Faculty of Engineering Projects

2022

L-Università ta' Malta
Faculty of Engineering

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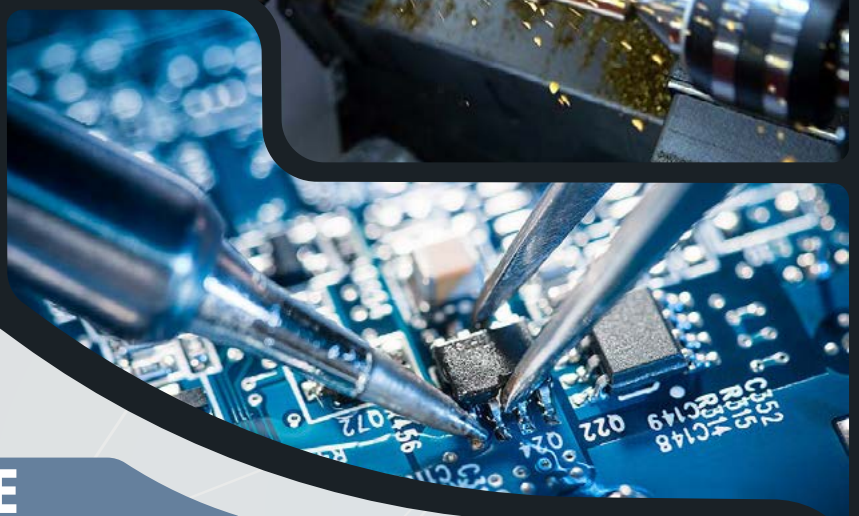

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DEVELOP **PRODUCE**

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Foreword

The global pandemic brought about so much disruption in our daily lives by stripping away from us almost all human interaction through social distancing. It has however given us an opportunity to really appreciate the small things in life, such as hanging out with close friends and family. With the help of science, we fought back and managed to start our return to normality. At University, this normality is being sensed in various ways. Students have now returned to the lecture room; laboratory sessions are running and exams are being planned in the traditional manner. But above all, the annual Engineering Projects Exhibition is being held once again! Our students and faculty members are therefore excited to host this key event and welcoming you back to our faculty. This year we are proud to present over 50 Engineering projects carried out by our final year students. We invite you to browse through this booklet which summarises the work of each project and showcases the dedication and achievements of our final year students. We look forward to meeting and discussing these projects throughout the exhibition in a social environment.

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

Certificate in Engineering Sciences

Undergraduate MQF Level 6
240 ECTS

MALTA ENGINEERING PROFESSION BOARD LOCAL WARRANT

B.Eng.(Hons) Electrical & Electronic Engineering

B.Eng.(Hons) Mechanical Engineering

EUR-ACE®

Engineering Council accredited degree

Institution of MECHANICAL ENGINEERS

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)

Postgraduate MQF Level 7
90 ECTS

by Research

Taught

M.Sc. in Engineering [Various Research Areas]

M.Sc. Integrated Product Development

M.Sc. Building Services Engineering

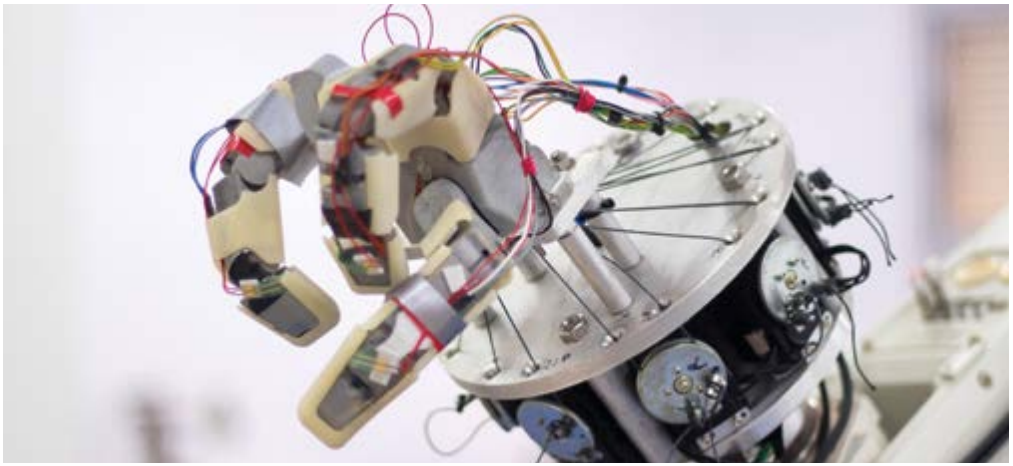
M.Sc. Maritime Engineering

M.Sc. Signals, Systems & Control

M.Sc. Biomedical Engineering

Postgraduate MQF Level 8

Ph.D. [Various Research Areas]



Bachelor of Engineering (Honours)

MQF Level **6**

Areas of Study

- Electrical and Electronic Engineering
- Mechanical Engineering

Duration

4 Years Full-Time

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 opportunities offered in various local and international industrial sectors such as the aerospace, biomedical, maritime, energy, telecommunications, electronics and manufacturing industries as well as those of building services.

The course focuses on two main universal engineering areas of studies; Electrical and Electronic Engineering and Mechanical Engineering.

The Electrical and Electronic Engineering programme addresses 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 fundamental concepts in mechanical, manufacturing and materials engineering, followed by further focus in 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 manufacturing, quality and reliability engineering, robotics and automation, structural integrity, surface engineering, tool design and manufacture.

This course is recognised by the local Bord tal-Inġiniera as a prerequisite when applying for the Engineering Warrant (Ing.) and is also internationally recognised by the European Federation of National Engineering Associations (FEANI) when applying for the Eur. Ing. qualification.

The Mechanical Engineering area of study is also accredited by the Institution of Mechanical Engineers (I.Mech.E.) UK and by the Royal Institute of Naval Architects (R.I.N.A.) UK on behalf of the Engineering Council UK 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 (ENAEE) and labelled as a first cycle Engineering degree under the EUR-ACE programme.

Entry Requirements

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

or

b) be in possession of the Certificate in Engineering Sciences from the University of Malta.

The Faculty Board may also consider applicants in possession of a qualification at MQF Level 5 in an engineering diploma, together with passes in the Secondary Education Certificate Examination at Grade 5 or better in English Language, Maltese, Mathematics and Physics, to join the course. Such applicants shall be required to present with the qualification they submit for entry, a detailed transcript showing their performance during their studies. They shall further be required to attend for an interview to assess whether they have the necessary aptitude to successfully follow the course.

Certificate in Engineering Sciences

MQF Level **4**

Duration

1 Year Full-Time

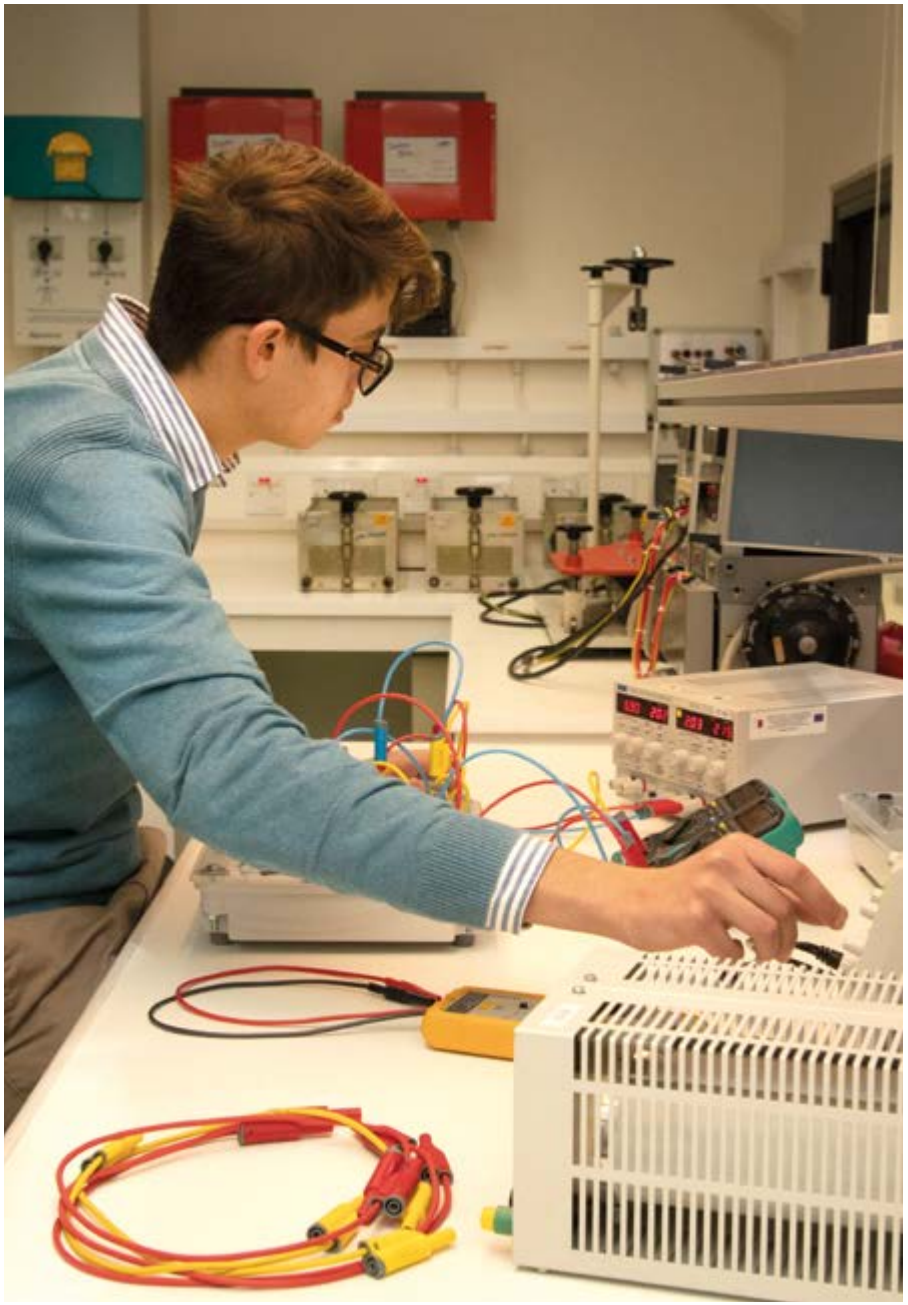
The Certificate in Engineering Sciences is a one-year certificate course intended to prepare students with the knowledge, skills and competencies necessary to follow the B.Eng. (Hons) course. During the course, students will be studying mathematics and physics, bringing the student's knowledge and understanding 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 the student to become a modern engineer.

Entry Requirements

General Entry Requirements together with an Advanced Matriculation Level pass in one of the following subjects: **Applied Mathematics, Chemistry, Computing, Engineering Drawing, Graphical Communication, Information Technology, Physics, Pure Mathematics,** or other science/numeric subjects as approved by the Faculty Board.

Applicants in possession of a qualification at MQF Level 4 in an engineering domain obtained with at least Pass with Merit, and of passes in the Secondary Education Certificate Examination at Grade 5 or better in **English Language, Maltese** and **Mathematics** may also apply.

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



Section 1

Additive Manufacturing

Impact of Moisture Absorption on Additive Manufactured Parts

Student: **Eucharist Bajada**
Supervisor: **Prof. Ing. Joseph Buhagiar** | Co-Supervisor: **Mr David Sciberras**
Industrial Partner: **Invent 3D Ltd**

What is your project about?

This project focused on investigating and analysing the correlation between moisture absorption by polymeric filament used for additive manufacturing of parts and the resulting variations in mechanical, thermal and surface appearances of the said manufactured part. In this project the additive manufacturing process that was used was Fused Deposition Modelling (FDM) and hence the raw materials used were in the form of polymeric filament spools. During this investigation four different sets of polymeric filament materials were used and these were subjected to a relative humidity for a period of time until controlled values of moisture absorption per spool were reached. This was done to see how the different percentages of moisture absorption affected the properties and the quality of the final additively manufactured part.

Why are you working on this project?

I selected this area in particular due to the fact that moisture absorption is a pertinent and recurring issue in the additive manufacturing field, especially in fused deposition modelling. Over and above, I have always found fused deposition modelling very interesting and this dissertation gave me the opportunity to delve further into this field. During this investigation I wanted to see and better understand how moisture absorption affects the mechanical, thermal and surface appearances of parts additively manufactured by means of fused deposition modelling. In order to do this, my dissertation started off with a 6-week internship program at Invent 3D so as to better understand the technology to be used during this investigation.

I strongly believe that the work conducted in this dissertation is relevant both to industry and the general public due to the fact that the recommendations I made could help the end user to produce better parts. As a result of this, not only would products made by means of this process be more affordable to the general public but also would incentivise further development by industry in this field.

Investigating the Corrosion-Wear Characteristics of a 3D Printed Surface Engineered Titanium Alloy

Student: **Kelsey Ann Vella**
Supervisor: **Dr Ing. Ann Zammit** | Co-Supervisor: **Ms Martina-Maria Pizzuta**

What is your project about?

In this project, the performance of 3D printed and surface-engineered Ti-6Al-4V titanium alloy was investigated by subjecting the samples to corrosion-wear testing. Such testing entails a reciprocating sliding wear test carried out under an applied potential in an artificial seawater solution to simulate the marine environment. This test was chosen since despite the material's excellent corrosion resistance, under friction conditions this material tends to exhibit poor wear resistance, especially when exposed to a corrosive environment. Thus, the main aim of this study is to determine whether, through surface engineering, the corrosion-wear performance of 3D printed Ti-6Al-4V can be improved to make it suitable for the production of lightweight parts intended for marine applications.

Why are you working on this project?

This project has allowed me to learn more about how material degradation can be combatted through surface treatments and determine which treatments are successful or not for this specific type of mechanism. Both material degradation and surface treatments are two areas of study which I have always found interesting. Moreover, this project is part of a larger project funded by the Malta Council for Science and Technology, aimed to solve issues regarding marine transportation, present in real-time. Currently, additive manufacturing has become a very popular route to manufacturing components due to the numerous benefits it provides. Furthermore, the corrosion-wear behaviour of such hybrid surface treatments has as of yet not been extensively studied. Therefore, this project allowed me to contribute to an aspect which is not yet well investigated. The success of the studied material would prove to be advantageous for the marine industry as components with a desirable set of properties and complex geometries can be rapidly manufactured when required on demand.

