Annual Activity Report

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Department of Systems and Control Engineering

Cover picture shows a real-time eye-controlled virtual keyboard application where the user types through eye movements which are recorded using a sleek and wireless device based on electrooculography. This application was developed as part of the Masters project entitled 'Gaze angle estimation using EOG signals', by Nathaniel Barbara.

Contents

1. Introduction

The past 12 months have been an intensive period for the Department of Systems and Control Engineering marked by the refurbishment of new departmental laboratories and academic work related to the new full-time Masters program in Signals, Systems and Control which starts this October 2017. This year is also marked by the local hosting and organization of two international academic events chaired by various academic members of the department. Besides the special activities outlined above, the Department continued to develop its research programs. This report summarizes the ongoing research in 15 research projects covering the areas of intelligent mobile robots, computer vision, speech and mu-sic processing, bio signal human computer interfacing, neuro-rehabilitation, transport modelling and applications to medical radiography and satellite engineering. Four of these projects are externally funded attracting around to EUR 500,000 to the University that serve to provide research employment, postgraduate, doctoral and postdoctoral scholarships, and support for the research itself. These projects, together with other mi-nor ones, have throughout the course of this year, supported 11 undergraduate final-year project students, 11 postgraduate students, 7 doctoral students and 1 postdoctoral fellow. It is noteworthy that for the second time, the Department has been awarded the Malta Innovation Award, receiving first prize for scientific innovation for the project Eye-Control, on the use of eye movements recorded through electrooculography for human-computer interfacing. The research results from this productive year are also manifested in the 17peer-reviewedinternationalpublicationsthathavebeengenerated, together with a number of other articles and abstracts that capture ongoing work or seek to communicate our scientific and technological work to the general public.

The Department has also led a very active outreach program towards young children and older pupils, holding over 22 outreach events throughout the year. The schedule for the upcoming academic year is already almost fully booked, demonstrating strong interest.

This year is the 10th anniversary of the Department. Over these years the Department has grown in size, resources, and teaching and research activities. This was due to the continued initiative and energy of all the members of the Department, who have made the Department their second home. This is not only for the benefit of the University, but more so for the benefit of the students and for the generation of knowledge.

30th September 2017   **Prof Ing. Kenneth P. Camilleri**
                                                              Head of Department

2. Staff Members

Professors:
- Prof. Ing. Kenneth P. Camilleri*, B.Elec.Eng.(Hons.), M.Sc. (Sur.), Ph.D. (Sur.), MIEE, SMIEEE, ACIArb* – Head of Department
- Prof. Ing. Simon G. Fabri, *B.Elec. Eng. (Hons.), M.Sc. (Sheff.), Ph.D. (Sheff.), SMIEEE*

Senior Lecturer:
- Dr Kenneth Scerri, *B.Eng. (Hons.), M.S (Oakland), Ph.D. (Sheff.), MIEEE*

Lecturers:
- Dr Ing. Marvin K. Bugeja, *B.Eng. (Hons.), Ph.D. (Melit.), MIEEE*
- Dr Tracey Camilleri, *B.Eng. (Hons.), Ph.D. (Melit.), MIEEE*
- Dr Alexandra Bonnici, *B.Eng. (Hons.), M.Phil. (Melit.), Ph.D. (Melit.), LLCM(TD), MIEEE*

Assistant Lecturer:
- Ing. Luana Chetcuti Zammit, *B.Eng. (Hons.), M.Sc.(Eng.)*

Visiting Academics:
- Mr David Debono, *B.Eng. (Hons.), M.Sc.*
- Mr Julian Mercieca, *B.Eng. (Hons.)*
- Ing. Andre Sant, *B.Eng.(Hons). M.Sc., MIEEE*
- Ms Rachael Darmanin, *B.Eng. (Hons.), M.Sc.(Eng.)*

Systems Engineers:
- Dr Ing. Stefania Cristina, *B.Eng.(Hons). M.Sc. (Melit.), Ph.D. (Melit.), MIEEE, MIET*
- Ms Lucianne Cutajar, *B.Eng. (Hons.)*

Senior Laboratory Officer:
- Mr Noel Agius

Clerks:
- Ms Sanchia Lentini
- Ms Darleen Abela

3. Research Activities

3.1 Research Projects

- **Development of a Training Robot Simulator for use at CERN**
  Main investigators: Dr. Ing. Marvin Bugeja, Prof. Ing. Simon G. Fabri
  Research students: Clare Saliba

  Conducted in collaboration with CERN, the European Organization for Nuclear Research, this project consists in the design and development of a realistic simulator for Telemax, one of the mobile robots used at CERN to safeguard personnel from exposure to radiation when performing maintenance on the particle accelerator. Telemax is equipped with a robotic arm that is operated remotely by a skilled operator in order to grab objects, open and close valves, and even perform relatively complex operations with tools, such as twisting. The simulator is required to train new personnel to tele-operate the robot, as well as to assess the robot's performance in new environments and to provide feedback from the simulator to the user via virtual on-board cameras to enhance realism. The developed simulator is based on ROS and Gazebo and has recently also been tested by some of the robot operators at CERN, who claim to have found the simulator very realistic and useful. The project is documented in the MSc by research dissertation of Ms Clare Saliba (submitted for examination: end of September 2017)
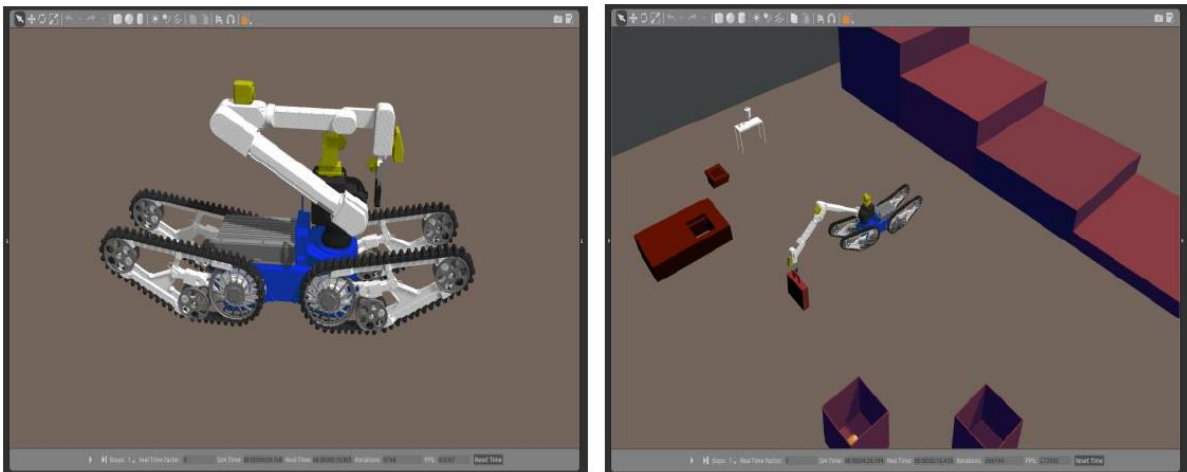
Telemax robot modelled in Gazebo, interfacing with objects used for testing

- **Coordination and Control of Multi-Robot Systems**
  Main investigators: Dr. Ing. Marvin Bugeja
  Research students: Ms Rachael Darmanin

For several decades, the robotics community has focused its research on the design of optimal and robust algorithms that enable a mobile robot to individually and autonomously perform a specific task. However, there are times when it is very difficult, if not impossible, for a single robot to execute the given task on its own. For instance, the task at hand can be too complex for a single unit, or it might involve a large physical space. Moreover, a system of multiple robots working together to achieve some common goal, often leads to a quicker, more robust and more efficient solution. However, such systems can only be designed if the task at hand is split and distributed in a manner that maximizes efficiency and enhances robustness, based on the capabilities of the individual robots in the team. Such systems have several real-life applications such as in: persistent surveillance, disposal of hazardous waste, warehouse management, and autonomous exploration. To this end, this doctoral research programme (started Oct 2016) is investigating how the coordination and cooperation between autonomous agents in a multi-robot system can be made more efficient, robust, and reconfigurable. This work aims to contribute an optimal framework that allows for task division, allocation and execution for multi-robot systeMs This framework shall then be applied to address a real-life relevant problem. The results of the reviewing stage of this project has been published in a review paper* at an international peer-reviewed conference in July 2017.

