aided Design (CAD), Computaional Fluid Dynamics (CFD), Composite Manufacturing, Data Analysis, Finite Element Analysis (FEA), Flight Dynamics & Stability, Instrumentation & Sensors, Material Testing (Destructive), Non-Destructive Testing (Thermal, Ultrasound, X-ray, etc…), Programming Tools (MATLAB, Python, etc…), Propulsion Systems (Gas Turbines, Electric, Hydrogen), Safety, Certification & Regulatory Compliance, Space Systems, Sustainability in Aerospace, Systems Integration, UAV/Drone Design & Testing, Vibration & Modal Testing, and Wind Tunnel Testing.

47: Life Cycle Assessment of Solar Panels

Supervisor: Natasha Mohamad

Project Type: Analytical; Software

Skills Developed: Data analysis, Programming tools (OpenLCA, Excel), Sustainability in Aerospace (transferable knowledge)

Resources: OpenLCA software, access to relevant life cycle databases (e.g., Ecoinvent), computer with adequate processing power.

Project Summary:

This project will evaluate the environmental impacts of producing crystalline silicon solar panels up to the factory gate. Students will use OpenLCA to model the process, focusing on raw material extraction (silicon, aluminium, glass), energy consumption during wafer production, and assembly. The project will highlight trade-offs in renewable energy technologies and encourage students to critically assess green-technologies. Expected outcomes include a quantified cradle-to-gate life cycle assessment (LCA), hotspot identification, and sustainability insights of solar panels used in Bristol.

14: Physics-Informed Neural Networks for process control in composites manufacturing

Supervisor: Dmitry Ivanov

Project Type: Experimental; Simulation;

Skills Developed: Artificial Intelligence & Machine Learning; Composite Manufacturing; Instrumentation & Sensors; FEA and numerical models (in MATLAB);

Resources: Induction rig with bespoke coils, composites manufacturing facilities, FEA and numerical models for induction heating and flow processes, process control demonstrations

Project Summary:

Composites manufacturing is challenging. In the process of transforming delicate compliant reinforcements and precursors into stiff strong structures, any mishandling of reinforcement or temperature fluctuation is likely to result in major defects and substantially compromise structural properties. The situation is particularly challenging when implementing new processes (such as direct induction curing) or novel material systems (such as reformable vitrimeric materials). There are various attempts to control the heating or flow processes using either physical modelling (which is computationally expensive and involves many hypotheses) or machine learning approaches (requiring unrealistically extensive data sets). In our project(s) we will explore the application of physics-informed and data-centred approaches to solving industrially relevant challenges in induction heating and liquid moulding. We expect to produce numerical and/or manufacturing demonstrations showing the path to process optimisation strategies.

54: Evaluation of Search and Rescue path planning algorithms using the SAREnv benchmarking tool

Supervisor: Steve Bullock

Project Type: Simulation; Software

Skills Developed: Data Analysis; Programming Tools (MATLAB, Python, etc…); UAV/Drone Design & Testing

Resources: Python

Project Summary:

Drones are increasingly used for time-critical search in wilderness and disaster rescue scenarios.

Researchers from the University of Bristol's Flight Lab and South Denmark University's Drone Centre have developed a dataset and framework to enable a standardised approach to evaluation of path planning algorithms. This project will survey the current range and state-of-the-art in search and rescue (SAR) path planning, downselect several approaches, and compare them using the SAREnv tool, and additionally will feed back on the utility of the tool and accompanying documentation, and possibly contribute improvements to the SAREnv codebase. Associated projects (should multiple students select this one) may include extensions to the evaluation framework such as improved visualisations (maybe using Unreal Engine), and adding 'viewshed' capabilities (what can a drone see from a given location). SAREnv: https://github.com/namurproject/SAREnv; Paper: https://doi.org/10.3390/drones9090628

57: Determine and optimise a satellite configuration for 24/7 global ionosphere monitoring to be used with GNSS

Supervisor: Talini Pinto Jayawardena

Project Type: Analytical; Design

Skills Developed: Computer Aided Design (CAD); Data Analysis; Programming Tools (MATLAB, STK, etc…); Space Systems;

Resources: MATLAB and STK. Standard personal laptop/desktop using university software licenses (or lab computers). All software require Microsoft, Linux or Mac OS.

Project Summary:

Ionosphere is an ionised layer in the upper atmosphere with electron structures that impact the performance of radio systems. The ability to observe the ionosphere continuously and globally helps us to understand the ionospheric processes and to mitigate impacts on radio systems. The impact of the ionosphere on GNSS signals can be used to image the ionosphere, similar to MRI scanners used in medical applications, using GNSS receivers on satellites. The project aims to determine a suitable optimal configuration of a satellite configuration that can image the dynamic nature of the ionosphere.

59: Numerical methods, aerodynamic shape optimisation and applied CFD analysis

Supervisor: Tom Rendall

Project Type: Analytical; Design; Experimental; Simulation; Software; Theoretical

Skills Developed: Computaional Fluid Dynamics (CFD); Finite Element Analysis (FEA); Programming Tools (MATLAB, Python, etc...); General analytical/numerical problem solving

Resources: In house numerical codes, commercial codes, student created codes, post-processing tools

Project Summary:

Projects exist generally in developing numerical methods for fluid modelling and/or fluid-elastic coupled behaviour, using mesh-based (finite volume) or meshless (SPH) methods. Numerical methods used for fluids analysis can also be used for design optimisation, which introduces the challenge of converting purely numerical design variables in to rational shape changes to be explored, and associated projects developing these paramaterisation methods. Project work can also attack student-led applied fluids problems, including UAV performance analysis, design and optimsiation, and exploring multidisciplinary (fluid plus structure) optimisation challenges. Previous applied projects have explored diverse topics including flap design, racecar CFD modelling, rotorcraft dynamics, composites manufacturing fluids modelling, acoustics, inflatable structures and tracking of cell motion for biochemistry experiments.

18: Experimental investigation of noise mitigation of airfoils in wind turbine applications

Supervisor: Esmaeel Masoudi

Project Type: Experimental

Skills Developed: Additive Manufacturing; Aerodynamics; Data Analysis; Instrumentation & Sensors; Programming Tools (MATLAB, Python, etc...); Sustainability in Aerospace; Wind Tunnel Testing;

Resources:

Project Summary:

Dynamic stall is an unsteady aerodynamic phenomenon that occurs when an airfoil oscillates beyond its critical stall angle of attack. This phenomenon is commonly observed in rotating machinery such as helicopter rotors during forward flight and wind turbine blades operating in varying wind conditions. This study presents an experimental investigation of the aeroacoustic characteristics of a NACA0012 airfoil undergoing dynamic stall induced by oscillatory pitching motions. Vortex generators are applied to assess their effectiveness in mitigating stall-related noise. Key dynamic stall parameters, including pitching frequency and amplitude, are systematically varied to evaluate their influence under different wind conditions. The findings of this research are particularly relevant to wind turbine applications, where stall-induced noise is regarded as a major barrier to public acceptance of wind energy installations.

