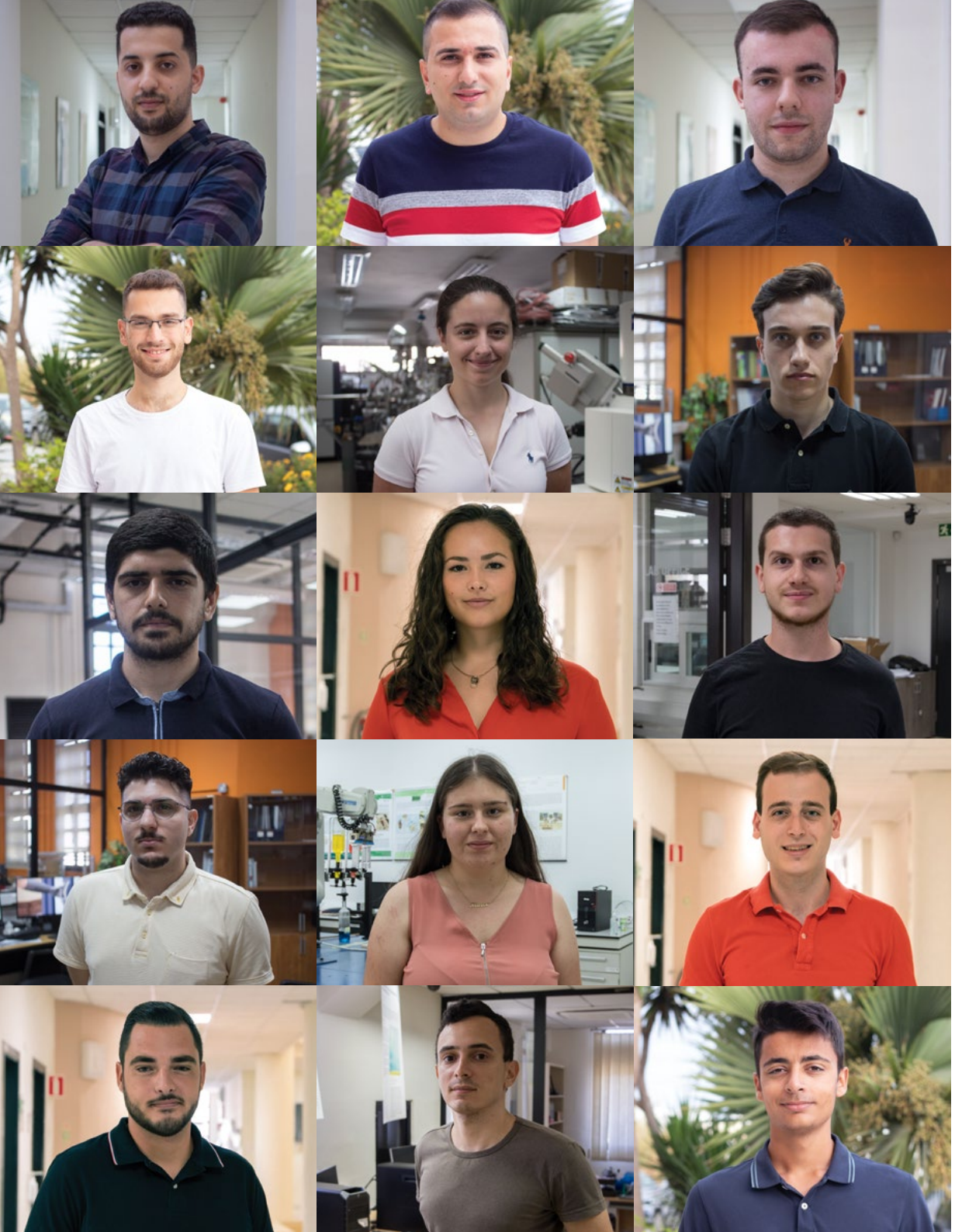

Faculty of Engineering Projects

2020

L-Università ta' Malta
Faculty of Engineering

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TURN YOUR PASSION INTO PURPOSE

Foreword

2020 has seen worldwide uncertainty, financial ruin, heartbreak, despair and various social and family hardships. The coronavirus pandemic has forced us all to re-evaluate the way we interact, do business and go about our daily lives. Education has taken a significant blow world-wide with virtual lectures, tutoring and online assessment taking the place of face-to-face instruction, student interaction and all the social benefits that campus life brings about.

Notwithstanding these difficulties and limitations, the Faculty of Engineering and its students have squared up to the challenge and made good headway towards completing the academic year, with as little disruption as possible to the education, training and formation of our future engineers.

Whilst the annual Engineering Projects Exhibition could not be held this year, we invite you to browse through this booklet which presents a showcase of the hard work and dedication of our students through their final year projects. We look forward to welcoming you to our Faculty and discover the exciting possibilities we have to offer.

Dr Ing. Andrew Sammut
Dean, Faculty of Engineering

#EngineeringTheFuture
#ShineAtUM

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Courses

International School for Foundations Studies Course

Certificate MQF Level 4
60 ECTS

Certificate in Foundation Studies in Engineering & ICT*

Faculty of Engineering Courses

Undergraduate MQF Level 4
60 ECTS

Certificate in Engineering Sciences

Undergraduate MQF Level 6
240 ECTS

MALTA ENGINEERING PROFESSION BOARD LOCAL WARRANT

B.Eng.(Hons) Electrical & Electronic Engineering

B.Eng.(Hons) Electrical & Electronic Engineering

European Accreditation of Engineering Programmes EUR-ACE®

Engineering Council accredited degree

Institution of MECHANICAL ENGINEERS

The Royal Institution of Naval Architects

Postgraduate MQF Level 7
90 ECTS

by Research

Taught

M.Sc. in Engineering [Various Research Areas]

M.Sc. Integrated Product Development

M.Sc. Building Services Engineering

M.Sc. Maritime Engineering

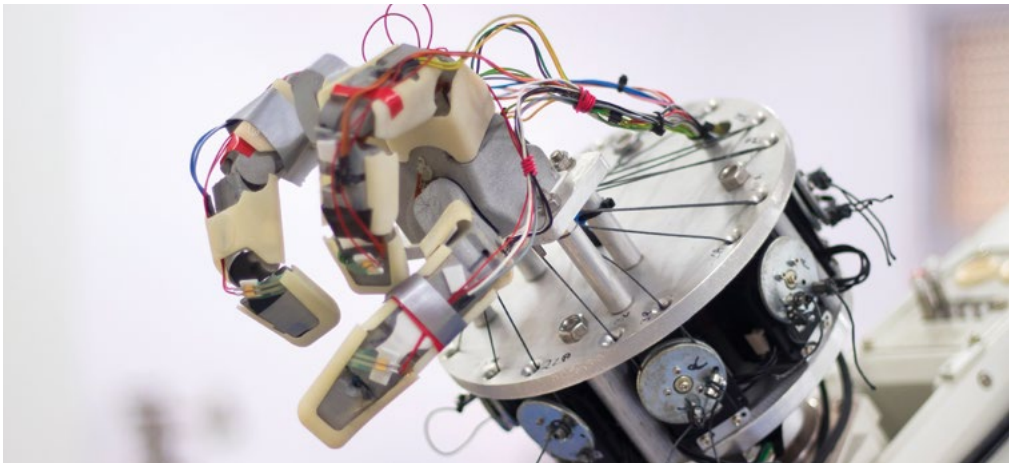
M.Sc. Signals, Systems & Control

NEW M.Sc. Biomedical Engineering

Postgraduate MQF Level 8

Ph.D. [Various Research Areas]

*For applicants who studied within an educational system that is not comparable to the Maltese educational system.



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 markets offered in various local and international industrial sectors such as the aerospace, biomedical, maritime, energy, telecommunications, electronics and manufacturing industries as well as that of building services. The course focuses on two main universal engineering areas of studies; Electrical and Electronic Engineering or Mechanical Engineering.

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

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

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

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

Certificate in Engineering Sciences

MQF Level **4**

Duration

1 Year Full-Time

Applicable for October 2020 & 2021

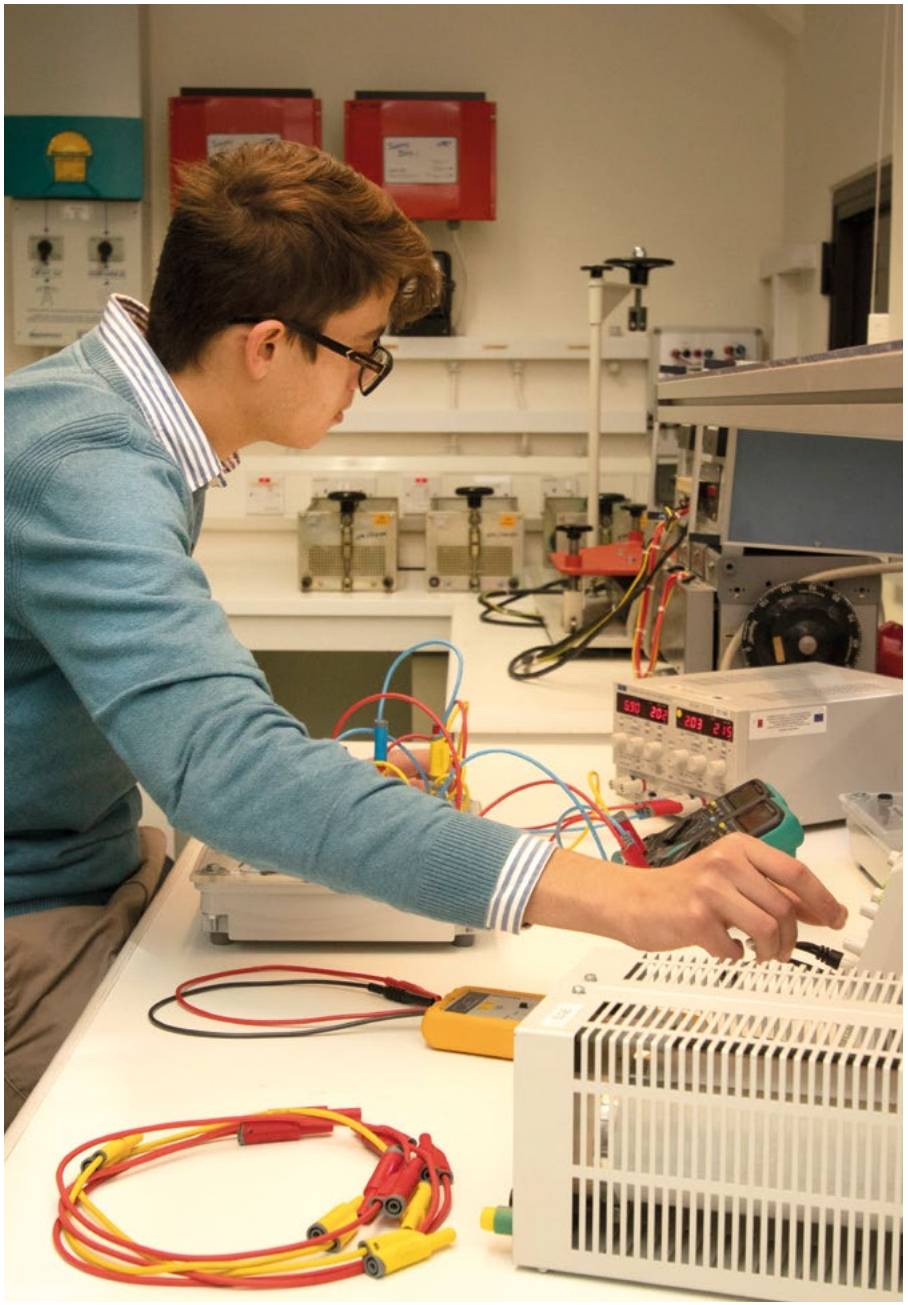
The Certificate in Engineering Sciences is a one-year certificate course intended to prepare students with the knowledge, skills and competencies necessary to follow the B.Eng. (Hons) course. During the course, students will be studying mathematics and physics, bringing the student's knowledge and understanding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



Section 1

Computer Vision & Artificial Intelligence

Computer-Vision Based Telemanipulation of an Interactive Kinetic Surface

Student: **Michaela Spiteri**
Supervisor: **Dr Ing. Stefania Cristina**

What is your project about?

One can have a conversation with someone remotely through video cameras and microphones in real-time or edit the same document in real-time remotely. However, to represent, discuss and even manipulate physical objects, spaces and surfaces remotely is an arduous task. An interactive kinetic surface would bridge this gap between telecollaboration across different locations.

The aim of this project is to design, implement and manipulate an interactive kinetic surface. The manipulation method was achieved through the use of hands and this was carried out using two avenues: through the use of a depth sensing device and by means of a neural network.

Why are you working on this project?

This project is a physical rendering of digital information, thereby not limited to one particular field of engineering. It includes computer-vision and deep learning which is an engineering way to mimic the human brain and its ability to solve complex problems and recognise patterns. There are several advantages to learning how information is processed in our brains. It can lead to a better understanding of systems and help develop technologies which solve what are currently considered as impossible problems. These technologies have applications in several fields of study including medicine, economics, ecosystems amongst others. The physical aspect of this project is more classical mechanical engineering including gears and systems to translate rotational movement into linear displacement. Another important aspect to this project is data links, the data is exchanged through several programming languages thereby maximising the advantages of each and allowing the user to achieve more with the acquired data.

Vision-based Human Pose Estimation for Sports Biomechanics

Student: **Yasmin Albaili**
Supervisor: **Dr Ing. Stefania Cristina**

What is your project about?

Computer vision pose estimation is a technique to recognize and track the body pose of humans in an image or a video, therefore predicting their intended movements. The tracking process is tackled through the identification of several key points, such as (neck, shoulders, and elbows) on the target in a given image or video without the use of physical sensors attached to the body. Human pose estimation is still a challenge, especially in crowded occluded scenes. Different methodologies to determine the human pose estimation is available, and this project is testing the robustness and the accuracy of available methods for sports biomechanics.

Why are you working on this project?

I have chosen the field of Systems and Control Engineering because it is a combination of analytical and theoretical research-based field, which provides precious solutions to the world.

My motivation is that human pose estimation would contribute to saving lives and ensure the wellbeing of our athletes. Achieving high accuracy human pose estimation would enable us to extend its application to other fields in the future. What interests me most is that I have been exposed to, and gained knowledge in, different engineering areas, such as artificial intelligence.

The importance of the project to the general public and industry is the estimation of the human pose in the context of sports biomechanics, to accurately offer awareness of athletic injury in early-stages and prevent future substantial injuries. Also, it plays a vital role in physiotherapy, where tracking and estimating the pose of patients during their therapy sessions increase the speed of the healing process.

Player Tracking and Heatmap Generation from broadcasted football games

Student: **Gilbert Vassallo**
Supervisor: **Dr Ing. Stefania Cristina**

What is your project about?

This work aims at developing an offline computer vision algorithm that takes broadcasted footage in an attacking or defending scenario as its input and aims to extract the players' positional data throughout the sequence of frames in which they are visible. The data is then visualised in the form of a heat map and a tracking sequence. This project explores newer and innovative methods for player detection and tracking.

Why are you working on this project?

First of all, football is something that I am very passionate about. In recent years, data analytics have come to play an important role in the sports industry, especially in football. Vision-based systems are being used in football to assist the referees in their decisions. A prime example of this is Video Assistant Referee (VAR). Clubs are always to gain a competitive edge on and off the pitch, and data analysis is allowing them to extract insights to improve player performance, prevent injuries and increase their revenue. Engineering in sports is still considered to be a new area of research that can present many opportunities for work and research in the future. Image processing and computer vision are areas of engineering that I grew very fond of during the engineering course.

Design of an Industrial Machine Vision System for O-Ring Quality Inspection

Student: **Clint Vassallo**
Supervisor: **Dr Emmanuel Francalanza**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

What is your project about?

The project's main objective is to design a reconfigurable machine vision system, thus allowing different machine vision applications to be carried out on the same system. This will allow manufacturing companies to increase their product inspection capabilities. Moreover, for the purpose of this project, the machine vision system must cater specifically for the dimensioning of the inner and outer radius of O-Rings supplied by Trelleborg Sealing Solutions. The dimension must fit within the tolerance specified by the industrial partner.