R. N. Darmanin, M. K. Bugeja, "A review on multi-robot systems categorised by application domain," in Proc. of the 25th Mediterranean Conference on Control and Automation (MED), Valletta, Malta, July 2017, pp. 701-706.

- **Mobile Robot Control**

  Main investigators: Prof. Ing. Simon G. Fabri, Dr. Ing. Marvin K. Bugeja

  Research students: Luke Camilleri, Jean Luc Farrugia, Julian Magri, Matthew Pulis
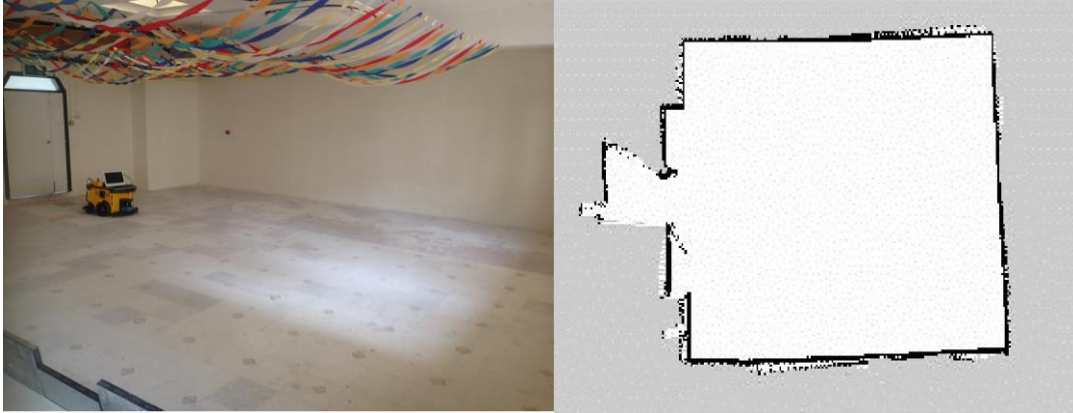
Left: Powerbot mapping an empty laboratory, Right: The map generated by Powerbot using SLAM

Projects in this area study various aspects of robot control on different platforms, including mobile robots and quadcopters.

Swarming algorithms have been investigated on teams of mobile robots through simulation and physical implementation. One approach was based on a team of four Khepera robots with swarming algorithms that generate movement in different formations and spontaneous flocking. Another approach was based on a heterogeneous swarm of three LEGO robots (EV3 and NXT), with particular emphasis on the use of swarming and collaboration for object transportation.

The final year project Mapping, Localization and Navigation in ROS was the latest in a series of projects aimed to study, implement and test a collection of robot mapping, localization and navigation algorithms in the Robot Operating System (ROS) framework.
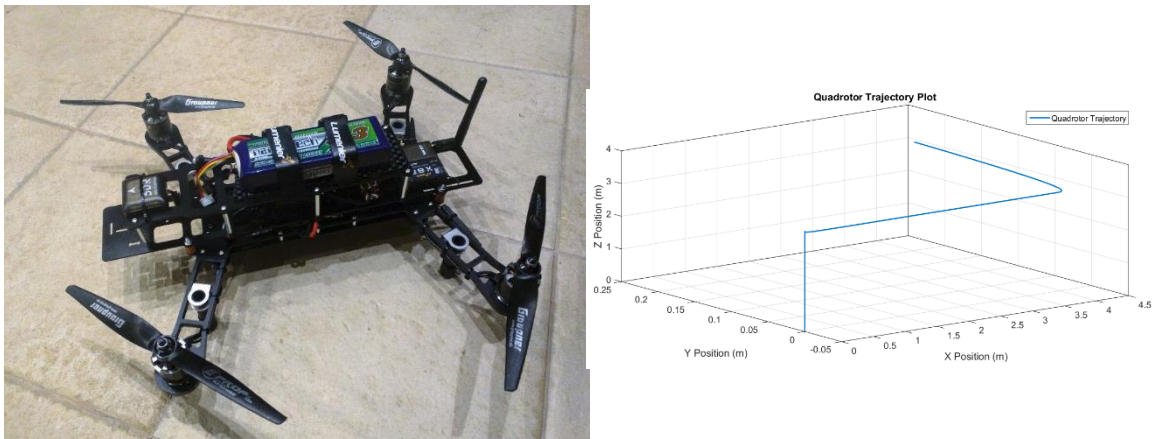
Left: The experimental quadcopter, Right: Quadcopter autonomous trajectory tracking simulation

This year's project focused on the comparison and performance evaluation of the mapping and localization modules. More specifically it employed physical experiments, using Powerbot, to evaluate the ROS modules GMapping, Hector SLAM, and AMCL. In addition, the project aimed to integrate a digital compass (within an IMU) to improve the robot pose derived from odometry, with the intention of improving the localization, mapping and navigation performance.

A new research track for our department is that related to the control of Unmanned Aerial Vehicles (UAVs). This research started this year in the form of a final year project named Autonomous Control of a Quadcopter. This project focused on the study, design and physical implementation of an autonomous control system for a quadcopter. The project deliverables included: a theoretical and literature review on the related topics, a realistic mathematical model of the quadcopter, a computer simulation of the quadcopter supporting various flight modes, and a real-life experimental quadcopter designed, built and tuned as part of this project's work.

- **Cognitive Vision for Sketch Understanding**
  Main investigators: Prof. Ing. Kenneth P. Camilleri and Dr Alexandra Bonnici

Human observers, can interpret sketches as 3D objects quite easily, using the artistic cues that are often introduced to the sketch to deduce the geometric shape of the sketched object. Replicating this interpretation on a machine is however, not a trivial task and the same artistic cues that humans use to aid the interpretation, increase the difficulties of the machine pre-processing required to identify these cues from the sketch strokes that define the shape of the object.
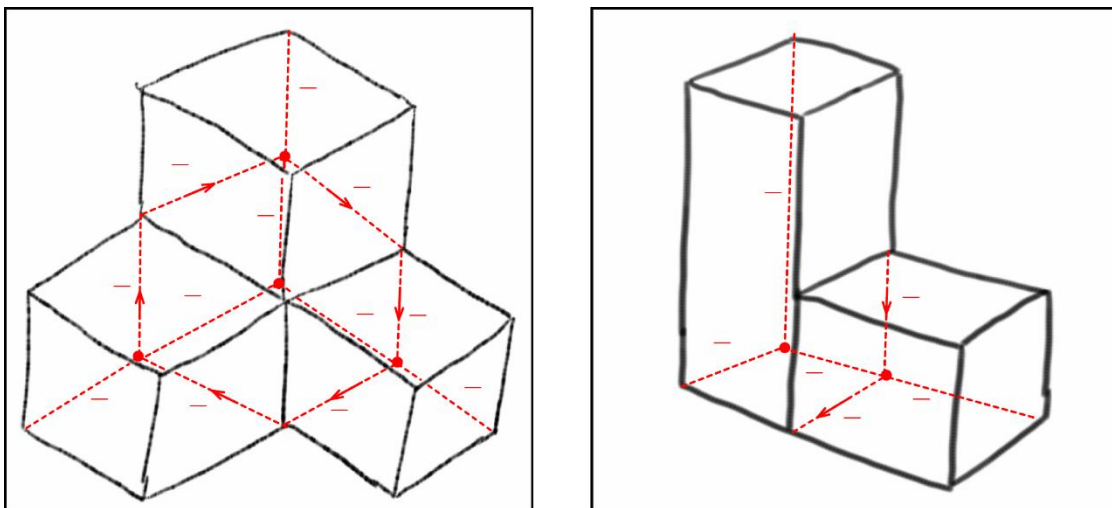
The process of obtaining a 3D representation from the 2D sketched drawing requires that the sketched image is first vectorised to extract the object edges from the 2D drawing. The artistic cues are then compared to canonical cues in order to determine an interpretation of the 3D geometry interpretation of the sketch. This 3D geometry interpretation is however, not sufficient to create a full 3D model since it only captures the visible part of the drawing. Humans are adept at deducing the hidden edges of the sketched drawing based on the sketched visible part. Hence, a list of canonical hidden junctions is created and these are used such that, in combination with the visible junctions, the hidden edges and junctions of the drawing are established. This leads to the creation of a wire frame representation from the simple 2D sketch, bringing us closer to the creation of a full 3D model from the 2D sketch.