Investigating the Effect of Heat Source Parameters for Additive Manufacturing of Inconel 718 on the Oxidation Resistance

Student: **Julian Farrugia**
Supervisor: **Ing. Bonnie Attard**

What is your project about?

Over the past years, there has been a prevalent movement towards improving the fuel use efficiency of aeroengines. The operating temperature of the engine is closely correlated with its efficiency and therefore the fuel consumption. One of the main limiting factors to increasing the operating temperature is the high temperature attack on the engine parts which is referred to as oxidation. Inconel 718 is a nickel-based superalloy primarily used in the hot sections of turbofan aeroengines where the temperatures exceed 400°C. Inconel 718 is very difficult to machine, thus it is beneficial to manufacture it using additive manufacturing. With additive manufacturing, the microstructure can be modified during the process to optimise component performance. This may have effects on the high temperature oxidative behaviour. The aim of this work was to investigate the effect of using different processing parameters to additively manufacture Inconel 718 on the oxidation rate at elevated temperatures.

Why are you working on this project?

Throughout my studies, I was always interested in subjects related with material development and its industrial application. Since the aviation industry always attracted me, I decided to focus my interest into investigating how aeroengine disc materials degrade through oxidation. The practical aspect of this project helped me to develop an understanding of the subject as I could relate the theory being studied to practical aspects. As part of my work, I also performed a significant amount of hands-on testing such as conducting several furnace treatments, microscopy, spectroscopy and nickel plating for the specimens being tested. The remarkable outcome of this study was that by using different processing parameters to additively manufacture Inconel 718, the oxidation rate was not affected. This is very relevant to an industrial setting since one can be more flexible when designing the part parameters for fabrication through additive manufacturing.

Testing of Component Parts and Subassemblies in Novel Medical Products Fabricated Using AM Technologies

Student: **Maximillian Bonello**
Supervisor: **Dr Ing. Pierre Vella**

What is your project about?

PRIME-VR2 is a project, which aims to make bespoke virtual reality controllers for patients requiring upper limb rehabilitation. This project is concerned with the testing of parts manufactured using 3D-printing, within the therapy module of the PRIME-VR2 Controller. Testing was done using a rigorous problem solving approach to first understand any problems within the system, then measure and analyse those problems, and finally mitigating any problems found. The main problem found was that the parts were printing larger than intended and therefore any parts that had to fit into each other could not do so resulting in the therapy module not being functional.

Why are you working on this project?

The PRIME-VR2 product required testing on various aspects of the design as functionality had to be ensured in the system. I was interested in working on this project as it formed part of PRIME-VR2 which aims to be novel, and of benefit to other people, while the project offered value to PRIME-VR2 as it has mitigated problems that could have otherwise been identified later in the development of the product. Furthermore, additive manufacturing (3D printing) is a technology that is still being developed, and being able to work with it, understanding its benefits and shortcomings was a great opportunity for myself as I aim to begin a career in engineering, with a particular interest being product design. Finally, I think this project is of value as additive manufacturing is a technology that has great applications, and we are still scratching the surface with its capabilities.

Pellet 3D Printing of High-Performance Polymer

Student: **Helenio Borg Muscat**
Supervisor: **Dr Arif Rochman** | Co-Supervisor: **Mr Albert Curmi**

What is your project about?

3D printing (Fused Filament Fabrication) is a manufacturing method which is being adopted by industry. Typically, the printing material is in the form of a filament wound around a spool. For this project, pellets were used instead, and this comes as a challenge since a miniature pellet extruder is required to fit in such a set-up. The material used was Polyether-ether-ketone (PEEK), a high-performance thermoplastic polymer, which has a workable temperature of above 360 °C. The aim of this project was to test the pellet extrusion 3D printer being developed and characterise the material and printed samples. The results showed that the printer can melt and continuously print samples from the high-performance polymer (PEEK), but adequate material temperature control is required to create strong a strong interlayer bonding strength of the prints.

Why are you working on this project?

Polymer manufacturing is a field that I find interesting. The combination of established polymer manufacturing methods like pellet extrusion and the new field of 3D printing is a great endeavour to reduce manufacturing steps, thus increasing efficiency, decreasing energy consumption and material waste. Manufacturing is the step where ideas and designs become a physical reality. I find this step in product creation interesting and satisfying.3D Printing is at the forefront of mass manufacturing adoption. Access to high-end manufacturing methods is becoming more common in households in the form of consumer-grade 3D printers. Advanced manufacturing methods are no longer bound to corporations but are now available to the creative consumer. The improvement in 3D printing should serve both the consumer and the industrial manufacturers, more efficient methods of products would lead to a decrease in price for consumers and an increase in profits for the manufacturers.

Performance Analysis and Optimization of Thermoset Elastomers 3D Printer

Student: **Nadine Mifsud**
Supervisor: **Dr Arif Rochman**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

What is your project about?

This research study aimed to investigate the ability to 3D print real rubber parts, using the previously built rubber 3D printer. For this purpose, the equipment and printing performance of the 3D printer were first improved to eliminate extrusion or printing problems such as melt fracture and warpage. A functional Design of Experiment (DoE), which is a statistical analysis, was then carried out to determine the most ideal parameters from a set of conditions, that are able to print parts which are visually and dimensionally accurate. Following this, printing tests were conducted to evaluate between 0.4 mm and 0.8 mm size nozzle. After which material testing was performed on the components printed with the improved parameters, and compared to those manufactured with typical moulding processes. The results determined that the 3D printed specimen had mechanical properties which were comparable to the compression moulded sample. Finally, a flat gasket and seal were 3D printed, which showed feasibility in printing real rubber parts.

Why are you working on this project?

Additive manufacturing, also known as 3D printing, has always been an area of interest in the last 2-3 decades. Even though this technology has greatly advanced in these last few years, there is little to no research on additive manufacturing of thermoset elastomers. The most similar material to rubber that is able to be 3D printed are thermoplastic elastomers (TPE). With the ability to print thermoset elastomers, industries like Trelleborg Sealing Solutions (TSS) would be able to manufacture rubber components and prototypes and hence, implement the necessary changes of the design at the first few stages of product development. Being able to take part in such a project allowed me to apply as well as broaden my knowledge, as the intricate material composition of thermoset elastomers provided several welcomed challenges when it came to printing.

Fabrication of Miniature Components Using AM Technologies

Student: **Andre Scicluna**
Supervisor: **Dr Ing. Pierre Vella** | Co-Supervisor: **Dr Arif Rochman**

What is your project about?

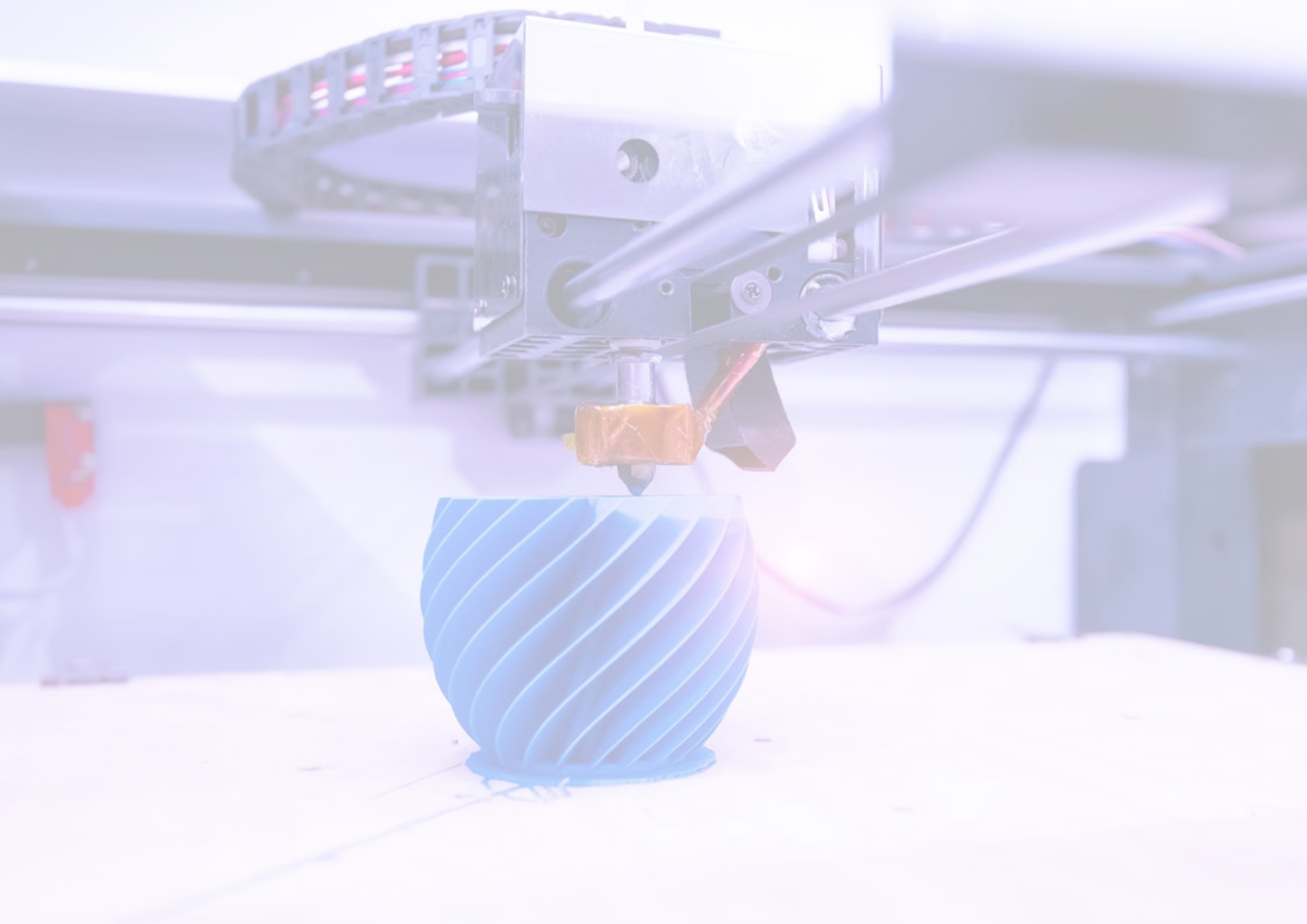
In the last decade, Additive Manufacturing has proven to be a feasible technique for the fabrication of components.

My project will use this technique for the fabrication of miniature components. The Department of Industrial and Manufacturing Engineering has a number of machines which use Additive Manufacturing technologies for rapid prototyping and for the fabrication of custom parts and tooling. These machines, however, have only been used to generate normal-sized components, and their ability to fabricate miniature components has not yet been explored.

This project aims to design and perform a number of experiments on some of these machines in order to evaluate their performance and the effectiveness in using them to fabricate miniature components.

Why are you working on this project?

Throughout the engineering course, I have taken great interest in the subjects related to Additive Manufacturing and have found miniature components interesting. Lately, in engineering, AM manufacturing has been incorporated in several industries, and this manufacturing technology has allowed for rapid development since it has tackled some unprecedented challenges. One of the challenges which was tackled throughout the previous years was that of fabricating miniature components using AM. Through the findings of this study, miniature components can be rapidly fabricated at lower costs and faster rates by the readily available AM systems at the Department of Industrial and Manufacturing Engineering at the University of Malta. The miniature components produced could then be used in various industries such as biotechnology, medical, and ultra-precision engineering industries. Throughout this project, I was able to put into practice the knowledge and problem-solving skills which were acquired while reading for a degree in Mechanical Engineering.



Section 2

Biomedical Engineering

Using Biomechanics to Determine the Optimal Playing Position of a Musician

Student: **Luca Vella**
Supervisor: **Dr Ing. Zdenka Sant**

What is your project about?

Musicians during their first lessons are taught how to hold their instrument and position their body in the correct way. As their skill improves, they discover that positioning can affect their sound quality, but at the same time it can affect their risk of strain or injury. Pain is a common occurrence throughout a musician's lifetime. The best way to prevent injury is to assess their posture and by correcting it to the optimal position that allows them to play just as well but it would not cause them more pain. This project investigates the movement created by different postures using AnyBody Software.

Why are you working on this project?

I have studied music starting from the age of 7 and during the past 13 years I have partaken in several clarinet and music performance masterclasses aimed at perfecting the art of performing. Throughout this time, I have had the opportunity to take part in numerous concerts alongside prestigious orchestras and also performing solo works internationally. Personal experience and that of fellow musicians have shown that discomfort and pain can become quite common during long and intense spells of playing that at times also required medical attention. When it comes to one's posture the focus tends to be on the tone and quality of the sound produced rather than preventing injury. This project would help prevent such discomforts by providing the proper posture and position a musician should adopt to avoid injuries altogether by signifying the differences if any, of a good or bad posture.

Design of a Low-Cost, Emotionally Pleasing Lower Limb Prosthesis

Student: **Rebecca Clark**
Supervisor: **Prof. Ing. Jonathan C. Borg**

What is your project about?

The lower limb prosthetics industry has evolved considerably over recent years, with some prosthetic limbs capable of smart features that allow them to adapt completely to different environments and movements by the user. However, while prostheses have been given ever increasing functionality, the problem remains that purchasing a limb is exceedingly costly. In fact, for a user to purchase a lower limb prosthesis which is relatively low cost, they must be willing to sacrifice aesthetics and emotionally pleasing features, as well as most functionality. Therefore, this project aims to solve this issue by designing a lower limb prosthesis which is both low-cost and emotionally pleasing.

Why are you working on this project?

I have always been interested in the prosthetics area of engineering, even from a young age. Having grown up with parents whose jobs are in the healthcare sector and help those around them, this field of engineering also allows me to help others, as providing a widely available lower limb prosthesis would surely aid in bettering the quality of life of numerous people. This project is highly relevant in today's industry, since prosthetic limbs are exceedingly expensive. These prostheses are even more expensive if the user wishes to add aesthetic looks to them. Therefore, a project such as this provides solutions and options for users which typically have limited choices for their own prosthetic limbs.

Development and Evaluation of a Prosthetic Hand Prototype

Student: **Giuseppe Galea Curmi**
Supervisor: **Prof. Ing. Michael A. Saliba**

What is your project about?

The aim of this project was to contribute to the development of a prosthetic hand prototype and to develop a new testing protocol used to evaluate the functional capabilities of artificial hands. The loss of an upper limb significantly impacts the life of an individual due to the importance of human hands in the execution of everyday activities, from the simplest to the most complicated tasks. Yet, rejection of prostheses remains high mostly due to high costs and weights of prostheses. Thus, the prototype addressed in this project attempts to achieve a highly functional 3D printed hand at low cost and low weight by replicating only the aspects of the hand which contribute the most to its proper function. An extensive testing procedure was also developed to evaluate the grasping and manipulation capabilities of the prototype.