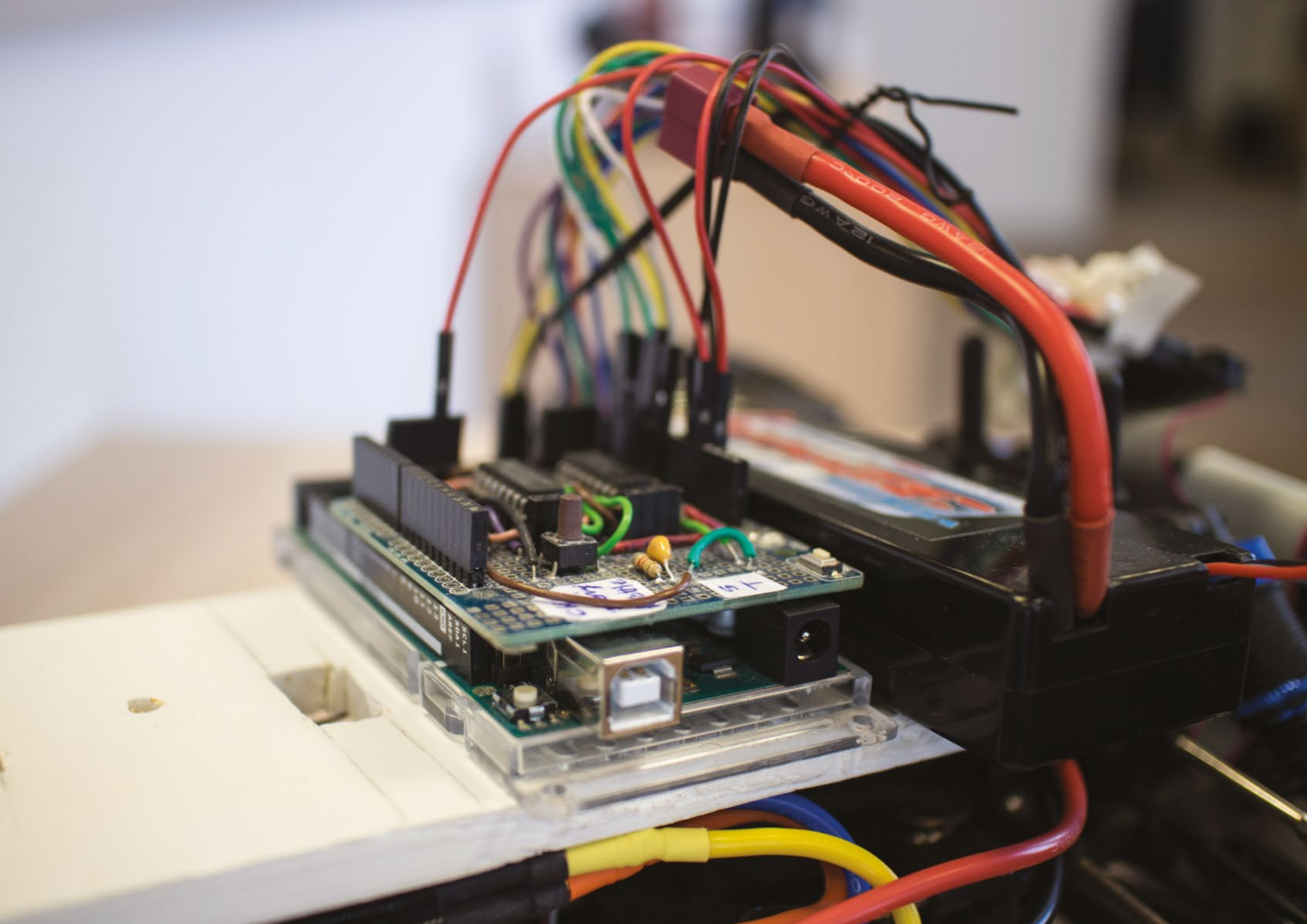
Additionally, the end result of this project will also compare different machine vision software in order to determine the most cost-effective system whilst ensuring that the requirements are met.

Why are you working on this project?

Machine vision is a rapidly growing field with new applications continuously being developed and implemented within today's manufacturing environments. Having the experience to conduct research on such a field along with an Industrial partner gave me the ability to tackle contemporary problems being faced within industry.

The motivation and drive which ensured the completion of this project is the need to correlate, software, mechanical and electrical engineering into one design. Thus, giving me the ability to grow and experience different aspects of engineering whilst applying various skills and competences which I have developed as an engineering student throughout my university experience.

Given the ever-growing competitiveness within the manufacturing industries, it is essential for such companies to adapt and implement machine vision applications in order to stay relevant and secure their place within industry.



Section 2

Biomedical Engineering

FEA of Foam Model Sternotomy Closure

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

What is your project about?

The project tackles the sternotomy closure technique, as implemented at Mater Dei Hospital in Malta, performed on a sternum foam model using computer simulation. The study addresses the performance of the renewed sternum after being dissected along its midline in two halves. The simulation helps to provide an examination of the sternal mechanical behaviour after sternotomy when the two halves are rejoined by means of stainless steel surgical wires. By modelling the wires and applying proper boundary conditions to prevent movement of the wires along the sternum and the sternal halves themselves, a biomechanical analysis is conducted on the amended sternum foam model.

Why are you working on this project?

I have always held a profound liking to the marvels of the human body mechanics. Technologies to safeguard the heart, such as sternotomy, spawn recurrently to increase human life expectancy. As engineers, we strive to analyse the sternotomy closure technique by interpreting the sternum model mechanical behaviour. From the results, we highlight solutions to reduce any post-operative risks for the patient after undergoing surgery. A major risk includes sternal separation through coughing and sneezing. It is our goal to ensure safety by being as minimally invasive as possible and ensure sternal stability and healing after the closure technique. The use of foam models and computer simulations is very handy to respect the ethical view of science involving human and animal activity. At the same time, surgeons can predict certain outcomes while providing a safe, cheap route to make necessary improvements to optimise the sternal closure technologies.

Detecting Movement Thoughts from Electrodes in the Brain

Student: **Ella Miceli Farrugia**
Supervisor: **Prof. Ing. Kenneth P. Camilleri** | Co-Supervisor: **Dr Tracey Camilleri**

What is your project about?

This project aims to analyse brain signal recordings from two patients who were opening and closing two types of pliers. These are the normal and reverse pliers and they differ in the sequence of hand movements required to manipulate them. The recordings were obtained by means of an invasive data-acquisition method known as stereo-electroencephalography (sEEG), which records signals from within the brain. In this project, standard signal processing, feature extraction and classification techniques are applied to the sEEG signals to recognise the hand movements used to handle the pliers and determine the intended movement from the signals themselves. Furthermore, the reliability of these feature extraction techniques is investigated.

Why are you working on this project?

I have for several years now been fascinated with biomedical engineering. It is a field of engineering which is constantly advancing. Brain machine interfaces (BMIs) are being developed to allow paralysed individuals to walk in mind-reading exoskeletons and others who have lost the use of their limbs to move robotic arms. The research being done on BMIs will no doubt help improve the quality of life of individuals suffering from paralysis following spinal cord injuries, strokes or other disorders, and could give them once again the independence they have lost. I believe this research could lead to some very powerful technology and I wish to contribute to its development. Knowing that this technology will in many ways help people, fuels my drive and passion for this field.

Analysis of EOG data recorded while reading

Student: **Matthew Mifsud**
Supervisor: **Dr Tracey Camilleri** | Co-Supervisor: **Prof. Ing. Kenneth P. Camilleri**

What is your project about?

This project deals with the analysis of eye movements performed by humans while reading, employing electrooculography (EOG) as an eye movement recording technique. Electrooculography makes use of non-invasive surface electrodes placed in close proximity to the eyes, to detect changes in the user's eye gaze. In this project, EOG data of a subject was recorded while the subject was reading and signal processing techniques were then implemented to automatically identify typical eye movements while reading, specifically forward and return saccades, fixations and blinks. Through the detection of these eye movements, reading statistics such as word estimates, reading speeds and number of lines read can be determined, providing useful information on the reading capabilities of the user. Furthermore, in this project, an eye gaze tracking algorithm was also developed, allowing the system to track the user's point of gaze while reading. This would allow for the possibility of clicking a hyperlink on a web page, for example, simply through eye movements, giving more control to individuals who use eye gaze tracking as a communication interface.

Why are you working on this project?

The area of biomedical engineering is a fascinating field which manages to bridge the areas of both engineering and medicine in an effort to develop and design solutions which can be used intrinsically by individuals with severe mobility impairments. To this effect, this project has analysed the biopotentials developed across the user's eyes in order to detect eye movements and also track the user's point of gaze. The development of such Human-Computer Interfaces (HCI), which do not make use of conventional inputs, provide an alternative means of communication for individuals suffering from mobility impairments hence also improving, their quality of life.

Distributed radiation dosimeter for a biologically-equivalent x-ray phantom

Student: **Gabriella Muscat**
Supervisor: **Ing. Evan Joe Dimech** | Co-Supervisor: **Dr Marc Anthony Azzopardi**

What is your project about?

Medical uses of radiation are consistently increasing throughout the years to provide information about the functioning of a person's specific organs via the use of x-ray imaging or computed tomography (CT) or to treat disease through the process known as radiotherapy. However, treatment using radiation has an adverse effect that may cause risks from overexposure ranging from trivial to fatal. Thereby, the need for radiation protection programs is of significant importance. The objective in medical radiation exposure is not to give the lowest dose, but to provide the safest dose. This thesis proposes a system which involves an economically feasible, mobile and miniature sensor where measurements of the absorbed dose are read instantaneously.

Why are you working on this project?

Biomedical engineering is the perfect combination of applying engineering principals and methods to improve human health and solve medical problems. As technology continues to advance, engineers continue to improve the equipment for medical professionals which enhance a better service to the general public. As a field, it is very self-satisfying as you are contributing to society by improving the health care system. This year's COVID-19 pandemic motivated many biomedical engineers to use their expertise in this field and come up with rapid solutions to ease the situation. Detection of the virus, improving protective personal equipment of health care workers and sterilisation system for ventilators, were all available to the general public in a short period of time due to their quick thinking, technical ability and careful measurement and analytical skills. This is field is continuously growing as health is the primary concern of every individual.


EOG WORDOMETER
Select Text:
Search for a document:
Start
Figure 1
File Edit View Insert Tools Desktop Window Help
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Horizontal EOG Component
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time (s)
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07/07/2020

Design and Evaluation of 3D Printed Polymeric Templates for Metallic Bone Scaffold Fabrication

Student: **Albert Curmi**
Supervisor: **Prof. Joseph Buhagiar** | Co-Supervisor: **Dr Arif Rochman**
Industrial Partner: **Mater Dei Hospital**

What is your project about?

The rehabilitation of a patient afflicted with a bone fracture involving substantial bone loss may be improved by implanting a load-bearing scaffold. Such a scaffold would be porous to allow bone ingrowth and may be biodegradable, aiming to degrade at the rate of bone regrowth.

In this work, a process that is capable of producing patient-specific, biodegradable, iron-based scaffolds, was developed. It uses SLA 3D printing to print the desired shape and then a coating of iron powder is applied. The coated specimens are then heat-treated to burn away the 3D printed shape and combine the separate iron powders.

Why are you working on this project?

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. I was attracted by the idea of developing a better rehabilitation process for orthopaedic patients as this would make me apply the knowledge I gained up till now on a subject with positive real-life consequences. Therefore, this made it satisfying to work on and gave me the drive to make the process work as desired.

Beyond simple motivation, the project worked with technologies which I enjoy working with, namely 3D printing and the associated 3D modelling. This work provided me with a measure of freedom to solve the problems at hand, in the manner I saw fit, something which I enjoyed doing, whilst developing further my knowledge of the field.

Catastrophic Tribocorrosion Damage of Cr_2N PVD coated Biomaterials

Student: **Rebecca Bugeja**
Supervisor: **Prof. Ing. Bertram Mallia** | Co-Supervisor: **Mr Antonino Mazzonello**
Industrial Partner: **Tribology Centre, Danish Technological Institute, Denmark**

What is your project about?

There are various forms of coatings in the engineering world, and my project explores how a few microns thick (4 microns is 22 times smaller than a human hair) ceramic chromium nitride (Cr_2N) coating, behaves when deposited on two popular biomedical alloys (Stainless steel and Cobalt-Chromium Molybdenum). This coating could potentially be applied to implants that are used inside the human body, (e.g. Hip Replacements) and find themselves in harsh environments. This research investigates the likelihood of the coatings failing catastrophically, such as, by the detachment from the underlying biomedical alloy and what were the reasons leading to such failure.

Why are you working on this project?

I am working on this project because it combines two things which I love and value, engineering and finding ways to help people. The aim is to improve the performance and longevity of implants that will contribute to a better quality of life. The research gives better insight on how the coating material investigated may fail during the action of mechanical and chemical stimulants when applied to two different biomaterials. In addition, I am fascinated to be working towards better implant materials and the multidisciplinary aspects that lie within.

Behind-the-ear EEG for SSVEP-based BCIs

Student: **Mandy Abela**
Supervisor: **Dr Tracey Camilleri**

What is your project about?

Brain-computer interface (BCI) systems give individuals with limited mobility the independence and ability to communicate with the external world without engaging in any muscular activity. This can be done through the recording of brain signals while the subjects are looking at flickering stimuli. These brain signals are typically recorded non-invasively through electroencephalography (EEG) where electrodes are placed at specific positions on the human scalp. However, this limits the practicality of BCIs as the system may not be easy to set up and the patients may not wish to wear the head cap with electrodes in public. Alternatives to this setup are thus being investigated, particularly the recording of EEG signals from behind the ear.

This project thus aims to analyse the classification performance obtained when recording EEG data from behind the ear region as opposed to the standard recording from the occipital brain region, for a BCI system involving the presentation of visual stimuli, where each stimulus would be attributed to a specific control function that the subject would want to execute.

Why are you working on this project?

I was always interested in the field of biomedical engineering as I find the fact that electrical engineering can be of great use in the medical field very fascinating. I was immediately interested in this dissertation as the findings of this study could act as a step forward in developing a practical BCI system for patients with limited mobility. Through such research, biomedical engineering is giving such vulnerable patients the ability to express their needs and wishes. Therefore, I was more motivated in doing this project as through my studies and using today's technology, I am helping these patients in having a better quality of life.

