Faculty of Engineering Projects

2021

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Msida MSD 2080

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Foreword

Over the past months we have witnessed some spectacular technological developments that will surely leave an imprint on the future existence of our species. Back in February, the Ingenuity helicopter conducted its first powered flight on Mars, and more recently, the SpaceX starship carried out a successful short mission that opened huge possibilities for future human travel to outer space. Witnessing such extreme feats of engineering in the midst of a global pandemic that brought about such devastating disruption to our basic human interactions, is truly astonishing.

Necessity is truly the mother of invention with the ongoing pandemic challenging almost every aspect of humanity whilst inspiring novel ways to go about performing daily business. Operations at the University also necessitated adaptation to suit the times, with virtual technology replacing almost every aspect of student interaction with lecturers, tutors and other Faculty staff. We are therefore very proud that our students have adapted well to this new norm and, despite the hardships, have achieved the consistent standard expected of engineering graduates of the University. We invite you to browse through this booklet which showcases the dedication and achievements of our final year students and look forward to welcoming you to the Faculty in the very near future.

Prof. Ing. Andrew Sammut
Dean, Faculty of Engineering

#EngineeringTheFuture
#ShineAtUM

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International School for Foundations Studies Course

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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

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B.Eng.(Hons) Mechanical Engineering

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M.Sc. Building Services Engineering

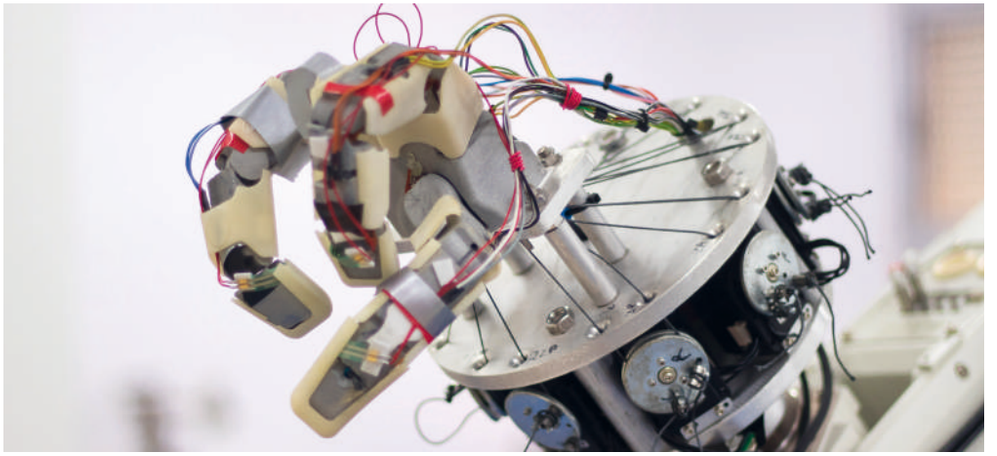
M.Sc. Maritime Engineering

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

Applicable for October 2020 & 2021

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 or Mechanical Engineering.

The Electrical and Electronic Engineering programme addresses the fundamental concepts in electrical engineering, electronics, signal processing and control systems. Students will be able to choose a variety of study-units geared towards the fields of energy generation, conversion, storage and smart distribution, renewable energy, green transportation, electronic sensing, acquisition and measurement, electronic product development, automated systems, autonomous vehicles/robots and software algorithms for signal, image and video processing.

The Mechanical Engineering programme addresses 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 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 domain, 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

Applicable for October 2020 & 2021

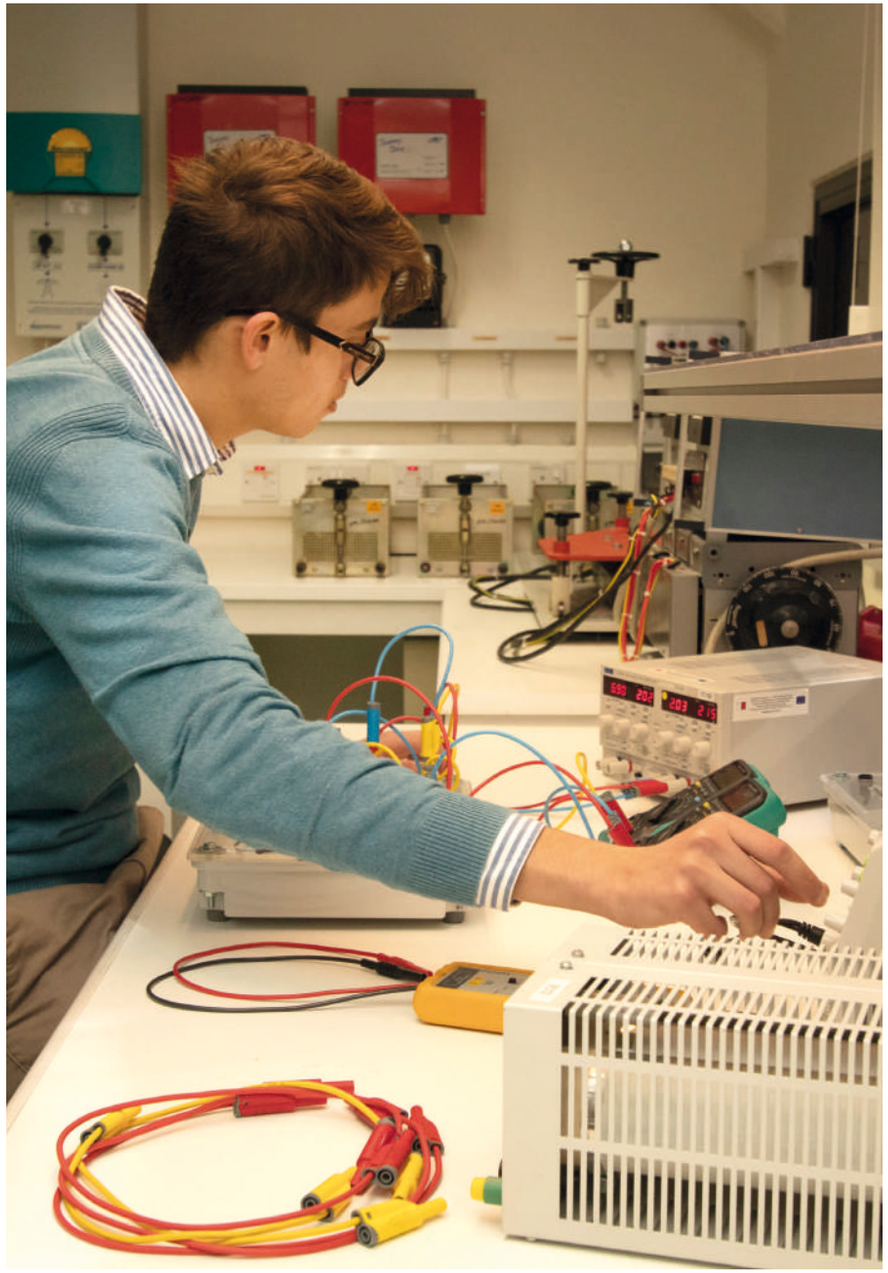
The Certificate in Engineering Sciences is a one-year certificate course intended to prepare students with the knowledge, skills and competencies necessary to follow the B.Eng. (Hons) course. During the course, students will be studying mathematics and physics, bringing the student's knowledge and understanding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

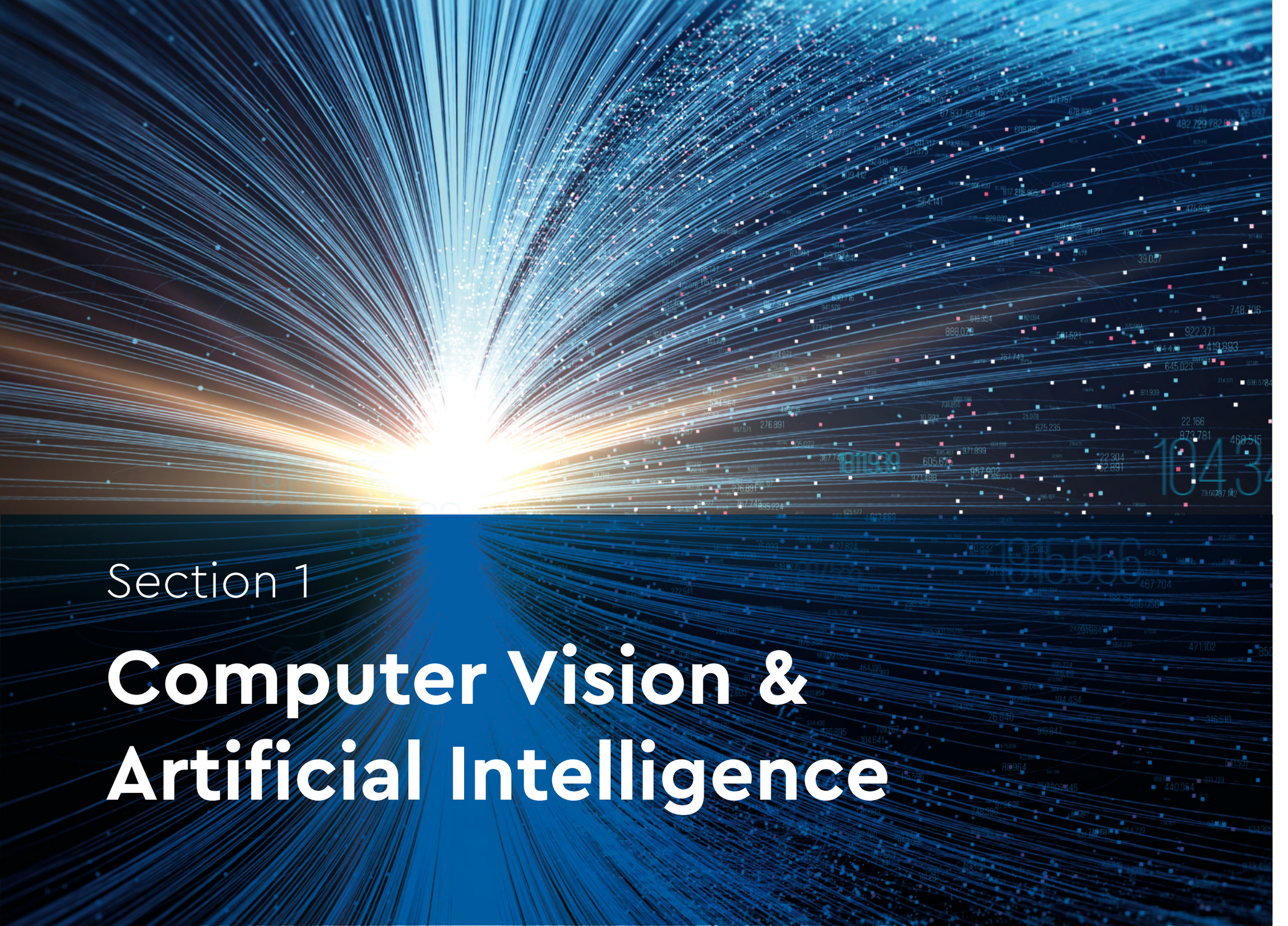
Entry Requirements

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

Computer Vision & Artificial Intelligence

Head Pose Estimation using Deep Learning

Student: **Jason Schembri**
Supervisor: **Dr Ing. Stefania Cristina**

What is your project about?

An important nonverbal form of communication is through the different rotations and movements of a human head. The head pose is the angle at which the head is oriented in relation to the camera, and it is usually represented in relation to three angles (yaw, pitch, and roll). Head pose estimation has for many years been estimated from specific face features that are detected across the image frames. However, the utilisation of face features to estimate head pose is challenging due to illumination changes during large head rotations and face deformations due to changes in facial expression. The use of deep learning methods to estimate head pose seeks to address these challenging variables, however, it is still a relatively new approach, and this project is testing the robustness and accuracy achieved when using neural networks for head pose estimation. The main objective of this project was to implement and compare the performance of a Convolutional Neural Network (CNN) when trained either on real or synthetic data to estimate the head pose angles.

Why are you working on this project?

Head pose estimation is employed in several computer vision systems, with deep learning being used to recognise head poses and solve other various complex problems. This project was chosen as I wanted to provide my contribution in using these methods. There are several advantages to learning how information is grasped by neural networks. It can lead to a better understanding of systems and help develop technologies which can provide a more efficient application. The development of a robust system for head pose estimation, which does not make use of conventional methods, would enable us to extend its application to other fields. Future work includes applying the method being presented for real-time head pose estimation. A possible scenario in which this application can be used is to assess drivers' attention and alertness.

Hand Gesture Recognition for an Augmented Reality Sandbox

Student: **Karl Miggiani**
Supervisor: **Dr Alexandra Bonnici**

What is your project about?

Enhancing children's creativity for educational benefit is a very advantageous concept. An interactive sandbox helps children in early learning stages to use their hands to play in the sand, whilst also learning life skills such as writing and drawing. The project's objective is to create a system that identifies and tracks hands, whilst recognizing gestures performed by the user in a sandbox region, through the use of a colour and depth camera. This system was developed so that the user can interact with computer software in a more facilitative manner without the need of a mouse and keyboard.

Why are you working on this project?

Ever since I began studying imaging, I realised how much more interesting the topic is. It has personally driven me towards learning about photography and having a more in-depth knowledge as to how a camera and imaging work. The area of study is demanding, relatively new and is still being continuously developed, however from what I have studied at the University of Malta Faculty of Engineering, this area of study has to be my favourite. Using cameras nowadays has become a part of the everyday norm. They are utilised in determining availability in car parks, speed cameras, robotics and in the case of this dissertation, controlling computer software using hand gestures. The system designed in my dissertation can be rolled out to public devices allowing the public to interact with a computer without the need of a mouse and keyboard, although in this case the algorithm will be used for an educational interactive sandbox.

