10

TEN YEARS

10TH ANNIVERSARY OF THE DEPARTMENT OF SYSTEMS AND CONTROL ENGINEERING

SMART WHEELCHAIR

L-Università ta' Malta

Annual activity report for the year 2017 - 2018 published by the

Department of Systems and Control Engineering
Faculty of Engineering
University of Malta
Msida, MSD 2080
Malta

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November 2018

Cover picture shows the Smart Wheelchair, designed and built by the Department during this academic year. The Smart Wheelchair is essentially a standard motorised wheelchair that has been equipped with a powerful embedded computer system, several sensors including a laser range finder and ultrasonic sensors, and a number of advanced algorithms that enable it to navigate autonomously in obstacle-cluttered environments. The Smart Wheelchair can operate in various modes. It can assist the user to navigate the environment safely, or take over completely and drive the user to the desired destination within a map, that can be generated beforehand by the Wheelchair itself. Thus far the project took the form of an undergraduate Final Year Project entitled 'Design and Implementation of a Smart Wheelchair,' by student Matthew Aquilina under the supervision of Dr Ing. Marvin K. Bugeja and Prof. Ing. Simon Fabri, and with the financial support of RIDT and APS bank.

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Key Performance Indicators

Members of Staff

Academics	8
Visiting Academics (a total of T6 appointments)	4
Systems Engineers	2
Senior Laboratory Officer	1
Administrative Staff	1.5

Externally Funded Members of Staff

Postdoctoral Researcher (also with the Centre for Biomedical Cybernetics)	1
Research Support Officer III	1
Research Support Officer II	1

Research Projects

30

Research Funds

€249,060

Students

Supervision/Co-supervision of B.Eng. Final Year Students	9
Supervision/Co-supervision of M.Sc. by Research Students	8
Taught M.Sc. Students	2
Supervision/Co-supervision of M.Phil./Ph.D. Students	11
Interns	4

Peer-reviewed Publications

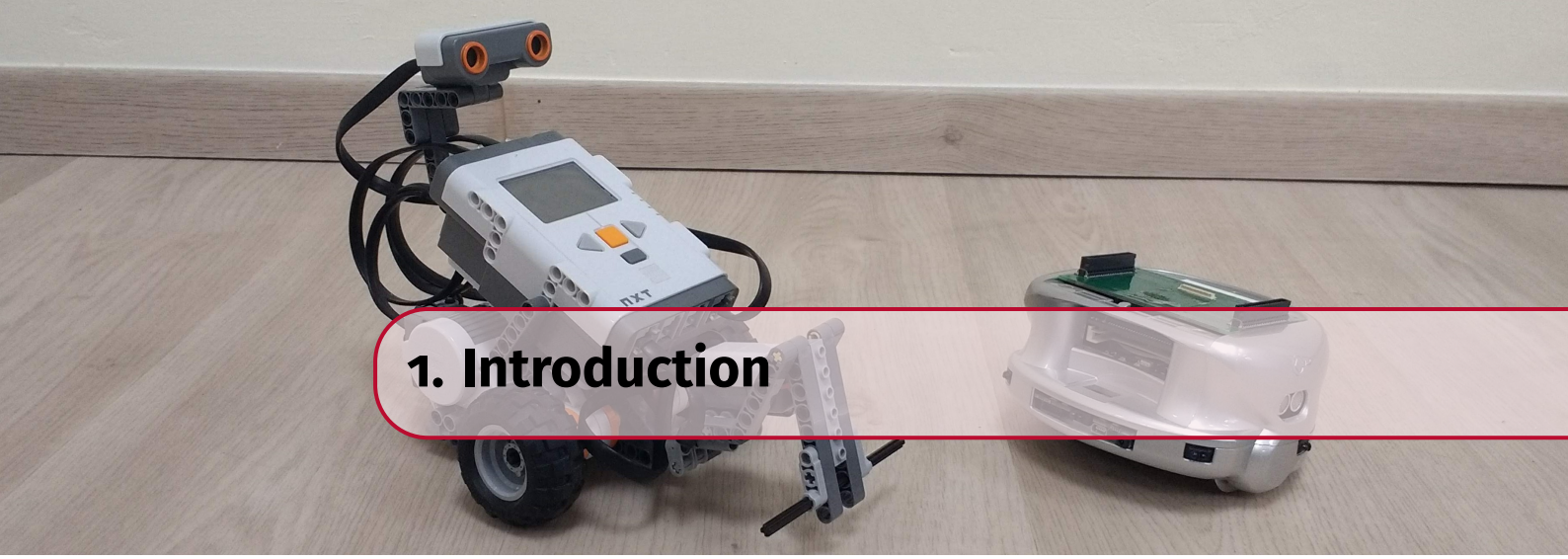
Conference papers	12
Journal papers	8

Teaching Activities

Postgraduate study units	16 (60 ECTS)
Undergraduate study units	15 (76 ECTS)

Public Outreach

Primary and secondary visiting students	∼ 470
National Events	3



1. Introduction

In December 2017, the Department of Systems and Control Engineering inaugurated the newly refurbished Control Systems Laboratory. This new laboratory has been reorganised into two distinct and separate zones, each dedicated to research and to practical teaching sessions, thus, both research and teaching activities can now run concurrently without disturbance. This has also created a larger research working area, which is crucial for experimentation and testing on mobile robotics, and a practical teaching zone laid out in a classroom-style layout of benches and audio-visual aids suiting the teaching needs.

This has now triggered the refurbishment of the space of the old Control Systems Laboratory which will be re-purposed to provide teaching and research space for the areas of Transport Modelling, Signal and Image Processing, and Computer Vision, which to date, have not had dedicated space to host students, projects and activities. We look forward to see the Department developing these areas further now being supported by this essential resource.

The Department is also proud that this year it successfully launched its full-time Masters programme in Signals, Systems and Control. These are still early days for this programme, but the Department is working hard on its internationalization and to facilitate international student admissions. This full-time Masters programme will now run again this October 2018. In order to create this Masters programme, the Department has created 60 ECTS worth of new study units at postgraduate level representing a 79% increase in SCE study-units.

The Department has continued work on a wide portfolio of research projects spanning the areas of: multi-robot systems and robot control; robot and computer vision; eye-gaze tracking using computer vision and biosignals; speech processing; music analysis and generation; brain signal processing and brain-computer interfacing; neuro-rehabilitation; CT radiation dose optimisation; transport modeling and control; cloud-based traffic light control; and satellite engineering. For the first time, this report provides the Key Performance Indicators which quantify the research funding level of the Department over this academic year at €249,060 (pro-rated over one year), most of which was raised through national funding sources. This funding supported the increasing number of research support officers, and supported some of the 20 peer-reviewed publications that SCE academics have published in international conferences and journals throughout this year.

The Department's contribution to outreach towards young children and older pupils remains a priority, exceeding 450 children visiting the Faculty over this year. Since this is close to full capacity, the Department, together with the Faculty, is looking at new modalities and resources to extend this outreach. The Department also retains an enthusiastic participation in national events, such as Science in the City, which serves to bring our science and engineering projects to the large number of people attending this annual event.

The Department has continued to grow thanks to all the members of the Department who have continued to invest in it and to take new initiatives. These results should make us all proud.

Prof Ing. Kenneth P. Camilleri
Head of Department
30th September 2018

2. Staff Members

2.1 Staff Members List

Full Professors

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

Senior Lecturers

Dr Kenneth Scerri, *B.Eng. (Hons.) (Melit.), M.S. (Oakland), Ph.D. (Sheff.), MIEEE*
Dr Ing. Marvin K. Bugeja, *B.Eng. (Hons.) (Melit.), Ph.D. (Melit.), MIEEE*
Dr Tracey Camilleri, *B.Eng. (Hons.) (Melit.), Ph.D. (Melit.), MIEEE*

Lecturers

Dr Alexandra Bonnici, *B.Eng. (Hons.) (Melit.), M.Phil. (Melit.), Ph.D. (Melit.), LLCM(TD), MIEEE*
Dr Ing. Stefania Cristina, *B.Eng.(Hons) (Melit.), M.Sc. (Melit.), Ph.D. (Melit.), MIEEE, MIET (from September 2018)*

Assistant Lecturers

Ing. Luana Chetcuti Zammit, *B.Eng. (Hons.) (Melit.), M.Sc.(Eng.), MIEEE*

Visiting Academics

Ing. Andre Sant, *B.Eng.(Hons.) (Melit.), M.Sc.(Eng.), MIEEE*
Dr Julian Mercieca, *B.Eng.(Hons) (Melit.), Ph.D.(Sheff.), MIEEE*
Mr David Debono, *B.Eng. (Hons.) (Melit.), M.Sc.(Eng.)*
Ms Rachael Darmanin, *B.Eng. (Hons.) (Melit.), M.Sc.(Eng.), MIEEE (until June 2018)*

Research Support Officer III

Dr Ing. Stefania Cristina, *B.Eng.(Hons.) (Melit.), M.Sc. (Melit.), Ph.D. (Melit.), MIEEE, MIET (until August 2018)*

Research Support Officer II

Ing. Rosanne Zerafa, *B.Eng. (Hons.) (Melit.), M.Sc.(Eng.)*

Systems Engineers

Ing. Lucianne Cutajar, *B.Eng. (Hons.) (Melit.)*
Ms Rachael Darmanin, *B.Eng. (Hons.) (Melit.), M.Sc.(Eng.), MIEEE (from July 2018)*

Senior Laboratory Officers

Mr Noel Agius

Clerks

Ms Sanchia Cilia Lentini
Ms Darleen Abela

2.2 Staff Academic and Administrative Activities

Prof. Ing. Kenneth 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 Chairman of the Doctoral Committee and of the M.Sc. by Research Board of Studies of the Centre for Biomedical Cybernetics. Prof. Camilleri represents the Centre on the Board of the Malta Neuroscience Network of the University of Malta. He is an *ex officio* member of: the Board of Studies of the Electrical & Electronic Engineering undergraduate programme; the Board of Studies of the M.Sc. by Research in Engineering; the Faculty of Engineering Board. He is also a member of the University Promotions Board. Prof. Camilleri also serves as a project proposal evaluator for Horizon 2020 actions.