Why are you working on this project?

My main motivation for choosing to work on this project was the aspect of designing and developing a prosthetic hand prototype, combining my love for developing innovative solutions with my passion for assisting people in whatever way possible. Prostheses play a significant role in enhancing the quality of life of individuals who experience limb loss, not only through improved physical functioning but also by reducing social isolation and possibly contributing to improved mental health. Despite the advancements in the medical field, the ageing population has resulted in an increase in the number of amputations, making the development of highly functional and low-cost prostheses vital to the restoration of hand function. Taking on this project also allowed me to explore the fields of robotics and electronics, areas in which I did not have a lot of experience, thus allowing me to challenge myself to gain new skills and expand my expertise. The project also allowed me to use emerging technologies, namely additive manufacturing (3D printing) and the associated 3D modelling and design.

Controlling External Devices Using an SSVEP-based BCI

Student: **Cheryl Gilford**
Supervisor: **Dr Tracey Camilleri** | Co-Supervisor: **Prof. Ing. Kenneth P. Camilleri**

What is your project about?

The project is composed of the design and implementation of a brain-computer interface (BCI), which uses the brain's electrical activity to communicate directly with a computer, with the ultimate benefit of this process being no requirement for muscle movement by the user. The BCI designed in this study works with steady-state visually evoked potentials (SSVEPs). These are signals developed in the visual cortex of the user's brain, as a result of exposure to repetitive flickering stimuli. Although these are high-performance systems, the flickering element of these stimuli presents multiple issues, from causing annoyance and fatigue to posing the risk of photoepileptic seizures in users who suffer from epilepsy. Consequently, an SSVEP-based BCI that uses subtle flicker was developed in this project, with the aim of reducing the annoyance caused by the flickering stimuli whilst still ensuring reliable BCI performance. The practical application of this BCI's design is to control a TV set.

Why are you working on this project?

The main aim behind the development of BCIs is to assist people with locked-in syndrome, which is caused by a number of long-term neurodegenerative diseases, like amyotrophic lateral sclerosis (ALS). The ultimate overarching goal in this field is to allow these individuals more autonomy and better quality of life. Through the ameliorated BCI system developed in this project, I aim to improve the user's experience when using these systems to access technologies including communication devices and personal computers.

BCI research has rapidly expanded and is no longer solely focused on assisting people with physical disabilities. Among many other applications, subjects may use such systems for the assessment of fatigue in attention-demanding jobs, like air traffic control or truck driving. Uses of BCI systems also include virtual reality gaming and intelligent transportation. The vast research within the field of neurotechnology and the diverse applicability of BCIs are of great interest to me, as such systems will potentially allow society to control and harness better what the brain can accomplish and introduce novel notions of control over one's environment.

Section 3

Building Services Engineering

Optimisation of the VRF Test Rig to Eliminate Oil Trapping in the Evaporator

Student: **Matthew Ghigo**
Supervisor: **Prof. Ing. Christopher Micallef**

What is your project about?

The VRF test rig in the Thermodynamics Lab had one major flaw due to the design of the heat exchangers. Oil was being trapped in the evaporator, which apart from increasing friction and stalling the compressor, reducing the heat transfer from the water surrounding the evaporator to the refrigerant. An oil separator was introduced into the system in order to eliminate the oil trapping problem. Various issues in the rig were rectified, including fluctuating readings from the temperature sensors, missing flow sensor readings at low refrigerant flow rates and the transparent end caps. Besides, a new program was written, which introduced manual control to the rig and a new remote GUI was designed using HTML.

Why are you working on this project?

Throughout the engineering course, lectures relating to thermofluids, in particular HVAC, were always of interest to me. I am also keen on programming and small scale electrical circuit design, which is the reason I opted to work on the VRF test rig. One of the most electrical intensive appliances in both commercial and domestic applications is climate control. Refrigeration is a hot topic amongst consumers during the summer months, due to record-breaking temperatures caused by global warming. Engineers around the World are constantly researching ways to obtain a more efficient system to reduce strain on the electrical grid and one's pockets. The manual control in the rig will enable the user to design experiments more easily. This work will contribute to solving the energy crisis to achieve a more sustainable way of living.

Assessing the Efficiency of Domestic Water Consumption in the Maltese Islands

Student: **Antonella Mizzi**
Supervisor: **Dr Jean-Paul Mollicone**

What is your project about?

The project assesses the efficiency of the domestic water consumption of a household by considering performance indices assigned to each appliance or activity that uses water. A water diary in the form of an electronic spreadsheet is kept by residents to record their consumption and activities. The data is processed in a custom program that automatically generates a detailed report of the household's water usage statistics, including personalised recommendations on how to use water more efficiently, and a one-page summary that includes a final global performance index that rates the household's water use efficiency.

Why are you working on this project?

Conscious of the water scarcity issue Malta is facing, which will be more pronounced by climate change, I wanted to do something to help in this regard. Due to the fact that Malta's households are the most water consuming sector and since water efficiency and conservation are the way forward to tackle the issue, with the help of my supervisor, a household water assessment was developed to aid the public to identify where the greatest amounts of water are consumed within a specific household, what caused such excess water consumption and how it can be tackled in order to use water efficiently and to conserve water. I really believe that every drop counts and I think that the household water assessment is fairly accurate and reliable and if it is implemented and the public takes it seriously, a change in domestic water consumption would be observed.

Conversion of the HVAC test rig from R12 to an environmentally friendly refrigerant

Student: **Riston Schembri**
Supervisor: **Prof. Ing. Christopher Micallef**

What is your project about?

Now-a-days the implementation of protocols led to the phasing out of R12, hence the conversion from R12 to a more environmentally friendly refrigerant, this being R134a, was required.

For a successful conversion, standard procedures on the test rig, such as pump down and flushing of mineral oil, were done. Furthermore, a new reciprocating compressor containing readily supplied Polyolester synthetic lubricant was installed together with a condenser. In addition to the main objective of converting the test rig, comparison of performance characteristics when operating the test rig using a thermal expansion valve and an electronic expansion valve was also performed. Hence, a micro-controller (Arduino Mega 2560) was employed as a control mechanism for the electronic expansion valve. Prior to testing, pressure and temperature sensors were calibrated against a known source to ensure accurate and repeated data readings.

Two different tests were performed, analysed and compared. Tests conducted concluded that operating the test rig with a thermal expansion valve registered a more energy efficient operation when compared to an electronic expansion valve, however the contrary was expected. A reason of such result might have been due to the unnecessary energy lost in the compressor due to the excess amount of superheat at the compressor's inlet when operating using the electronic expansion valve. In addition, the refrigerating capacities of both tests were calculated to be equal, thus the only variation was concluded to be from the work input of the compressor.

Why are you working on this project?

With the continually rising demand for comfort, technologies are being adopted and improved to alter undesired ambient conditions by altering the unwanted outdoor air properties to ones which are comfortable for the occupants. Furthermore, engineers must keep in mind the on-going issue of global warming and ozone depletion which should be taken as a serious threat to the environment, especially due to the negative effects it imposes on society.

This dissertation encourages people to adopt more environmentally friendly alternatives, in this case being adopting a refrigerant with negligible ozone depleting potential, while also meeting the comfort demands requested by each individual. In addition, by choosing to operate an air-conditioning unit with R134a a more energy efficient operation is achieved, hence a win-win situation can be achieved. My main interest regarding this dissertation is to advise people to mitigate unnecessary hazardous elements to prolong the ozone layer's lifetime.

Lastly, this dissertation helps the general public to understand the negative effects brought about by hazardous elements and provides possibilities on how such effects can be diminished while optimising energy efficiency for air-conditioning systems.

Section 4

Computer Vision & Artificial Intelligence

Draw To Model: A 3D Interpretation Tool For Paper-Based Drawings

Student: **Gaetano Bugelli**
Supervisor: **Dr Alexandra Bonnici**

What is your project about?

3D modelling is typically performed using CAD software, which takes time and has a steep learning curve. Moreover, prior to constructing a model, designers often first produce a sketch. Sketch-based modelling (SBM) can interpret such a sketch and reconstruct a 3D model from it. In this way, the modelling process is expedited. Several SBM systems have been developed, however it is difficult to compare between them since they accept different kinds of inputs and produce different kinds of outputs. Thus, in this dissertation, a protocol for evaluating the performance of SBM systems was devised. The protocol provides a means to create standardized sketches from existing 3D models, reconstruct 3D models from sketches and evaluate the accuracy of reconstructed models. Since the protocol has a standard input and output it provides a means to benchmark SBM approaches. The protocol was proven to work with two SBM approaches and can be adapted and applied to evaluate any SBM approach.

Why are you working on this project?

I opted to undertake this project as it involved two interests of mine: design and artificial intelligence. The use of artificial intelligence has been explored in a multitude of applications, some of which have already integrated it. Although several sketch-based modelling systems have been developed, none have yet been integrated in industrial applications. By providing a means for easier comparison between methods, the protocol I devised indicates which SBM system works best for different cases, which can facilitate earlier adoption by industry. Ultimately, eliminating the constraint to use CAD software, makes 3D modelling more accessible. This makes it easier for one to create 3D models for 3D printing and creation of NFTS amongst others.

Identifying Optimal Investment Strategies with Deep Learning

Student: **Samwel Portelli**
Supervisor: **Dr Kenneth Scerri**

What is your project about?

With the advent of Artificial Intelligence (AI) and the availability of computational power, together with the large volumes of data available, algorithmic systems capable of identifying profitable investments are now possible. In fact, the aim of this project was to develop and compare Deep Learning (DL) methods to determine which one is the most accurate in forecasting future stock prices. These future predictions are then used by a program designed to identify the most profitable investments, according to the provided predictions. During a year which contained the devastating effect of the COVID-19 pandemic breakout on the stock's value, the implemented system managed to generate a simulated profit of 97.22%.

Why are you working on this project?

Artificial Intelligence (AI) has been a growing field for the past few decades. However, in the past few years, there has been an exponential influx of new technologies, which lead to the application of this technology in a wide variety of fields. This field is of interest to me because it is constantly evolving and it is applicable to different areas of engineering. Furthermore, financial data forecasting through the use of algorithms is a challenging task which interested me.

This technology has been a major factor in the success of Fintech companies, which are able to generate substantial profit algorithmically. Making this technology available to the general public could potentially give them the opportunity of generating substantial income. On the other hand, this technology could help companies in the financial industry convert workforce from human traders to an algorithm-based system.

DocRead – A Document Segmentation Tool

Student: **Erika Spiteri Bailey**
Supervisor: **Dr Alexandra Bonnici** | Co-Supervisor: **Dr Ing. Stefania Cristina**

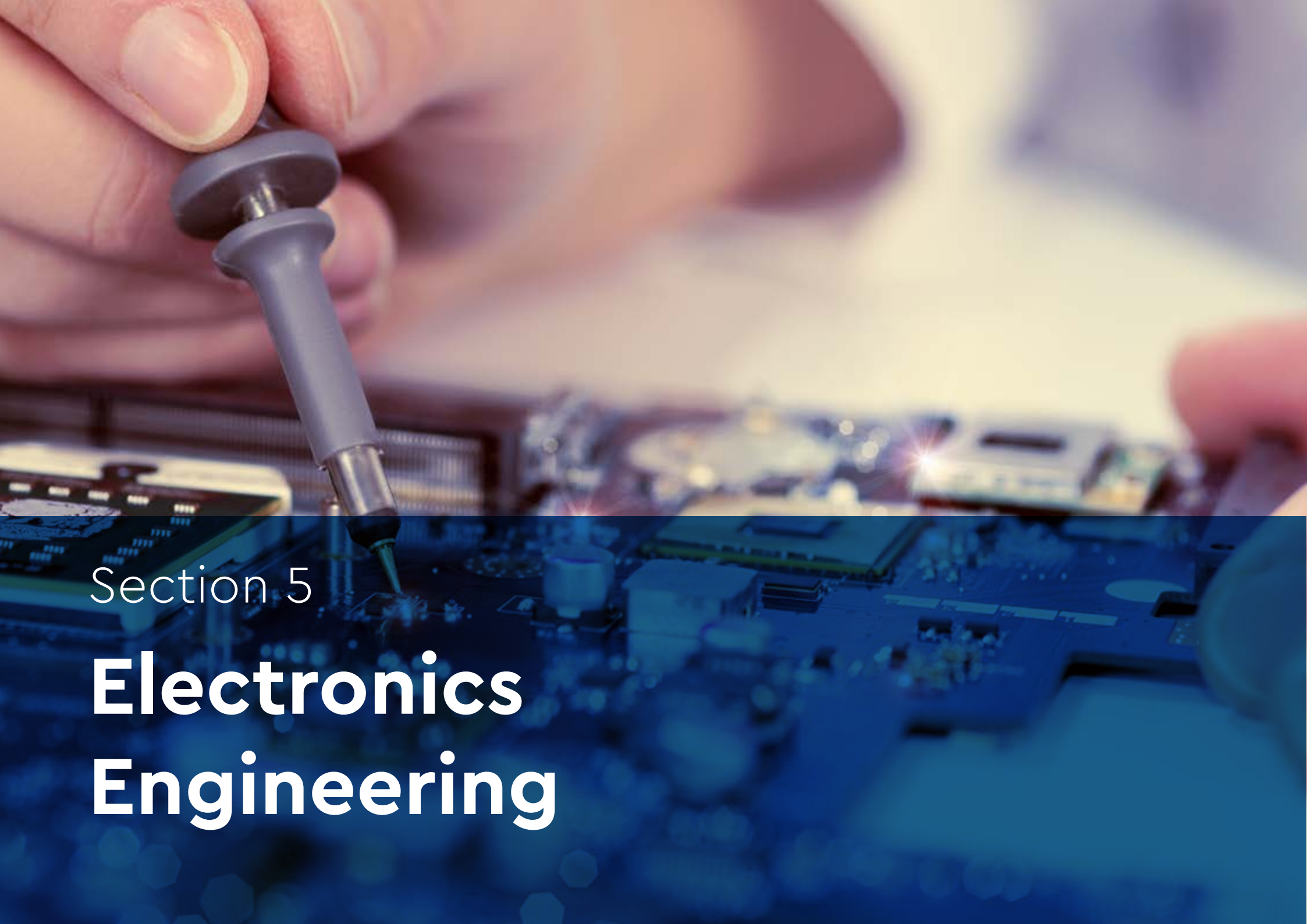
What is your project about?