Experimental Sternotomy Closure Analysis

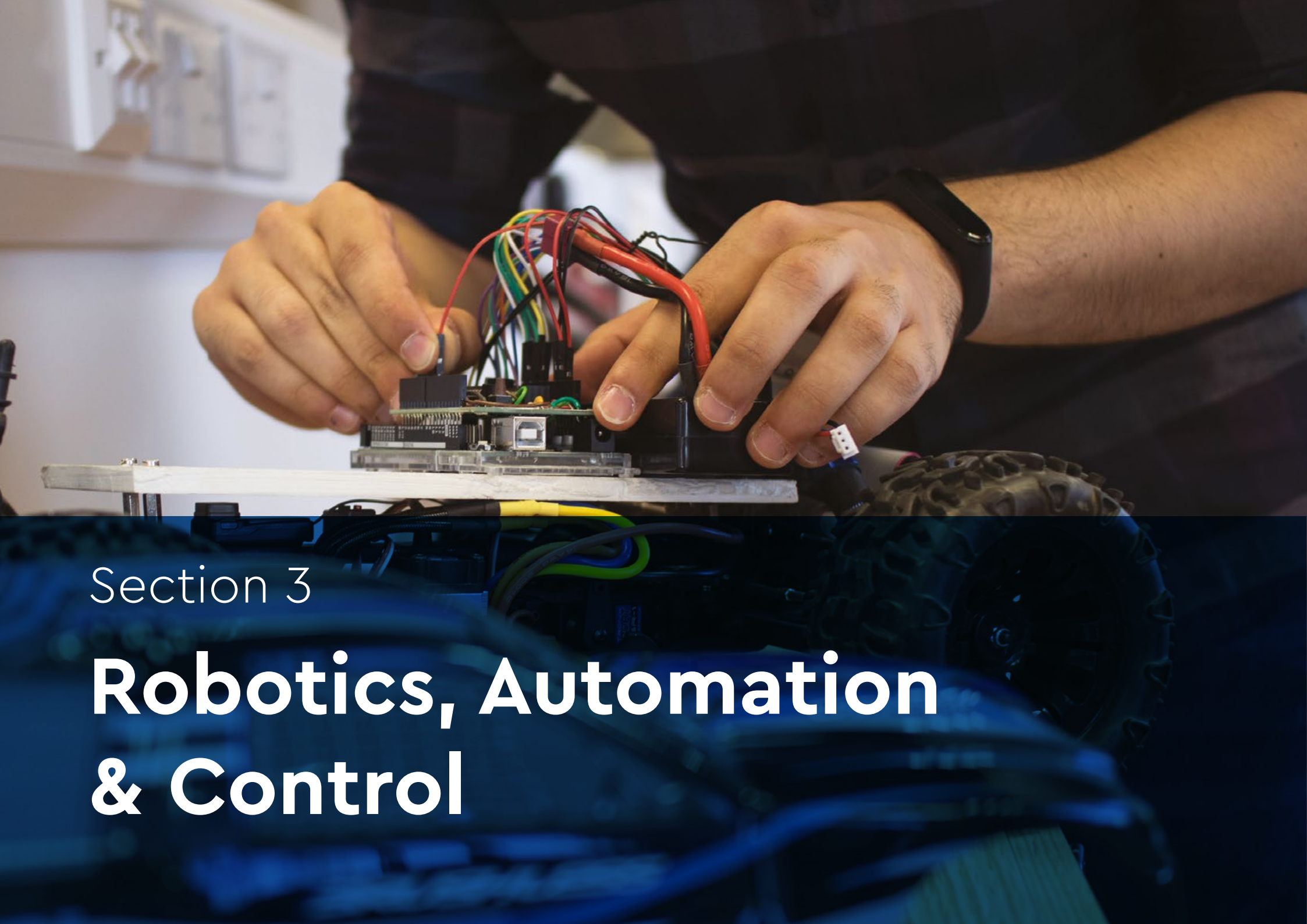
Student: **Keith Abela**
Supervisor: **Dr Ing. Zdenka Sant**

What is your project about?

The aim of this dissertation was to carry out analysis on a suturing technique used in median sternotomy. The analysis was performed using a foam model of the human sternum having similar material properties to the actual human bone. A testing frame was designed and constructed to mount the sternum foam model onto a tensile testing machine and the forces exerted on the foam model were then examined. The forces exerted on each costal cartilage were obtained and the total axial force experienced by the costal cartilages on one side of the sternum foam model was compared to the actual force being applied by the tensile testing machine.

Why are you working on this project?

The bioengineering field is a combination of biomedical and engineering expertise. Bioengineering has contributed to the development of revolutionary and life-saving concepts, such as developing new and improved materials to be used for transplants and designing and manufacturing more efficient new tools for surgeons and doctors. One of the many medical fields which involve carrying out critical surgeries daily is the cardiovascular field. The scope of this project was to improve on suturing techniques used in median sternotomy, which is the process that is nowadays considered as the go-to approach when it comes to surgeries involved in the chest area. Such projects and studies contribute to the improvement of such critical surgeries which in turn could save lives in the future.



Section 3

Robotics, Automation & Control

Development of Miniaturised Robots for Swarm Deployment

Student: **Brian Azzopardi**
Supervisor: **Dr Ing. Brian Zammit**

What is your project about?

The scope of this project is to develop miniature robots to be used in the area of swarm robotics. Swarm robotic systems typically replicate the behaviour of natural swarms of animals and bacteria. Two common examples of such natural swarms are the trails formed by ants between their nest and a food source, and schools of fish. A robotic swarm is composed of a number of simple individual robots with limited intelligence, which work together to reach a complex common goal, such as finding an object or forming a shape. Before designing the robot and developing a prototype for testing, some swarm behaviours and existing swarm robotic platforms must be reviewed to identify the required capabilities.

Why are you working on this project?

Robotic systems are becoming more popular in various areas, including swarm robotics. This field is particularly interesting because of its inspiration from nature, and because each robot in the swarm typically follows a set of very simple rules which are common for all members. Despite their limited capabilities and the simple rules they follow, complex tasks can still be performed. The design of these robots poses various challenges. The performance of a robotic swarm depends a lot on both the mechanical and the electronic design of the robots, therefore, bad design choices would limit the collective capability of the swarm. Another thing I like about this project is that although it focuses on electronic circuitry and PCB design, it also consists of other aspects, such as microcontroller programming and 3D modelling for the design of the robot's body.

An Autonomous Robotic Pacer for Track Runners

Student: **Mohamed Attir**
Supervisor: **Dr Ing. Marvin Bugeja**

What is your project about?

Amateur Runners and professional athletes usually follow a preplanned training session by running for a certain distance at a certain pace. Various wearable gadgets provide such information but to a limited degree of accuracy. It is known that a running companion or professional pacer can improve the quality of the training sessions by guiding the runners to run at a certain pace to achieve the goal of the training session better. The aim of this project is to design a Robotic Pacer that can be programmed to run a certain distance in a certain time to mimic the role of a human running companion and help runners to perform better during training on a standard running track.

Why are you working on this project?

The topic of control systems and their theoretical analysis was very interesting to me. However, learning its theory is something, but relating it to the actual processes and control systems is another thing. Also, the topic of robotics and autonomous robots is very intriguing to me and similar to the previous case, the theory misses out on many different aspects that involve the implementations of robots. Lastly, I like projects that are hands-on and require both hardware and software skills, and this one summed up most of the above reasons.

Safety and Security in a Digital Industrial Automation Systems

Student: **Luca Caruana**
Supervisor: **Dr Ing. Emmanuel Francalanza**
Industrial Partner: **Methode Electronics Malta Ltd.**

What is your project about?

The manufacturing industry, in which several goods used in everyday life are produced, is continuously changing and improving. Changes include new technologies and machines as well as the way these machines transfer data between each other. These changes bring about hazards and threats on the shop floor, that need to be tackled by applying Safety and Security solutions. This project takes these changes into consideration to establish a step-by-step procedure through which hazards can be identified. After the hazards are identified, these are assessed to determine the risk created by each. Further to the assessment, the risks are tackled by determining the appropriate solutions, which eventually help reduce the risk level on the shop floor.

Why are you working on this project?

Engineering is quite a broad field, but one of the most relevant areas in Engineering for Malta is the Industrial and Manufacturing area. Several large companies, such as Methode Electronics Malta Ltd., have based their manufacturing production in Malta and this offers many job opportunities and experience. It is important, however, to make sure that these jobs offered do not impose any kind of threat on the employees, be it an operator, technician or maintenance personnel. To do so effectively, Safety and Security measures need to be implemented. Nowadays, the ever-growing awareness of Safety and Security in the workplace is being given more importance. Thus, what makes this project exciting and remarkable is the fact that that it focuses on the current trend and focus in the industry around the world, while also experiencing something tangible which can easily be put to the test.

Developing a Replication Method using Additive Manufacturing

Student: **Andre' Mizzi**
Supervisor: **Ing. Claire Seguna** | Co-Supervisor: **Dr Ing. Emmanuel Francalanza**

What is your project about?

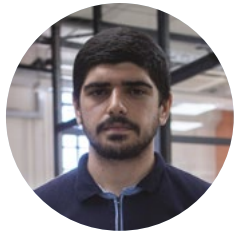
Industrial robotic manipulators are machines that are used for manufacturing, military, surgical, construction and countless other applications. Their primary function is to move (manipulate) objects around a specific volume (workspace), from one precise location to another. On the other hand, 3D printing is a method of manufacturing that enables the transformation of a computer-generated design directly into a physical model automatedly and within a respectable time span. This project explores the possibility of designing an original industrial robotic manipulator and subsequently transforming the design into an operational prototype through the application of 3D printing technologies.

Why are you working on this project?

The future is robotics. The future is 3D printing.

This project combines two of the most relevant engineering technologies that are driving the fourth industrial revolution, coined 'Industry 4.0'. Primary fields of engineering relating to this project include Mechatronics, Robotics, Automation, and Additive Manufacturing (3D printing).

Throughout this course, I had primarily grown fond of mechatronics and robotics, and so this project seemed like the optimal opportunity for me to delve further into these subjects. However, throughout my work, I have also taken great interest in functional 3D printing and have applied learned concepts in the production of an originally designed robotic manipulator prototype. This work highlights the immense potential of this technology not just for enthusiast applications, but also for functional rapid prototyping ventures in all industries. Additionally, the complete design process can be revised and referred to along with the final physical prototype generated.



Control of a Ball and Beam Apparatus

Student: **Simon Sultana**
Supervisor: **Dr Ing. Simon G. Fabri**

What is your project about?

The ball and beam apparatus is usually found in most research labs for testing several methods to control the position of the ball on the beam according to the desired reference point, which is the aim of this project. It is also used to resemble real-time complex systems, such as

- In aircraft stabilization while turning, during take-off, before landing and during turbulence
- In robots to balance objects while walking.

The system consists of a beam attached directly at its centre to a motor, supported by a stand. A ball is accommodated on the beam over which it can freely roll sideways. This system has two degrees of freedom:

- The ball freely rolling along the beam which is measured using a sensor
- The beam rotating about its central axis

Each degree of freedom is measured using a dedicated sensor.

Why are you working on this project?

Control systems theory is used in various engineering fields. By understanding the fundamentals of controls, it enables opportunities to solve many different engineering problems as an engineer. For example, as an electrical engineer, you will need to be able to design switching power regulators which are in almost every electrical device and rely on feedback as they can be unstable if designed incorrectly. As a communications engineer, you might be building an automatic gain control circuit that automatically increases the gain in weak signals and decreases it in strong signals. As a mechanical engineer, you might be concerned with vibrations and damping in your structure and you may have to design an isolation system in a motor mount for it. As an aerospace engineer, you might be asked to solve a problem with aircraft flutter.

Nonlinear Optimisation for Itinerary Planning

Student: **Amy Spiteri**
Supervisor: **Dr Kenneth Scerri**

What is your project about?

Creating intelligence for a mobile application which provides custom itineraries for tourists visiting Valletta, for a full or half-day. An itinerary is a planned route which includes multiple points of interest, ordered in such a way that the time spent travelling is minimised. The designed intelligence takes into consideration user preferences when selecting highly rated points of interest. It also considers constraints such as time budgets, point of interest opening hours and in the case of the full-day trip, restaurant recommendations for lunch and dinner.

Why are you working on this project?

Travel has become a major part of our lifestyle. Nowadays, shorter trips to cities have risen in popularity. In fact, millions of tourists travel to Malta each year, with the majority of them visiting Valletta throughout their stay. As a result, tourists face the dilemma of selecting points of interest to visit and ordering them in such a way that would minimise the time spent travelling between them. Such planning requires time and patience. Thus far, online services such as TripAdvisor, only offer information on the points of interest to visit. To order them for a minimal duration of travel, one would need to use other services such as Google maps. Moreover, travel agents tend to focus on pre-planned trips rather than custom ones. Therefore, an online itinerary planner would prove to be very useful for the general public.

Development of Design Improvements to a Flexible Modular Automation Product Assembly System

Student: **Wayne Chircop**
Supervisor: **Dr Ing. Joseph Zammit** | Co-Supervisor: **Ing. Alan Xerri**
Industrial Partner: **Toly Products Ltd.**

What is your project about?

Toly Products Ltd. is a global manufacturer of packaging products for the Cosmetics Industry. Toly opened a brand-new factory in Bulebel Industrial Estate in June 2019. The new plant helped the company to focus more on flexibility and have a much more modern and safe manufacturing plant.

Recently, Toly has designed and commissioned a new flexible automation concept. This concept was developed to address changes which took place in the market. However, the process has limitations. In this project, the limitations of the flexible automation concept will be analysed, and potential solutions will be explored.

Why are you working on this project?

First of all, I selected this dissertation project as it provided me with the opportunity to make my first contact with professional reality. Working with industry, allows me to not only solve engineering problems by transferring the knowledge and skills acquired from university but also to interact with an organization and its representatives. Secondly, the subject of Industrial Automation always interested me, and this project allowed me to gain more knowledge in this area.

Nowadays, industrial manufacturing companies are facing increased demand for premium quality products and services which can only be supplied by a high level of productivity. Consequently, industrial automation becomes vital in addressing these requirements.

Automation is important to industry as it provides numerous advantages, such as higher production rates, better product quality, improved safety, higher flexibility, reduction in waste, more efficient use of materials and reduced factory lead times.

Control of Connected and Autonomous Vehicles (CAVs)

Student: **Leon Gatt**
Supervisor: **Dr Kenneth Scerri**

What is your project about?

The aim of this study is to review and implement control algorithms for CAVs, and to quantify their benefits through calibrated simulations at a local signalized junction at different CAV market penetration rates. To analyze the impact that CAVs can have on an urban junction, the tests carried out in this project will be performed on a tuned model of the Rue d'Argens and Sliema Road junction in Gzira. As there are a large number of different approaches that could be taken to improve traffic at urban junctions, it was decided to implement four different traffic management systems and compare the performance benefits they each have on the junction.

Why are you working on this project?

The need for urban transportation often negatively impacts our urban environment, health and standard of living. The rapid increase in transportation demand brought about several unforeseen and unintended problems with significant negative effects, mainly on the environment and our health. One of these problems is traffic congestion which leads to increased delays, driver's frustration, pollution, collisions as well as fuel consumption. The problem of traffic congestion is being experienced by the majority of commuters. It is quite challenging to solve with many of the proposed solutions often resulting in the expansion of the road infrastructure. However, this is not a feasible long-term solution, especially in dense urban areas. As significant breakthroughs may be achieved through the recent development of Connected and Autonomous Vehicles (CAVs), this study aims to quantify the possible benefits that could be experienced by commuters using a local urban junction with the introduction of such vehicles.

Tele-operation of an Industrial Robot

Student: **Maria Dolores Micallef**
Supervisor: **Prof. Michael A. Saliba**

What is your project about?

This project is about the teleoperation of an industrial robot. Robot teleoperation can be simply explained as the remote control of any robot. The robot available at the University of Malta is controlled using 3D linear and rotational data. The main aim was to develop a motion tracking system for the arm and transfer this data to control the robot remotely.

The motion tracking system was developed after analysing the available tools used for such tasks. The MPU9250, which is a chip comprising of triaxial accelerometer, gyroscope and magnetometer, was selected. Through the developed programs, the data extracted using the Arduino Uno was processed, yielding the required data to control the robot.

For the data transfer, a mode of communication had to be selected. The Ethernet interface was selected after comparing the two possible means offered by the robot controller: the RS-232C and the Ethernet interface. Finally, another two programs were developed to allow for this data transfer using C++ and Melfa Basic IV programming languages.

Why are you working on this project?

Robotics is something that has fascinated me from a very young age, let alone robot teleoperation. Robot teleoperation is a growing and powerful sector which can be utilised in various sectors including industry, medical, maritime, civil protection, and construction amongst others. You can never get bored working with robots given this variety.

This field of engineering offers a never-ending list of benefits. Risks are mitigated when robot teleoperation is used for bomb disposal. Moreover, surgeons can perform life-saving procedures remotely.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Section 4

Transportation & Racing

An Airborne Collision Detection and Alerting System

Student: **Neil Sultana**
Supervisor: **Dr Ing. Brian Zammit**

What is your project about?

With the ever-increasing demand in air travel, more aircraft are taking to the skies to replenish such demand. Regrettably, Aircraft Collision Avoidance Systems (ACASs) are primarily designed to operate on large commercial aircraft with no requirement to be installed on light training aircraft. This raises the need for having an ACAS system equally available to light aircraft. The developed system will assist the pilot flying in practising situational awareness whilst also being able to alert any potential conflict. This dissertation discusses some research into radar technology and its mode of operation, the extraction and decoding of ADS-B data from Mode-S extended squitters, hardware and software selection as well as designing algorithms for evaluating the decoded ADS-B data.

Why are you working on this project?

Being able to combine the aviation industry with that of engineering was always intriguing. In view of this, I opted to develop a system to assist aspiring pilots with their flight training. Not only that but also enhance their safety by alerting them of any potential conflict. It for sure was an interesting journey that resulted in a good learning experience and interesting developments along the way.

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Determination of the Forces of Lift and Drag on a Hydrofoil in a Cavitation Tunnel

Student: **Mariana Zammit Munro**
Supervisor: **Dr Ing. Simon Mizzi**

What is your project about?