24: Understanding and Solving Forming Challenges in Composites Manufacturing

Supervisor: James Kratz

Project Type: Experimental; Analytical;

Skills Developed: Artificial Intelligence & Machine Learning; Composite Manufacturing; Data Analysis; Programming Tools (MATLAB, Python, etc...);

Resources: Forming cell in the BCI lab.

Project Summary:

Forming composite materials into complex 3D shapes is a critical challenge in aerospace, automotive, and renewable energy sectors. This project invites students to explore the scientific principles behind composite forming, to identify key manufacturing issues (e.g., wrinkling, fibre misalignment, bridging, etc...), and propose evidence-based solutions. Students will engage with real-world case studies by conducting experiments, and develop a structured approach to improve forming outcomes for new materials. The student will be provided with materials to form and collect their own data to analys using machine learning based image analysis. Pre-existing matlab scripts and images of carbon fibre defects can be provided to practice analysing images for defects, coding, or machine learning. The outcomes will help determine if new material forms can be made into real parts.

22: Understanding Toughening Mechanisms in Composites for Cryogenic Space Environments

Supervisor: Ian Hamerton

Project Type: Analytical; Simulation;

Skills Developed: Data Analysis; Finite Element Analysis (FEA); Material Testing (Destructive); Programming Tools (MATLAB, Python, etc...);

Resources: Experimental fracture and DMA/CTE datasets (supplied), software, Relevant literature (supplied), BCI Lab Access (potential).

Project Summary:

The performance of fibre-reinforced composites in cryogenic environments is often limited by matrix microcracking, arising from thermal expansion mismatch and the brittle response of polymers at low temperature. One approach to mitigating this damage is the incorporation of core–shell rubber

(CSR) particles, which can enhance fracture toughness by promoting energy-dissipating mechanisms. This project will build upon an existing experimental dataset of fracture properties for different CSR-modified epoxies tested across low and cryogenic temperatures. The purpose is to develop a modelling framework that links observed temperature-dependent behaviour to the underlying material and particle characteristics. Potential tasks include building analytical or computational models of fracture processes, comparing predictions with experimental toughness values, and exploring how CSR chemistry and glass transition influence performance. Expected outcomes are a validated dataset–model comparison leading to an improved understanding of toughening mechanisms above and below CSR glass transitions.

49: Application of biological principles to 'grow' the structures of the future

Supervisor: Prof Richard Trask

Project Type: Design; Experimental

Skills Developed: Additive Manufacturing; Composite Manufacturing; Material Testing (Destructive); Working in Team

Resources: 3D printer in DML lab. Testing machines

Project Summary:

In biological materials and structures, intricate architectures exist across the nano-, micro- and mesoscales, allowing the biological system to exhibit tailored functional materials properties. This is usually achieved by the selective placement of active and passive materials to produce 4D actuation (i.e. 3D movement over time). In an engineering sense, we can now create unique deployment strategies (folds and non-folds) and coupled linear or non-linear sequencing through 3D printing of smart materials. We can equally control the deformation patterns through smart deposition. The goal of this study is to design and manufacture programmable shape transformation of 4D printed fibre reinforced thermoplastic composites. Working closely with my group you will evaluate and critique technical literature on morphing biological systems; you will apply engineering design and manufacturing knowledge to create a 3D morphing prototype; you will critically analysis and evaluate the technical results.

44: Testing mechanical properties for humidity and electric responsive 4d printed actuator material.

Supervisor: Charles de Kergariou

Project Type: Design; Experimental

Skills Developed: Additive Manufacturing; Data Analysis; Material Testing (Destructive) Programming Tools (MATLAB, Python, etc…):

Resources: I already have everything needed. Maybe order some material. Lab access required.

Project Summary:

The idea is to create a new filament for 3D printing made out of electrical and humidity actuating materials (Similar to S. J. Ahn et al. "3D printing with a 3D printed digital material filament for programming functional gradients," Nature Communications, vol. 15, 2024. but with different materials). The filament will then be used to create 4D printed actuators which can respond to humidity and electrical current. The material will also be tested mechanically depending on the amount of electrical and humidity actuation material. Tasks will be: -3d print -producing 3d printed specimen -mechanical testing -actuation. The aim of the project is to look at the influence of the amount of each material in the filament on the mechanical properties of the materials obtained from the printing of this filament.

7: Better Bamboo for Building

Supervisor: Ben Woods

Project Type: Design; Experimental

Skills Developed: Sustainability in Aerospace; Mechanical Characterisation: Composite Manufacturing; Computer Aided Design (CAD); Material Testing (Destructive); Programming Tools (MATLAB, Python, etc…);

Resources: Access to the Composites lab, including custom bamboo forming equipment, testing machines, etc

Project Summary:

Bamboo is a beautifully efficient plant combining high performance natural fibre reinforced composite material with an incredibly sophisticated design architecture that has highly optimised structural efficiency. Humans have built with bamboo for many thousands of years, however it also has large amounts of variance in its geometry and material properties, which impedes widespread adoption. You can help develop an exciting new manufacturing process which we have shown can accurately reshape bamboo to have consistent, precise dimensions while retaining its efficient structure. This opens up a vast new world of possibilities for building better with bamboo. We will decide together the focus of your project, which is likely to involve a combination of design, manufacturing, and testing on either the forming process, trusses built from formed bamboo, or joints connecting multiple formed pieces together. You will work directly with Prof. Woods and the PhD student developing the concept, and will learn a wide range of engineering skills while helping create a more sustainable future.