For students and scholars with visual impairments, text-to-speech synthesis is a valuable tool. While they are currently not supported by existing reader tools, non-textual features such as tables, equations, cross-references and figures will be used to supplement the text in scientific work. In order to pick appropriate representations for text-to-speech synthesis, these non-text items must be removed and separated from the content. Thus, the goal of this dissertation was to differentiate between different types of page objects on a generalised document image. Modern, state-of-the-art technology was used to provide accurate and efficient page object detection.

Why are you working on this project?

Despite having no coding background prior to University, I developed a strong interest in the subject through the various study units offered throughout the course. The Department of Systems and Control Engineering provided ample room for growth in this field. In this field of engineering, it is possible to learn and work with the latest technologies, which I found very exciting.

It is a struggle to lead a life where reading is a high-effort, slow and tedious task. The need for such a project was substantiated by the gap in the market for products interpreting all types of page documents. The integration of people with print disabilities into society as independent people is reliant on such technology. Knowing that my work would contribute to society in general, I was motivated to contribute my best effort to effectively carry out this task.



Section 5

Electronics Engineering

Compact UHF Patch Antenna design for a PicoSatellite

Student: **Martha Vella**
Supervisor: **Dr Ing. Marc Anthony Azzopardi** | Co-Supervisor: **Mr Oliver Vassallo**

What is your project about?

During this project, a preliminary design for a UHF antenna for the first Maltese satellite, UoMBSat-1, was investigated. The frequency range chosen, which will be used both for transmission and reception, offers modest losses such as free-space path loss and atmospheric absorption. However, at this range, the challenge is the long wavelength (at around 70 cm) when compared to the satellite dimensions, a cube of side length 50 mm. Due to the restrictions imposed on the satellite's volume and weight, a fractal patch antenna was preferred over the larger, more complex, deployable antenna design.

Why are you working on this project?

Miniature satellites were introduced in recent years to democratize space by providing the opportunity to researchers and students to design and launch satellites in orbit, at low costs. This project provided the challenge to work and design within the constrains set by standards and previous works while still presented the opportunity to do research and be part of a team of expertise working on the satellite.

The primary mission of this pico-satellite is to perform experiments when in orbit and obtaining information on the ionosphere. The use of the PocketQube satellites can be varied and amended accordingly to the requirements presented. Hence, the layout and construction of the system can be implemented in further applications, having the possibility to perform various missions, utilising the designed structure. To analyse the data acquired and monitor the state of the satellite, a good communication link must be established, thus, it was required to design an antenna that is efficient and has relatively high gain.

Radio System Integration for a UHF Geodesic Phased Array System

Student: **Christopher Conrad**
Supervisor: **Dr Ing. Marc Anthony Azzopardi** | Co-Supervisor: **Mr Andre Micallef**

What is your project about?

In recent years, the space industry has shifted its focus to the launch of large constellations of small satellites. These developments pose a new challenge to low-cost ground stations, which must be capable of tracking and communicating with one or more moving satellites simultaneously. This can be achieved using phased array antennas, in which accurately controlled signals are simultaneously transmitted from multiple antennas. These signals interfere with each other to generate one or more communication beams in specific directions in space. This project involves the design, implementation and testing of a low-cost phased array radio system that can communicate with satellites currently orbiting the Earth.

Why are you working on this project?

Aerospace and communications engineering have always piqued my interest, so I immediately jumped at the opportunity to work on a project that merged these two fields. The prospect of developing a new type of satellite ground station in Malta made this endeavour even more enticing. The designed system will help pave the way for the launch of Malta's first satellites in the coming years, by offering a reliable platform to track and communicate with the spacecraft. A novel low-cost phased array architecture has been developed, capable of communicating with satellites or aerial vehicles operating at low frequencies. This will provide universities and radio amateurs with a cost-effective solution for developing a phased array radio station. In turn, it will help make such communication systems more accessible to both the educational and industrial markets, fuelling the drive for further investment and research in the field.

Non-Volatile High Performance Storage Solution for Embedded Applications

Student: **Thomas John Galea**
Supervisor: **Mr Andre Micallef** | Co-Supervisor: **Mr Luke Vassallo**

What is your project about?

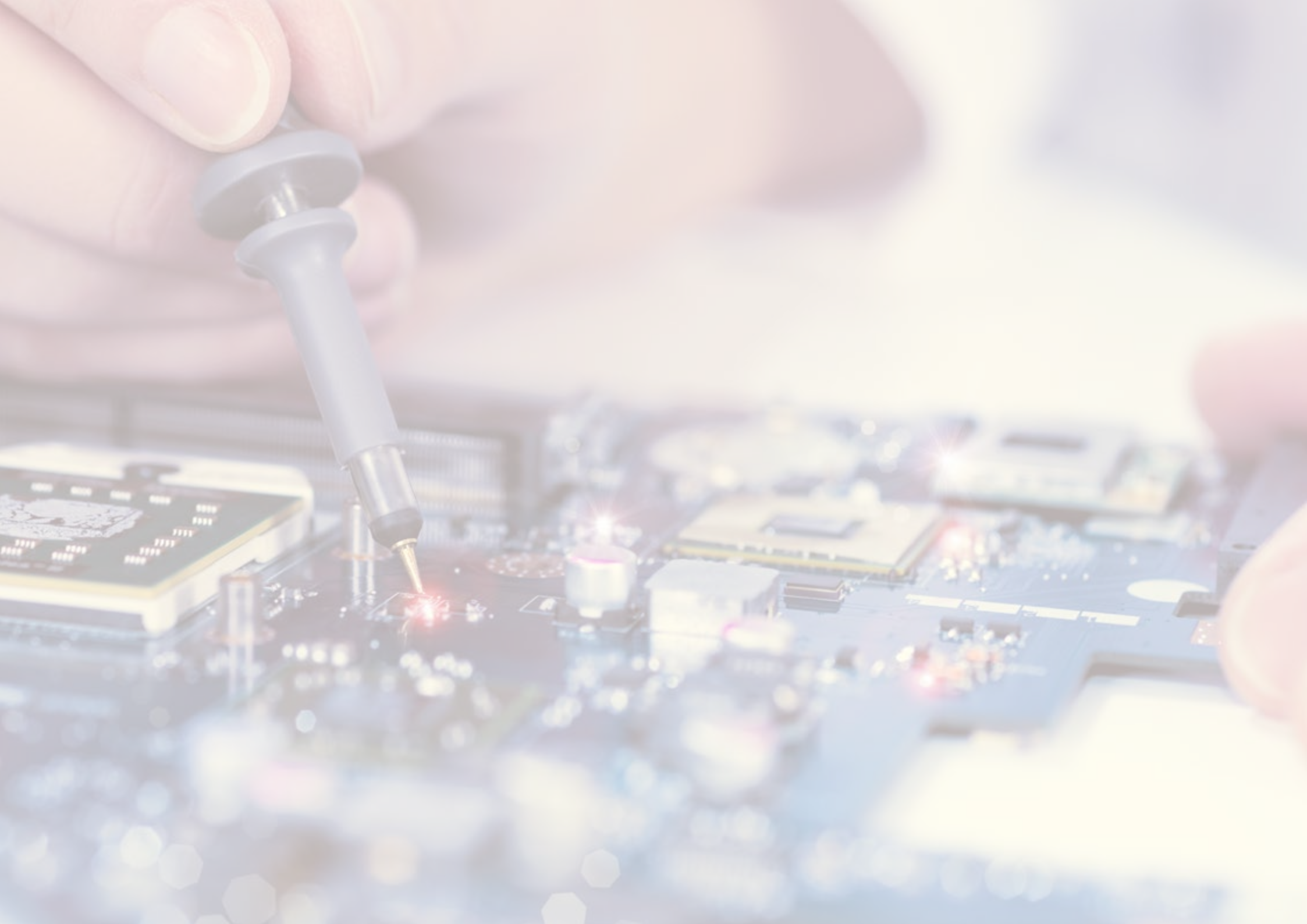
High speed systems, such as very high-performance film and scientific cameras, have achieved speeds such that current memory storage technologies are the bottleneck in their performance. Up until recently, only volatile technologies – memory whose data is only kept as long as the device is powered - could satisfy the low latency, large capacity, and high bandwidth requirements demanded by these systems. This work hence aimed to develop a memory storage system that is high performance and non-volatile, for use in embedded systems, particularly Field-Programmable Gate Array (FPGA) devices, which allow for quick prototyping and highly reconfigurable designs.

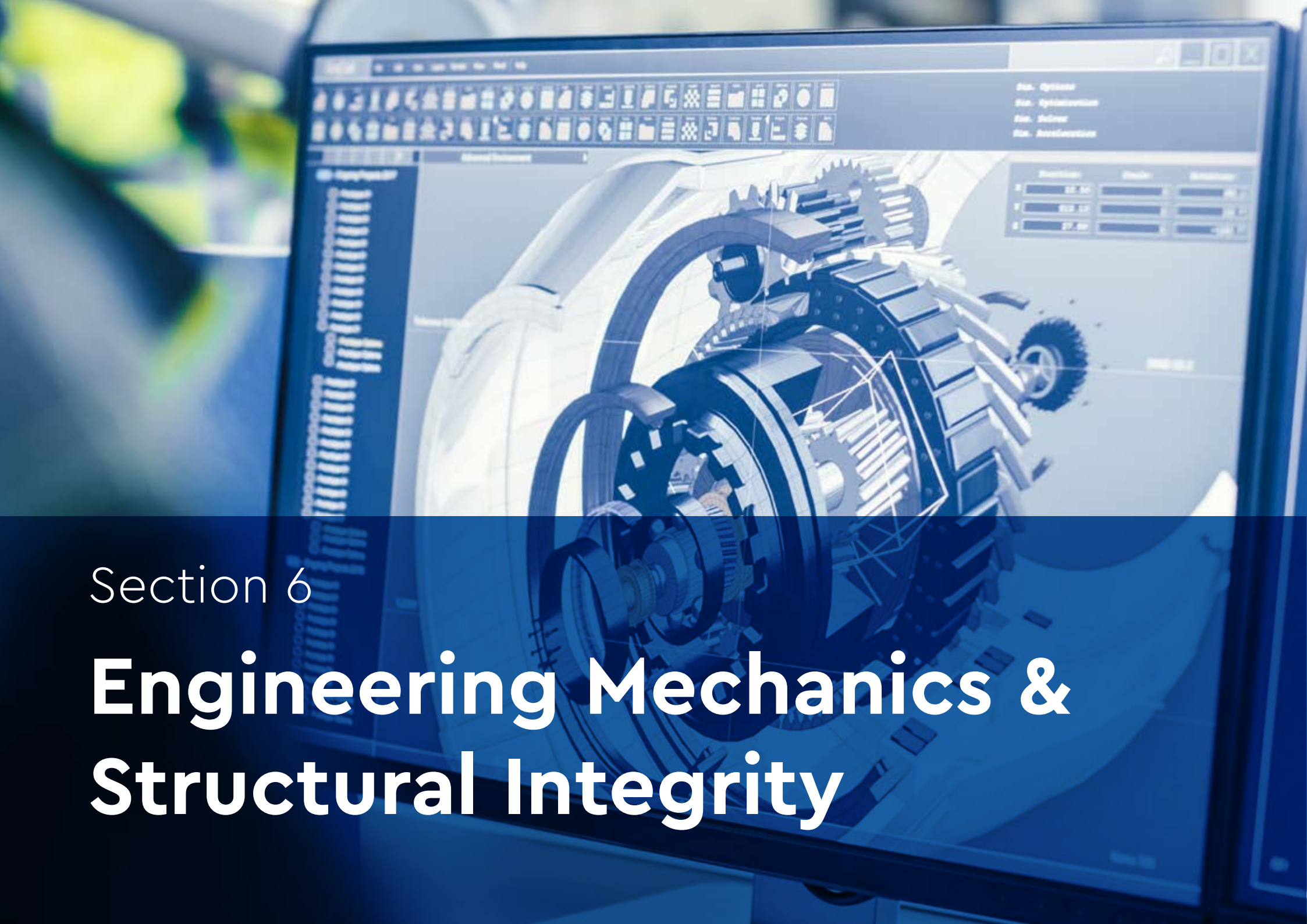
It emerged that this work involved the design, manufacturing, and assembly of a Printed Circuit Board (PCB) to host two Non-Volatile Memory Express (NVMe) PCI Express solid-state drives, or SSDs. Furthermore, the hardware and FPGA architecture designed resulted in read and write speeds of 2000MB/s and 1000MB/s respectively.

Why are you working on this project?

Electronics at large has transformed our society in every aspect of life. Pushing the envelope on the capabilities of electronics engineering through high-speed electronic design continues to pioneer both our day-to-day lives and the scientific community alike. The resulting work is intended to be implemented as part of MEMENTO, a high bandwidth high-frame rate camera to serve the industrial and scientific markets. Such a device is highly valuable in both film and science applications, and the work achieved here will contribute to ensuring high-speed storage and furthering its functionality and market competitiveness. Furthermore, the developed system can be applied to a myriad of engineering sectors and devices that make use of data acquisition and collection.

The opportunity to contribute to the MEMENTO product development has been extremely rewarding. It has also allowed me to further my skills and curiosity. The ability to design and implement such cutting-edge technology is both highly motivating and satisfying in being able to deliver the final product.





Section 6

Engineering Mechanics & Structural Integrity

Failure Analysis of Towbar Shear Pins

Student: **Rachel Zammit Mangion**
Supervisor: **Prof. Martin Muscat**

What is your project about?

The focus of my project was on the shear pins found in tow bars used to push back aircraft and tow them around the airfield such as along taxiways and runways or in hangers. Shear pins are designed to fail when excessive forces are exerted on the towbar by the tug, thereby protecting the aircraft and its nose landing gear from damage. When they do fail, however, accidents may occur. There is concern in the industry that shear pins may fail prematurely. This work studied whether premature failure could be due to fatigue. Finite element analysis was used to model the towbar system for this purpose, and it was found, that fatigue may indeed lead to the premature failure of these pins.

Why are you working on this project?