- **WildEye - Eye-Gaze Tracking in the Wild**
  Main investigators: Prof. Ing. Kenneth P. Camilleri and Dr Ing. Stefania Cristina

Eye movements have long been recognised to provide an alternative channel for communication with, or control of, a machine such as a computer, substituting traditional peripheral devices. The ample information inherent to the eye movements has attracted increasing interest through the years, leading to a host of eye-gaze tracking applications in several fields, including assistive communication, automotive engineering, and marketing and advertising research.

This project has been awarded funding under the FUSION R&I Technology Development Programme 2017, and has been recently kicked off with the collaboration of Seasus Ltd as the commercial partner. The project proposes a passive eye-gaze tracking platform aimed to provide an alternative communication channel for persons with physical disabilities, permitting them to perform mundane activities such as to operate a computer, hence improving their quality of life and independence, or for normal individuals as an additional access method, permitting an auxiliary control input for computer applications, such as games.

In the proposed platform, eye and head movements will be captured in a stream of image frames acquired by a webcam, and subsequently processed by a computer (and possibly mobile devices) in order to estimate the gaze direction according to the eye and head pose components. Mapping the eye-gaze to a computer screen will permit commands to be issued by the selection of icons on a suitably designed user interface. This project will be addressing challenges associated with eye-gaze tracking under

uncontrolled daily life conditions, including handling of head and non-rigid face movements, and reduction or elimination of user calibration for more natural user interaction.

- **Visual object recognition based on textual descriptions**
  Main investigators: Dr Albert Gatt and Prof. Ing. Kenneth P. Camilleri
  Research Students: Mr Marc Tanti

This research project, undertaken in collaboration with the Institute of Linguistics, combines the computer vision expertise of the Department with linguistic description of images provided by the Institute. Specifically, the aim of the project is to generate linguistic captions for images and seek methods that can generate descriptions of objects by recognition of its parts. This research has led us to study the use of deep neural networks to this problem. In this context, typically, a convolutional neural network (CNN) extracts image features and a recurrent neural network (RNN) encodes linguistic information. The most common architectural model "injects" the CNN-extracted visual features directly as an input to the RNN, thus making it part of the linguistic encoding process, as shown in Figure A. An alternative architecture that we have investigated encodes the visual and linguistic features separately, with these being "merged" at a subsequent feed-forward stage, as shown in Figure B. Our work suggests that the "merge' architecture is superior to the "inject" approach, leading not only to architectures that are more suitable for this task but also to an insightful interpretation on the role of the RNN and CNN processes.
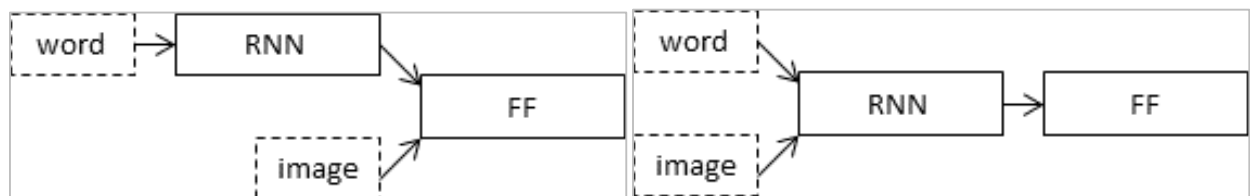

Figure A

Figure B

- **Developing a practical human machine interface**
  Main investigators: Dr Tracey Camilleri, Prof. Ing. Kenneth P. Camilleri, Dr Owen Falzon, Ms Rosanne Zerafa
  Research Students: Rebecca Vella

One of the most intuitive brain computer interface (BCI) systems is that based on visually evoked potentials. In such a system, the brain signals of a subject gazing at specific visual stimuli are recorded through electroencephalography (EEG) and processed in real time to allow the subject to control an application. This project focuses on the practicality aspect of the system by developing techniques that make it possible to use this BCI in everyday life. This year the project focussed on i) carrying out a study to compare different EEG recording systems and ii) implementing algorithms which are known to have very little or no training requirements. For the former, 9 different EEG systems were compared, ranging from high end laboratory equipment to cheaper and more commercial EEG headsets. Data was recorded from 14 subjects performing both eyes-open, eyes-closed experiments, as well as looking at visual stimuli flickering at specific frequencies. The analysis of the data is currently being done to assess and compare the different headsets and their practicality. From the algorithmic point of view, canonical correlation analysis (CCA) was implemented and compared to the power spectral density analysis technique that was so far adopted in our SSVEP based BCI systeMs CCA is known to have very little or no training requirements, which could help make the use of an SSVEP based system for everyday use, more feasible.

- **Gaze angle estimation using electrooculography (EOG) signals**
  Main investigators: Dr Tracey Camilleri
  Research Student: Nathaniel Barbara

This project builds on a previous research project where electrooculography (EOG) signals were used to interface with a virtual keyboard. Two EOG recording modalities, specifically the standard two-pair gel-based configuration and the JINS MEME glasses comprising three dry electrodes on the nose pads and nose bridge, were compared and writing speeds of 6.44 and 7.11 letters per minute were achieved.

The year the project focussed on using EOG signals for continuous gaze angle estimation. The first part of the study compared the standard one-input polynomial model used to translate peaks in respective horizontal and vertical EOG components to corresponding gaze angles, against a novel multi-channel input linear regression model. The latter was found to give a mean absolute horizontal and vertical angular error of 1.31 ± 0.45° and

1.66 ± 0.24° respectively using signals acquired from the conventional setup, and 2.44 ± 0.89° and 2.05 ± 0.76° using the MEME glasses. These results showed a significant improvement over those obtained using the standard single channel, first order, polynomial model.

The second part of the study involved the implementation of a real-time eye movement detection and classification technique to distinguish between saccades and blinks. Three different techniques, referred to as the two threshold technique, the linear model for classification and the combined technique were compared, with the latter proving to give the best overall results in terms of saccade and blink detection accuracy as well as time taken to label the event. Average saccade and blink classification accuracies of 96.42 ± 0.97% and 99.92 ± 0.20% were obtained considering EOG signals acquired from the conventional setup, while those achieved by the MEME glasses were of 95.33 ± 1.75% and 99.42 ± 0.74%.

Finally, the gaze angle estimation regression model as well as the eye movement detection and classification technique were combined and used to interface with a real-time eye-controlled virtual keyboard, which opposed to the one developed last year, allowed the subject to carry out continuous movement in an asynchronous fashion rather than adopting a step-wise control interface. When the keyboard was tested on 10 different subjects, average effective writing speeds of 12.78 ± 5.03 and 10.75 ± 5.41 characters per minute were achieved using the conventional setup and the MEME glasses respectively.
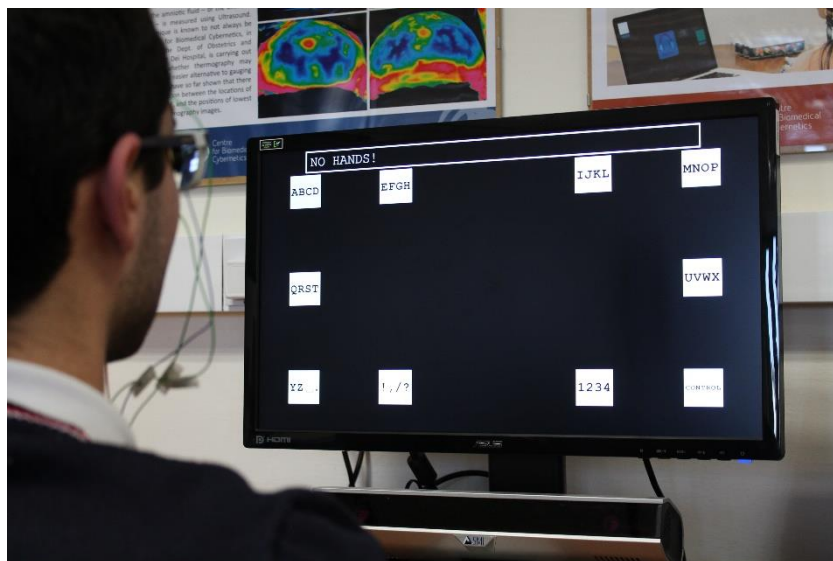
Icon layout of the EOG controlled virtual keyboard

- **BrainApp - Brain Controlled Applications**
  Main investigators: Dr Tracey Camilleri, Prof. Ing. Kenneth P. Camilleri and Dr Owen Falzon

A Brain Computer Interface (BCI) gives a person the ability to communicate with and control machines using brain signals instead of peripheral muscles. BCIs allow people with severely restricted mobility to control devices around them, increasing level of independence and improving quality of life. BCIs may also be used by healthy individuals, e.g. in gaming, and are expected to become a ubiquitous alternative means of communication and control.

