



Faculty of Engineering Projects

2026

Faculty of Engineering
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Foreword

I am pleased to introduce the 2026 final-year project booklet of the Faculty of Engineering.

As in previous years, this booklet brings together the work of our students at the final stage of their undergraduate studies. These projects represent many months of effort, discussion, testing, redesigning and problem-solving. They also show the range of interests and abilities within the Faculty, and the different ways in which engineering can be applied to real and practical challenges.

Final-year projects are never only about the final result. They are also about the process: understanding a problem, making decisions, dealing with limitations, learning from what does not work, and improving a solution along the way. This is an important part of the formation of an engineer, and it is something that is clearly reflected in the work presented here.

I would like to congratulate our students on reaching this important milestone. I also thank the academic staff, technical staff, administrative staff and supervisors who guided and supported them throughout the year. Their contribution is essential to the success of these projects and to the wider work of the Faculty.

I hope that this booklet gives readers a good sense of the work being carried out by our students, and of the commitment, curiosity and ability that they bring to their chosen field.

Prof. Ing. Andrew Sammut

Dean, Faculty of Engineering



#EngineeringTheFuture
#ShineAtUM

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Courses

International School for Foundations Studies Course

Certificate MQF Level 4
60 ECTS

Certificate in Foundation
Studies in Engineering & ICT

Faculty of Engineering Courses

MATSEC Certificate

Certificate MQF Level 4
60 ECTS

Undergraduate MQF Level 6
240 ECTS

Postgraduate MQF Level 7
90 ECTS

Postgraduate MQF Level 8

Certificate in Engineering Sciences

ENGINEERS EUROPE

MALTA ENGINEERING
PROFESSION BOARD
LOCAL WARRANT *

B.Eng.(Hons) Electrical &
Electronic Engineering

B.Eng.(Hons) Mechanical Engineering
The course is accredited
by the below entities

European
Accreditation
of Engineering
Programmes
EUR-ACE®

Engineering
Council
accredited degree

Institution of
MECHANICAL
ENGINEERS

THE ROYAL
INSTITUTION
OF NAVAL
ARCHITECTS

Exit after 4 years – Bachelor of Engineering
(Honours) (240 ECTS)

Exit after 3 years – Bachelor of Technology
(min. of 180 ECTS)

Exit after 2 years – Higher Diploma in General
Studies (min. of 120 ECTS)

Exit after 1 year – Diploma in General Studies
(min. of 60 ECTS)

Get
QUALIFIED

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LOCAL WARRANT

Funding routes for these
postgraduate degrees
are available.

by Research

Taught

M.Sc. in Engineering
[Various Research Areas]

M.Sc. Integrated
Product Development

M.Sc. Building Services Engineering

M.Sc. Intelligent Systems,
Signals & Control (online)

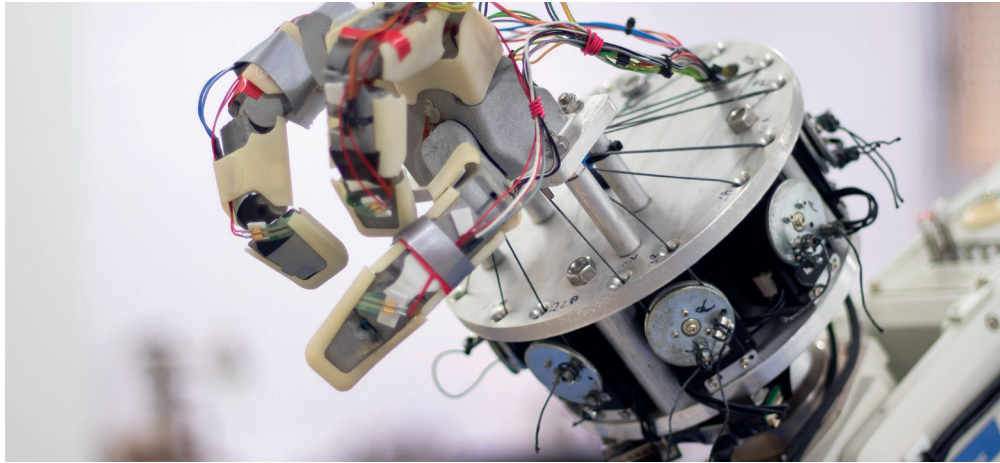
M.Sc. Biomedical Engineering

Ph.D. [Various Research Areas]

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LOCAL WARRANT

* Through the course one can apply for
the engineering warrant and following
that the Eur. Ing qualification.



Bachelor of Engineering (Honours)



UM STREAM
Science & Technology



MQF
Level 6



DURATION
**4 Years Full-time /
8 Years Part-time Day**



**COURSE
FINDER**



AREAS OF STUDY

- Electrical and Electronic Engineering
- Mechanical Engineering

The Bachelor of Engineering (Honours) course develops the fundamental scientific and mathematical knowledge, engineering design, analysis and practice together with the interdisciplinary economic, ethical and social skills necessary for the different engineering-related job markets offered in various local and international industrial sectors such as the aerospace, biomedical, maritime, energy, telecommunications, electronics and manufacturing industries as well as that of building services. The course focuses on two main universal engineering areas of studies; Electrical and Electronic Engineering or Mechanical Engineering.

The Electrical and Electronic Engineering programme addresses the fundamental concepts in electrical engineering, electronics, signal processing and control systems. Students will be able to choose a variety of study-units geared towards the fields of energy generation, conversion, storage and smart distribution,

renewable energy, green transportation, electronic sensing, acquisition and measurement, electronic product development, automated systems, autonomous vehicles/robots and software algorithms for signal, image and video processing.

The Mechanical Engineering programme addresses the fundamental concepts in mechanical, manufacturing and materials engineering, and then focuses on one of three streams as selected by the student: Applied Materials in Engineering; or Applied Mechanics and Thermofluids Engineering; or Industrial and Manufacturing Engineering. Students will be able to choose a variety of study-units geared towards fields such as aerospace engineering, automotive engineering, biomaterials, biomechanics, building services, energy, maritime engineering, nanomaterials, polymer and composites manufacture, quality and reliability engineering, robotics and automation, structural integrity, surface engineering, tool design and manufacture.

This course is recognised by the local Engineering Profession Board as a prerequisite for the application of the Engineering Warrant (Ing.) and is also internationally recognised by the European Federation of National Engineering Associations (FEANI - Eur.Ing.).

The Mechanical Engineering area of study is also accredited by the Institution of Mechanical Engineers (I.Mech.E.) U.K and by the Royal Institute of Naval Architects (R.I.N.A.) U.K. on behalf of the Engineering Council U.K. as, in part, satisfying the requirements of a Chartered Engineer (CEng - second cycle degree) and fully meeting the requirement of an Incorporated Engineer (IEng). The Mechanical Engineering area of study is also recognised by the European Network for the Accreditation of Engineering Education (ENAE) and labelled as a first cycle Engineering degree under the EUR-ACE programme.

ENTRY REQUIREMENTS

Either

- satisfy the General Entry Requirements together with **two** Advanced Level passes at Grade C or better in **Pure Mathematics and Physics**

or

- be in possession of the **Certificate in Engineering Sciences** from the University of Malta.

The Board may also consider applicants in possession of a qualification at MQF Level 5 in an engineering domain, together with passes in the SEC Examination at Grade 5 or better or at SEC Level 3 in **English Language, Maltese, Mathematics and Physics**, to join the Course.

Applicants admitted in terms of the 'maturity (adult learners) clause' shall be required to submit with their application a letter written in English giving their motivation for applying for the Course, together with a copy of their Curriculum Vitae.

Certificate in Engineering Sciences



UM STREAM
Science & Technology



MQF
Level 4



DURATION
1 Year Full-time /
2 Years Part-time Day



COURSE
FINDER



The Certificate in Engineering Sciences is a one-year certificate course intended to prepare students with the knowledge, skills and competencies necessary to follow the B.Eng. (Hons) course. During the course, students will be studying mathematics and physics, bringing the student's knowledge and understanding of these two subjects to the level which meets the specific requirements of the B.Eng. (Hons) degree course. The programme also includes studies specific to the engineering profession. Through engineering workshops and laboratories, the programme will complement theoretical skills with practical skills in mechanical fitting, machining and manufacturing, electrical installations, electronics and control engineering. Moreover, a unit in computer systems and programming will help to prepare you to become a modern engineer.

ENTRY REQUIREMENTS

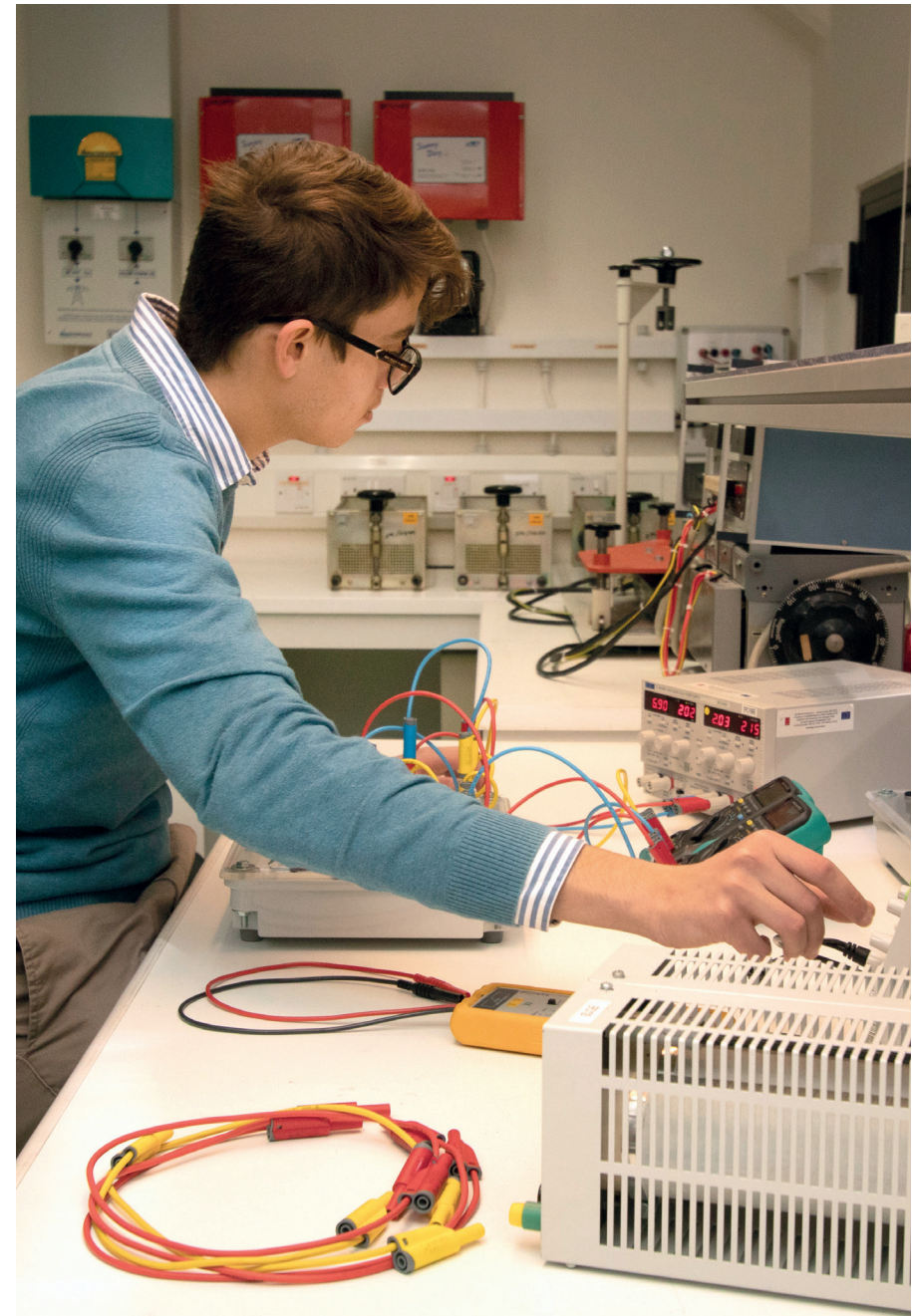
Either

have obtained a minimum of 36 points in examinations taken as part of the Matriculation Certificate and be in possession of passes in the Secondary Education Certificate Examination at Grade 5 or better in **English Language, Maltese and Mathematics** together with a pass at Advanced Matriculation Level in one of the following subjects: **Applied Mathematics, Chemistry, Computing, Engineering Drawing, Graphical Communication, Information Technology, Pure Mathematics, Physics** or other science/numeric subjects as approved by the Faculty Board;

or

be in possession of a diploma in an engineering domain which the Board deems as appropriate, classified at MQF Level 4, as well as passes in the SEC Level at Grade 5 or at SEC Level 3 or better in **English Language, Maltese and Mathematics**.