2: Design of a Strain-Activated Compliant Spoiler for Flexible Wing Wind Tunnel Testing

Supervisor: Alberto Pirrera

Project Type: Design; Experimental;

Skills Developed: Additive Manufacturing; Finite Element Analysis (FEA); Nonlinear Structural Mechanics; Experimental Testing (Wind Tunnel/Structural Prototyping);

Resources: Access to CAD and FEA software; 3D printing facilities for polymer prototypes; Laboratory facilities for structural bench testing; Potential integration into wind tunnel rigs

Project Summary:

This project builds on recent research into passive gust load alleviation devices that exploit sequential, interacting instabilities [1, 2]. The goal is to adapt the design of a morphing spoiler, previously demonstrated in [2], for integration into a flexible wing suitable for wind tunnel testing. Unlike the prior version, which was actuated using external mechanisms, the spoiler in this project will be entirely passive as originally intended: deployment will be triggered by compressive strain in the wing during bending. You will be tasked with designing and prototyping a monolithic, 3D-printed structure that integrates the compliant spoiler mechanism into a wing section or skin panel. The project combines nonlinear structural mechanics, additive manufacturing, and aeroelastic design, and the resulting prototype will contribute to a larger experimental campaign on morphing wings. [1] https://royalsocietypublishing.org/doi/pdf/10.1098/rspa.2022.0861 [2] https://arc.aiaa.org/doi/pdf/10.2514/1.J065343

45: Seabird manoeuvrability and control in turbulent coastal environments

Supervisor: Jasmin Wong

Project Type: Analytical

Skills Developed: Data Analysis; Flight Dynamics & Stability; Programming Tools (MATLAB, Python, etc...); Other: Photogrammetry

Resources: Data will be provided

Project Summary:

Tidal, coastal habitats are dynamic and heterogenous environments, and are made worse by the increasing number of extreme weather events. Despite this, many seabirds thrive in these environments with some species, such as members of the Alcidae family (murres, guillemots, auklets, and puffins), having morphological and behavioural adaptions to move in both air and water. In birds, turbulence has been found to reduce controllability and increase energetic costs. This project aims to understand how these seabirds change flight behaviour in response to atmospheric turbulence, and explore what the benefits or consequences of having done so. The student will receive some video data of puffin, guillemot, and kittiwake flights, alongside wind data. They will learn to reconstruct 3D trajectories from video data, analyse manoeuvres and contextualise them against wind parameters. Furthermore, there is scope to expand this analysis to explore how visual information can improve flight control under turbulent conditions. Overall, this project will provide novel data on how seabird behaviour changes with their environmental habitat, which will inform and improve conservation efforts, and inspire control policies for flying in turbulent conditions in engineered uncrewed aerial vehicles.

31: Exhaust gas energy recovery for hybrid vehicles.

Supervisor: Lindsay Clare

Project Type: Research; Analytical.

Skills Developed: Information gathering; understanding of energy conversion; gas flow to mechanical, mechanical to electrical; understanding losses at each conversion stage; system efficiency.

Resources:

Project Summary:

Waste energy in exhaust gases is often used to drive turbosuperchargers in cars and commercial vehicles, but may also be harnessed to provide mechanical or electrical power to feed into the drivetrain (Wright R3350 engine), or into a hybrid system such as the E-turbo (F1 MGU-H). The use of a velocity turbine, a.k.a. blowdown turbine, allows energy to be extracted with little exhaust back-pressure, offering the possibility of retro-fitting a power-recovery turbine to an engine without appreciably disturbing exhaust gas flow. The energy harnessed may then be used to generate electrical power to feed into a hybrid powertrain. There is research material available on turbocompounding on which to base a turbine design and also on the design of high speed electrical generators for exhaust gas turbines. The student is not expected to design a turbine or generator in detail, but to make an estimation of waste energy available for the chosen vehicle and draw on existing turbine/generator designs, applying appropriate adaptation and scaling.

20: Beyond Elliptical: Parametric Lift Distribution for Efficient Wing Sizing

Supervisor: Fintan Healy

Project Type: Analytical; Design

Skills Developed: Aerodynamics; Finite Element Analysis (FEA); Programming Tools (MATLAB, Python, etc...); Safety, Certification & Regulatory Compliance; Sustainability in Aerospace;

Resources: Programming langauge of the students choice

Project Summary:

In early conceptual aircraft design, it is common to assume an elliptical lift distribution when estimating gust and manoeuvre loads during a rapid wing sizing procedure. While this assumption simplifies analysis, it can lead to significant overestimation of wing mass, particularly for high-aspect-ratio wings. Historical work by Prandtl and R.T. Jones has shown that elliptical distributions are not optimal when aircraft weight is considered. This project aims to challenge the elliptical assumption by developing a simple parameterisation of lift distribution, coupled with a simplified wing sizing tool, to explore how the optimal cruise lift distribution varies with parameters such as aspect ratio and wing sweep.

12: Interactional aerodynamics of propellers in eVTOLs configurations

Supervisor: Daniele Zagaglia

Project Type: Analytical Experimental; Software

Skills Developed: Aerodynamics; Data Analysis; Instrumentation & Sensors; Programming Tools (MATLAB, Python, etc...); Wind Tunnel Testing;

Resources: Wind Tunnel Lab.

Project Summary:

The recent emergence of new UAM (Urban Air Mobility) and eVTOLs (Electric Vertical Take Off anf Landing) concepts has created the need of better understanding the aerodynamic behaviour of these complex configurations. Non-standard aerodynamic problems worthy of investigation include propeller-propeller interaction, propeller-wing interaction, shrouded propellers, aerodynamic of propellers during the conversion phase, and others. Scope of the project is the experimental investigation of one of this configurations by means of wind tunnel testing. A typical project will include literature review to understand the state of the art of research on the selected configuration, wind tunnel testing by either conducting your own experiment or by shadowing a researcher already testing in the wind tunnel, data analysis and then physical interpretation of the obtained results.

3: An investigation of wingsail geometry and performance

Supervisor: Ann Gaitonde

Project Type: Analytical;

Skills Developed: CFD; Data Analysis; Programming Tools (MATLAB, etc...);

Resources: STAR CCM+

Project Summary:

The majority of goods imported and exported by the UK arrive by sea and the maritime industry is a significant source of global greenhouse gas emissions. Consequently regulatory bodies including the International Maritime Organisation (IMO) are seeking significant reductions in emissions. There are a number of technologies that could contribute to achieving the new emissions targets for sustainable shipping, one of which is Wind Assisted Propulsion Systems (WAPS). A number of candidate systems have been proposed, but one which has significant advantages over other systems is the WingTek Triplane wingsail. CFD studies and a trial of a previous version on a cargo ship travelling across the Atlantic show that it can deliver excellent thrust performance across a large operational envelope and can comply with safety requirements which competitors cannot. Further computational studies of the wingsail geometry will explore how performance could be impacted by changes in design. The expected outcome would be data comparisons between the baseline design and the modified design.