Application of Artificial Intelligence for Energy Efficiency Analysis of Compressed Air Systems

Student: **Daniel Farrugia**
Supervisor: **Dr Ing. Emmanuel Francalanza** | Co-Supervisor: **Dr Ing. Paul Refalo**

What is your project about?

This project investigates the use of Artificial Intelligence (AI) on data related to Compressed Air Systems (CAS), aimed at improving their energy efficiency. Compressed Air (CA) has many applications within society and industry, among which are tyre inflation, spray painting, and powering pneumatic tools and cylinders. However, CA generation and utilisation are very inefficient processes and leakages and faults are two of the major contributing factors. This study uses data collected from a CAS test bed at UM and compares different classification algorithms to try and identify leaks and faults. The results obtained detail promising leak and fault detection capabilities. Such an AI implementation for leak and fault detection exhibits potential improvements to the conventional detection methods.

Why are you working on this project?

Artificial Intelligence is a rapidly growing field of study with virtually endless applications. It was conceived in the mid-20th century and by the end of the same century, technological advancements allowed the idea to be implemented in practice. This means that we are experiencing the early stages of a potentially gigantic discipline. Hence, the main reasons why I chose this area of engineering are its novel nature and its wide range of applications, including Manufacturing, E-commerce, Gaming, Agriculture, Marketing and Social Media. With regards to the specific application presented by this project, research indicated that so far, CA distribution and utilisation-related studies are very scarce and hence, a gap was identified. The fact that not much work has been done in this particular field of engineering makes the project all the more interesting. The relevance of this project within industry is that almost all establishments use CA and hence, the results would benefit practically everyone.

Maltese Text Recognition Tool for those with Disability to Access Text

Student: **Emma Fenech**
Supervisor: **Dr Alexandra Bonnici** | Co-Supervisor: **Dr Ing. Stefania Cristina**
Industrial Partner: **ACCESS Disability Support Unit, University of Malta**

What is your project about?

The main objectives of this project were the design and development of an end-to-end tool which accepts photographs of Maltese text, recognizes them, and speaks them out loud. To make said tool as accessible to as many people as possible, it was decided to use a common mobile phone camera as the image acquisition device. This, though, now meant that appropriate computer vision techniques would also be necessary to correct any image deformations and thus ensure the best possible outcome. Current gold standards for Optical Character Recognition (OCR) and Text-to-Speech (TTS) synthesis in English were also reviewed and analysed to adopt them for the Maltese language and consequently be able to develop a robust tool, without the language barrier.

Why are you working on this project?

A point brought up by the ACCESS Disability Support Unit (ADSU) at the University of Malta was that people with print disabilities carrying out their education in English can utilise commercially available reader pens, however, no such technology is available for Maltese material. Therefore, a level of inequality arises, since one ends up being dependent on another human to do this job for them, making it harder to keep up with homework, classwork, and examinations.

As a person who has always appreciated the beauty of the Maltese language, I believe that anyone pursuing it should not be discouraged solely because there are no tools to aid them when unable to recognize text. Thus, hopefully, this project will be a step towards preserving our language. Throughout the design, testing, and development, the implementation of engineering skills was used to fuse together traditional image processing with modern machine learning approaches to increase support of text-to-speech synthesis of a minority language, while also making these tools more accessible and applicable to lower quality document images.

Iris Segmentation and Centre Localisation using Deep Learning

Student: **Emily De Munck**
Supervisor: **Dr Ing. Stefania Cristina** | Co-Supervisor: **Prof. Ing. Kenneth Camilleri**

What is your project about?

The eye and eye-gaze have many different applications, for example, gazing behaviour in marketing industries to design packages or in the automotive industry to check the driver's attention. The first step in eye-gaze tracking is to localise the eye and even more specifically the iris centre. This project uses deep learning to perform this localisation task. Deep learning is a form of artificial intelligence where a computer can learn to locate the iris region by using thousands of examples where this iris region is already predefined.

Why are you working on this project?

This project gained my interest because the subject of eye-gaze tracking has applications in such a wide range of industries. By immersing myself in this subject, I am also learning a lot about computer vision in general, which is already widely used but still has a lot of potential. On top of that I have always found the human brain and its working incredibly interesting. Therefore, it is fascinating to see and learn to understand how a computer, using deep learning techniques, is able to mimic the behaviour of our still fairly mysterious brain so well. Lastly this project helped me to improve my Python programming skills, which is a nice bonus.

Deep Sketching: Vectorization of Sketched Drawings using Deep Learning

Student: **Nicole Bonnici**
Supervisor: **Dr Alexandra Bonnici**

What is your project about?

The project is about converting hand drawn sketches into their vector representations that can be interpreted by computer-based systems. A Fully Convolutional Neural Network was investigated to automatically clean raster rough sketches into their line drawing counterpart. A custom loss function, inspired from traditional, feature-based line drawing algorithms was introduced to train the network. While a dataset consisting of images found in the wild was curated to train and test the network. The results obtained show that the designed network can convert rough overstrokes into their clean line counterparts. Moreover, the network can remove artifacts such as shading and hatching lines to retain only the contours without losing any detail in these contours.

Why are you working on this project?

The project is based on computer vision and image analysis which is a growing field meant to teach computers to interpret and identify the visual world. It is a rapidly growing field in the engineering world as it has the potential to be applied to many areas. The project includes the use of deep learning which is an engineering way to mimic the human brain and its ability to solve complex problems and recognise patterns.

The aim is to use the proposed method to help artists and designers through allowing them the freedom to sketch on paper and easily convert this to a computer-based drawing. Being someone who enjoys drawing, I had experienced the learning curve that comes with drawing on a software, as well its advantages. Thus, I could recognise the need to simplify the way we can communicate with a machine through a sketch. The method proposed could be used in virtual reality systems and 3D printing applications.

Analysis and Development of Augmented Reality (AR) Technology in the Manufacturing Industry

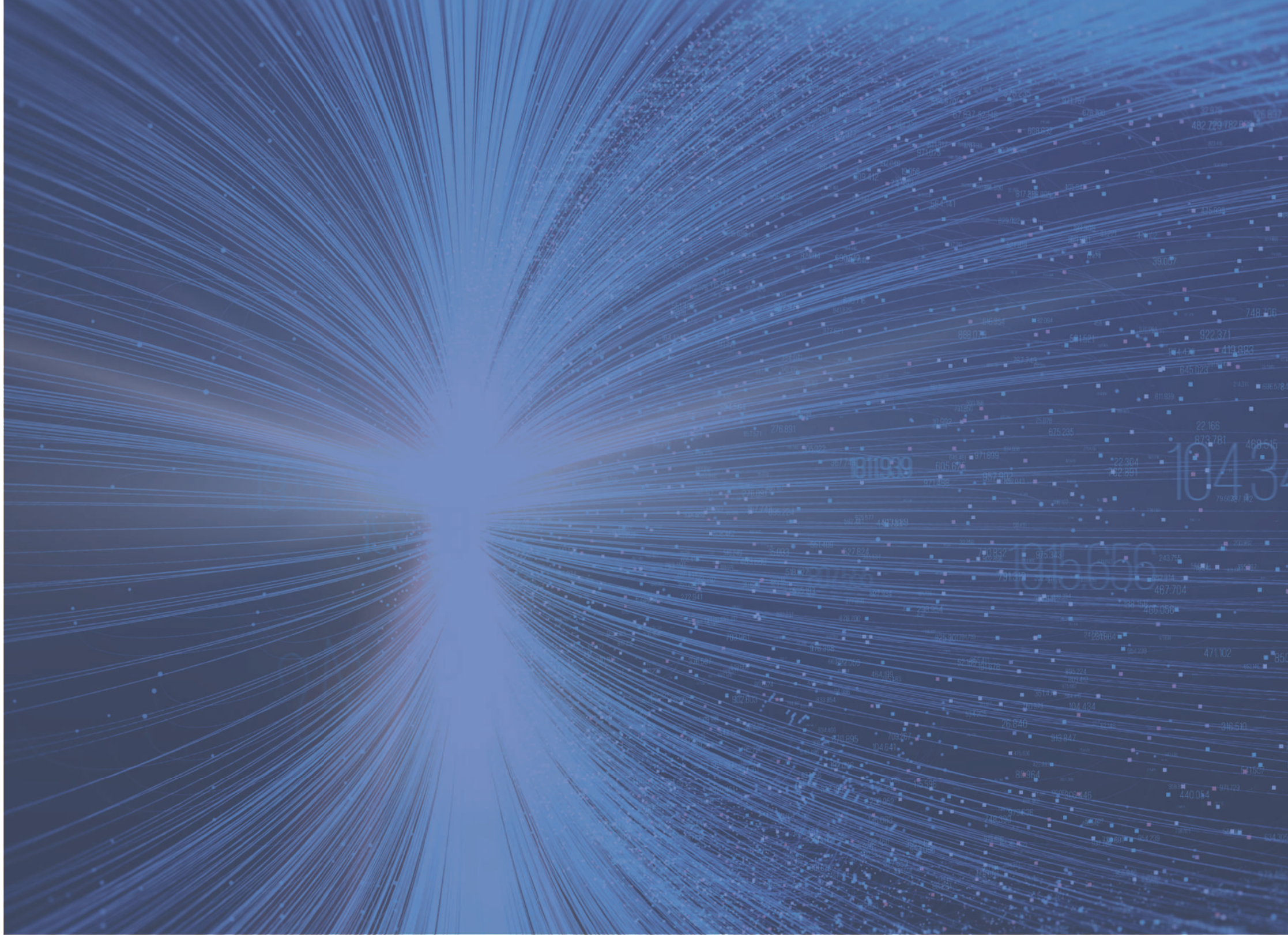
Student: **Andrea Bondin**
Supervisor: **Dr Ing. Joseph Paul Zammit** | Co-Supervisor: **Mr Anthony Caruana**
Industrial Partner: **Methode Electronics Malta Ltd.**

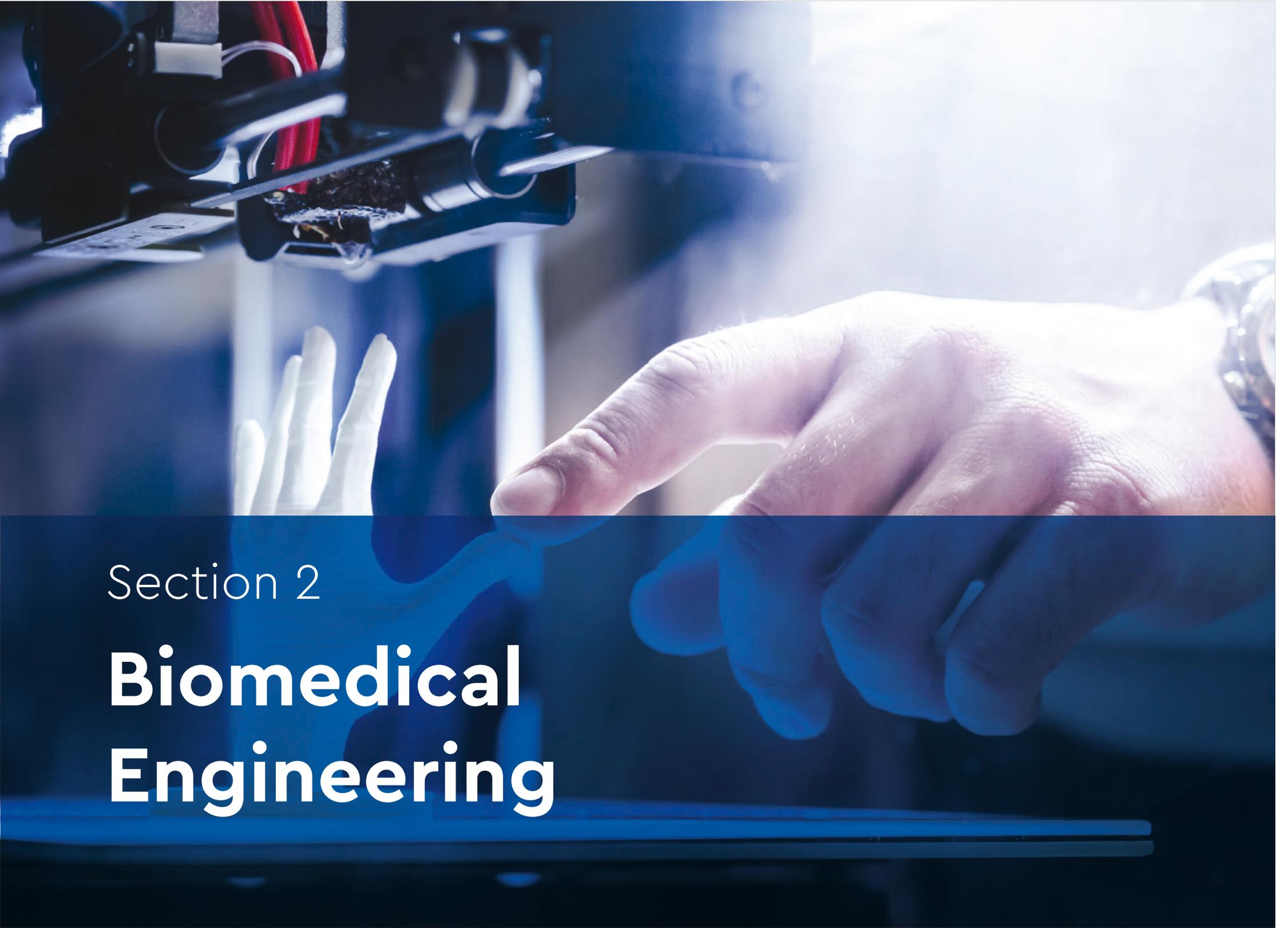
What is your project about?

This project provides an in-depth analysis of the adoption of AR-based technologies within the manufacturing industry through a specifically designed case study. Industry 4.0 technologies have revolutionised manufacturing maintenance strategies, and it is anticipated that Extended Reality (XR) technologies, such as Augmented Reality (AR), will feature heavily in the development of future maintenance strategies. The ultimate goal of every maintenance strategy is to maximise uptime of production whilst keeping downtime to a minimum. This project investigates time-consuming areas within the repair process of machinery and eventually presents a complete proposal for the adaptation of AR technology to the industrial partner.