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-2016-010-T 'Wild-Eye' and the RIDT Malta Neuroscience Network Brain Fund Award 'DeepMotionBCI'. Prof. Camilleri is a Co-investigator for the National R&I Fund Awards R&I-2015-032-T 'BrainApp', R&I-2015-048-T 'FIHI', R&I-2017-002-T 'Deep-FIR', R&I-2017-028-V 'MAProHand', R&I-2018-012-V 'EyeCon', R&I-2018-004-V 'NIVS' and R&I-2018-024-V 'ESC'. Prof. Camilleri is a member on the Editorial Board of the Journal of Neuroscience Methods (Elsevier) and regular reviewer for several journals, including: IEEE Transactions on Image Processing; IEEE Transactions on Signal Processing; IEEE Signal Processing Letters; IEEE Computing in Science and Engineering; IEEE Access; IEEE Transactions on Systems, Man and Cybernetics: Part A; SPIE Journal of Electronic Imaging; SPIE Optical Engineering; Expert Systems; Neuroscience Methods; and Taylor & Francis Brain Computing Interfacing Journal. He is also International Programme Committee member of several international conferences, including: The Twelfth International Conference on Advanced Engineering Computing and Applications in Science (ADVCOMP 2018), The Fifteenth International Conference on Intelligent Environments (IE 2018) and the Seventeenth International Conference on Computer Analysis of Images and Patterns (CAIP 2017). Prof. Camilleri was general chair for the Seventeenth ACM Symposium on Document Engineering (DocEng2017).

Prof. Ing. Simon G. Fabri

Administrative

Prof. Fabri holds membership on several University boards and committees including the Academic Resources Funds Committee, the Board of the Institute of Linguistics, the Board of the Institute for Climate Change and Sustainable Development, the Quality Assurance Committee, the Doctoral Academic Committee, the Board of Studies of the M.Sc. in Signals, Systems and Control, and the M.Sc. Board of Studies and Doctoral Committee of the Centre for Biomedical Cybernetics. Prof. Fabri is coordinator of the department's Internal Research Workshop Series and the M.Sc. course on Signals, Systems and Control. He is a member of the Malta Government Engineering Profession Board and the Executive Board of the Mediterranean Control Association.

Academic

Prof. Fabri is the project leader of the ERDF Project "Modernising the University of Malta's Control Systems Engineering Laboratory". He is a member on the Editorial Board of the International Journal on Advances in Intelligent Systems and Associate Editor of the International Journal of Systems Science published by Taylor & Francis. Prof. Fabri is co-investigator in the MCST National R&I funded projects (FUSION) R&I-2015-042-T 'Speechie' and R&I-2017-003T 'Ride+Safe'. He is a reviewer for several journal submissions, including: the International Journal on Advances in Intelligent Systems, Transactions of the Institute of Measurement and Con-

trol, the International Journal of Control, the Journal of Vibration and Control, Mathematical Problems in Engineering and IEEE Transactions on Systems, Man and Cybernetics and reviewer committee member or associate editor for several international conferences.

Dr Kenneth Scerri

Administrative

Dr Scerri is a member of the Engineering Faculty Board and chair of the Faculty of Engineering International Affairs Committee. He is currently working on the establishment of the Intelligent Transportation Research Laboratory at the Faculty of Engineering.

Academic

Dr Scerri is a reviewer for the International Journal of Systems Science and various international scientific conferences. He is also a member of the Transportation and Data Science research groups at the University of Malta.

Dr Ing. Marvin K. Bugeja

Administrative

Dr Bugeja is the national representative on the general assembly of the European Control Association (EUCA). He is also the Faculty's representative on Senate and a member of the University of Malta Scholarship Selection Board; a member of the Board of Studies of the M.Sc. in Language and Computation offered by the Institute of Linguistics and Language Technology; a member of the Board of Studies of the M.Sc. in Signals, Systems and Control offered by the Faculty of Engineering; and a member of the Faculty of Engineering 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. In addition Dr Bugeja is a member of the Astrionics research group (Astrea), and a member of the Particle Detector and Accelerator research group, both of the University of Malta, as well as a regular invited lecturer at the ISMMB, Dept. of Mechatronics, Faculty of Mechanical Engineering, Brno University of Technology, Brno, Czech Republic.

Dr Tracey Camilleri

Administrative

Dr Camilleri is a member of the Faculty's M.Sc. by Research Board of Studies, the Faculty's representative in the Malta Neuroscience Network, the counselor of the IEEE Malta student branch and a member of the IEEE Malta Section committee.

Academic

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. Dr Camilleri is the principal Investigator of the National R&I Fund Award R&I-2015-132-T 'BrainApp' and the National R&I Fund Award R&I-2018-012V 'EyeCon', and co-investigator of the RIDT Malta Neuroscience Network Brain Fund Award 'DeepMotionBCI'.

Dr Alexandra Bonnici

Administrative

Dr Bonnici is a member on the Faculty's Board of Studies (B.Eng. electrical stream) as well as the Doctoral Board of Studies for the Centre of Biomedical Cybernetics. Dr. Bonnici coordinates the Faculty of Engineering Technology Clubs and is the coordinator of the Carousel Week.

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 is also a member of the Steering Committee of the ACM International Symposium on Document Engineering and is an associate editor on Xjenza, the journal of the Malta Chamber of Scientists.

Dr Ing. Stefania Cristina

Administrative

Dr Cristina supports the Faculty PR committee, particularly in the organisation of the annual Engineering Exhibition. She serves as a project proposal evaluator for Horizon 2020 project proposals and is Hon. Secretary of the Malta Group of Professional Engineering Institutions (MGPEI).

Academic

Dr Cristina is a reviewer for several conferences and journal submissions, including the International Workshop on Assistive Computer Vision and Robotics (ACVR), the ACM Symposium on Eye Tracking Research and Applications (ETRA), the ACM Symposium on Document Engineering (DocEng) and the ACM Transactions on Multimedia Computing, Communications, and Applications (TOMM). Dr Cristina is part of the Project Management team of the National R&I Fund Award R&I-2016-010 'WildEye'. She was a program co-chair for the Seventeenth ACM Symposium on Document Engineering (DocEng2017).

Ing. Luana Chetcuti Zammit

Administrative

Ing. Chetcuti Zammit is an IEEE member. She is currently helping in the establishment of the Intelligent Transportation Research Laboratory at the Faculty of Engineering.

Academic

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

3. Academic Activities

3.1 Research Activities

Research Projects

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 agent, 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[1] at an international peer-reviewed conference in July 2017.

[1] 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.

Smart Wheelchair

MAIN INVESTIGATORS: Dr Ing. Marvin K. Bugeja, Prof. Ing. Simon Fabri, Prof. Ing. Kenneth Camilleri
RESEARCH STUDENTS: Mr Matthew Aquilina

FUNDING BODY: RIDT University of Malta	FUNDING AMOUNT: €1,500
FUNDING BODY: APS Bank	FUNDING AMOUNT: €4,200

AWARDEES OF BOTH GRANTS: Dr Ing. Marvin K. Bugeja, Prof. Ing. Simon Fabri, Prof. Ing. Kenneth Camilleri

This academic year also saw the design and implementation of the first smart wheelchair of the department, which was funded by RIDT and APS. This project's main objective was to convert a standard motorised wheelchair into a smart wheelchair that features a number of fully-automatic and semi-automatic functions to assist the user to navigate a given environment safely. In its fully automatic mode, the smart wheelchair uses its laser range-finder to build a two dimensional map of its environment. This map is then used by advanced on-board path-planning and obstacle-avoidance algorithms, to drive the wheelchair safely from one place to another. The semi-automatic mode allows the user to provide direction commands, while the wheelchair assists the user by steering itself automatically around any obstacles lying in its path. In this manner the smart-wheelchair improves both usability and safety. The designed smart wheelchair was tested successfully and the results were recently submitted for publication in the proceedings of a major peer-reviewed conference in robotics. This project has the financial support of RIDT and APS bank.

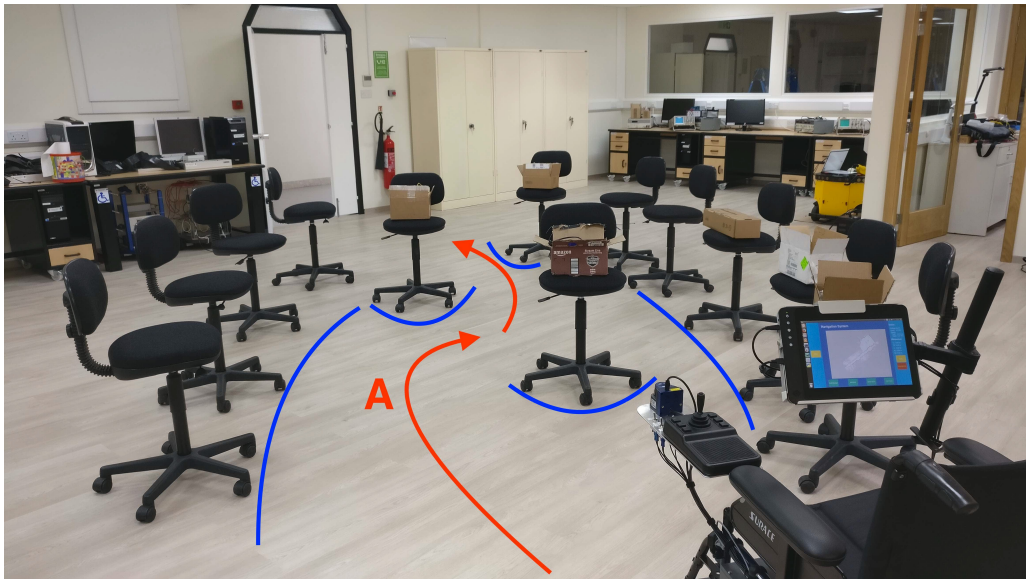


Figure 3.1: The smart-wheelchair navigating through obstacles.

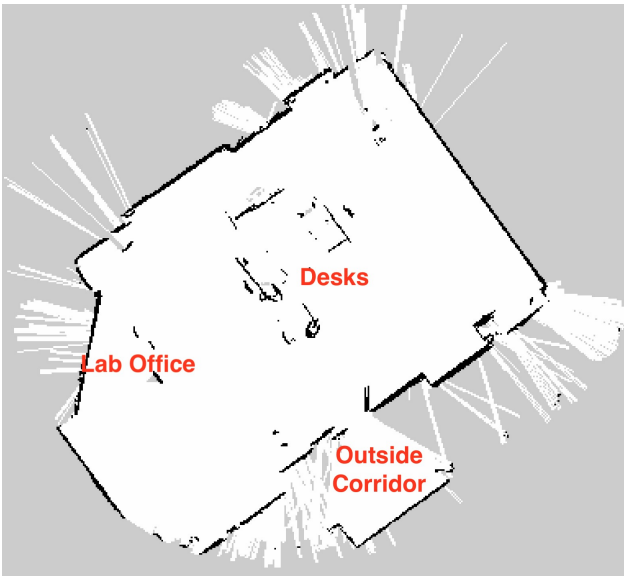


Figure 3.2: A 2D map generated by the smart-wheelchair.