53: Weaving simulation for composite textile preforms

Supervisor: Stephen Hallett

Project Type: Simulation; Software

Skills Developed: Finite Element Modelling, Composite Manufacturing; Data Analysis; Programming Tools (Python);

Resources: SimTex software, weave style information

Project Summary:

Aerospace composites are reinforced with fibres (usually carbon) in a range of formats, e.g. unidirectional, short fibre, woven, braided etc. Of these, woven reinforcements are gaining popularity due to their ability to form near net-shape preforms, with minimised waste and infinite storage life - the liquid resin is injected/infused separately at the time of component manufacture. A notable example of an aerospace textile composite component is the Safran/GE LEAP engine fan blade. In order to design with textile preforms, it is important to have information about the internal weave yarn architecture. Traditionally this is done through extensive manufacturing trials, but this is wasteful and expensive. Recent research at the University of Bristol has developed software for modelling of textile materials. To date this has been used for a range of manufacturing processes and stages, but never for modelling the weaving itself. In this project students will investigate the feasibility of using the SimTex software suite to model textile preform weaving.

37: Engineering Origami : Modelling and Applications

Supervisor: Mark Schenk

Project Type: Simulation; Analytical; Prototyping.

Skills Developed: Computer Aided Design (CAD); nonlinear Finite Element Analysis (FEA); Programming Tools (MATLAB, Python, etc...); Prototyping;

Resources: ABAQUS, MATLAB, Python, laser cutter

Project Summary:

Origami, the traditional art of paper folding, has found a wide range of engineering applications, ranging from deployable space structures to medical devices and architected materials. These applications make use of origami's fascinating mechanical properties, such as the ability to stow compactly before deploying to a large functional configuration, a tailored nonlinear mechanical response, multi-stability, etc.

Projects in this area often combine different methods and approaches; the description of origami geometry is generally analytical; the modelling of the nonlinear structural response of origami structures is done using the ABAQUS Finite Element Analysis software, but will also require MATLAB/Python scripting to generate models and process results; the building of small-scale prototypes will make use of laser cutters and 3D printers.

Specific project topics could include conical Miura-ori bellows for deployable space habitats, numerical modelling of the folding of curved-crease origami, origami-inspired manufacture of composite structures, deployment dynamics of origami structures, etc.

8: Nature-inspired passive vibration control in lightweight aerospace structures under resonance conditions

Supervisor: Brano Titurus

Project Type: Analytical; Design; Simulation

Skills Developed: Vibration analysis using Finite Element Analysis (FEA); Programming Tools (MATLAB); Aerospace Systems; Optimisation and advanced data analysis.

Resources: Matlab, internal/external data, optional vibration experiment.

Project Summary:

Future high performance aerospace structures such as wings, blades, empennage, panels, booms, etc. will suffer from increased vibrations. Lightweight and slender configurations, novel architectures, complex and varying working conditions are among the root causes leading to resonance, stability or reduced life concerns. This project will study nature-inspired strategies of dynamic design involving tendons, absorbers and other methods of passive vibration control aiming to apply them in lightweight aerospace structures. The project will use Matlab as the main tool for modelling and data analysis. The project will use Finite Element (FE) method to model complex Dynamic Systems. The supporting data will be sourced internally using existing collections, optional experimental pilot studies or external benchmarks. Typically, the research will consist of broad inter-disciplinary literature review, baseline FE modelling in Matlab, model validation and parameterisation, model refinement, performance analysis (e.g., sensitivity) and optimisation (e.g., gradient or evolutionary). Possible targeted systems include high aspect ratio wing, large wind turbine blade, high aspect ratio sattelite/antenna, eVTOL multi-rotor wing.

48: Data-driven prediction of buckling initiation site in compressed cylinders

Supervisor: Rainer Groh

Project Type: Experimental; Simulation

Skills Developed: Artificial Intelligence & Machine Learning; Data Analysis; Non-Destructive Testing (Thermal, Ultrasound, X-ray, etc…); Programming Tools (MATLAB, Python, etc…)

Resources: Structures lab access

Project Summary:

Thin-walled cylinders are used in various applications ranging from fuselages and launch vehicle stages. When thin-walled cylinders are compressed, they are susceptible to buckling and this occurs at loads well below what is suggested by analysis. As a result, cylinders are designed with very conservative safety factors. One way to improve the design process, is to devise a non-destructive testing framework that can predict when a manufactured cylinder will buckle, which would provide information on potential remedial measures. Such a methodology has recently been developed, where a cylinder is probed laterally from the side to measure its resistance to indentation, but the method is very dependent on the location of probing. Buckling of cylinders is a local event, where a single dimple initiates a dynamic buckling sequence. Probing should occur at the weakest spot where the dimple initiates. However, this site is not known a priori as it depends on imperfections in manufacturing and loading. The goal of this project is to use pre-buckling deformation measurements (e.g. using digital image correlation) and data-driven modal decomposition to predict where the dimple will form, and thereby inform the probing site.

26: A numerical study on the effect of forming on dry fabric permeability

Supervisor: Jonathan Belnoue

Project Type: Analytical; Simulation; Software; Theoretical

Skills Developed: Artificial Intelligence & Machine Learning; Composite Manufacturing; Data Analysis; Programming Tools (MATLAB, Python, etc…);

Resources: MATLAB, Python

Project Summary:

Resin infusion based manufacturing methods are growing in popularity due to the potential to lower manufacturing costs and production times for complex and high rate parts in fields such as wind energy, automotive, and aerospace. Resin Infusion schemes are difficult to model accurately due to both the complexity of the calculation, and the unreliability of the supplied data. The calculations rely heavily on accurate permeability data as one of the three key parameters in the governing Darcy's Law equation (the others being viscosity and Pressure differential). Permeability is heavily affected by the forming process which can have a significant impact on the infusion behaviour. There is a lot of work in the open literature on modelling various forming and infusion processes. However there is suprisingly only little work linking the two. The project will built a simulation framework linking forming to infusion simulation and explore if such a framework allows more accurate simulations of infusion processes.

36: Flight mechanics study of asymmetric hydrogen-fuelled aircraft

Supervisor:	Mark Lowenberg
Project Type:	Design; Simulation
Skills Developed:	Flight Dynamics & Stability; Safety, Certification & Regulatory Compliance; Sustainability in Aerospace; Systems Integration.
Resources:	MATLAB or alternative coding/plotting software; aircraft design resources (textbooks, code such as AVL, etc.)

Project Summary:

Liquid hydrogen (LH2) is being considered as a potential fuel for transport aircraft in the future. It must be kept at cryogenic conditions which gives rise to numerous difficulties in terms of its storage, ducting, etc.