Why are you working on this project?

The demands and expectations from goods and services have never been so pressing, and as a result there is a big drive from manufacturing companies to perform at optimum levels. By doing so, a competitive edge is gained over competitors through lower manufacturing costs. Maintenance of production assets amounts to around 15% - 70% of the total cost of products, and therefore it is imperative that such a manufacturing discipline is targeted for continuous process improvement. The biggest personal motivation behind this research is to understand the potential for AR-based technologies to improve manufacturing processes. Further to showing the potential benefits of AR to improve processes within manufacturing, an interesting point that came out from this research is that Industry 4.0 technologies cannot be introduced on the shopfloor as a standalone. Instead manufacturing companies still need to pair AR with classical process improvement methodologies, so that their introduction is one which is fruitful and not counterproductive.





Section 2

Biomedical Engineering

Design for a Modular, Dynamic, Standing Device for Disabled Persons

Student: **Shaun Demicoli**
Supervisor: **Prof. Ing. Philip Farrugia**

What is your project about?

A standing device is a device that helps various physically challenged persons that have mild to severe disabilities to maintain a standing position. Standing assists such individuals to earn the physical, mental and emotional health benefits that come with this movement, in turn reducing the dangers and health risks which are often associated with prolonged sitting. The main aim of the project is to come up with an innovative solution to this problem by developing a multi-functional, safe and comfortable standing device that would let a person with a disability carry out daily tasks and interact with people in a standing position.

Why are you working on this project?

Sitting for long periods of time can be uncomfortable for people with limited mobility. It is important that, as anyone else, they also have the opportunity to switch positions throughout the day. Modular design means that it can be adapted to the needs of people with various disabilities. Dynamic on the other hand is how a device can be easily and repeatedly adjusted in response to environmental changes or the user's functional needs. Hence it is important to provide a multi use standing frame that is affordable, making sure it has an improved adjustment capability and at the same time accommodate a wider range of users.

From an engineering standpoint, I opted for this final year project due to my interest in Engineering Design. I love the problem solving side of it, the feeling that there is always something new to learn and the creativity you get when digging into a new concept. I love the way I can use my intellect and creativity so widely to make the world just that little bit better.

Design of 3D Printed Customisable Post-Stroke Rehabilitation Devices to Provide A High-Quality User Experience

Student: **Benjamin Darmanin**
Supervisor: **Prof. Ing. Philip Farrugia** | Co-Supervisor: **Mr Edward Abela**

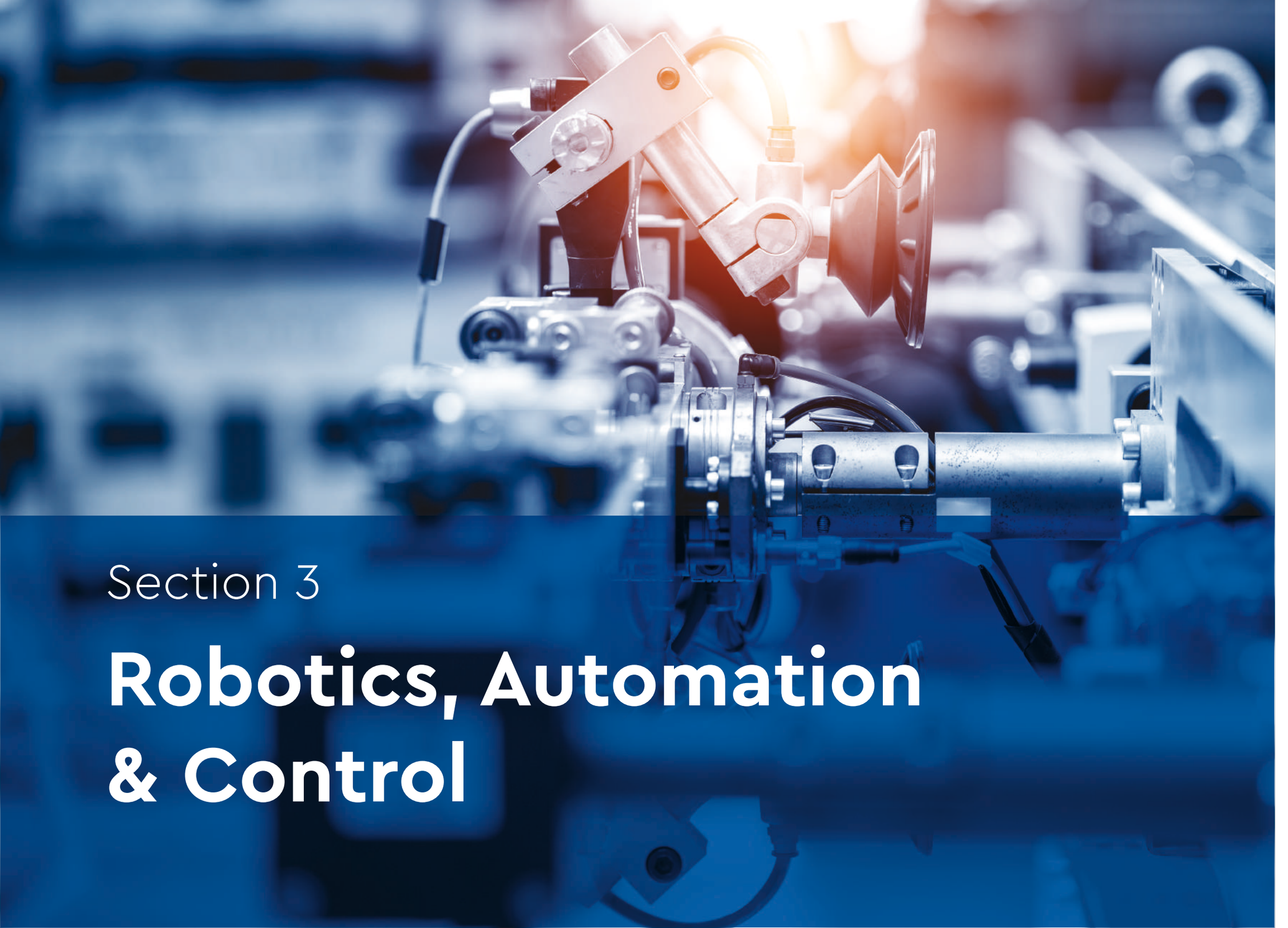
What is your project about?

Strokes are one of the leading causes for disabilities in the world. Hence, rehabilitation devices have been introduced to post-stroke rehabilitation programs to facilitate the therapists' work and assist the patient. The popularity of 3D printing in the healthcare industry has also increased due to its high customisability benefits. Therefore, the primary objective of this project was to analyse the design of a 3D printed customisable rehabilitation device which provides a high-quality User Experience for post-stroke patients. The design was based on feedback and comments of post-stroke patients and therapists, who at the end were very satisfied with the prototype device.

Why are you working on this project?

I was always interested in innovation and product design. Therefore, this project offered a great opportunity to use the problem-solving skills and knowledge gained during the four-year course and apply it in the design of customisable rehabilitation devices to help post-stroke patients and their clinicians. 3D printing has become one of the most popular fabrication methods to produce customisable products. A new application sector where it is being employed is rehabilitation devices.

By correctly exploiting the customisability benefits of 3D printing, the end-user can have a high-quality experience during the therapy which can potentially lead to more effective exercises and improved functional rehabilitation. For the device to provide a high-quality user experience it needs to be highly effective, efficient, and satisfactory to the user. The purpose of this research is to prove that 3D printing can not only meet the functional requirements of a post-stroke rehabilitation device, but also provide a more comfortable, ergonomic, customisable, and aesthetically pleasing solution for patients.



Section 3

Robotics, Automation & Control

A Robotic Training Partner for Track Runners

Student: **Christian von Brockdorff**
Supervisor: **Dr Ing. Marvin Bugeja**

What is your project about?

For runners, be them casual or professional, pacing is an important aspect in any training session or race. Proper pacing enables the runner to build better endurance and running power, especially when running long distances. This project deals with the design and implementation of a line following robot to be used as a training partner by driving along one of the lines on a running track at a pace specified by the runner through a smartphone, and therefore act as a physical pace-setter. In contrast to using a smartwatch for example, this method of pacing is especially beneficial as it adds a visual element to the training which can give the runner extra motivation to keep to a desired pace.

Why are you working on this project?

I have a keen curiosity on the application of robots and how they can be used in everyday situations to provide efficient, accurate and reliable services. I also have an interest in running and sports in general and I believe that this project can help make track running more interesting and exciting for runners and non-runners alike by introducing a new method of pacing. Additionally, the end product of this project can potentially be patented and sold on the market for athlete teams or individual runners to enhance their training sessions with a unique piece of equipment which nothing already on the market compares to in terms of ease of usability, functionality and cost. This can make it a very desirable product which can be a viable business model if further research is done to improve the robot and production costs are optimised.

Multi-Robot Coverage Control

Student: **Luke Scicluna**
Supervisor: **Dr Ing. Marvin Bugeja**

What is your project about?

Robot technology has come a long way, especially the interaction of multiple robots working together to finish a common task. The aim of this project was to create an accurate simulation of a group of robots solving the coverage control problem. The coverage control problem involves using a team of robots to cover a given area in some optimal way. More specifically each robot in the team is assigned a region to cover depending on its position and possibly other factors, such as available energy and sensor capabilities.

Why are you working on this project?

I am working on this project for a number of reasons. Firstly, I acquired an affinity for robotics throughout my university experience seeing that robots have become an essential part of society and it is becoming more evident that robots can undertake more responsibilities that are typically associated with humans. Secondly, I am also very interested in Control Engineering. This is why this project originally grasped my attention because it combines the field of Control Systems and Robotics.

Throughout my work on this project, I have learned that coverage control algorithms provide the tools necessary to use robots in new applications such as in autonomous surveillance or search and rescue. Therefore, it provides context towards the potentially life-saving applications of these algorithms. This project has provided me with a new appreciation for the coverage control problem and a desire to eventually witness these potential applications become a reality.

An Exploratory Study on the Application of an Industrial Robot as a Bartender

Student: **Matthew Hoiles**
Supervisor: **Prof. Ing. Michael Saliba**

What is your project about?

This project explored the feasibility of applying an industrial robot as a bartender. To facilitate such an implementation, the role of a bartender had to be explored in great depth. This included the functional tasks carried out by the bartender, but also the social-emotional tasks such as communication with customers. Thus, an in depth study was carried out to explore and develop the best possible robotic service system setup to carry out both the functional tasks and the social-emotional tasks. All of this while maintaining the beverage variety and functional versatility of the robotic system.

Why are you working on this project?

This project allowed me to apply various principles which I have learnt throughout the engineering course. Having worked as a professional cocktail barman myself, I understood the different elements of the bartending service, which allowed me to interlace my previously gathered experience in that industry and apply it to developing a successful robotic service. The social element in a bar is an indissoluble aspect of the experience and thus needed great attention while maintaining the efficiency benefits provided by a robot. By applying my love for all things engineering to this type of service, I got the unique opportunity to carry out this exploratory study, all thanks to my open minded supervisor for taking this type of project on! This study provides the prospective adoptee of such technology an in-depth analysis of the different aspects of such an implementation, including costs and payback periods.

Control of Connected and Autonomous Vehicles

Student: **Shawn Darmanin**
Supervisor: **Dr Kenneth Scerri**

What is your project about?

The aim of this study is to simulate and control the flow of Connected and Autonomous Vehicles (CAVs) through a local signalized urban junction. The central intersection considered in this study is the Rue D'Argens and Sliema road junction. Traffic flow readings from this junction are used to calibrate the simulated network according to actual flows. A traffic management system is implemented to control CAVs and group them into platoons. Furthermore, by controlling the traffic light timings, platoons can pass through the junction uninterrupted. In this dissertation, the behaviour of CAVs is also studied and a new car-following model is implemented to the simulated network model.

Why are you working on this project?

Transportation is a broad field that can be relatively improved with the help of optimized control systems. Today, the Maltese population is highly dependent on vehicles for transportation. This is resulting in traffic congestion on a daily basis in multiple localities. Traffic provides a trigger to several other problems, one of which is poor air quality resulting in increased health risks. Therefore, it is in everyone's interest that traffic should be reduced drastically and health hazards possibly eliminated completely. The development of Connected and Autonomous Vehicles (CAVs) is a significant breakthrough that could lead towards mitigating or even eliminating traffic build up. From this project, CAV traffic management systems statistically showed significant improvements to the urban road network. Additionally, after implementing a new car-following model, improvements were made during high congestion periods. When CAVs are available to the general public, these traffic management systems would be highly beneficial to mitigate traffic congestion while avoiding collisions.

Design of a Smart Robotic Linear Rail

Student: **Danika Galea**
Supervisor: **Dr Ing. Emmanuel Francalanza** | Co-Supervisor: **Ing Claire Seguna**

What is your project about?

The constant development of technology has driven Industry 4.0 to become a prominent phenomenon which is nowadays implemented heavily in automated systems, especially robotics. This project explores the design and fabrication of a linear traversing rail system with the incorporation of smart manufacturing to enable operability of a system that can be utilised for various applications such as pick and place, spraying and welding. Such a system was implemented with a 6-axis robot to attain an overall 7-axis system to allow for better robot utilisation while also maintaining accuracy and safety.

Why are you working on this project?

Throughout this project there is the involvement of one of the most renowned engineering technologies phenomena which is Industry 4.0. Throughout these years, study units which I had developed most interest in were Automation and Mechatronics hence, this title was deemed as the best option to pursue. With the inclusion of the aforementioned study units, there was digital manufacturing, being Industry 4.0, which is something that was rather new for me. Incorporating a smart system within an automation system has greatly increased my interest in these sectors whilst also learning to apply any theoretical knowledge into a real functioning product.