I chose to work on this project because I am interested in the effects of fatigue on components in operation as well as the aviation industry in general. I also considered this topic to be the perfect stepping-stone for me to continue my studies and work in this sector. This study is specifically relevant to the aviation industry since many accidents caused by shear pin failure have led to the damage of aircraft and equipment, and in some cases even to personal injury and fatalities. Thus, this work, and future initiatives based upon it, may contribute to a better understanding of the occurrence of fatigue in shear pins, and its effects thereof, to mitigate the risks of premature failure in operation. In this way, it could contribute to safety in aviation.

Progressive Failure Analysis of tapered GFRP Composite Poles

Student: **Yanica Sultana**
Supervisor: **Dr Ing. Brian Ellul**

What is your project about?

This project investigates how the different layups of filament wound Glass Fibre Reinforces Polymer (GFRP) poles affect the structure's ability to withstand external forces such as wind. The different GFRP poles were modelled on a software, where the failure progression of the GFRP poles was modelled beyond failure initiation, more commonly known as first-ply failure (FPF). A progressive failure analysis (PFA) was carried out to assess the poles' structural performances and compare the results to the experimental prototype poles. The results of this thesis show the comparison between the actual and the software scenarios for GFRP poles as well as the reasons as to why the software shows that numerically, first ply failure occurs earlier than the actual physical failure recorded when using physical prototypes.

Why are you working on this project?

I selected this field of engineering because the issue explored in this project is a real-life problem that occurs all over the world and the solutions for such issues can be modified and implemented in different aspects of engineering which can lead to improved structures.

My personal motivation about this work is that I hope to make life easier for people like my father that need to maintain designs and ideas created by engineers.

This work relevant to the general public and the industry because numerical analysis is more cost effective than experimental and since the results are quite similar to the experimental then numerical analysis is more ideal. You can also redo various simulations and test different parameters without incurring large costs.

Section 7

Maritime Engineering

Preliminary Design of a Superyacht

Student: **Jacques Azzopardi**
Supervisor: **Prof. Ing. Claire De Marco**

What is your project about?

In this final year project, using a universal design method for designing marine vessels, a preliminary design of a superyacht was developed to satisfy several client requirements and, most importantly, comply with maritime rules and regulations. Necessary calculations were computed and analysed by reviewing current yacht trends and studying theoretical aspects of resistance, stability, and seakeeping. Then, to better visualise the developed design, utilising multiple software, a hull was modelled, which was used for lines plans, tank plans, general arrangement, and 3D renders.

Why are you working on this project?

During the past four years, the units that mostly piqued my interest were naval architecture and the other maritime units. Hence, with the intention of pursuing a career in the maritime industry, I set my first preference on conducting a final year project related to it to gain experience and widen my knowledge of the sector.

From hundreds of years ago to this day, our global economy mainly depends on the maritime industry to design and build ships of all shapes and sizes to transport resources and products, provide services, and as a platform for leisure purposes. With this said, naval architects and maritime engineers are constantly needed to design new innovative vessels as similarly done in this project and also to maintain and refit vessels already in service to ensure the safety of people and the environment.

Preliminary Design of a Monohull Racing Sailing Yacht

Student: **Harry Grima**
Supervisor: **Prof. Ing. Claire De Marco**

What is your project about?

The sport of yacht racing is once again becoming rather popular all around the world, especially in Malta due to the island's advantageous climate. Therefore, the scope of the project was to create a preliminary design for a monohull sailing yacht, specifically for racing. Each year there are more and more local sailing races and international regattas being held, yet there is still a lack of competitive smaller yachts. Hence, the yacht chosen to be designed was to be a relatively small racing sailing yacht that would be able to compete against the very best competitive yachts on the market. Racing yachts although similar in appearance to general pastime yachts have characteristics that are optimised to enhance the performance of the final design. Features such as geometrical form, keel, sail and mast attributes and combinations need also to be considered to enhance the sailing yacht performance.

Why are you working on this project?

I have chosen this field of engineering as my main interest lies within the maritime industry. Yachting has also become a big part of my life as a very close colleague of mine races competitively all around the world and the idea for a racing sailing yacht actually stemmed from my colleague. Yachting is seen as a sport and activity that requires enormous amounts of capital in order to succeed, although that is not the case as each yacht, big or small, can win a race or regatta. Hence, I was highly interested in creating a smaller yacht preliminary design that could be competitive in such races and regattas. Lastly, after I graduate I plan on becoming a naval architect, which meant that a project that was heavily focussed on the design and simulation of a monohull yacht would help me to better understand the fundamental concepts and pertinent detail attention required by a naval architect.

Impact of Blockage Effects on Resistance Tow-Testing for Sea-Faring Vessels

Student: **Kyle Verbraeken**
Supervisor: **Dr Simon Mizzi**

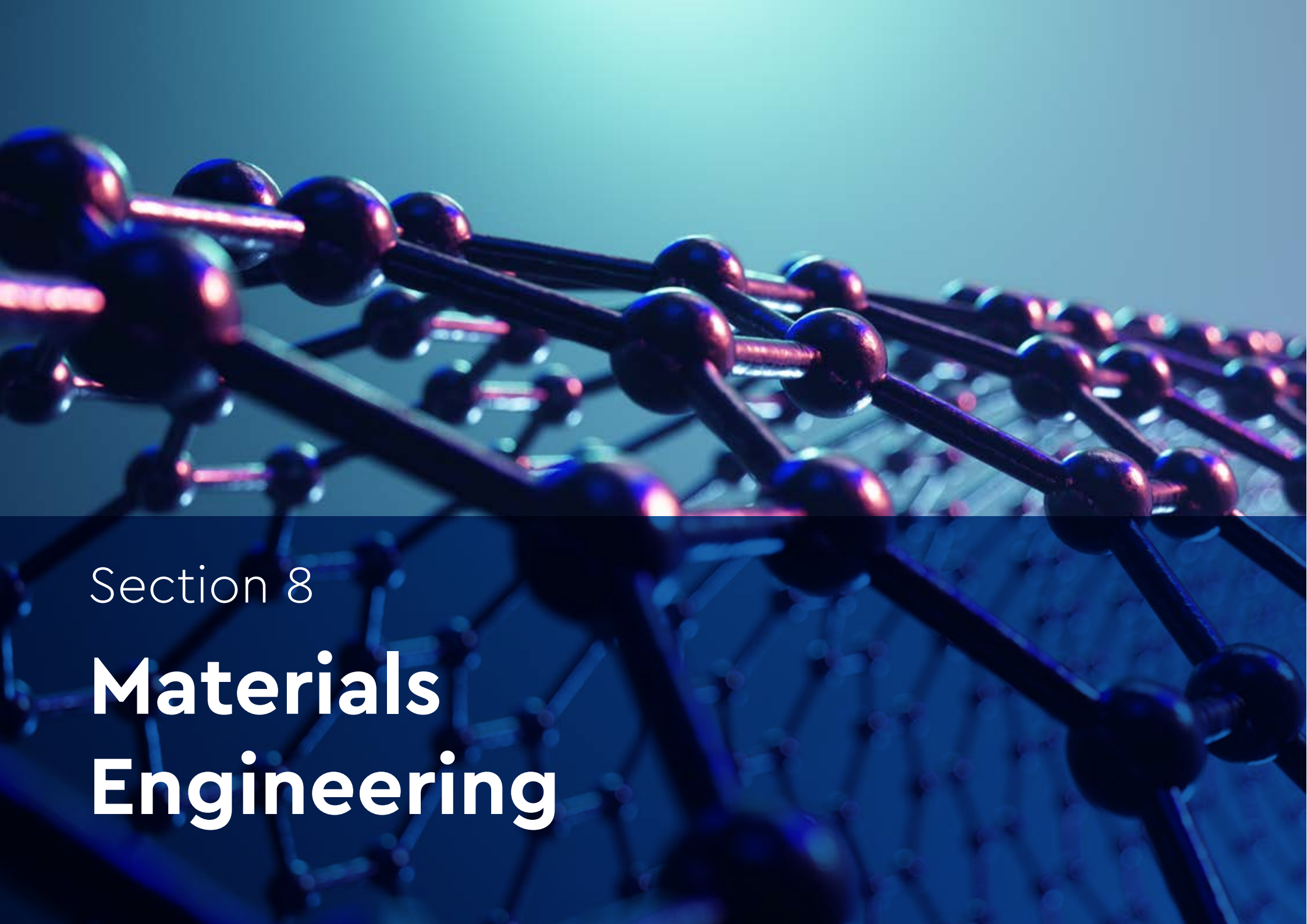
What is your project about?

Ship testing is a significant part of the ship design process. Ship resistance testing is crucial since the engine power required may be estimated. However, it is not feasible to construct a new vessel for each improved design, hence ship testing is performed on scaled models in a pool of water known as a towing tank. A critical difference between a ship in open water and a towing tank is that the waves produced by the vessel are reflected along the tank's boundary, affecting the generated results. The project revolves around the study of the impact of resistance caused by the tank's finite geometry and the effectiveness of analytical correctors currently available.

Why are you working on this project?

From the bolts fixing an ordinary lightbulb to a large scale Airbus A380, state of the art engineering innovation formed the world we live in today. Engineering is the process in which science, together with innovation and technology, is used to produce artefacts to facilitate life.

Marine transportation of goods and people is a significant part of today's thriving industry, thus sparking my interest in conducting research within the maritime engineering industry. The project is particularly interesting due to the importance of accurate power estimation of large scale vessels. Using the project's findings, the finite boundary effect on the calm water resistance test could be understood more clearly whilst defining the most suitable means of correction. Finally, with the project findings, the University of Malta now possess the most suitable vessel beam and draught dimensions to obtain the least analytical error associated with the correction for the tank particularly used by the university.



Section 8

Materials Engineering

Characterising the microstructure of wrought iron and steel armour plate from the Grandmaster's Palace Armoury

Student: **Jacob Bezzina**
Supervisor: **Dr Daniel Vella**
Industrial Partner: **Heritage Malta**

What is your project about?

The main objective of this project was to shed light on the metallography of plate armour pieces belonging to the Arms and Armoury collection at the Grandmaster's Palace Armoury in Valletta. Unlike modern steels, wrought iron and steel produced in the 16th century contains a significant volume fraction of non-metallic slag inclusions. Slag finds its way into the metal because of the inefficiency of the extraction processes of iron from its ore, but was also added deliberately to serve as flux. In this project, a technique called Raman micro-spectroscopy was employed to examine these slag inclusions and characterise their mineral composition. Another technique known as Energy Dispersive Spectroscopy allowed the same slag inclusions to be characterized for chemical composition. The slag inclusions entrapped in the metal hold information about the processes employed in the past by which iron ore was converted into workable iron. The manufacturing methods employed to fabricate the armour pieces from wrought iron and steel plate hundreds of years ago are partly locked in their microstructure.

Why are you working on this project?

Engineering metallurgy and history have been topics of interest for me ever since I was a child. Being able to combine these two passions for the purpose of this project was an amazing opportunity for which I am thankful for. During my time at the university, my appreciation for the metallurgical aspects in engineering grew. Through this project I hoped to share some of that interest by discussing the use of engineering techniques applied to uncover the history behind the armour production, as well as how engineering concepts were employed in their manufacture, in a time where such concepts were not well understood.

Raman micro-spectroscopy was a powerful tool used in this study. Whilst commonly used within the field of heritage materials, the use of this technique is novel when considering the analysis of slag inclusions within armour pieces is quite sparse in literature, and through this work I hope to display its usefulness within this particular field.

Investigating the deposition of graphene oxide on polymeric foams for filtration applications

Student: **Denise Sciberras**
Supervisor: **Dr Ing. Anthea Agius Anastasi** | Co-Supervisor: **Ms Maria Magro**

What is your project about?

Water scarcity is an ever-growing problem in our world, and great efforts are made towards overcoming this problem. An effective way of obtaining clean, potable water is through various filtration techniques, which require constant development to adapt to today's needs, especially in terms of materials. Graphene oxide (GO) is a material which has shown promising qualities in the filtration sector. Its base structure consists of atoms of carbon, Earth's second-most abundant element. However, it has interesting chemical structures attached to this base structure, which can interact with salts present in solutions such as seawater, and hence filter them out to bring about desalination. This project studies depositing graphene oxide onto foam, creating an overall robust material for desalination purposes.

Why are you working on this project?

My interest in nanomaterials was what prompted me to delve into this area of engineering, accompanied by the spectacular properties of the recently discovered graphene-based materials. Being very small materials active on the nanoscale (1,000,000 times smaller than a millimetre), they have astounding qualities, some of which trump those of commonly known materials such as metals. Filtration is a very important sector for all of us and water scarcity is an issue of concern to everyone. Furthermore, studies in this area may eventually lead to helping people in regions of the world which are already suffering from this problem. Therefore, tackling this matter using high-potential novel materials like graphene oxide opens up intriguing pathways in research and can lead to valuable and rewarding results.

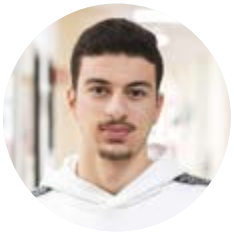
Synthesis of 3D Graphene Networks

Student: **Ryan Busuttil**
Supervisor: **Dr Ing. Anthea Agius Anastasi** | Co-Supervisor: **Prof. Ing. Glenn Cassar**

What is your project about?

This project aims to conduct and study the assembly of graphene into three-dimensional graphene (3D) constructions. Graphene is a two-dimensional (2D) nanomaterial composed of a single-atom layer of carbon atoms. It possesses exceptional properties, however, these may be better exploited by constructing these graphene layers into a 3D assembly of sheets. Doing so promotes improved structural integrity, higher specific surface areas and fast electron transportation, all of which make this nanomaterial a suitable material candidate in a multitude of potential applications. In this study, porous 3D graphene networks were produced, having different properties, each of which were tested to determine the most optimal network for high-efficiency adsorption applications.

Why are you working on this project?



Personally, I decided to undertake this project because I was fascinated with the idea of working with nanomaterials. Graphene specifically, is a nanomaterial which I had not heard of before, which is why it sparked my interest. It is to this day, still being explored and studies are ongoing with the aim of better understanding this “wonder material”. The possibility of being amongst the scientists who were able to learn and contribute their knowledge on graphene was exciting. After familiarizing myself with this nanomaterial, it has become clear that graphene is key to developing and optimising future novel applications. The current issue lies in being able to fabricate these 3D graphene networks from graphene, whilst producing decent yields and being of good quality, without increasing defects in the structure. Such a challenge may be overcome by exploring different synthesis techniques and through process parameter modification, determine the best results possible. Doing so could open the possibility of using graphene in future novel applications, such as in energy storage, filtration, sensory devices, flexible displays, and drug delivery.