Robot Control

MAIN INVESTIGATORS: Prof. Ing. Simon G. Fabri, Dr Ing. Marvin K. Bugeja
RESEARCH STUDENTS: Ms Nicole Bonello, Ms Abigail Spiteri, and Ms Elysia Bonello.
FUNDING BODY: University of Malta Research Grants
FUNDING AMOUNT: €4,200
AWARDEES: Prof. Ing. Simon Fabri, Dr Ing. Marvin K. Bugeja

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

Eye-in-hand techniques for visual servoing of a five degrees-of-freedom robotic manipulator were investigated, combining methodologies from computer vision, robotics and control. In such systems, feedback on the external scene is obtained through a video camera that is physically mounted on, and moves with, the robotic arm. In this project, this visual servoing system was implemented on a physical set-up. The greatest challenge was found to lie in the communications channel between the vision and the control algorithms.

Figure 3.3: The eye-in-hand visual servoing system

Another project dealt with the design and implementation of a unicycle mobile robot. Balancing of such a system is an interesting nonlinear and multivariable control problem. Balancing along the pitch axis is obtained by controlling the motion of the wheel making contact with the ground, whereas a reaction wheel mounted on the body of the robot is used to achieve balance in the roll axis.

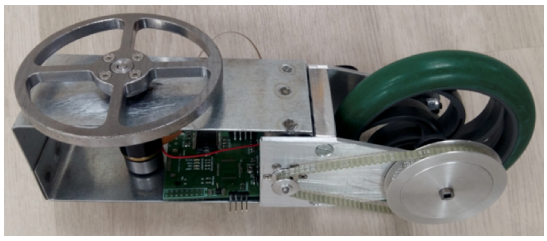


Figure 3.4: The unicycle mobile robot

Another project dealt with aerial robotic vehicles, in particular quadcopters. This project involved an in-depth study of the control schemes designed for the Pixhawk-mini flight controller, which are based on the PX4 open source platform. This study included both realistic simulations, in Gazebo, and experimental validation of the control systems used for the previously built experimental quadcopter. This year, the physical implementation of the quadcopter was further developed to obtain an accurate measurement of its relative altitude, through the use of a laser rangefinder. Therefore, the quadcopter is now able to automatically hold the absolute altitude when flown over uneven terrain.

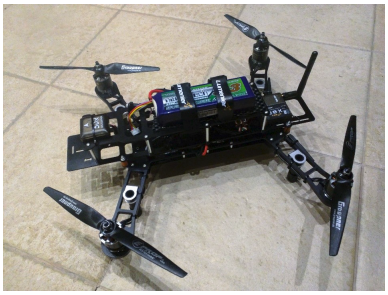


Figure 3.5: The experimental quadcopter.

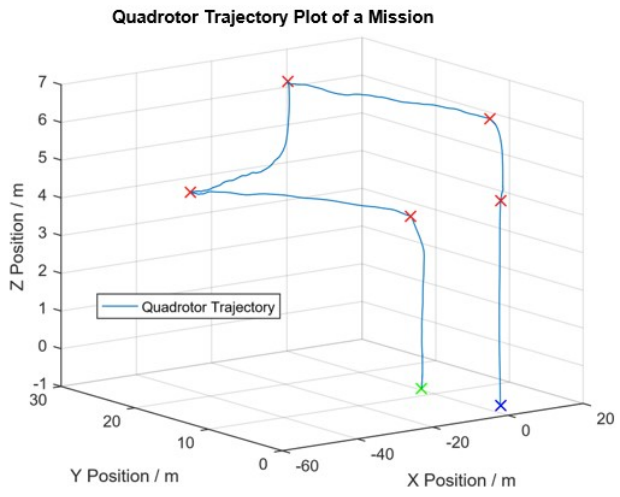


Figure 3.6: 3D trajectory of the real experimental quadcopter.

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.

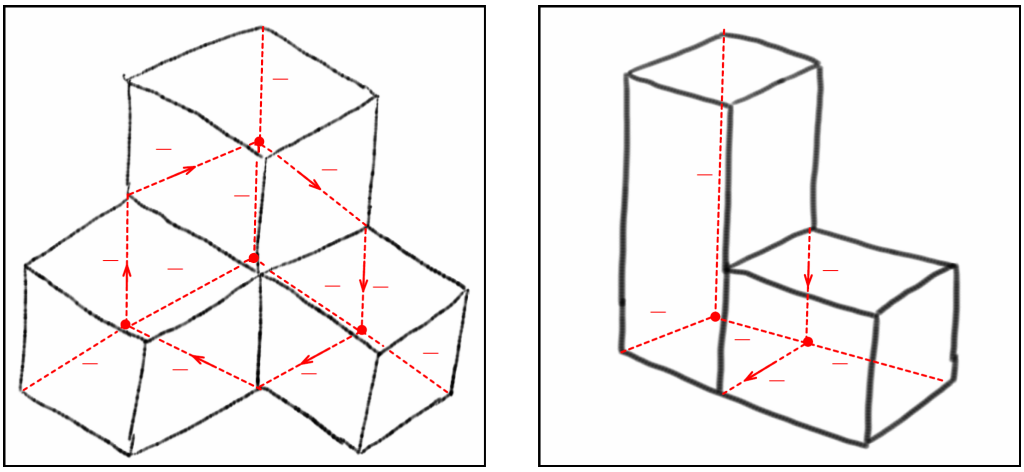


Figure 3.7: The hidden edges and their edge interpretation obtained upon application of a Genetic Algorithm with geometry constraints.

WildEye - Eye-Gaze Tracking in the Wild

MAIN INVESTIGATORS: Prof. Ing. Kenneth P. Camilleri and Dr Ing. Stefania Cristina
RESEARCH SUPPORT OFFICER: Dr Stefania Cristina
FUNDING BODY: FUSION R&I Technology Development Programme 2017
FUNDING AMOUNT: €141,313 (out of the total project funding €193,943 for the consortium)
AWARDEE: Prof. Ing. Kenneth Camilleri

FUNDING BODY: University of Malta Research Grant
FUNDING AMOUNT: €2,100
AWARDEE: Prof. Ing. Kenneth Camilleri

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 commenced on the 31st of July 2017 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.

During the past year, research work has focused on the estimation of head pose under non-rigid face movement, through the development of a method for head pose estimation that caters for non-rigid face deformations following the identification of relevant literature. Seasus have also completed work on the design and development of a user interface prototype, through the formal definition of the user interface requirements and functionalities.

Visual object recognition based on textual descriptions

Main investigators: Dr Albert Gatt[2] and Prof. Ing. Kenneth P. Camilleri
Research Students: Mr Marc Tanti [3]

This research project, undertaken in collaboration with the Institute of Linguistics and Language Technology, 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 3.8b. An alternative architecture that we have investigated encodes the visual and linguistic fea-

[2]Institute of Linguistics and Language Technology
[3]Institute of Linguistics and Language Technology

tures separately, with these being "merged" at a subsequent feed-forward stage, as shown in Figure 3.8a. 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. Recent work investigated the sensitivity of the various architectures of neural image caption generators to the visual input. This work showed that the extent to which image captioning architectures retain and are sensitive to the visual information depends on the type of word being generated and its position in the caption.

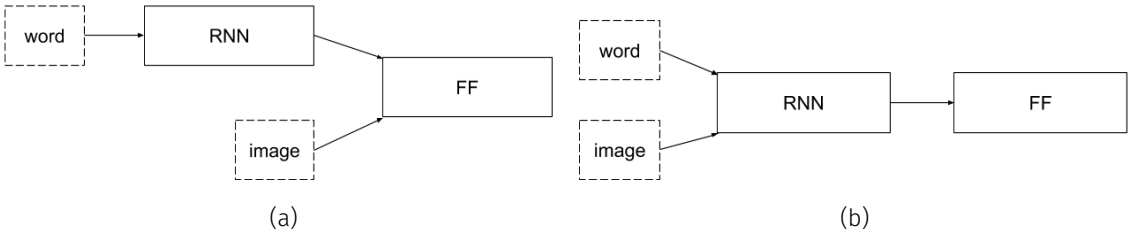


Figure 3.8: Two deep neural network architectures. (a) shows a 'merge' architecture and (b) shows an 'inject' architecture.

Developing a practical human machine interface

Main investigators: Dr Tracey Camilleri, Prof. Ing. Kenneth P. Camilleri, Dr Owen Falzon, Ing. Rosanne Zerafa, Mr Nathaniel Barbara
Research Students: Ms Natasha Mary Padfield
Funding Body: University of Malta Research Grants
Funding Amount: €2,100
Awardee: Dr Tracey Camilleri

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) completing the analysis of comparing data recorded from different EEG headsets, and ii) developing a multimodal human computer interface system.

Comparing different EEG headsets
This study compared the signal quality of six commercially available EEG signal acquisition systems in order to evaluate their application in a BCI. This is one of the largest studies in terms of subjects and systems, involving the whole variety in terms of amplifier (research, consumer), electrode type (gel-based, saline-based, dry, active, passive), transmission technique (wired, wireless) and cost. We established an approach to evaluate the signal quality by means of a short SSVEP experiment. The results obtained demonstrated that although high-end traditional EEG equipment may be the best choice for clinical applications, low-end wireless research grade gel-based EEG systems are comparable in terms of signal quality and therefore may be an effective alternative to BCI applications developed for real environments.

Low-cost EEG headsets, although favourable by most users in terms of design and comfort, suffer from poor signal quality and therefore may not yet be satisfactory for developing effective BCIs. Dry electrodes were more prone to noise artifacts and therefore may not be consistent and robust enough for certain applications. Other factors in line with signal quality, such as end user and application, should also be considered when deciding which EEG system is best suited for a particular BCI. A journal paper on this work has been submitted and further work is now being done to address the major revisions requested.

Developing a multimodal human computer interface system
The goal of this analysis was to fuse two biosignal based human computer interface (HCI) systems that were already developed in our group to implement a real time hybrid HCI system. Specifically, the latter was aimed to combine a steady state visual evoked potential (SSVEP) based HCI with an eye gaze tracking HCI based on electrooculography (EOG). The aim of a hybrid system is to overcome the shortcomings of the individual systems and producing a more robust technology. Specifically, in this analysis, the goal was to use eye gaze tracking to help reduce the annoyance factor of the flickering stimuli of the SSVEP-based BCI and use a double blink gesture as an on-off switch of the HCI system. Data was recorded from 5 subjects with the results so far showing that the pure EOG-based system had the highest accuracy and that there were no statistically significant differences in accuracy when comparing the SSVEP-based HCI and the hybrid system. More analysis on the recorded data is currently being done.