Section 4

Transportation

Further Experiments on the Free-Piston Engine

Student: **Stefan Portelli**
Supervisor: **Prof. Robert Ghirlando**

What is your project about?

This project is about the free-piston engine at the University of Malta. The engine does not operate in firing mode and does not start. This project mainly focuses on engine simulations of the free-piston engine that are used to investigate why the engine is not operating in firing mode. A free-piston engine is not a conventional engine since it lacks parts such as a crankshaft and a flywheel. A computational model was done in both MATLAB and Excel, from which the in-cylinder pressure at each instant of displacement and respective volume is calculated. The work output of the engine could then be analysed and it could be concluded whether the engine is providing enough work output, to counteract the frictional forces that it encounters. Furthermore, GT-Power was used to model the free-piston engine and various simulations were carried out to investigate further the cause of failure of the engine.

Why are you working on this project?

This project provided me the opportunity to learn how to use the engine modelling software GT-Power that is used by a large number of vehicle manufacturers. I used this software to model the free-piston engine, and investigate why it is not operating in firing mode. I am working on this project to learn more about two-stroke engines and understand how the performance of these types of engines can be improved. Moreover, throughout this project I am learning more about automotive engineering, and the role that free-piston engines have in this field of engineering. Nowadays, electric vehicles are gaining headlines, due to the strict emission requirements being imposed by governments around the world. Free-piston engines can be used as an auxiliary power unit in electric vehicles, so that once the batteries are exhausted, the free-piston engine generates electricity instead.

Road Infrastructure Preparation for Connected and Autonomous Vehicles: A Preliminary Study for Malta

Student: **Matteo Martinelli**
Supervisor: **Dr Ing. Michael A. Saliba**

What is your project about?

The objective of this project is to explore, through research, the preparation required to Malta's road infrastructure for the implementation of self-driving vehicles. The research includes the working principles and the technology used in the sensory equipment of a Connected and Autonomous vehicles. This research can then be applied to create a conversion strategy for Malta's infrastructure and ensure that minimal vehicle operation failures occur during use.

Why are you working on this project?

It is estimated that Connected and Autonomous Vehicles will be implemented sooner or later on our roads. Self-driving vehicles will have many benefits such as a reduction in air pollution and traffic congestion. It is also found that human error is responsible for more than 90 % of road accidents and self-driving vehicles will reduce the number of road accidents by 50%. My aim was to be part of this futuristic development so that Malta can be one of many countries for this implementation. Through this project I was able to expand my knowledge on various sensor equipment and conclude the feasibility of the infrastructure transition to accommodate such vehicles.

Optimization of Performance and Emission Characteristics of LPG-Diesel Engine Constrained by Knock Limits

Student: **Mario Schembri**
Supervisor: **Prof. Ing. Mario Farrugia**

What is your project about?

This project revolves around the study of the addition of Liquid Petroleum Gas (LPG) on a Peugeot 2.0HDi diesel engine. During this dissertation, the LPG controller circuit was upgraded to perform the best peak and hold pulse injection time of the two injectors. The turbocharger was also eliminated to make the engine behave similar to naturally aspirated. Following these upgrades, tests were performed in standard diesel (STD) operation and dual-fuel operation. The data obtained was used to investigate and optimize the performance and emission characteristics of an LPG-diesel engine, while being constrained by knock limits.

Why are you working on this project?

Throughout the years, I have grown a special interest in the field of mechanical engineering due to the innovative and creative ideas being created by engineers and the vast opportunities in engineering. However, working on combustion engines has been always my biggest dream. Thus, as a final year project, I have decided to further my studies on combustion engines, especially on diesel engines, to expand my knowledge and gain experience on how the LPG addition behaves when mixed with diesel fuel. Moreover, I have always shown a great interest in the environment. Thus, during my dissertation, I have studied how the implementation of LPG fuel can potentially reduce the emissions content while achieving higher performance from the diesel combustion engines.

Vehicle Road Load Determination and Assessment of Road Grade Effects on Fuel Consumption

Student: **Keith Grima**
Supervisor: **Prof. Ing. Mario Farrugia**

What is your project about?

This project is basically about utilising the chassis dynamometer, which was recently installed in the thermodynamics lab this year, as well as a test vehicle for investigating how road inclinations affect the fuel consumption of a vehicle. This was accomplished by collecting speed versus time data in real typical Maltese roads, as well as the road grade (measure of road steepness) of the same Maltese roads. The resistive forces acting on the vehicle at different speeds (road load) were also acquired by carrying out the appropriate experiment. The chassis dynamometer could then use the aforementioned collected data to replicate the drive in the lab, and fuel consumption measurements could be taken and compared with road grade.

Why are you working on this project?

I have chosen to carry out my project in this field due to my interest in automotive engineering, and its increasing importance in today's world. I find that automotive engineering is one of today's most exhilarating engineering industries. This automotive engineering project has provided me with further insight in this intriguing field. This specific project has sparked my interest as it investigates road incline effects, which are not taken into account by many standard drive cycles used to assess whether vehicles are within emission and fuel consumption limits for type approval. Not considering road inclinations may result in underestimating the fuel consumption and emission of vehicles, especially when representing driving in regions like Malta, where significant inclines are commonly encountered.

Section 5

Sustainability & Energy Efficiency

Testing the Electrical Power Generation of a Prototype Multi-Bladed Wind Turbine System

Student: **Miriana Mifsud**
Supervisor: **Dr Cedric Caruana Mifsud**

What is your project about?

The Faculty of Engineering has been involved in the design of a small-scale nine-bladed wind turbine to provide an efficient alternative to the Chicago windmills distributed across Malta. A prototype was previously constructed and deployed at the Government experimental farm in Għammieri. An emulator rig was subsequently developed in the Electrical Power lab. This dissertation studies the electrical performance of the prototype under controlled laboratory conditions, in the field, and through software modelling. The effect of increasing generator temperature on the electrical parameters was identified. Field tests were performed under various wind conditions. A software model was tuned and used as a reference for the field tests.

Why are you working on this project?

Our generation has been raised to be aware of climate changes due to global warming. Therefore, I have always felt the need to contribute to the production of new, clean energy sources which would ultimately improve energy efficiency and reduce emissions on a global level. Power generation through the harnessing of wind energy is a relatively new concept in Malta, which is why this dissertation was the perfect opportunity to aid in the current environmental issues. Although large-scale Wind Energy Conversion Systems (WECS) are not feasible to implement on our islands due to the small rural areas, small-scale WECS are still considered to have potential. Solar renewable energy has been exhaustively researched on our island and the literature shows that there is a need for multiple renewable energy resources to cater for most weather conditions. It is expected that wind energy is substantial enough to supplement the currently implemented renewable energy sources on the Maltese islands.

Modelling the Loads and Motions of a Floating Offshore Wind Turbine with Asymmetric Moorings

Student: **Wayne Formosa**
Supervisor: **Prof. Ing. Tonio Sant**

What is your project about?

Wind turbines are being installed in deep-water offshore wind farms, where utilising floating structures that are connected to the seabed by means of moorings is the economical solution. A benefit of these floating structures is that, by varying the mooring lengths of each turbine accordingly, the configuration of a wind farm can be optimised to minimise the interference between different turbines. Therefore, the overall power output of offshore wind farms can be increased. Hence in this project, the motion of a single floating offshore wind turbine as well as the loads in the moorings as asymmetry is introduced to the mooring system are investigated.

Why are you working on this project?

The concept of harvesting wind by floating offshore wind turbines has the potential to address several problems. First of all, despite being highly efficient in terms of power output, fossil fuels emit greenhouse gases that cause global warming, and at the same time, they are depleting very rapidly. On the other hand, wind is a clean and inexhaustible energy resource, meaning that it is capable of keeping up with the constantly increasing energy demand without being detrimental to the environment and people's health. However, the concept of floating wind turbines is still in its infancy stages and its potential can only be reached through extensive research. As a result, floating offshore wind can also create new job opportunities and benefit the economy. Given the advantages of offshore wind energy over non-renewable energy resources, it is important to develop this concept further to maximise its efficiency.

An Energy Model for Malta

Student: **Christian Cagliari**
Supervisor: **Prof. Robert Ghirlando**

What is your project about?

The objective of the dissertation is to create an energy model for Malta that can aid to achieve the United Nations and European Union goals for 2030 and 2050. These goals primarily consist of a required share in renewable energy and restrictions on emissions that must be achieved by 2030 and 2050. The purpose of these goals is to ensure that the energy sector can sustainably develop. The energy sector consists of the electricity, transport and heating and cooling sectors. Since Malta is part of the United Nations and the European Union, Malta is obliged to achieve these goals.

Why are you working on this project?

The energy sector is a major sector in every country and is one of the fundamental aspects of society, therefore it is our obligation to ensure that the sector will sustainably develop. Sustainable development is a term that is used to describe the development of society in a way that does not harm the environment, whilst allowing the human race to develop. Sustainable development is therefore essential in order to reduce the effects of certain repercussions such as global warming. This dissertation provided a challenging topic that affects everyone in the Maltese islands and therefore it intrigued me to put all my effort in designing a feasible energy model that can be a fundamental base to solve one of the major challenges of today's societies. This engineering challenge was not easy but has great reward in knowing that what was achieved can be the fundamental base of future projects.

Assessment of Parameters affecting the Energy Consumption of a Pneumatic Pick and Place System

Student: **Kelly Busuttil**
Supervisor: **Dr. Ing. Paul Refalo** | Co-Supervisor: **Dr Ing. Emmanuel Francalanza**

What is your project about?

The use of compressed air in industry has gained significant popularity due to the benefits associated with this practice. However, compressed air systems are considered as quite inefficient, leading to increased consumption and expenses for organisations. The inefficiency of compressed air systems is caused by the common formation of losses, such as leaks or malfunctioning components. When such problems go undetected for long periods of time, the result on the environment is highly detrimental. The aim of this project was to identify a set of parameters which could be monitored in real-time in industry to identify when inefficiency sources have formed within compressed air systems. This would allow for earlier detection of problems, so that they could be eliminated, leading to less consumption.

Why are you working on this project?

Energy efficiency has become increasingly important due to the higher demand for energy in the present world, and the greater amounts of emissions and environmental degradation being created. As such, energy sources such as electrical energy and the use of hydraulics are being replaced with compressed air, as it is a cleaner and cheaper energy source which is less harmful to the environment and creates less waste. Due to this, I believe that the study of sustainability improvements within compressed air systems is greatly required. I found this area of study very interesting as I know that new findings on this topic will have substantial beneficial effects, both to industry as well as to the surrounding environment. Other than this, I believe that sustainability within industrial applications is the way forward for the engineering profession.

Numerical Modelling of the Flow Velocities in the Near Wake of Floating Offshore Wind Turbines

Student: **Luke Jurgen Briffa**
Supervisor: **Prof. Ing. Tonio Sant**

What is your project about?

The aim of this project was to investigate the behaviour of the disturbed wind behind a horizontal floating offshore wind turbine rotor, up to twice the rotor diameter behind the turbine. The wind turbine was subjected to four different operating conditions. In the four operating conditions, the wind turbine rotor was either aligned or misaligned with the wind while the floating platform of the floating wind turbine was either stationary or subjected to a sea wave. Using numerical modelling techniques, the four operating conditions were compared to each other to understand the impact of misalignment and floating conditions on the disturbed wind behind the rotor.

Why are you working on this project?

Energy efficiency has become increasingly important due to the higher demand for energy in the present world and the greater amounts of emissions and environmental degradation being created. Energy sources such as electrical energy and the use of hydraulics are being replaced with compressed air, as it is a cleaner and cheaper energy source which is less harmful to the environment and creates less waste. Due to this, I believe that the study of sustainability improvements within compressed air systems is greatly required. I found this area of study very interesting as I know that new findings on this topic will have substantial beneficial effects, both to industry as well as to the surrounding environment. Other than this, I believe that sustainability within industrial applications is the way forward for the engineering profession.

Building Integrated Photovoltaics – A case study

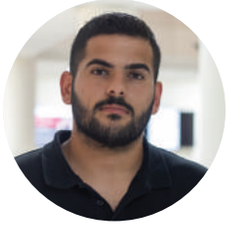
Student: **Gianluca Galea**
Supervisor: **Prof. Ing. Maurice Apap** | Co-Supervisor: **Dr Alexander Micallef**

What is your project about?

The aim of this project was to model the monthly and annual production of a hypothetical high-rise building whose façade is integrated with building applied photovoltaics (BAPVs) or building integrated photovoltaics (BIPVs). The location and base dimensions of the hypothetical building were based on those of the Portomaso business tower. BAPVs are modules that can be easily fitted to the existing surface whilst BIPVs are a replacement for traditional construction elements with integrated solar modules. Using these models, the monthly and annual yield of different module interconnections such as string inverter and micro-inverter interconnections, can be investigated to determine the viability of such interconnections for different BAPV/BIPV projects.

Why are you working on this project?

I have chosen this project as I have always been interested in the renewable energy sector, and the means in which engineering can be utilized to effectively create a cleaner environment. With EU2030 clean energy targets right around the corner and most low-rise traditional buildings have already installed roof-mounted photovoltaics over the years in Malta, we are running out of space and options to meet the targets. For high-rise buildings which have a small roof area when compared to the total internal floor area, the installation of facade building integrated photovoltaics (BIPV)s would significantly increase the generation of clean energy, hence reducing the carbon footprint of such buildings. My fascination towards net zero energy buildings (NZEBs) drove me to evaluate the performance and viability of such a BAPV/BIPV project simulated in Malta.



The Use of Recycled PET for High Performance Injection Moulded Components

Student: **Michael Psaila**
Supervisor: **Dr Ing. Paul Refalo** | Co-Supervisor: **Dr Arif Rochman**

What is your project about?