This project has been awarded funding under the FUSION R&I Technology Development Programme 2017, and has commenced on the 31st of July with the collaboration of 6PM as the commercial partner. This project proposes the development of a novel application controlled directly with brain signals, opening up accessibility to individuals suffering from motor disabilities, and providing alternative access methods to healthy individuals. BCIs acquire the electrical brain activity using electroencephalography (EEG) electrodes, relying on brain phenomena such as those evoked by flickering visual stimuli, known as steady state visually evoked potentials (SSVEP). In the proposed system, stimuli are associated to commands, and EEG signals are processed to detect the intent associated to the brain pattern. A BCI challenge is to have BCIs operating in real environments amidst the nuisance signals generated by normal user actions. The project proposes solutions to this challenge, operating in real-time at the user's will. It also aims at addressing the annoyance factor of the flickering stimuli, ensuring that the system can be used comfortably for long periods of time, if necessary.

- **CT Radiation Doses in Nigeria: Establishment of Diagnostic Reference Levels and Radiation Dose Optimisation**
  Main Investigators: Prof Ing. Simon G. Fabri, Dr. Francis Zarb (Department of Radiography, Faculty of Health Sciences), Prof Mark McEntee (Brain and Mind Research Institute, The University of Sydney, Australia)

Research student: Mr Idris Garba

Computed Tomography (CT) procedures are considered as high radiation dose examinations. In view of this, every country is encouraged by international regulatory agencies such as the IAEA and ICRP, to develop Diagnostic Reference Levels (DRLs) that aim to establish radiation levels that should not be exceeded where good practice is applied, without compromising the quality of the scans for clinical purposes in the interest of patient protection. The aim of this project is to establish national DRLs for CT examinations in Nigeria for the purpose of radiation dose optimisation.

The study will apply quantitative methodologies with a cross sectional research design identifying the radiation dose in terms of Computed Tomography Dose Index (CTDI) and Dose Length Product (DLP) for CT examinations. Both retrospective and prospective approaches were adopted. Retrospective dose data for the initial radiation dose assessment was collected for adults and paediatrics. This data was used to identify those centres where high or possibly unnecessary radiation exposure is used. Meanwhile, another data sheet will be used to collect data for the prospective re-evaluation of the radiation dose after optimisation for centres where there is unnecessary high radiation dose value with respect to other CT centres or countries. The optimisation will be carried out through adjustment of the CT scan parameters (kV, mAs, slice thickness, pitch) while maintaining acceptable image quality for diagnostic purposes.

- **Transport Modelling and Control Applied to the Maltese Traffic Network**
  Main investigators: Prof. Ing. Simon G. Fabri, Dr. Kenneth Scerri, Prof. Maria Attard (Inst for Sustainable Development and Climate Change)
  Research student: Ms Luana Chetcuti Zammit

As increasing traffic demands are reaching critical levels worldwide, advanced traffic signal management is becoming a fundamental requirement. Intelligent Transportation Systems (ITS) have been implemented through the evolution and generation of traffic signal control concepts that integrate advances in control, communications and computational technologies to provide, amongst others, intelligent control of traffic lights that adapt themselves according to time-varying traffic density or to changing road conditions.

Despite recent advances in ITS, current systems can become suboptimal when networks are subject to major unanticipated irregularities, such as roadworks, accidents and extreme weather conditions, or to drastically changing and unpredictable traffic demand, say during rush hour., Autonomous-based systems are required to self-handle these complexities by modelling the network behaviour and adapting to the changes as required, in order to control traffic signals so as to optimize the flow of vehicles. Our aim in this research is to obtain a computationally efficient numerical model to reflect the changing traffic behaviour with little prior knowledge of the underlying traffic parameters. Hence online joint state and parameter estimation algorithms are being developed to tune the model and control the signals in real time according to dynamic traffic conditions. Recent developments in this work have been presented at the 2017 Mediterranean Conference on Control and Automation and several other IEEE conferences.
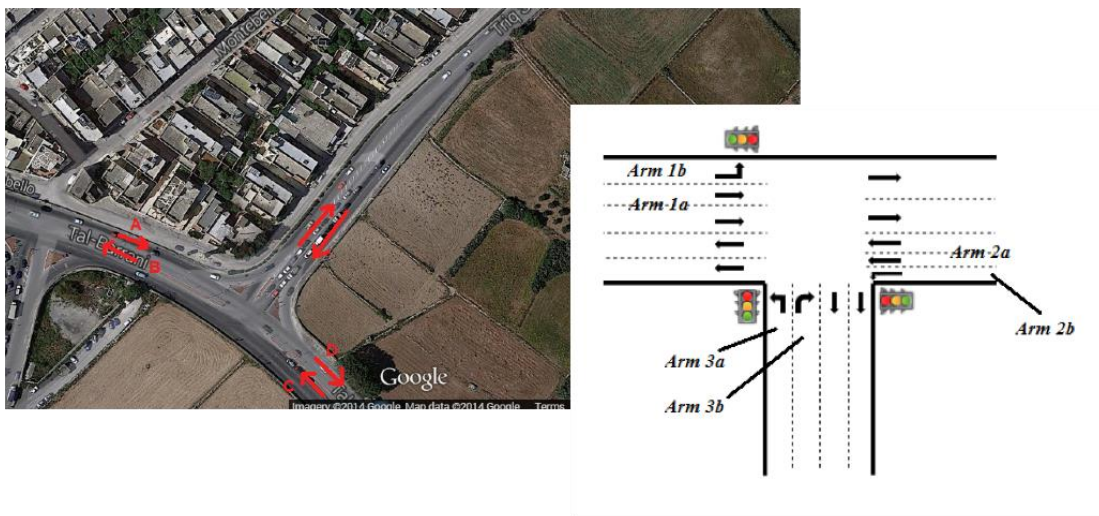
- **Attitude Control of a Pico Satellite**
  Main investigators: Prof. Ing. Simon G. Fabri, Dr. Ing. Marvin K. Bugeja, Dr. Ing. Marc Anthony Azzopardi
  Research student: Denise Baldacchino

This project is part of the Faculty-wide Astrea project aimed at launching a pico-satellite designed and developed at the University of Malta. This project focused on a 3-axis satellite attitude control system using reaction wheels. Each reaction wheel is mounted on the shaft of a micromotor that is connected to the body of the satellite. Powering up the motor develops a torque and the satellite reacts with an equal and opposite torque, thereby changing its attitude. This action needs to be controlled by a closed-loop system.

Initially, the design of a complete model of the kinematics and dynamics of the satellite in orbit of the Earth was developed and simulated. This was followed by a physical mock-up of the satellite to be used in the laboratory so as to design and test as proof of concept the reaction wheel attitude controller. An optimal control strategy was used for this purpose. The sensors and controller were implemented on the mock-up as a stand-alone embedded microcontroller system.