Applicants may be required to attend for an interview to assess whether they have the necessary aptitude to follow the Course with profit.



Registration
Human Resources
Legal
Accounting
Finance
Marketing
Publicity
Production
Research
Business
Development
Engineering
Manufacturing
Planning

Section 1

Biomedical Engineering

Decoding Blinks: Investigating Vision-based Eye-Tracking and EOG Methods for Blink Detection and Characterization

Student: **Matthias Muscat**
Supervisor: **Prof. Inġ. Tracey Camilleri** | Co-Supervisor: **Dr Inġ. Nathaniel Barbara**

What is your project about?

Blinks occur naturally about 15-20 times per minute, yet these seemingly simple eyelid closures carry vital information about our health and focus. This project analyses the characteristics of different types of blinks, such as spontaneous blinks, double blinks, reflex blinks and cued blinks. These blinks are recorded through two different modalities: one based on electrical signals recorded using electrodes attached around the eyes, known as electro-oculography (EOG), and another based on video recordings of the eyes recorded through wearable glasses, known as video-oculography (VOG). Automatic blink-detection methods are also implemented and compared. Robust detection of blinks could be used in real-world applications including driver fatigue monitoring, human-computer interaction, and medical diagnostic assessments.

Why are you working on this project?

I chose this project because it aligns closely with my engineering interests in bio-signal processing, data analysis and human-centred technology. I was drawn to the idea of working on a project focusing on eye activity because blinking, although a seemingly simple subconscious action, can provide valuable insights into an individual's cognitive load, attention levels and fatigue.

This intersection of physiological data analysis and practical engineering applications makes this project both technically engaging and meaningful in practice. Beyond the laboratory, accurate blink detection plays a critical role in safety and healthcare applications, including monitoring driver and machine operator fatigue, supporting assistive technologies and enabling medical diagnostic assessments.

Hence, this project contributes to the advancement of intelligent sensing systems that have a direct impact on public safety and quality of life. Overall, this project provided an opportunity to apply engineering principles to a problem with clear and tangible, real-world benefits.



Computational Analysis of Carotid Haemodynamics with Increasing Atherogenesis

Student: **Jacob Mifsud**
Supervisor: **Prof. Inġ. Christopher Micallef**

What is your project about?

Certain vascular diseases are known to produce organic deposits on arterial walls, narrowing blood vessels such as the carotid artery in the neck and constricting blood flow. Medical practitioners must decide if and how to intervene before a stroke occurs. This project investigates how different degrees of narrowing alter the way blood flow behaves through the carotid artery and its branching vessels, and how the physical interpretation of such changes relate to the severity of this disease. Through the use of Computational Fluid Dynamics (CFD) simulations of blood flow in idealised arterial geometries with increasing plaque build-up, the study evaluates key fluid dynamic quantities such as wall shear stress (WSS) and flow patterns that may be interpreted as indicators of risk. The aim is to identify flow-based criteria that could support and refine existing clinical grading methods for carotid disease, highlighting a direct link to prognostic practices.

Why are you working on this project?

Carotid artery disease sits at the intersection of fluid mechanics and medicine, seeing as it is provenly driven by subtle changes in blood flow. The serious consequences of such an illness are highly visible in stroke statistics and long-term disability. Clinically, decisions regarding surgery are still mainly guided by how narrow the vessel appears through hospital imaging, even though two patients with similar stenosis grades can experience very different flow conditions and risks. This project was chosen to explore this gap by combining an interest in biomedical engineering with CFD numerical software, using systematic engineering rationale to quantify how plaque build-up alters the fluid flow behaviour within this specific vascular region. By linking these fluid dynamic measures to the approaches of current prognostic frameworks, the work aims to create a foundation of advanced simulations being made more accessible to clinicians and, in a long-term perspective, contribute to more patient-specific and timely treatment decisions for people at risk of stroke.



Design of a novel wearable device to manage overactive bladder

Student: **Zahida Parnis**

Supervisor: **Prof. Ing. Philip Farrugia** | Co-Supervisor: **Prof. Ing. Owen Casha**

What is your project about?

Overactive Bladder is a condition that can significantly affect a person's quality of life. This project focuses on developing a small, body-worn medical device to monitor symptoms related to Overactive Bladder (OAB) throughout daily activities. The device is designed to provide real-time tracking and data analysis by utilising integrated sensors that communicate results to the user or urologist. By combining thoughtful design, accurate sensing technology, and suitable materials, the device supports ongoing symptom monitoring without causing irritation or interfering with the user's routine. The overall aim is to create a discreet, reliable, and comfortable solution that can withstand continuous use while helping individuals better understand and manage their condition.

Why are you working on this project?

Overactive Bladder (OAB) affects approximately 20% of the population, spanning over a wide range of ages and impacting both men and women. Despite the large number of individuals living with OAB, the tools available to monitor symptoms are often limited, inconvenient, or uncomfortable to use. I was motivated by the challenge of designing a device that is not only medical useful, but also meets the practical requirements of being comfortable, discreet, and easy for people to integrate into their daily lives.

This design project brings together several areas I enjoy, which include product design, materials engineering, and medical technology, while allowing me to create something that can genuinely help users better understand their condition. Wearable health devices are becoming increasingly important in modern healthcare, offering several advantages over traditional methods. In this case, the technology provides more accurate and reliable information than manual symptom logs and enables secure, continuous monitoring throughout the day. My goal is to contribute to a future where health tracking is more accessible, user-friendly, and supportive of personalised care.



A conceptual image with a blue monochrome palette. A human hand is shown from the bottom, cupping a glowing, wireframe globe. A network of white lines connects several 3D cube icons, each featuring a padlock symbol. These cubes are distributed around the globe, suggesting a global network or data flow. The background is a dark blue gradient with faint, abstract patterns.

Section 2

Artificial Intelligence

AI Model for Fraud Detection in Blockchain Transactions

Student: **Sebastian David Aquilina**
Supervisor: **Dr Ing. Luana Chetcuti Zammit**

What is your project about?

The rapid proliferation of fraudulent activity on the Ethereum blockchain has driven growing demand for automated detection systems capable of identifying malicious addresses in real time. This dissertation presents the design, implementation, and evaluation of a real-time fraud detection system that employs a three-model weighted ensemble. The ensemble is deployed within a web application that scores live Ethereum addresses as transactions occur, supported by a four-tier degradation architecture that ensures continuous operational availability.

Why are you working on this project?

I chose this area because fraud on blockchain platforms creates real financial losses for users and undermines trust in decentralised systems, driving demand for practical detection tools that work beyond laboratory conditions. The system was trained on a dataset of 9,841 Ethereum addresses and, on the holdout test set, achieved an AUC-ROC of 0.9983 and an F1-score of 0.9803, exceeding performance reported for more complex deep learning architectures in the existing literature. However, a comprehensive six-part evaluation revealed significant discrepancies between holdout and live performance, with recall on known fraud addresses reaching only 16.7% at the holdout-optimal threshold, exposing limitations for operational deployment. The principal contribution of this work lies in demonstrating that algorithmic diversity through combining sequential boosting, parallel bagging, and isolation-based anomaly detection can substitute for architectural complexity, while providing an honest assessment of the gap between academic evaluation metrics and operational deployment realities.



Deep Learning Prediction of Cardiac Pathologies for Cardiovascular Risk Stratification

Student: **Benjamin Buttigieg**
Supervisor: **Dr Kenneth Scerri** | Co-Supervisor: **Dr Liam Butler**

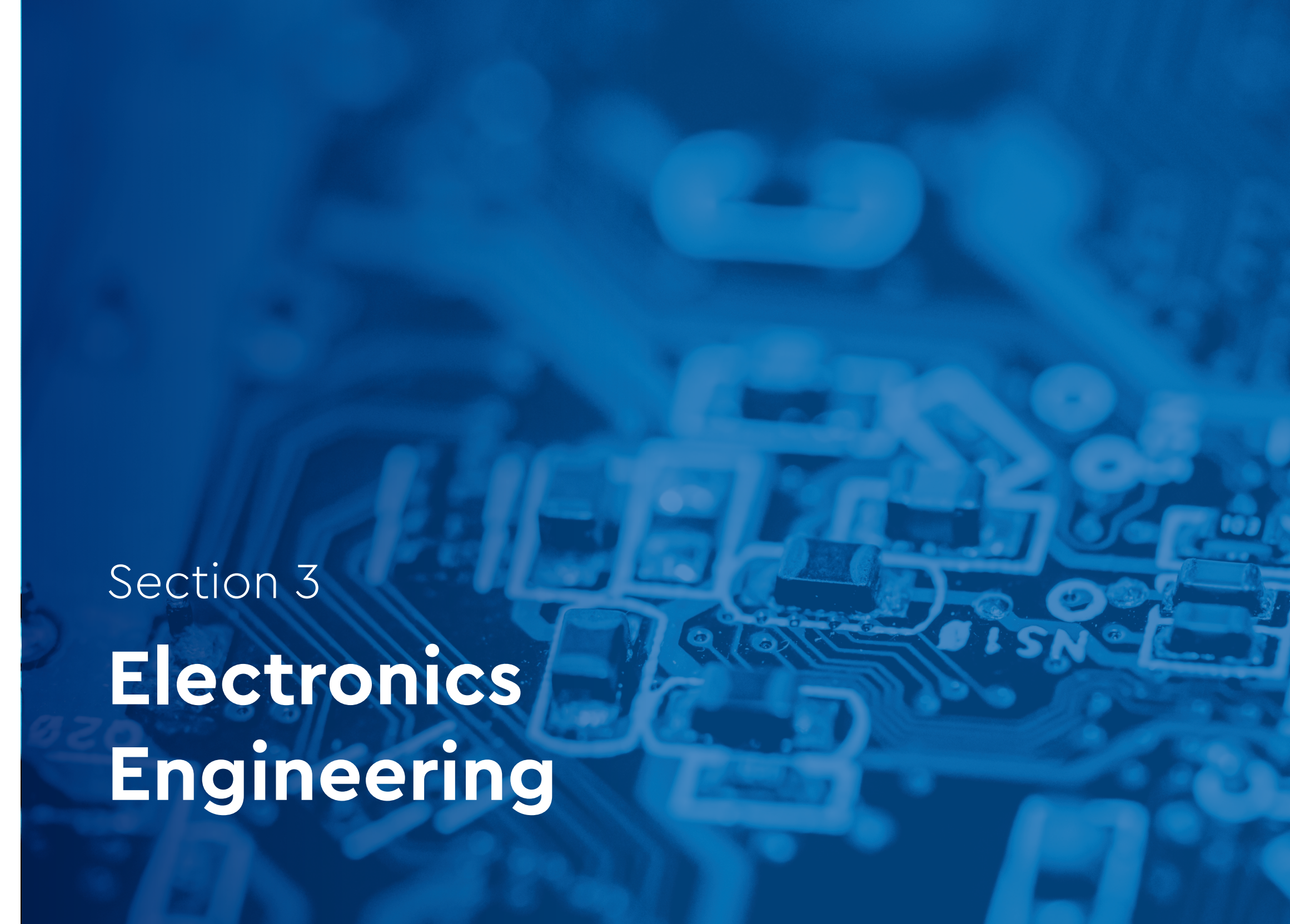
What is your project about?