Gaze Angle Estimation using a Dense Multi-Channel EOG Electrode Configuration with Varying Head Pose Compensation (EyeCon)

Main investigators: Dr Tracey Camilleri, Prof. Ing. Kenneth Camilleri
Research Student: Mr Nathaniel Barbara
Funding Body: FUSION R&I Commercialisation Voucher Programme
Funding Amount: €20,060
Awardee: Dr Tracey Camilleri

Electrooculography (EOG) is an eye movement recording technique which is typically used in eye-gaze tracking applications, particularly to develop human-computer interface (HCI) systems, targeted mainly at the mobile impaired. Specifically, EOG captures the electrical activity that is generated by the human eye, which could be regarded to behave like an electric dipole, having the positive and negative poles at the cornea and retina respectively. In fact, the eye creates an electrical field and the electrical signal generated by this field is recorded through EOG via a number of electrodes which are attached to the subject's face, in peri-orbital positions around the eyes.

The main hypotheses of this project are:

1. Multiple EOG channels recorded via a denser electrode configuration around the eyes could be fused together to estimate the gaze angles with a better estimation performance when compared to the performance which is typically achieved using the conventional two-pair EOG electrode configuration;
2. Adopting a dense array of electrodes around both eyes allows the ocular pose of both

globes to be estimated separately, thereby offering another reliable solution to estimate the subject's gaze angles;

3. As a corollary, information about the ocular pose of the two globes would allow the angular ocular vergence to be estimated and hence, also the depth of the subject's POG within a three-dimensional visual field;
4. Variations in the EOG potential characteristics due to different head poses could be mathematically modelled such that the EOG-based ocular pose estimates could be compensated based on the subject's head pose;
5. The developed head pose compensation algorithms and EOG-based angular gaze estimation techniques could be fused with head pose estimation solutions to develop a fully self-contained head pose-free EOG-based eye-gaze tracker, which could be used to develop real-time eye movement-based HCI applications, allowing users to interact naturally and without restrictions.

In the past months work focussed on finding a model that can translate the continuous EOG recordings into corresponding gaze angle estimations using multiple EOG channels. This has led to the well known issue of baseline drift in EOG signals and different techniques of handling this drift are currently being investigated.

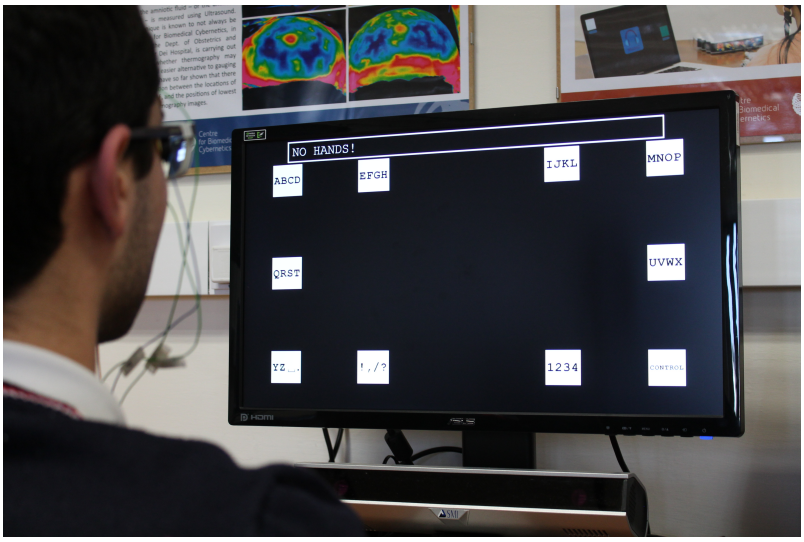


Figure 3.9: Icon layout of the EOG controlled virtual keyboard.

BrainApp - Brain Controlled Applications

Main investigators: Dr Tracey Camilleri, Prof. Ing. Kenneth P. Camilleri and Dr Owen Falzon
Research Support Officer: Ing. Rosanne Zerafa
Funding Body: FUSION R&I Technology Development Programme
Funding Amount: €136,335 (out of the total project funding €181,793 for the consortium)
Awardee: Dr Tracey Camilleri

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 2017 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.

Some of the work that was carried out in the past year included:

Analysis of EEG data recorded with distractors
This study analysed the effect of distractors on steady-state visually evoked potential (SSVEP) data to establish how these nuisance signals, typically present in the real-world would, effect an SSVEP-based brain- computer interface (BCI) system. The distractors introduced to the SSVEP-based experiments were auditory, visual and movement stimuli, specifically selected to reflect the use of various BCI systems outside the laboratory. An assessment on the influence of these nuisance signals on SSVEP data as compared to SSVEP data with no distractors was done by examining the frequency spectrum of the SSVEP responses followed by the implementation of feature extraction techniques, specifically canonical correlation analysis (CCA) and power spectral density analysis (PSDA), and a statistical analysis on the results obtained. A longitudinal study was also carried out by recording data on three different days. The results from ten subjects over three sessions revealed that the spectra of the auditory distractors condition are comparable with the no distractors condition. In fact no statistically significant difference is found between the classification performance of these two conditions. On the other hand, there is a decrease in the signal-to-noise ratios (SNRs) of the visual and movement distractors conditions. This is reflected with a significant decrease in the SSVEP performance of 4.29 % and 12.14 % for the two distractor conditions respectively compared to the no distractors condition. However, a significant above-chance level performance for the six class BCI system could still be obtained with all the distractor conditions, suggesting that SSVEP-based BCIs could be used in an uncontrolled environment. The longitudinal analysis revealed that the difference in performance between the four SSVEP experimental conditions was consistent across sessions performed on different days.

Analysis of EEG data recorded from different EEG headsets
This analysis compared the signal quality of six commercially available EEG signal acquisition systems in order to evaluate their application in a BCI. This is one of the largest studies in terms of subjects and systems, involving the whole variety in terms of amplifier (research,

consumer), electrode type (gel-based, saline-based, dry, active, passive), transmission technique (wired, wireless) and cost. We established an approach to evaluate the signal quality by means of a short SSVEP experiment. The results obtained demonstrated that although high-end traditional EEG equipment may be the best choice for clinical applications, low-end wireless research grade gel-based EEG systems are comparable in terms of signal quality and therefore may be an effective alternative to BCI applications developed for real environments. Low-cost EEG headsets, although favourable by most users in terms of design and comfort, suffer from poor signal quality and therefore may not yet be satisfactory for developing effective BCIs. Dry electrodes were more prone to noise artifacts and therefore may not be consistent and robust enough for certain applications. Other factors in line with signal quality, such as end user and application, should also be considered when deciding which EEG system is best suited for a particular BCI. A journal paper on this work has been submitted and further work is now being done to address the major revisions requested.

Autoregressive modelling for classification of SSVEPs
The goal of this analysis is to investigate how SSVEP data can be modelled using autoregressive models, and use these models for classification of the SSVEP data. A study on the optimal order of these models has been made and performance has been compared to standard SSVEP detection techniques such as canonical correlation analysis. Further work on this part of the project will be carried out in the coming months.

CT Radiation Doses in Nigeria: Establishment of Diagnostic Reference Levels and Radiation Dose Optimisation

Main Investigators: Prof. Ing. Simon G. Fabri, Dr Francis Zarb[4], Prof. Mark McEntee[5]
Research student: Mr Idris Garba [6]

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 has applied quantitative methodologies with a cross sectional research design to identify 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. A novel optimisation proedure was developed and executed whereby, through systematic adjustment of the CT scan parameters (kV, mAs, slice thickness, pitch), radiation dose is minimised while maintaining acceptable image quality for diagnostic purposes. Meanwhile, another data sheet was used to collect data for the

[4]Department of Radiography, Faculty of Health Sciences
[5]Brain and Mind Research Institute, The University of Sydney, Australia
[6]Department of Radiography, Faculty of Health Sciences

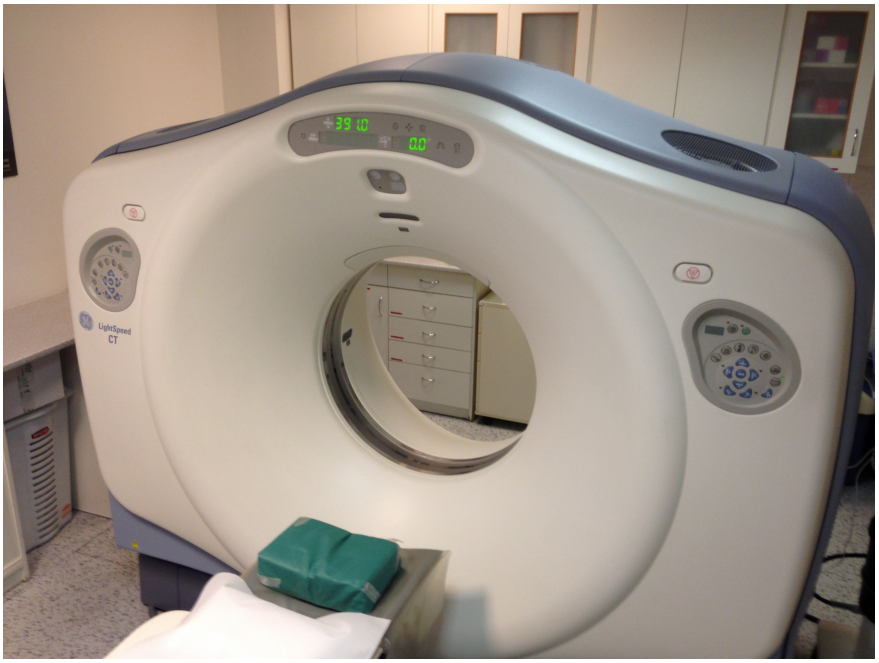


Figure 3.10: Typical CT scanning equipment

re-evaluation of the radiation dose after optimisation in centres where there is unnecessary high radiation dose value with respect to other CT centres or countries.

Transport Modelling and Control Applied to the Maltese Traffic Network

MAIN INVESTIGATORS: Prof. Ing. Simon G. Fabri, Dr Kenneth Scerri, Prof. Maria Attard[7]
RESEARCH STUDENT: Ing. 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. The aims of this research are to obtain a computationally efficient numerical model to reflect the changing traffic behaviour with little prior knowledge of the underlying traffic parameters through novel real-time joint state and parameter estimation algorithms and to design novel control strategies for adjusting the signals in real time according to changing traffic conditions captured by the model.

[7] Institute for Sustainable Development and Climate Change

Figure 3.11: A junction map extracted from Google Maps.