The main investigators are also involved in a Masters by Research project (student: Mr Darren DeBattista, ESE dept.) on the same theme but having a broader focus. More specifically, this MSc project focuses on the design and realization of the flight-ready hardware implementation of an attitude control and determination system (ADCS) for the UoMBSat1 Pico-Satellite.
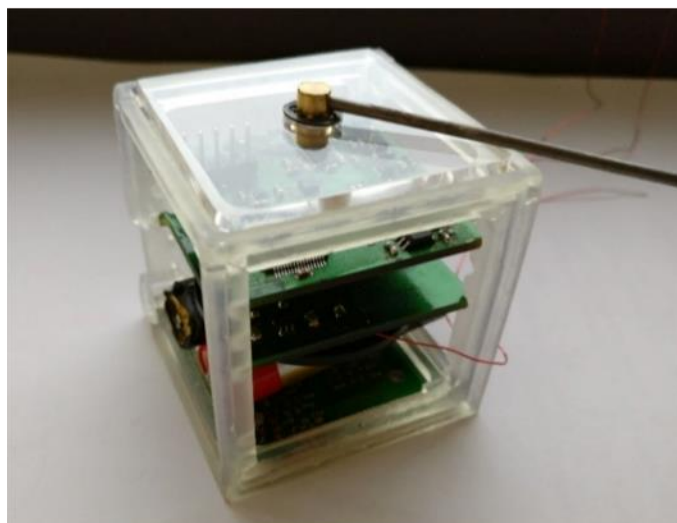
The physical mock-up of the satellite used as proof of concept
for the attitude control system

- **A Speech Recognition and Analysis System for SPEECHIE**
  Main investigators: Prof. Ing. Simon G. Fabri, Dr. Ing. Owen Casha, Dr. Ing. Philip Farrugia
  Research student: James Attard

  This research forms part of the SPEECHIE research project funded by the FUSION R&I Technology Development Programme 2016 that aims to develop a novel device which facilitates language therapy for children that are subject to speech impairment. This aspect of the project focuses on the development and implementation of speech recognition and analysis capabilities to monitor the child's performance and allow for autonomous interaction during therapy sessions.

- **Localisation and Detection of Barcodes using Aerial Robots.**
  Main investigators: Alexandra Bonnici, Marvin Bugeja, Simon Fabri, Kenneth Camilleri
  Research student: Charlotte Camilleri

  While barcode readers are common and available to end users via numerous mobile-phone or tablet-PC applications, the readers generally assume that the barcode is upright and well-focused in the imaging window. The user therefore has to ensure that the barcode capture device is well focused on the barcode in question. In this work, we seek to relax the image capture constraints allowing for barcode detection and decoding even in instances where the barcode is rotated, blurred due to motion blur, or other artefacts on the barcode. The project has application in warehouse system management whereby an aerial robot is used to scan barcodes of items which are stored on tall warehouse shelving. The project will seek the development of image processing algorithms which are robust to image artefacts and which are scale and rotation invariant.

- **Musical Score Analysis**
  Main investigators: Alexandra Bonnici, Stefania Cristina, Kenneth Camilleri

Printed musical scores have, for centuries, given musicians the necessary instructions to reproduce musical pieces according to the composer's intent. The musical score presents information related to the melodic and rhythmic nature of the notes as well as other information related to the expressive nature of the note, such as its articulation, loudness and any ornamental embellishments that may be added to the notes. In addition, the musical score, presents the music player with the sequence with which the music is to be played since, unlike the reading of text, the reading and playing of music is not bound by reading in a forward direction only.

While musical notation has developed to suite the needs of printed publications, the style is not necessarily well adapted for display on mobile devices, in particular, digital tablets. Here the size of the display screen makes the notation unreadable unless constant zooming and panning on the page are made. Thus, through this research, we analyse images of printed musical scores in order to adapt these for display on digital devices. Throughout this year, we focused on the flattening of the score, whereby the repeat instructions present in the score were located and used to re-write the musical score in the proper order it should be played. Moreover, eye-gaze tracking was used to keep track where the player is looking at while playing and hence automatically execute page turns without requiring the music player to remove his/her hands from the instrument to do so.

See [here](#) for a demo of the eye-gaze page turner.

4. Student Projects and Supervision

4.1 B.Eng. Students

Project Title	Student	Supervisor
Attitude Control of a Pico-Satellite with Reaction Wheels	Denise Baldacchino	Prof Ing. Simon G. Fabri Dr. Ing. Marvin Bugeja
Region Tracking in Thermographic Video for Robust Local Temperature Estimation in Humans	Christina Bonett	Dr. Owen Falzon Dr. Kenneth Scerri

EMG-based Finger Movement Estimation	Gabriel Calleja	Prof Kenneth P. Camilleri Prof Michael Saliba
Swarm Robotics	Luke Camilleri	Prof Ing. Simon G. Fabri
Autonomous Control of A Quadcopter	Julian Magri	Dr. Ing. Marvin Bugeja
Computational Modelling of Expressive Music Performance	Maria Mifsud	Dr. Alexandra Bonnici
Modelling Of Stage 2 Sleep EEG Data	Nathasha Mary Padfield	Dr. Tracey Camilleri
Robotic Mapping, Localisation and Navigation in ROS	Matthew Pulis	Dr. Ing. Marvin Bugeja
Connected Vehicles and Road Infrastructure for Urban Mobility	Nirvana Sciberras	Dr. Kenneth Scerri
An IoT Solution for Traffic Light Control	Marija Vella	Dr. Kenneth Scerri
Web Browsing Using Brain Signals	Rebecca Vella	Dr. Tracey Camilleri

4.2 M.Sc. By Research Students

Project Title	Student	Supervisor	Department
Training Simulator for Teleoperated Robots Deployed at CERN	Ms Clare Saliba	Dr. Ing. Marvin K. Bugeja Prof Ing. Simon G. Fabri	SCE
A Speech Recognition and Analysis System for SPEECHIE: A Device Supporting Children with Language Impairment	Mr James Attard	Prof. Ing. Simon Fabri Dr. Owen Casha	SCE
Continuous Eye Gaze Tracking using EOG Signals	Mr Nathaniel Barbara	Dr. Tracey Camilleri Prof. Ing. Kenneth Camilleri	SCE
Localisation and Detection of Barcodes using Aerial Robots	Ms Charlotte Camilleri	Dr. Alexandra Bonnici Dr. Ing. Marvin K. Bugeja	SCE
Combined Visual and Thermal Imaging for Non-	Ms Lucianne Cutajar	Dr. Owen Falzon Prof Ing. Kenneth P. Camilleri	SCE

Project Title			
Contact Physiological Signal Measurement			
Swarm Robotics for Object Transportation	Mr Jean-Luc Farrugia	Prof. Ing. Simon Fabri	SCE
Thermographic Analysis of the Abdominal Region of Pregnant Woman	Ms Annelie Ciantar	Dr. Owen Falzon Prof Ing. Kenneth P. Camilleri	CBC
An EEG-Based Biometric System	Ms Elysia Calleja	Dr. Owen Falzon Prof Ing. Kenneth P. Camilleri	CBC
Enhancing the Common Spatial Patterns Method for BCI Classification by Integrating Temporal Information	Mr Edward Zammit	Dr. Owen Falzon Prof Ing. Kenneth P. Camilleri	CBC
Automated Analysis of Thermal Images for Peripheral Vascular Disease Monitoring	Mr Jean Gauci	Dr. Owen Falzon Prof Ing. Kenneth P. Camilleri	CBC
Design of an Attitude Control and Determination System for the UoMBSat1 Pico-Satellite	Mr Darren DeBattista	Dr. Ing. Marc A. Azzopardi Dr. Ing. Marvin Bugeja Prof. Ing. Simon Fabri	ESE

4.3 M.Phil. / Ph.D. Students

Project Title	Student	Supervisor	Department
Coordination and Control of Multi-Robot Systems	Ms Rachael Nicole Darmanin	Dr. Ing. Marvin Bugeja	SCE
Autonomic Control for Road Network Management using Geocomputational Tools	Ing. Luana Chetcuti Zammit	Prof Ing. Simon G. Fabri Prof M Attard	SCE
CT Radiation Doses in Nigeria: Establishment of Diagnostic Reference Levels	Mr Idris Garba	Prof Ing. Simon G. Fabri Dr. Francis Zarb Prof Mark McEntee	SCE