Cardiovascular disease ranks among the main causes of mortality globally and is becoming more common because of health and lifestyle factors. This project focuses on creating Artificial Intelligence (AI) tools that can analyse heart signals (ECGs) to help identify people who may be at high risk of serious heart conditions such as heart attacks or heart muscle enlargement. By training artificial intelligence systems using existing medical data, the project aims to support earlier detection and prevention. It also examines if simpler heart recordings from smartwatches, particularly Apple Watches, can provide medical insights equivalent to medical equipment. The overall goal is to make heart risk screening more accessible, faster, and easier for everyday use.

Why are you working on this project?

I chose to work on this project because of my strong interest in Artificial Intelligence, particularly in deep learning, machine learning, and data science applications, which have been my main areas of focus. This project allowed me to connect AI with signal processing and medical applications, giving the work a clear purpose and real-world significance. Cardiovascular diseases affect a large number of individuals globally and are of great significance to society, highlighting the crucial need for early detection and prevention. The opportunity to investigate how computer systems can analyse heart signals to detect high-risk patients motivated me to work on a topic that could contribute to more accessible and efficient healthcare solutions. I was also interested in investigating how modern wearable technologies, such as smartwatches, could assist in medical screening outside traditional hospital environments. Overall, this project combined my technical interests with the chance to address a significant problem that can benefit the general public.





Section 3

Electronics Engineering

Radio-nuclide Detection for Solid State Gamma Spectrometer

Student: **Gianluca Galea**
Supervisor: **Prof. Ing. Marc Anthony Azzopardi**

What is your project about?

This project aims to build a system capable of identifying certain types of radioactive materials through certain characteristics of the radiation they emit, in a compact and low-cost package. This requires the use of a highly sensitive light detector, as well as the creation of analogue and digital electronics, and software capable of interpreting the data collected in order to identify radioactive materials.

This project builds on the work of a previous student, Mohammed Alouzi, and seeks to simplify, compact, and improve the hardware and software he had designed, allowing for different radioactive materials to be easily distinguished with minimal effort from the user.

Why are you working on this project?

I chose to work on this project as I wanted to improve my knowledge of electronics and software through practical application, and this project required various skills including digital and analogue electronics, PCB design, embedded software, digital communication, and application development. Hence, this project offered a challenging environment where I was able to push my limits and learn new skills and improve old ones. The project also has strong ties to physics, and specifically nuclear physics, a field I have a great personal interest in.

The system developed over the course of this project has applications in a wide variety of fields, from identifying the sources of cosmic rays, to analysing the composition of geologic samples, to environmental monitoring and identifying potentially hazardous materials.



Section 4

Engineering Mechanics & Structural Integrity

Structural Integrity Phenomena for Nuclear Fusion Component Design

Student: **Benjamin Mifsud**
Supervisor: **Prof. Ing. Pierluigi Mollicone**

What is your project about?

This project investigates some aspects of how structural components in nuclear fusion reactors respond to the intense and repeating stresses they experience during operation, start up, and shutdown. Various structural integrity phenomena can occur under such conditions. This study focuses specifically on shakedown and ratchetting. Shakedown is a behaviour where the material, initially loaded with some cycles, eventually reaches a stable state and no longer undergoes permanent deformation. In contrast, ratchetting involves the continuous accumulation of deformation during each cycle, which can eventually lead to structural failure. The work involves creating an analytical framework to predict these responses and identify the limits of structural stability. These predictions are then tested through an experimental mechanical characterisation procedure designed to assess material samples. Computational models are also used to assess stability under representative cyclic loading.

Why are you working on this project?

Nuclear fusion has the potential to provide nearly limitless clean energy, but the machines required to create it must withstand a harsh environment. Ensuring the structural integrity of reactor components is a fundamental requirement for the operational safety, longevity, and economic viability of future fusion power plants. The study investigates a framework for assessing material behaviour through a combined approach involving analytical, experimental, and computational methods. By synthesising physical testing with numerical analysis, the work offers a detailed comparison of different assessment techniques. Furthermore, the computational framework provides the flexibility to potentially explore additional loading scenarios, such as the influence of thermal loads, which are difficult to replicate in a purely mechanical experimental setup. This approach establishes a foundation for future research and structural assessment strategies in high-performance energy environments.



Assessing the Structural Integrity of Marine Bollards

Student: **Francesca Mifsud Cremona**
Supervisor: **Prof. Eur. Ing. Martin Muscat**

What is your project about?

Mooring bollards are essential fixtures in every port and marina, yet they are often taken for granted or treated as simple components until a failure occurs. Despite their critical role, they frequently face failures like baseplate cracking or bolt pull – out. These failures are normally the results of underestimated loads. This project used advanced computer simulations (FEA) to move beyond simple design rules and perform a more in-depth structural integrity assessment of marine mooring bollards. By comparing 200t and 300t rated bollards under extreme 294t pulls, the project evaluates whether smaller designs are sufficient or if larger models are necessary to be able to secure a vessel in a port. The study also investigates how the Mediterranean Sea climate and repetitive loading affect long – term durability, providing an engineering basis for choosing the most efficient and reliable mooring equipment.

Why are you working on this project?

I chose this project since personally I have a significant interest in the maritime industry. This led me to notice that marine mooring bollards, are often overlooked as simple components which one can just install with minimal considerations. I am particularly interested in the challenge of value engineering, to find the balance where a design is structurally sound enough to prevent catastrophic failure but not so oversized that it creates unnecessary expense.

This research serves an important public interest by addressing the silent risks associated with modern massive ships entering our harbours daily. Since bollards are the primary link between the vessel and the land, their failure can lead to catastrophic accidents, including personnel injury or environmental disasters like oil spills. By applying advanced engineering checks to predict the failure of mooring bollards, this project moves towards a future of zero – failure infrastructure. Ultimately, this work is about safeguarding our coastlines and protecting both the people who work in our ports and the maritime environment we all share.



Mechanical Design, Analysis and Testing of a Monolithic FDM Motion-Reduction Compliant Mechanism

Student: **Jake Camenzuli**
Supervisor: **Prof. Ing. Claire Muscat-Fenech**

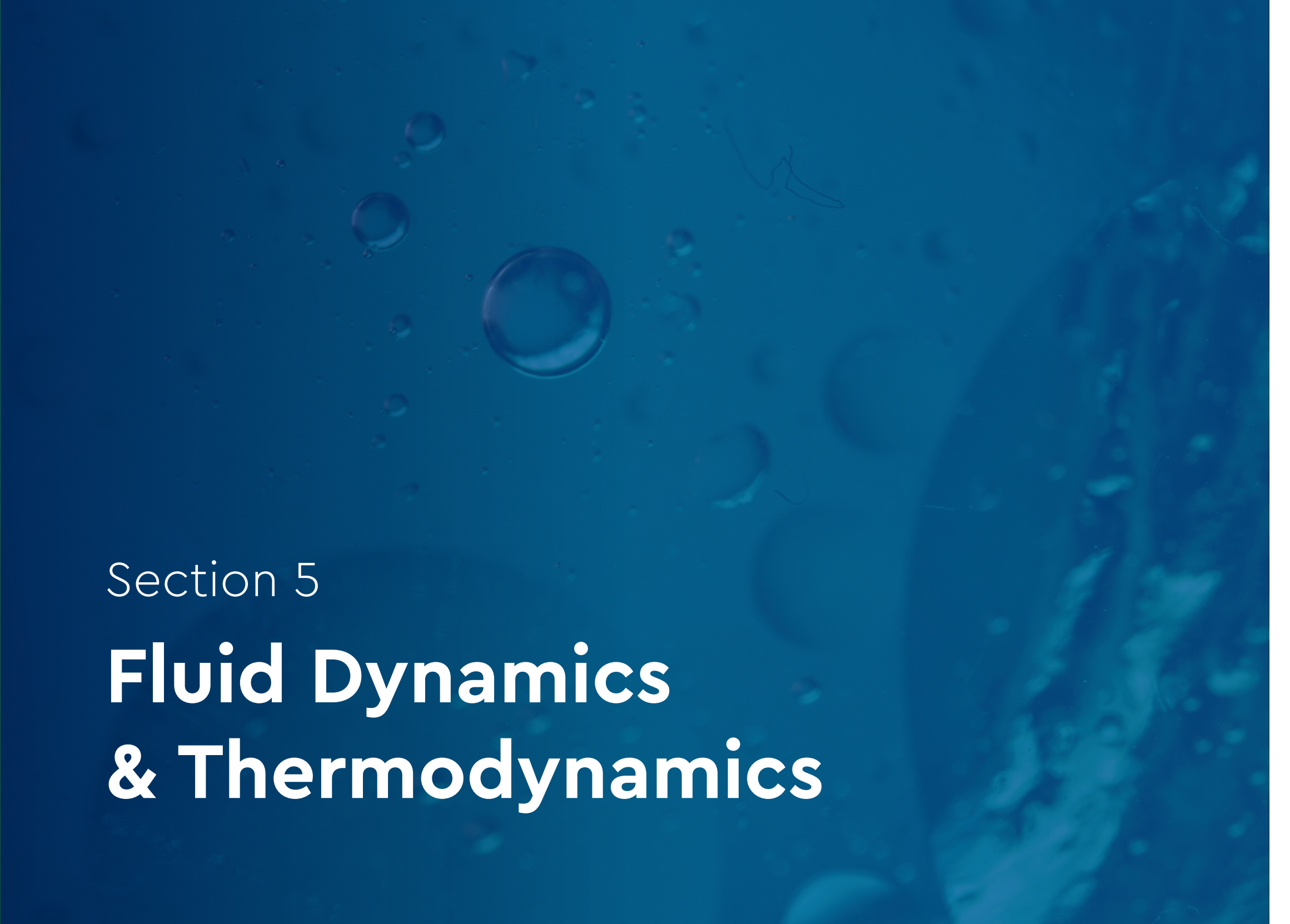
What is your project about?

Most precision mechanisms that reduce or convert motion rely on assemblies of rigid parts — gears, hinges, and pins — that introduce friction, wear, and manufacturing tolerances. This project investigates whether a single, jointless 3D-printed plastic part can replace such assemblies by flexing elastically to produce controlled, reduced motion. Using computer simulation and analytical modelling, a compliant mechanism is designed and fabricated as one piece on a standard FDM printer, paired with a small displacement sensor serving as a case study. The aim is to establish a reliable mechanical design process for this type of structure, applicable wherever low-cost, precise motion control is needed.

Why are you working on this project?

Throughout my degree I developed a strong interest in finite element analysis and additive manufacturing — this project offered a direct opportunity to apply both in a context where their interaction is itself the research question. Compliant mechanisms have been studied for decades in precision engineering, yet systematic design guidance for FDM-fabricated variants at macro scale remains scarce, making the work both timely and relevant. FDM is no longer a niche technology; it is fast, low-cost, and accessible to hobbyists and small teams, meaning a validated workflow developed here could be adopted far beyond an academic setting. Combined with the open-source potential of both the methodology and the printed designs, this work could democratise access to precision motion control for researchers and engineers without specialist manufacturing facilities. Replacing multi-part machined assemblies with a single printed component also reduces material waste and production complexity — benefits applicable across robotics, instrumentation, medical devices, and any compact motion-control application.



The background of the slide is a close-up photograph of water droplets on a blue surface. The droplets are of various sizes, with some being large and in sharp focus, showing internal reflections. Others are smaller and blurred in the background. The overall color palette is a range of blues, from deep navy to lighter, hazy tones where the droplets are out of focus.