There exist substantial challenges to the certification of LH2-fuelled aircraft and ensuring their crashworthiness. In particular, since LH2 is highly explosive in contact with air or water, the layout must ensure that passengers and crew are sufficiently removed from the fuel tanks, ducts and cross-over pipes (which are necessary on multiple-engine aircraft to ensure that fuel can be fed from one wing to an engine on the other wing). Most proposed solutions entail storing the fuel in the fuselage: this not only violates the above requirement but also makes the fuselage very long - which introduces stability and take-off rotation issues.

Therefore, an innovative alternative configuration for LH2 airliners is needed. Nangia, Hyde and Cooper have devised a 'gondola'-type layout, with a main fuselage for passengers and another for the hydrogen fuel (no fuel in the wings); engines could be mounted on the section of wing between the two fuselages. Fundamental CFD modelling and preliminary aeroelastic work suggest that the concept is practically viable.

However, the layout is, unlike, almost all aircraft, asymmetric. This proposed RP3 entails a flight mechanics study in order to better understand the stability and control challenges for such an aircraft and potential solutions to ensure that stability and handling qualities requirements can be met.

52: Kestrel wing morphing flight dynamics

Supervisor: Shane Windsor

Project Type: Experimental; Simulation;

Skills Developed: Aerodynamics; Flight Dynamics & Stability; Programming Tools (MATLAB, Python, etc...); UAV/Drone Design & Testing;

Resources: No special equipment required

Project Summary:

Birds control their flight differently to aircraft, morphing their wings and tail to modify flight forces, rather than having discrete hinged control surfaces. Some birds, like kestrels, are more manoeuvrable than similar sized fixed-wing uncrewed air vehicles (UAVs) and are able to fly in more turbulent wind conditions. In collaboration with the RMIT in Australia we measured the flight kinematics of kestrels flying in a wind tunnel using a motion capture system and also developed a kestrel replica morphing robot. This has generated an extensive dataset that can be analysed to model how kestrels use wing morphing to achieve a given flight manoeuvre. In this project the student will use the existing dataset and flight dynamics model to explore patterns in the birds wing motions used and what other wing motions they could have used to achieve the same outcome. This project could be expanded to consider morphing wing flight control in UAVs and other bird species.

58: Machine Learning for Wind Energy

Supervisor: Terence Macquart

Project Type: Simulation; Software;

Skills Developed: Aerodynamics; Artificial Intelligence & Machine Learning; Data Analysis; Programming Tools (MATLAB, Python, etc...);

Resources: Open source ML library such as Pytorch

Project Summary:

This project focuses on developing machine learning–based surrogate models for aerodynamic and elastic analysis tools used in wind turbine design. Traditional high-fidelity simulation codes, while accurate, are computationally expensive and limit their use in rapid design iterations. The goal is to replace these costly simulations with fast and reliable surrogate models that can support preliminary design studies. The student will be given access to an in-house wind turbine analysis code to generate training datasets and will rely primarily on open-source machine learning libraries for model development. Expected tasks include data preparation, training and validation of surrogate models, and performance evaluation. The final outcome will be a functional surrogate capable of replicating the key outputs of the original analysis tools.

5: Co-evolving Design Morphologies and Control for Aerial Robots with Reinforcement Learning

Supervisor: Bahadir Kocer

Project Type: Simulation; Software; Theoretical; Design

Skills Developed: Artificial Intelligence & Machine Learning; Computer Aided Design (CAD); Flight Dynamics & Stability; Programming Tools (e.g. Python); Aerodynamics.

Resources: Software

Project Summary:

This project investigates the co-development of robotic body morphologies with a particular focus on aerial robotic systems. Conventional designs often rely on standardised structures, which restrict adaptability and limit performance in unstructured environments. By contrast, biological systems exhibit a wide diversity of forms that enhance dexterity, resilience, and efficiency. The project will employ reinforcement learning to co-evolve body morphologies and control strategies, ensuring that physical form and flight trajectories are optimised in tandem for greater efficiency. This approach will enable adaptation to diverse atmospheric conditions such as turbulence, variable wind fields, and fluctuating densities. Potential tasks include optimisation of morphologies, trajectory learning, the design of aerial platforms, and testing their efficiency in simulated environments. A particular focus would be on how atmospheric phenomena such as thermals, ridge lift, and dynamic soaring can be harnessed to extend flight endurance. Expected outcomes include new morphological principles that improve environmental sensing, robustness, and energy efficiency in next-generation aerial robotic systems.

43: Investigating the flight of maple seed within a wind tunnel setting

Supervisor: Byung Kwon Jung

Project Type: Design; Experimental;

Skills Developed: Aerodynamics; Computer Aided Design (CAD); Programming Tools (MATLAB, Python, etc...); Wind Tunnel Testing;

Resources: Vertical wind tunnel, aritifical maple seed, load cell, access to dynamics lab

Project Summary:

Maple seeds spin as they fall from a tree, a motion that slows their descent and allows them to disperse further. Whilst autorotating the seed also produces a flow mechanism known as the leading-edge vortex (LEV), which enhances lift and contributes to their unique flight. In this project, you will explore the aerodynamics of real/artificial maple seeds within a wind tunnel setting. Your main tasks will include measuring thrust and rotational speed under different flow conditions using a load cell, and comparing these results to numerical predictions by a code written in MATLAB . As the project develops, there may also be opportunities to apply Particle Image Velocimetry (PIV) to visualise and quantify the LEV, offering deeper insight into the fluid mechanics at play. By engaging in this work, you will strengthen your analytical skills, gain hands-on experience with sensors and experimental setups, and build a solid understanding of bio-inspired flight.

39: Parametric Optimization of Bluff Body Geometry Using Physics-Informed Neural Networks (PINNs)

Supervisor: Mohammad Jadidi

Project Type: Simulation; AI-Driven Engineering Design

Skills Developed: Artificial Intelligence & Machine Learning; Computaional Fluid Dynamics (CFD); Programming Tools (Python).

Resources: PhysicsNeMo Framework; OpenFOAM

Project Summary:

This project explores the use of Physics-Informed Neural Networks (PINNs) and NVIDIA's PhysicsNeMo Sym to optimize the geometry of a bluff body under fluid flow conditions. The purpose is to develop a machine learning model that can predict pressure loss and scalar concentration across a range of parametric geometries, enabling efficient design optimization. The context lies in the growing demand for intelligent, scalable simulation tools in engineering applications such as urban design andaerodynamics, where traditional CFD methods are computationally intensive. Key tasks include defining parametric geometry, training a PINN model to solve governing PDEs, and applying optimization techniques to identify optimal configurations. Expected outcomes include a trained PINN capable of generalizing across design variations, reduced simulation cost, and a demonstration of AI-driven parametric design. This project builds on NVIDIA's tutorial for heat sink optimization and extends it to bluff body applications. Reference: https://docs.nvidia.com/physicsnemo/latest/overview.html

9: Numerical Optimisation Tools for Aerodynamics

Supervisor: Christian Allen

Project Type: Analytical; Simulation.