Project Title	Student	Supervisor	Department
and Radiation Dose Optimisation			
Modelling Spatial Context in Maltese Sign Language Recognition from Video Sequences	Mr Mark Borg	Prof Ing. Kenneth P. Camilleri Prof Marie Alexander	SCE
Visual Object Recognition based on Textual Descriptions	Mr Marc Tanti	Dr Albert Gatt Prof Ing. Kenneth P. Camilleri	Institute of Linguistics
An Enhanced Wearable System for Kinematic and Kinetic Gait Analysis	Mr Nikiforos Okkalidis	Dr. Owen Falzon Dr Dr. Ing. Marvin Bugeja, Dr Alfred Gatt Prof Ing. Kenneth P. Camilleri	CBC
Quantifying Atherosclerosis using Freehand 3D Ultrasound Imaging	Mr Carl Azzopardi	Dr Yulia Hicks (Cardiff University, Wales, UK) Prof. Kevin Cassar, Prof. Ing. Kenneth P. Camilleri (University of Malta, Malta)	Cardiff University, Wales, UK

4.4 Postdoctoral scholars

Project Title	Student	Supervisor	Department
Neural Correlates of Upper Limb Somatosensory Impairments and Recovery after Stroke: An EEG Investigation	Dr. Lisa Tabone	Prof Ing. Kenneth P. Camilleri, Prof Geert Verheyden (Katholieke Universiteit Leuven, Belgium)	SCE

4.5 Summer Internships

Alexandra Bonnici supervised Nicholas Zammit, a third year student on a summer internship for a total of 80 hours. During this internship, Nicholas wrote Matlab code which can be used to automatically generate MusicXML files using the information obtained from digital image processing of music scores.

5. External Lecturers and Visitors

From the Brno University of Technology, Czech Republic
On Wednesday 13th September 2017, Prof Robert Grepl from Brno University of Technology delivered a half-day practical workshop on Object-Oriented-Programming and GUI applications in MATLAB. The goal of the workshop was to provide a hands-on introduction to Object Oriented Programming (OOP) in MATLAB. Example applications included the design of a complex Graphical User Interfaces (GUI) in MATLAB. The workshop was attended and positively received by a number of academics, technical staff and postgraduate students from the faculty of engineering.

6. Teaching Activities

The Department is responsible for teaching several study-units within the B.Eng.(Hons) programmes in Electrical and Electronic Engineering, Mechanical Engineering and the B.Sc.(Hons) ICT course in Communications and Computer Engineering. It also participates in the M.Sc. course in Language and Computation organised by the Institute of Linguistics and the M.Sc. in Environmental Management and Sustainability organised by the Institute of Earth SysteMs

A Selection of study units offered by the Department in 2016/2017		
SCE1201	Dynamic Systems and Signals 1	5 credits
SCE2201	Numerical Methods for Engineers	5 credits
SCE2111	Automatic Control Systems 1	5 credits
SCE2112	Control Systems 1	5 credits
SCE2210	Introduction to Control Systems	5 credits
SCE2213	Automatic Control Systems 2	5 credits
SCE3101	Dynamic Systems and Signals 2	5 credits
SCE3205	Dynamic Systems and Signals 3	5 credits
SCE3204	Image Analysis and Computer Vision	5 credits

SCE3110	Control Systems 2	6 credits
SCE3113	Automatic Control Systems 3	5 credits
SCE3216	Automatic Control Systems 4	5 credits
SCE3112	Control Systems Technology and Automation	5 credits
ENR3008	Team Project	5 credits
SCE4101	Computational Intelligence 1	5 credits
SCE4102	Systems Theory	5 credits
LIN5508	Language and Embodied Agents (part of)	10 credits
IES5009	Introduction to System Dynamics	6 credits
OMS5004	Data Resources in Operational Oceanography (part of)	10 credits
ENR5006	Research Methods (part of)	5 credits

Clinical and Physiological Data Analysis (CAPDA) Course

Two academics from the Department contributed to the organisation and delivery of the second of a series of courses provided under the auspices of the Centre for Biomedical Cybernetics which is targeted for individuals who are interested in the acquisition and analysis of clinical and physiological signals and who may not possess any prior technical knowledge, as well as for individuals with a technical background who may be interested in clinical and physiological data analysis. This course was held between the 31st July and 11th August 2017 and consisted of 7 modules, specifically:

- EEG Fundamentals
- EEG Practical
- Signal Processing
- MATLAB
- EEGLAB
- Human Motion Fundamentals
- Human Motion Practical

The contribution of the Department was through Professor Kenneth Camilleri who prepared and delivered the Signal Processing module, and through Dr Tracey Camilleri who prepared and delivered the EEG Practical module and the EEGLAB module.

7. Staff Publications (October 2016 - September 2017)

A.Bonnici, S. Cristina and K. Camilleri, "Preparation of Music Scores to Enable Hands-free Page Turning Based on Eye-gaze Tracking" in Proc. of the 2017 ACM Symposium on Document Engineering (DocEng '17), Valletta, Malta, Sept. 4-7, 2017

M. Borg and K. P. Camilleri, "Towards a Transcription System of Sign Language Video Resources via Motion Trajectory Factorisation", in Proc. of the 2017 ACM Symposium on Document Engineering (DocEng '17), Valletta, Malta, Sept. 4-7, 2017

M. Tanti, A. Gatt and K. P. Camilleri, "What is the role of recurrent neural networks (RNNs) in an image caption generator?", 10th International Natural Language Generation conference (INLG2017), Santiago de Compostela, Spain, Sept. 4-7, 2017

R. N. Darmanin, M. K. Bugeja, "A review on multi-robot systems categorised by application domain," in Proc. of the 25th Mediterranean Conference on Control and Automation (MED), Valletta, Malta, July 2017, pp. 701-706.

C. Grech, T. Camilleri and M. K. Bugeja, "Using neural networks for simultaneous and proportional estimation of upper arm kinematics," in Proc. of the 25th Mediterranean Conference on Control and Automation (MED), Valletta, Malta, July 2017, pp. 247-252.
O. Falzon, R. Zerafa, T. Camilleri and K. P. Camilleri, 'EEG-Based Biometry Using Steady State Visual Evoked Potentials', in Proc. of the 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'17), Jeju, South Korea, Jul. 2017.

J. Gauci, O. Falzon, K. P. Camilleri, C. Formosa, A. Gatt, C. Ellul, S. Mizzi, A. Mizzi, K. Cassar, C. Sturegon, and N. Chockalingam, 'Automated Segmenation of Regions of Interest from Thermal Images of Hands', in Proc. of the 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'17), Jeju, South Korea, Jul. 2017.

N. Gauci, O. Falzon, T. Camilleri and K. P. Camilleri, 'Phase-based SSVEPs for Real-Time Control of a Motorised Bed', in Proc. of the 39th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC'17), Jeju, South Korea, Jul. 2017.

D. Baldacchino, D. Debattista, R. Rotin, D. Cachia, M.A. Azzopardi, S.G. Fabri, and M.K. Bugeja, "Review and Feasibility of Active Attitude Control and Detumbling for the UoMBSat-1 PocketQube Pico-Satellite", in Proc. of the 25th Mediterranean Conference on Control and Automation – MED 2017, pp. 1237-1243, Valletta, Malta, Jul. 2017.

L. Chetcuti Zammit, S.G. Fabri and K. Scerri, "Online state and parameter estimation for a 4-arm traffic junction", in Proc. of the 25th Mediterranean Conference on Control and Automation – MED 2017, pp. 737-742, Valletta, Malta, Jul. 2017.

D. Bonello, M. A. Saliba, K. P. Camilleri, "An Exploratory Study on the Automated Sorting of Commingled Recyclable Domestic Waste", *Procedia Manufacturing*, vol. 11, pp. 686-694, ISSN 2351-9789, 2017. Available: https://doi.org/10.1016/j.promfg.2017.07.168. (http://www.sciencedirect.com/science/article/pii/S2351978917303748). Keywords: Material recovery facility; automation; universal gripper

L. Chetcuti Zammit, S.G. Fabri and K. Scerri, "Simultaneous Traffic Flow and Macro Model Estimation for Signalized Junctions with Multiple Input Lanes", in Proc. of the 3rd International Conference on Vehicle Technology and Intelligent Transport Systems – VEHITS 2017, pp. 157-164, Porto, Portugal, Apr. 2017.