Section 5

Fluid Dynamics & Thermodynamics

A Numerical Investigation of the Pressure Losses across Hydraulic Coaxial Valves

Student: **Iven Said**
Supervisor: **Prof. Inğ. Tonio Sant** | Advisor: **Dr Inğ. Luke Aquilina**
Academic Partner: **FLASC B.V.**

What is your project about?

Valves are essential components found in countless systems, from industrial machinery and water networks to aircraft and power plants yet every time a fluid passes through one, energy is lost to friction and turbulence. Understanding and minimising these losses is important for improving the efficiency of such systems. This project analyses a coaxial valve, a design where an internal moving part slides along the centreline of the pipe against a seat to open or close the flow. Using computer-based fluid simulations, pressure losses were investigated across multiple conceptual seat designs and under different operating conditions, with the aim of better understanding and improving the performance of the coaxial valve with each design.

Why are you working on this project?

Fluid mechanics has always been an area of engineering that I find genuinely interesting, particularly how fluid behaviour governs the performance of real systems. Valves may seem like simple components, but their design has a direct impact on how efficiently a system operates. The connection between small design choices and larger system performance is what drew me to this topic. Furthermore, the coaxial valve is a relatively modern design that has received limited attention in published research, presenting a real opportunity to contribute something meaningful in this field. From a broader perspective, improving valve efficiency has practical relevance across many industries, including manufacturing and renewable energy systems, where reducing energy losses translates directly into lower operating costs and a smaller environmental footprint. On a personal level, this project has allowed me to develop hands-on experience in computational fluid dynamics and numerical analysis, skills I intend to carry forward in my engineering career.



Experimental and Computational Investigation of the Aerodynamic Drag Coefficient of Padel Rackets

Student: **Gabriel Scerri**
Supervisor: **Dr Brian Ellul Grech** | Co-Supervisor: **Dr Jean-Paul Mollicone**

What is your project about?

My project explores how the design of padel rackets affects how they move through the air. Many padel rackets feature different hole patterns, which are believed to reduce air resistance and improve performance. However, there is limited understanding of how the number and placement of these holes actually influence airflow during a swing.

To address this, both computational simulations and experimental methods are used to analyse airflow around different racket designs. The study examines how variations in hole configurations influence drag forces acting on the racket. The aim is to identify which hole configurations allow the racket to move more efficiently, helping to improve swing speed and overall player performance.

Why are you working on this project?

I chose this project based on my personal interest in padel and my curiosity about how equipment design affects performance. As a player, I noticed that different rackets have varying hole patterns, which led me to question whether these differences are purely aesthetic or actually influence how the racket moves through the air. This observation motivated me to investigate the aerodynamic effects of these design variations.

This project also connects well with my interest in engineering and fluid dynamics, as it allows me to apply theoretical knowledge to a real-world scenario. In particular, it involves key principles such as drag force and airflow, which are fundamental in understanding how objects interact with moving air.

The findings are relevant not only to sports equipment design but also to broader engineering fields where reducing air resistance is important, such as in automotive and aerospace industries. By understanding how small design changes affect airflow, engineers can create more efficient and better performing products.



Experimental and Computational Assessment of a Parachute-Based Aerodynamic Decelerator for Atmospheric Descent

Student: **Julian Edward Pullicino**
Supervisor: **Dr Jean-Paul Mollicone** | Co-Supervisor: **Dr Brian Ellul Grech**

What is your project about?

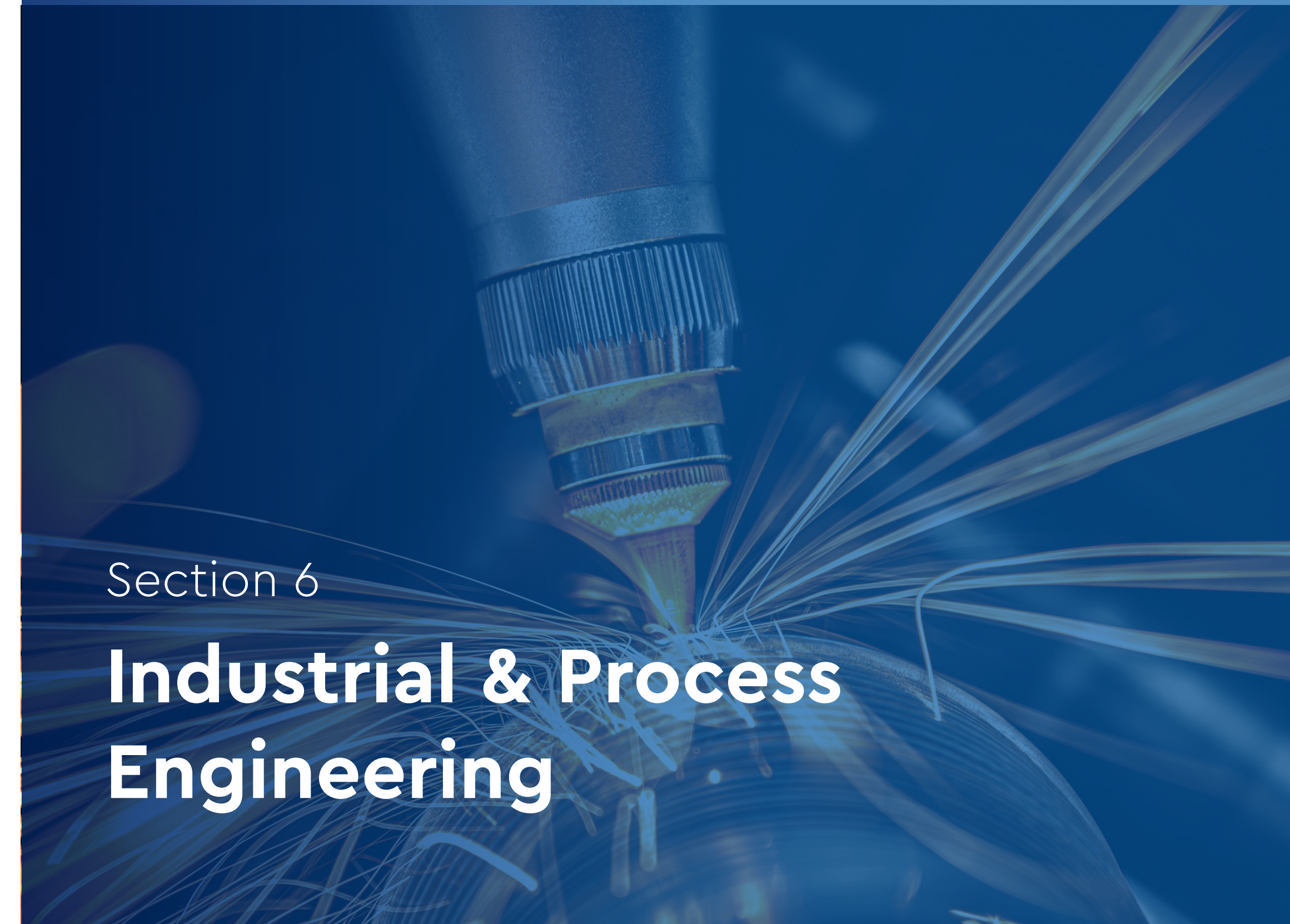
This dissertation investigates how parachute-based systems can be used to safely slow down objects returning to Earth from space. As small satellites and experimental payloads become more common, there is a growing need for simple and reliable recovery methods. The study examines how a parachute behaves at different velocities, focusing on the drag it generates and its ability to slow and stabilise descent. Analysis is carried out both for the parachute in isolation and with a capsule positioned upstream, to assess the influence of altered airflow. Both computer simulations and wind tunnel experiments are used to analyse behaviour under controlled conditions. By combining these approaches, the project aims to provide a clearer and more reliable understanding of system performance.

Why are you working on this project?

This project was chosen out of a long-standing interest in aerospace engineering and the broader space industry, driven by a fascination with space missions and the wider universe from a young age. Therefore, understanding how objects safely return to Earth presented both a complex engineering challenge and a meaningful application within this field.

Through initial research, it became evident to me that computational simulations and experimental testing are often treated separately, which can reduce the overall confidence in the results, as simulations may lack validation. This prompted a particular interest in assessing how closely numerical predictions can replicate real physical behaviour and in identifying discrepancies between the two approaches.



A close-up, high-contrast photograph of a welding torch tip in the process of welding a metal joint. The torch is dark and metallic, with a series of fine, radiating lines of light emanating from the point of contact, creating a starburst effect. The background is a deep, solid blue, which makes the bright sparks and the metallic components of the torch stand out. The overall image has a technical and industrial feel.

Section 6

Industrial & Process Engineering

Optimising Moulding Parameters to Mitigate Wire Sweep in Semiconductor Packaging Using Design of Experiments (DoE)

Student: **Abdumhiman Shagruni**
Supervisor: **Dr Ing. Joseph Zammit** | Co-Supervisor: **Ing. Carlo Azzopardi**
Industrial Partner: **STMicroelectronics Malta**
Funded Project Name: **STMicroelectronics**

What is your project about?

This project focuses on improving the quality and reliability of semiconductor devices, specifically Quad Flat Packages (QFPs), by reducing a common semiconductor manufacturing defect known as wire sweep. Wire sweep occurs during the transfer moulding stage, where internal bonding wires may deform due to the flow dynamics of the encapsulating material, potentially leading to electrical failure or degraded device performance. The project adopts a structured Six Sigma DMAIC (Define, Measure, Analyse, Improve, Control) methodology to systematically identify, analyse and mitigate the root causes of this defect. In addition, Design of Experiments (DoE) is applied to quantitatively evaluate the influence of key moulding parameters and to determine the optimal conditions that minimise wire sweep. The outcome is a data-driven optimisation of the transfer moulding process, contributing to enhanced manufacturing yield, improved product reliability and reduced operational costs.

Why are you working on this project?

From a personal and professional perspective I chose this project due to its strong alignment with my interest in manufacturing engineering and process optimisation within an industrial context. The collaboration with STMicroelectronics Malta provided an opportunity to apply theoretical concepts, particularly within the Six Sigma DMAIC framework to real-world semiconductor manufacturing challenges. This experience has enabled the development of key competencies in data analysis, experiment design and systematic problem-solving, and process optimisation using DoE, which are essential within quality engineering domains. Furthermore, the project offers valuable insight into high-reliability manufacturing environments, reinforcing the importance of robust process control in industries where product performance is critical. Overall, the project represents a meaningful integration of academic knowledge and industrial practice, supporting both my professional development and contribution to improving manufacturing performance.



5-Axis Indexing Additive Manufacturing Towards Quasi-Isotropic Components

Student: **Luke Treeby Ward**
Supervisor: **Prof. Arif Rochman**

What is your project about?

This project focuses on improving 3D printing to create stronger and more reliable parts. Traditional 3D printers build objects by stacking flat layers, which makes the final product weak in certain directions, similar to how wood splits easily along its grain. This weakness, known as anisotropy, limits the use of 3D-printed parts in demanding industries.

To solve this, the project uses a 5-axis printer, which can tilt and rotate the part or the print head while printing. This allows the machine to lay down material in many different directions, "weaving" the layers together to ensure the part is equally strong from all sides. The goal is to make 3D-printed components more durable and more uniform in strength, opening up new possibilities for high-performance engineering.

Why are you working on this project?

I chose additive manufacturing because I've seen its potential firsthand. Having a 3D printer at home and used professional machines in the automotive industry to prototype designs, I realised how much the field is growing. I wanted to move beyond basic models and work on the cutting-edge future of printing.

This background led to my current focus which is solving the "weakness" of traditional prints by exploring 5-axis technology. I am driven by the challenge of developing smarter machines that can create stronger, more complex parts.

Ultimately, this research is relevant to both industry and the public because it makes 3D-printed parts as reliable as those produced by traditional manufacturing. By eliminating "weak spots," we can create durable components for sectors like aviation, automotive and medical. Furthermore, this approach eliminates the need for support structures and reduces material waste, making 3D printing more advanced, efficient, and sustainable.