Skills Developed: Data Analysis; Programming Tools (MATLAB, Python, etc...); Interpolation Methods; Optimisation.

Resources: None. Only requires access to a laptop with Matlab and/or Python.

Project Summary:

Aerodynamic shape optimisation using numerical methods requires the combination of a number of tools, each which can be considered separately: 1) a simulation tool (CFD code) to compute the aerodynamic quantities of interest, i.e. lift, drag, moment. The level of fidelity of the CFD code determines to accuracy of the load computations, and of course the cost of each CFD call; 2) a method to define the design space, i.e. define the design variables that parameterise and control the geometry of the aerodynamic surface; 3) based on the deformations of the CFD surface mesh, a method to deform the CFD volume mesh accordingly; 4) if aeroelastic optimisation is considered, a fluid-structure coupling data interpolation method is also required; 5) an optimiser to explore the design space based on the design variables. For each new generation of design variables, the CFD code is normally rerun to compute the updated aerodynamic loads; 6) However, depending on the expense of the CFD code, a surrogate interpolation model can be built of the existing aerodynamic data which can then be interrogated instead of calling the CFD code, as it is much cheaper. This project will consider aerodynamic shape optimisation, specifically tools 2, 3, 4 or 6; CFD codes or optimisation codes are normally used as 'black-boxes' to simply provide data. Only one method will be considered in the project, but similar technology can be used for tools 3, 4, and 6. The project will involve code development of suitable mathematical methods.

10: Understanding Canopy Flow: Nature's Turbulent Dance Around Obstacles

Supervisor: Claudia Nicolai

Project Type: Analytical; Experimental;

Skills Developed: Data Analysis; Programming Tools (MATLAB); Basic insights of experimental fluid mechanics; Communication skills

Resources: Dataset from past investigation will be provided.

Project Summary:

Canopy flow is a fascinating type of fluid motion that occurs when air or water moves through and around porous obstacles—think forests, underwater plants, city buildings, or even arrays of wind and tidal turbines. These obstacles don't just sit there passively; they actively shape how the flow behaves. In nature, aquatic vegetation can slow down water, protect shorelines from erosion, and even help trap carbon—making it vital for climate regulation. On land, forests and urban structures stir up the air, creating complex turbulence that affects how heat, moisture, and pollutants spread through the atmosphere. Understanding canopy flow helps us design better cities, protect natural habitats, and optimize renewable energy systems. It's a perfect example of how physics meets ecology and engineering in the real world. In this project, you'll learn how scientists collect and analyse experimental data to uncover the physics behind these flows. You'll gain practical experience in data processing and interpretation and develop your communication skills by presenting your findings using slides (or another format you prefer) and discussing them with your supervisor—just like in a real research environment.

55: Modelling, simulation and emulation of UAV electric propulsion systems

Supervisor: Steve Burrow

Project Type: Analytical; Experimental; Simulation Theoretical

Skills Developed: Artificial Intelligence & Machine Learning; Avionics; Computer Aided Design (CAD); Data Analysis; Instrumentation & Sensors; Programming Tools (MATLAB, Python, etc…); Propulsion Systems (Gas Turbines, Electric, Hydrogen); Systems Integration; UAV/Drone Design & Testing;

Resources: Computer with MATLAB as a start, can be developed to hardware if desired.

Project Summary:

Today electrical power is now the de-facto solution for small UAV propulsion. The relatively lower energy density of the chemical electrical energy storage options compared to hydrocarbon fuels requires careful design and operation to ensure maximum mission duration, however adopting electrical technologies offers possibilities around energy scavenging or generation as well as closer operational integration with other UAV systems. To fully exploit the possibilities of future electric propulsion systems, for example to offer real time energy prognosis in response to weather forecasts, requires high fidelity models of the individual components and overall system which may include validation from measured flight data and/or hardware in the loop emulation of the systems.

32: A cybersecurity threat plan for a University Satellite Ground Station

Supervisor: Lucy Berthoud

Project Type: Simulation; Software; Theoretical

Skills Developed: Satellite and ground communication systems; Incident response planning; Security analysis Data Analysis; Safety, Certification & Regulatory Compliance

Resources: University Ground Station diagrams and software manuals; Cybersecurity software such as Wireshark and Nmap (open source); Regulatory guidelines

Project Summary:

This project will develop a practical threat response plan for a cyber security incident targeting a university ground station operating UHF, VHF, and S-band communications. Ground stations are vital for satellite data reception and research, yet often overlooked in cyber security planning. The work will focus on identifying common vulnerabilities, mapping potential attack paths, and outlining straightforward mitigation measures. Tasks include basic risk assessment, protocol review, and small-scale simulation of attack scenarios. Expected outcomes are a concise, well-structured threat plan, improved awareness of cyber risks in space communications, and recommendations suitable for adoption by university ground station teams.

51: Smart porous hybrid nanocomposites for energy and environmental applications

Supervisor: Sanjit Nayak

Project Type: Experimental; Analytical

Skills Developed: Composite Manufacturing; Data Analysis; Instrumentation & Sensors; Material Testing (Destructive); Non-Destructive Testing (Thermal, Ultrasound, X-ray, etc…)

Resources: Labs for material synthesis; Various analytical equipment (IR, thermal analyses, X-ray diffraction, electron microscope, etc)

Project Summary:

Metal-organic frameworks or MOFs is a class of materials known for their high porosity and ultrahigh surface area that can be used for various applications, such as hydrogen storage, carbon capture, and so on. However, due to their polycrystalline form, it is challanging to integrate the MOFs into functional devices. This project will address this problem, and will involve synthesis of known MOFs using established procedure, and then integrate into polymer matrix to form hybrid nanocomposites. The developed nanocomposites will be characterised using various analytical methods, and their mechanical and funtional properties will be studied for energy and environmental applications (such as hydrogen storage, carbon capture, water harvesting, etc).