Attitude Control of a Pico Satellite

MAIN INVESTIGATORS: Prof. Ing. Simon G. Fabri, Dr Ing. Marvin K. Bugeja, Dr Ing. Marc Anthony Azzopardi[8]
RESEARCH STUDENTS: Mr Darren Debattista [9], Mr Peter Valletta [10]

This project is part of the Faculty-wide Astrea project aimed at launching a pico-satellite designed and developed at the University of Malta. During the past year, this subproject focused on data fusion techniques for reliable simulation of the satellite attitude and position through various sensors, and the design of 3-axis attitude control systems using reaction wheels and magnetorquers.

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 test the attitude determination and control systems as a proof of concept.

A Speech Recognition and Analysis System for SPEECHIE

MAIN INVESTIGATORS: Prof. Ing. Simon G. Fabri, Dr Ing. Owen Casha[11], Dr Ing. Philip Farrugia[12]
RESEARCH STUDENT: Mr James Attard
FUNDING BODY: FUSION R&I Technology Development Programme 2016
FUNDING AMOUNT: €9,000 (funding to support a researcher supervised by SCE Department)

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 smart toy which facilitates language therapy for children who are subject to speech impairment. The department's role in this project focused on the development and implementation of bilingual speech recognition and analysis systems to monitor the child's performance and allow for autonomous interaction during speech therapy sessions. This multidisciplinary project also includes the collaboration

[8] Department of Electronic Systems Engineering
[9] Department of Electronic Systems Engineering
[10] Department of Electronic Systems Engineering
[11] Department of Microelectronics and Nanoelectronics
[12] Department of Manufacturing Engineering

of Flying Squirrel Games, an industrial partner, and staff and students from the Department of Communication Therapy at the Faculty of Health Sciences.

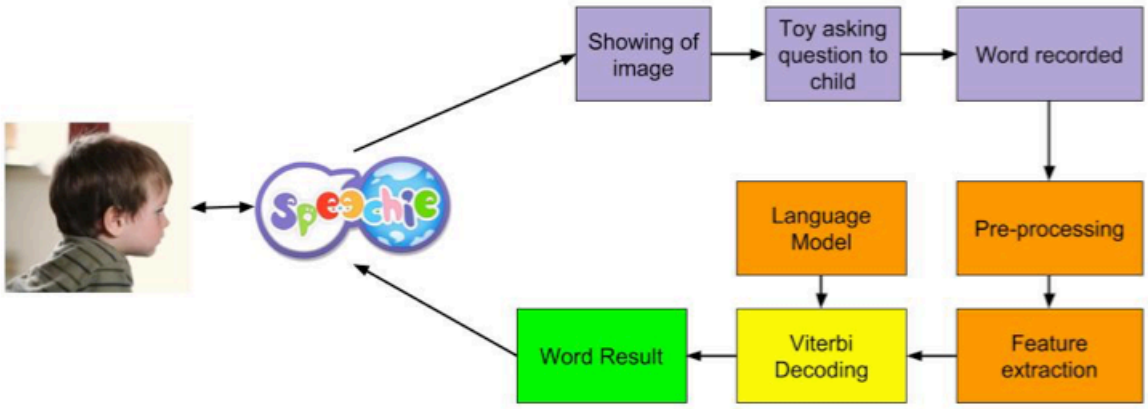


Figure 3.12: Use of the speech recognition system in the SPEECHIE device

Localisation and Detection of Barcodes using Aerial Robots

MAIN INVESTIGATORS: Alexandra Bonnici, Marvin Bugeja, Simon Fabri, Kenneth Camilleri
RESEARCH STUDENT: Ms 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: Dr Alexandra Bonnici, Dr Ing. Stefania Cristina, Prof. Ing. Kenneth Camilleri
FUNDING BODY: University of Malta Research Grants
FUNDING AMOUNT: €2,100
AWARDEE: Dr Alexandra Bonnici

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, un-

like the reading of text, the reading and playing of music is not bound by reading in a forward direction only.

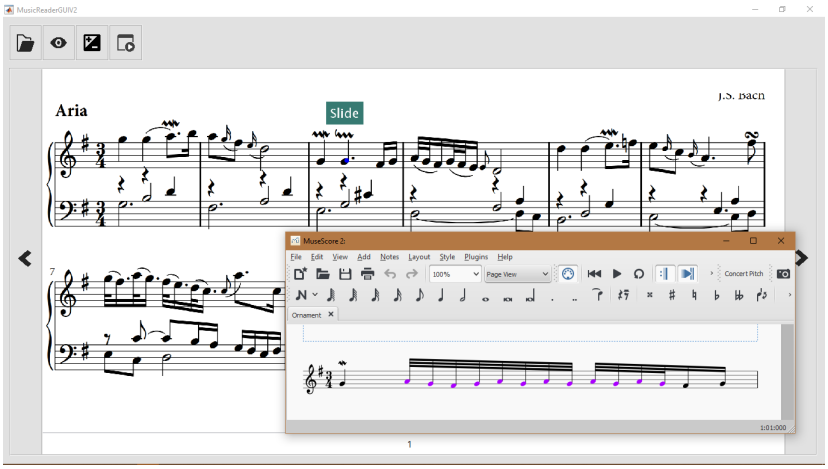


Figure 3.13: A user-interface which allows the pianist to select an ornamented noted and display this as a fully expressed ornament.

While musical notation has developed to suite the needs of printed publications, advances and widespread availability of technology no longer restricts music to the printed score. By performing optical musical recognition (OMR) we can identify the contents of the musical score and re-write this into digital formats, notably in MusicXML format which can be displayed on music readers such as MuseScore among others, and in the MIDI format which can be played by digital instruments. In the former case, we use musical knowledge on the interpretation of ornaments to fully express ornamented notes, creating a user interface which allows the piano student to switch between the notated ornament and the fully expressed ornament as illustrated in Figure 3.13. The MIDI file format allows us to interpret the musical notation and introduce expressiveness to the notes. Here, machine learning techniques such as Kalman filters are used to introduce expressions which are implied by the music but not necessarily notated in the score.

Cloud-Based Intelligent Traffic Light Control

Main investigators: Dr Kenneth Scerri
Research Students: Various
Funding Body: University of Malta Research Grants
Funding Amount: €2,100
Awardee: Dr Kenneth Scerri

This research projects aims to develop the infrastructure and software for a cloud connected intelligent solution for traffic light control in urban environments. Developed over multiple years with the efforts of both undergraduate and postgraduate students, this project has developed and validated the hardware required to measure vehicle queues at the urban intersections. The cloud architecture required for the implementation of the machine learning algorithms have also been extensively investigated and a working solution is being tested. This project is now entering its final phase of testing the complete solution on a local traffic light junction.

Intracranial stereo-EEG analysis during grasping movement and intent: a neuroscientific and brain-machine interface study (DeepMotionBMI)

Main Investigators: Prof. Kenneth P. Camilleri, Dr Tracey Camilleri, Prof. Giuseppe De Giovanni[13], Dr Fausto Caruana [14]
Funding Body: RIDT Brain Research Fund of the Malta Neuroscience Network
Funding Amount: €5,000
Awardees: Prof. Kenneth P. Camilleri, Dr Tracey Camilleri, Prof. Giuseppe De Giovanni, Dr Fausto Caruana

This proposal in collaboration with the University of Parma concerns the signal analysis of intracranial stereo-EEG collected from 14 patients during voluntary opening and closing of a set of normal and reverse-action pliers while the position of the pliers was also being measured. This work seeks to build on earlier single neuron recordings, obtained from macaque monkey by the Parma group, to throw light on the human neural basis of the opening and closing motor actions and on the higher level intentional grasping action which can be differentiated from the data obtained when subjects used the normal versus the reverse-action pliers. It is planned that through spectral analysis and bandlimited ERP analysis of the motor system activity insight into the neural basis of grasping action in humans may be obtained and related to the earlier single neuron recording work. Furthermore, this work intends to investigate singletrial classification of the open-close event and of the actual plier opening in the context of the further development of brain-machine interfaces, building on the University of Malta's track record of work on scalp EEG brain-computer interfacing, which in turn may be used to control external devices without muscle control or drive neural prostheses.

A prospective longitudinal study investigating underlying mechanisms of upper limb somatosensory impairments of people with stroke

Main Investigators: Dr Lisa Tabone, Prof. Kenneth P. Camilleri, Prof. Dr Geert Verheyden [15]
Funding Body: Reach High Scholars Programme
Funding Amount: €198,000 (in collaboration with the University of Malta, Centre for Biomedical Cybernetics, and Katholieke Universiteit Leuven)
Awardees: Dr Lisa Tabone, Professor Kenneth P. Camilleri, Prof. Dr Geert Verheyden

Somatosensation includes exteroception (e.g. touch and pain), proprioception (e.g. position sense) and higher cognitive somatosensation (e.g. stereognosis). In a prospective longitudinal study involving 70 people with stroke which were assessed on admission to an acute ward and at two, four and six months' post-stroke, Upper Limb (UL) stereognosis (which was associated with UL motor performance) and proprioception were more frequently impaired than tactile sensations. In the aforementioned and other, but smaller longitudinal studies on somatosensory dysfunction, only clinical measures were used. Clinical measures do not allow the investigation of underlying mechanisms of brain dysfunction. One safe, non-invasive and portable method that can be used to monitor brain activation is electroencephalography (EEG)

[13] University of Parma, Italy
[14] University of Parma, Italy
[15] Katholieke Universiteit Leuven

which records the electrical activity of the brain at the scalp. It has been suggested that oscillatory EEG rhythms between sensorimotor cortices might have an important function post stroke. Furthermore, a relationship was found between severity of UL motor impairment and event-related desynch7 ronization in the unaffected hemisphere. Thus, further longitudinal studies exploring changes in brain activation in relation to the clinical manifestation of somatosensory impairments from the early to the chronic stage are warranted. Such studies can provide a more thorough understanding of whether over-activity in the unaffected cortex is a contributor to sensorimotor impairments and subsequently, when being an independent predictor for motor outcome, provide a rationale for novel treatment options.

This project aims to investigate the changes in brain activation of UL somatosensory impairments post stroke, and specifically to:

1. Pilot EEG measurements of brain activation for UL somatosensory impairments in people with stroke and present a standardised protocol;
2. Identify the longitudinal recovery pattern of clinical somatosensory measurements and corresponding changes in cortical EEG activity for UL somatosensory impairments in the early, sub-acute and chronic stage of stroke;
3. Investigate the longitudinal relationship of changes in cortical EEG activity for UL somatosensory impairments and clinical somatosensory measurements with UL motor impairment and function, spasticity and stroke impact in the early, sub-acute and chronic stage of stroke.