Digital Light Processing Based Fabrication of Biomimetic Micro-Moulded Polymer Inserts for Antifouling Applications

Student: **Noel Busuttill**

Supervisor: **Prof. Ing. Pierre Vella** | Co-Supervisor: **Prof. Arif Rochman**

What is your project about?

Shark skin is covered with numerous dermal denticles, which are tiny tooth-like structures featuring micro-scale riblets, that have been widely studied for their ability to enhance antifouling performance by reducing bacterial adhesion and improving fluid-surface interactions. Inspired by this concept, this project investigated the biomimetic design and fabrication of shark skin-inspired surfaces, focusing on two specific geometries aimed at reducing fouling for medical applications. Digital Light Processing (DLP) was first used to rapidly fabricate mould inserts incorporating these micro-structures in a high-temperature resin, providing the necessary resolution and thermal stability for subsequent replication. These inserts were then integrated into a Micro-Injection Moulding (μ IM) system to produce a small batch of polypropylene (PP) parts containing the riblet features. Additionally, wettability analysis was conducted on the PP riblet structures to evaluate fluid-surface interactions and their influence on fouling.

Using this proposed experimental approach, enabled the investigation of how surface topography and manufacturing parameters affect dimensional accuracy of the inserts and the corresponding replicas.

Why are you working on this project?

Additive Manufacturing (AM), also known as 3D printing, is known for its fast, high-resolution, and cost-effective fabrication capabilities. Although this technology has advanced significantly in recent years, limited research has been carried out to explore the use of AM to produce shark-skin-inspired riblet designs for rapid tooling applications. Furthermore, this project integrates biomimicry, AM, rapid tooling, and Micro-Injection Moulding (μ IM) to address real-world engineering challenges. Shark skin provides a natural example of how surface structure alone can reduce biological adhesion without relying on chemical treatments. This is significant in biomedical applications, where reduced biological adhesion enhances performance and hygiene.

Digital Light Processing (DLP) and μ IM enable high-resolution fabrication. However, achieving accurate and repeatable features remains challenging due to material behaviour, geometry, and process constraints. Accordingly, this project evaluates the capabilities and limitations of these technologies in accurately replicating micro-riblet features. Furthermore, the thermal and mechanical performance of resin-based rapid tooling is a critical factor and was therefore analysed to ensure it withstands μ IM conditions. Consequently, by addressing these challenges, the final moulded parts were characterised for dimensional replication and antifouling performance.

Overall, this work shows my interest in using engineering to turn natural performances into practical, manufacturable solutions, while addressing key challenges in micro-scale fabrication.



An aerial photograph of a large oil tanker ship sailing on a deep blue ocean. The ship has a white upper hull and a red lower hull. It is moving from the top left towards the bottom right, leaving a white wake. The deck is visible with various structures, pipes, and a helicopter landing pad marked with a green 'H'. In the far distance, a range of low mountains is visible on the horizon under a clear sky.

Section 7

Maritime Engineering

Preliminary Design of a Cruising Catamaran

Student: **Alec Cini**
Supervisor: **Prof. Inġ. Clair Muscat-Fenech**

What is your project about?

The project involves the design of a sailing catamaran, a twin-hulled vessel intended for efficient and stable coastal cruising. The primary objective is to develop a vessel that achieves a balance between performance, safety, and onboard comfort. Key challenges include ensuring the vessel remains lightweight while still providing adequate living space and maintaining stability across varying sea conditions. The project addresses these issues by exploring design solutions that enhance efficiency and usability, ultimately aiming to produce a vessel that offers a safe, reliable, and enjoyable experience for users without compromising practicality.

Why are you working on this project?

I chose to work on this project because of my strong interest in naval and marine engineering, particularly in the design and performance of vessels. Ships play a vital role in transportation, tourism, and recreation, and I have always been interested in how their design influences efficiency, safety, and user experience. Designing a sailing catamaran allows me to apply engineering principles in a practical and meaningful way, combining technical problem-solving with creativity.

This project is also relevant to the wider public, as there is an increasing demand for more efficient and environmentally friendly modes of marine transport. Sailing vessels, in particular, offer a sustainable alternative by reducing reliance on fuel. By focusing on improving performance, efficiency, and comfort, this work contributes to the development of safer and more efficient vessels that can benefit both the needs of users and the maritime industry.



Preliminary Design of a Double Ended Electric Ro-Pax Ferry

Student: **Daniel Attard**
Supervisor: **Prof. Inġ. Claire Muscat-Fenech**

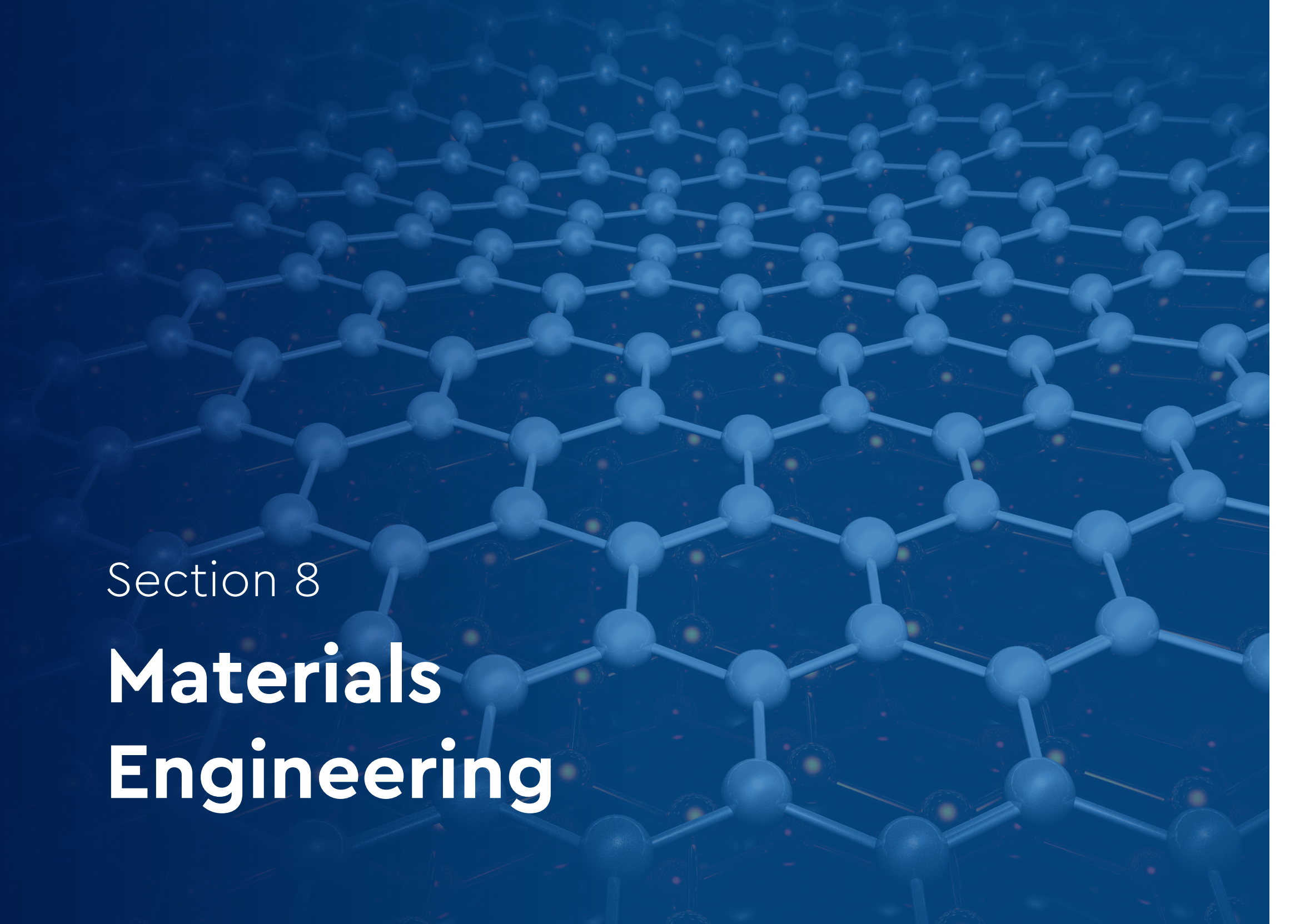
What is your project about?

The objective of this project is to generate a preliminary design of a double ended electric Ro-Pax ferry, with the intent of transporting passengers and motorbikes. The primary aim is that of exploring cleaner and more efficient modes of transport across the Maltese islands. Vehicles and passengers can embark and disembark from either end of the ferry, improving operational efficiency, reducing substantially the turnaround time in port. The focus on passengers and motorbikes rather than heavy vehicles is intended to encourage cleaner transportation options, whilst reducing traffic congestion and environmental impact.

Why are you working on this project?

The role of engineering in the ever evolving maritime industry has always been of interest to me. Major transitions in this field are on the rise due to the European Green Deal, which targets the maritime sector for decarbonisation and the push for green ferry technology. Another motive for this project is the need for a new inter-island transport link. Presently the only vehicle ferry route operates solely at the northern part of the island, and is reaching its saturation limit due to the growing population and traffic. The development of an electric ferry at a more central location, limited to passengers and motorbikes not only supports cleaner options, but also aims at relieving the traffic congestion in the northern part of the Maltese island and its sister island - Gozo, especially during peak times, whilst also contributing to a more environmentally friendly transportation system.





Section 8

Materials Engineering

Enhancing 3D-printed stainless steel: The impact of shot peening on the mechanical performance of aerospace components

Student: **Gilbert Abela**

Supervisor: **Prof. Inġ. Ann Zammit** | Co-Supervisor: **Prof. Inġ. Glenn Cassar**

Academic Partner: **Prof. Ing. Lars-Erik Rännar** and

Dr Stefan Roos, Mid Sweden University

Department of Engineering, Mathematics and Science Education

What is your project about?

This project investigates the enhancement of fatigue performance in 3D-printed stainless steel for use in aerospace components, such as structural brackets and fluid delivery systems. While metal additive manufacturing, such as Powder Bed Fusion, enables the production of complex geometries; the resulting parts are often susceptible to surface roughness, residual stresses and microstructural defects. These features compromise the fatigue performance of the additively manufactured material under repeated loading. This research focuses on shot peening, a post-processing surface treatment, where fine spherical particles are accelerated onto the surface of the material, reducing surface roughness and inducing compressive stresses. The study aims to evaluate the material's resistance to crack initiation and failure, thereby enhancing reliability and component durability in real-world applications.

Why are you working on this project?

This project is driven by the advancement of additive manufacturing in modern engineering, especially in specialised industries such as aerospace where weight reduction, high performance and reliability are paramount. The limitation in fatigue performance currently restricts the widespread adoption of this technology in safety-critical applications. Hence, it is essential to address this challenge in order to realise the full potential of metal additive manufacturing.

I chose to contribute to this field as it is a newly emerging form of technology, offering scope for innovation and significant improvements to be made. The opportunity to contribute to an actively developing area of engineering is motivating, especially with a strong interest in understanding how surface treatments can improve material characteristics. I found this area of study very interesting, with the findings from this research expected to contribute to the industry by supporting the development of stronger and more reliable components. Ultimately, this research promotes safer and innovative engineering solutions for modern society.



Development of PVD Coatings for Enhanced Dry and Near-Dry Machining Applications

Student: **Kieran Axisa**

Supervisor: **Prof. Inġ. Glenn Cassar** | Advisor: **Dr Andre Giordimaina**

What is your project about?

This research aims to extend the performance and lifetime of cutting tools used in machining through the development of advanced Physical Vapour Deposition (PVD) coatings. In modern manufacturing high temperatures and friction cause rapid tool wear, a challenge traditionally managed by costly and environmentally detrimental lubricants. This study investigates sustainable alternatives by developing and characterising thin-film coatings such as titanium nitride (TiN), chromium nitride (CrN), and titanium chromium nitride (TiCrN). By evaluating these coatings under dry sliding-wear conditions, the project seeks to optimise surface durability and eliminate industrial reliance on conventional cooling fluids, fostering more eco-friendly manufacturing processes.