28: Inference of Flight System Parameters from Air Traffic Data

Supervisor: Josh Hoole

Project Type: Analytical; Simulation;

Skills Developed: Data Analysis; Instrumentation & Sensors; Programming Tools (MATLAB, Python, etc…);

Resources: MATLAB or Python, Glider Air Traffic Data (accessed), Glider Onboard Data (accessed)

Project Summary:

With the growing availability of crowd-sourced air traffic data through platforms such as the Opensky Network and Flightradar24, there is possibility of using such data sources to infer the status of aircraft systems to support activities of structural health monitoring. The University of Bristol's glider is equipped with on-board high resolution monitoring of the air data system and airframe accelerations, as well as an ADS-B transciever, which permits the trajectory of the glider as would be seen within air traffic data to be captured. A previous project took initial succesful steps towards using the air traffic data trajectory of the glider to infer the accelerations of the glider during thermalling turns using statistical models. There is the opportunity to further explore this topic by investigating whether air traffic data can be used to infer other system parameters such as pitch and roll.

62: AI-Enhanced Attitude Control for Agile Scientific Satellites

Supervisor: Yusuf Acar

Project Type: Analytical; Simulation

Skills Developed: Artificial Intelligence & Machine Learning (Reinforcement Learning) Spacecraft Dynamics & Control (GNC) Advanced Simulation (MATLAB & Simulink) Data Analysis & Technical Reporting

Resources: A university computer with MATLAB, Simulink, and the Reinforcement Learning Toolbox™. All required software is available via standard university licenses.

Project Summary:

This project investigates the application of artificial intelligence to enhance the performance of satellite attitude control systems.This project will develop an AI agent to control a satellite's orientation. The student will first replicate a high-fidelity single-axis satellite simulation in MATLAB/Simulink. They will then design, train, and integrate an AI agent to perform both rapid slewing maneuvers and high-stability pointing. The expected outcome is a rigorous comparative analysis of the different controllers, evaluating their performance on key metrics such as pointing accuracy, fuel efficiency, and robustness to system uncertainties. The goal is to demonstrate the feasibility and potential benefits of model-free AI control for future autonomous space missions.

17: Composite materials characterisation and inspection

Supervisor: Byung Chul (Eric) Kim

Project Type: Analytical; Design; Experimental; Software;

Skills Developed: Composite Manufacturing; Instrumentation & Sensors; Material Testing (Destructive); Non-Destructive Testing;

Resources: BCI lab, universal testing machines

Project Summary:

The research typically involves experimental characterisation of composite materials (dry or pre-impregnated, unidirectional or woven, cured or uncured) to understand their forming and consolidation characteristics, often together with inspection of their fibre architectures. Such characterisations are normally conducted with universal testing machines along with custom-designed test fixtures, often together with a sophisticated vision system (e.g. digital image correlation). The analysis of test data or inspection sometimes requires a bespoke image analysis tool or open-source tools. The projects will provide opportunites to acquire a good understanding of composite materials and their material behaviours, testing and analysis methods, and experimental skills.

42: Study on the honeycomb cell deformation during the curved-surface forming

Supervisor: Boyue Chen

Project Type: Design; Simulation;

Skills Developed: Data Analysis; Finite Element Analysis (FEA); Programming Tools (MATLAB, Python, etc…);

Resources: software (abaqus, Matlab)

Project Summary:

Honeycomb sandwich structures consist of two relatively thin face sheets bonded to a relatively thick lightweight honeycomb, which combines good stiffness, strength, and energy absorption properties. Directly bending the honeycomb into the designed surfaces remains the most cost-effective approach to manufacture curved sandwich components such as aircraft wing leading edges. Numerically predicting the cell deformation during the forming becomes critical for assessing the conformability of the honeycomb panel to the designed curved geometry. The student will be given existing examplified Abaqus model and matlab code to practise FEA modelling of constraint bending and data capturing/analysis. The student will refine the model to parametrically study the influence of surface curvature and cell architecture on the deformation severity. As the project goes on, there will be opportunity to refine the cell architecture to improve the honeycomb conformability.

61: Efficient and rapid curing of composites using 3D printed tools

Supervisor: Vincent Maes

Project Type: Analytical; Design; Experimental; Simulation; Software; Theoretical

Skills Developed: Additive Manufacturing; Composite Manufacturing; Instrumentation & Sensors; Sustainability in Aerospace;

Resources: Basic work can be carried out in the GE lab and the Meltio M450 is run by technical staff, for designing of novel tool, Inventor or similar CAD software will be needed.

Project Summary:

This project looks to build on previous work studying the energy efficiency and cure acceleration enabled by 3D printed lattice structures. The intial tasks in this project will take existing 3D printed tool pieces and existing experimental set-ups to study forced airflow based heating and cooling for curing small composite samples. In parrallel the student can develop and work with technical services to 3D print a novel tool using the Meltio M450. The novel tool can then be used to study this technology at higher scale and complexity. Implementing the novel tool would also involve addressing any changes to the set-up needed to connect in the newly developed tool into the airflow systems.

60: Thrust Vector Control for Agile UAVs

Supervisor: Tom Richardson

Project Type: Simulation; Software;

Skills Developed: Flight Dynamics & Stability; Programming Tools (MATLAB, Python, etc…);

Resources: MATLAB / Simulink

Project Summary:

This project will develop a MATLAB/Simulink model for an agile UAV which uses thrust vectoring for control. The student will be given an existing aircraft model and will extend it to include a thrust vectoring actuator. A control system will be developed for the model and simple manouvres carried out in simulation to demonstrate the potential benefit of thrust vectoring for small fixed wing UAVs. As the project develops the student will build up an understanding of closed loop control, simulation and the improvements in agility offered by thrust vectoring in addition to conventional control surfaces.

41: Effects of specimen curvature on impact response in composite beams

Supervisor: Paul Weaver

Project Type: Analytical; Design; Simulation; Software; Theoretical

Skills Developed: Finite Element Analysis (FEA); Composite Structures; Computer Aided Design (CAD)

Resources: ABAQUS FEA

Project Summary:

Laminated composite structures are ubiquitous in lightweight aerosdpace structures, comprising beam, plate and shell components. Leading edges of propellers, wings and turbne blades are subject to impact events from rain and hail to bird-strike. As such aerodynamic efficiency and structural integrity can be compromised. There has been much done on charactersing impact damage for straight beams. However, recently developed structural analysis techniques have shown an unexpected stress response in which the expected through-thickness compression can reverse and become tensile near the bottom surface, potentially acting as failure sites, including tensile failure and delaimation. This project will use ABAQUS finite element analysis to identify the location and magnitude of this tensile region and assess its effect on potential failure.