The aim of this project was to create a force measurement set-up for use within a cavitation tunnel, which can then be used to design ship rudders and other control surfaces. Cavitation is a phenomenon that can cause erosion and failure of ship propellers and rudders, leading to high maintenance costs. By means of this set-up, cavitation can be studied while lift and drag forces are being measured, and engineers can test different rudder designs to improve the stability and manoeuvrability of ships.

Why are you working on this project?

I am working on this project because I am particularly drawn to the field of maritime engineering, and enjoy experimental research and the design of innovative solutions. This project is particularly interesting as it incorporates Force Sensitive Resistors (FSRs), which are extremely thin force measuring sensors. This project was challenging mainly due to the introduction of a force measurement system into high-velocity water streams, because of size constraints, potential damage to electronic equipment and leakage.

Research engineers in the maritime engineering industry can profit from this set-up for the design of more efficient rudders and study of cavitation. It can also be used to validate Computational Fluid Dynamics (CFD) turbulence models and cavitation simulations used for design, which is a very important developing sector in the industry. This set-up can also be applied to aerospace research, through the testing of different aerofoil shapes at low speeds.

A High Voltage DC supply for the More Electric Aircraft

Student: **Melania Grech**
Supervisor: **Prof. Maurice Apap** | Co-Supervisor: **Dr Alexander Micallef**

What is your project about?

My project is about the More Electric Aircraft (MEA)which is the concept of replacing most of the hydraulic, pneumatic and mechanical power systems onboard an aircraft with electrical ones. This has several advantages such as reducing the system weight which implies that the aircraft will use less fuel. Due to the increase in electrical loads, the aircraft's electrical power system becomes significantly larger than those in conventional aircraft. Higher power loads require higher voltage levels to reduce cable sizes, and as a significant proportion of the increased load is due to inverter-driven motor loads, high voltage DC buses are being introduced. The advantage of using high voltage DC is that the cables are thinner and fewer cables are required than when using AC. The generating system on an aircraft is AC, my project consisted of analysing and designing an autotransformer rectifier unit to convert from AC to DC.

Why are you working on this project?

I have chosen this topic because it is a relatively new topic in engineering and there is a lot more to be learned and discovered. I always had an interest in aeroplanes and how they work. The electrical system of an aircraft is composed of multiple units and it is interesting to learn how everything works together.

The MEA consumes less fuel thus less greenhouse gases are emitted in the atmosphere hence this aircraft is more environmentally friendly than conventional aircraft. A decrease in fuel consumption will also reduce the operational cost of the aircraft allowing airlines adopting MEA technology to be more competitive.

A DC Brushless Drive for a Micro Light Aircraft

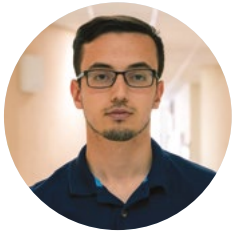
Student: **Michael Fsadni**
Supervisor: **Prof. Joseph Cilia**
Industrial Partner: **Abertax Kemtronics Ltd.**

What is your project about?

This project was centred around the process involved in the integration of a complete drive system for a microlight aircraft. Such a drive system consists of a brushless dc motor, a motor controller, a lithium-ion battery, and a propeller. This process includes several aspects such as modelling and simulation of the system, the design, construction and testing of a lithium-ion battery, as well as the programming and implementation of the correct communication protocols. Once the integration of the whole system is complete, it could then be eventually used to power microlight aircraft or implemented as an auxiliary power source for a glider.

Why are you working on this project?

The concept of electrically powered aircraft has been around since the late 19th century with the development of airships. Since then, there have been significant developments in the industry, with the main goal of researchers being a future where aviation becomes fully electric. The prospect of a fully electric future for the aviation industry would bring about several benefits, both to the industry itself as well as the environment. As it stands, the global aviation industry contributes around 2% of all human-induced carbon dioxide emissions. Therefore, a fully electric future for aviation will be much more sustainable and less harmful to the environment. Being an aviation enthusiast, and having an interest in electric drive systems, it was only natural for me to take on this project and give a small contribution towards achieving the goal of a fully electric future for the aviation industry.



Onboard Bus Voltage Regulation for All-Electric Ships using the DC Microgrid concept

Student: **Justin Formosa**
Supervisor: **Dr Alexander Micallef** | Co-Supervisor: **Prof. Maurice Apap**

What is your project about?

The Shipboard power system of marine vessels has been based on alternating current (AC) for decades. Nowadays, marine engineers are starting to opt for hybrid/all-electric power distribution systems. Manufactures in the marine industry are nowadays also adopting the direct current (DC) system in All-Electric Ships (AES). This technology provides cleaner, more efficient, flexibility in the power system design and is more eco-friendly. In marine vessels, the integrated power system (IPSs) integrated with renewable energy sources (RES) and energy storage systems (ESSs) can be classified as shipboard microgrids (SMGs) in which energy sources and electrical loads are connected in parallel. When the ship is at sea, the SMG is considered as an islanded microgrid.

Why are you working on this project?

I have always been interested in marine engineering, and how engineering could provide the means to a renewable and cleaner environment. Every individual around the world is taking action to invest in renewable energy. However sadly, when it comes to the marine industry ships are still being produced with the same traditional ways of propulsion. I immediately was interested in this dissertation as the findings of this study will be a step forward in developing All-Electric Ships using the DC microgrid concept for electric propulsion. Personally, I believe that this is the better alternative which can provide cleaner, more efficient, more flexibility in the power system design and an eco-friendly electric power distribution system thanks to the improvements of today's technology.

Design, Building and Testing of Plug-in Hybrid Electric Drive for a Small Boat

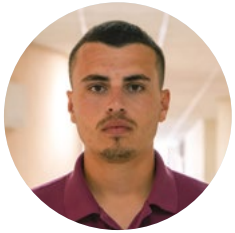
Student: **Jaron Schembri**
Supervisor: **Prof. Joseph Cilia**

What is your project about?

With the advancement in technology of batteries and electric drives, over the past few years, the concept of having an electric or hybrid-electric drive system as an alternative to having an internal combustion engine (ICE) powering your means of waterborne transportation has regained a lot of interest. This project presents the design, building and testing of a plug-in hybrid-electric drive system for a small boat which uses battery energy storage in conjunction with photovoltaic panels and an onboard ICE powered DC generator. The main objective of the project was to design a system that could achieve a long-range without the need of stopping to charge batteries using shore power.

Why are you working on this project?

I am working on this project as I am very interested in both the marine industry and the engineering industry. My aim was to design a system which is very efficient and environmentally friendly in order to conserve the natural habitats found in our seas and around the coast of the Maltese Islands. From when I was a young child boats were always one of my hobbies. Therefore, building such a system was of great interest as I always wondered what is required to have a boat which is powered using electrical power instead of using fuels. The system designed for this project can easily be commercialised hence the general public can opt to power their small boats using such a system. This would lead to less emissions produced and reduce the running costs of their propulsion system to nearly zero.



Natural, Hybrid and Lightweight Composite Panels for Maritime Applications

Student: **Ritienne Sultana**
Supervisor: **Prof. Ing. Claire De Marco**

What is your project about?

Sandwich panels consist of two thin, strong and stiff facings that are separated from each other by a thick, low-density core. The aim of this project is to determine the properties of bio-based sandwich panels made of Biotex® flax fibre facings and Amorim® CoreCork NL20 core, bonded together by ONE Super Sap® high bio-based laminating epoxy. Single and multi-layered sandwich panels of the same overall thickness were fabricated, in order to study any possible benefits that intermediate layers may have on the overall mechanical properties of the sandwich structure. Sandwich properties were investigated through three different characterisation tests, namely long beam flexure, short beam shear and edgewise compression, each adopting the respective ASTM standard procedures.

Why are you working on this project?

The interactions between the components of a sandwich structure allow for excellent mechanical properties to be achieved, namely a high flexural stiffness and an excellent strength-to-weight ratio. Sandwich panels are known for the ability to produce lightweight components, that are increasingly being applied in structural applications. Fabrication of sandwich panels is dominated by the use of synthetic, petroleum-based materials that make the panels difficult to dispose of at the end of their lifespan. Furthermore, production methods of synthetic materials are energy-intensive, generating excessive amounts of carbon dioxide that contribute to global warming. The recent increase in environmental awareness has brought about a change in the materials used, with studies showing that in many cases, natural materials offer weight reduction, tailored functionality and economic benefits. The research project allowed for the determination of the properties of single and multi-layered bio-based sandwich panels, while promoting the use of environmentally sustainable technologies in structural applications.

Development of a Data Acquisition System for the UoMR Team

Student: **Luke Vella**
Supervisor: **Dr Ing. Brian Zammit**

What is your project about?

Every year or two, the University of Malta Racing team builds a formula-style racing car from scratch. The team would like to install an electronics system in their car to obtain information about the car's performance and to assess the mechanical designs which were implemented to build the car. Electronic sensors were installed, and in this project, a data acquisition system was developed to read data from the sensors and log the data onto an SD card. Furthermore, a robust data network was installed to improve noise immunity.

Why are you working on this project?

I have selected the area of automotive electronics because I enjoy working on systems which involve both electrical sub-systems and mechanical sub-systems. Automotive engineering gives me a general understanding of how most machines work and its technology is always evolving. I was always fascinated with the advanced electronic systems that are present in motor vehicles. Nowadays automotive engineering is very relevant, people use automotive systems regularly to travel from one place to another, moreover at present, the automotive industry is transitioning from combustion engine vehicles to electric-powered vehicles, which are key to improve public health and to create a more sustainable living.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Optimisation of a Propeller for a High-speed Sea Craft

Student: **David Xuereb**
Supervisor: **Dr Simon Mizzi**

What is your project about?

The project involves the optimisation of a marine propeller to mitigate cavitation using computer simulation. Cavitation is a phenomenon that occurs as the pressure in the water drops and water vapour bubbles form. Cavitation formation may result in reduced performance, vibrations, and material degradation. Propellers rotating at high speeds are very susceptible to cavitation formation. Therefore, a numerical model of a cavitating propeller was developed and validated against experimental data. The model was modified with the addition of a duct around the propeller as a measure to reduce cavitation. Finally, an optimisation framework which found the best set up of the duct was implemented to optimise the performance of the propeller.

Why are you working on this project?

Throughout my studies, the units in the course have introduced me to several fields in engineering. Fluid mechanics has been a subject which appealed to me, whilst maritime engineering has always been a field which interested me. Therefore, I found this project as a perfect opportunity to develop my knowledge regarding the subject. Additionally, computational fluid dynamics (CFD) is a tool which is growing in the maritime industry. Therefore, the project allowed me to explore CFD and grasp a better understanding of it. Since the project involves an optimisation strategy to reduce cavitation formation, it allowed me to discover features which affect cavitation and appreciate the importance of optimisation processes.

Further Experiments on the Free-Piston Engine

Student: **Justin Debono**
Supervisor: **Prof. Robert Ghirlando**

What is your project about?

This study involves further experimentation and modifications to the free-piston engine (FPE) prototype at the University of Malta. In recent years, the FPE prototype has always failed to reach self-sufficient operation in the firing mode. Therefore, this study deals with tackling the high amount of friction present within the engine. Friction tests were performed on each component of the engine, where three main components were identified as the main contributors to the high friction and were subsequently redesigned. The implemented modifications decreased the total friction substantially. Engine tests were then carried out, however, the FPE still failed to reach self-sufficiency. A one-dimensional model of the engine was also developed using Ricardo WAVE. The FPE model was developed by employing an imposed piston motion sub-model to simulate the piston motion profile of one cylinder piston of the prototype. Finally, simulations showed a decrease in overall engine performance after the sub-model was imposed.

Why are you working on this project?

The automotive field of engineering is one that interests many due to the regular research and advancements carried out by various companies in industry. The rising threats of global warming due to the continuous burning of fuels to supply energy for land and marine transport vehicles, has compelled engineers within various institutions and companies to design innovative and less harmful sources of power. Although significant advancements have been made to conventional engines (CEs), the levels of efficiency and emissions are limited by the basic working principle of these engines. This technological restriction has made CEs susceptible to possible replacements. The FPE, which was invented in 1922 but scrapped by many due to various problems and restrictions of the time, has been revisited as a possible contender to CE technology. The FPE has resurfaced due to its superiority in certain aspects namely, higher power to weight ratio, higher efficiency, multi-fuel capability and the reduction in the number of engine components.

LPG Dual-Fuel Implementation and Simulation on a Common Rail Diesel Engine

Student: **Samuel Mifsud**
Supervisor: **Prof. Ing. Mario Farrugia**

What is your project about?

This project revolves around the study on LPG and diesel dual fuelling. The work performed in this dissertation includes the construction and implementation of an LPG fuelling system onto a 2.0HDi Peugeot diesel engine, using two LPG injectors and a controller circuit that was purposively constructed to supply the required peak and hold pulse nature for the injectors to operate successfully. Following this, a dual fuel simulation model of such engine was developed with the help of Riccardo WaveBuild Engine simulation software. This was used in order to investigate the performance and fuel consumption characteristics of LPG addition along with diesel.

Why are you working on this project?

Working on combustion engines has always been my major interest in the field of engineering. Thanks to formula student experience, I had the opportunity to gain practical experience as well as technical know-how on spark ignition engines, mainly within the field of ECU tuning, turbocharging and creation of simulation models. These have helped me a lot when working on this project. I chose this project because it provided an opportunity for me to expand my knowledge on compression ignition engines as well as LPG fuelling systems and mechatronic control systems in operating fuel injectors. This will be beneficial for my future career in working with automotive companies, as some of these companies are investing in such research to be able to meet the stringent emission targets.

Visualisation of ICE Combustion

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

What is your project about?

The project consists of remodifying a single-cylinder spark-ignition engine to visualise the combustion behaviour. The actual cylinder head was replaced with a thick Perspex to attain optical access into the cylinder, and a high-speed camera was used to record the engine running. Moreover, the engine was modified to be able to record the in-cylinder pressure variations against the volume displacement. The obtained data was used in conjunction with an analytical method (Rassweiler and Withrow method) which is used to define the cumulative percentage of the heat generated from the conversion of the chemical energy into heat. Lastly, the project also consists of determining the mean flame speeds achieved during the combustion cycle and comparing the experimental data to numerical data using the WAVE software.

Why are you working on this project?

During my studies, the course has exposed me to various areas in engineering. Throughout the years, I have grown a keen interest in automotive engineering. Thus, I found it appropriate to further develop my knowledge in this regard. Moreover, combustion has always been considered as a complex phenomenon to understand. To date, the analytical explanation for the combustion is in elementary development under a limited range of conditions. Nevertheless, this project allowed me to understand in further detail the combustion behaviour using both analytical and numerical tools under the variation of some parameters including fuel, load and Air to Fuel ratios.

Experimental and Simulation Analysis of Turbocharged Engine Transient Response Improvements using Compressed Air

Student: **Gabriel Dimech**
Supervisor: **Prof. Ing. Mario Farrugia**

What is your project about?

The unresponsiveness of a turbocharged engine can be mitigated using several mechanical means. This project deals with the measurement of a turbocharger's lag, building a set-up that injects air into the turbocharger to reduce the lag and simulating, using computer software, the effects of injecting air into the turbocharger of turbocharged engine. The results of the simulation show a large improvement in the engine's performance when air injection is used. Air injection not only eliminates the turbocharger's unresponsiveness but also significantly improves the engines power output.

Why are you working on this project?

The automotive industry has always fascinated me and the University of Malta gave me the opportunity to research this field. Since the unresponsive nature of turbochargers is a major problem when turbocharging engines, researching ways of how turbocharged engines can be made to be more responsive is remarkably interesting.

The downsizing of engines is a recent development within the automotive industry aimed at reducing emissions from automobiles. This has led to the widespread use of turbochargers making consumer engines unresponsive and consequently, unengaging to drive. Several techniques that make turbochargers more responsive and thus reduce turbo-lag exist. Compared to other means of reducing turbo-lag, air injection is cheap and easy to implement. However, it is not installed on consumer vehicles but it is mostly used on heavy duty diesel engines. I hope that my work highlights the benefits of air injection for consumer vehicles and raises awareness about the usefulness of an air injection system.