Why are you working on this project?

This project is driven by the growing demand for more sustainable manufacturing processes. Traditional machining relies heavily on cutting fluids, which increase operational costs and pose environmental and health risks. Transitioning to dry or near-dry machining offers clear benefits but introduces challenges such as increased tool wear and thermal degradation. From a personal perspective, this topic involves materials and surface engineering technologies, both of which I find fascinating. More specifically, I have a particular interest in understanding how microstructural design and processing parameters influence real-world performance and optimising them. The project also provides hands-on experience with advanced coating techniques and characterisation methods, bridging theoretical knowledge with practical application. Crucially, developing the specialised know-how to operate advanced PVD equipment within Malta is of strategic importance. Establishing this local expertise ensures that high-end surface engineering can be performed domestically, supporting regional industrial growth and reducing reliance on external facilities.



Effect of Shot Peening on the Mechanical and Corrosion Performance of Components for Marine Applications

Student: **Claire Refalo**
Supervisor: **Prof. Ing. Ann Zammit**

What is your project about?

This project investigates how a surface treatment called shot peening affects materials used in marine environments, focusing on a small boat's propeller shaft, exposed to saltwater and constant mechanical stress. Two materials are studied: AISI 316L stainless steel, widely used in marine applications and 4140 steel as a potential alternative.

The aim is to understand whether shot peening improves durability or unintentionally reduces resistance to impact and corrosion. Marine components often fail due to repeated cyclic loading, leading to fatigue failure over time. While shot peening improves the fatigue life by strengthening the surface, this study explores whether such improvements may negatively influence other properties.

Why are you working on this project?

I chose to work on this project because I am interested in how engineering materials perform in real-world environments, especially harsh ones like the sea. Living in Malta, where we are surrounded by the sea, has made me more aware of how important marine structures and components are in everyday life, from small boats to larger maritime systems.

Marine components are constantly exposed to saltwater and repeated mechanical loading, making them highly prone to degradation and failure. Understanding how to improve durability is a both meaningful engineering challenge. While shot peening is widely used to improve the fatigue life, its effects on other important characteristics, like corrosion resistance and impact toughness is not fully understood, making it an interesting area to investigate.

This work is relevant because improving the lifespan of marine components can reduce maintenance costs, prevent unexpected failures and increase safety. It also contributes to more sustainable engineering by reducing material waste and the need for frequent replacements.



Effect of Ammonia Flow Rates on the Performance of the Nitriding Process

Student: **Nathan Spiteri Hogan**
Supervisor: **Prof. Ing. Maurice Grech**

What is your project about?

Gas-Nitriding is a thermochemical case-hardening process in which nitrogen is diffused into the surface of metal parts, improving their tribological and mechanical properties. When carried out on steel parts two distinct layers are formed. These are the compound (white) layer, which consists primarily of Iron-Nitrogen compounds, and the diffusion zone which consists of diffused elemental nitrogen, and nitrogen compounds which form with the steel's alloying elements. These two layers increase the hardness and wear-resistance of the steel without incurring large dimensional changes, making gas-nitriding an ideal process to be used in industrial applications where strict dimensional tolerances are required. In gas-nitriding, Ammonia gas is supplied into the nitriding furnace and heated to be utilised as the source of nitrogen. Therefore, the main objectives of this project were to understand how changes to the Ammonia flow rate throughout the process would affect the resultant material properties, and to use this information to optimise the nitriding parameters and gas usage of the process implemented by the University of Malta.

Why are you working on this project?

The Department of Metallurgy and Materials Engineering at the University of Malta specialises in case-hardening techniques such as gas-nitriding, and as such this project presented an opportunity to carry out research without any obvious obstacles due to being equipped with all the necessary facilities and knowledge required from the get-go. Additionally, the area of research builds upon the theoretical knowledge that was accumulated throughout numerous assignments throughout the course of my studies, as well as the work which was carried out during my student-internship placement at the University of Malta, making this project feel like the most logical natural progression to conclude my undergraduate experience. Finally, the project presented an opportunity to make a tangible and lasting contribution to the Department of Metallurgy and Materials Engineering by aiding to optimise the nitriding processes they carry out, thus aiding the lecturing and lab staff whom I owe a great deal in shaping my time as an engineering student.



Investigating the degradation processes affecting gaskets in modern Diesel IC Engines

Student: **Jacob Gafa Craus**
Supervisor: **Prof. Ing. Stephen Abela**

What is your project about?

My project investigates one of the most frequent issues that occurs in car internal combustion engines (ICEs), which is the leakage of oil. This mainly occurs from gaskets, which are small but crucial components used to seal two parts together and allow fluids to flow without leakage. However, gaskets are exposed to high temperatures, pressures and chemical reactions from modern fuels and lubricants, potentially causing them to fail over time. Such failures lead to the engine working less efficiently, increasing maintenance times, and potentially breaking down. My project is meant to analyse the root of these problems, identify them and compare different parameters to better understand what accelerates the deterioration of the gasket and how this can be improved.

Why are you working on this project?

I chose to work on this project as I am interested on the reason why many individuals, including myself, observe an increased frequency of oil leakages from modern car engines. As car manufacturers currently focus more on environmental friendliness and performance enhancements of their engines, smaller parts like gaskets and their compatibility with modern fuels and lubricants are often neglected despite the critical role they play. Their premature failure can lead to significant mechanical issues, and it is not uncommon for current owners to sell or scrap their modern cars after a few years, relative to older cars which would typically function for a few decades.

This work is relevant to the public as it directly analyses everyday vehicle reliability. By identifying the root causes for such premature failures, it offers the potential to improve the reliability of modern engines, reducing repair frequency and maintenance costs, as well as extending the engine lifespan by a significant margin. Such improvements contribute heavily to the sustainability of cars and the reduction of material consumption.



Development and Evaluation of Biodegradable Calcium Phosphate/PLA Coatings for WE43 Magnesium Alloy Bone Substitutes

Student: **Bernard Pullicino**
Supervisor: **Prof. Ing. Bertram Mallia**
Co-Supervisor: **Prof. Daniel A. Vella**

What is your project about?

The project entails the development of dual-layer coatings applied on a wrought WE43 magnesium alloy, with the aim of retarding the onset of corrosion for use as a biodegradable bone implant. Calcium phosphate (Ca-P) coatings are used to slow corrosion in physiological conditions while introducing calcium and phosphorous to promote bone regeneration. Different Ca-P chemical conversion treatments produce phases with varying solubilities, enabling controlled degradation rates tailored to different healing times. An additional biodegradable PLA coating is applied for more controlled degradation over a period ranging from several weeks to months, supporting the implant until complete bone regeneration occurs.

Why are you working on this project?

Bone is the second most transplanted tissue worldwide, with approximately 1.71 billion people suffering from musculoskeletal conditions and 2.2 million bone grafts performed annually. While bone tissue can naturally self-regenerate, larger defects exceeding a critical threshold require surgical intervention and implantation. Magnesium-based implants offer a promising solution due to their biodegradability; however, their rapid corrosion in physiological environments can lead to premature mechanical failure. Although WE43 magnesium alloy exhibits improved corrosion resistance due to its alloying elements, further surface engineering is required to delay degradation until sufficient bone healing has occurred.

This project investigates the use of calcium phosphate coatings to extend the corrosion resistance of the implant while simultaneously providing the elements necessary to promote bone tissue formation. The addition of a biodegradable polylactic acid (PLA) layer is intended to further control degradation, allowing the implant to retain structural integrity during the early stages of healing before gradual degradation after approximately 6 weeks. This approach aims to reduce the need for secondary surgeries and improve patient outcomes.



Empirical Process Development for High-Performance Laser Powder Bed Fusion

Student: **Emma Grant**

Supervisor: **Prof. Ing. Glenn Cassar** | Co-Supervisor: **Prof. Ing. Ann Zammit**

Academic Partner: **Dr Stefan Ross, Mid Sweden University – Department of Engineering, Mathematics and Science Education**

What is your project about?

This project focuses on developing a reliable printing procedure for producing 316L stainless steel components using Laser Powder Bed Fusion (L-PBF), a form of metal 3D printing. To achieve this, specimens produced using L-PBF are compared with those made using Electron Beam Powder Bed Fusion (EB-PBF), as well as with conventionally manufactured (wrought) 316L stainless steel. The study also examines how factors such as build orientation (horizontal vs vertical) and laser power influence strength and toughness. By understanding these effects, the project seeks to optimise printing conditions for stronger, more dependable components.

Why are you working on this project?

I chose this project because metal additive manufacturing is an extremely interesting and rapidly evolving field that is transforming how complex components are designed and produced. Technologies like L-PBF enable the creation of fully dense metal components with intricate geometries, built layer by layer from powder, beyond the capabilities of conventional manufacturing. This makes the field both innovative and highly relevant to modern engineering challenges.

What makes this project particularly engaging is its hands-on nature, involving working directly with advanced equipment, from machine preparation and powder handling to process parameter optimisation and component analysis. What I find particularly fascinating is how slight variations in process parameters, such as laser power and build orientation, influence mechanical performance and microstructure. Developing a deeper understanding of this relationship is key to producing highquality printed components with improved performance. This research contributes to improving manufacturing quality in industries such as aircraft components and biomedical surgical implants, where performance and consistency are critical.



Investigating the Influence of Precursor Concentration on the Compressive and Piezoresistive Behaviour of rGO Aerogels

Student: **Neil Sultana**

Supervisor: **Dr Ing. Anthea Agius Anastasi**

Co-Supervisor: **Prof. Daniel A. Vella**

What is your project about?

This project focuses on the development of reduced graphene oxide (rGO) aerogels, which are considered the world's lightest solid material. rGO aerogels are highly porous materials made of carbon sheets only a few atoms thick. A first step in making rGO aerogels starts with a dispersion of graphene oxide in water. The dispersion then gels into a hydrogel. The hydrogel is frozen rapidly in liquid nitrogen and then dried under a vacuum to produce the aerogel. One of the main objectives of this project is to make these aerogels stronger and more useful in various applications. The outcomes of this project include assessing the mechanical behaviour of the aerogel when compressed, while simultaneously measuring its electrical conductivity. These properties would help investigate how the material could be used, for example, as a sensor to feel very small changes in pressure, such as heartbeats or blood flow.

Why are you working on this project?

I am working on this project because of my interest in how materials behave at the scale of atoms and molecules. In particular, researching materials such as graphene is very interesting due to its extremely low weight and very high strength. These aerogels act as a transition between the nanoscale and a 3D object that can be applied to various needs in many industries. By investigating the compression and electrical behaviour of this material, I am helping to move the rGO aerogels from a laboratory experiment into a material used to solve real-world problems. These rGO aerogels could be used as pressure sensors that could be the newest method for non-invasive health monitoring, utilising the ultra-lightweight properties of the aerogels to detect any cardiovascular issues without the need for any bulky hospital equipment. This material could also be used to sense small changes in public infrastructure, such as bridges or aircraft wings, showing changes before they are visible to the human eye.



Characterisation of Calcium Phosphate Conversion Coatings on Additively Manufactured WE43 Magnesium Scaffolds

Student: **Ilaria Tabone**

Supervisor: **Prof. Ing. Joseph Buhagiar** | Co-Supervisor: **Prof. Daniel A. Vella**

Industrial Partner: **Mater Dei Hospital, Southeast University and Jiangxi University of Science and Technology**

Funded Project Name: **OsteoMag-3D**

What is your project about?