N. Barbara, T. A. Camilleri, "Interfacing with a speller using EOG glasses", IEEE International Conference on Systems, Man and Cybernetics (SMC 2016), Budapest, Hungary, Oct. 2016.

8. Staff Academic Activities

Dr A. Bonnici
Administrative
Dr Bonnici is a member on the Faculty's Board of Studies (B.Eng electrical stream). She also coordinates the Faculty of Engineering Technology Clubs

Academic
Dr Bonnici is a reviewer or committee member for international conferences and journals, including: The Eurographics Workshop on Sketch Based Interfaces and Modelling, Computer and Graphics Journal, The International Symposium on Document Engineering and The Eurographics Conference on Visualization. Dr Bonnici was also Program Chair for the 17th ACM International Symposium on Document Engineering

Dr Ing. M. K. Bugeja

Administrative

Dr Bugeja is a Faculty representative on Senate. He is also a member on the Faculty's Board of Studies (M. Sc. in Language and Computation) and a member of the Faculty's IT affairs committee.

Academic

Dr Bugeja is a reviewer or programme committee member for several conferences and journal submissions, including the IEEE Transactions on Cybernetics, the International Journal of Systems Science, Neurocomputing, the International Journal by Elsevier and the International Conference on Informatics in Control, Automation and Robotics among others. Dr Bugeja was Lead Programme Chair of the 25th Mediterranean Conference on Control and Automation held in Malta on the 3rd - 6th July 2017. Dr Bugeja is a M.Sc. external examiner at the Brno University of Technology.

Prof Ing. K. P. Camilleri

Administrative

Prof Camilleri is the Head of the Department of Systems and Control Engineering. He is also the Director for the Centre for Biomedical Cybernetics and occupies the post of Chariman in the Doctoral Committee of the Centre for Biomedical Cybernetics and MSc by Research Board of Studies of the same Centre for Biomedical Cybernetics. Prof Camilleri is a member (*ex officio*), Electrical & Electronic Engineering Board of Studies, MSc by Research in Engineering Board of Studies, Faculty of Engineering Board and the University Promotions Board. Prof Camilleri serves as a project proposal evaluator for Horizon 2020 project proposals. Prof Camilleri is a member of the Malta Neuroscience Network.

Academic

Prof Camilleri is the project leader (Biomedical Engineering Sub-project) of the ERDF Project "Strengthening of the Analytical Chemistry, Biomedical Engineering and Electromagnetics RTDI Facilities". He is a Principal investigator for the National R&I Fund Award R&I-2012-057 'Eye Communicate', National R&I Fund Award R&I-2016-010-T 'WildEye' and RIDT Malta Neuroscience Network Brain Fund Award 'DeepMotionBCI' . Prof Camilleri is a Co-investigator for the National R&I Fund Award R&I-2013-028 'TIPMID', National R&I Fund Award R&I-2015-032-T 'BrainApp', National R&I Fund Award R&I-2017-002-V 'Deep-FIR' and National R&I Fund Award R&I-2017-028-V 'MAProHand'.

Prof Camilleri is a member on the Editorial Boards of the Journal of Neuroscience Methods, the International Journal on Advances in Intelligent Systems and of the Research Journal of

Information Technology. He is a reviewer for several journal submissions, including: IEEE Transactions on Image Processing, IEEE Transactions on Signal Processing, IEEE Signal Processing Letters, IEEE Computing in Science and Engineering, IEEE Transactions on Systems, Man and Cybernetics: Part A, Journal of Electronic Imaging, Optical Engineering, Expert Systems, International Journal of Systems Science, Neuroscience Methods and Brain Computing Interfacing Journal (Taylor & Francis). He is also a Reviewer or International Programme Committee member of several international conferences, including: The Eleventhth International Conference on Advanced Engineering Computing and Applications in Science (ADVCOMP 2017), The Fourteenth International Conference on Intelligent Environments (IE 2017) and the Seventeenth International Conference on Computer Analysis of Images and Patterns (CAIP 2017). Prof Camilleri is a member on the Editorial Board of the Journal of Neuroscience Methods, the International Journal on Advances in Intelligent Systems, and the Research Journal of Information Technology. Prof Camilleri was a general chair for The Seventeenth ACM Symposium on Document Engineering (DocEng2017).

Dr. T. Camilleri

<u>Administrative</u>

Dr. Camilleri is a member of the Faculty's MSc by Research Board of Studies and also a member of the IEEE Malta Section committee and the Malta Neuroscience Network. Dr. Camilleri hosted the opening ceremony of the Faculty of Engineering exhibition and also assisted in the organisation of the second Brain Awareness Week held in Malta between the 13th and 17th of March 2017.

<u>Academic</u>

Dr Camilleri is a reviewer for journal submissions including: Journal of Selected Topics in Signal Processing, Journal of Biomedical Engineering and Control and IEEE Transactions on Biomedical Engineering. She is also an advisor for the IEEE Malta Student Branch. Dr Camilleri is a principal Investigator: National R&I Fund Award R&I-2015-132-T 'BrainApp'.

Ing. Luana Chetcuti Zammit

<u>Administrative</u>

Ing. Chetcuti Zammit is an IEEE member. She acted as Publicity Chair of the 25th Mediterranean Conference on Control and Automation held in Malta on the 3rd - 6th July 2017 and also participated in the Digital Expo during the Digital Assembly 2017, held in Valletta on the 15th-16th June 2017.

Ing. Chetcuti Zammit is a reviewer for several international conferences such as the Australian Control Conference.

Prof Ing. S. G. Fabri

Administrative

Prof Fabri is the project leader of the ERDF Project "Modernising the University of Malta's Control Systems Engineering Laboratory", he is a member of the Government Engineering Profession Board and member of the Administrative Council of the European Control Association (EUCA). Prof Fabri is a member on several University boards/committees including: Academic Resources Funds Committee, Board of the Institute of Linguistics, Board of the Institute for Climate Change and Sustainable Development, Malta Neuroscience Network, Quality Assurance Committee and the Doctoral Committee of the Centre for Biomedical Cybernetics. Prof Fabri is coordinator of the department's Internal Research Workshop Series and the MSc course on Signals, Systems and Control. Prof Fabri was the lead general chair of the 25th Mediterranean Conference on Control and Automation held in Malta at the Valletta Campus on the 3rd - 6th July 2017.

Academic

Prof Fabri is a member on the Editorial Board of the International Journal on Advances in Intelligent Systems and also a member on the Editorial Board as well as associate Editor of the International Journal of Systems Science. Prof Fabri is co-investigator in the National R&I funded project R&I-2015-042-T 'Speechie'. He is a reviewer for several journal submissions, including: the International Journal on Advances in Intelligent Systems, Transactions of the Institute of Measurement and Control, the International Journal of Control, the Journal of Vibration and Control, Mathematical Problems in Engineering and IEEE Transactions on Systems, Man and Cybernetics.

Prof Fabri is a Reviewer Committee Member for several international conferences, including: Tenth International Conference on Advanced Engineering Computing and Applications in Sciences, 2016, the International Conference on Informatics in Control, Automation and Robotics, 2016 and the fourteenth Mediterranean Conference on Medical and Biological Engineering and Computing, 2016. Prof Fabri is a PhD External Examiner at the University of Le Havre, France and The University of Sheffield, UK.

Dr Kenneth Scerri

<u>Administrative</u>

Dr Scerri is a member of the Engineering Faculty Board and member of the Faculty of Engineering Doctoral Committee. He is Chair of the Faculty of Engineering International Affairs Committee.

<u>Academic</u>

Dr Scerri is a reviewer for the International Journal of Systems Science and various international scientific conferences.

9. Prizes, Awards and Appointments

DocEng 2017 Best Paper Award

Mark Borg and Kenneth Camilleri were awarded the DocEng 2017 best paper award for their paper entitled "Towards a Transcription System of Sign Language Video Resources via Motion Trajectory Factorisation".