3.2 Student Projects and Supervision

3.2.1 B.Eng. Students

Project Title: Design and Implementation of a Smart Wheelchair
Student: Matthew Aquilina
Supervisor: Dr Ing. Marvin Bugeja
Co-Supervisor: Prof. Ing. Simon Fabri

Project Title: A Flight Control Scheme for a Quadcopter: Implementation and Validation
Student: Elysia Bonello
Supervisor: Dr Ing. Marvin Bugeja

Project Title: A self-balancing unicycle robot
Student: Nicole Bonello
Supervisor: Prof. Ing. Simon Fabri

Project Title: Model Predictive Control of a Quadruple Tank Level System
Student: Nicholas-Kane Grixti
Supervisor: Prof. Ing. Simon Fabri

Project Title: EMG Assisted Knee Brace
Student: Nicholas Patiniott
Supervisor: Prof. Ing. Kenneth Camilleri
Co-Supervisor: Prof. Ing. Simon Fabri

PROJECT TITLE: Eye-in-hand Visual Servoing with a Robotic Arm
STUDENT: Abigail Spiteri
SUPERVISOR: Prof. Ing. Simon Fabri
CO-SUPERVISOR: Prof. Ing. Kenneth Camilleri

PROJECT TITLE: Discrimination of Ceramic Types using Image Processing
STUDENT: Amy Tanti
SUPERVISOR: Dr Alexandra Bonnici
CO-SUPERVISOR: Dr Ing. John C. Betts[16]

PROJECT TITLE: Attitude Determination of a Pico-Satellite
STUDENT: Peter Valletta
SUPERVISOR: Dr Ing. Marvin Bugeja
CO-SUPERVISOR: Prof. Ing. Simon Fabri

PROJECT TITLE: Vision-based Sensory and Reinforcement Biofeedback System
STUDENT: Gail Vella
SUPERVISOR: Prof. Ing. Kenneth Camilleri

3.2.2 M.Sc. by Research Students

PROJECT TITLE: Towards Robot-Assisted Living through Universal Design of the Environment
STUDENT: Ms Yesenia Aquilina[17]
SUPERVISOR: Prof. Ing. Michael A. Saliba[18]
CO-SUPERVISOR: Prof. Ing. Simon Fabri

PROJECT TITLE: A Speech Recognition and Analysis System for SPEECHIE: A Device Supporting Children with Language Impairment
STUDENT: Mr James Attard
SUPERVISOR: Prof. Ing. Simon Fabri
CO-SUPERVISOR: Dr Owen Casha [19]

PROJECT TITLE: Localisation and Detection of Barcodes using Aerial Robots
STUDENT: Ms Charlotte Camilleri
SUPERVISOR: Dr Alexandra Bonnici
CO-SUPERVISOR: Dr Ing. Marvin Bugeja

PROJECT TITLE: Combined Visual and Thermal Imaging for Non-Contact Physiological Signal Measurement
STUDENT: Ing. Lucianne Cutajar
SUPERVISOR: Dr Owen Falzon [20]
CO-SUPERVISOR: Prof. Ing. Kenneth Camilleri

[16] Department of Classics and Archaeology
[17] Dept. of Industrial and Manufacturing Engineering
[18] Dept. of Industrial and Manufacturing Engineering
[19] Dept. of Microelectronics & Nanoelectronics
[20] Centre for Biomedical Cybernetics

PROJECT TITLE: Thermographic Analysis of the Abdominal Region of Pregnant Woman
STUDENT: Ms Annelie Ciantar[21]
SUPERVISOR: Dr Owen Falzon
CO-SUPERVISOR: Prof. Ing. Kenneth P. Camilleri

PROJECT TITLE: An EEG-Based Biometric System
STUDENT: Ms Elysia Calleja[22]
SUPERVISOR: Dr Owen Falzon
CO-SUPERVISOR: Prof. Ing. Kenneth P. Camilleri

PROJECT TITLE: Enhancing the Common Spatial Patterns Method for BCI Classification by Integrating Temporal Information
STUDENT: Mr Edward Zammit[23]
SUPERVISOR: Dr Owen Falzon
CO-SUPERVISOR: Prof. Ing. Kenneth P. Camilleri

PROJECT TITLE: Design of an Attitude Control and Determination System for the UoMBSat1 Pico-Satellite
STUDENT: Mr Darren DeBattista[24]
SUPERVISOR: Dr Ing. Marc A. Azzopardi[25]
CO-SUPERVISOR: Dr Ing. Marvin Bugeja
ADVISOR: Prof. Ing. Simon Fabri

3.2.3 Taught M.Sc. Students

PROJECT TITLE: Development of a Hybrid Human Computer Interface System using SSVEPs and Eye Gaze Tracking
STUDENT: Ms Natasha Mary Padfield
SUPERVISOR: Dr Tracey Camilleri
CO-SUPERVISOR: Prof. Ing. Kenneth P. Camilleri

PROJECT TITLE: Natural Language Processing for Sentiment Analysis
STUDENT: Mr Gabriel Calleja
SUPERVISOR: Dr Kenneth Scerri

3.2.4 M.Phil. / Ph.D. Students

PROJECT TITLE: Electrode Modelling for Applications of Functional Electrical Stimulation
STUDENT: Ms Mary Grace Cassar [26]
SUPERVISOR: Prof. Cristiana Sebu, [27]
CO-SUPERVISOR: Prof. Ing. Kenneth Camilleri

[21] Centre of Biomedical Cybernetics
[22] Centre of Biomedical Cybernetics
[23] Centre of Biomedical Cybernetics
[24] Electronic Systems Engineering
[25] Electronic Systems Engineering
[26] Department of Mathematics
[27] Department of Mathematics

PROJECT TITLE: Switching Multiple Models for SSVEP-Based Brain-Computer Interfaces
STUDENT: Ing. Rosanne Zerafa
SUPERVISOR: Dr Tracey Camilleri
CO-SUPERVISORS: Dr Owen Falzon, Prof. Ing. Kenneth Camilleri

PROJECT TITLE: Gaze Angle Estimation using a Dense Multi-Channel EOG Electrode Configuration with Varying Head Pose Compensation
STUDENT: Mr Nathaniel Barbara
SUPERVISOR: Dr Tracey Camilleri
CO-SUPERVISOR: Prof. Ing. Kenneth Camilleri

PROJECT TITLE: Coordination and Control of Multi-Robot Systems
STUDENT: Ms Rachael Nicole Darmanin
SUPERVISOR: Dr Ing. Marvin Bugeja

PROJECT TITLE: Autonomic Control for Road Network Management using Geocomputational Tools
STUDENT: Ing. Luana Chetcuti Zammit
SUPERVISOR: Prof. Ing. Simon G. Fabri
CO-SUPERVISOR: Prof. Maria Attard [28]

PROJECT TITLE: CT Radiation Doses in Nigeria: Establishment of Diagnostic Reference Levels and Radiation Dose Optimisation
STUDENT: Mr Idris Garba[29]
SUPERVISOR: Prof. Ing. Simon G. Fabri
CO-SUPERVISOR: Dr Francis Zarb[30]
ADVISOR: Prof. Mark McEntee[31]

PROJECT TITLE: Vision-based Automatic Sign Language Recognition
STUDENT: Mr Mark Borg
SUPERVISOR: Prof. Ing. Kenneth P. Camilleri
ADVISOR: Prof. Marie Alexander [32]

PROJECT TITLE: Visual Object Recognition based on Textual Descriptions
STUDENT: Mr Marc Tanti[33]
SUPERVISOR: Dr Albert Gatt [34]
CO-SUPERVISOR: Prof. Ing. Kenneth P. Camilleri

[28] Institute for Climate Change and Sustainable Development
[29] Faculty of Health Sciences, University of Malta
[30] Faculty of Health Sciences, Univ of Malta
[31] The University of Sydney, Australia
[32] Institute of Linguistics and Language Technology
[33] Institute of Linguistics and Language Technology
[34] Institute of Linguistics and Language Technology

PROJECT TITLE: An Enhanced Wearable System for Kinematic and Kinetic Gait Analysis
STUDENT: Mr Nikiforos Okkalidis[35]
SUPERVISOR: Dr Owen Falzon
CO-SUPERVISORS: Dr Ing. Marvin Bugeja, Dr Alfred Gatt
ADVISOR: Prof. Ing. Kenneth P. Camilleri

PROJECT TITLE: Quantifying Atherosclerosis using Freehand 3D Ultrasound Imaging
STUDENT: Mr Carl Azzopardi[36]
SUPERVISOR: Dr Yulia Hicks[37]
ADVISOR: Prof. Kevin Cassar [38], Prof. Ing. Kenneth P. Camilleri

PROJECT TITLE: Cloud-Based Reinforcement Learning for Traffic Light Control
STUDENT: Mr Michiel Berckvens[39]
SUPERVISOR: Dr Kenneth Scerri

3.2.5 Postdoctoral Scholars

POSTDOCTORAL SCHOLAR: Dr Lisa Tabone
PROJECT TITLE: Neural Correlates of Upper Limb Somatosensory Impairments and Recovery after Stroke: An EEG Investigation
MENTOR: Prof. Ing. Kenneth P. Camilleri
MENTOR: Prof. Geert Verheyden[40]

3.2.6 Internships

Establishing an evaluation dataset and protocol for vectorisation algorithms

STUDENT: Mr Andre Tabone
SUPERVISOR: Dr Alexandra Bonnici

The interpretation of sketches has an important role in the design process, allowing sketches to be rendered as 3D models. One key aspect of this process is the use of vectorisation algorithms which allow the paper-based sketches to be converted into vectors. During the 60-hour internship, Mr Andre Tabone programmed an easy-to-use user interface which allows the researcher to create ground truth data from sketches with shadows and shading. Through this interface, the researcher can create regions of confidence around junction points as well as represent the drawing lines with splines or straight lines as appropriate.

Comparison of images from archaeological sites

STUDENT: Ms Diana Antic
SUPERVISOR: Dr Alexandra Bonnici

During the excavation of archaeological sites, archaeologists need to take note the differences

[35] Centre for Biomedical Cybernetics
[36] Cardiff University, Wales, UK
[37] Cardiff University, Wales, UK
[38] Dept. of Surgery
[39] Katholieke Universiteit Leuven, Belgium
[40] Katholieke Universiteit Leuven, Belgium

that exist between different strata of the excavation. This is typically done manually, with the archaeologist meticulously noting the differences in rock colour and consistency. During this 60-hour internship Ms Diana Antic explored two image processing techniques which can potentially aid archaeologists in this task. The first algorithm uses image compression to compare the texture of two images while the second algorithm uses colour histograms to compare the similarity in colours between the two images. Both algorithms rank images taken from the site according to similarity, thereby have the potential of alerting the archaeologist when a dissimilar image is added to the library of images.