Carbon Fibre Laminates and Sandwich Panels for the Development of a Monocoque Formula SAE Chassis

Student: **Daniel Sean Bezzina**
Supervisor: **Prof. Ing. Martin Muscat** | Co-Supervisor: **Prof. Ing. Claire De Marco**
Industrial Partner: **University of Malta Racing (UoMR)**

What is your project about?

The University of Malta Racing (UoMR) team consists of a number of students whose aim is to design, build, test an open-wheel vehicle and ultimately compete in a Formula Society of Automotive Engineers (FSAE) competition. One of the objectives for increasing race car dynamic performance is that of minimising the overall mass of the vehicle. Optimisation of the chassis structure could contribute significantly to weight reduction. All previous team chassis iterations were based on spaceframe design. The aim of this dissertation was to provide a backbone for the development of a carbon-fibre reinforced polymer (CFRP) semi-monocoque chassis to achieve this objective.

Why are you working on this project?

I have been a member of the team since joining University in 2015 and participated in two competitions since, in Italy in 2018 and Silverstone, U.K. in 2019. Throughout the progression of the course I have developed an interest in 3D modelling, structural mechanics and finite element analysis (FEA). In particular, I have witnessed other competing teams make use of structurally efficient composite structures including that of the chassis. This furthered my interest in pursuing the field of structural analysis and the knowledge of engineering analysis of composites. This area of study is also a relatively new scientific field with current research and development occurring in the world scene. Combining all this with the fact that I feel suited to a project which involves the use of advanced software packages and quantitative analysis, this motivated me to create the proposal for this project and further the work created by previous students in the mission of developing a lighter and stiffer chassis structure.

Aerodynamic efficiency and flow behaviour of an FSAE Vehicle

Student: **Brandon Zammit**
Supervisor: **Dr Simon Zammit**

What is your project about?

The project aimed to investigate how downforce can be generated and drag reduced by varying the underbody of a Formula Student vehicle. Simulation software was used to test for such variations and observe the resulting flow behaviour, downforce and drag. Produced computer simulations were compared against existing experimental data to measure their accuracy. Optimisation was then performed to find the best underbody geometry that produces the least drag and the most downforce. This resulted in candidate solutions that can serve as a basis for future Formula Student vehicle designs and provided a better understanding of how flow behaviour generates the required downforce.

Why are you working on this project?

The project was done on behalf of the University of Malta Racing team, which designs, builds and competes with a Formula 1 style car in an international Formula Student competition. The competition not only serves as a dynamic event that tests a car for its speed and efficiency, but also as an opportunity for participating students to showcase their engineering knowledge to internationally renowned design judges. Hence, this project aimed to provide the team with a further understanding of aerodynamic behaviour and how downforce would enhance vehicle performance to better justify design decisions made. Furthermore, state of the art simulation software was used to help the team both obtain accurate results and better visualise flow behaviour. This would serve as an essential basis for the team's future ambition of successfully implementing a fully-fledged aerodynamic package for competition.

Section 5

Sustainability & Energy Efficiency

Using KNX based home automation system to optimize energy efficiency in a domestic application

Student: **Naomi Muscat**
Supervisor: **Prof. Ing. Cyril Spiteri Staines** | Co-Supervisor: **Dr Alexander Micallef**
Industrial Partner: **Harbour Solutions**

What is your project about?

In this project, a load-shifting technique is proposed, which is aimed at optimizing customers' daily household energy costs by scheduling loads from peak load periods to off-peak periods according to a time varying electricity tariff. This project also analyses the effect on the daily cost of electricity if the energy generated from a photovoltaic system is utilized for self-consumption. Moreover, in this project a semi-automated load-switching algorithm was implemented using a KNX technology.

Why are you working on this project?

Malta's on-going growth in the construction sector encourages developers to invest in more modernized technologies to provide a more comfortable environment suited for society's hectic lifestyle. Automation systems have always been associated with the industrial sector or high-end residential premises, but with the growing demand for automation systems in homes in the past decades, has made this technology more accessible.

This project captured my interest as it combined both my interest in home automation and energy efficiency. This project provided me with a basic introduction of what a home automation system consists of and its application. One of the benefits of home automation that is of everyone's interest in electricity cost savings, hence more consumers should become more aware of the available smart home technology on the market and their benefits.

Evaluating the Impact of Blade Design on the Aerodynamic Performance of Floating Wind Turbines

Student: **Enrico Fenech**
Supervisor: **Prof. Tonio Sant**

What is your project about?

The wind available at deep waters is highly resourceful due to the low roughness of the water surface and since no obstructions to the air flow are present. For this reason, wind turbines are being built on floating platforms. However, since such systems are not fixed in place, the waves impinging on the platform will cause it to move, hence disturbing the air flow which can potentially impact the turbine's energy yield. Therefore, the aim of this project is to investigate how the power output varies due to such motions by considering various rotor blade geometries and sea conditions.

Why are you working on this project?

To reduce the effects of climate change, it is important to keep the global temperature rise as low as possible. Such a task requires the addition of various renewable energy sources into the grid to lessen our dependency on fossil fuels. The crucial role played by wind energy in this pressing issue is what made me eager to pursue this topic. Offshore floating wind turbines provide the possibility to countries which have limited land available and who are surrounded by deep waters, to start considering wind energy as their next step towards a more sustainable energy mix. Additionally, the methods used to predict the power generated by a wind turbine can also be used for aircraft and marine propellers. Hence, this ability to transfer knowledge from one field to another also persuaded me to carry out a project in this area.

Sustainable packaging manufacturing using recycled PET bottles

Student: **Luca Spiteri**
Supervisor: **Dr Ing. Paul Refalo** | Co-Supervisor: **Dr Arif Rochman**

What is your project about?

Polymers are nowadays produced in large quantities and are used in many different applications. Plastic manufacturing is thus responsible for the consumption of significant amounts of virgin material, energy, and water, together with emissions such as CO_2 and other toxic gases. This study aims to show how PET can be recycled and reused for different products. This is done by recycling PET water bottles that are produced locally in Malta. This minimises material consumption and reduces landfilled material and ocean disposed of waste, which will result in a better environment. Toxic gas emissions, energy, and water consumption are also reduced.

Why are you working on this project?

Polymer manufacturing has always interested me due to the flexibility of polymers in general. Polymers such as PET are cheap, lightweight and most importantly, are easy to recycle. However, from the 200 billion PET bottles produced each year, only 15% is recycled, the rest is disposed of in the landfills, or ends up in the ocean. This leads to negative environmental and social impacts, therefore this recycling rate must be increased. This study aims to show that plastics such as PET can be easily recycled, and on top of that, show the positive effects that recycled PET has on both the environment and society. Safeguarding the environment and the community is crucial, however, no company will opt for recycling if the process is not economically feasible. This study also shows that by intelligent recycling systems and modern technology, recycling polymers such as PET can also be profitable.

Sustainability Assessment of Recyclable and Reusable Plastic Cosmetic Packages

Student: **Isaac Jordan Gatt**
Supervisor: **Dr Ing. Paul Refalo**
Industrial Partner: **Toly Products Ltd.**

What is your project about?

The main goal of this project was to assess the impacts of reusability and recyclability with regards to a plastic cosmetic package sold by Sephora and manufactured by Toly Products Ltd. Malta. The impacts were assessed by considering the entire life cycle of the product, from the material extraction stage and manufacturing, to the distribution, and consumer use phase. This was done by utilising two principal tools, which are Life Cycle Analysis (LCA) to determine the environmental impacts associated with the product's life cycle, and Life Cycle Costing (LCC) to determine the financial aspect associated with the proposed methodology.

Why are you working on this project?

The importance of sustainability has become increasingly relevant in past years, with the government, businesses, and the general public alike striving to improve their environmental footprint in various aspects of their life. This sense of sustainable urgency also applies to the cosmetic industry, which contributes significantly to the global plastic manufactured and used worldwide. This motivated me to tackle this field of engineering, to help contribute towards the beneficial cause of environmental sustainability.

This work is primarily relevant to Toly Products Ltd. since the product is manufactured by them, and the results from this dissertation can help them improve their environmental impact. However, it is also relevant to environmentally aware Sephora consumers, for them to get informed about the impacts associated with the product they are using, by either reusing the product and extending its use phase, or recycling the product at its disposal phase.

Development of a Vehicle Pneumatic Test Bed for Sustainability Analysis

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

What is your project about?

The purpose of the project was to design a system to monitor the pneumatic system in a bus. This type of system is used to supply compressed air to components such as the air brakes and air suspension. Since it is not possible to fit a bus in the University labs, another system, in test bed form, was designed to incorporate most of the elements found in a typical bus pneumatic system. This would eventually be used to perform a sustainability analysis by analysing the effects of leaks. From this analysis one could eventually find the amount of extra fuel consumed and emission emitted.

Why are you working on this project?

From a young age, the inner workings of vehicles had always interested me and that it is why I chose to complete this project. Apart from this, vehicles are constantly being designed to be more and more sustainable. This gave me the opportunity to investigate the sustainability analysis of buses since currently only work in the development of the engine has be done by manufacturers to reduce emissions. These efforts will be of great benefit in the efforts to reduce emissions since the pneumatic system is the third highest consuming system in a typical bus. In the future, my work be further developed to automatically detect and pin point air leaks in buses, which not only makes the servicing and maintenance easier, but also helps in decreasing the consumption of fuel.

Designing an Environmentally Friendly Packaging for a Smart Therapeutical Device

Student: **Tamasine Camilleri**
Supervisor: **Prof. Ing. Philip Farrugia** | Co-Supervisor: **Dr Ing. Paul Refalo**

What is your project about?

The objective of this project is to design packaging for the Olly Speaks toy. This is a device which helps young children with language and speech impairment to develop and learn new skills through play. It is important that the packaging designed in this project not only protects the toy during transportation but also has minimal negative impacts on the environment. The packaging of toys currently on the market were evaluated, to understand sustainability techniques being used in their design. Three design concepts were then generated and tested to see if they do protect the toy, and their sustainability was also evaluated.

Why are you working on this project?

Sustainable development is a topic which is very important, to me but also to the wellbeing of the environment and society. I feel like sustainability should be an essential aspect in society, as it allows for today's generation to meet our needs without hindering the ability of future generations to meet their own needs. This should be done without negatively affecting the world around us. I have also always taken notice to the packaging of products that I purchase, as it is an exciting part of a purchase; from viewing the packaging in the shop to opening the packaging to reveal the product inside. The packaging should attract the customer's eye, and when done well it can be very effective. So being able to learn the processes and decisions taken when designing packaging, while also giving importance to sustainability, was an opportunity that I could not pass on.

Section 6

Product & Process Development

The Design of a Stylish Prosthetic Hand with Degrees of Freedom

Student: **Gabriel Cassar**
Supervisor: **Prof. Ing. Johnathan C. Borg**

What is your project about?

My project is about designing a prosthetic hand which has Degrees of Freedom (DOF), meaning that the prosthetic hand must include several features which move in order to perform a task, for example, moving fingers. Several concepts were generated throughout the project, and through the use of several engineering tools, a final concept was selected. Then, the selected concept was further improved with the use of several prototypes generated with the use of 3D Printing and eventually tested to evaluate the capabilities of the generated design. Finally, some design guidelines to aid future work within this field were generated.

Why are you working on this project?

From a young age, I have always been intrigued about how engineering and critical problem solving could be used in order to improve the lives of people within society. Having a strong background on Computer Aided Design (CAD) as well as the use of 3D Printing, I felt motivated to select this project as my Final Year Project. When one looks at prosthetic hands available on the market currently, one could classify the available prosthetic hands in two main categories; one category being prosthetic hands which have a lot of Degrees of Freedom, yet they are very expensive, and the other category being prosthetic hands which still have some DOF, and are a little cheaper yet still cost thousands of euros. Hence, through this project we could design a prosthetic hand which has good functionality, looks stylish and is relatively cheaper than the available prosthetic hands on the market.

3D Printing of Dynamic Mechanical Assemblies

Student: **Luke Sultana**
Supervisor: **Prof. Ing. Jonathan C. Borg**

What is your project about?

There are two ways to generate an assembly through 3D Printing; one could 3D print the parts separately and assemble them afterwards, or one could 3D print the whole assembly in one go, with all the parts already assembled. A dynamic mechanical assembly is one which has a unique functionality which often operates through the translation of motion. This project discusses the challenges of 3D printing functional assemblies, and how best to tackle these challenges. This is done through experimentation to discover the capabilities of the 3D printers available, as well as to test a number of case studies. Finally, a number of case study assemblies were 3D printed, and a set of structured guidelines was presented to assist future 3D printing of assemblies.

Why are you working on this project?

The title of this project stood out to me immediately and I felt especially drawn towards it because of the 3D printing aspect to it. I have always been fascinated by additive manufacturing, and throughout the Mechanical Engineering course I found that I preferred study units that were oriented towards designing models such as 'Computer Aided Design' (CAD) and 'Engineering Design', and I immediately knew that this project was the one I wanted to work on. The idea of rapid prototyping a whole assembly that functions straight out of the 3D printer is intriguing, to say the least, and choosing this project meant that I could gain experience and further knowledge about rapid prototyping technology. Through this project, the set of guidelines that was generated by the end will aid in the future 3D printing of functional assemblies in one go.

Thermoset Elastomer Additive Manufacturing

Student: **Christian Spiteri**
Supervisor: **Dr Arif Rochman**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

What is your project about?

The main aim of this project is to develop a thermoset elastomer extrusion system that attaches onto a 3D printing unit and produce parts out of NBR, HNBR and FKM rubber materials. This encompasses various tasks, firstly, to design and machine an extrusion system to process thermoset elastomer materials, secondly, to be able to extrude thermoset elastomers effectively and finally to compare results with a benchmarked compression moulded rubber parts.

Why are you working on this project?

As a mature student enrolled in the mechanical engineering course, the focus of studies was mostly pushed towards the industrial area. This is because most foreign companies especially those which operate in Malta focus more on industrialisation. Also, the industrial stream offers a variety of subjects that targets production and management control of manufactured products and most importantly focuses more on the innovation side of engineering. This project was selected for two reasons, firstly because this project involved designing new concepts that will target additive manufacturing of never yet printed materials. Secondly, because this project was in collaboration with a Maltese leading company (Trelleborg Sealing Solution). The opportunity of developing a product which has not been invented yet enabled me to show my capabilities in concept generation, product designing and testing.

Design Optimisation of a Smart Therapeutic Device Housing Produced by Injection Moulding

Student: **Ludina Albulushi**
Supervisor: **Prof. Ing. Philip Farrugia** | Co-Supervisor: **Dr Arif Rochman & Mr Emanuel Balzan**

What is your project about?

My project is being carried on an existing therapeutic device, called Olly Speaks. This device is mainly used by Speech-Language Pathologists (SLPs) during therapy sessions with children with Developmental Language Disorders (DLD). Compared to current practices, Olly Speaks provides a more rewarding and engaging experience for children.

The objective of this project is to reduce the overall cost of the current design of the therapeutic device by optimising its design, such that the current integrated screen is replaced by a portable device (Tablet or smartphones).

The basic design cycle was followed to come up with a new design solution consisting of an attachment device to mount a tablet or a smartphone to Olly Speaks.

Why are you working on this project?

I have chosen this engineering topic over other topics because of the challenges that I foresaw whilst reading the project proposal. Any design topic poses its own distinct challenges for engineers.

Apart from it being an engineering design-related project, I have a personal motivation to use my engineering skills to help people, such as children with DLD. I felt very proud to be part of the research team working on such an innovative therapeutic smart device. Given that my project goal was to improve the design of Olly Speaks to make it more competitive, I felt very satisfied that my work contributed a step to have the device closer to the market. Furthermore, by making the device more affordable, means that the benefits that Olly Speaks has on the development of a child with DLD can be reaped by a wider audience.

Design of an Innovative Flush Hinge Mechanism for Cosmetic Compact Cases

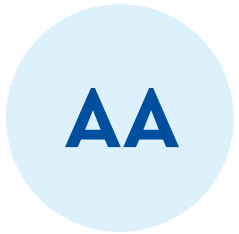
Student: **Andrew Abela**
Supervisor: **Prof. Ing. Jonathan C. Borg**
Industrial Partner: **James Attard Kingswell, Innovation Engineer at Toly Products Malta**

What is your project about?