Developing Photocatalytic Titanium Dioxide Nanocomposite Coatings

Student: **Jean Claude Mallia**
Supervisor: **Dr Sophie M. Briffa** | Co-Supervisor: **Dr Ing. Anthea Agius Anastasi**

What is your project about?

This research project focused on the development of a polymer-based coating containing titanium dioxide nanomaterials for glass surfaces. The aim was to improve the polymer coating by introducing titanium dioxide nanomaterials in order to induce self-cleaning and antimicrobial effects on exposure to UV radiation from natural sunlight or artificial sources. Other properties such as hydrophobicity, surface stability and hardness were also investigated. The development and use of such coatings seek to reduce costs related to cleaning supplies and services by keeping the surface of the coated component clean and by reducing infection transmission.

Why are you working on this project?

I chose the field of nanotechnology due to the interesting and different properties that these materials possess over their bulk form resulting in their extensive potential in various applications. I was keen to work with nanomaterials to learn more about their distinct capabilities and to have the opportunity to create a coating with desirable properties which were simply activated by natural sources such as sunlight. Over the past year, my interest grew as I learnt more about the numerous industries where these nanomaterials can be implemented due to their small size and intrinsic properties which enabled certain products to be reduced in size. This size reduction has become quite desirable in today’s world.

Recent global events have made coatings with self-cleaning and antimicrobial effects quite desirable as this will help to reduce costs, water consumption and time related to cleaning and also reduce the chances of infection. Such coatings can be beneficial for applications such as high touch surfaces, hospital windows and interior controls in vehicles.

Development of a Hydrogel Layer onto Porous TiN Coated Ti6Al4V for Implantable Neural Stimulation Electrodes

Student: **Luigi Bonavia**
Supervisor: **Prof. Ing. Bertram Mallia** | Co-Supervisor: **Ms Jeanelle Arpa**

What is your project about?

Interdisciplinary efforts in the past decades have enabled advancement in neural technology and the stimulation of neurons that target problematic diseases and conditions such as epilepsy, paralysis and Parkinson's disease. Frontier research has recently been focused on advancing the electrochemical properties of electrodes beyond those of traditionally employed materials to reduce invasiveness and inflammation, maintain the electrodes' mechanical and electrical stability with chronic use, and preferably be target-tissue specific.

Porous titanium nitride (TiN) deposited using physical vapour deposition techniques has been put forward as a prospective candidate electrode material capable of being applied for micro-sized electrodes. Its porosity enhances the electrochemical characteristics but also results in some drawbacks. Notably, drawbacks include the facilitation of fibroblast attachment which is further aggravated by the high mechanical mismatch of the TiN electrode with the neural interface.

In this work, a methodology for the deposition of an alginate layer over porous TiN was developed with the goal of reducing electrode fouling. Furthermore, the effects of the gel on the original electrochemical properties of the porous TiN electrode were assessed to evaluate their applicability

Why are you working on this project?

The amalgamation of several fields of studies presents a great potential for the advancement of biomedical devices, which has drawn my interest. This project combines the fields of material engineering with medicine and biology. Such research allows for the advancement of medical treatment technology leading to a better quality of life for the patients requiring treatment. My contribution towards implantable electrode materials research consisted of the development and testing of a hydrogel layer onto porous TiN electrode material. It gives me great satisfaction that the employment of this surface modification could alleviate problems associated with fouling following electrode implantation.

Welding of Heat Treatable Aluminium Alloys

Student: **Nigel Farrugia**
Supervisor: **Prof. Ing. Maurice Grech**

What is your project about?

This research aims to study how an aluminium alloy loses its properties after being welded and discover how the original properties can be restored by heat treatment. Aluminium is an abundant material in industry, mainly chosen for its strength to weight ratios, good weldability and excellent corrosion resistance. Heat treatment of aluminium alloys involves heating the material to high temperatures and rapidly cooling it to enhance its properties. The material is tested in the untreated, welded, and heat treated conditions by testing the tensile, impact, and hardness properties.

Why are you working on this project?

Colin Chapman, the founder of Lotus, had a famous philosophy which said, "*Simplify, then add lightness*." Another famous philosophy was, "*Adding power makes you faster on the straights, but subtracting weight makes you faster everywhere*." It is one thing to strip a car apart to make it faster, but I prefer building a car from the ground up with these philosophies by studying the best possible materials that can withstand anything you can throw at them without the added weight. Aluminium is an excellent material for this application since some alloys have strength comparable to some steels while being much lighter. When welding is involved, however, be it for assembly or repair, the structure loses its strength if left untreated. Therefore, this research is a step forward in building the perfect car, with added lightness.

Section 9

Product Development

Design of An Environmentally Friendly Lip Gloss Packaging

Student: **Nicolai Noel Cutajar**
Supervisor: **Prof. Ing. Jonathan C. Borg** | Co-Supervisor: **Mr James A. Kingswell**
Industrial Partner: **Toly (Malta) Ltd**

What is your project about?

Toly (Malta) Ltd is a worldwide cosmetic packaging manufacturer, which is constantly seeking new ways to develop products that meet the necessary customer requirements, while reducing their respective environmental impacts. This was the driving factor to develop an environmentally friendly lip gloss packaging from an end-of-life perspective. The current lip gloss packaging design poses a number of challenges in the recycling process of this product. Therefore, this project focuses on the development of an innovative lip gloss packaging which has a significantly longer life span and can be partially recycled, in order to make this product more environmentally friendly.

Why are you working on this project?

The reason I chose to work on this project was because environmental impacts are a major factor in the design of packaging. Environmentally friendly designs are an important step in reducing the environmental impacts of products that we use on a daily basis. Therefore, given that the state of the planet's environment is currently fragile, I was very happy to work on a project which may help reverse this problem. Since the utilisation of lip gloss is becoming increasingly popular, the requirement to develop an environmentally friendly lip gloss packaging is also becoming more important. Designing environmentally friendly products will aid companies to remain competitive and provide customers with desirable solutions.

3D Model Creation of an O-ring Tool Using Parametric Modelling

Student: **Jeremy Farrugia**
Supervisor: **Dr Ing. Joseph Paul Zammit**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

What is your project about?

The manufacturing industry is a competitive environment which Is constantly on the lookout for methods which can reduce the time taken to develop a product. The aim of this project is to automate the process for tool designers working on the design of prototype moulds to produce O-ring samples, where instead of manually designing the mould and the corresponding tasks involved (3D modelling and Tool Drawings), the process would be fully automated.

This project exploits features present in computer design software to automate the production of rapid prototype moulds for O-rings whilst at the same reducing the workload for the tool designers.

Why are you working on this project?

The motivation for choosing such a project comes from my interest in the product design and the manufacturing industry. Being a major sector on the Maltese Islands, the manufacturing industry always has room for improvement, allowing persons working in engineering to use their creativity and innovative character to craft solutions that may improve a company's processes.

A highly skilled person working on a repetitive process is something that, in my mind, is a waste of valuable resources for a company. The opportunity to automate a manual and repetitive process was one that caught my interest, and this project gave me the opportunity to find a solution for this problem, whilst also creating an opportunity for the individual to use their resources more effectively in a more demanding task.

Section 10

Renewable Energy & Energy Storage

Modelling and Analysis of the Hydraulic Flow Losses in Hydro-Pneumatic Energy Storage Systems During Charging

Student: **Briam Mifsud**
Supervisor: **Prof. Ing. Tonio Sant** | Co-Supervisor: **Ing. Luke Aquilina**

What is your project about?

A fundamental problem which, present energy storage systems fail to address is the integration of renewable energy production of a large scale into typical conventional energy system. In simple terms current systems do not address the mismatch between energy demand and supply. The solution for the aforementioned issue is a hydro-pneumatic energy storage system, a system where the fluid will be pumped to an accumulator which will displace a liquid piston for air compression. Hence, the main aim of this research was to focus on developing a numerical model of a hydro-pneumatic energy storage system using Simulink on MATLAB® to estimate the hydraulic flow losses which were encountered in such system under different flow conditions during charging. Besides addressing the mismatch between energy supply and demand, the development of an HPES system was essential since such a system can provide a predictable supply which is intended for short to medium term use and hence this makes the system a viable option in being used to help developing countries or countries which find it hard to have constant electricity generated due to unforeseen circumstances such as war, natural disasters, failure and so on.

Why are you working on this project?

Ever since I was a young kid, my parents and I loved traveling, we travelled to a variety of countries including high-income countries, low-income countries and also newly emerging countries. Hence, this led me to see, first-hand the issues going on around the world, where, unlike most high-income countries, developing countries suffered from a number of issues, one of which is the unstable/unpredictable electricity due to natural disasters, failing economies, wars and many other issues. Therefore, seeing as I can make even the smallest difference by contributing the insights of my findings in order to further improve a system such as the hydro-pneumatic energy storage system (which was developed by FLASC team at the University of Malta), is both, very motivational seeing as this will help many people in the near future, as well as interesting. Moreover, this work, as previously mentioned is a very vital one both for the general public and the industry itself. This is the case since, as global warming gets worse, natural disasters will increase, which means a system such as the HPES system could be of big help to many countries in the near future.

Modelling the Performance of an Array of Seawater Pumps for Offshore Hydro-Pneumatic Energy Storage Applications

Student: **Andrea Cassar**
Supervisor: **Prof. Ing. Tonio Sant** | Co-Supervisor: **Mr Andrew Borġ**

What is your project about?

In an offshore hydro-pneumatic energy storage system, a pump is used to inject seawater into a pressure containment system (PCS) which is pre-charged with compressed air, thus storing energy. However, during the charging phase, the pump will be subjected to a wide operating pressure window, thereby having an impact on its operational efficiency. One way of injecting seawater into the PCS involves the use of a single large centrifugal pump operated with a variable speed drive.

This project aims at analysing the possibility of replacing the single large pump with an array of smaller fixed-speed pumps arranged in serial/parallel configurations in order to reduce the costs involved while retaining relatively high operating efficiencies. A feasibility study based on the operational efficiency of both pumping units was conducted by constructing numerical models using the Simulink® software. Furthermore, simulations were performed at various states of charge of a gas-charged accumulator.

Why are you working on this project?

We are all aware of the devastating effects which climate change and global warming are leaving on planet earth primarily due to the fast-growing levels of CO_2 emissions. The global energy's sector shift from fossil fuels to renewable energy sources coupled with the need for innovative energy storage solutions have instilled in me a passion for the field of renewable energy. It is a field of engineering which is constantly advancing since the intermittent nature of renewable energy sources requires efficient and effective ways of addressing the mismatch between the supply of energy and its demand. Knowing that this project can lead to a more efficient hydro-pneumatic energy storage system involving reduced costs, fuels my drive for a cleaner and more sustainable world.

Assessing the Photocatalytic Activity of TiO_2 Nanotubes using a Photoelectrochemical cell

Student: **Josmar Camilleri**
Supervisor: **Dr Ing. Stephen Abela** | Co-Supervisor: **Dr Ing. Paul Refalo**

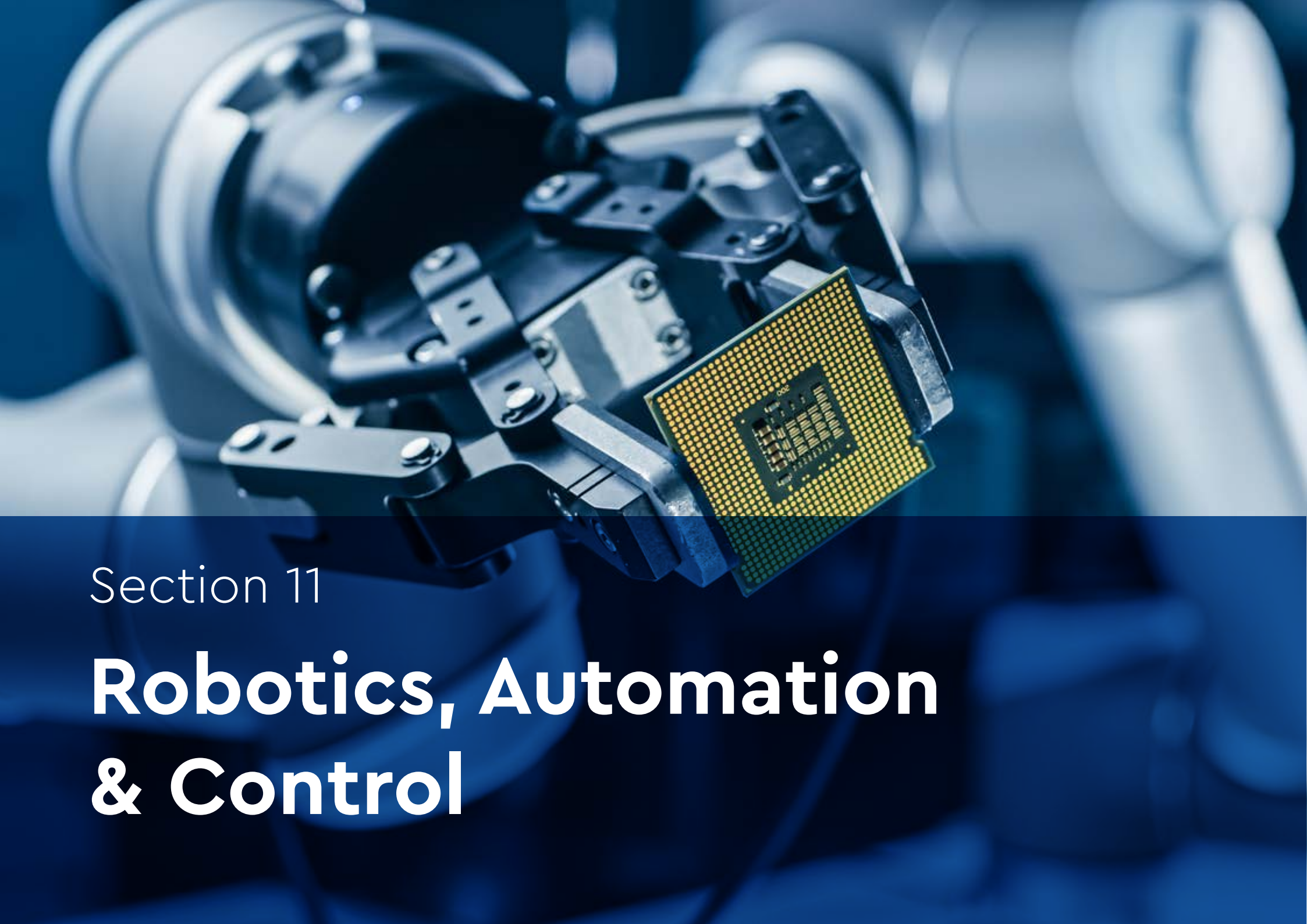
What is your project about?