Recycling plastic is very common in today's world in order to give material a second life. However, due to contamination and chemical reactions, these plastics suffer from significant material degradation during the materials' use-phase and during reproduction, resulting in lower mechanical properties. My project investigates new ways and sustainable additives that can be added in order to upscale the properties of injection moulded recycled PET, commonly used in packaging and transparent beverage bottles. The aim is that the reproduced recycled PET displays greater properties than their virgin form and even reach high-performance properties, to display superb thermal and mechanical properties.

Why are you working on this project?

Plastic pollution in our environment and seas is not only an eye sore but an environmental consequence that humankind needs to start taking responsibility for. This is what inspired me to work on this project, as I believe in ensuring a better future, a sustainable lifestyle and better quality in life. Although plastic production is necessary for our everyday lives and for economies to thrive, a balance should be sought to reduce the environmental impact of plastic mass production. The solution to this would be to make use of recycled plastic material that is otherwise regarded as waste. The research conducted contributes to the ever-growing search for the best and most sustainable ways to upscale the properties of recycled PET, particularly by investigating the most sustainable additives that can be used to reach the properties required while reducing the cost and environmental damages of the newly reproduced material.

Development of a Sustainability Assessment Framework for the Maintenance of Manufacturing Equipment

Student: **Luke Meli**
Supervisor: **Dr Ing. Pierre Vella** | Co-Supervisor: **Dr Ing. Paul Refalo**

What is your project about?

Nowadays, manufacturing companies look towards applying sustainable principles in their operations and processes, including the maintenance of equipment. This project proposes a framework capable of assessing the economic, environmental, and social impact on sustainability from a maintenance process. Companies can hence create an assessment that would suit their needs, as the framework includes various methodologies in order to suit different applications. By creating a generic and scalable framework, it can be used to compare different maintenance processes and set industry standards. As part of the project, the framework was also implemented within local companies to better understand how it works in practice.

Why are you working on this project?

I chose to work on this project as I have a keen interest in sustainability, always trying to learn more on how we can improve the world we live in. This project gave me the opportunity to apply all that I have learnt throughout the course in order to develop a solution to a real-life problem faced by manufacturing companies worldwide. Sustainability plays an important role in a company's strategy, hence, I got to learn more on how sustainable principles improves a company's strategy and performance. Similarly, applying sustainable principles to maintenance also led me to learn more about maintenance in general. By learning more about maintenance, I got to learn more about how general manufacturing machines work. Through this project I have created a solution that companies can utilise to improve their sustainability performance, and carefully manage their economic, social, and environmental impacts.

3D Printing and Injection Moulding of Plastic Packaging: An Environmental and Financial Comparative Assessment

Student: **Cheryl Bezzina**
Supervisor: **Dr Ing. Paul Refalo**
Industrial Partner: **Toly Products Ltd.**

What is your project about?

In recent years, manufacturing companies have been exploring alternative manufacturing processes which reduce their environmental burden. The aim of this project was to analyse the environmental and economic feasibility of using 3D printing instead of injection moulding to produce cosmetic plastic packaging manufactured by Toly Products Ltd. Using a life cycle assessment, the environmental impacts associated with printing and moulding the compact were assessed. Moreover, the economic feasibility of 3D printing replacing injection moulding was examined through a life cycle costing analysis. Quality testing was also carried out since the printed compacts must be functional and have better or comparable visual quality to the injection moulded counterparts.

Why are you working on this project?

The global cosmetic products market is constantly growing, with the majority of cosmetic plastic packaging ending up as waste in landfills. Awareness on the importance of sustainable products has increased, with consumers becoming more knowledgeable on the importance of sustainability. Many are leaning towards purchasing products which are more environmentally friendly in terms of ingredients and packaging. Moreover, many companies are opting for alternative technologies that are more environmentally conscious. Many people believe that 3D printing has introduced us to a new industrial revolution, with the possibility that manufacturing using conventional methods might be replaced by additive technologies. The potential of 3D printing to reduce the environmental burden of conventional manufacturing technologies was the main motivator for this project. The results obtained in this project, although primarily relevant to Toly Products Ltd, also provide insight to consumers who are becoming more conscious of the impact of their purchasing decisions.

Section 6

Product & Process Development

Two-Component Injection Moulding of Thermoset Elastomer and Rigid Thermoplastic

Student: **Mirhea Spiteri**
Supervisor: **Dr Ing. Pierre Vella** | Co-Supervisor: **Dr Arif Rochman**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

What is your project about?

Two-Component (2K) Injection Moulding (IM) allows the production of components made from two material types without the use of conventional over-moulding process or post-processing, such as assembly. The project involves the injection moulding of two different materials, the Polyphtalamide (PPA) 30% glass fibres thermoplastic material, in combination with a thermoset elastomer material either with Fluoroelastomer (FKM) or Ethylene Propylene Diene Monomer (EPDM). The aim of this dissertation was to investigate the effect of interface roughness of the thermoplastic and thermoset elastomer fabricated samples and analyse the bond strength obtained in rubber to plastic (R2P) specimens.

Why are you working on this project?

The Injection Moulding industry continues to thrive due to its inexpensive and mass-production of items. The development of two-component injection moulding technology has provided more advanced capabilities and benefits such as multiple colours for aesthetic design, reduced assembly, and the development of soft-grip surfaces on rigid structures. The global demand for this injection moulding process is increasing rapidly, especially in industries where precision is essential such as, in the automotive and medical industry. Through this project, I had the opportunity to work with Trelleborg Sealing Solutions, where I was able to put to practice the knowledge acquired throughout the engineering course especially on injection moulding and product testing.

Design of a Child Resistant Cosmetic Closure Mechanism

Student: **Julian Scerri**
Supervisor: **Prof. Ing. Jonathan C. Borg**
Industrial Partner: **Toly Products Ltd.**

What is your project about?

The global cosmetic products industry is constantly searching for innovative products. Some customers may prefer child-resistant packaging, which means that children cannot inadvertently open cosmetic packages and consume toxic chemical products. Therefore, there exists a need to create a new cosmetic closure mechanism that has a premium and clean appearance while still being child-resistant. The aforementioned packaging must be designed by means of utilising engineering methods and tools so that a child cannot obtain access to the cosmetic product's contents. On the other hand, this should be simple enough for adults to obtain access and use with ease.

Why are you working on this project?

As a child, Steve Jobs was one of my idols, continuously developing revolutionary products. Even though Apple were not developing these products from scratch, they managed to refine them and make them accessible to the general public. Many companies aspired to achieve what Apple did, however they weren't close to being as successful. Today Elon Musk is my new idol. Both Apple and Tesla have one thing in common, they are not afraid to reach and achieve what others thought was impossible, and that is what drives me forward. This is what made me embark on this project. Obviously, this project is nowhere close to the scale of a project at Apple or Tesla, however, it exposed me to the skills needed to carry out such tasks as well as develop certain capabilities which are required in the industry. This work is rewarding for both the designer as well as the end-user, since one stimulates the other.

Digital Manufacturing Methods for Archaeological Model Development

Student: **Jasmine Mallia**
Supervisor: **Dr Ing. Emmanuel Francalanza** | Co-Supervisor: **Dr Ing. John C. Betts**

What is your project about?

Effort is being made to include innovative digital manufacturing approaches within archaeology to tackle the lack of an engaging experience at museums and archaeological sites. Therefore, the aim was to develop an archaeological model using digital manufacturing methods. The User-Centred Design (UCD) approach was integrated in this study through online questionnaires and interviews with museum or archaeological site curators, archaeologists, and visitors. A requirements analysis was carried out, followed by a decision framework based on the implemented UCD approach. A detailed implementation with the selected digital manufacturing methods was developed based on one of the possible outcomes of the decision framework. This implementation was evaluated to fulfil the UCD approach and validate the presented solution. Therefore, this study shows that digital manufacturing methods can be employed within archaeology, resulting in an immersive and sensory experience for the user.

Why are you working on this project?

Throughout the years, archaeology has lacked in offering an immersive user experience. Museums have kept artefacts in glass cases limiting visitors from having an interactive experience. As for archaeological sites, the visit typically consists of walking through the site and visually observing the surroundings. It is being proposed that with the use of digital manufacturing, archaeology is complemented with a user-inclusive and sensory experience. Apart from benefiting the visitor, digital manufacturing methods help both the curators and archaeologists when analysing, documenting, and reconstructing sites and artefacts through non-intrusive methods. This means that such methods can help preserve data and cultural heritage, while facilitating information transfer to both professionals and the general public. I was highly interested in such a study since it helped me enhance my knowledge in the engineering field beyond the manufacturing context. This case study consisted of a digital manufacturing implementation for Ta' Kaċċatura site, located in Wied Dalam near Birżebbuġa, Malta and the oil press artefact.

Optimisation of Welding Procedure for a High-Pressure Steam Pipe Network at the Delimara Power Station

Student: **Matthias Grech**
Supervisor: **Prof. Ing. Maurice Grech**
Industrial Partner: **Witech Solutions**

What is your project about?

At the Delimara power station, circumferential cracks have been identified at the welded joints of pipes supplying superheated steam. It was suspected that failure may have occurred as a result of the welds exhibiting a reduced elevated temperature strength. The original forwarded welding procedure did not constitute the use of subsequent heat treatments, thus this project sought to optimize the weld elevated temperature strength through heat treatment procedures, specifically a post-weld heat treatment, and a quench and tempering procedure.

Why are you working on this project?

After having worked with Witech Solutions (W.S.) for the past few years as a trainee engineer, primarily on heavy steel structures, my interest in welded steel structures grew. When W.S. proposed to research on different means of optimizing the welding procedure currently employed at the Delimara power station, in regard to 16Mo3, I saw the opportunity and took the challenge. Such a goal, as complex as it was to achieve, was further complicated by the fact that the system under consideration resided at elevated temperature conditions. This however, further motivated me in exploring the optimum welding procedure, that would ultimately yield enhanced weld elevated temperature performance.

Development of Additive Manufactured Polymeric Templates for Bone Scaffold Manufacture

Student: **Elton Galea**
Supervisor: **Prof. Ing. Joseph Buhagiar** | Co-Supervisor: **Ms Christabelle Tonna**
Industrial Partner: **Orthopaedic and Trauma Department, Mater Dei Hospital, Malta**

What is your project about?

Metallic orthopaedic scaffolds are implanted in patients with fractures and damaged tissues to encourage bone healing. These scaffolds should ideally be biodegradable in order to eliminate the need for a secondary surgery to remove them after bone healing.

In this project, iron-based scaffolds having a gyroid pore-strut architecture were prepared using a modified replication method. Tacky polymeric templates were produced by Stereolithography 3D Printing and coated with a fine iron powder. These coated templates were then heat treated in a furnace with controlled atmosphere at a temperature of 1120°C. The heat treatment thermally removed the polymeric template and allowed for the sintering of the fine iron powder coating. This allowed the polymeric scaffold to be replicated to a metallic one.

Why are you working on this project?

I selected this project because it falls under the biomedical engineering field. This field interests me a lot since it improves the patient's quality of life. In fact, implanting biodegradable scaffolds eliminates the need for a second surgery, easing the patient's mind as these surgeries cause additional pain and extra costs.

Additionally, additive manufacturing interests me a lot because it is a vast, flexible field that allows the production of the often complex geometry required for specific applications, in this case bone scaffolds. This thesis is part of project BioSA: Biodegradable Iron for Orthopaedic Scaffold Applications (R&I-2017-037) which is financed by the Fusion Technology Development Program and managed by the Malta Council for Science & Technology.

Filament Development for Laser Assisted FDM 3D Printing

Student: **Gabriel Borg**
Supervisor: **Dr Arif Rochman**
Industrial Partner: **Laser Engineering Ltd.**

What is your project about?

Fused deposition modelling (FDM) 3D printed parts lack strength and long term durability due to poor layer bonding. Therefore, this project aims to make use of localised laser heating to increase the layer bonding and hence the overall strength of the part. The selected laser operates within the near infrared range (NIR) and since PLA and ABS do not promote optimal laser absorption at this wavelength, additives were added. A filament maker was used to extrude PLA and ABS filaments with graphite powder as this additive promotes NIR absorption. Laser assisted FDM 3D printing was done using the developed filaments and this method was found to significantly increase the layer bonding strength of printed parts.

Why are you working on this project?

I choose this project based on my interest in 3D printing technology and sustainability in manufacturing. I am always keen on investigating new ways to be more sustainable and additive manufacturing, most notably 3D printing, is a sustainable approach towards manufacturing. In the near future, 3D printing is set to exponentially grow in manufacturing, particularly fused deposition modelling (FDM). However, in order to have this predicted growth, the major drawbacks of FDM 3D printing must be addressed and mitigated. From personal experience, FDM manufactured parts lack overall strength and long term durability. Therefore, I chose this project as it gave me the opportunity to investigate a potential technology that has the capability of overcoming this drawback, thus guaranteeing the future of FDM 3D printing. As a future engineer, I am always thriving on finding innovative ways to improve processes. The success of this project will revolutionise FDM 3D printing as this technology may be adopted by other industry sectors.