This project investigates the application of calcium-phosphate conversion coatings on biodegradable, 3D-printed magnesium alloy scaffolds used as bone substitutes in orthopaedic applications. These orthopaedic scaffolds serve as temporary support structures and feature complex internal architectures, such as Gyroid and Voronoi designs, which are intended to mimic the mechanical behaviour of natural bone and promote tissue integration. The primary aim of the coating is to control the rapid degradation of magnesium, ensuring that the scaffold provides sufficient mechanical support during the healing process before safely dissolving in the body. While calcium-phosphate coatings have previously been successfully applied to flat samples, this project extends the technique to intricate 3D-printed geometries. Overall, this research contributes to the development of next-generation, patient-specific biodegradable implants.

Why are you working on this project?

I chose to pursue this project because of my strong interest in the intersection of materials science, additive manufacturing and biomedical engineering. These fields are fundamentally redefining modern medicine, steering it toward a future of highly personalised healthcare, tailored to individual patient anatomy. I have always been fascinated by how engineering can be used to improve people's quality of life. In particular, I am inspired by the concept of temporary patient specific 3D-printed metal implants designed to facilitate recovery. These orthopaedic implants, also known as scaffolds, can safely bio-resorb once healing is complete, representing a shift away from conventional surgical approaches. Working in this area aligns with my professional goal of developing innovative engineering solutions that address real medical challenges. Ultimately, I am also driven by a personal ambition to see complex material innovations translated from theory into practical applications that enhance patient recovery and make a meaningful difference in people's lives.



Investigating Liquid Nitrogen Assisted Freeze-Dried rGO Aerogels for the Filtration of Polystyrene Nanoparticles

Student: **Angele Camilleri**

Supervisor: **Prof. Daniel A. Vella**

Co-Supervisor: **Dr Ing. Anthea Agius Anastasi**

What is your project about?

Aerogels are ultra-lightweight, sponge-like materials with a highly porous internal structure. This gives rise to remarkable potential for applications such as insulation, filtration, and environmental remediation. This project focuses on producing aerogels from reduced graphene oxide. To produce rGO aerogels, graphene oxide is first dispersed in water and allowed to form a gel. The gel is then rapidly frozen using liquid nitrogen, and is then dried to form an aerogel under vacuum. This method directly shapes the material's internal pore architecture, which is important in filtration applications.

Plastic pollution has reached a scale where synthetic micro- and nano sized particles, too small to see with the naked eye, are now found in rivers, oceans, and drinking water. The aerogels produced in this project were used to filter away polystyrene nanoparticles contaminating water. This was done to assess the feasibility of using rGO aerogels as a filtration media for nanoscale plastic contaminants.

Why are you working on this project?

I chose this project because it brought together two areas I have always been interested in; nanomaterials and the environment. The fact that you can take a material, engineer it at a scale that is completely invisible to the naked eye, and end up with something that has real, practical uses is what makes this field of interest to me. Reduced graphene oxide aerogels are a great example of this. They are incredibly lightweight structures whose porous architecture gives them real potential in several applications. Whereas the concern for the environment stems from a growing awareness of how significantly human activity is affecting the natural world around us. Nanoplastics are now present in water systems across the world, and their long-term effects on both ecosystems and human health are still not fully understood. Being able to investigate whether an aerogel could play a role in filtering them out of water felt like a genuinely worthwhile problem to work on. It is the kind of project that connects what you learn in a degree to something that has real-world relevance.





Section 9

Product Development

Design and Prototyping of a Modular Upper-Body Exoskeleton for Human-Centred Industrial Operations

Student: **Steven Gilson**
Supervisor: **Prof. Ing. John C. Borg**

What is your project about?

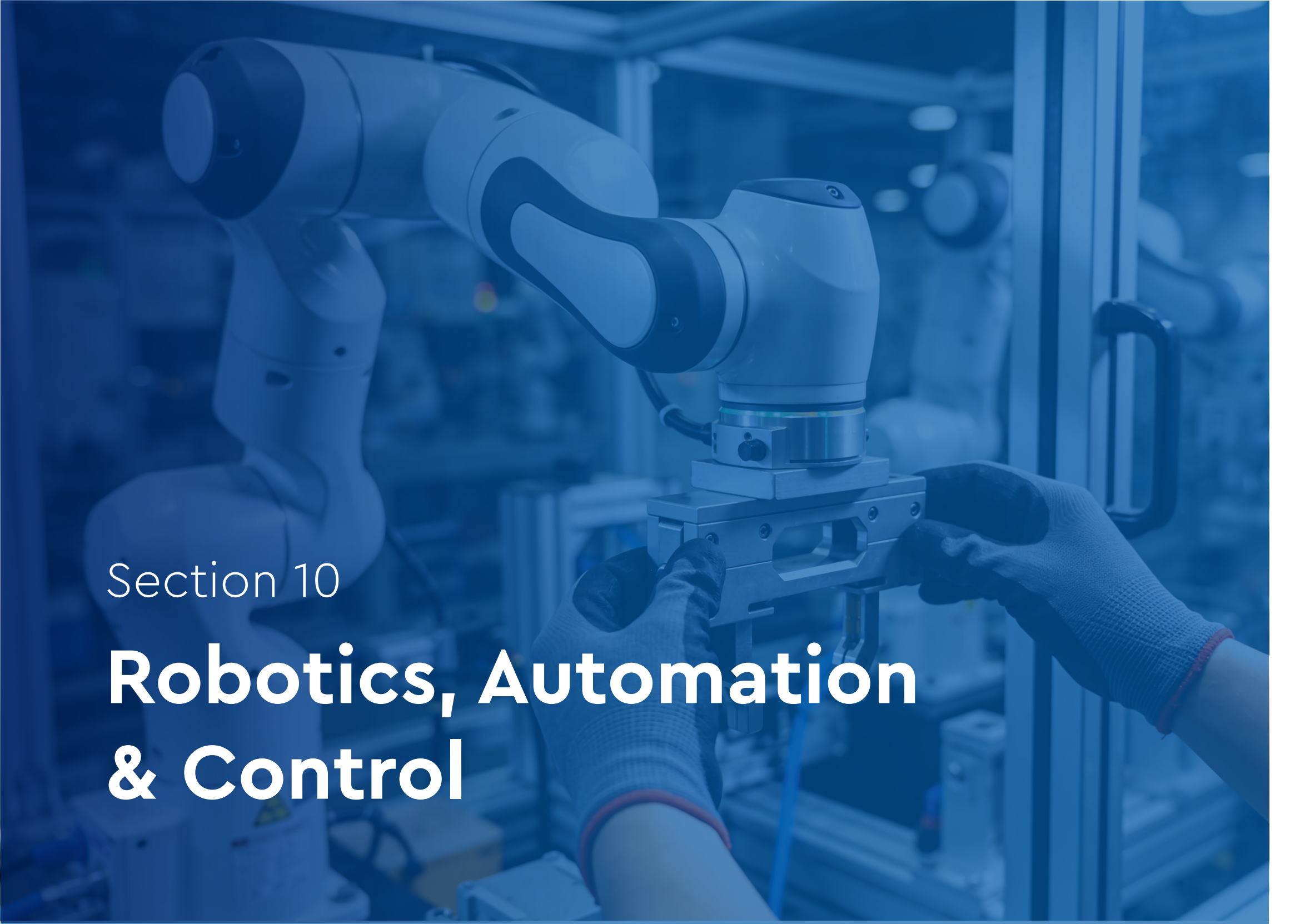
This project focuses on the design and development of a wearable robotic suit, known as an exoskeleton. This device is worn to physically and cognitively assist workers during demanding industrial tasks. The system takes the form of a lightweight, body-worn frame that provides extra strength and support while performing physically and cognitively taxing activities such as tightening bolts, operating tools overhead, or carrying out repetitive assembly tasks throughout a long shift. Unlike fully autonomous industrial robots, which struggle with the unpredictability and complexity of real-world work, this exoskeleton keeps the human in control while reducing physical strain and the risk of injury. A key focus of the project is making the system affordable and practical such that components are designed to be modular, meaning that individual parts can be swapped or adapted and are manufactured using low-cost techniques.

Why are you working on this project?

The motivation behind this project stems from a longstanding passion for the intersection of mechanical engineering, product design, and emerging technology. Throughout the course of study, a consistent interest has been drawn towards projects where engineering directly improves human lives, and assistive wearable technology is one of the core areas. The growing prevalence of musculoskeletal injuries in industrial workplaces is a serious and often overlooked problem where workers in manufacturing and maintenance environments routinely sustain long-term physical damage from repetitive strain and heavy lifting. Engineering, in this context, holds a clear responsibility to address such challenges.

Beyond the social relevance, the project was driven by the technical challenge of developing a system that is simultaneously functional, structurally sound, and cost-effective. The prospect of leveraging several manufacturing techniques and mechatronics to achieve this, areas of deep enthusiasm throughout the degree, made the project especially compelling. Ultimately, this work represents a step towards making assistive exoskeleton technology accessible not only to large corporations, but to smaller industries and developing regions where worker welfare is equally important, but budgets are limited.



A blue-tinted photograph of an industrial setting. A robotic arm is positioned on the left, reaching towards a metal fixture. Two human hands, wearing grey work gloves, are on the right, adjusting the fixture. The background shows a factory floor with various equipment and structures.

Section 10

Robotics, Automation & Control

A 4-tank Water Level Control System with Nonlinear MPC

Student: **Astrid Lee Schembri Friggieri**
Supervisor: **Prof. Ing. Simon G. Fabri**

What is your project about?

Regulating water levels in interconnected tank systems presents a challenging control problem due to the strong interaction between tanks. In a four-tank system, a change in the water level of one tank influences the levels of the others, resulting in complex system dynamics that are difficult to manage. This project focuses on improving water level regulation using both computer simulation and hardware implementation. Previous work applied a linear control approach that maintained stability only for a specific initial condition. Building on this foundation, the project adopts a nonlinear Model Predictive Control strategy capable of handling a wider range of operating conditions. The aim is to design a system that automatically regulates water levels while maintaining stability.

Why are you working on this project?

I chose the field of systems and control engineering, because many of the operations that we interact with, in our every day lives, such as buses, airplanes, and cars, are noticeably complex, yet we tend to perceive them as inherently safe. In reality, these systems rely on advanced control methods that continuously stabilise their behavior for everyone's safety. Systems and control engineering allows me to explore this subject by designing controllers that maintain the stability of a system and help it adapt to its surroundings ever-changing conditions. From a young age, my personal motivation stemmed from a desire on how these systems function behind the scenes and how this knowledge helps me make the world a safer place, as well as to contribute to innovations in robotics and smart infrastructure. This project provided me with the opportunity to develop a control strategy for a complex system, which focused on water level control, in a quadratic-tank system with nonlinear predictive control.



Implementing Collaborative Robotic Operations in Manufacturing Environments

Student: **Nathan Zammit**
Supervisor: **Prof. Ing. Emmanuel Francalanza**

What is your project about?

Modern factories are increasingly using collaborative robots, known as cobots, which are designed to work safely alongside human operators, without the need for protective barriers. A key challenge in deploying these robots in flexible manufacturing systems is ensuring they can accurately locate where their tasks must be performed. This project develops a vision-guided system where a camera mounted directly on the robot's arm, can direct the robot's movements. A specially designed vision target was created to test the accuracy of the system and facilitate re-alignment and re-deployment of the system. Using this setup, three different software platforms and approaches are evaluated and compared to identify which delivers the most repeatable and precise performance.

Why are you working on this project?

My interest in this project came from a fascination with how robotics and artificial intelligence can be combined to advance the manufacturing industry. Having studied the principles of industrial automation and flexible manufacturing throughout my degree, my interest grew about how robotics can contribute to these sectors. The gap between theoretical capability and real-world performance is where the most interesting engineering problems tend to live. Apart from my personal interests, this field is in the forefront of technology and offers multiple opportunities for future advancements and work. As the industry moves toward more human-centred manufacturing, the ability to quickly and accurately deploy a cobot at a new workstation without extensive manual recalibration, is a meaningful technical challenge. Answering which software platform and approach best helps with reaching this goal will give information that has great value for engineers aiming to implement such a system.