Current hinge mechanisms used in cosmetic compact cases, including also premium brands such as Chanel and Dior, all convey a disruptive look at the back of the compact, due to the way current hinges are designed. Such hinges negatively impact compact cases' aesthetics. Therefore, my final year project is precisely intended to design an innovative flush hinge mechanism via engineering skills and methodologies to solve this problem. This novel hinge can then be used to hinge cosmetic compact cases or smaller palettes which ultimately leaves a clean, flush, and premium look at the back of the compact.

Why are you working on this project?

First and foremost, manufacturers and product designers from all around the world still haven't managed to solve and provide a flush hinge mechanism for cosmetic compact cases. Therefore, being personally inclined towards developing and finding innovative design solutions, I consider myself lucky to have been given such an opportunity to help and provide Toly Products Ltd (a world leader in the development of cosmetic packaging) an innovative solution to this cosmetic compact case problem. Furthermore, this project provided me with an opportunity to practise and develop my skills and interests in 2D and 3D CAD Modelling, polymers and moulding processes and the redesign procedures to ultimately design a hinge mechanism which could possibly become patented. Perhaps might also one day, my innovative hinge mechanism would be developed further and utilised by consumers all around the world in such a common product as cosmetic compact cases.



Design of E-Commerce Resistant Cosmetic Packaging

Student: **Joel Cauchi**
Supervisor: **Prof. Ing. Jonathan C. Borg** | Co-Supervisor: **James Attard Kingswell**
Industrial Partner: **Toly Products Ltd.**

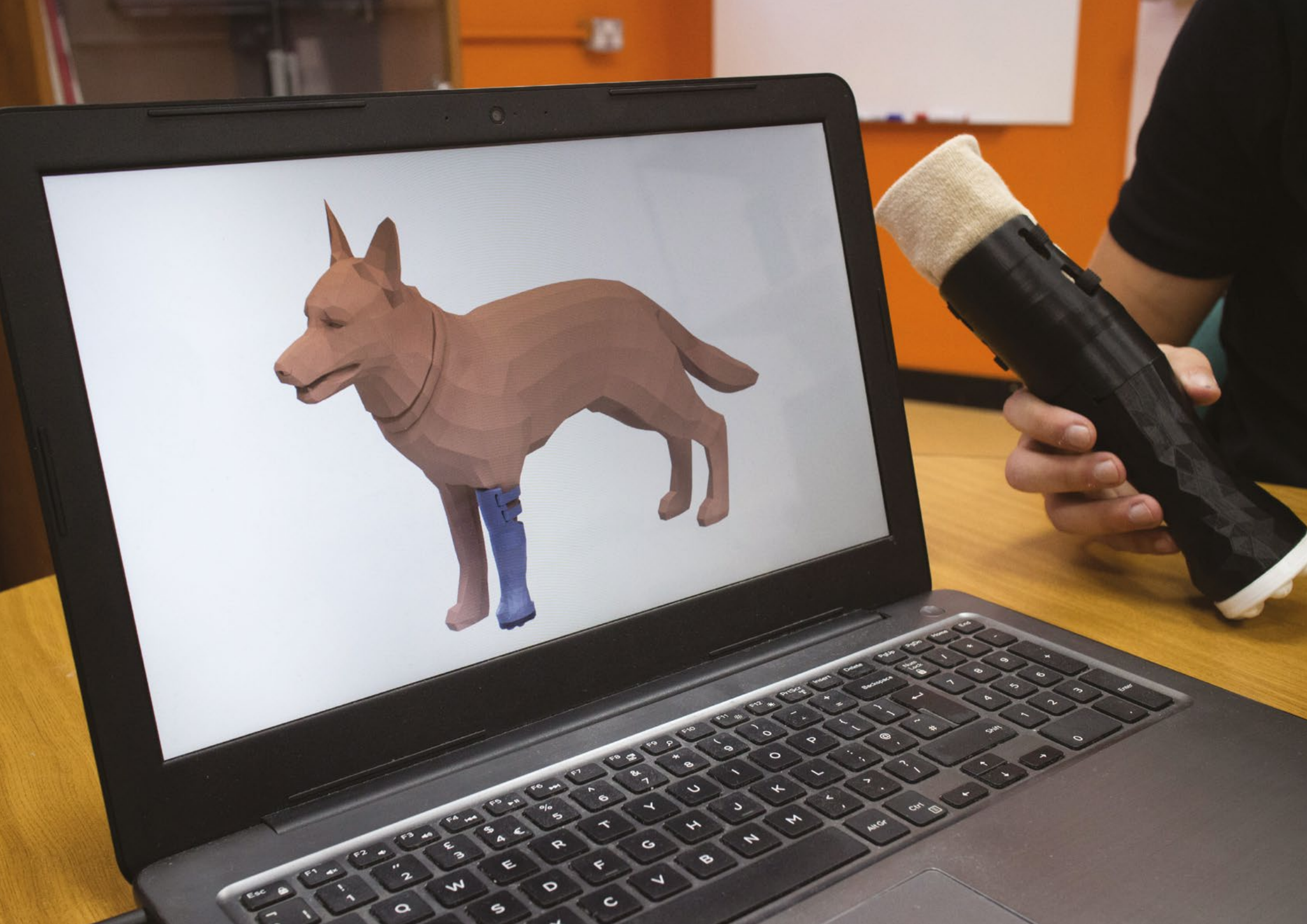
What is your project about?

The Project is about developing a compact cosmetic packaging that can be shipped worldwide without any additional packaging. The design had to pass the ISTA 6 (International Safe Transit Association) testing procedure which included drop and vibration testing. The ISTA 6 concept is used by Amazon, where products that are ISTA 6 compliant can be shipped directly from the seller without any additional packaging from Amazon that would increase the cost. The project included redesigning an existing compact from Toly, selecting the most promising and cost-effective concept, 3D printing the concept for testing purposes and producing a detailed design solution.

Why are you working on this project?

This project gave me the opportunity to take on a challenging design type project. It was one of my choices since I wanted to challenge myself and increase my designing skills as well as my 3D modelling skills. This project can help Toly to design a product that would not need extra packaging, mainly single-use plastic, to get it to the customer's doorstep. Hence, the impact that this would have on the environment would be large, considering that Toly would produce a minimum of 500,000 units per year.

The solution would also result in a decrease in the shipping cost to the customers. This design can also give future opportunities to incorporate the same concept used in this compact packaging and use it in other new designs and manufacture them as E-Commerce Resistant. Producing this product to be shipped without additional packaging may also encourage other companies to do the same and design products that are E-Commerce Resistant to increase Sustainability.



Design for Additive Manufacturing of Dog Limb Prosthesis

Student: **Matthew Bonello**
Supervisor: **Prof. Ing. Philip Farrugia**

What is your project about?

This project is about the designing process to achieve an ideal dog prosthetic limb design for 3D printing. The research was set to generate knowledge to help both technical and non-technical individuals to develop dog limb prosthesis models for additive manufacturing, without encountering any difficulties or ambiguities. Thus, the study consisted of the application of 3D printing unique capabilities, in addition to testing of 3D printing parameters in order to come up with optimal design solutions at a low price and short print time.

Why are you working on this project?

3D printing is a growing field and is currently used in various sectors, such as aerospace, medical, and automotive, amongst many others. In this research, the medical field is considered since in the future I long to offer the knowledge I gained through my studies in medical problems that are distressing millions of individuals, including both humans and animals. In this study dogs that underwent a limb amputation or limb deformity are studied as currently in Malta dogs with such circumstances have to adapt to these difficult living conditions. Therefore, through this research, I wish to lay a solid foundation for dogs with limb deformities or amputees, to have the opportunity of attaining a prosthetic limb and allow them to have an ordinary life.

Development of a Product Security Marking for Plastic Injection Moulding Components

Student: **James Pecorella**
Supervisor: **Dr Joseph Zammit** | Co-Supervisor: **James Attard Kingswell**
Industrial Partner: **Toly Products Ltd.**

What is your project about?

The project is about developing a method to identify authentic products manufactured by Toly, from counterfeit products manufactured by counterfeiters. The first step of the project was to understand all the relevant information such as, Intellectual Property, Counterfeiting and what product security marking solutions are currently available. The second step entailed identifying Toly's desires and convert them into design requirements.

The project continues by exploring NFC technology and utilising it as a product security marking solution. This required the project to then source the technology that will be utilised, analyse and design the implementation of the NFC solution on Toly's production line, and design an authentication system in terms of software.

Why are you working on this project?

Counterfeiting robs legitimate businesses and governments of billions annually, and places end consumer at risk due to uncertified products. This project gave me the opportunity of developing a product security marking solution which will help protect Toly's products, their customers' products, and revenue, but most importantly the end consumers of these products. This project can reduce the global impact of counterfeiting by enabling end consumers to participate in the authentication of the products they purchase or plan on purchasing. This will empower end consumers by being able to differentiate between authentic and counterfeit products, report products which are counterfeit and assist authorities in their fight against counterfeiting.

Using NFC as a product security marking solution will further the ability of the solution beyond sole authentication of the product. NFC solution will remain active after purchases allowing end consumers to interact with the brand owners through their products. This solution will prove to be a great return on investments for Toly's customers by offering both authentication ability of products as well as consumer engagement.

Developing an enhanced Video Communication System between Multidiscipline Dispersed Teams

Student: **Abigail Pulè**
Supervisor: **Dr Ing. Joseph Zammit** | Co-Supervisor: **Mr Alan Caruana**
Industrial Partner: **Methode Electronics Malta Ltd.**

What is your project about?

Today's globalisation encourages several companies that are globally distributed to virtually collaborate together on a common task to maximise time and money. However, with all of its advantages this brings, when it comes to communicating virtually there can be drawbacks. One of the drawbacks are the misunderstandings due to language differences. In order to have a successful virtual team collaboration, there are some elements that make this communication more effective and efficient. These elements are; having the right team, the right equipment and a good technique to collaborate, share knowledge and reduce.

This project utilizes the DMAIC (Define, Measure, Analyse, Improve, Control) process improvement methodology on a team collaboration system at Methode Electronics Ltd. This system, also known as the Hawk-Eye system, is used to video conference between Malta and Egypt to avoid experts in Malta to travel to Egypt for troubleshooting, problem-solving production and maintenance issues on production assembly lines. With this project, the enhancement of the Hawk-Eye system resulted in improving communication, collaboration and knowledge sharing. Ultimately, the company will reduce travelling expenses and operational costs.

Why are you working on this project?

Quality and technology are two elements that always thrilled me and encouraged me to keep on broadening my knowledge. I am very interested in the area of quality since a Quality Engineer will be able to work with team members with different capabilities and expertise with the goal to make sure that the final product or process is safe, reliable and meets the customer requirements whilst being cost-effective and efficient. This project enabled me to deepen my knowledge in this field and how quality together with technology and good communication tools are beneficial to maximise time and money in industry. In unexpected situations such as the COVID-19 pandemic, it has highlighted the importance of virtual communication, which is an asset to maintain normality.

Furthermore, this field of engineering solves the most impactful problems in the world and creates more efficient processes and systems. Engineers are continuously changing the world to the better with innovations and solutions that affect everyone's lives and lifestyle.

Performance Analysis and Optimisation of Pellet FDM 3D printer

Student: **Stephen Bonello**
Supervisor: **Dr Arif Rochman**

What is your project about?

This project mainly analyses the performance of a recently developed pellet FDM 3D printer including optimisation of some problems. The printer was optimised in terms of heating capacity to print high-performance polymer such as PEEK (Polyether ether ketone). This specific printer utilises plastic in pellet form instead of traditional filament since the screw extrusion printing process is used as the printing head. Such a setup reduces the cost of printing by cutting down the price required to buy the raw material, as plastics in pellet form are much cheaper than in a form of extruded filament.

Why are you working on this project?

Most of the plastics in pellet form are less expensive than filaments normally used for typical FDM 3D printers. Being capable of using pellets in such a form, gives the capability of having a wider range of plastics to choose from. Additionally, the choice of buying a filament FDM 3D printers that can print high-performance polymers is still very limited, which makes such printers very expensive. The basis of this project is that of optimising the printing head so that it is able to print a wide range of common standard polymers as well as engineering and high-performance polymers including their modification using additives and fillers. All of this could lead not only to an affordable 3D printer but also to a lower printing cost for customers from the common public and industry.

Production Process Improvement via Lean Six Sigma Implementation

Student: **Clyde Borg**
Supervisor: **Dr Ing. Emmanuel Francalanza** | Co-Supervisor: **Dr Ing. Conrad Pace**
Industrial Partner: **ProMinent Fluid Controls Ltd.**

What is your project about?

My project is about using technical methods to improve the production process at ProMinent Fluid Controls. This method is referred to as Lean Six Sigma, which is a methodology used to optimise a process. In this project, the Lean Six Sigma method was applied at two different levels of the company. The first method was used to revise the way that workstations are organised on the shop floor to improve the way material is handled from one workstation to another. Furthermore, this method was applied again to enhance a workstation design to accommodate employees during operation. It was important to design the table to prevent the possibility of strain injuries as a result of excessive workload during work.

Why are you working on this project?

I am working on this project to portray the importance of implementing lean manufacturing in the industry. Lean involves implementing improvements to minimise waste in a company. Minor changes can be applied by companies, in which these will help to optimise the performance of its processes. The Lean Six Sigma offers a structural framework in which several lean tools can be used. Additionally, this project highlights that improvements should be made aligned with the employees' needs during work. It is essential that employees should feel comfortable and that any recommended improvements have to be communicated with employees to obtain a solution which is positive for both the company's performance and boosts employees' engagement with work. I believe that employees' efficiency during work improves by designing a work environment healthy for themselves and by acknowledging their work efforts. ProMinent allowed me to be able to implement these changes and be directly involved in a company in the industry, which was an invaluable experience in the development of my career as a future engineer.

Improvement of Sheet Metal Cutting and Engraving using a Laser Cutting Machine

Student: **Luke Cassar**
Supervisor: **Dr Ing. Pierre Vella**
Industrial Partner: **Zaminox Ltd.**

Abstract

Laser cutting has become widely used for both prototyping and high-volume manufacturing in most sheet-metal processing applications. This is due to the relatively higher precision, consistency, cut quality and the capability for automation of this process.

However, these beneficial qualities are dependent on many factors, including not just the laser cutting process parameters, but also the sheet material and thickness, such that when cutting different materials and thicknesses, the process parameters must be altered accordingly to achieve a successful or optimal laser cut.

In practice, laser machine manufacturers provide preset parameter combinations for different materials in general such as stainless steel, mild steel etc. However, parameters for more specific applications such as cutting stainless steel 304 with compressed air using continuous cutting mode are not available. Consequently, using these general parameters provided by the laser machine manufacturer for more specific applications is suboptimal.

Thus, the main objective of this study is to find the optimal process parameters that will maximise laser cut quality when cutting a 5mm stainless steel 304 sheet using the Bystronic Byspeed 3014 CO_2 laser cutting machine. This was achieved through several steps. Firstly, the metrics that define cut quality were determined and prioritized. Secondly, the factors that affect these quality metrics the most were determined and prioritized. Thirdly, design of experiments, specifically the Box Behnken Design method, which is capable of creating a second-order model, was used to efficiently sample data on the laser cutting process when cutting a 5mm ss-304 sheet. Fourthly, this data was used to model the process using a hyper-parameter optimized shallow neural network for each quality metric, and the models where validated. Lastly, a multi-objective genetic algorithm was used in conjunction with the neural network to find the optimal solutions for the quality metrics and basic guidelines for the company that allowed us the use of their Byspeed 3014 laser cutting machine, where created.


Procan ALPHA
BOY

Optimization of Laser Tool Cleaning Equipment

Student: **Raiza Casha**
Supervisor: **Dr Ing. Pierre Vella**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

What is your project about?

The project is about the use of laser to clean moulds and remove the elastomeric residue left behind when compression moulded parts are removed from the mould. By designing a set of experiments the ideal working parameters that remove the most residue in the shortest amount of time were identified. To identify these parameters quantitative measurements and qualitative images were taken. Thus, a set of recommended guidelines for the improved process were established.

Following this, ageing experiments were conducted on samples to identify the metallurgical effects caused by the laser. The results obtained identified the allowable intensity of the laser beam and the duration for which the laser can be used on the mould without having any negative metallurgical effects on the mould surface.