Performance Analysis and Improvement of a Thermoset Elastomers 3D Printer

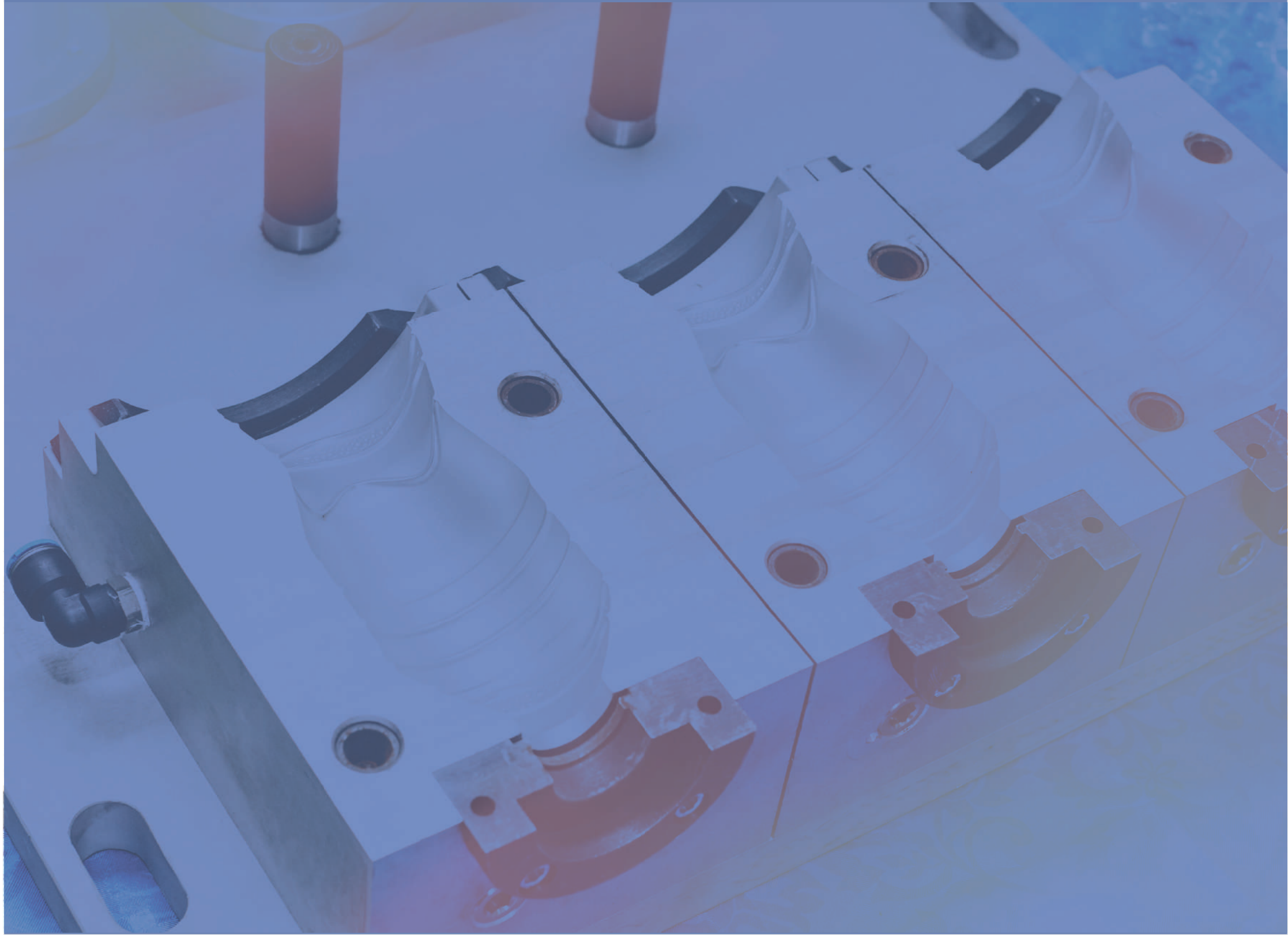
Student: **Gianella Bugeja**
Supervisor: **Dr Arif Rochman**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

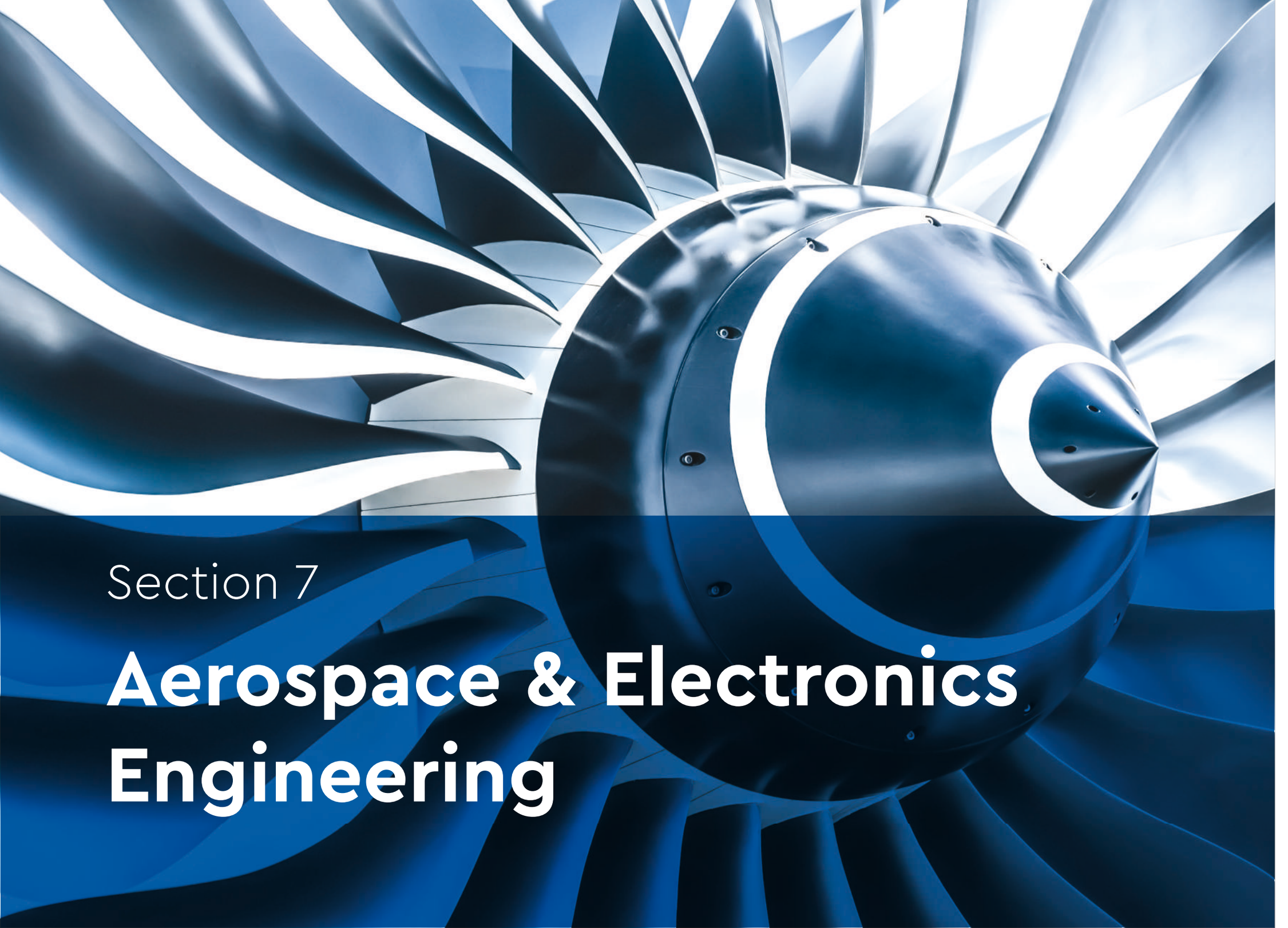
What is your project about?

This project is about a performance analysis and improvements of a previously developed thermoset elastomers 3D printer. Thermoset elastomers are also known as rubbers which, due to their molecular structure, face multiple challenges to be processed by additive manufacturing processes such as 3D printing. By carrying out in-depth research on the chemistry of the rubber materials, in particular on Nitrile Butadiene Rubber (NBR), as well as the different technologies available, the rubber 3D printer was improved. NBR material could be printed, analysed, and compared to compression moulded samples. The results obtained were comparable between the 3D printed samples and the compression moulded samples, however, optimisation needs to be carried out to further enhance the printed samples' mechanical properties and aesthetics.

Why are you working on this project?

Additive manufacturing plays an important role in industries whereby means of 3D printing, prototypes can be manufactured in a cost effective and efficient manner. Although numerous materials are applied by 3D printing techniques, the application of thermoset elastomers in 3D printing has not yet been achieved or perfected to a satisfactory level. Until today, production of rubbers still depends upon processes such as injection moulding, compression moulding and thermoforming. All these processes require the production of expensive moulds and moulding tools, which are time consuming and expensive to produce. With developments in 3D printing of thermoset elastomers, rubber manufacturing industries like Trelleborg Sealing Solutions Malta would benefit. Having a 3D printing technique that is compatible with thermoset elastomers allow rubber manufacturing industries to print samples prior the development and production of the moulding tools. Hence, improvements and optimisation of the products can be achieved efficiently prior production starts.





Section 7

Aerospace & Electronics Engineering

Acoustic Assessment of Noise Suppression Technologies for Aerospace

Student: **Matthew John Vella**
Supervisor: **Dr Ing. Simon Mizzi**

What is your project about?

The aim of the project was to thoroughly analyse the steps that are required in order to carry out a noise study on open rotors. An open rotor is a big propeller geared to a jet engine of an airliner, which helps in providing higher fuel efficiencies. Unfortunately, it generates a lot of noise, which must be reduced to acceptable levels before it is allowed to operate in the real world. In a nutshell, the project is a simple guidance aimed at providing the reader with thorough knowledge on different types of open rotor noises and with the necessary steps to analyse its noise sources computationally.

Why are you working on this project?

As an area of study, Aerospace Engineering has always fascinated me. I am a huge aviation enthusiast, and anything related to aircraft engineering, from aircraft designs to propulsion systems, have always been my top interests in life. The work I carried out in this thesis interests me the most as it deals with the problems of a rather new propulsion technology that will eventually re-shape the aviation industry in the future if the necessary arrangements are carried out. Learning on new propulsion technologies and on ways of how to improve them was of great interest to me. This work is very relevant to both the aviation industry and the public as it provides knowledge on the high noise levels generated by open rotors, which can be very disturbing. The aviation industry must keep on building knowledge on this work since open rotor noise levels must be reduced before being allowed to operate.

Optimisation Framework for Aerospace Geometrical Features

Student: **Owen Fenech**
Supervisor: **Dr Ing. Simon Mizzi**

What is your project about?

My final year project is about improving the design of an aircraft. The focus of this project was the aircraft's wing, however, the concept behind optimisation is common for different geometrical features and this project will serve as a framework for future work on the subject. Furthermore, this project was all done using Computational Fluid Dynamics (CFD) software, that is, software used to study the flow of a fluid over a solid body. CFD is the new future of optimisation since as shown throughout this project the process was done without the need to physically create the geometry and without the need for expensive wind tunnels.

Why are you working on this project?

As engineers, our job is to solve problems and we constantly strive to make things better. Throughout the years, the aviation industry has become the leading mode of transport to travel from one country to another. The early aircraft were designed to maximise aircraft speed and capabilities. However, with the increase in the use of aircraft and other transport, we are consuming fossil fuels at an alarming rate and we are damaging the planet. To mitigate this issue, the focus of aircraft design shifted from speed to maximum efficiency and payload. An effective way to achieve this is by optimising current aircraft designs. The aim of this project is to look into optimisation techniques and build an optimisation framework that can potentially be used to optimise different aircraft geometry such as wings, rudders and fuselage.

Design of an Embedded Processor for Image Processing Applications

Student: **Timothy Mark Xuereb**
Supervisor: **Dr Paul Zammit** | Co-Supervisor: **Mr Andre Micallef**

What is your project about?

The aim of this project is to design a microprocessor with an architecture optimised for real-time image processing on embedded systems. The processor architecture design is defined as a vector processor where the difference from other scalar processors is how instructions are executed. A scalar processor executes instructions in a sequential order thus, repetitive loops, which are often found in image processing applications take up more clock cycles than they should. This results in image processors missing their real-time deadlines, given that embedded systems have limitations in clocking speed due to the size of the application. The designed vector processor achieved speed improvements by an order of magnitude for the same clock frequency on matrix arithmetic operations which are fundamental steps in image processing.

Why are you working on this project?

Image processing converts images into digital form and allows operations to be performed on the image, such as enhancement, or getting useful information from the image. There are various applications for embedded real-time image processing, for example, industrial quality control, robotics, automation and the automotive industry. However, current embedded processors are not optimised for real-time image processing and results in the requirement of bulky heat sinks on the system due to a high clock frequency and expensive processors. These limits affect the cost of products with image processing thus limiting the availability of such image processing systems.

Volumetric Display Device

Student: **Fabian Camilleri**
Supervisor: **Mr Andre Micallef**

What is your project about?

In this project a Volumetric Display Device is designed and implemented. Volumetric Displays are a type of display technology that provide depth to two-dimensional images. This technology removes the need for special glasses to view a three-dimensional image. This project focuses on the Rotating Helix Volumetric Display screen type. The required components that made up this Volumetric Display were designed both in hardware and software, and were later combined to achieve a three-dimensional image.

Why are you working on this project?

Current traditional media portrays depth information with the help of special glasses which limit the user to a limited viewing angle. For this reason, it is required to design and implement a three dimensional volumetric display that is capable of previewing a three dimensional image with no constraints. Three dimensional displays is a technology that is only seen in futuristic and sci-fi movies. Being able to produce one is truly fascinating. This technology is still evolving and being part of the early stages of these displays is very interesting. The application of this display is truly infinite. This display could be easily used to project a three-dimensional image that is difficult to picture using a two-dimensional screen. This display could be easily used in classrooms, in the medical field, in industry and in online communication, to name a few.

Characterisation of MEMS Inertial Sensors

Student: **Nikolai Dimech**
Supervisor: **Dr Paul Zammit**

What is your project about?

MEMS inertial sensors (gyroscopes and accelerometers) are compact, inexpensive, rugged, consume little power, and are widely available. However, compared to traditional inertial sensors, MEMS inertial sensors suffer from larger integration errors. Furthermore, their performance varies significantly from one unit to the other and are often not completely specified by the manufacturer. As a result, using such sensors for precision applications such as navigation is challenging. This project's goal was to create a test platform and acquire data to characterise MEMS inertial sensors. This would enable a designer to experimentally determine the performance of a certain sensor unit, thereby evaluating its suitability for a specific application and customising the design for that unit.

Why are you working on this project?