Section 11

Sustainable & Energy Efficiency

Electric-Hydrogen based DC Microgrid for green energy transportation

Student: **Claudia Lanni**

Supervisor: **Prof. Ing. John Licari** | Co-Supervisor: **Prof. Ing. Cyril Spiteri Staines**

What is your project about?

The project builds on a previously developed DC (Direct Current) microgrid that integrates a photovoltaic system and a battery energy storage system to supply power to a DC load. The system stores excess solar energy in the battery and uses it later to support the load when PV generation is not sufficient. However, when the generated power exceeds both the load demand and the battery capacity, the surplus energy can be used to produce hydrogen for green energy transportation instead of being fed back to the grid. Therefore, this project introduces an electrolyser to improve how the excess energy is managed. The work focuses on the design and operation of the electrolyser's power converter, as well as its control system, to ensure proper integration within the microgrid. Finally, the complete system is tested under different conditions to verify stable and reliable performance.

Why are you working on this project?

I chose to work on this project due to my strong interest in renewable energy and the growing need for more sustainable energy systems. As concerns about climate change and environmental impact continue to increase, it is important to find better ways to manage energy from renewable sources. One of the main challenges with renewable energy is that it is not always generated at the same rate as it is consumed, which can affect the stability of the DC microgrid. This creates a need for efficient energy storage solution that can handle excess energy and maintain reliable operation. Hydrogen offers an advantage in this context, as it allows energy to be stored for longer period by absorbing surplus energy that would otherwise destabilise the system. Therefore, this is what motivated me to explore this topic further and gain a deeper understanding.



Design of a Cryogenic Heat Exchanger for Energy Recovery in Air Separation Units

Student: **Jaden Borg**

Supervisor: **Prof. Ing. Christopher Micallef**

Industrial Partner: **Multigas Ltd.**

What is your project about?

Air Separation Units (ASUs) are used to separate air into its main components with a high purity yield of both nitrogen and oxygen. To do this, high amounts of electricity and energy are required to be able to cool down and liquify the air for separation through a process called counter-current distillation. When liquid nitrogen must be converted back to gas for use, heat exchangers in the form of ambient air vaporisers are used. However, the energy that was previously required to liquify nitrogen is wasted to atmosphere. This thesis investigates the design of a cryogenic heat exchanger to transfer heat from the process cooling water required to cool down several compressors within the ASU, to the liquid nitrogen that needs to be vaporised. Through the integration of this heat exchanger, energy is recuperated in the form of lowering the temperature of the cooling process water.

Why are you working on this project?

My motivation to work on this project stems from a deep interest in both thermodynamics and enhancing sustainability through engineering. Cryogenic Air Separation Units (ASUs) are fundamental to modern industry in both the industrial and medical sectors. However, one main drawback of cryogenic ASUs is the inherently energy intensive process, primarily due to the substantial waste heat generated during multi-stage compression required to separate air in various high purity products. Through this project I aim to address several complex engineering barriers to cryogenic thermal energy recovery, such as mathematically modelling and managing the insulating effects of ice formation on cryogenic heat exchangers. Through the validation of this model, this work would offer a scalable solution in reducing both the carbon footprint and operational costs of the cryogenic ASU processes, directly benefitting both the engineering field and the general public.



Renewable Energy-Powered UAV Charging System for Autonomous Wind Turbine Inspection and Wind Field Monitoring

Student: **Matteo Di Luzio**
Supervisor: **Prof. Ing. Tonio Sant**

What is your project about?

Offshore wind farms are expanding rapidly and are expected to play an increasingly important role in the transition to cleaner energy systems. At present, however, inspection and monitoring activities still rely heavily on crewed vessels and technicians working in challenging and weather-dependent conditions at sea.

The main objective of this dissertation is to evaluate the feasibility of an offshore charging system to support unmanned aerial vehicles (UAVs) used for wind turbine inspection and wind monitoring in the central Mediterranean, with the broader goal of enabling safer, more efficient, and more sustainable offshore wind farm practice.

Why are you working on this project?

The motivation for this project arises from its interdisciplinary nature and its clear significance for industrial practices. Offshore wind farms represent a key element of the ongoing energy transition, yet inspection and monitoring activities still predominantly rely on crewed vessels travelling to turbines at sea, which remains logistically demanding and highly weather-dependent. In parallel, unmanned aerial vehicles (UAVs) are emerging as versatile tools across many sectors, with applications ranging from infrastructure inspection and environmental monitoring to logistics and emergency response, underlining their growing relevance in modern engineering practice.

The project provides a structured opportunity to apply and deepen my understanding of aerodynamics, energy systems, and practical engineering design within a single, well-defined application. Beyond its technical scope, it is also meaningful on a personal level, as it supports safer operations and more sustainable practices, in line with the broader objective of contributing to engineering solutions that deliver tangible benefits in real-world contexts.



Interfacing of protection relays with real-time power network software models

Student: **Andre Debattista**
Supervisor: **Prof. Cedric Caruana** | Co-Supervisor: **Prof. Reiko Raute**

What is your project about?

This project looks at how electricity networks can respond safely when something goes wrong, such as a fault, short circuit, or damaged equipment. The main challenge is making sure the problem is isolated quickly without unnecessarily cutting power to large areas. In simple terms, the system should identify exactly where the issue is and switch off only that part, while keeping electricity flowing everywhere else. The project explores how to improve this process so power systems become safer, more reliable, and less disruptive to everyday life. This is especially important as modern electricity networks become more complex with renewable energy and changing patterns of power use. This project tackles this mainly using Protection relays together with simulations.

Why are you working on this project?

I chose to work on this project because power systems are an essential part of everyday life, yet most people only notice them when something goes wrong. I was particularly interested in this area because it combines practical engineering with a strong social impact. Protection and discrimination in power systems focus on making electricity networks safer, more reliable, and better able to respond to faults without causing unnecessary disruption. This interested me because even small improvements in these systems can help prevent equipment damage, reduce outages, and maintain power supply to homes, businesses, and critical services. As electricity networks become more complex due to renewable energy integration and changing demand patterns, these challenges are becoming even more important. Working on this topic allowed me to explore a field that is both technically meaningful and highly relevant to the public, while contributing to solutions that support a safer and more dependable energy infrastructure.



Sustainability Assessment of Mechanical Polymer Recycling

Student: **Chanel Saliba**

Supervisor: **Prof. Ing. Paul Refalo** | Co-Supervisor: **Prof. Arif Rochman**

What is your project about?

Thermosets polymers are typically found in various products ranging from electronics to construction materials, and conventionally end up in landfills or are incinerated, causing serious environmental harm. Unlike thermoplastics, these polymers cannot simply be remelted and reused, making recycling difficult. This project assesses the life cycle impacts of grinding these waste thermosets into a fine powder and using them as fillers with thermoplastics to give them a second life. By doing so, the goal is to divert thermosets from landfills and incinerators, in an environmental and financially feasible way without negatively affecting the recyclability of thermoplastics.

Why are you working on this project?

My decision to work on this project stems from a longstanding interest in sustainability and a desire to create engineering solutions that have a meaningful, lasting impact on the environment and society. From an early age, I have been drawn to understanding how systems interact with the natural world, and this curiosity has shaped both my academic and professional pursuits.

This project represents a natural convergence of my technical skills and personal values. Sustainability is no longer a peripheral concern but it is at the core of modern engineering challenges. I believe engineers have a responsibility to develop solutions that address these challenges head-on.

Beyond personal motivation, this work is highly relevant to the broader field, as industries are under increasing pressure to adopt greener practices and contribute to a circular economy. Contributing to this shift, even incrementally, is what drives my commitment to this project.





Section 12

Transportation

A 10 kW Electric Drive for a Planing Hull

Student: **Kyle Grima**

Supervisor: **Prof. Ing. Joseph Cilia** | Co-Supervisor: **Prof. Ing. Michael Galea**

What is your project about?

My project focuses on developing an electric propulsion system for a small speedboat. Most electric boats are design to run at speeds up to 5 knots due to the design challenges at higher speeds. The main aim of my project is to simulate, design and build a drive system capable of reaching speeds beyond 10 knots, where the power and energy demands become much more significant. To do this, I have built a detailed simulation of the full propulsion system in order to evaluate the expected performance in practise. The simulation includes both the electrical and mechanical parts of the system, such as the battery, inverter, motor, gearbox, propeller, and boat model. A key aim is to make the model as accurate as possible so that it reflects real operating conditions and can be used to support design decisions. Finally, the drive system will be implemented in the speedboat selected for this project.

Why are you working on this project?

I chose this project because it combines several areas of electrical engineering that I find interesting, especially electric machines, control systems, and system integration, while also addressing a real transport problem. One of the main motivations behind the project is the possibility of using electric propulsion for water transport in harbour areas, where reducing noise disturbance and air pollution is becoming increasingly important. Traditional fuel-powered boats can create both environmental and acoustic problems, particularly in places where people live, work, or travel regularly. This project gave me the opportunity to work on something practical that could contribute to cleaner and quieter marine transport. I am also interested in the challenge of modelling the full system as accurately as possible, since this requires understanding how all the components interact rather than looking at each part separately. For the wider public, this work is relevant because it supports the move towards more sustainable transport solutions.



Advanced Design Methodologies for High-Performance Automotive Contactors in Harsh Environments

Student: **Catherine Cilia**

Supervisor: **Prof. Ing. Michael Galea**

What is your project about?

Contactors are switches that make or break electrical connections and are used in many applications, such as for industrial and residential switching and protection. While this is a mature technology, the availability of lightweight, compact and high current carrying contactors for DC-powered platforms operating in harsh environments is limited, and further research is needed in this area.

In this project, considerations for the design of contactors able to operate in high current carrying conditions, powered through DC batteries are proposed, developed and validated. An advanced design process for such a contactor is proposed and analysed in detail, through a custom-built analytical model. Advanced finite element modelling is then used to fine-tune and accurately optimise the contactor design. Experimental validation is also achieved, through the building and testing of a physical prototype of the contactor, highlighting the robustness of the design methodologies proposed.

Why are you working on this project?

My project addresses the limited availability of market-ready products for contactors which can operate at high currents in harsh environments. The commercial availability of such contactors is limited by contact erosion, overheating, device size and cost. Consequently, achieving reliable switching in compact and weight-constrained systems remains a significant design challenge.

This multidisciplinary project spans several areas of engineering, with a primary focus on electromagnetism. I am particularly drawn to the fact that the behaviour of physical mechanisms can be accurately modelled and predicted through theoretical equations. The interaction between electromagnetic forces and mechanical motion is especially interesting, and it forms the foundation of contactor operation. Furthermore, my motivation for this project stems from the opportunity to design a foundational contactor model that can act as a basis for further development. By establishing a good initial design, this work can be progressively refined through continued research and analysis, with the long-term goal of achieving a very high-end high-performance contactor.

This project is highly relevant, as contactors play a critical role in ensuring safety and reliability in electrical systems. Rapid disconnection during faults is essential to prevent damage, making improved designs valuable to both industry and society.



Notes

W**STESERV**

CREATING RESOURCES FROM WASTE

INTERCONNECT
MALTA

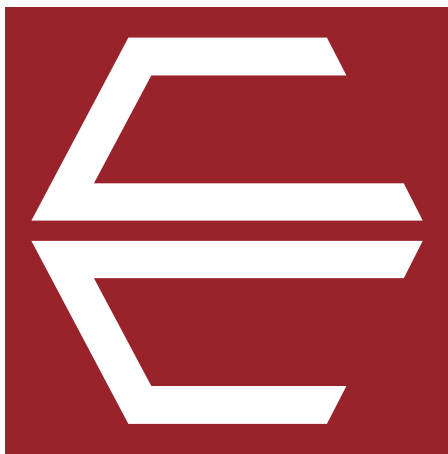


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