15: Investigation of reduced order models

Supervisor: Dorian Jones

Project Type: Analytical;

Skills Developed: Coding; Data Analysis; Programming Tools (MATLAB, Python, etc…);

Resources: STAR CCM+; MATLAB;

Project Summary:

Full order unsteady CFD is computationally expensive and infeasible for many calculations involved in aerospace design. The idea of a reduced order model is to use small amounts of high fidelity unsteady CFD data to train a small, lower cost system that captures the dominant physics of the full order model. There are a number of possible methods that are under development. This project will investigate reduced order models suitable for aerodynamics problems. This will require running CFD codes and coding in MATLABor Python and the expected outcome is a model validated compared to the full order CFD.

46: Biomedical composite prosthetic element testing

Supervisor: Laura Rhian Pickard

Project Type: Experimental

Skills Developed: Composite Manufacturing; Data Analysis; Material Testing (Destructive); Non-Destructive Testing (Thermal, Ultrasound, X-ray, etc…);

Resources: Lab access required, use of pultrusion rig, test machine, DIC and imaging.

Project Summary:

Fibre reinforced composites perform well in tension, so applications from wind turbines to medical prosthetics are limited by performance under compression. The NextCOMP programme has created nature-inspired composites to improve compressive performance, which use pultruded rods as elements in larger structures. Your project will use a novel 4 point bend ‘cradle’ test to characterise the performance of rods with different constituents, for example a baseline vs rods with a nano-additive. You will be introduced to the pultrusion process using our in-house rig and will learn to prepare for and carry out the test, use Digital Image Correlation to measure the strains on the rods and analyse the results. If time allows you may also use imaging techniques such as microscopy, SEM or X-ray CT scanning to assess the structure of the rods and image the failures. Your results will contribute directly to development of this new approach to composites.

30: Mechanical characterisation of additively manufactured polymers using Shear Compression Specimen

Supervisor: Karthik Ram Ramakrishnan

Project Type: Design; Experimental

Skills Developed: Additive Manufacturing; Data Analysis; Material Testing (Destructive); Programming Tools (MATLAB, Python, etc…)

Resources: 3D printers (Formlabs Form 4L resin printer and Prusa XL 5), Shimadzu test machine, Video extensometers, Lab access

Project Summary:

Additive manufacturing (AM), also known as 3D printing, has revolutionized the manufacturing landscape by enabling the fabrication of complex three-dimensional parts through layer-by-layer material deposition. A comprehensive understanding of the mechanical properties of additively manufactured components becomes increasingly critical as AM technologies transition from prototyping to end-use applications across various industries, including aerospace, automotive, and biomedical engineering. Although extensive research has been conducted on the tensile and compressive properties of polymers produced via 3D printing, the shear behaviour—an essential mechanical property influencing structural reliability and functional performance—remains comparatively underexplored. This gap in the literature is particularly critical, as components in real-world applications are often exposed to complex loading conditions involving substantial shear stresses. In this project, the student will conduct mechanical tests on additively manufactured polymers using a Shear Compression Specimen geometry with particular emphasis on the effect of temperature on the mechanical response.

38: Evaluation of Double-Double Concept for Composites Design

Supervisor: Prof. Michael Wisnom

Project Type: Design; Experimental;

Skills Developed: Composite Manufacturing; Data Analysis; Finite Element Analysis (FEA); Material Testing (Destructive);

Resources: Composites Manufacturing, Mechanical testing; FE software

Project Summary:

Prof. Steve Tsai, one of the most influential figures in composites design and analysis, has been promoting the concept of "Double-Double" (DD) layups comprised of two different sets of angle plies ($\pm\Phi/\pm$) as an alternative to Quad layups with 0°, 45°, -45° and 90° plies. This allows continuous variation of properties by changing the angles, allowing better optimisation, and lower minimum number of plies, leading to weight savings.The concept is currently attracting a lot of interest, but there is a lack of data to confirm some of the claims. One of the potential concerns is the greater susceptibility of DD laminates to premature delamination from the edges. This project aims to evaluate some of the benefits and drawbacks of DD layups by carrying out analysis and experimental testing and comparing with conventional Quad layups. There may be the opportunity to present and discuss the research with Prof. Tsai.

16: Flight dynamics verification of airborne wind energy systems

Supervisor: Duc Nguyen

Project Type: Experimental

Skills Developed: avionics; flight dynamics & stability; UAV design and testing

Resources: Unmanned aircraft, round-the-pole equipment

Project Summary:

Student will verify the stability characteristics of a round-the-pole flight vehicle in open-loop and closed-loop configuration. The vehicle is representative of a fixed-wing airborne wind energy system, which is a class of tethered flying vehicles used for energy generation. The student is expected to have completed a summer internship on flight testing of tethered vehicles or gained similar experience from elsewhere. A strong background in dynamics and control is also desirable. Test flights will confirm the roll instability in open-loop configuration, followed by a closed-loop test with a stability augmentation controller.

4: Resin 3D printing for smart polymer materials

Supervisor: Anna Baker

Project Type: Experimental

Skills Developed: Additive Manufacturing; Computer Aided Design (CAD); Instrumentation & Sensors; Material Testing

Resources: Prusa SL1S resin printer (DML lab); PrusaSlicer

Project Summary:

Resin 3D printing uses light to cure liquid resins into high-resolution, complex parts. Like FDM printing, it builds objects layer by layer, but offers superior accuracy, surface finish, and material versatility. This includes smart polymers—materials that respond to environmental stimuli such as heat, light, pH, or hydration—used in applications like actuators, sensors, artificial muscles, drug delivery, camouflage, and valves.

This project will explore smart polymer resin formulations for the Prusa SL1S, aiming to print and characterize responsive materials. Testing will include mechanical, thermal, and stimulus-driven behavior to evaluate both the material and the printing process. The student will receive initial formulations designed to exhibit smart responses, along with training in resin printing, software use, and guidance on material characterization.

50: Effects of Z-pins on RF transmissivity of GFRP composites

Supervisor: Samudra Dasgupta

Project Type: Analytical / Design / Simulation

Skills Developed: Structures-Electromagnetics couping, Multi-functional Composite Design, COMSOL

Resources: COMSOL multi-physics software (UoB license available), CAD

Project Summary:

Aircraft nose radome is often exposed to impact damages from bird-strike and other Foreign Object Damages (FOD). One way to improve the impact resistance for such structures is to provide out-of-plane 3-d reinforcements - z-pins being one such option. However, use of z-pins is likely to compromise the RF transmission properties of these materials (traditionally glass fibre reinforced polymeric (GFRP) composites). The project will investigate the extent of such degradation in the RF transmissivity of such GFRP materials as a function of the geometry, material and the layout plan for the z-pins, and also the frequency of operation for the radome. The project will primarily use analytical / simulation tools for the above study.