The engineering industry is all about innovation; making technical advances to provide simpler and cost-effective solutions. This can be seen in this work since with the advancements in silicon technology and MEMS technology, these inertial sensors have been renovated into small, compact and inexpensive packages for consumers. The result of this project provides the ability of confirming that certain MEMS sensors are within the claims of the manufacturers. The characterisation of MEMS inertial sensors outline that these sensors are perfect for consumer and low-level industrial applications, such as; smart wearables, handheld devices, drones, small robotics and similar projects. These applications require a level of accuracy that is limited and therefore not harmful if an error occurs. This is unlike certain grades of applications, such as high end tactical or military application where there are lives at stake and inaccuracies may lead to serious or fatal injuries.

Real Time Audio Transport Over Network

Student: **Jean Daniel Callus**
Supervisor: **Mr Andre Micallef** | Co-Supervisor: **Mr Luke Vassallo**

What is your project about?

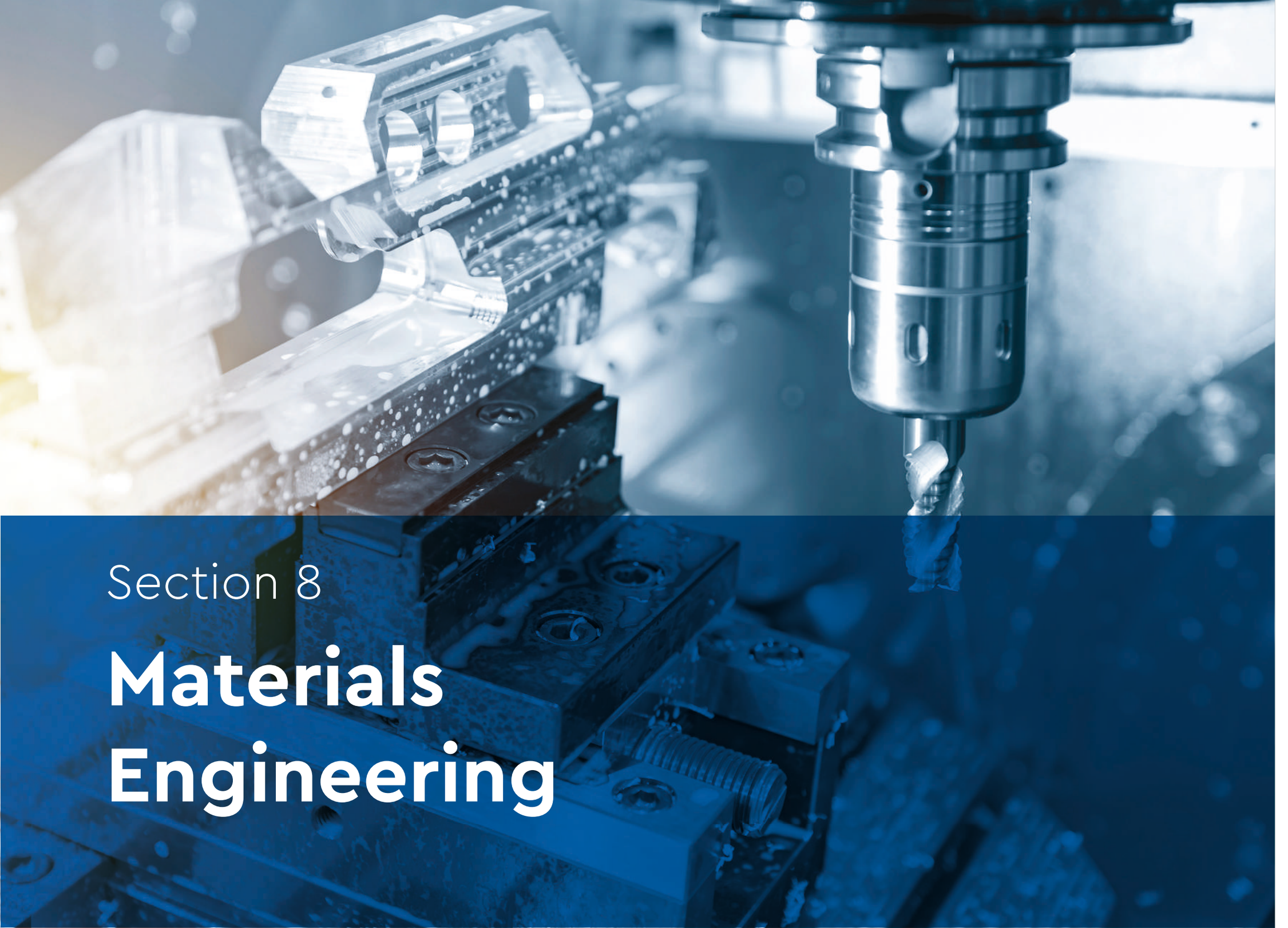
Traditionally speaking, audio communication systems used to exhibit limitations which resulted in the degradation of the overall quality of such systems. These limitations can be expressed in terms of flexibility and cost effectiveness amongst others. Making use of an audio network infrastructure solves these limitations and offers even more functionality.

The scope of this project is to design and implement an embedded system which is capable of transporting several high fidelity audio channels over a network with a delay which isn't noticeable by the human ear.

Why are you working on this project?

Audio related technology has always been of interest to me. My enthusiasm towards music and theatrical productions have always been a prominent part of me, even from a young age. The technology surrounding such activities had aspired me to learn more about its inner workings and resulted in enrolling for an engineering degree. Moreover, I have always been affectionate about electronics. Throughout the degree, I feel that I have garnered enough knowledge to be able to confidently implement embedded systems from scratch.

Being able to join my inclinations towards audio and electronics together for my final year project was a trivial choice. Furthermore, it is of great personal satisfaction to be working on technology that is just now being introduced into several markets.



Section 8

Materials Engineering

Investigating the Properties of Alumina Thin Films Applied by the Sol-Gel Process

Student: **Rebecca Mifsud**
Supervisor: **Dr Daniel A. Vella**

What is your project about?

The aim of this project was to apply coatings of alumina over fused quartz glass to try to improve the glass's anti-reflective properties. Application of the coatings was done via the sol-gel dip coating process, which consisted of dipping the glass slides in an alumina solution and then pulling them out slowly to allow for an alumina film to deposit over the surface. The slides are then dried in order to remove the alcohol, leaving only the alumina deposited on the glass. The surface of the coated glass was modified further by a water treatment procedure. This greatly improved the anti-reflective properties of the glass.

Why are you working on this project?

Materials engineering has always interested me more than other engineering fields, which is why choosing to continue my studies in this field was a natural choice. Surface engineering is an ever-growing field in material science and is, in my opinion, very fascinating. It deals with the modifications of surfaces of bulk materials in order to enhance particular material properties through a localised process.

In this project, a thin film of alumina was applied over glass to increase light transmissivity through it, thereby decreasing reflectivity. We also looked at how the alumina films can change the water-repellency of the glass, which would have a direct impact on the cleanliness of the surface. Such water-repellent surfaces are becoming increasingly popular as an extra protective layer on electronic devices. In water treatment applications, UV-lamp glass covers can be treated with alumina films to improve transmissivity of UV-light through glass.

Surface Modification of Porous Titanium Nitride (TiN) Implantable Neural Stimulation Electrodes

Student: **Julian Micallef**
Supervisor: **Prof. Ing. Bertram Mallia** | Co-Supervisor: **Ms Jeanelle Arpa**
Industrial Partner: **Dr Lars Pleth Nielsen, The Danish Technological Institute**

What is your project about?

The human nervous system allows the coordination of movements and sensory information, rendered possible by the delivery of rapid signals via neurons. Every year, several persons endure impairment to the nervous system due to disease or injury. In the field of implantable neural stimulation devices, the state-of-the-art pushes for smaller electrodes that may also be required to provide higher charge densities. Concurrently, electrode performance degradation and adverse tissue reactions need to be mitigated. Conductive polymers have a relatively low elastic modulus in comparison to conventional materials that can diminish elastic mismatch between the electrode and tissue. Moreover, conductive polymers can alleviate adverse tissue reactions. The project investigates the coating of a porous titanium nitride (TiN) implantable neural stimulating electrode with a conductive polymer coating to better the electrochemical characteristics of the electrode.

Why are you working on this project?

Research drives progress in the biomedical engineering field. This area of study adopts an interestingly holistic approach by intertwining the fields of engineering, medicine and science. Progress in the biomedical engineering field helps achieve a longer life expectancy and a better quality of life. I was interested in working on a project to improve neural stimulation electrode surfaces made from porous TiN through surface modification. It was remarkable to explore how the application of a thin conductive polymer layer on the electrode surface can enhance the performance of the electrode. The aspiration to deliver even a small contribution with my research project kept me motivated throughout the project.

A Study on the Firing of Sourced Maltese Clay into a Usable Product

Student: **Luke Xuereb**
Supervisor: **Dr Daniel Vella** | Co-Supervisor: **Dr Ing. John C. Betts**

What is your project about?

Clays have been used to manufacture pottery since the Neolithic period. One of the important stages of this procedure is firing, a thermal process by means of which raw clay is transformed into a fired ceramic body. The dissertation focus was on the study of clays for the manufacture of pottery. In this work, various firing parameters were tested to see how the pottery produced varied with different conditions.

Why are you working on this project?

This project researches local archaeological pottery production and clay found in the Maltese Islands. This project will thus assist archaeological research by developing a better understanding of the potential and constraints of using raw material from Malta, and would allow archaeologists to gain insights into the technological choices and actions of ancient potters. This dissertation is part of a wider project, "Compiling Fabric Identity for Pottery from Maltese Sites" or CoFIPoMS Project, launched in May 2020. The Department of Classics & Archaeology of the University of Malta is leading the project, supported by Heritage Malta, the national agency for museums, conservation practice and cultural heritage. It is funded by the European Horizon 2020 research and innovation programme.

Modelling and Characterisation of Residual Stresses Induced by Laser Shock Peening in Austempered Ductile Iron

Student: **Greta Grima**
Supervisor: **Dr Ing. Ann Zammit** | Co-Supervisor: **Prof. Ing. Glenn Cassar**

What is your project about?

This project was focused on studying the effects of laser shock peening on austempered ductile iron. Laser shock peening uses high energy laser beams in order to improve the surface mechanical properties of metals by inducing compressive stresses in the surface that are retained even after the process has been finished. However, it is very difficult to analyse the effects of the process in real time. Thus, by generating a simple numerical model using computer simulations, the process could be further analysed in order to predict the outcome and avoid unnecessary expensive experimental costs. Laser shock peening of austempered ductile iron was also experimentally carried for model validation and the effects were characterised using optical microscopy, hardness testing and X-ray diffraction.

Why are you working on this project?

Throughout my studies, I have been introduced to a range of units in multiple engineering fields. In particular, the field of surface engineering has interested me. Furthermore, this project combined experimental work with computer simulations which gave me a foothold into both hands-on and theoretical aspects of engineering. In addition, this project allowed me to gain further experience in the generation of computer simulations. Laser shock peening is a relatively novel process in the physics world and has been successfully applied to important engineering components such as turbine blades and bearings for the aerospace industry with a strong potential in automotive components such as transmission gears. Thus, being able to assess its outcomes using computer simulations can push its development further.

Development and Testing of Filament Wound Composite Poles

Student: **Nicole Farrugia**
Supervisor: **Prof. Ing. Duncan Camilleri** | Co-Supervisor: **Prof. Martin Muscat**

What is your project about?

Throughout this study, E-glass/polyester poles were fabricated using a process known as filament winding, during which, fibreglass in the form of a filament was transferred onto a rotating mandrel at a specifically defined angle. For the purpose of this particular study, fibre angles of 25°, 45° and 75° were fabricated, in addition to a combination of 25° and 75°. After having obtained the best quality possible, the poles were then tested by means of a test rig that was specifically designed and constructed for the purpose of this investigation. The test rig was designed to subject the poles under bending and torsion conditions to replicate the loads that utility poles (light posts) usually experience, such as wind loads. From the testing carried out, the behaviour of the poles could be observed. Additionally, parameters, such as the deflection exhibited by the poles and the maximum load before obtaining a significant amount of damage, were also observed.

Why are you working on this project?

The main reason as to why I chose to pursue my Final Year Project on composites is mostly driven by my future aspirations. 'Composite materials' is an ever-growing field which has piqued my interest for quite some time. In practice, composite materials have started to replace their traditional metallic counterpart products due to their superb lightweight and mechanical properties – properties which are obtained by combining different reinforcements and resins. I wish to end my engineering education by enrolling in a postgraduate course which specialises in composite materials. By doing so I would be able to grasp a better understanding of these materials, why they are chosen for certain applications, the failure mechanisms they possess and how various processes are used to manufacture them, amongst others. With such materials, a manufacturer can engineer a product which has specifically designed mechanical properties. In addition to the fact that composites make up a large portion of products that one encounters every day, I consider this field to be quite relevant in industries within various sectors such as aerospace, automotive and marine.

Comparison of Magneto-Elastic Characteristics of Some Steel

Student: **Joseph Buhagiar**
Supervisor: **Prof. Ing. Maurice Grech**
Industrial Partner: **Methode Electronics Ltd.**

What is your project about?

Magneto-elastic torque sensors make use of magnetic materials that exhibit a change in their magnetic field when subjected to a torque. A local company manufactures such devices from a stainless-steel type X46Cr13. This material may however not be the foremost steel for such an application. Thus, this study investigated three other steels also known to exhibit magneto-elastic characteristics and compared them to each other and to X46Cr13. In fact, this project concluded that two out of the three steels studied are ideal for use as torque sensors and are even magnetically superior to the material currently in use.

Why are you working on this project?

Torque sensors are used in various industries, including the automotive and aviation industries, to collect torque measurements from a rotating shaft. Due to the nature of their application, it is critical that the information gathered by such sensors is accurate. Yet, traditional torque sensors make use of strain gauges, which can loosen over time. As a result, the collected data may be inaccurate.