Malta Innovations Award 2016 & WIPO IP Enterprise trophy

EyeControl, a project by Dr Tracey Camilleri, Mr Nathaniel Barbara and Prof. Kenneth Camilleri were awarded the first prize for scientific innovation. EyeControl focusses on the use of eye movements recorded through electrooculography (EOG) to provide the possibility for a subject with limited mobility to communicate or control his environment. Instead of using standard keyboards, remote controllers or touch screens, these individuals can use their eye movements as an alternative control interface. EyeControl thus helps to provide these individuals with more independence and a better quality of life. This project also received the WIPO IP Enterprise trophy from the World Intellectual Property Organization.

10. Participation in courses, meetings and overseas visits

10.1 Hosting the 25th Mediterranean Conference on Control and Automation MED 2017

The Department organised and hosted the 25th Mediterranean Conference on Control and Automation held on the 3-6 July 2017 at Valletta Campus. This series of conferences is organized under the auspices of the Mediterranean Control Association (MCA). The IEEE Control Systems Society and the IEEE Robotics and Automation Society were technical co-sponsors. The technical program consisted of 246 papers presented across 38 regular sessions and 3 invited sessions in 6 parallel tracks. Three Plenary Keynote Lectures by distinguished speakers - Prof. Visakan Kadirkamanathan, Prof. Marios Polycarpou and Prof. Raffaello D'Andrea - were delivered on each day of the conference. A tutorial on nonlinear control of power inverters for smart grid integration was delivered by Dr. George Konstantopoulos.

Social events included a Welcome Reception at Valletta Campus, a Valletta evening tour, and a tour of the historic city of Mdina followed by the conference Gala Dinner. A Farewell Lunch was also held at the end of the conference. All events were well attended and participants had very positive comments on the technical programme, the social programme and the conference venue.

10.2 Participation and hosting the DocEng2017 Symposium

The Department was responsible for hosting the 17th International Symposium on Document Engineering between the 4th and 7th September at the Valletta Campus, Malta. The Symposium started off with three tutorials on Historical Documents, delivered by Basilis Gatos, Malware Analysis in Document Engineering, delivered by Charles Nicholas and User Evaluations in the Document Engineering Field, jointly delivered by Steven Simske, Margaret Sturgill and Kim Marriott. Theresa Zammit Lupi delivered a keynote on The Notarial Archives Valletta: Starting from Zero on the 5th September while John Collomosse delivered his keynote: Sketched Visual Narratives for Image and Visual Search on the 6th September. Two Birds-of-a-Feather sessions discussed the use of documents on small devices and the future of scientific publishing.

Participants were also treated to a varied social program with a dinners and walking tours in Birgu, Valletta, and Mdina as well as a visit to the Hagar Qim temple complex.

The Symposium technical and social program were well received with the symposium being described as one of the best organized in the DocEng history.

10.3 Attendance at the meeting of the General Assembly of the European Control Association

In July 2017 Prof. Simon G. Fabri attended the annual General Assembly meeting of the European Control Association (EUCA) which was held in Toulouse, France. Prof. Simon G. Fabri is the Malta representative on the General Assembly of EUCA.

10.4 PhD External Examiner

In October and November 2016, Prof Simon G. Fabri was hosted at the University of Le Havre (France) and The University of Sheffield (UK) as visiting external examiner for doctoral students studying at these institutions.

10.5 Research visit at Brno University of Technology, Czech Republic

In April 2017 Dr. Ing. Marvin K. Bugeja visited the Department of Mechatronics at Brno University of Technology, hosted by the head of department Prof. Robert Grepl. Dr. Bugeja delivered lectures and practical sessions on "Introduction to Nonlinear Systems Analysis" and "Linear Systems Analysis" to classes of postgraduate and undergraduate students respectively. Moreover, he discussed possibilities of joint research projects and lecturing visits between the two departments. As a result of these discussions, Prof. Grepl agreed to visit our department and deliver a practical workshop later in the year. This event is reported in Section 5.

Postgraduates students during one of Dr. Bugeja's practical sessions

11. Collaboration with Third Parties

Research collaboration with the Department of Metallurgy and Materials Engineering (DMME) on the design of a test-jig for artificial hip-joints
During 2017, Dr. Ing. Marvin Bugeja was involved in a number of consultation meetings on the design of a motor controlled and data acquisition system for a testing jig being developed by Mr Donal Dalli as part of his PhD research work on artificial hip-joints.

12. Public Outreach

12.1 Participation in the San Anton Career fair
On the 24th November 2016, Alexandra Bonnici attended the San Anton School Career Fair which was held on the school grounds between 15:00 and 19:00. During this event, Alexandra gave a talk to Form 2 students after which she spent the rest of the evening demonstrating several student projects.

12.2 Participation in the St. Martin's College Career fair
On the 17th March 2017, Alexandra Bonnici attended the St. Martin's College Career Fair which was held on the school grounds between 12:00 and 15:00. Here, Alexandra spoke with sixth form students as well as students in From 4 and 5, giving practical demonstrations of several student projects.

12.3 Participation in the St. Monica STEM fair
On Sunday 2nd April 2017, Luana Chetcuti Zammit and Alexandra Bonnici participated in the St. Monica STEM fair which was held between 09:00 and 14:00 on the school premises in Birkirkara. The fair was open to all primary and secondary school students and their parents. Practical demonstrations of student projects were given and Luana and Alexandra explained the various job opportunities available in Engineering.

12.4 Participation in the Junior College Career Week (Think ahead...which course?)
On the 2nd December 2016, Alexandra Bonnici attended the Junior College Career week between 09:00 and 16:00. During this day, Alexandra gave a talk to Maths and Physics students which explained the different facets of a career in Engineering as well as course requirements and job prospects. She then spent the rest of the day demonstrating several students projects to show the practical aspect of Engineering.

12.5 Participation in the Robotics Week

On Friday 13th January 2017 Marvin Bugeja and Alexandra Bonnici hosted two primary school children groups for a practical workshop on robotics as part of the European Robotics Week Initiative.

12.6 Organisation and Participation in the Faculty of Engineering Technology Clubs

With the collaboration of the Faculty of Engineering and other Department members, Alexandra Bonnici organised a series of hands-on workshops targeting school children to raise awareness on the different Engineering careers as well as the route towards enrolling in the Engineering degree course. These workshops consisted of a talk on Engineering followed by a mechanical and electrical themed workshop. Through the technology clubs, the Faculty saw a total of 436 students, 20 of whom were Form 5 students from the Archbishop's Seminary and San Gorg Preca College, while the rest were Form 2 students from various state, church and private schools in Malta and Gozo.

12.7 Participation in the Kids on Campus

The department held its annual meeting with the children from the Kids on Campus Summer School, with Alexandra Bonnici giving a practical workshop on Image Processing to twenty 11-year olds on the 10th July and Lucianne Cutajar, Stefania Cristina, Rosanne Zerafa and Norbert Gauci hosting 4-year olds on 18th and 19th July, doing workshops with thermal imagery and motion tracking.

12.8 Participation in Job Shadowing

With collaboration from the guidance practitioner at St. Nicholas College as well as various faculty members, Alexandra Bonnici hosted four Form 4 from the college on a job shadowing event. Here the four students spent a week following various faculty members doing practical tasks from different Engineering disciplines.

12.9 Guidance Teacher Talk

With collaboration from the Chamber of Commerce, Alexandra Bonnici also helped organise a talk for a group of 60 guidance practitioners from various schools in Malta. The scope of this talk was to explain to these practitioners the variety of career paths available to a modern Engineering student as well as the academic route required to achieve such careers.

12.10 Participation in Science in the City

Dr Ing Stefania Cristina and Ms Rosanne Zerafa presented two recently funded R&I projects, WildEye and BrainApp, explaining to the general public the main goals of the projects and our experience in the fields of eye gaze tracking and brain computer interface systeMs

Science in the City was held on Friday 29th September 2017.

12.11 Participation in the Malta Robotic Olympiads

Prof Kenneth Camilleri and Dr Alexandra Bonnici participated in the Malta Robotic Olympiads with a talk entitled 'In the Eye of the Beholder, In the Eye of the Machine', scheduled for presentation on the 24th March 2017. The aim of the talk was to raise awareness of the complexity of human perception of pictures and sound and hence the highlight the difficulties involved in creating perceiving machines. The presentation also highlighted some of the work carried out within the department in the area of machine interpretation of sketches.