Water scarcity is an ever-growing global issue that resulted from overdevelopment and complete disregard of society to the ecosystem of our planet. To make better use of the water available, recycling technologies are being used. Photocatalysis is an advanced treatment technology that uses a photoreactive material to completely degrade pollutants found in water. In this project, a photoelectrochemical cell was designed and fabricated to investigate the photocatalytic characteristics of such materials by measuring the electrical response. Nanotextured titanium Dioxide (TiO_2), which is one of the most effective photocatalysts, was studied using this device. By varying UV irradiance, the process efficiencies at different conditions were found. This determined the optimal conditions required by the TiO_2 to conduct the treatment at maximum efficiency.

Why are you working on this project?

Nanotechnology has become important in various fields and applications that affect our daily lives. Engineering, medicine, computing, and communications are some of the fields that have been recently impacted by the utilisation of nanomaterials. Nanomaterials piqued my interest when I was first introduced to such materials during the engineering course because of their ongoing development and expanding impact across numerous industries.

This project focuses on one of the major issues that we face globally, water scarcity. Being aware of such issue, I was motivated by how photocatalysis can make a difference in the way we reuse water without the production of harmful by-products. The device produced in this study can help characterise newly developed nanotextured photocatalysts to further improve their photocatalytic ability. This in turn can improve the effectivity and efficiency of the photocatalytic process and promote itself for personal and industrial applications.



Section 11

Robotics, Automation & Control

Automation during Additive Manufacturing – A case study for 3D Printed Bespoke VR Rehabilitation Devices

Student: **Kurt Baldacchino**
Supervisor: **Prof. Ing. Philip Farrugia**

What is your project about?

Presently, Virtual Reality (VR) technology is being used for rehabilitation of post stroke patients using off-the-shelf VR devices. The Department of Industrial & Manufacturing Engineering together with an international consortium working on the PRIME-VR2 project is addressing this gap in the market by 3D printing VR rehabilitation devices which are specially designed to fit a person's needs using additive manufacturing. One of the stages currently adopted in manufacturing these tailor-made VR devices involves the manual folding of one of the VR device's components during 3D printing. As such, this case study aims at designing an automation system, to eliminate this manual folding operation. The solution proposed is to design a robotic arm's end effector which is flexible, accurate, and is small enough to operate in a 3D printer's build volume.

Why are you working on this project?

Automation is an interesting concept which lacks research when applied to additive manufacturing. There are many market possibilities and future implications tied with this work, so it was my personal motivation to address this gap in the market. There is not much information available on this topic, so this work can serve as an initial guide. Currently, off-the-shelf components and devices are used to aid rehabilitation of post stroke patients, but the use of off-the-shelf components also applies to other applications, which narrows down the target user. People may have different needs for different applications, so this research is also beneficial to the general public and not just the target users of this case study. Automating the additive manufacturing process, as in this case study, can help make tailormade products more economically feasible. Therefore, if these products are more economically feasible, it may be possible to purchase a custom order at a reasonable price.

Design for Safety in Industrial Automation Systems

Student: **Amberlynn Bonello**
Supervisor: **Dr Ing. Emmanuel Francalanza**
Industrial Partner: **Methode Electronics Malta Ltd.**

What is your project about?

Safety is an aspect that raises ambiguities in Industry 4.0 drivers such as collaborative robots (cobots). Cobots permit fenceless physical collaboration between human and robot, appropriately justifying their name. Obscurities regarding the level of attainable safety in cobots may in return adversely affect the system's trustworthiness. Given that safety does not solely refer to physical safety, the project will explore different facets of safety and how these influence the perception of trust in collaborative systems. A cobot system is implemented and assessed to lay a solid foundation for future safe and trustworthy cobot system designs.

Why are you working on this project?

The future lies in robotics, technology and faster production rates. However, it is very important that as we advance forward, we do not compromise on the operator's physical and psychological being. I have always been an avid believer that opportunities on the shopfloor are to be given to everyone, therefore this project has allowed me to merge two distinct fields, engineering and psychology; and open the potential for more research to take place. Designing safe collaborative robotic systems has led to a deeper appreciation of the mark that an engineer can leave on society. An engineer's design can either enhance or deter the end user's experience, especially when factors such as safety and trustworthiness take place. This project aspires to be a turning point in the way a collaborative system design process takes place.

Development of a Modular Test Jig for 3D Printed Bespoke VR Rehabilitation Devices

Student: **Jael Deguara**
Supervisor: **Prof. Ing. Phillip Farrugia** | Co-Supervisor: **Dr Ing. Pierre Vella**

What is your project about?

The Department of Industrial and Manufacturing Engineering is involved in a €4M Horizon 2020 project, titled *"Personalised Recovery Through a Multi-User Environment: Virtual Reality For Rehabilitation" (PRIME-VR2)*. The idea is that instead of using an off-the-shelf device, one can use a 3D printed VR rehabilitation device which is purposely designed according to the person's needs. The tailor-made wearable device is being developed specifically for three target users, namely persons who suffered a sports injury, post-stroke patients and children with dystonia

In view of this context, this project aims at designing and building of a modular test jig for such 3D printed bespoke rehabilitation devices. As specified in the grant agreement of PRIME-VR2, the VR device has to provide its service for up to 10,000 cycles. The upper limb movements that must be tested include; flexion and extension of the wrist, flexion and extension of the fingers, and supination and pronation of the wrist.

Why are you working on this project?

VR technology in the medicinal world is highly advantageous because clinicians can now obtain efficient data regarding the rehabilitation stages of the patient. The use of VR in rehabilitation provides a high quality user experience, compared to conventional rehabilitation. Performing testing on the 3D printed device is essential to ascertain that the product fulfils all the predefined requirements. Testing provides an abundance of knowledge concerning the tested product, and the data gathered can be particularly beneficial to the production design sector

I always had a keen interest in innovation and design which made this title ideal for me as it brought out my problem-solving, creative thinking and innovation skills. The whole journey was both exciting and challenging, from the design stage up to the manufacturing and assembly stage. It was a very nice experience working with different people, having different backgrounds throughout the course of this project.

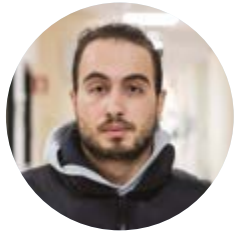
Design and Construction of a Stair Cleaning Robot

Student: **Andrea Galea Musu'**
Supervisor: **Prof. Michael A. Saliba**

What is your project about?

The project assigned involved the design and development of a device that could clean staircases. During the past decade an increase in domestic robot applications has been observed, especially a rapid increase in the use of floor cleaning robots. This project aimed at addressing a limitation faced by floor cleaning robots. Such floor cleaning robots cannot clean stairs and are limited to cleaning level ground, thus a working concept of a robot that can descend steps and move along the width of the step was designed, programmed and constructed. The robot did not include the cleaning mechanism itself however, the step cleaning process design and program were included.

Why are you working on this project?



Robotics engineering is a field in which constant research and development are being made. Different types of machine automation have been introduced primarily in industry. This field was selected primarily since it included a combination of electronic devices that are integrated with mechanical devices to produce a final mechatronic device capable of carrying a task that a human would consider boring or repeated. A sense of satisfaction is achieved when a device that replaces human effort is first designed and built at a later stage, and the minimisation of human effort makes up a large part of engineering. The specific topic by the name of *'Design and Construction of a Stair Cleaning Robot'* was selected since it included design and fabrication of such a design, a section of mechanical engineering that I enjoy doing very much.

This project has the possibility of being introduced to the domestic sector at a later stage, since at this time stair cleaning robots are not commercially available on the market like floor cleaning robots. Such a project would provide a possibility to automate the whole floor cleaning process with the introduction of a device that can clean staircases.

Design and Development of a Remote-Control System for Electric Wheelchairs

Student: **Luca Fenech**
Supervisor: **Dr Ing. Marvin K. Bugeja**

What is your project about?

Electric powered wheelchairs (EPWs) are normally designed to be operated only by the person seated in the wheelchair using an onboard joystick that is wired to the motors' drivers. Unfortunately, this configuration does not allow the wheelchair to be operated remotely, such as through a wireless remote-control. This feature might be quite handy for someone who has to move their, or someone else's, wheelchair when they are not seated in it. This might be required, for example, to clear up space after transferring to another chair or bed in the same room, or to drive the wheelchair to a charging station from a distance. The aim of this project is to design and create a wireless remote-control system that can be easily installed on a regular EPW, such that the user can control the wheelchair wirelessly from a close distance.

Why are you working on this project?

I was very intrigued to work on this project mainly because it combines two of my passions: engineering, and ways that it can be used to help others. I have always had a passion for engineering from a very young age, since I have always been fascinated to see how things manoeuvre. Hence, I have chosen the field of Systems and Control Engineering since it is responsible for creating, implementing solutions, and developing control for physical systems. In addition, this project was ideal since I am very passionate about projects that are hands-on, involving both software and hardware aspects.

Wheelchairs have always been an essential part in an inclusive society. Such mechanism helps wheelchair users to move from one place to another, making their life easier and more independent. Moreover, controlling an EPW through wireless communication assists current wheelchair users in gaining more mobility and independence. It is important to note that to this date, almost no commercial company has launched a ready-made product that would enable a wheelchair to be controlled wirelessly out-of-the-box. This fact continued to strengthen my motivation to work on this project.

Plant Automation with Motion Control

Student: **Ryan Pace**
Supervisor: **Dr Ing. Reiko Raute**

What is your project about?

In this dissertation, a plant automation system was designed to continuously cut pieces from any type of material, according to the length specified by the operator, while the material consistently moves on a conveyor belt system. This system, known as a profile milling machine, is an extremely important machine within the manufacturing industries, since it manufactures top quality products. Indeed, its use has been applied into a wide range of applications, including wood, paper, plastics apart from metals. Both the electrical and mechanical design of the plant have a significant impact on its performance. As a result, poor design decisions would limit the proposed system's collective capabilities. Furthermore, the project also required the design of user interfaces for both control and monitoring purposes of the operational plant.

Why are you working on this project?

Engineering is a vast subject, however, from the initial stages of this course I was interested the most in Power and Control studies. A researcher's ultimate objective within the automation sector is to further enable the globe to become entirely automated in the future. One of the most important sectors in Malta is industrial and manufacturing engineering. Hence, the importance of automation is continuously on the rise. Continuous advances in technology aim to improve efficiency, and hence productivity, while reducing human errors. This is further enhanced through an increasing importance being given to catering for safety and maintaining flexibility within the process. This dissertation piqued my interest right away since I enjoy projects that are hands-on and involve both hardware and software expertise. The building of the setup, along with its design, provided me with several opportunities to improve my knowledge regarding this field.

A Pacesetting Mobile Robot for Track Runners

Student: **Andrew Pirotta**
Supervisor: **Dr Ing. Marvin K. Bugeja**

What is your project about?

Training sessions followed by runners using an athletic track typically consist of running fixed distances at specific predetermined paces. Runners would need to keep their target pace by either completing the distance within a predetermined time, by using a GPS-enabled smartwatch. Ideally however, they would keep their target paces by physically following another runner running at that specific pace. This gives the runner a visual physical target, and someone to compete. This psychologically helps the runner to keep up even when fatigued. This project aims to replace a human pacesetter with an autonomous mobile robot which can be programmed to move on a running track at specific speeds and simultaneously follow one of the lines on the track.

Why are you working on this project?

I chose this project because it had a multi-disciplinary aspect to it. Although it mainly focused on the areas of control and robotic engineering, it also had an aspect of electronics, microcontroller programming, computer vision, and 3D modelling. These were all areas which I enjoy. In my free time I enjoy going on runs to try and keep in shape. For all these reasons, this project allowed me to work in areas that I have experience in, and that I like. A mobile pacesetting robot for track runners would provide runners with a new method to maintain the desired pace during training. This method would have multiple benefits over training with a more experienced runner. The mobile robot pacesetter would be able to accurately travel at the desired pace for the entire training session. Another benefit is that it would be portable and can be used at the convenience of the runner.

Design and Implementation of a Miniature Stewart Platform and Control System

Student: **Andrew George Vella**
Supervisor: **Prof. Ing. Simon G. Fabri**

What is your project about?

Since discovering the advantages of using parallel manipulators in the 1980s, the Stewart Platform has gained a significant amount of attention, with its applications nowadays ranging from flight simulators and telescope positioning systems to virtual reality seats. Such a platform consists of six extensible legs, which can be used give the top plate any desired position and orientation with respect to the bottom plate. This project presents the complete design and implementation of a miniature Stewart Platform, starting from mechanically building the platform all the way to developing the electronic and control aspects needed to accurately position the robot.

Why are you working on this project?

Engineering has fascinated me from a very young age, especially the robotics field. The relevance of robots in society has been exponentially increasing for many years. These can be used to solve problems to improve society as a whole, from inventing robots that help people with mobility problems to innovating in the renewable energy sector for a cleaner environment.

The main reason why I chose this dissertation title is that the Stewart Platform robot had to be designed and built from scratch. I found it really fascinating and satisfying to be able to accurately control the platform to follow a desired trajectory, after having spent months designing and building its physical structure. I also find it compelling to build a robot with a superior function than that of the separate parts it is made up of. This reminds me that “the whole is greater than the sum of its parts”, as stated by Aristotle.

Modelling and Simulation of a Robot Hot-Wire Cutter

Student: **Jacob Jordan Catania**
Supervisor: **Dr Ing. Marvin Bugeja** | Co-Supervisor: **Prof. Ing. Simon G. Fabri**
Industrial Partner: **I+A Limited**

What is your project about?

The aim of this project is to develop, implement, and test a realistic simulator of a particular robotic manipulator to be used to automate hot-wire cutting. This is done with the use of MATLAB, Robot Operating Software (ROS), and Gazebo. All of this software is installed and executed on Linux.