Identification of note pitches from a musical recording

STUDENT: Ms Louisa Magnabosco [41]
SUPERVISOR: Dr Alexandra Bonnici

The identification of note pitches from a musical recording is often carried out by means of windowed Fourier analysis. However, many algorithms described in the literature are restricted to single notes and the extension to polyphony is non-trivial due to the presence of overtones. During this internship, Ms Maria Magnabosco investigated techniques which may be used to identify note pitches from polyphonic music.

Cloud Architecture for IoT Solutions

STUDENT: Mr Onur Mahmut Pisirir [42]
SUPERVISOR: Dr Kenneth Scerri

Connecting hardware devices to the cloud, enables the leveraging on the cloud's expandable storage and computing power. It is thus an excellent candidate for the development of intelligent solutions for urban traffic application, where the data to be processed is significant in both volume and speed. Thus, in this project, a robust cloud architecture for receiving data from cloud-enable sensors and process this data based on various machine learning solutions was developed, tested and deployed.

3.3 Staff Publications

Journal Publications

1. L. Tedesco Triccas, Sarah Meyer, Dante Mantini, Kenneth Camilleri, Owen Falzon, Tracey Camilleri, Geert Verheyden, "A systematic review investigating the relationship of electroencephalography and magnetoencephalography measurements with sensorimotor upper limb impairments after stroke", Journal of Neuroscience Methods, 2018. [Accepted Paper]
2. A. Gatt, O. Falzon, K. B. Cassar, C. Ellul, K. P. Camilleri, J. Gauci, S. Mizzi, A. Mizzi, C. Sturgeon, L. Camilleri, N. Chockalingam, C. Formosa, "Establishing differences in thermographic patterns between the various complications in diabetic foot disease", International Journal of Endocrinology, To be published, 2018.

[41] Federal University of Santa Maria, Brazil
[42] Suleyman Oemlrel University, Izmir, Turkey

3. N. Barbara, T. A. Camilleri and K. P. Camilleri, "EOG-Based Eye Movement Detection and Gaze Estimation for an Asynchronous Virtual Keyboard", Biomedical Signal Processing and Control, vol. 47, pp. 159-167, January 2019. [Accepted Paper]
4. A. Gatt, K. Cassar, O. Falzon, C. Ellul, K.P. Camilleri, J. Gauci, S. Mizzi, A. Mizzi, C. Sturgeon, N. Chockalingam, C. Formosa, "The identification of higher forefoot temperatures associated with peripheral arterial disease in type 2 diabetes mellitus as detected by thermography", Primary Care Diabetes, Volume 12 , Issue 4 , pages 312 - 318, August 2018.
5. R. Zerafa, T. Camilleri, O. Falzon and K. P. Camilleri, "To train or not to train? A survey on training of feature extraction methods for SSVEP-based BCIs", Journal of Neural Engineering, vol. 15, July 2018.
6. A. Gatt, O. Falzon, K. Cassar, K.P. Camilleri, J. Gauci, C. Ellul, S. Mizzi, A. Mizzi, N. Papanas, C. Sturgeon , N. Chockalingam, "The Application of Medical Thermography to Discriminate Neuroischemic Toe Ulceration in the Diabetic Foot", The International Journal of Lower Extremity Wounds, 17(2):102-5, June 2018.
7. S. Cristina, K. P. Camilleri, "Unobtrusive and Pervasive Video-Based Eye-Gaze Tracking", Image and Vision Computing, vol. 74, pp. 21-40, June 2018.
8. N. Zammit, O. Falzon, K. Camilleri, R. Muscat, "Working memory alpha–beta band oscillatory signatures in adolescents and young adults", European Journal of Neuroscience, March, 2018.

Conferences Publications

1. J.L. Farrugia and S.G. Fabri, "Swarm Robotics for Object Transportation", Proceedings of the 2018 UKACC 12th International Conference on Control, pp.353-358, Sheffield, United Kingdom, September 2018.
2. M. Tanti, A. Gatt, K. Camilleri, "Quantifying the amount of visual information used by neural caption generators", ECCV 2018 Workshop on Shortcomings in Vision and Language (SiVL), Munich, Germany, September 2018.
3. A. Bonnici, J. Abela, N. Zammit & G. Azzopardi "Localisation, Recognition and Expression of Ornaments in Music Scores", DocEng '18 Proceedings of the 2018 ACM Symposium on Document Engineering, August 2018.
4. A. Bonnici, J. Abela, N. Zammit & G. Azzopardi "Vectorisation of sketches with shadows and shading using COSFIRE filters", DocEng '18 Proceedings of the 2018 ACM Symposium on Document Engineering, August 2018.
5. C. Saliba, M.K. Bugeja, S.G. Fabri, M. Di Castro, A. Mosca and M. Ferre, "A Training Simulator for Teleoperated Robots Deployed at CERN", Proceedings of the 15th International Conference on Informatics in Control, Automation and Robotics – ICINCO 2018, Vol.2, pp.283-290, Porto, Portugal, July 2018.
6. O. Falzon, A. Ciantar, L. Sammut, M. Schembri, Y. Muscat Baron, J. Calleja-Agius, P. Demicoli and K. P. Camilleri, "Principal component analysis of dynamic thermography data from pregnant and non-pregnant women", Engineering in Medicine and Biology Society (EMBC), 2018 Annual International Conference of the IEEE, pp. 5664-5667, Honolulu, Hawaii, July 2018.
7. L. Cutajar, O. Falzon, A. Mizzi, I. Swaine, K. Springett, S. Mizzi, "A novel method to determine dynamic temperature trends applied to in-shoe temperature data during walking.", En-

gineering in Medicine and Biology Society (EMBC), 2018 Annual International Conference of the IEEE, pp. 3958-3961, Honolulu, Hawaii, July 2018.

8. A. Ciantar, O. Falzon, L. Sammut, M. Schembri, Y. Muscat Baron, J. Calleja-Agius, P. Demicoli and K. P. Camilleri, "Registration of dynamic thermography data of the abdomen of pregnant and non-pregnant women.", Engineering in Medicine and Biology Society (EMBC), 2018 Annual International Conference of the IEEE, pp. 5668-5671, Honolulu, Hawaii, July 2018.
9. N. Barbara, T. A. Camilleri and K. P. Camilleri, 'Comparative Performance Analysis of a Commercial Wearable EOG Glasses for an Asynchronous Virtual Keyboard', 2018 British Human Computer Interaction Conference, Belfast, Northern Ireland, July 2018.
10. A. Gatt, M. Tanti, A. Muscat, P. Paggio, R.A. Farrugia, C. Borg, K.P. Camilleri, M. Rosner, L. van der Plas, "Face2Text: Collecting an Annotated Image Description Corpus for the Generation of Rich Face Descriptions", 11th edition of the Language Resources and Evaluation Conference, LREC 2018, Miyazaki, Japan, May 2018.
11. A. Bonnici, M. Mifsud, & K. Camilleri 2018, "Expressive Piano Music Playing Using a Kalman Filter", EvoMUSART 2018: Computational Intelligence in Music, Sound, Art and Design, pp. 78, April 2018.
12. L. Chetcuti Zammit, S.G. Fabri and K. Scerri, "Online state and multidimensional parameter estimation for a macroscopic model of a traffic junction", Proceedings of the 2017 IEEE 20th International Conference on Intelligent Transportation Systems – ITSC 2017, pp. 1159-1164, Yokohama, Japan, October 2017.

3.4 Internal Research Workshop Series

This year marks the second year during which the internal research workshop series was held. Such workshops were open for the staff and postgraduate students of the Department and of the Centre for Biomedical Cybernetics, as well as close research collaborators from other departments or institutes. Table 3.1 summarizes the workshops carried out during this academic year.

Table 3.1: Summary of the Internal Research Workshops of the year 2017 - 2018

IRWS 2017 - 2018

Dr Kenneth Scerri	Bayesian Estimation: Or How I Learned to Stop Worrying and Love Non-Gaussian Distributions	24th November 2017
Prof. Ing. Simon G. Fabri	Causal Loop Diagrams & Stocks and Flows: how non-engineers model and simulate dynamic systems	25th January 2018
Dr Owen Falzon	Frequency Domain and Time-Frequency Domain Analysis Using MATLAB	20th April 2018
Dr Tracey Camilleri	Model Fitting and Validation	20th June 2018

Figure 3.14: IRWS presented by Dr Kenneth Scerri

Figure 3.15: IRWS presented by Prof. Ing. Simon Fabri

3.5 International Workshop on Sketch-based Interfaces and Machine Interpretation of Sketches

Between the 14th and 16th March 2018, the Department of Systems and Control Engineering held a workshop on sketch-based interfaces and machine interpretation of sketches. The workshop was held with the support of the Malta Council of Science and Technology through the International Partnership Scheme. The workshop included a mix of senior researchers, research students and masters students, and saw the participation of Paul Rosin and Juncheng Liu from the University of Cardiff, Wales; Metin Sezgin, Piril Canturk and Alican Akman from Koc University, Turkey; Johann Habakuk Israel, Florian Hermuth, Patrick Fehling and Tom Landwehr from Hochschule für Technik und Wirtschaft Berlin, Germany; Alfredo Ferreira, University of Lisbon, Portugal and Kenneth Camilleri, Philip Farrugia, Alexandra Bonnici, Stefania Cristina, Natasha Padfield and Gabriel Calleja from the University of Malta. The workshop also saw the participation of four industrial participants, namely James Attard Kingswell from Toly Products, Stefania Mercieca and Maria Bezzina from Daaa Haus and Ronald Cristina from Playmobil.

During the workshop, researchers were given the opportunity to present their various work in relation to sketching interfaces and the machine interpretation of sketches as well as dis-

cuss open challenges in the field as shown in Figure 3.16. The industrial participants provided insightful knowledge on the use of sketches in an industrial setting as well as the various workflows used in industry. This helped the workshop participants to highlight potential technological gaps. The three days of the workshop served as a means to strengthen ties between the five institutions involved, giving participants the opportunity to explore joint research and teaching opportunities.

Figure 3.16: Workshop participants enjoying a discussion over lunch

3.6 Participation in Courses, Meetings and Overseas Visits

12th UKACC International Conference on Control

In September 2018, Prof. Ing. Simon Fabri and Mr Jean Luc Farrugia attended the 12th UKACC Conference on Control held at the University of Sheffield in the UK. They presented their paper entitled "Swarm Robotics for Object Transportation" which was accepted for publication in the conference proceedings.