To overcome such a challenge, modern torque sensors rely on the magneto-elastic effect, a measurable change in the materials' magnetic characteristics when subjected to deformation (in this case a twist). This technology does not require the use of strain gauges and is intrinsic to the shaft itself. Thus, magneto-elastic torque sensors quite possibly represent the future of torque data measurement.

This project gave me the opportunity to contribute towards an innovative solution to a contemporary problem. Thanks to my work, the future of magneto-elastic torque sensors seems even more promising.

Monitoring the photocatalytic activity of nanotextured TiO_2-coated surface in real time

Student: **Leonel Bonnici**
Supervisor: **Dr Ing. Stephen Abela**

What is your project about?

Our unsustainable ways yielded climate change and water scarcity. Though effective solutions for water provision exist, they often involve the use of harmful chemicals and massive amounts of energy, further contributing to climate change. This project aims at finding a way to monitor the water cleaning effect by photocatalysis in real time. A 3D-printed photoelectrochemical cell was designed and constructed in which a nanotextured TiO_2-coated surface is immersed in distilled water and a saline solution. By monitoring the current change and floating potential of the photocatalytic surface when irradiated by UV-A light, the characteristic voltage and current response was recorded. This provided an insight of how these measurements can be used as indicators of the photocatalytic activity in real time, thereby serving as a feedback loop in a photocatalytic water treatment control system.

Why are you working on this project?

I have selected this field of engineering because nanotechnology and nanomaterials have always been intriguing, and due to this field being relatively new, it comes with a myriad of challenges while also having the possibility of affecting every industry. Furthermore, this project directly addresses worldwide problems such as water scarcity, climate change and pollution, which I personally find compelling since they negatively affect every person on this planet, thereby suitable solutions need to be presented. My motivation is that by continuing to understand photocatalysis, it can be extremely impactful on today's society by being widely available to every household, thereby drastically decreasing the stress on the provision of the water source.

Investigating the Induced Defects in Stacked Graphene Layers on a Silicon Substrate via Raman Spectroscopy

Student: **Jeremy Bonello Boissevain**
Supervisor: **Dr Ing. Anthea Agius Anastasi**

What is your project about?

In this work, energetic particles and a chemical etchant were used to induce damage in single and double layers of carbon atoms known as single and bi-layer graphene. The controlled introduction of atomic defects in both single and bi-layer graphene has been shown to modify important material properties such as its electrical and thermal properties.

The amount of damage induced in the graphene nanostructures is determined using a characterisation technique known as Raman spectroscopy. This type of technique provides qualitative and quantitative information on the type and density of defects being introduced in the graphene crystal lattice.

Why are you working on this project?

Since its discovery back in 2004, graphene has shown immense potential in improving various types of technologies in many different industries such as folding displays for the electronic industry, super capacitors for the electrical industry, and biosensors for the medical industry.

Having the ability to modify graphene's properties through defect introduction further increases the potential use of graphene in a wide variety of applications. For example, efficient filtration and desalination membranes can be produced by introducing nanopores in graphene. The main driving force behind this project was contributing to the current body of knowledge within the scientific community regarding defect engineering of graphene for water filtration. Being able to successfully desalinate sea water using two atomically thick sheets has the potential to revolutionize the water treatment industry.

The work presented aims at developing a method to consistently introduce defects in both single and bi-layer graphene sheets, contributing to the industrialization of graphene.

Sustainable Natural Fibre Composites for Maritime Applications

Student: **Sara Azzopardi**
Supervisor: **Prof. Ing. Claire De Marco** | Co-Supervisor: **Prof. Martin Muscat**

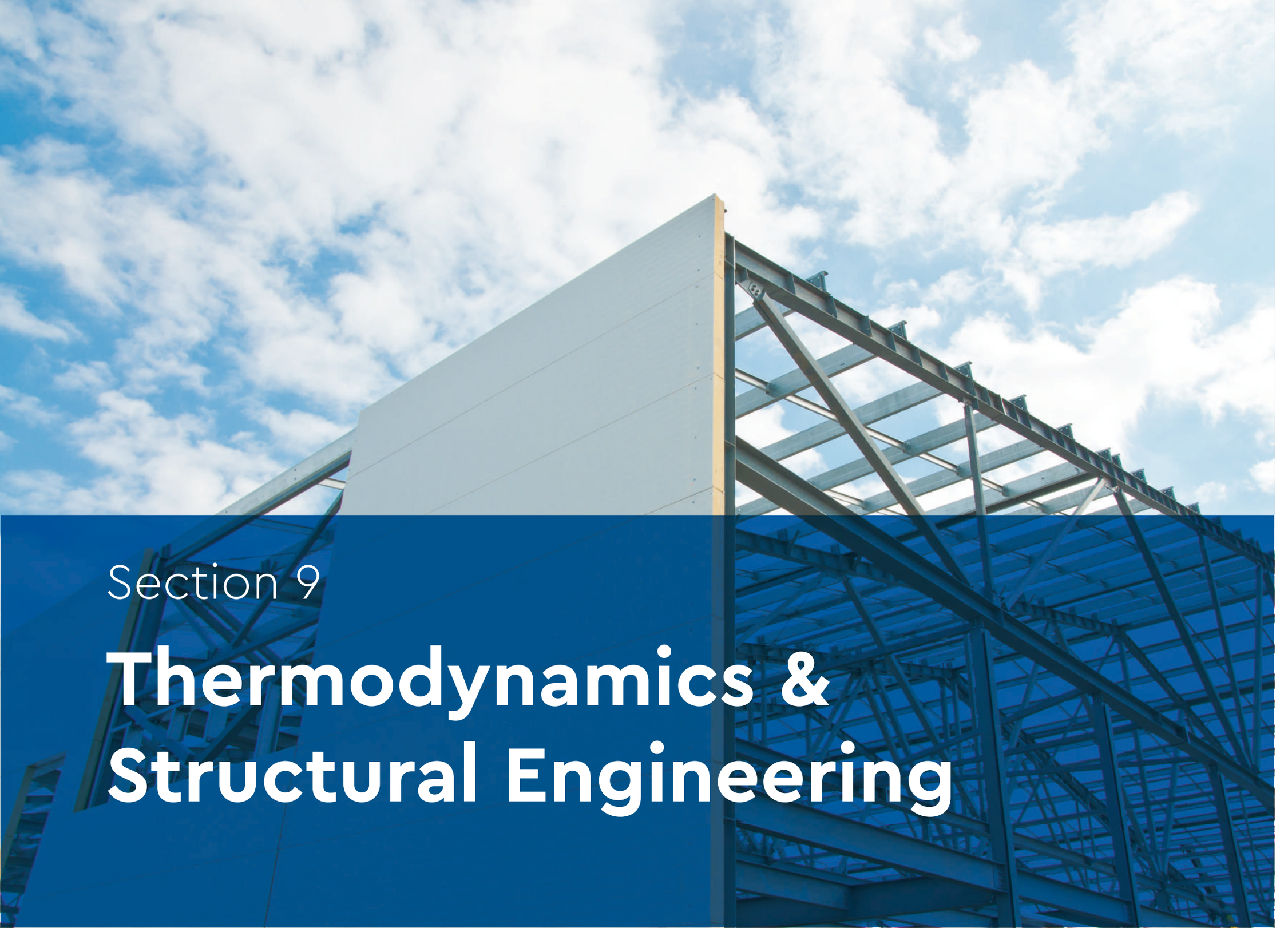
What is your project about?

Natural fibre composites have gained substantial popularity and have been increasingly used in recent years due to the wide range of benefits that natural fibre composites offer, including the sustainable and environmentally friendly origin, renewability, corrosion resistance, low cost and low density. One of the aims of this project was to characterise natural sisal fibres that have originated from Brazil, in terms of density, diameter and tensile properties whilst following the required ASTM standards. Consequently, the effect of multiple fibres and twist combinations on the tensile strength of sisal yarn was assessed. An additional aim of this project was to fabricate a unidirectional natural fibre composite that is composed of the aforementioned sisal fibres and bio-based epoxy resin by the vacuum infusion process. Subsequently, the tensile and flexural properties of the natural fibre composite were obtained by following the applicable ASTM standards.

Why are you working on this project?

I have always been interested in finding sustainable and environmentally friendly alternatives in everyday objects in order to try and minimise as much as possible the adverse effects imposed on the environment. Therefore, the idea of fabricating a natural fibre composite rather than a conventional synthetic composite immediately intrigued me.

Composites have become a new distinct classification of materials in the mid-20th century and are increasingly being used for their low weight, high fatigue strength and corrosion resistance. However, composites also have some drawbacks such as the difficulty that is faced at the end-of-life disposal. This project has therefore brought upon an appreciation towards the potential that natural fibre composites have with replacing synthetic composites, in order to try and reduce the harmful effects of synthetic composites on the environment. In addition, natural fibre composites further reduce the weight and cost associated with composites, which are both of crucial importance for certain applications.



Section 9

Thermodynamics & Structural Engineering

Computational Analysis of Fibre-Reinforced Polymer Utility Poles

Student: **Christian Stewart**
Supervisor: **Prof. Martin Muscat** | Co-Supervisor: **Prof. Ing. Duncan Camilleri**

What is your project about?

Electrical transmission utility poles are important as they enable the distribution of power and communication lines in all parts of the country. These utility poles can be made from fibre-reinforced composites and fabricated using the filament winding process. The manufacturers of such poles seek to minimise the manufacturing costs by reducing the amount of time and material required to fabricate poles with high mechanical properties, such as high strength and stiffness. In this project, numerical programs are developed and used to carry out computational analyses which help achieve these goals.

Why are you working on this project?

In this project, the area of fibre-reinforced composite materials is studied. Composite materials are used in a myriad of sectors, such as aerospace, maritime, as well as civil applications, because of the advantages they offer, namely being lightweight and strong. Because of my interest in the computational analysis of composite materials, this project enables me to further investigate the capabilities of composite materials through numerical simulations. Furthermore, this work prepares me for postgraduate studies, which revolve around the use of composite materials in the aerospace sector. The work in this thesis is beneficial for the pole manufacturing industry, as it helps to increase the efficiency of pole fabrication, making it less costly. The public will also benefit from this work, because stronger utility poles are able to withstand harsh weather conditions, ensuring that power cuts caused by damage to power lines are kept to a minimum.

A Numerical Thermal Model of a Building

Student: **Liam Portanier Mifsud**
Supervisor: **Prof. Ing. Christopher Micallef** | Co-Supervisor: **Dr Ing. Daniel Micallef**

What is your project about?

The main aim of my Final Year Project was to develop a model for a room test cell found at the University of Malta, which would be able to predict the room air temperature. The project also investigated several unknowns when modelling, such as the ground and sky. Another important aspect was making sure that the model delivers correct temperature readings. This was done by comparing the model's temperature results to a set of temperature readings collected by a previous project (at the Faculty for the Built Environment) and comparing to readings outputted by a software which is commonly used.

Why are you working on this project?

The reasons I chose this project were due to my interest in buildings, sustainable energy usage and heat transfer and the fact I have always wanted to build a numerical model. The project also required a good understanding of Solar Physics which only added to the interest when choosing the title. Building energy modelling also has ample room for growth with many sub-areas still considered as unknowns, which is why I felt great pride being able to contribute knowledge to the area.

The project is very important for both the general public and industry. Research has shown that a significant portion of energy usage and CO2 emissions in the EU results from the building sector. Given the world's drive towards a greener future, it is important that buildings become even more sustainable than they currently are, and modelling buildings helps optimise building energy performance so that necessary adjustments are made.

Impact Response of Single and Multiple Layered Renewable and Sustainable Sandwich Composite Panels

Student: **Katrina Degiorgio**
Supervisor: **Prof. Ing. Claire De Marco**

What is your project about?

Over the past years, composite sandwich structures have gained popularity within the engineering fields. Composite sandwich panels consist of two thin facings separated by a thick core and bonded together with a resin, resulting in a lightweight material, having excellent mechanical properties and characteristics. Sandwich panels are mainly fabricated from non-renewable resources, resulting in high greenhouse gas emissions during production. The increase in environmental awareness consequently led to the effort of providing more eco-friendly materials for composites. The use of natural materials and bio-based resins offer advantages such as weight and cost reductions, while being recyclable and eco-friendly. Moreover, marine structures are susceptible to impact from foreign objects, thus the aim of this study was to investigate the impact behaviour of green sandwich panels when subjected to quasi-static low velocity indentation impact (QSLVII).

Why are you working on this project?

Throughout the engineering course, I always found subjects related to marine and material engineering interesting. Lately, the engineering sector has been developing processes and materials which are sustainable, due to the increase in environmental awareness around the world. Being aware of the situation and believing that sustainability is the way forward, I decided to test sandwich panels which are made out of recyclable and eco-friendly materials and investigate the impact behaviour. The findings of this study will be a step forward in developing natural composites to be used within various engineering fields, such as the marine industry amongst others. Using natural composite materials would reduce the emissions of greenhouse gases and decrease the amount of waste dumped in landfills, as a result of the improved end-of-life cycle of the materials.

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To set up, improve and control the manufacturing processes, that transform the raw material into the valuable finished product that can be delivered in the market.

Maintenance Engineers
To ensure the upkeep of the equipment and minimum downtime through repairs and preventive and predictive maintenance

Automation Engineers
To identify opportunities for automation and contribute towards the design and upkeep of new automation initiatives. Run tests to identify bugs, and develop solutions for an optimised automation process.

Data Scientists (inc, AI)
Works on data analytics and algorithm generation to analyse, process and model data to support the organisation and help interpret results to create opportunities for improvement.

Industrial Engineers
To devise efficient systems in the set-up of the manufacturing lines in the most effective manner, by means of integrating workers, machines, material, information and energy together.

Quality Engineers
Works on Product/process validation, setting up the quality checks, and conducting reliability testing and failure analysis to ensure a robust product according to the customers' requests.

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20928500 | malta@hotset.com | www.hotset.com