Why are you working on this project?

Laser cleaning has been increasing in popularity. This is because lasers can be used in analysis, monitoring and cultivation of artefacts. The laser cleaning method replaced other methods namely the use of heavy chemicals that could be toxic to the user and to the environment. High control, versatility and minimal contact are some of the positive attributes that encourage laser intervention.

Through this project, I have increased my knowledge on an innovative process which is so versatile and complex that its functionality is ever so increasing. Having been exposed to such innovative technology provides me with solid foundations for my future in the manufacturing industry thus enhancing my skills. Through the project, I put to practice the knowledge obtained during the past four years into a problem posed by the industrial partner. This was a guide of how things should be done in my future career as an engineer.

Micro Injection Moulding and Characterisation of Polymers with Fibre Reinforcement

Student: **Nadine Xuereb**
Supervisor: **Dr Ing. Pierre Vella** | Co-Supervisor: **Dr Arif Rochman**

What is your project about?

My dissertation regards micro injection moulding and the testing of these moulded parts, which are made out of polymeric materials containing fibres. In a few and simple words, the project involves the production of micro parts utilising a micro injection moulding machine owned by the University of Malta. The materials used in the production of these parts are Polypropylene with 30% glass fibres (PP30GF) and Polyamide (more commonly known as Nylon6) with 30% glass fibres (PA630GF). Once production is completed, testing of these parts then follows using different testing equipment to characterise them according to the measure properties.

Why are you working on this project?

If you had to look around, you will notice two ongoing advances that devices, such as phones, are decreasing in size and hence require smaller components and that the majority of these devices that are manufactured contain plastic components. In fact, this is something that greatly interests me, which is why this project managed to draw my attention. As one can assume the smaller the component is, the stronger it has to be, this means that the materials chosen might include fibres. Materials containing these fibres have different polymeric structures, which will give them better properties than the base material. To date no literature can be found in relation to this subject, hence this provided me with the opportunity to produce micro parts with such materials using micro injection moulding and test the parts' capabilities with the use of various testing equipment, which is continuously growing and becoming more sophisticated.

Additive Manufacturing of High Pressure Hydraulic Seal

Student: **Daniel Farrugia**
Supervisor: **Dr Arif Rochman**
Industrial Partner: **Trelleborg Sealing Solutions Malta**

What is your project about?

The project's aim is to convert the production of high-pressure hydraulic seals from using conventional machining to additive manufacturing as it can drastically reduce the overall production costs mainly due to minimal material waste. By using a high temperature 3D printer, high-pressure hydraulic seals are to be produced with high accuracy and strength comparable to those obtained from machining. In 3D printing, the product is built by depositing material in a number of layers and the main challenges are to obtain strong layer bonding and good surface finish. This is achieved through experimentation in changing both the process parameters (such as temperatures and extrusion rates) and design for product optimisation.

Why are you working on this project?

As a mechanical engineering student who chose to focus the studies in the industrial area, I am interested in production lines and product designing and this project gave me the opportunity to do both. Additive manufacturing is a leading innovation which managed to infiltrate several engineering sectors and by time it is taking over certain conventional methods. This project focuses directly on high-temperature 3D printing, it involves the use of high-performance engineering polymers which are still being studied and improved by many universities and large companies around the world. Therefore knowing that I was one of the few people who had the opportunity to contribute to this study makes me even more proud of achieving good results in such sophisticated technology and motivates me to continue studying and apply my knowledge to different engineering areas.

An Investigation of Process Improvement Methodologies for the Aviation Industry

Student: **Casey Muscat**
Supervisor: **Dr Ing. Joseph Zammit**
Industrial Partner: **AirX Charter Ltd.**

What is your project about?

This thesis executes a comparison of four process improvement methodologies (Six Sigma, Lean, Kaizen and TQM) to identify the most suitable for the aviation industry, followed by a validation of the selection, through a proof-of-concept.

To arrive at the selection of the ideal methodology, various tools were utilised to ensure that the selection is factual and relevant to the industry; these included: Observing the industry and its characteristics, mapping the process at hand, designing and executing a detailed questionnaire in efforts of gaining a deeper insight into the process/industry and obtaining input from experts within the organisation.

The analysed data was then inputted in a 'Methodology Matrix' in order to identify the methodology that best fits the characteristics and critical success factors of the organisation. The feasibility of the chosen methodology was then tested by applying it to one of the industrial partner's processes and evaluating the results.

Why are you working on this project?

Business/Manufacturing processes establish your productivity and success; hence they must be endlessly monitored, evaluated and improved. Process Improvement projects are aimed at adjusting the processes to achieve a more efficient way of getting work done, with higher quality at a lower cost.

My interest in the aviation industry, combined with the need for process improvement to ensure continuous growth of the organisation, lured me to propose this dissertation.

Business Aviation involves the effective interlocking of departments to ensure that the airline upholds its high degree of service during the execution of a flight. With many activities going on at the same time, it is obvious that the company's processes must be highly efficient and effective. In this context, I believed that this sector is perfect for the application of a process improvement methodology.

The industrial partner, AirX Charter Ltd., highly embrace process improvement within their daily activities; however, they have never embarked on a project solely dedicated to processing improvement. Hence, their operations were used as a foundation to further portray the potential benefits of process improvement.

Exploring further the process capabilities of the Sodick AP3L

Student: **Dylan Muscat**
Supervisor: **Dr Ing. Pierre Vella**

What is your project about?

This project was to understand further the accuracy of the Sodick AP3L when creating features on the micro-scale, i.e. less than 1mm. This is an electrical discharge machine which creates cavities without making physical contact whereby the desired shape is obtained by using electrical discharges. The experiments were split up in two sections. The first was to check the repeatability of the machine and to understand the error in the system. The second set of experiments were to investigate an issue when creating a slot, due to wear of the electrode, leading to inaccuracies.

Why are you working on this project?

There is a lack of knowledge on the EDM process, and also specifically when using the Sodick AP3L. Although expensive, it is widely used to manufacture tooling for applications such as injection moulds and therefore, this project was as an opportunity to understand further its capabilities and how the process can be improved.

The process itself is what makes it stand out from other conventional techniques. The metal being removed by nothing other than a spark is exceptionally interesting. I have always liked metal fabrication, design and tool-making. Throughout this project, I have also created parts to use with the existing setup in order to take measurements.

This project is more relevant to the industry as it would be best used to create moulds in very hard materials, create cavities without having a force applied on the tool itself, and through my research on the microscale, accuracy on these tasks can be improved further.

Two-Component Injection Moulding of Thermoset Elastomer and Rigid Thermoplastic

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

What is your project about?

The project's aim is to investigate the bonding mechanism found in two-component injection moulding products in cooperation with TSS Malta. The project aims to investigate the bonding mechanism between two different rubber compounds with the same thermoplastic material that will further the current understanding of the bonding mechanism and help with product development in future.

In two-component injection moulding, a specialised machine is used which combines the use of two separate injection units and uses two separate material preparation processes to create a product made out of two materials, in this instance the materials being used are one rubber compound and one plastic.

Why are you working on this project?

With two-component technology being the next frontier in the sealing industry, I was drawn towards this project as soon as I got the opportunity to learn about it. Taking part in this project will have given me the opportunity to be at the cutting edge of modern sealing technology and the opportunity to work directly on a production machine will prove invaluable for my career path going forward.

With practical experience being one of the few areas that the University of Malta cannot offer in the same degree as the theoretical subjects, this project will also have allowed me to explore and appreciate the practical aspect of industrial engineering. With rubber also being an area that is not expanded upon in the coursework as much as plastics or metals, I also viewed this as an opportunity to further my understanding of rubber sealing technology.

Section 7

Space & Electronics Engineering

Distributed Electrical Power Supply for a PicoSatellite

Student: **Muad El Belazi**
Supervisor: **Dr Ing. Marc Anthony Azzopardi** | Co-Supervisor: **Dr Alexander Micallef**

What is your project about?

During the launch of large satellites, the solar panels are folded away and after deployment, the panels would be pointed at the sun. However, in the case of a picosatellite (PQ), there is limited capacity for using foldable solar panels, therefore, six solar panels are used to cover the entire surface of cubic PQs. This means the panels of the satellite would receive different and changing amounts of light and thus each panel needs its own maximum power point tracker (MPPT). The power from all solar panels must efficiently combine at the point of common coupling (PCC), while regulating the voltage to charge the batteries and reach the energy consumers in the spacecraft. This project aims to develop a resilient and intelligent DC-Picogrid architecture internal to a picosatellite to combine the power from each panel and ration it appropriately between each consumer and storage, without allowing any single point failure to propagate throughout the Picogrid.

Why are you working on this project?

The project was chosen for two reasons. The first reason is due to my interests in the power electronic, sector. The second reason is that the model was designed taking into consideration the atmosphere of space, which I did not use to have a lot of knowledge regarding the topic. This made the project even more interesting because this project led me to gain knowledge on in space and also gave me the opportunity to build a better background regarding the operation of power supplies.

Attitude and Orbital Determination of a PicoSatellite

Student: **Matthew Magro**
Supervisor: **Dr Ing. Marc Anthony Azzopardi** | Co-Supervisor: **Dr Ing. Marvin Bugeja**

What is your project about?

The aim of this project is to determine the orientation and position – called attitude and orbit in spacecraft terms – of a small satellite that will be circling the earth at around 7km/s. The attitude and orbit location of the satellite needs to be known at any given time so that antennas on earth can be pointed towards the satellite. The ASTREA PicoSat is a 5x5x5cm cube-shaped satellite that houses many different systems The onboard, one of which is the system being developed in this project. The system makes use of light sensors on each face of the PicoSat to determine the direction of the sun. It also makes use of a magnetometer and a gyroscope – used to detect the earth magnetic field and the angle of rotation of the satellite in space – to obtain an accurate result.

Why are you working on this project?

Working on aerospace technology or even anything related to outer space seemed long out of my grasp until I was approached by the opportunity to work on the design of the first Maltese satellite. I took the opportunity (along with my lab associates) to work on designing a PicoSat prototype that acquired the data from the sensors as a third year project; the project kind of grew with me since then. My main motivation for this project is the fact that a part of my work might be able to go up in space one day and to contribute to the tiny community for small satellites in Malta. The work on this satellite may pave a way towards a future that allows for the gathering of data from space using cheap components that are found in today's smartphones. More specifically, this project simulates the orbital conditions encountered in space in a setup that has never been documented before.

Measurement techniques for pico-satellite micro-thrusters

Student: **Karl Xuereb**
Supervisor: **Prof. Ing. Pierluigi Mollicone** | Co-Supervisor: **Dr Ing. Marc Anthony Azzopardi**

What is your project about?

This project's aim was to develop a method to measure the thrust of a cube pico-satellite micro-thruster. A cube pico-satellite is a small satellite, consisting of a number of 5x5cm cubes that house the electronics. The micro-thruster is normally housed in such a cube. Since these micro-thrusters are very compact, they tend to use a solid fuel which is burnt to create a material known as plasma. This plasma is ejected to create thrust, but the thrust is so small it can't be measured using normal tools. As a result, a custom method of measuring the thrust had to be created.

Why are you working on this project?

Engineering has been a passion of mine since I was a young child, and I was always curious as to how things worked. When I was presented with the opportunity to work in a new field that I had never even heard of prior to starting this project, I jumped at the opportunity. Pico-satellites are still a relatively young field, with only a lot of unknowns around them. Being given the opportunity to contribute to a fledgeling field is something many people dream of, and this project gave me the opportunity to do just that.

The relatively low cost of launch and manufacture of pico-satellites makes them attractive among a number of industries. More and more companies are taking note of their versatility, and different uses for them are being explored.

Digital Antenna Array Combiner and Divider using FPGAs

Student: **Luke Abela**
Supervisor: **Dr Ing. Marc Anthony Azzopardi** | Co-Supervisor: **Dr Ing. Owen Casha**

What is your project about?

The ability of a phased array antenna situated at the ground-station to communicate/transmit data with another phased array antenna (which could be a satellite in space or an antenna placed on the roof of a building). For communication, there must be two-phased array antennae, one transmitting and one receiving.

A **phased array antenna** is a set of physical antennae, which are computer-controlled. The transmitting antenna creates a focused beam that can be steered electronically in different directions without physically moving the antenna.

This project focused on designing the hardware needed to:

a) digitally combine the received signals (according to an algorithm);
b) convert the combined received signal back to analogue (physical) form; and
c) resend back the signal to the transmitting antenna.

Why are you working on this project?

This project focuses on space, radiofrequency, and communications engineering. The University of Malta has been developing the UomBSat1, Malta's first pico-satellite measuring 5 x 5 x 5cm.

The hardware developed in this project is intended to be used for the ground-station located at the University's Faculty of Engineering.

The background required to take on such a project, overlapped with the areas of electronics engineering being part of the undergraduate course at the University.

Phased Arrays Antenna systems are commonly used in military, space, broadcasting and communications engineering.

The MESSENGER spacecraft deployed by NASA was the first deep-space mission to use a phased array antenna for communications. It was a space probe mission to the planet Mercury (2011 – 2015).

Phased Arrays Antenna systems have been adopted by many AM broadcast radio stations to enhance the area coverage of their broadcast.

Design of a Processor for Embedded Image Processing Applications

Student: **Matthew 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, or more generically, a processing element or system-on-chip that is optimised for real-time image processing tasks. This shall be primarily achieved through the design on an FPGA of various image-processing accelerating peripherals, each controlled by a softcore microcontroller.

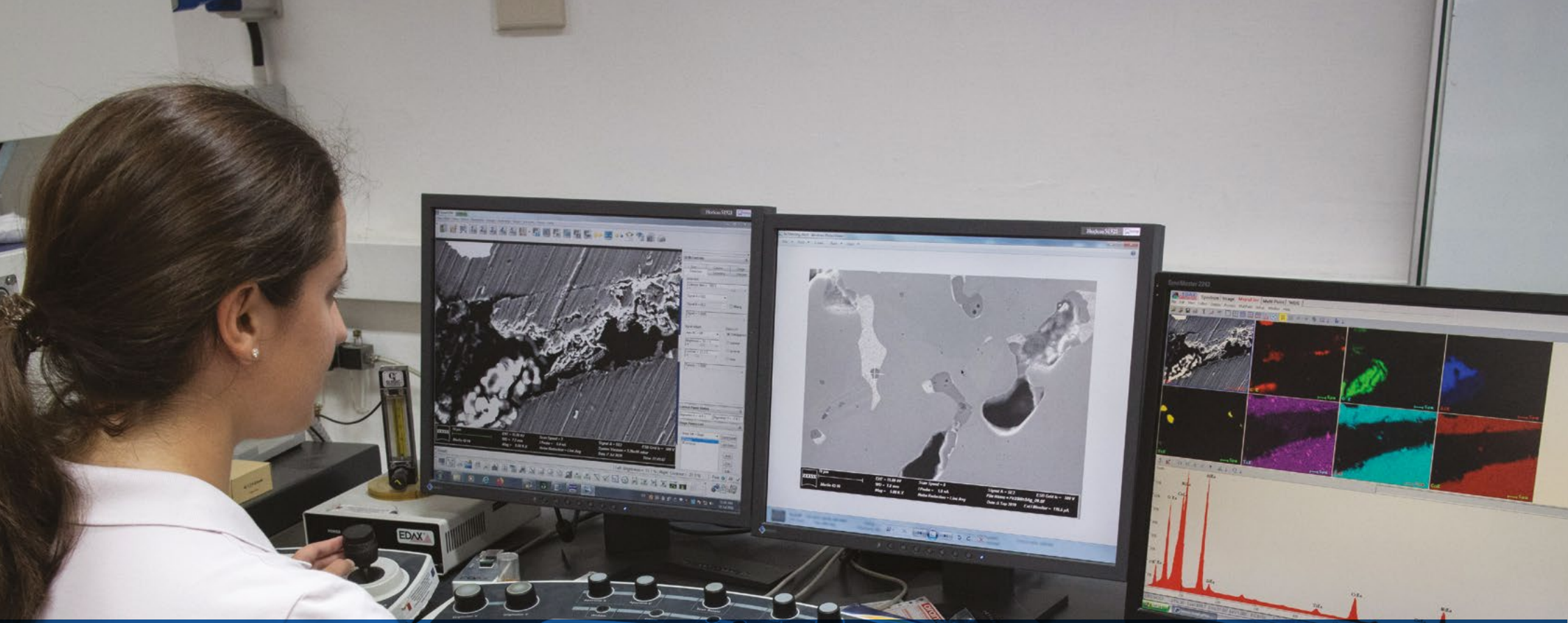
The project included the design of hardware accelerators for morphology, convolution and RGB to HSV conversion. These peripherals were chosen due to their utility in image processing applications such as object recognition. A VGA peripheral was also designed so that the processor can display images. Processing for the morphology, convolution and VGA peripherals takes place independently of the processor's routine since data is offloaded to the peripheral and the processor can then access the result when the operation is complete.