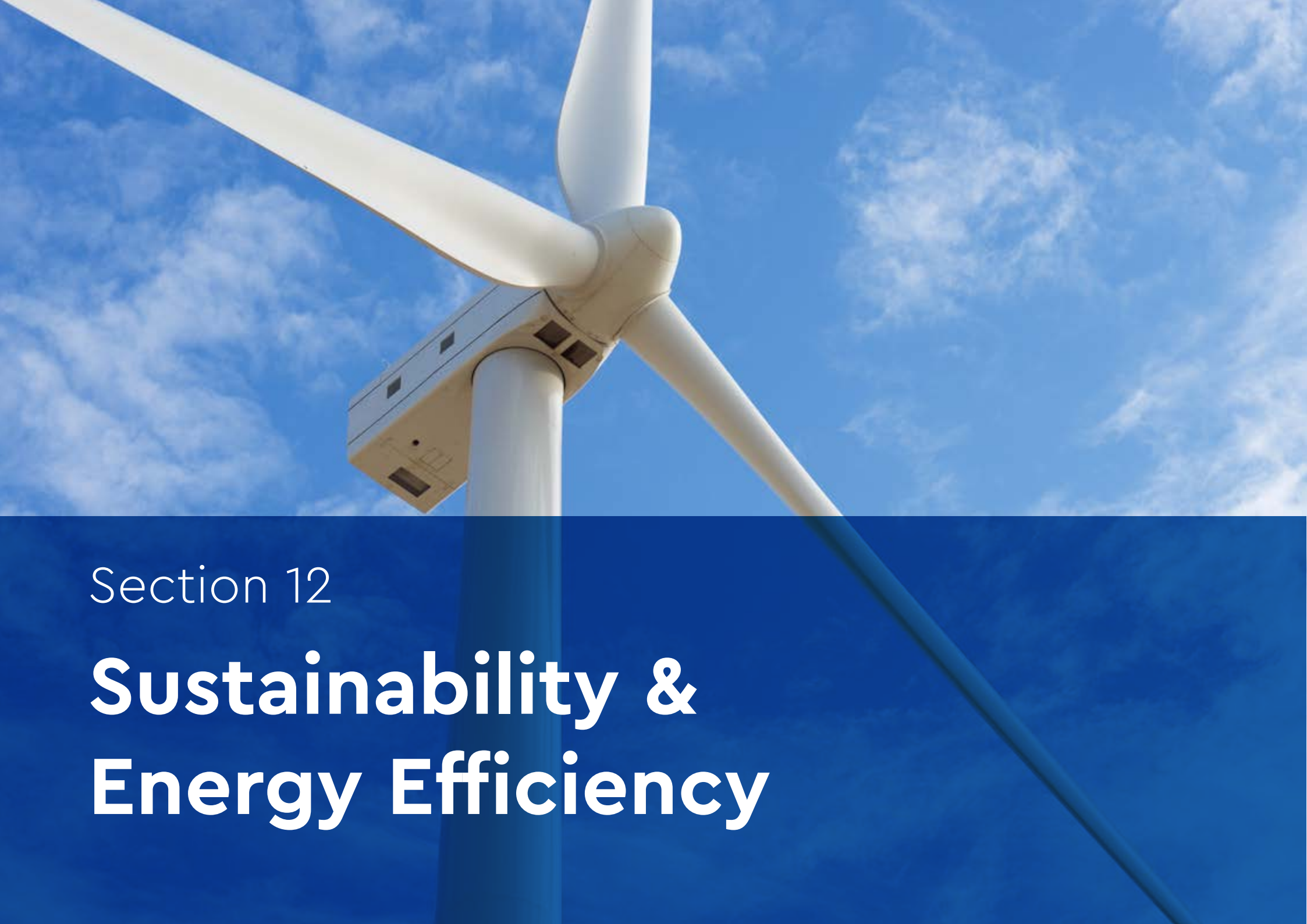
In MATLAB, the user can define the desired robot position and orientation, and the best physically achievable joint-angles solution is then chosen automatically. The selected solution is then actuated in the virtual robot model with the corresponding joint angles. Once the simulation is complete, the trajectory of each joint is then plotted and displayed virtually on a realistic simulator.

This project was done in collaboration with the I+A, a local design studio.

Why are you working on this project?

Robotics is becoming more widely used in today's industry, and can be used to help others to achieve what they want in an efficient manner. The concept of a robot was always an interest of mine, where curiosity on how the robot moves and works, and how it knows what it needs to do was always something that I found fascinating. With the help of engineering, I took this opportunity to learn more about robotics, where I would be able to show what I have learnt over the last four years during the engineering course.

Moreover, since this project is done in collaboration with an Industry partner, it also provides me the opportunity to give something to the industry. Such a project also helps to get a better idea on what working in the industry is like.



Section 12

Sustainability & Energy Efficiency

Assessing the Use of Biodegradable Polymers for Plastic Packaging

Student: **Sarah Mifsud**
Supervisor: **Dr Ing. Paul Refalo** | Co-Supervisor: **Dr Arif Rochman**

What is your project about?

The aim of my project was to assess the financial, functional, and environmental implications of substituting fossil-based polymers with biobased and biodegradable alternatives in the cosmetic packaging industry. Given the ever-increasing plastic pollution in our environment due to the excessive production of plastic packaging, this study aimed to offer a viable alternative to lessen the burden on the environment while still offering a high-quality substitute. Throughout the assessment, the aim was to quantify the financial and environmental distinction between fossil-based and biodegradable materials while still assessing the functional implications of these materials in the cosmetic packaging industry.

Why are you working on this project?

I have always been passionate about the environment, and I believe that with an engineering background, one is well equipped with the fundamental skills to tackle sustainability issues. Moreover, the cosmetic packaging industry contributes substantially to the plastic pollution littering our environment. Therefore, by investigating alternatives for this industry, one would potentially contribute to an overall positive impact on the environment. Furthermore, when it comes to sustainability, one cannot simply opt for a biodegradable material due to its superior environmental performance without considering the cost of mass-producing it. This is why I believe that this project is insightful to Toly Products Malta and the cosmetics packaging industry, as it paints the whole picture by quantifying the environmental, financial and functional consequences of implementing biodegradable alternatives. This project has been an eye-opening experience. It allowed me to appreciate that in industry, seemingly insignificant changes may result in substantial environmental and financial repercussions and should never be disregarded.

Energy Optimisation of the Control of Motors used for Water Boosting Applications

Student: **Sean Grech**
Supervisor: **Prof. Ing. Cyril Spiteri Staines** | Co-Supervisor: **Dr Ing. John Licari**
Industrial Partner: **Harbour Solutions**

What is your project about?

The aim of this project was to investigate a commissioned water boosting application within an industrial environment and come up with methods on how to improve the energy efficiency of such system. In the manufacturing industry, pumping applications including process cooling, adds up to 27% of the total electrical consumption. Therefore by ensuring that the main components of the system are working at their maximum efficiency, a significant reduction in costs is achieved. This project was carried out in conjunction with Harbour Solutions, which is a company that specialises in Building Management Systems (BMS) that cater for industrial control systems, including the process cooling system under this study. The process cooling system that was investigated is located at Toly Malta.

Why are you working on this project?

Energy efficiency has always been an area which interested me. By choosing this project I was able to investigate this important aspect from a technical point of view. Moreover I enhanced my knowledge on water boosting applications within an industrial setting and the main components that such systems are based upon.

From an industrial point of view it is essential that manufacturing firms monitor the efficiency of their systems. In doing so, they could benefit from a reduction in electricity tariffs and also pro-longed lifetime of their equipment. This is key for any manufacturing firm, as we are living in a day and age where electrical efficiency is a top priority. Thus through this project I contributed an efficiency study which applies to a large local industrial setting.

Characterisation of Sources of Inefficiency in a Pneumatic Pick and Place System

Student: **Miguel Borg**
Supervisor: **Dr Ing. Paul Refalo** | Co-Supervisor: **Dr Ing. Emmanuel Francalanza**

What is your project about?

A variety of industries use compressed air as an essential source of energy due to its benefits. Nevertheless, compressed air systems are inefficient, resulting in high energy consumption, costs and environmental emissions. The objective of this project was to characterise and detect sources of inefficiencies concerned with compressed air systems. A portable monitoring system was designed to have the capability to test and characterise pneumatic systems in different industrial environments.When connected to production and automation systems, this system will be used to monitor compressed air parameters and detect and identify faults.

Why are you working on this project?

The ambition towards reducing energy consumption, its costs and environmental impacts via sustainable measures is a key challenge around the world. The energy consumption of industrial plants such as manufacturing facilities is considerably high resulting in increasing emissions. Sustainable Manufacturing, which addresses one of the Sustainable Development Goals (SDG 12 – Responsible Consumption and Production) is a key theme that industries should consider in order to mitigate the effects of environmental issues such as global warming. Hence, my motivation for this project was to help make the environment a little bit greener via the utilisation of the portable testing system designed. This field of study piqued my attention since I am confident that results on this subject will have significant positive implications for both industry and the environment.

Section 13

Thermofluids

Conceptual Aero-Cooling Designs for High-Pressure Turbines in Jet Engines

Student: **Karl Zammit**
Supervisor: **Dr Simon Mizzi**

What is your project about?

The project focuses on assessing the impact of heat transfer modelling on high-pressure turbine (HPT) discs and on providing proof-of-concept designs to minimise the severity of the fluctuations in the thermal stresses experienced during operation. Both technologies used in today's jet engines and those whose working principles have only been investigated outside the context of application to the HPT are explored. A brief pilot study to investigate potential approaches to comparing conceptual designs while reducing the required computational resources is also included.

Why are you working on this project?

Having taken a liking to the prospect of a career in the aerospace industry over the years, working on this project has helped me explore one of the many avenues an engineer might find themself working on in the field. I have never been one to back down from a challenge. Although the prospect of working on a project involving a combination of structural and fluid mechanics and heat transfer seemed quite daunting at first, the project grew on me throughout the year, bringing with it a great deal of satisfaction.

A disc failure in a jet engine would have catastrophic consequences, making the turbine disc one of the most critical flight components. The contribution of the development of the HPT has the potential of breaking down some of the barriers to unlocking further gains in turbojet efficiency, leading to more power and at a lower fuel consumption.

Section 14

Transportation

Testing Emissions and other Parameters from Vehicles driven on the Chassis Dynamometer

Student: **Jake Woods**
Supervisor: **Prof. Ing. Mario Farrugia**

What is your project about?

The regulations for vehicle testing are based on simulated conditions which do not include uphill and very slow-moving traffic sections. Driving conditions in Malta, however, are characterised by frequent stopping due to traffic and by inclined roads. Therefore, day to day driving in Malta is dissimilar to simulated test conditions. The aim of this dissertation was to determine the impact of periodic stopping and driving up inclined roads on the fuel consumption and emissions of a vehicle. This was carried out by subjecting the vehicle to multiple tests, replicating conditions similar to those encountered in Malta, and analysing the data obtained to determine whether, under realistic local conditions, the emissions are below the regulatory limits.

Why are you working on this project?

I have selected this field in engineering mainly due to my interest in the automotive industry. The overwhelming majority of daily travel within the Maltese Islands is currently done through personal vehicles. Therefore, thousands of vehicles are continually emitting harmful substances into our environment. Recently, the European Union has tightened its regulatory limits regarding vehicle emissions in what has been considered to be the strictest update to the regulations ever made. Vehicle emissions had reached worldwide headlines a few years ago due to the DieselGate scandal, which at the time had interested me, and which I had followed closely. The scandal revolved around the vehicle manufacturer Volkswagen, who were found guilty of installing a secret software into their vehicles to essentially cheat the system by emitting less amounts of harmful substances only during testing. Therefore, I was interested in finding out whether this scandal has caused car manufacturers to put more effort into decreasing emissions.

IoT-Based Air Quality Monitor

Student: **Neil Buttigieg**
Supervisor: **Dr Kenneth Scerri**

What is your project about?

This project aims to design a device that monitors air quality. This device tracks the levels of different pollutants in the air and stores these readings in the cloud. The user is able to view these readings through an application that shows the measurements in real-time. Few devices such as this exist on the market that are meant for domestic use. The main challenge faced in this project is to connect all the different parts of the project together, from the sensors to the cloud architecture that will store and visualise the data.

Why are you working on this project?

This project is a mix of electronics and cloud development. Electronics has always been one of my main interests in engineering. The cloud is not a topic that I had studied in the course, however it is a growing field that I find interesting and wanted to learn more about. Air quality is a topic that I find interesting as some members of my family suffer from asthma, so such a device would be helpful for them.

This project is very relevant to present issues in Malta. The large number of construction projects taking place, combined with the large number of cars on the roads negatively impact air quality. Furthermore, people are spending ever increasing portions of their lives indoors. This fact is worrying when you consider that indoor air quality can be over twice as bad as it is outdoors. It is because of these reasons that having the ability to monitor the air quality in your house is beneficial.

Detection of Traffic Events from Social Media Data

Student: **Aiden Bezzina**
Supervisor: **Dr Ing. Luana Chetcuti Zammit**

What is your project about?

In this day and age, traffic congestion remains to be one of the most challenging issues to counteract. One major contributing source to congestion is traffic anomalies due to the randomness element (location and time) that tends to surround them. Detecting these types of traffic anomalies in both a timely and efficient manner allows commuters to plan their route accordingly, thus mitigating any future or further traffic congestion. The goal of this dissertation was to develop a traffic-based information system that relies on social media data. The social media platform of choice was Twitter.

Why are you working on this project?

For as long as I can remember, I have always had a keen interest in traffic management, and its underlying procedures. In recent years, more newly licensed motor vehicles are taking to the roads, giving rise to the need for proper traffic management. Consequently, many variants of traffic event detection systems were developed, with the majority relying on physical sensors. However, these tend to be restricted by sensor coverage due to sparsely placed sensors, thus making such approaches inefficient. Additionally, such systems are also not very cost-effective due to the high cost of physical sensor installation and maintenance. With internet access being essentially universal in this day and age, social networking sites tend to consist of a very large user base that is capable of generating an endless amount of information about an extensive range of topics. Advancements in the field of machine learning have provided ways in which social networking sites can be exploited to detect events, particularly traffic events, resulting in a very cost-effective and efficient way of detecting traffic anomalies.

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Vision At STMicroelectronics Malta we strive for continuous improvement, ensuring we reach our customers' requirements and strengthening our business strategy. In this new manufacturing era, the Plant's vision is to transform into an Industry 4.0 Plant, through the implementation of Digitization, Data Analytics, Artificial Intelligence, Automation and Robotization. With the implementation of these technologies, we aim to improve our Time to Market and Productivity, achieve Quality 4.0, and to create a dynamic and interesting working environment for all employees.

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