Participation in the DocEng Symposium

In September 2018, Dr Alexandra Bonnici attended the 18th International Symposium on Document Engineering which was held in Halifax, Canada. During this symposium, Dr Bonnici presented two papers, one entitled "Localisation, Recognition and Expression of Ornaments in Music Scores" and "Vectorisation of Sketches with Shadows and Shading using COSFIRE filters". The latter paper was shortlisted for the DocEng best paper award.

Participation in EvoMusArt Conference

In April 2018, Dr Alexandra Bonnici and Ms Maria Mifsud attended the 7th International Conference on Computational Intelligence in Music, Sound, Art and Design which was held at the Unversity of Parma, Italy. They presented their paper entitled "Expressive Piano Music Playing Using a Kalman Filter".

Lecturing and Research visit at Brno University of Technology, Czech Republic

In March 2018 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 “Nonlinear Systems” and ”Linear Control Systems Analysis and Design” to a number of postgraduate and undergraduate students respectively. Moreover, he discussed possibilities of joint research projects and lecturing visits between the two departments.

IEEE 20th International Conference on Intelligent Transportation Systems

In October 2017, Ing. Luana Chetcuti Zammit attended the 20th International Conference on Intelligent Transportation Systems held in Yokohama in Japan. She presented the paper entitled ”Online state and multidimensional parameter estimation for a macroscopic model of a traffic junction” which was accepted for publication in the conference proceedings.

3.7 External Lectures and Visitors

From the Brno University of Technology, Czech Republic

On 13th September 2018, Prof. Robert Grepl from Brno University of Technology delivered a lecture on ”A New Framework for the Design of Complex Applications with a Graphical User Interface (GUI) in MATLAB”. Prof. Grepl started his lecture by demonstrating and comparing the various tools that are already available in MATLAB for the design and implementation of graphical user interfaces (GUIs). He then introduced a novel tool that is being developed by himself and his research team for this specific purpose. He provided a number of interesting examples and described several success stories to bring out the benefits and the open-challenges of such tool. The lecture was attended by a number of academics, technical staff and postgraduate students from the University of Malta.

From the University of Lorraine, France

In May 2018 Prof. Didier Theilliol from the University of Lorraine and CRAN visited the department to discuss collaboration programmes between the two entities. Prof. Theilliol also delivered a lecture entitled ”Fault-tolerant Control Design: Applications to UAV Test Beds” where current and future research was presented in order to solve challenging problems devoted to safety-critical systems such as unmanned aerial vehicles (drones) in a fleet.

3.8 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. Additionally, the Department also delivers a taught M.Sc. in Signals, Systems and Control programme on full-time and part-time basis. 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. These study units are listed and summarized in Table 3.2.

Table 3.2: A selection of study units offered by the Department in 2017/2018

Unit code	Unit Name	ECTS Credits
SCE Undergraduate Study Units		
SCE1201	Dynamic Systems and Signals 1	5
SCE2111	Automatic Control Systems 1	5
SCE2112	Control Systems 1	5
SCE2201	Numerical Methods for Engineers	5
SCE2213	Automatic Control Systems 2	5
SCE3101	Dynamic Systems and Signals 2	5
SCE3205	Dynamic Systems and Signals 3	5
SCE3204	Image Analysis and Computer Vision	5
SCE3110	Control Systems 2	6
SCE3112	Control Systems Technology and Automation	5
SCE3113	Automatic Control Systems 3	5
SCE3114	Introduction to Control Engineering	5
SCE3216	Automatic Control Systems 4	5
SCE4101	Computational Intelligence 1	5
SCE4102	Systems Theory	5
Other Undergraduate Study Units supported by SCE		
ENR3008	Team Project (unit co-ordination and supervision of two team projects)	5
ENR4200	Engineering Project (final year project supervision by several academic members of the department)	20
SCE Postgraduate Study Units		
SCE5101	Linear Dynamic Systems and Signals	6
SCE5102	Estimation and System Identification	6
SCE5103	Continuous-time Control Systems	5
SCE5104	Discrete-time Control Systems	5
SCE5105	Advanced Signal Processing	5
SCE5106	Research Methods for Systems and Control Engineering	4
SCE5201	Machine Learning and Pattern Recognition	10
SCE5202	Nonlinear Systems and Control	5
SCE5203	System Optimisation and Control	4
SCE5204	Adaptive and Intelligent Control	5
SCE5205	Computer Vision	5
SCE5301	Research Project in Systems and Control Engineering	30
Other Postgraduate Study Units supported by SCE		
LIN5508	Language and Embodied Agents (part of)	10
IES5009	Introduction to System Dynamics	6
OMS5004	Data Resources in Operational Oceanography (part of)	10
ENR5006	Research Methods (part of)	5
ENR5007	Engineering Seminar	5

4. Prizes, Awards and Appointments

Promotion to Senior Lecturer

In May 2017, Dr Tracey Camilleri has been promoted to Senior Lecturer.

In November 2017, Dr Ing. Marvin K. Bugeja was promoted to Senior Lecturer with effect from 28 October 2016.

Appointment

Dr Stefania Cristina has been appointed as Lecturer with the Department with effect from 1st September 2018.

Warrant Awards

Ing. Lucianne Cutajar and Ing. Rosanne Zerafa were awarded the Engineering Warrant in December 2017.

5. Collaboration with Third Parties

Collaboration with the University of Lorraine, France

Prof. Didier Theilliol from the University of Lorraine and Prof. Simon G. Fabri initiated collaboration between the two institutions through a new Erasmus+ agreement. Through this contact, the Faculty shall be also participating in the International Carousel Week coordinated by the University of Lorraine involving a week-long sponsored exchange programme for first year engineering students from Malta, France, Hungary and Finland.

Collaboration with the University of Catania, Italy

Prof. Simon G. Fabri and Prof. Maide Bucolo from the University of Catania initiated an Erasmus+ collaboration agreement between the two institutions, focusing mainly on biomedical signal processing. Through this agreement, academic staff and postgraduate students will have the opportunity for mobility periods between the Department of Systems and Control Engineering in Malta, and the *Dipartimento di Ingegneria Elettrica, Elettronica e Informatica* in Catania.

6. Public Outreach

6.1 Inauguration of the new Control Systems Laboratories

In celebration of its 10th year anniversary, the Department of Systems and Control Engineering held the official opening of its newly relocated Control Systems Engineering Laboratory, followed by a reception and exhibition. Head of Department Prof Kenneth P. Camilleri, and past-Head Prof Simon G. Fabri introduced the event by briefly describing the inception of the department in 2007 and its development during the past 10 years. This event was attended by staff members, past and present students, as well as the Faculty Dean, Dr Ing. Andrew Sammut, and Pro-Rector, Prof. Godfrey Baldacchino, who also delivered opening speeches. The President of the Chamber of Engineers, Ing. Norman Zammit, was also in attendance.

Figure 6.1: Inauguration of the new Control Systems Laboratories during the 10 year celebrations of the Department's existence.

Figure 6.2: The new Systems and Control Research Laboratory.

6.2 Participation in career fairs

iChoose

On the 28th June 2018, Alexandra Bonnici attended the iChoose Career Fair which was held at the Hotel Phoenicia between 09:00 and 19:00. During this event, Alexandra spoke to several students seeking career advice as well as demonstrating several student projects.

6.3 Laboratory Visits by Schools

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 450 students, from various state, church and independent schools.

Tours for St Aloysius sixth-form students

The department hosted a group of sixth form students from St Aloysius College during their annual visit to the Faculty. During this visit, Alexandra Bonnici demonstrated some department and student projects in the Biomedical Engineering and Control Engineering Laboratories.

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 Robotics to twenty 11-year olds on the 24th July and a further two classes, each of 20 4-year old children on 31st and 7th August, doing workshops in Control and Robotics.

Participation in Job Shadowing

With collaboration from the guidance practitioner at St. Nicholas College as well as various faculty members, Alexandra Bonnici hosted nine 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.

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.

6.4 Participation in National Events

Malta Innovation Summit

Dr Tracey Camilleri, Dr Owen Falzon and Mr Nathaniel Barbara participated in the Malta Innovation Summit held on Friday 12th October 2018. During this Summit, the three particiapatns demonstrated the Department's work on human machine interfaces controlled through biosignals, particularly brain signals and eye movements, as well as work focussing on thermal imaging.

Participation in Science in the City

Dr Tracey Camilleri coordinated the participation of the Department during Science in the City, which was held on Friday 28th September 2018. Dr Ing. Stefania Cristina and Ing. Rosanne Zerafa participated in *Meet the Researcher*, where they presented their work done in the field of EEG and eye-gaze tracking. They explained to the general public the main goals of the projects and their experience in the field. Furthermore, Prof. Ing Kenneth Camilleri, Dr Ing. Marvin Bugeja, Dr Kenneth Scerri, Dr Alexandra Bonnici, Dr Owen Falzon, Mr Nathaniel Barbara, Ms Rachael Darmanin and Mr Jeanluc Mangion, all participated during the event by exhibiting research projects in the fields of image processing, music analysis, thermography, EOG, robotics and EEG.

Participation in the Malta Robotic Olympiads

Ing. Lucianne Cutajar, Mr Jean Gauci, Mr Nathaniel Barbara and Ms Rachael Darmanin participated in the Malta Robotics Olympiads 2018 by exhibiting some of the equipment and research projects in the field of robotics, thermography, EOG and EEG. The aim was to explain to the general public how academic research can also lead to the development of practical, real-life applications.

6.5 Media Exposure

Non-peer reviewed articles

1. T. Camilleri, "Brain Control," THINK Magazine, 27th June 2018.
2. T. Camilleri, "Brain technology for independence," 22nd July 2018.
3. "Photo of the Week", The Sunday Times of Malta, 22nd July 2018.
4. C. Porter, T. Camilleri, "The web and brain signals," The Sunday Times of Malta, 5th August 2018.
5. S. Cristina and K. P. Camilleri, "University of Malta's WildEye project seeks to capture the eye-gaze tracking market," Lifestyle & Culture section, The Malta Independent, 9th September 2018.

Television Appearances and Interviews

1. Ms Rachael Darmanin, TVM news feature, "Studenta Maltija b'riċerka dwar robots li jistgħu jsalvaw il-ħajjiet," 3rd August 2017.

7. Contact Us

For further information, we invite you to visit:

- our **Facebook** page: www.facebook.com/um.scedepartment/
- our **University webpage**: www.um.edu.mt/eng/sce

Furthermore, you may wish to contact us through one of the following means:

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