Why are you working on this project?

There are various applications for embedded image processing, for example, vision assistance in cars, industrial quality control and robotics. With the advent of Artificial Intelligence, traditional image processing with conventional mathematical operations remains just as valid since pre-processed images as inputs result in less complex neural networks, thus taking up less resources.

Vision-related processing requires significant processing power and resources due to a large number of mathematical operations, many times in parallel, that must be performed for a digital system to interpret an image. Images tend to be represented by relatively large amounts of data; therefore, bandwidth is another major hurdle to overcome.

Through the design of custom hardware that accelerates certain operations, we can achieve the necessary performance and efficiency to process images on embedded hardware in real-time. FPGAs allow us to prototype custom digital designs relatively quickly by enabling us to reconfigure the chip as per one's design and configurations.



Section 8

Materials Engineering

Characterisation of Knight and Issue Armour from the Palace Armoury, Valletta

Student: **Martina-Marie Pizzuto**
Supervisor: **Dr Daniel Vella**
Industrial Partner: **Heritage Malta**

What is your project about?

The Palace Armoury in Valletta has a collection of prestigious decorated Knight armour pieces, usually given the great publicity. However undecorated Issue armour pieces, not given as much importance.

In this study, the processes of manufacture of the more common undecorated historical armour were determined. This included: determining the metal extraction process and the heat treatments employed towards the final stages of production. The process of extracting the raw material to produce armour is clearly distinct from the fabrication of the final armour piece but the evidence for both extraction and fabrication methods are held within the metal itself.

Why are you working on this project?

When I started the Bachelor course in Engineering, I was introduced to Materials Engineering. I was immediately interested in learning how the underlying microstructure of materials can have an impact on the mechanical performance of a part. Such factors are controlled by heat treatments imposed onto the metal.

In this current study, I had to adopt a reverse engineering approach were, from the historical armour pieces I was provided with, I had to determine possible heat treatments applied in their fabrication. I was also able to shed light on the ironmaking process. Growing up, I greatly enjoyed every opportunity to visit the Palace Armoury and I always wanted to learn more about how armour was produced and manufactured. Hence, when the opportunity arose, I first handily took the occasion to conduct this study. From this work, the public can appreciate the processes involved in producing armour from an engineering point of view.

Structural adhesive bonding of CFRP tubing to metallic inserts

Student: **Samuel Grech**
Supervisor: **Dr Ing. Ann Zammit**

What is your project about?

This project is about exploring the possibility of constructing high strength joints between carbon fibre tubes and aluminium inserts to replace heavier steel links found in Formula Student vehicles. The study delves into how the bond strength changes on increasing the bonded surface area, as well as applying phosphoric acid anodising as a surface preparation technique on aluminium to improve the strength of the joint.

This project was done in conjunction with the University of Malta Racing, the University's Formula Student team, and provides the necessary justification to consider carbon fibre and aluminium joints for their suspension and steering links, with the aim of developing a very light design.

Why are you working on this project?

This project involves two of my favourite aspects in mechanical engineering, automotive and surface engineering. I have involved myself intensely in the Formula Student team for the past 4 years and grew a great appreciation for the automotive field. Close collaboration with the team and the faculty has allowed for projects such as this to take shape and be implemented in a tangible, real-world application for other younger students to learn. Having a good background of materials engineering has allowed me to combine two industries into one project.

I have always had a passion for motorsport, and this project along with UoMR have given me the opportunity to pursue a master's degree in motorsport engineering

Section 9

Thermodynamics & Structural Engineering

Refrigeration Test Rig

Student: **Clayton Fenech**
Supervisor: **Prof. Christopher Micallef**

What is your project about?

In this final year project, a refrigeration test rig was constructed which was going to be used for experiments by engineering students. The test rig was designed to be controlled electronically which enabled quick changes to how the system operated and hence is quite useful for experimentation. Two of the key components of the refrigeration system were the condenser and evaporator, which was used to transfer heat energy to and from the refrigerant, the working fluid. These were designed in a way that the refrigerant was visible, enabling observation of the two-phase changes of the refrigerant, condensation and evaporation.

Why are you working on this project?

I have selected this area of engineering because it is a very interesting field which includes a combination of different areas such as design and calculations as well as electronics and programming. The integration of these areas together in this project allowed for increased knowledge and experience which were essential since this is what is typically found in real-life engineering work. In addition, this project involved both theoretical sections such as calculations involved in the design of the condenser and evaporator, as well as practical sections where the actual test rig was built and tested. Nowadays, especially due to global warming, a lot of people are investing in air conditioners, most of which use the refrigeration cycle used in this project. Hence, this project is very important to the industry because ideal conditions for optimum efficiency can be found due to the electronically controlled system.

Thermodynamic model of an $NH_3 - H_2O$ Refrigeration System

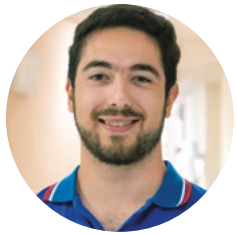
Student: **Isaac Vella**
Supervisor: **Prof. Christopher Micallef** | Co-Supervisor: **Prof. Robert Ghirlando**

What is your project about?

Normal compressor-driven refrigeration systems, such as the ones found in ordinary fridges, freezers and air conditioners waste a lot of energy. Additionally, they require energy in the form of electricity, which is a high grade of energy. The absorption refrigeration system studied in this work uses the waste heat from a marine diesel engine. Heat is a lower grade of energy when compared to electricity and this is the major advantage of this system. The application of the thermodynamic model developed was the refrigeration of fish aboard fishing vessels. The advantage of incorporating this system on fishing vessels is in reducing the amount of electricity required onboard and thus, wasting less fuel.

Why are you working on this project?

The interest in this project stemmed from my interest in sustainability and renewable energy. The fact that waste heat from an engine is used instead of dissipated directly into the environment could have major implications in sectors facing new legal requirements on engine efficiencies and fuel content. The heat in the exhaust gases of marine engines can account for as much as 25 % of the energy in the fuel, which is a significant amount. There is also the possibility of adopting such a system for industrial use, where large spaces have to be cooled and roofs of large area are available for the installation of solar collectors. If thermal systems such as the one in this work can outperform normal solar panels, a complete paradigm shift in renewable energy could occur for applications where refrigeration is required.



Identification of Elasto-Plastic Material Properties and Residual Stresses of Welded Structures

Student: **Diane Scicluna**
Supervisor: **Prof. Ing. Duncan Camilleri**

What is your project about?

My project researches the residual stresses left over from welding two large, thin, steel plates together, as well as the distortions, experienced by these metal plates when welded with two different types of wires. The welding in my project was carried out using MIG welding, which uses consumable welding wires to melt the metal plate and allows them to be joined together. The residual stresses and the distortions were measured and analysed using different experimental procedures. From these results, it is possible to identify and analyse the effects that the different wires have on both the residual stresses and distortions experienced by the plate.

Why are you working on this project?

I selected this particular topic as my Final Year Project as welding is one of the most commonly used hot-work processes and is used by various industries yet there are limited practical sessions about it in our course. Therefore, I wanted to focus my efforts on learning more about it and in doing so learnt how to operate the automated welding rig found in the University welding lab. For me, welding is very interesting because although it was discovered in the 1800s, it is still being used today in many industries. Distortion and residual stresses caused by welding are some of the most prominent issues experienced in the industry, and through this research, it will be easier to identify them and hopefully come up with possible solutions.

Design Build and Test of an Experiment on Stress Concentrations

Student: **Christian Cauchi**
Supervisor: **Prof. Ing. Pierluigi Mollicone**

What is your project about?

This project was a continuation of another final year project from previous years. The project aimed at modifying and improving a truss testing experiment at the University of Malta. Trusses are very important in the building of bridges, and several other large structures, and hence, studying the force transfer and deflection in such systems is very important. The old setup at the university was not very useful due to high inaccuracies, but during this project, it was made much more accurate and can now be used by students to perform experiments on trusses.

Why are you working on this project?

This experimental setup is aimed for the Applied Mechanics section of mechanical engineering. This area deals with the transfer of forces, stresses, strains, etc. and the trusses experiment demonstrates these transfers in this topic. The use of this setup will help first-year mechanical engineering students to bridge the gap between the theoretical and practical aspects of truss systems, helping the students to better understand the topic.

This project interested me more than others since the product will facilitate the learning process for students like myself. Also, this project involved a very hands-on approach, which I am very glad to have performed. This allowed me to experience the process of designing a part, sourcing for materials, having the part machined, testing it, and modifying it again, followed by further testing. This is a process that is commonly found in an engineer's work.

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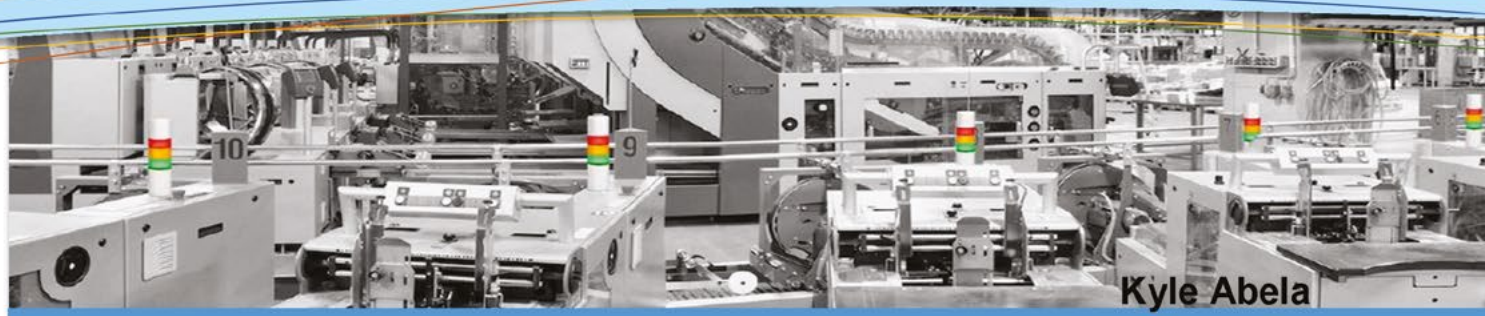
Learning to Work

Facilitating the transition from an Educational Background to the Engineering Field



Kyle Abela

An abrupt and life changing experience is commonly encountered when transitioning from an educational lifestyle to the pursuit of an engineering profession which is fundamental for the Maltese industrial sector. This transition however, can be facilitated by the theoretical background that is offered at the University of Malta and the professional development that is continually invested by leading companies such as AIM Enterprises Ltd.

AIM Enterprises Ltd. is a local business that supplies pneumatic and electrical control solutions for specifically designed technologies employed by manufacturers in the Maltese industrial sector. Since its inception more than 19 years ago, AIM Enterprises Ltd. has strived to supply products that are efficient and cost effective. As a result of the ever changing demands and technologies within the engineering field, it is also essential to invest in the expertise and knowledge of the engineers of tomorrow. To do so, AIM Enterprises Ltd. has established a close relationship with the University of Malta in order to introduce students with equipment that is manufactured by world leaders in pneumatics and control systems such as SMC and OMRON. This would ensure the early exposure of future engineers to real world case studies and applications while also retaining an academic environment.

This relationship initially bared fruition through a successful collaboration between the University of Malta and AIM Enterprises Ltd. which led to the development of a testbed that was capable of simulating and evaluating various compressed air system parameters. Compressed air is an essential commodity in industrial applications. Therefore, it is critical for academics, suppliers, manufacturers and engineers to understand its fundamental scientific behaviour. Lack of information could potentially result in repeated breakdowns, curtailed production yields and significant financial losses for the end user. For these reasons, the scientific results of this collaboration are continuously interpreted with industrial partners of the company to mitigate losses and provide highly efficient solutions in a competitive market.

Furthermore, this collaboration has paved the way for future collaborations between both entities which involve more intricate applications and solutions.

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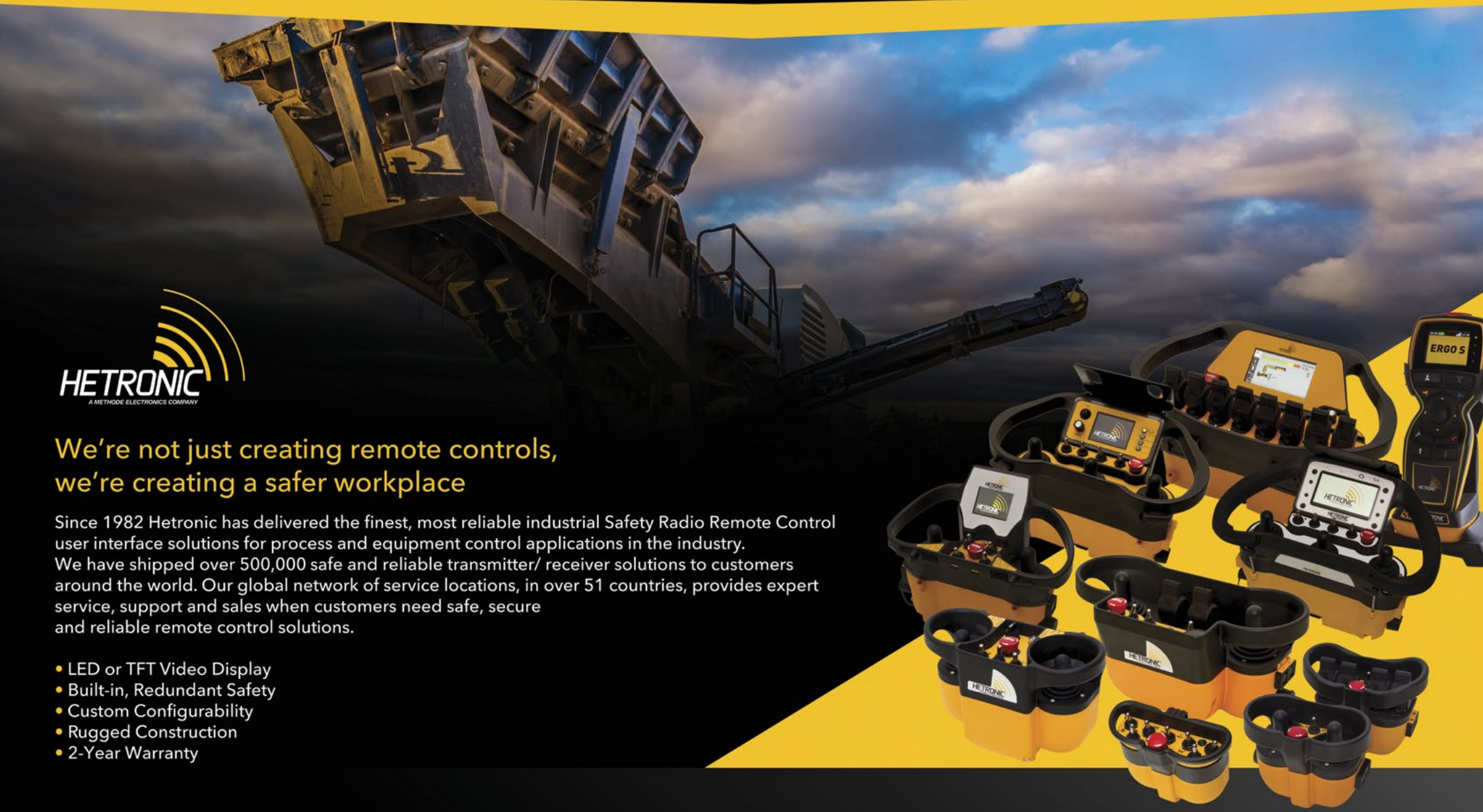

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